Desert Fishes Council

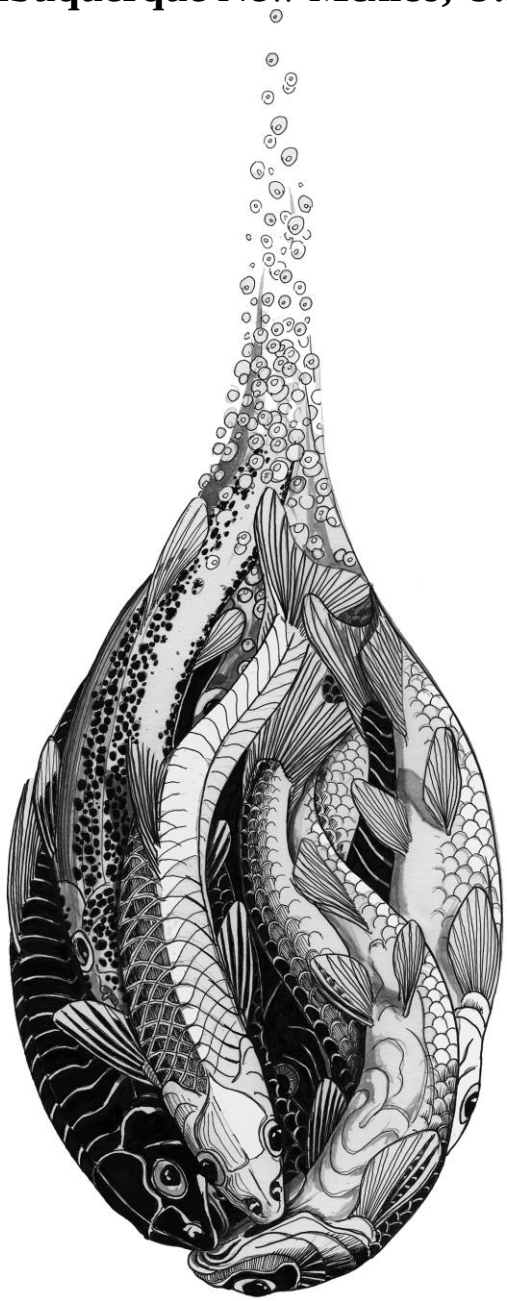
Consejo de los Peces del Desierto

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

48th Annual Meeting

Long Program

15-19 November 2016
Hotel Albuquerque
Albuquerque New Mexico, U.S.A.



Artwork by W.H. Brandenburg

Desert Fishes Council
Event Locations

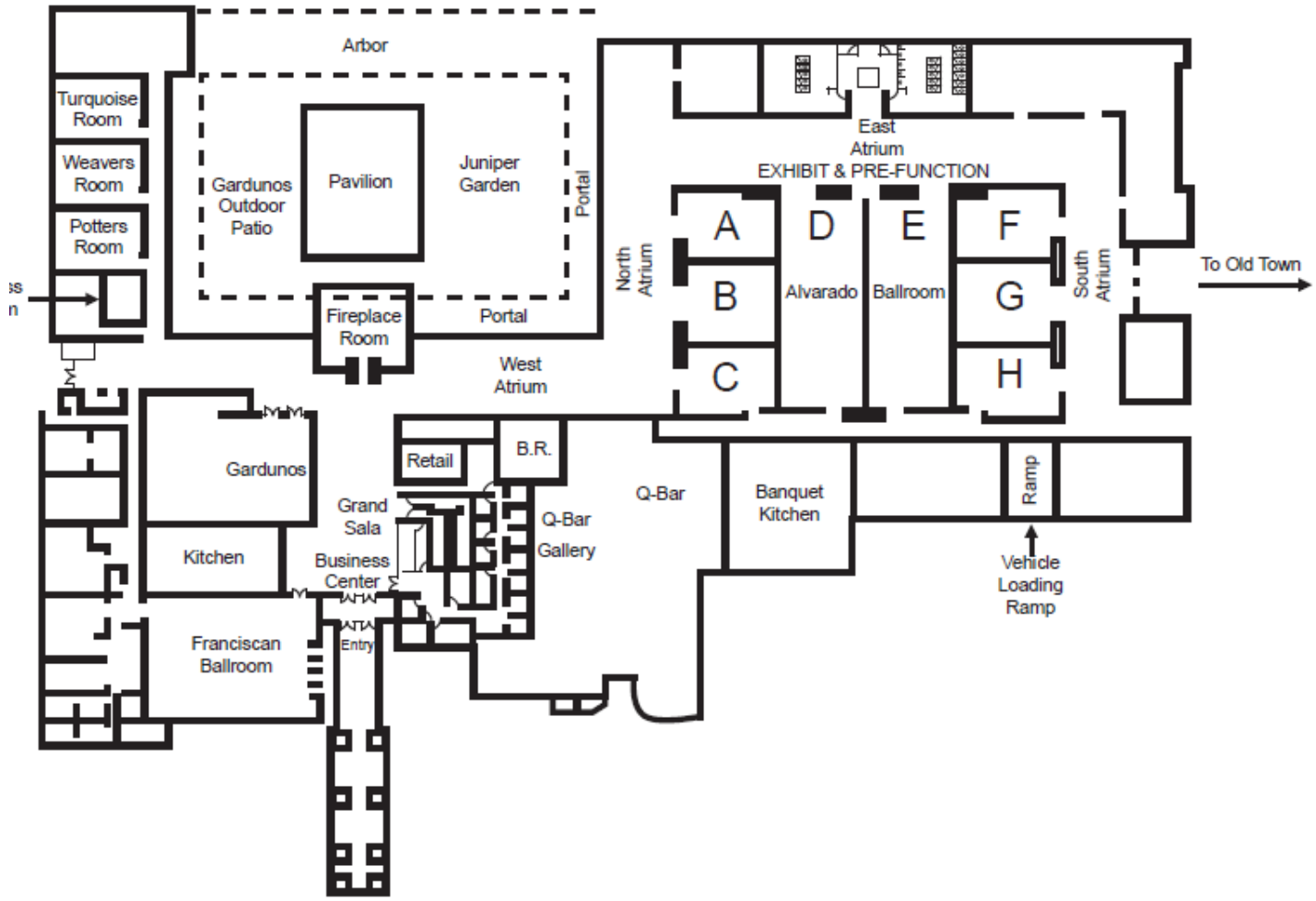
Tuesday, 15 November 2016	**Event**	**Location**
13:00 -18:00	Registration	West Atrium
14:00-16:00	Yaqui Catfish discussion	Salon A
16:00-17:00	PIT-tag seminar	Alvarado Ballroom (ABCD)
18:00-20:00	Social	Casa Esencia
Wednesday, 16 November 2016		
08:00-08:15	Welcome	Alvarado Ballroom (ABCD)
08:15-10:15	Plenary Session	Alvarado Ballroom (ABCD)
10:15-10:30	Break	East Atrium
10:30 -12:00	General Session I	Alvarado Ballroom (ABCD)
12:00-13:15	Lunch	On your own
13:15-16:45	General Session II	Alvarado Ballroom (ABCD)
18:00-20:00	Poster Session	North Atrium
20:00-22:00	Truchas Mexicanas (video)	Alvarado Ballroom (ABCD)
Thursday, 17 November 2016		
08:00 -10:00	General Session III	Alvarado Ballroom (ABCD)
10:00-10:15	Break	East Atrium
10:15-12:00	General Session IV	Alvarado Ballroom (ABCD)
12:00-13:15	Lunch	On your own
13:15-17:00	General Session V	Alvarado Ballroom (ABCD)
17:00-18:30	Business Meeting	Alvarado Ballroom (ABCD)
19:00-21:00	Banquet	Alvarado Ballroom (EFGH)
Friday, 18 November 2016		
08:00-08:15	Awards Presentations	Alvarado Ballroom (ABCD)
08:15-12:00	General Session VI	Alvarado Ballroom (ABCD)
12:00-13:15	Lunch	On your own
13:15-17:00	General Session VII	Alvarado Ballroom (ABCD)
18:00-20:00	Student Networking Session	Franciscan Ballroom
Saturday, 19 November 2016		
08:00- 17:00	Acoma Field Trip	Hotel Albuquerque entry (Grand Sala)

Meeting Venue

Hotel Albuquerque at Old Town

Hotel Albuquerque at Old Town - Albuquerque, New Mexico
800 Rio Grande Blvd. NW | Albuquerque, New Mexico 87104
#phone: 505.843.6300 | toll-free: 1.800.237.2133 | fax: 505.842.8426

Floor Plan



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Presenters, please load your presentation by 6:00 pm the day before your presentation (Sandia Boardroom – behind registration desk).

TITLES IN BLUE FONT ARE STUDENT AWARD PRESENTATIONS

TUESDAY 15 NOVEMBER 2016

2016-11-16 13:00-18:15 **Registration**, West Atrium

2016-11-16 14:00–16:00 **Yaqui fishes management discussion** (open to all), Salon A

2016-11-16 16:00–17:00 **PIT tag seminar** (open to all), Alvarado Ballroom

2016-11-16 18:00-20:00 **Social**, Casa Esencia – Hotel Albuquerque at Old Town

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WEDNESDAY 16 NOVEMBER 2016

2016-11-16 8:00 **Opening Remarks**

2016-11-16 8:15 Plenary Session: "**Is the Rio Grande Savable?**"
Chaired by Laura Paskus
Panelists: Steve Platania, Brad Udall, Adrian Olgesby

2016-11-16 10:15 **Break**

2016-11-16 10:30- 12:00: General Session I: David Rogowski, Moderator

2016-11-16 10:30:00: **A report on the renovation of Los Ojitos Spring, Sonora, México, with comments on the populations of Yaqui chub and Yaqui topminnow occurring there**

Minckley, Chuck[*1]. (1-Cuenca los Ojos).

Los Ojitos spring is represented by a roughly rectangular pool (75 X 50 m), 1.5 m deep and flows 200 m into the San Bernardino River. It is known as part of the "Old Ciénega" by longtime residents. Historically, it was part of the ciénega habitat present adjacent to the river in the recent past. It was dammed in 2000 as it had become incised and was back cutting

into its source. Today, it emerges some 60 m above the pond, flows into it, and exits through a PVC pipe, into a ditch, flowing into the river some 100 m from its source. I first saw it in 2008, when it was relatively cattail free, and open water. Since that time, it filled in with cattails, and became a very restricted habitat for fishes. Sections became debris filled areas, which were occasionally anoxic and unavailable to the Yaqui chub, *Gila purpurea*, and the Yaqui topminnow, *Poeciliopsis sonoriensis* that occur there. A population of the San Bernardino spring snail, *Pyrgulopsis bernardina*, is also present. How these species came to be in the spring is unknown, and they may represent relicted populations trapped as the ciénega was down cut and drained. I have found no evidence that they were stocked into the habitat. Because of the uniqueness of these species, and their listed status, it was decided to maintain this habitat. This was done using funds from the Desert Fishes Council to hire a crew from Cuenca los Ojos, to physically remove the majority of the cattails. This was done in a week in September and I have been followed up with spraying the remaining plants with an appropriate herbicide. The dead material is also being removed with a commercial weed cutter and put in compost piles along the bank. These efforts will continue in order to maintain this habitat into perpetuity. A population estimate will be made for the Yaqui chub population in the pond, in October, and presented at the meetings.

2016-11-16 10:45:00: **Rio Yaqui Fish Management and Protection by the U.S. Fish and Wildlife Service**

Radke, William*[1]. (1-U.S. Fish & Wildlife Service).

San Bernardino National Wildlife Refuge and Leslie Canyon National Wildlife Refuge are located in southeast Arizona, adjacent to the international border with Mexico. The primary role of the two refuges is the sustainability and recovery of native fish in the Río Yaqui Basin. These are two of the few refuges administered by the U.S. Fish & Wildlife Service that were created specifically to protect native fish. The refuges are along the northern margin of the Río Yaqui basin, which begins as Río Papigochic in Chihuahua, receives water from Río de Bavispe in Sonora, and flows south into the Sea of Cortez near Ciudad Obregon. Most of the watershed is in Mexico, with only a small percent draining the Sulphur Springs and San Bernardino Valleys in the United States. The San Bernardino Valley once supported permanently flowing creeks, springs, and marshy wetlands. In addition, the giant sacaton grassland in the valley was once described as "a luxuriant meadow some eight or ten miles long and a mile wide." The delicate balance within the northern Río Yaqui Basin was able to provide historic habitat for a multitude of plants and animals, including eight kinds of native fish. These are the beautiful shiner (*Cyprinella formosa*), Yaqui chub (*Gila purpurea*), Yaqui catfish (*Ictalurus pricei*), Yaqui topminnow (*Poeciliopsis occidentalis sonoriensis*), Mexican longfin dace (*Agosia* sp.), Mexican stoneroller (*Campostoma ornatum*), Mexican round-tailed chub (*Gila minaceae*), and Yaqui sucker (*Catostomus bernardini*). Six of these species were found nowhere else in the United States. The extensive wetlands here were crucial to fish survival, but depletion of the underground aquifer ultimately led to severe habitat changes and the eventual local extinction of many species. In addition, the ultimate introduction and spread of non-native fish and Asian tapeworm continue to threaten the existence of native fish populations. Fish recovery actions include stabilizing and maintaining existing populations, establishing self-sustaining populations, and restoring wetland habitat so that the fish will be able to thrive once again.

2016-11-16 11:00:00: **Recent distributional status of the Yaqui catfish (*Ictalurus pricei* Rutter, 1896) in northwest Mexico/Estatus reciente de la distribución del bagre Yaqui (*Ictalurus pricei* Rutter, 1896) en el noroeste de México**

Varela-Romero, Alejandro*[1], Minckley, Chuck[1]. (1-DICTUS Universidad de Sonora, 2-Native Fish Advocate).

The Yaqui catfish (*Ictalurus pricei*) is the unique nominal species recorded from Northwest Mexico, occurs from the Yaqui River and Fuerte River on the Pacific Slope, and it once occurred in the Sonora River on the Pacific drainages, and endorheic Casas Grandes River on the Atlantic Slope in the State of Chihuahua. Historic and recent field surveys focusing on native fishes, provided field data on northwestern Mexico fish fauna to evaluate Yaqui catfish distribution. Actual distribution of the Yaqui catfish persist mainly in the Fuerte and Yaqui River basins. We presumed the loss of natural population in the Bavispe sub-basin. A growing population of Yaqui catfish was recently recorder for the Arroyo Cajon Bonito, but genetic confirmation is required. The introduced population in the United States in the past is functionally extinct. Scattered collection from the Fuerte River basin confirms the existence at the Urique, and Batopilas sub-basins. The Fuerte River basin populations probably became the more abundant in the actual distribution of the species. Threats to Mexican populations are habitat alterations, water depletion, introduction of exotics, population reduction, and hybridization with non-native introduced *Ictalurus*. The conservation status of the species increase to Threatened, but we recommend increase to Endangered, and a systematically and comprehensively re-survey throughout the range of the species to evaluate current distribution, abundance, population status, genetic integrity and threats in Mexico and US.

El bagre Yaqui (*Ictalurus pricei*) es la uúnica especie nominal registrada para el Noroeste de México, occure en el Río Yaqui y en el Río Fuerte en la vertiente Pacífico, y ocurrió en el Río Sonora de las cuencas del Pacífico y en el endoréico

Río Casas Grandes en la vertiente del Atlántico en Chihuahua. Los muestreos históos y recientes sobre peces nativos, proveen datos de campo sobre fauna nativa en el noroeste de México para evaluar la distribución del bagre Yaqui. La distribución actual del bagre Yaqui es principalmente en las cuencas de los ríos Fuerte y Yaqui. Presuminos la pérdida de las poblaciones naturales en la subcuenca del Bavispe. Recientemente se ha descubierto una población en incremento de bagre Yaqui para el Arroyo Cajón Bonito, pero se requiere confirmar su identidad genética. Las poblaciones introducidas en el pasado en los Estados Unidos están funcionalmente extintas. Se confirma la existencia de la especie en la cuenca del Río Fuerte por escasos registros de colectas en las subcuencas del Urique y Batopilas. Probablemente las poblaciones de la cuenca del Río Fuerte resulten las más abundantes en la distribución actual de la especie. Las amenazas sobre las poblaciones mexicanas son la alteración del hábitat, abatimiento del nivel del agua, introducción de exóticos, reducción poblacional y hibridización con (*Ictalurus* no-nativos. El estatus de conservación de la especie se ha incrementado a Amenazada, pero recomendamos elevarlo a en Peligro y desarrollar un re-muestreo sistemático y comprehensivo a lo largo del rango de la especie para evaluar su distribución actual, estatus poblacional, integridad genética y amenazas en US y MEl bagre Yaqui (*Ictalurus pricei*) es la uúnica especie nominal registrada para el Noroeste de México, occure en el Río Yaqui y en el Río Fuerte en la vertiente Pacífico, y ocurrió en el Río Sonora de las cuencas del Pacífico y en el endoréico Río Casas Grandes en la vertiente del Atlántico en Chihuahua. Los muestreos históos y recientes sobre peces nativos, proveen datos de campo sobre fauna nativa en el noroeste de México para evaluar la distribución del bagre Yaqui. La distribución actual del bagre Yaqui es principalmente en las cuencas de los ríos Fuerte y Yaqui. Presuminos la pérdida de las poblaciones naturales en la subcuenca del Bavispe. Recientemente se ha descubierto una población en incremento de bagre Yaqui para el Arroyo Cajón Bonito, pero se requiere confirmar su identidad genética. Las poblaciones introducidas en el pasado en los Estados Unidos están funcionalmente extintas. Se confirma la existencia de la especie en la cuenca del Río Fuerte por escasos registros de colectas en las subcuencas del Urique y Batopilas. Probablemente las poblaciones de la cuenca del Río Fuerte resulten las más abundantes en la distribución actual de la especie. Las amenazas sobre las poblaciones mexicanas son la alteración del hábitat, abatimiento del nivel del agua, introducción de exóticos, reducción poblacional y hibridización con (*Ictalurus* no-nativos. El estatus de conservación de la especie se ha incrementado a Amenazada, pero recomendamos elevarlo a en Peligro y desarrollar un re-muestreo sistemático y comprehensivo a lo largo del rango de la especie para evaluar su distribución actual, estatus poblacional, integridad genética y amenazas en México y US.

2016-11-16 11:15:00: **A pup's life: Pupfish growth, reproduction, and movement in a hypervariable environment**

Jones, Alexander C.[*1], Hunt, Joseph R.[1], Pansin, Chalisa[1], Aleksic, Maja[1,] Chamnong, Olivia[1], Dalpatadu, Shalini R., Hillyard, Stanley[1], van Breukelen, Frank[1]. (1-University of Nevada, Las Vegas).

Salt Creek, located in Death Valley National Park, is among the most extreme environments fish are known to inhabit. Depending on spatial location and season, temperatures in Salt Creek range from 0° C to over 40° C. Thus many have assumed that Salt Creek Pupfish are well adapted to temperatures as high as 40° C based mainly on anecdotal observations. However, it is not known whether the pupfish observed in the areas of the creek that reach such temperatures survive. We conducted a mark-recapture study to determine whether fish that are marked in the warmer, ephemeral habitats at Salt Creek move to permanent, cooler habitats as the creek dries. The number of fish recaptured from the ephemeral portions of the creek decreased markedly as the summer progressed. However, fish in the ephemeral portions of the creek grew faster and benefited from an earlier breeding season. These data indicate that there are both costs and benefits for fish which colonize ephemeral habitats at Salt Creek.

2016-11-16 11:30:00: **Assessing Modified Prepositioned Areal Electrofishing Devices (PAEDs) for Surveying Fish Habitat Use in Desert Streams**

Nemec, Zach C.[*1], Lee, Larissa N. [1,] Bonar, Scott A. [2.] (1-Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 2-U.S. Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona).

Precise methods are often needed to characterize habitat use by fishes, especially for litigation and detailed habitat modelling. Pre-positioned areal electrofishing devices (PAEDs) have been developed to survey stream fishes and develop habitat suitability criteria. PAEDs, which consist of a shore-based generator and a submerged electrical grid, are less intrusive than other electrofishing methods and result in little to no fright bias, i.e., flight response, in fishes from the electrical stimuli. Standard practice allots eleven minutes post-implementation of the devices to allow fishes to recolonize the area. Thus, these low-cost apparatuses can sample distinct areas of stream reaches to assess the microhabitat of fishes. Challenges to using PAEDs include speed of deployment and difficulty of their transport to remote areas. Here we compare various forms of PAEDs to establish a technique for effective fish sampling at remote sites that considers fright bias, fish mortality, and the size of the electrical field. A digital multimeter and underwater videography were used to assess the electrical fields of various PAED designs and the fright bias induced by different techniques. We found that modified

PAEDs connected directly to a boat-mounted AC power source were sufficient for sampling desert fishes without inducing mortality or fright bias. Also, neither using two devices simultaneously nor using a 30-m extension cord affected voltage near the electrodes. This study demonstrated effective ways that PAEDs can be used to sample stream fishes in remote areas when collecting microhabitat parameters.

2016-11-16 11:45:00: **Celebrating and conserving the diversity of desert fishes**

Hoagstrom, Chris[*1], Houston, Derek[2], Mercado-Silva, Norman[3]. (1-Department of Zoology, Weber State University, 2-Department of Natural Resource Ecology and Management, Iowa State University, 3-Centro de Investigación en Biodiversidad y Conservación, Universidad Autónoma del Estado de Morelos).

The desert environment is a hotbed of endemism in fishes. Ongoing research continues to discover and describe more and more endemic diversity. Based on an up-to-date literature review, there are over 300 putative endemic taxa (species, subspecies, and distinct evolutionary lineages) occurring throughout arid/semiarid North America. These endemics are distributed among 28 separate geographical areas, each of which has a history of isolation from other areas due to limited aquatic connectivity that restricts inter-area dispersal. Overall, there is very little faunal overlap between opposing subgroups of 13 "ワnorthern"ン and 15 "southern"ン areas of endemism. This is evidence that each subgroup constitutes a distinct desert region for fish endemism, with greater levels of aquatic connectivity among areas within regions than between them. However, nested within this subdivision, all areas of endemism have unique assemblages of endemics. In addition, estimated times of origin for endemic taxa are broad and range from the Middle Miocene to the Quaternary. Thus, endemic biodiversity has arisen largely independently throughout these desert areas and has built up over millions of years. That is, each area of endemism has been a generator of endemic taxa and, thereafter has served as a "living museum"ン o"ワnatural repository"ン for ancient taxa that have accumulated over time. Hence, to preserve the sum of desert-fish biodiversity, conservation efforts will be needed in all areas of endemism. Further, conservation actions must prioritize protection of the natural habitats and ecological processes that have produced and maintained each unique taxon.

2016-11-16 12:00:00: **Lunch**—on your own

2016-11-16 13:15 – 16:45 General Session II : Chris Hoagstrom, Moderator

2016-11-16 13:15:00: **Predation shapes morphology of spring Gambusia in Northeastern Mexico**

Moody, Eric[*1], Lozano-Vilano, Maria de Lourdes[2]. (1-Arizona State University, 2-UANL).

Perennial limnocrene springs represent unique environments in arid landscapes due to their more lentic nature, environmental stability, and often, a lack of piscivorous fish. In the Chihuahuan desert, numerous limnocrenes have been colonized by fishes such as Gambusia. Over time, these populations diverged genetically and phenotypically from riverine ancestors, but it is not clear what drives this phenotypic divergence. We investigated this question in the Gambusia panuco species group, which includes the riverine *G. panuco*, the spring endemics *G. alvarezi* and *G. hurtadoi*, and a fourth species, *G. marshi*, found in a variety of habitats with and without predators. We employed a geometric morphometric analysis to examine how body shape of both male and female fish differs among species, habitats, and predation pressures We found that riverine and spring species diverged morphologically, with *G. marshi* exhibiting a variable, intermediate body shape. Within *G. marshi*, morphological variation was explained by piscivore presence in both sexes but by habitat type only in males, suggesting that predators exert a stronger selective force on Gambusia morphology among both sexes but that males also respond to differences in the physical environment. Further supporting this notion, fish from sites with piscivores present had larger caudal relative peduncle areas. We also found that sexual dimorphism in size was higher in spring environments among species regardless of predator presence, indicating that some sexual constraints on morphology may exist. These results are of particular importance because many desert spring fishes are threatened by declining groundwater levels and introduced species, both of which could alter the morphology of these fish if they persist under altered environmental conditions.

2016-11-16 13:30:00: **Lets Jump In: A Phylogeographic Study of the Great Basin Springfishes and Poolfishes, Crenichthys and Empetrichthys (Cyprinodontiformes: Goodeidae)**

Campbell, Cooper[*1], Piller, Kyle[1]. (1-Southeastern Louisiana University).

Crenichthys and Empetrichthys are two genera of goodeid fishes that are poorly studied and lack clear taxonomic distinction in terms of their species and subspecies status. Many of the members of these two genera are federally listed as endangered due to anthropogenic impacts and their disjunct distribution across the Great Basin. As a result, clarification of the taxonomy of these populations has been limited by the constraints on specimen acquisition due to conservation

concerns. Most recently, with the cooperation of natural resources agencies, we obtained tissue samples for 18 different populations inclusive of nearly all species and subspecies. The objective of this study was to examine the phylogenetic relationships of the populations, subspecies, and species of Crenichthys and Empetrichthys using both mitochondrial and nuclear markers analyzed using Bayesian inference. We also examined genetic variation within and between populations, estimated divergence times, and generated haplotype networks. The results of this study represent a first step towards understanding the evolutionary history and taxonomic diversity of this understudied group of fishes.

2016-11-16 13:45:00: **Native Fish Conservation Areas in the Chihuahuan Desert of Texas**

Garrett, Gary P.[*1], Birdsong, Timothy[2], Labay, Ben[3], Bean, Megan[2.] (1-University of Texas, Department of Integrative Biology, 2-Texas Parks and Wildlife Department, 3-Siglo Group).

Texas Parks and Wildlife Department, in partnership with University of Texas Fishes of Texas Project and Siglo Group, has developed a statewide network of focal watersheds that represents a set of native fish “strongholds”. In the Chihuahuan Desert region of Texas six Native Fish Conservation Areas in the Rio Grande, Pecos and Devils rivers were delineated and 39 focal fish species were identified as priorities for conservation. This was accomplished using a spatial prioritization analysis that identifies focal areas for conservation based on species distribution models for priority fish taxa. An Advisory Council of experts in the region has also been developed and they will be tasked with identifying priority conservation, restoration, monitoring and research actions for preservation of native fishes, their habitats and other aquatic resources in these watersheds. In addition, this collaboration will help to catalyze cooperation, collaboration and leveraging of technical and financial resources among local, state and federal natural resource management agencies, universities, NGOs and other local partners that contribute to conservation in the Chihuahuan NFCAs.

2016-11-16 14:00:00: **Effects of Fire on an Intermittent Stream: Monitoring the Response of the Aquatic Macroinvertebrate Community**

Dorff, Nathan[*1], Bogan, Michael[1]. (1-University of Arizona, School of Natural Resources and the Environment).

Wildfires are natural disturbances that shape terrestrial landscapes and can alter aquatic ecosystems. Wildfires can be followed closely by flood events that cause debris flows and scouring, potentially compounding effects on aquatic systems. In 2011, the Horseshoe 2 Fire of southeast Arizona burned over 90,000 hectares and was followed by massive monsoonal rains. These rains triggered flood events that scoured creek beds within the range. In one stream within the affected area, East Turkey Creek, we monitored the aquatic macroinvertebrate community both pre- and postfire. Sampling began in 2008 and continues twice a year in three sites along the stream. We found that taxonomic richness was significantly reduced postfire, while overall abundance of aquatic macroinvertebrates remained the same. We also observed postfire increases in the relative abundances of certain r-strategist taxa. The most common taxa within the system prefire (baetid mayflies and blackflies) remained the most common following the fire, while other species were undetected for two years postfire, including the largest shredder and the top predator in the system. We have looked at three years of samples postfire and are continuing to monitor the macroinvertebrate response. Recovery to prefire levels of species richness took over two years, which is longer than what has been observed in similar studies. Potential explanations for the slower recovery are the severity of the fire and the flood events that followed and the fact that the entire drainage was impacted (e.g. no flood refuges). With hotter and drier conditions in the Southwest expected due to climate change, more frequent and higher severity fires may also occur. Understanding how these new fire regimes will alter aquatic systems will therefore become more important as climate continues to change.

2016-11-16 14:15:00: **Equivocal species Equivocal species boundaries in desert fishes: Gila (Cyprinidae) in the Upper Colorado River Basin**

Chafin, Tyler K[*1], Douglas, Marlis R[1], Douglas, Michael E[1]. (1-University of Arkansas).

Contemporary stream hierarchy of the Colorado Plateau reflects a volatile drainage evolution shaped by tectonism and climate. These provided alternating periods of drainage segregation and amalgamation, and thus a complex evolutionary theater for fish lineages to isolate, adapt, or merge. The resulting phylogenetic histories are reticulated and thus evolutionary processes remain difficult to segregate and infer. However, increased affordability of genomic approaches allows for alternative scenarios of lineage diversification to be statistically evaluated. We used reduced-representation genomic methods to examine patterns of admixture among three divergent lineages of *Gila* endemic to the Upper Colorado River: Roundtail chub (*Gila robusta*), Humpback chub (*Gila cypha*), and bonytail (*Gila elegans*). A hypothesis-testing framework was employed to: (a) infer biogeographic and demographic processes driving lineage evolution; (b) evaluate historical and contemporary introgression among inter-specific populations; and (c) characterize intra-specific differentiation. Our analyses highlight the porous nature of ‘species boundaries' and extend conservation initiatives by clarifying intra- and inter-specific delineations.

2016-11-16 14:30:00: **Oregon / Northern California Area Report, November 2016**

Scheerer, Paul[*1], Leal, Jimmy[2], Brandt, Troy[3], Smith, Terry[4], Markle, Doug[5], Divine, Paul, Banks, David[1], Reid, Stewart[7]. (1-Oregon Department of Fish and Wildlife, 2-Bureau of Land Management, 3-River Design Group, 4-US Forest Service, 5-Oregon State University, 6-California Department of Fish and Wildlife, 7-Western Fishes).

The northwestern extreme of the desert region includes several endorheic drainage subbasins in Oregon, northeastern California, and northwestern Nevada (Fort Rock, Chewaucan, Goose, Warner, Catlow, Alvord, Malheur Lakes, Coyote Lakes, and Quinn). This region supports remnant fish faunas that once inhabited extensive pluvial Pleistocene lakes.

Oregon Department of Fish and Wildlife (ODFW): 1) estimated Warner sucker, *Catostomus warnerensis*, abundance in the Twentymile Creek subbasin (Warner basin) and monitored movement of PIT tagged suckers to assess passage at a newly constructed, sucker-friendly fish ladder, 2) obtained a population estimate and evaluated habitat conditions for Foskett speckled dace, *Rhinichthys osculus ssp*., in Foskett and Dace Springs (in cooperation with BLM), 3) obtained a population estimate and evaluated habitat conditions for Borax Lake chub, *Gila boraxobius*, at Borax Lake in the Alvord basin, 4) assessed fish assemblage structure (native and nonnative) in the Owyhee basin, 5) provided information for a range-wide redband trout conservation in the Upper Snake River basin, and 6) participated in a Lahontan cutthroat working group meeting in Reno, NV.

The Bureau of Land Management (BLM), with help from ODFW, continued ongoing habitat restoration (manual) at Foskett Spring for Foskett speckled dace, including the thinning of aquatic vegetation from pools dug in 2013 and 2014 in the tule and cattail marshes. Permits are secured to conduct mechanical restoration next winter. BLM also secured additional funds ($215K) for the next phase of the Honey Creek passage and screening project to benefit Warner suckers and redband trout (6 unscreened and unladdered diversions remain to be completed).

Doug Markle, retired Oregon State University professor, completed “A Guide to Freshwater Fishes of Oregon”, which includes detailed information on the taxonomy and distribution of Oregon's desert fishes.

The US Forest Service (USFS), with collaboration from USFWS and ODFW conducted population index surveys for Modoc suckers in Thomas Creek. Counts were down ~50% from 2015 counts, likely due to drought (low stream flows) in 2015, but within the range of variability observed over the past decade.

The River Design Group, in collaboration with the Lake County Watershed Council, US Fish and Wildlife Service (USFWS), BLM, USFS, and Oregon Watershed Enhancement Board (OWEB): 1) conducted surveys and provided fish passage conceptual plans and prioritization to benefit redband trout in the Deep Creek subbasin of the Warner Basin, 2) completed surveys and provided design plans for channel realignment to address an eroding terrace and road ditch discharge in the Thomas Creek Basin to benefit Goose Lake redband trout, Modoc suckers, Pit-Klamath lamprey, and speckled dace (construction planned for Fall 2016), 3) conducted hydrologic/hydraulic analyses and fish passage alternatives associated with irrigation diversions in the Warner basin to benefit Warner sucker and redband trout, 4) conducted reconnaissance plan to prioritize fish passage barriers and habitat restoration in the Goose Lake basin, and 5) conducted fish passage and habitat restoration projects in the Chewaucan basin to benefit redband trout.

The California Department of Fish and Wildlife (CDFS) conducted drought monitoring on three streams in the Goose Lake basin (Lassen, Cold, and Willow Creeks) that provide habitat for Goose Lake redband trout, Goose Lake sucker, Goose Lake lamprey, and Pit sculpin) and six tributaries that provide habitat for Modoc sucker (Turner, Washington, Coffee Mill, Hulbert, Dutch Flat, and Johnson Creeks). Preliminary results indicated high stream temperatures and reduced flows affected both quantity and quality of available fish habitat due to extreme drought conditions, although conditions have improved since 2015. CDFW also received a grant to conduct genetic analysis of Eagle Lake Rainbow trout (samples will be collected in 2017 and 2018) to evaluate genetic diversity and inbreeding related to the effects of artificial propagation of this native strain. Stewart Reid, Western Fishes, 1) monitored Modoc sucker populations in Northern California including suppression of green sunfish in Turner Creek, 2) worked with Pit River Tribes to assess current and historical fish distribution in NF Pit River including a Tribal Ecological Knowledge component (questionnaires and interviews) and an historical/ethnographic component and outreach component to inform community of traditional food fishes.

016-11-16 14:45:00: **Standing Between Life and Extinction: Ethics and Ecology of Conserving Aquatic Species in the American Southwest**

Propst, David L.[*1], Williams, Jack[1], Bestgen, Kevin[1], Hoagstrom, Christopher[1]. (1-Museum of Southwestern Biology, University of New Mexico, 2-Trout Unlimited, 3-Colorado State University, 4-Weber State University).

In the 25 years that have passed since publication of ‘Battle Against Extinction; Native Fish Management in the American West', considerable progress has been made in conservation of some species and little or none for others, new technologies and approaches for species conservation were developed and implemented, some known threats diminished, others increased, and heretofore unrecognized or unappreciated threats emerged. Considering the new challenges and opportunities, it is appropriate to again assess the landscape to review what has been accomplished and what may be done to provide a secure future for native aquatic fauna in the American West. Since initiation of this effort at the 2015 DFC meeting, a book prospectus was drafted, authors invited to contribute, a contract signed with The University of Chicago Press to publish ‘Standing Between Life and Extinction', and authors began, hopefully, working on their chapters. The book title is from a statement by Phil Pister in a 1993 article he wrote for Natural History (Vol. 102, Issue 1). As currently envisioned, the book will have 28 chapters that cover topics including biodiversity and its loss in arid-land systems, increasing human populations and human-induced habitat loss, recent discoveries and accomplishments, ongoing, evolving, and new challenges to aquatic fauna, and a future molded by a warming globe. We anticipate submitting a final draft to University of Chicago Press in September 2017 and publication by early 2019. We also anticipate organizing a special symposium at the 2018 Death Valley meeting featuring many of the book's authors.

2016-11-16 15:00:00: **Riverscape Genetics of Speckled Dace (*Rhinichthys osculus*): A Contrasting Study of the Colorado River and Great Basin Drainages**

Mussmann, Steven M[*1], Douglas, Marlis R[1], Douglas, Michael E[1]. (1-University of Arkansas).

The ubiquitous distribution of Speckled Dace (*Rhinichthys osculus*) throughout all major drainage basins of the western United States is a direct result of an ever changing landscape. Hydrological processes have altered the distribution and diversity of Speckled Dace across the western landscape, resulting in narrow endemism for many unique subspecies and promoting secondary contact between previously isolated lineages. This study conducts a population-level assessment of Speckled Dace within the exorheic Colorado River Basin (CRB), and the many endorheic drainages of the Great Basin (GB). To do so, we employ double digest restriction associated DNA (ddRAD) sequencing to recover approximately 9,000 loci for the purpose of evaluating genetic diversity of Speckled Dace in these contrasting basins. Assessment of 1,000 samples collected from 100 dace populations throughout the west identified varying levels of population structure. In the CRB, four unique, widely distributed groups were detected, corresponding to the Upper Colorado, Gila River, Virgin River, and Little Colorado drainages. Ten lineages with much more restrictive distributions were detected in the GB. Population analyses are currently being used to evaluate the potential for historic mixing of populations, with the unique properties of these riverine systems being inferred as the driver of Speckled Dace evolution.

2016-11-16 15:15:00: **Heating up eco-evolutionary dynamics: thermal adaptation exacerbates the ecological consequences of warming**

Fryxell, David C.[*1], Palkovacs, Eric P.[1]. (1-UC Santa Cruz).

Predictions about the impacts of climate change on ecosystems have been based largely on studies that place organisms adapted to current climate conditions into future climate scenarios. Such an approach assumes that today's organisms will be interacting in tomorrow's climate. However, climate change causes adaptive evolution, which may change ecological interactions and alter predictions for ecosystem responses. We tested whether thermal adaptation in the common desert aquatic invader, western mosquitofish (*Gambusia affinis*), has ecological effects and asked whether those effects dampen or exacerbate the consequences of warming. We used recently diverged mosquitofish populations from a warm-source and a cool-source to examine divergence in traits. We then tested ecosystem effects in ambient and warmed (+2 C) experimental ponds. Populations showed trait divergence consistent with thermal adaptation; warm-source fish grew slower and were relatively smaller at maturity. In experimental ponds, warming reduced zooplankton body size and biomass. The introduction of mosquitofish exacerbated this effect, with the warm-source population causing a greater shift towards small-bodied zooplankton taxa than the cool-source population. Our results suggest that thermal adaptation may be an important pathway by which climate warming can impact ecosystems. Experiments that test the ecosystems effects of climate warming using organisms adapted to current climate conditions may underestimate these effects.

2016-11-16 15:30:00: **Conservation efforts for the Endangered Moapa dace, *Moapa coriacea* at the Warm Springs Natural Area, Clark County, Nevada**

Syzdek, David[*1]. (1-Southern Nevada Water Authority).

The Moapa Warm Springs in southern Nevada is a regional spring complex that form 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 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 (USFWS), Nevada Department of Wildlife (NDOW), and the US Geological Survey, SNWA is conducting stream restoration work and intensive habitat improvements to reverse the population's decline. Following the February 2008 nadir, dace numbers have been generally increasing. NDOW and SNWA have subsequently 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 fan palms (*Washingtonia filifera*), is 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 which allows this fish access to its entire historical range. Moapa dace numbers are currently stable and work continues to improve dace habitat, improve stream connectivity, and to monitor for invasive species.

2016-11-16 15:45:00: **Spatio-temporal variation in parasite communities maintains diversity at the major histocompatibility complex class II in the endangered Rio Grande Silvery Minnow**

Osborne, Megan[*1], Pilger, Tyler[1], Lusk, Joel[2], Turner, Thomas[1]. (1-University of New Mexico, 2-US Fish and Wildlife Service).

We combined genetic (MHC Class II and microsatellites), parasitological and ecological data to explore the relationship between these factors in the remnant wild Rio Grande silvery minnow population, an endangered species found in the southwestern United States. Fish were infected with multiple parasites on the gills and there was spatio-temporal variation in parasite communities and patterns of infection. Despite its highly endangered status and chronically low genetic effective size, Rio Grande silvery minnow had high allelic diversity at MHC Class II with more alleles recognised at the presumptive DAB1 locus compared to DAB3 locus. We identified significant associations between specific parasites and MHC alleles against a backdrop of generalist parasite prevalence. We also found that individuals with higher individual heterozygosity (at neutral loci) and higher amino acid divergence between MHC alleles had lower parasite abundance and diversity (as measured by an index of parasitization). Taken together, these results suggest a role for fluctuating selection imposed by spatio-temporal variation in pathogen communities and divergent allele advantage, in maintenance of high MHC polymorphism. Understanding the complex interaction of habitat, pathogens and immunity in protected species will require integrated genetic and field studies to ensure that sufficient diversity is maintained to respond to novel pathogens, and changing host-pathogen interactions.

2016-11-16 16:00: **Use of PIT-tags and PIT-tag detection systems for monitoring fisheries conservation projects**

MacKinnon, Peter[1] (1- Biomark)

2016-11-16 16:15:00: **Does size matter in post-stocking survival of roundtail chub when released into a river with hungry predators?**

Tennant, Laura[*1], Ward, David[1]. (1-U.S. Geological Survey, Grand Canyon Monitoring and Research Center, Southwest Biological Science Center, Flagstaff, AZ).

Programs to recover rare or endangered fishes commonly rely on hatcheries for supplemental stocking of rare fish into areas with depleted populations. Roundtail chub *Gila robusta* is one such fish that has experienced severe declines in number and distribution in Arizona in recent years. Thousands of roundtail chub are reared annually at the AZGFD Bubbling Ponds Native Fish Conservation Facility and stocked into the Verde River and its tributaries as part of ongoing recovery efforts for this species. Hatchery-reared native fish typically suffer high mortality rates when stocked into natural environments with established populations of introduced fishes. Piscivorous fishes are able to select for size specific prey based on prey body depth and the gape size of the predator. These relationships indicate that at the size at which roundtail chub are commonly

stocked they are highly vulnerable to predation. We assessed survival of hatchery-reared roundtail chub with two electrofishing efforts, sixteen and eighty days post-stocking. Size differences of fish between initial and post-stocking efforts were apparent. We conclude that size of hatchery-reared fish may need to be considered prior to stocking and that a total length of at least 150 mm is needed to alleviate post-stocking predation pressure on roundtail chub in the upper Verde River.

2016-11-16 16:30:00: **Discovery of Native Trouts in the Rio Conchos of Chihuahua, Mexico**

Tomelleri, Joseph[*1], Hendrickson, Dean A.[2]. (1-Americanfishes.com, 2-University of Texas at Austin, Biodiversity Collections).

Truchas Mexicanas is a binational group that has been studying the native trout of México since 1997. This is the story of how Truchas Mexicanas worked with native Rarámuri to document two new species of native trout in the Rio Conchos basin in México.
Truchas Mexicanas es un grupo binacional que ha estudiado las truchas nativas de México desde 1997 al presente. Aquí contamos como trabajó el grupo con la población indígena de los Rarámuri para documentar dos especies nuevas en la cuenca del Río Conchos.

2016-11-16 16:45:00: **Every last drop: Putting limited data to use in understanding multiple impacts of hydrologic alteration on native fish communities in the Big Bend region of the Rio Grande**. Brian G. Laub[1*], Phaedra Budy[2, 1] (1- Department of Watershed Sciences and The Ecology Center, Utah State University, Logan, Utah 84322, 2- U.S. Geological Survey, Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, Utah 84322.

Hydrologic alteration impacts patterns of floods and droughts, water quality, physical habitat characteristics, and can provide favorable conditions for nonnative species. Understanding the relative importance of these different and often synergistic factors for native fish communities is critical for prescribing river management actions. However, data for conducting such analysis is often limited, particularly in desert rivers lacking charismatic, endangered sport fishes that garner significant money and attention. The Big Bend reach of the Rio Grande is a case in point, because although the area is critically important for Rio Grande native fish, and even with land protected on both sides of the river, there are no charismatic native fishes that attract the attention of public and private agencies to the degree, for example, of Pacific salmon. Thus, we are challenged with using limited data to identify the most important factors for native fish can help prioritize future studies and management effort. Toward this end, we synthesize current understanding of the river ecosystem in a conceptual model emphasizing links between physical, e.g., habitat and water quality, and biotic components, e.g., fish and invertebrate communities. We analyzed existing data on fish communities, active channel width, hydrology, and water quality at several sites using structural equation models, in order to gain insight into the relative importance of different controlling factors on the fish community. The model results suggest active channel width, nonnative fish relative abundance, and hydrologic forcing all have strong direct effects on the native fish community, and hydrologic forcing has strong indirect effects on native species richness through water quality and nonnative relative abundance. The models also reveal that primary limiting factors differ for different fish species. For example, water quality had a much stronger influence on red shiner than on speckled chub, which was more strongly correlated with channel width. Although data limitations warrant some caution in interpretation, the models reveal important hypotheses to test in future research and provide a method for using limited data collection efforts to better understand multiple, interacting factors driving native fish communities.

2016-11-16 18:00 **POSTER SESSION:** see below for titles. North Atrium

2016-11-16 20:00-22:00: **Truchas Mexicanas** (video) - Alvarado Ballroom (ABCD)

2016-11-16 18:00-20:00: POSTER SESSION – North Atrium

2016-11-16 18:00:00: **Validating the Use of Otoliths and Scales for Aging Rio Grande Silvery Minnow Based on Known Age Individuals**

Lang, Kathy[*1]. (1-ABQ BioPark).

Otoliths and/or scales are often used to determine the age of fishes. This practice allows biologists to estimate species-specific characteristics such as growth rates, age at sexual maturity and maximum age. These estimates can then be used to

make decisions regarding the management of that species. While standardized procedures for assigning ages to otoliths and scales have been developed and accepted, there is still the possibility of error in assigning ages to a particular species unless the chosen aging method has been validated. A validation study should: 1) determine the location of the first annulus and 2) prove that the annuli are laid down exactly once per year. These studies can be done via indirect methods (e.g. marginal increment analysis) or via direct methods (e.g. mark/recapture studies or holding fish for over one year). The ABQ BioPark's Aquatic Conservation Facility maintains several year classes of the endangered Rio Grande silvery minnow, *Hybognathus amarus*, to serve as broodstock for the captive propagation program. Adult fish are kept in outdoor systems and exposed to near-natural temperature fluctuations for most of their lives. This captive population, therefore, can be used to validate the aging of this species. Beginning in September 2016, otoliths and scales from any naturally-occurring mortality of a Rio Grande silvery minnow are being collected and examined for validation of annulus formation on those structures. Preliminary results indicate that otoliths provide a more accurate assignment of age than scales, and that annuli are, in fact, laid down once per year on the otoliths.

2016-11-16 18:00:00: **N-mixture modeling for juvenile Rio Grande Blue Sucker in the Trans-Pecos region of the Rio Grande**

Miyazono, Seiji[*1], Fritts, Sarah[2], Grabowski, Timothy B[3], Grisham, Blake[2], Mayes, Kevin[4], Bean, Preston. (1-Texas Cooperative Fish & Wildlife Research Unit, Department of Natural Resources, Texas Tech University, 2-Department of Natural Resources, Texas Tech University, 3-U.S. Geological Survey, Hawaii Cooperative Fishery Research Unit, University of Hawaii-Hilo, 4-Texas Parks and Wildlife Department, River Studies Program, 5-Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center).

Blue Sucker *Cycleptus elongatus* is a state-listed threatened species in Texas and is considered vulnerable throughout its range. Once considered a single, wide-ranging species, blue suckers are now recognized as a complex of closely related, but genetically and morphologically distinct species within the genus *Cycleptus*, including an undescribed species within the Rio Grande Basin. Numerous factors are likely driving the decline of Blue Suckers in Texas, including flow alteration, water quality, habitat fragmentation, and changing land use patterns, but it is not clear how these factors interact to influence the abundance and distribution of blue suckers. We examined relationships between the abundance of juvenile Rio Grande Blue Sucker (RGBS), *Cycleptus* sp., and various abiotic variables in the Trans-Pecos region of the Rio Grande in Texas using N-mixture modeling. Pool area was the most important covariate for juvenile RGBS abundance. As pool area increased, the abundance of RGBS increased. The detection of RGBS decreased from April to June in 2016 possibly because RGBS grew larger and became less vulnerable to our sampling methodology (seining). We suggest that slow current areas could be important nursery habitat for juvenile RGBS in the Rio Grande, and that changes in flow regime that affects the availability of this habitat type could significantly affect recruitment of RGBS.

2016-11-16 18:00:00: **Native Fish in the Classroom: Bringing Clarity to Fish in Turbid Habitat**

Kelley Currens, Donny[*1], Limanovich, Tom[1], Melloy, Justin[1], Shaw, Daniel[1]. (1-Bosque School).

As participants in the US Fish and Wildlife Service's Native Fish in the Classroom program we provide student perspectives about the value and impact of caring for native fish in a school setting. We demonstrate how often unseen fish from an urban river, temporarily housed in classroom aquaria, can serve as ambassadors for an entire river system. Furthermore we explain the requirements for a successful multi-year Fish in the Classroom program from the perspectives of both a fisheries agency and teachers and their students.

2016-11-16 18:00:00: **Diversity of benthic macroinvertebrate communitues at tributary confluences of the Pecos River**

Delaune, Kelbi D.[*1], Longing, Scott[2], Pease, Allison A.[1]. (1-Texas Tech University Department of Natural Resource Management, 2-Texas Tech University Department of Plant and Soil Sciences).

Tributary streams offer basal resources for aquatic food webs and unique habitats to taxa that differ from the mainstem of the river. Because of this, many tributary confluences are known to be biological “hot spots” for species diversity, making them important for river conservation strategies. This is especially true for rivers in arid regions where resources are limited and anthropogenic influences are often great, as stream tributaries may serve as refuge locations for biota. 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 the effects of tributary confluences on the diversity of benthic macroinvertebrate assemblages across four sites that encompass a range of habitat conditions. Our study sites were at the confluences of Taiban Creek, Rio Hondo, Black River, and Independence Creek. Across sites, we found an increase in macroinvertebrate diversity both at and below the tributary confluence. This difference was most pronounced for the Independence Creek and Black River sites, where coarse substrates and riffle habitats supported relatively high

diversity. Total phosphorous levels decreased below tributary confluences except Independence Creek, where levels were too low to be detected. The Taiban Creek confluence had the highest levels of phosphorous, followed by the Black River and Rio Hondo confluences. These findings support other studies showing that tributaries influence in-stream habitat characteristics and macroinvertebrate diversity in rivers.

2016-11-16 18:00:00: **How much water does the Rio Grande River need? The ecological consequences of an altered flow regime on an arid river**

Blythe, Demitra*[1], Budy Dr., Phaedra[1]. (1-Utah State University).

The flow regimes and associated ecosystem function of many arid desert rivers in southwestern North America have been significantly altered from their historic state due to drought, anthropogenic alteration and urban use. Since the 1800s the construction of dams, human use and consumption, and declining yearly precipitation has significantly decreased flows, degraded water quality, and changed the frequency and magnitude of large flood events throughout the Rio Grande River. In this study, we examine the impacts of an altered hydrologic regime for the Rio Grande River native fish community. We use a multi-faceted approach to 1) examine the fish community and structure, 2) compare algal samples across levels of habitat complexity to track food resources spatially, and 3) examine discharge patterns around known hypoxic events. We found fish diversity (evenness based on Shannon's Diversity Index) was greatest and lowest in reaches we a priori classified as high and low (‘simple') complexity, respectively, at the microhabitat scale. At the macrohabitat scale, where we compared diversity between alluvial valleys and canyons, fish diversity was greater in canyon sites than at alluvial sites. The proportion of native minnows (as potential indicators of endangered Rio Grande Silvery Minnow habitat) was greatest within ‘moderate' or ‘simple' habitat reaches. Further, seston algae and soft sediment periphyton abundance (i.e., food resources) were significantly lower within ‘complex' reaches compared to ‘moderate' or ‘simple' reaches, which occur primarily in alluvial sections. Conversely, periphyton abundance on hard substrates was greater and more variable for ‘complex' reaches, which occur primarily in canyon sections. Finally, there were more frequent hypoxic events following steady, low magnitude (<100 cfs) flows lasting longer than one week. Collectively, these results suggest reaches within the alluvial valleys or those considered more ‘simple', have less diversity and are potentially more susceptible to changes in flow magnitude than sites considered highly ‘complex' or located within a canyon. Further, habitat availability, particularly in alluvial reaches, may be a potential limiting factor for native fish maintenance and recovery in the Rio Grande River.

2016-11-16 18:00:00: **What's for lunch? Novel method for gut content analysis elucidates food resource availability and selectivity**

Bixby, Rebecca*[1], Burdett, Ayesha[2], Tave, Douglas[3], Hutson, Alison[3]. (1-University of New Mexico, 2-New Mexico Museum of Natural History and Science, 3-Interstate Stream Commission).

Gut content analysis of invertebrates and fish has long been used to examine food resource selectivity and determine food web structure. Most gut content analyses identify vertebrate and invertebrate prey taxa. Some studies identify algal taxa but very few identify both animal and algal taxa from the same fish gut, giving a more complete picture of available food resources. We have developed methodologies to analyze both algal and invertebrate composition from environmental samples and individual fish guts to utilize Ivlev's Electivity Index (IEI) to assess feeding habits of a grazing fish, the Rio Grande silvery minnow (*Hybognathus amarus*). Samples were collected in 2011 and 2012 from the Los Lunas Silvery Minnow Refugium, a conservation fish culture facility where the fish forage for natural food resources with no supplemental food provided in the outdoor environment. Periphyton and macroinvertebrates were collected monthly (July-October) from four natural substrates (concrete run, sediment in pools, macrophytes, water column) at the facility. Standard methods were used to identify and enumerate periphyton and invertebrates from these environmental samples. In addition, larval fish were also collected monthly from the facility. In the lab, standard body length and total gut length were measured. Macroinvertebrates and zooplankton were identified to the lowest practical level (often family) and enumerated from each fish gut. Algae were identified to genus, including diatoms to species, and enumerated from the same gut samples. Total algal and invertebrate numbers then were calculated per densities per individual fish gut, giving the ability to combine algal and invertebrate data sets and compare fish diets of different ages. In the environmental samples, periphyton was dominated by two diatoms *Nitzschia perminuta* (17% across all samples) and *Epithemia sorex* (9%) and green desmids (*Cosmarium* spp.; 13%), while the macroinvertebrate community was dominated by ostracods (33%) and chironomids (26%). Gut contents reflected opportunistic resource use: ostracods, diperans, upright-growing diatoms, and unicellular green algae were important food resources (IEI>~0.5). In contrast, other algal and invertebrate taxa were only recorded in the environment but not in the guts (IEI<0). Results from this study demonstrate the potential of this more comprehensive method to evaluate food resources available for grazers and also provides a window into the foraging habits of grazing fish.

2016-11-16 18:00:00: **Native fish conservation and management in the Upper/Middle Rio Grande, Pecos River, Canadian River, Tularosa and Guzman basins, New Mexico during 2016**

Gilbert, Eliza[*1], Archdeacon, Thomas P.[2], Davenport, Stephen R.[2], Mata-Gonzales, Melissa M.[2], Paroz, Yvette M.[3], Myer, Dustin M., Osborne, Megan J.[4], Wick, Jill M.[5]. (1-American Southwest Icthyological Researchers, 2-U.S. Fish and Wildlife Service, New Mexico Fish and Wildlife Conservation and Ecological Services Offices, 3-U.S. Forest, Service Region 3, 4-University of New Mexico, 5-New Mexico Department of Game and Fish).

In 2016, a number of actions were undertaken to further conserve native fishes within these five basins. In the upper Rio Grande basin, surveys were conducted to determine the conservation status of *Gila pandora* Rio Grande Chub and *Catostomus plebeius* Rio Grande Sucker. These surveys were coordinated among state, federal, tribal, and nongovernmental agencies and helped initiate development of conservation management plans for these two species. Also in the upper Rio Grande, *Oncorhynchus clarki virginalis* Rio Grande Cutthroat Trout habitat renovation is ongoing. In the middle Rio Grande, the Rio Grande Silvery Minnow Population Monitoring Project and the Genetics and Propagation Project both received strong positive evaluations by external expert reviewers. Assessments were conducted to ensure the project were providing robust information to stakeholders and to allow programmatic improvements where needed. Surveys of fishes in the Pecos River document the continued presence of multiple Notropis taxa with *Notropis simus pecosensis* persisting but *N. jemezanus* and formerly common *Hybognathus placitus* Plains Minnow appearing to decline. In the lower portion of the Canadian River, just prior to entering Texas, a limited reach of the river supports two rare fish; *Notropis girardi* Arkansas River Shiner and *Macrhybopsis tetranema* Peppered Chub. Population and genetics monitoring describing these species' conservation status is underway. *Cyprinodon tularosa* White Sands Pupfish is a charismatic and endemic fish of the Tularosa Basin. A study (dissertation) has begun on this species' ecology. Planning documents (an Environmental Assessment and Conservation Plan) for management of White Sands Pupfish were completed in 2016 and will allow for repatriation of this species to historic habitats and habitat restoration. Genetic and population augmentation continue for this species as well. Within the Guzman basin, habitat restoration designed to increase the carrying capacity of the Mimbres River for *Gila nigrescens* Chihuahua Chub, which began in 2015 and was completed in early 2016 on land owned and managed by New Mexico and also on land owned by The Nature Conservancy. Recent surveys of these restored areas documented use of the habitat by Chihuahua Chub.

2016-11-16 18:00:00: **Implementation of native fish conservation areas in Texas**

Bean, Preston[*1], Garrett, Gary[2], Birdsong, Timothy[1], Labay, Ben[3], Bean, Megan[1]. (1-Texas Parks and Wildlife Department, 2-The University of Texas at Austin, 3-Siglo Group).

Native Fish Conservation Areas (NFCA's) were developed using a spatial prioritization analysis of species distribution models to identify focal areas for conservation efforts. Following development of the NFCA's, workshops focused on subsets of the NFCA's (NFCA's in the Canadian, Red, Brazos, and Colorado Rivers to date) were held to identify project-level actions for achieving eight objectives for conserving native fish and their habitats including: protect and maintain intact, healthy habitats; restore impacted habitats; restore stream and habitat connectivity; mitigate effects of invasive species; organize networks of public and private landowners; develop conservation demonstration areas; conduct research to fill critical information gaps; conduct adaptive management and reporting. Representatives from state and federal resource management agencies, conservation NGO's, and university researchers contributed toward identifying these actions. Results from the NFCA workshops are now being use to guide conservation efforts in order to most effectively and efficiently utilize available resources for conservation.

2016-11-16 18:00:00: **Genetic structure of Mexican golden trout defined by GBS methods.**

Escalante, Marco A.[*1], Garcia-De Leon, Francisco J.[1], Perrier, Charles[2], Ruiz-Luna, Arturo[3], Manel, Stephanie[2]. (1-Laboratorio de Genética para la Conservación, Centro de Investigaciones Biológicas del Noroeste, Instituto Politécnico Nacional, 195, Col. Playa Palo de Santa Rita, 23096 La Paz, BCS, Mexico , 2-CEFE UMR 5175, CNRS – Université de Montpellier – Université Paul-Valéry Montpellier -EPHE, laboratoire Biogéographie et écologie des vertébrés, 1919 route de Mende, 34293 Montpellier Cedex 5, France, 3-Laboratorio de Manejo Ambiental, Centro de Investigación en Alimentación y Desarrollo AC, Sábalo-Cerritos s/n, 82100 Mazatlán, Sinaloa, Mexico).

Mexican golden trout (*Oncorhynchus chrysogaster*) is an endemic species that inhabits Fuerte; Sinaloa and Culiacán basins in Northwestern Mexico and represents one of the salmonid species with southernmost distribution in the world. Mexican golden trout originates from a coastal anadromous trout during Pleistocene, being isolated in the high mountains of different watersheds in the western part of mainland Mexico. *O. chrysogaster* range is reduced to the highest parts of the mountains, and this species is threatened by several anthropogenic and environmental factors; climatic global change and mainly the introduction of the exotic rainbow trout (*Onchorhynchus mykiss*) with aquaculture purposes. Recent works have divided Mexican golden trout in different genetic populations, however, these studies have been conducted with few neutral genetic markers. With the development of a greater number of markers Next Generation Sequencing opens the possibility to

investigate more subtle genetic structure, and to detect both neutral and adaptive genetic variation (Allendorf et al. 2010). In this study, 271 Mexican golden trout and 24 cultured rainbow trout samples were collected at 27 sites in Northwestern Mexico. Genotyping by Sequencing (GBS) technics produced 10,000 SNPs markers for the 285 individuals analyzed. Population genetics analyses were performed through neighbor joining methods and assignment tests (Jombart 2008; Raj et al. 2014). Those analyses highlighted six different genetic clusters for Mexican golden trout and few native populations showed signal of genetic introgression from cultured rainbow trout. Analyzes of gene flow and effective population size are in process. Considering the importance of the genetic legacy of O. chrysogaster conservation efforts should increase preserving its habitat and biodiversity, in the same way aquaculture activities with exotic trout on its distribution area must be stopped. Our results will help to propose conservation strategies.

2016-11-16 18:00:00: **Reproductive Strategies of White Sands Pupfish (*Cyprinodon tularosa*) Inhabiting Stable and Stochastic Habitats**

Baca, Adam*[1], Peterson, Damon[2], Caldwell, Colleen A.[3]. (1-Department of Fish, Wildlife and Conservation Ecology, New Mexico State University, 2-Department of Biology, New Mexico State University, 3-U.S. Geological Survey, New Mexico Cooperative Fish and Wildlife Research Unit).

One of the fundamental theories in the evolution of mating systems is the interplay between mate choice and reproductive signaling. Reproductive signals such as bright coloration, body size, and agonistic behavior influence selection by female mates; however, these signals may not be an accurate means of judging the relative fitness of an individual. When such signals fail, animals may adopt a reproductive bet-hedging strategy where reproductive investment is based on the reliability of a given cue to compensate for variation in reproductive success across generations. The White Sands pupfish (*Cyprinodon Tularosa*) was used to test the hypothesis that mate choice strategies are influenced by environmental stability. Wild fish were collected from two locations on Salt Creek, White Sands Missile Range in the Tularosa basin of southcentral New Mexico. Each location was characterized by either highly variable flows marked by stream drying and extreme temperatures or stable flows with consistent diel patterns of water temperature. A series of camera monitored laboratory experiments characterized whether reproductive signals of male pupfish from chaotic vs. stable environments affected mate choice of female pupfish from the same environments. Detectable differences were observed between pupfish from stable versus chaotic stream environments in both the distribution of eggs among nest holding males. Additionally, reproductive effort, measured by total number of eggs produced, were significantly different between fish originating in stable versus chaotic systems. These results suggest that reproductive investment may decrease as habitat stability decreases due to the breakdown of reliable reproductive signals and highlight the importance of understanding local adaptations and the importance of maintaining population structure integrity.

2016-11-16 18:00:00: **Gila National Forest Stream Temperature and Intermittency Monitoring Network to Assess Effects of a Changing Climate for Native Fishes of Special Interest**

Wallin, Tyler*[1], Caldwell, Colleen A.[2]. (1-Department of Fish, Wildlife and Conservation Ecology, New Mexico State University, 2-U.S. Geological Survey, New Mexico Cooperative Fish and Wildlife Research Unit).

Stream temperature, flow, and the presence of non-native fishes can affect the distribution of native cold- and cool-water fishes. This is especially true for native fishes that have already experienced significant contractions in their historic range. The Gila and Mimbres drainages, located in southwestern New Mexico, support a unique cold- and cool-water native fish fauna adapted to the arid stream systems in which they evolved. These fishes, however, are losing ground to non-native fishes and the loss of habitat due to intermittency from stream drying. The objective of this work is to establish a stream temperature and intermittency-monitoring network throughout the two drainages in coordination with federal, state, and NGO partners. Temperature data from this network will be used to model current and future distribution of native fishes and co-occurrence of non-native fishes. Implementing this network will require three types of temperature data loggers over 100 sites across two drainages. Either the ProV2 or the Tidbit loggers (Onset, Inc.) will be used to record hourly water temperature across varying habitat conditions. In addition, a modified HOBO™ Pendant Temperature/Light data logger will be deployed in streams to document intermittency from drying (presumably loss of fish habitat). The use of these loggers coupled with current and historical fish population data will allow us to model current and future critical habitat. The monitoring network is planned to extend past the lifetime of the WRRI grant and continue to aid in the management of fishes of greatest conservation need.

2016-11-16 18:00:00: **Guide to Cyprinid Fish Larvae and Early Juveniles of the Upper Colorado River Basin with Computer Interactive Key**

Snyder, Darrel E.*[1], Seal, Sean C.[1], Charles, Jennifer A.[1], Bjork, C. Lynn[1]. (1-Colorado State University, Larval Fish Laboratory).

Use of collections of fish larvae and young-of-the-year juveniles to help document fish spawning sites and seasons or assess larval production, transport, distribution, nursery habitat, survival, and other aspects of early life history, requires diagnostic criteria to accurately distinguish target species from similar appearing taxa in the waters sampled. To facilitate identification of the larvae and early juveniles of fifteen carps and minnows (most of the Cyprinidae) in the Upper Colorado River Basin (UCRB), including the five native species (three endangered), developmental series of reared and collected specimens were studied for differences in size relative to developmental state, morphology, meristics, and pigmentation. The results, including detailed descriptive species accounts, comparative summary tables, and instructions for downloading and using the associated computer-interactive key, were documented as a manuscript in a final report to the Upper Colorado River Endangered Fish Recovery Program and published as Colorado Parks and Wildlife (CPW, formerly CDOW) Technical Publication 47 (Snyder et al. 2016). Electronic (PDF) copies of the guide are available on the CPW and Larval Fish Laboratory (LFL) websites, the latter at http://warnercnr.colostate.edu/lfl-downloadable-keys-guides-and-bibliography; printed copies are available upon request to CPW. The associated key (as well as a family-level computer-interactive key) is available at the same LFL website and on a compact disk accompanying printed versions of the publication. This guide complements a previously published guide to the larvae and early juveniles of UCRB catostomids (Snyder and Muth 2004, CDOW Technical Publication 42). Together, these guides complete a long series of descriptive investigations begun over 35 years ago with publication of *Contributions to a Guide to the Cypriniform Fish Larvae of the Upper Colorado River System in Colorado* (Snyder 1981, Bureau of Land Management Biological Sciences Series No. 3, Denver).

2016-11-16 18:00:00: **Comparison of Larvae and Early Juveniles of *Hybognathus* Species (Cyprinidae) in Colorado and New Mexico**

Snyder, Darrel E.*[1], Brandenburg, W. Howard[2], Sherrod, John P.[2], Bjork, C. Lynn[1], Charles, Jennifer A.[1], Seal, Sean C., Platania, Steven P.[2], Bestgen, Kevin, R.[1]. (1-Colorado State University, Larval Fish Laboratory, 2-American Southwest Ichthyological Researchers, Albuquerque).

Hybognathus are small-bodied minnows with a small, slightly subterminal, crescent-shaped mouth, long coiled gut, dark peritoneum, typically 8 dorsal- and 8 anal-fin rays, dorsal fin origin before the pelvic fins, and about 35-40 lateral-line scales. Three of seven recognized species species are found in Colorado (CO) or New Mexico (NM). Rio Grande silvery minnow *H. amarus* (RGSM) is a federal and NM endangered species that was endemic to the Rio Grande and Pecos River basins, but is now restricted to the middle Rio Grande, NM. Plains minnow *H. placitus* (PM) is native to Great Plains drainages, including eastern CO, where it is state endangered, and NM, where, as a non-native species, it has displaced RGSM in the Pecos River. Brassy minnow *H. hankinsoni* (BM) is a more northern, very wide-spread species native to, and state threatened in, eastern-most CO; however, non-native populations have become established in limited reaches of the Colorado River in western CO (and Utah). RGSM and PM broadcast eggs in open, flowing water that quickly swell to large size, become semi-buoyant, and drift downstream, whereas BM broadcasts smaller, demersal, adhesive eggs in relatively still, vegetated shallows. Based mostly on reared series, larval development of the three species is very similar with small, oblique, terminal mouths forming shortly after hatching; oval eyes in earlier larvae (slightly oval in RGSM and some PM); typically 25-27 preanal and 36-38 total myomeres; and preanal lengths averaging 69-74% of standard length (SL). PM hatch, complete yolk absorption, and tend to become mesolarvae at larger sizes than the others (typically hatch at 5-6 vs 3-4 mm SL), whereas BM usually develop gut coils and transition to later developmental intervals at slightly larger sizes (typically juveniles by 15-16 mm SL). Just-hatched RGSM and PM have unpigmented eyes and bodies, whereas BM have no or little eye pigment but notable body pigment including a distinctive, widely scattered pattern of melanophores over the dorsum of head, eyes, and body—perhaps unique among North American cyprinids. Also unlike the others, later BM larvae develop a midventral line of melanophores from heart to vent and oblique branchial-preopercular lines under the head, and later juveniles develop stronger body pigmentation and a more complete lateral band. The mouths of juvenile RGSM and PM become more horizontal, ending near bottom-of-eye level, but in BM remain more oblique, ending at mid-eye level. Later juveniles of PM have longer snouts and smaller eyes than RGSM.

2016-11-16 18:00:00: **Heat Shock Protein 90 controls pelvic fin development in a desert pupfish**

McKenna, Ken [1], Aleksic, Maja[1], Pansin, Chalisa[1], Jones, Alexander[1], Puentedura, Georgina[1], Hillyard, Stanley, Van Breukelen, Frank[1]. (1-University of Nevada, Las Vegas).

Heat Shock Protein 90 (HSP90) is an important molecular chaperone that assists with protein folding and has been shown to mask genetic variability in fish. HSP90 is often diverted to other roles within cells during heat shock and other stressful conditions. We hypothesized that HSP90 played an important role in the development of pelvic fins in pupfish. We focused on HSP90's role in pelvic fin development because a lack of pelvic fins is often used as a diagnostic tool for identifying the critically endangered Devils Hole Pupfish (*Cyprinodon diabolis*). We reared two species of pupfish at 28 °C and 33 °C and measured a reduction in total number of pelvic fin rays and in pelvic fin presence at the higher temperature. We then inhibited HSP90 at different developmental periods in a Refuge population of fish derived from *C. diabolis* using 17-DMAG and a heat shock of 33 °C. We demonstrated that total number of fin rays is reduced when HSP90 is inhibited using both chemical means and an ecologically relevant heat shock. Our results support past findings that suggest that pelvic fin development in pupfish is plastic. Developmental plasticity could thus explain at least one of the morphological features used to identify *C. diabolis*.

2016-11-16 18:00:00: **Virgin River Chub *Gila seminuda* apparent response to high flows in the lower Virgin River (Arizona and Nevada, USA) (2009–2015)**

Rogers, Ronald [*1], Albrecht, Brandon[1], Ambos, Aaron[2], Kegerries, Ronald[1]. (1-BIO-WEST , 2-Southern Nevada Water Authority).

BIO-WEST Inc., in cooperation with the Southern Nevada Water Authority (SNWA), the U.S. Bureau of Reclamation, and members of the Lower Virgin River Recovery and Implementation Team, have been monitoring the native fish community, more specifically the endangered Virgin River Chub *Gila seminuda*, in the lower Virgin River (river kilometer 140–104) since 2009. Following several high flow events, increased catch rates, a decrease in mean total length, and elevated numbers of small, wild *G. seminuda* were observed during long-term monitoring from 2009–2015. Additionally, multiple size classes were detected during this same time period, suggesting that recent recruitment of this species has occurred in the Virgin River. While the impact of high flow events on the *G. seminuda* population is not fully understood, it is evident that they are a benefit to the species. Long-term monitoring provides valuable information about the *G. seminuda* population and will potentially answer some of the persistent questions about how high flow events impact this species and the habitat in which it lives. Future studies will continue to enhance our knowledge of this species and aid management and conservation decisions.

2016-11-16 18:00:00: **Landscape-scale effects on genetic and phenotypic variation in a native stream fish**

Reese, Rosalee[*1], Diver, Tracy[2], Franssen, Nathan[2], Pilger, Tyler[3], Turner, Thomas[3]. (1-American Southwest Ichthyological Researchers, 2-USFWS, 3-University of New Mexico).

Understanding how genetic and phenotypic diversity is maintained and promoted in desert fish communities is important for effective conservation. In order to assess landscape-level effects of genetic and phenotypic variation, we quantified genetic and morphological variation of longfin dace (*Agosia chrysogaster*) from 12 sites throughout the Gila River Basin, NM, USA, and tested associations of these levels of variation with landscape factors and local habitat characteristics. Genetic and phenotypic divergence among populations was found at significant levels, suggesting gene flow was limited. While morphology showed positive trends with geographic distance and habitat characteristics, a significant correlation was not found. Thus, local habitat conditions are likely causing phenotypic variation as opposed to genetic variation.

2016-11-16 18:00:00: **Preliminary observations and notes about spawning behavior in captive Zuni bluehead sucker, *Catostomus discobolus yarrowi***

Ward, Kim[*1]. (1-ABQ BioPark).

The Zuni bluehead sucker is a medium bodied sucker found in small isolated populations in Western New Mexico and Arizona. It was listed as endangered in New Mexico in 1975 and was federally listed as endangered under the Endangered Species Act in 2014. The ABQ BioPark's Aquatic Conservation Facility has held individuals from the Tampico Springs and Agua Remora-Zuni River watershed-populations since 2007. Successful captive spawning and recruitment has occurred in outdoor holding systems beginning in 2009. In April of 2012, protolarval fish (~10 mm TL) were observed in one of the outdoor raceways. An underwater camera was deployed to find spawning locations and observe behavior. Video was captured of a single large female flanked by up to ten smaller males exhibiting bright red coloration. This is perhaps the only video documentation of spawning behavior in this species. Physical parameters such as water chemistry and substrate

preference were recorded for future reference. These observations may be used to describe spawning behaviors and improve captive husbandry practices and future management decisions regarding conservation and critical habitat designation.

2016-11-16 18:00:00: **Colorado Pikeminnow: Forgotten Predator of the Lower Colorado River**

Ward, David Lance*[1]. (1-U.S. Geological Survey, Grand Canyon Monitoring and Research Center, Southwest Biological Science Center, Flagstaff, AZ).

Colorado Pikeminnow *Ptychocheilus lucius* were historically one of the most abundant fish in the Lower Colorado River in the pre-dam era. By the 1970's they had been extirpated from below Glen Canyon Dam. In 2002, when recovery goals for Colorado Pikeminnow were written it was determined that no conservation actions conducted downstream of Glen Canyon Dam would count toward recovery. This decision was to be re-evaluated during 5-year status reviews, but has not occurred. Adult Colorado Pikeminnow still persist in the Verde River and hundreds of miles of the mainstem Colorado River below Glen Canyon Dam still match Colorado Pikeminnow life history requirements. Arguments against repatriation of Colorado Pikeminnow into the lower basin are typically based on fears over potential adverse impacts to other endangered native fishes. These fears appear to be largely unfounded based on gape to body-depth relationships and behavioral adaptations of co-evolved native species. Juvenile humpback chub *Gila cypha* and razorback sucker *Xyrauchen texanus* quickly outgrow the gape of all but the largest pikeminnow. Additional data and improved understanding of Colorado Pikeminnow biology indicates revision of the recovery goals may be warranted, to include management actions and recovery criteria for Colorado Pikeminnow in the lower Colorado River Basin.

2016-11-16 18:00:00: **Apache-Sitgreaves National Forests Water Temperature Monitoring Program, Status of Selected Apache Trout *Oncorhynchus apache* Streams**

Coleman, Stephanie[1], Ward, Jerry[1] (1- USDA-Forest Service, Apache-Sitgreaves National Forests Supervisors Office, Springerville, Arizona)

In 2011 the Wallow Fire occurred on the Apache-Sitgreaves National Forests (ASNFs), impacting over 500,000 acres. Most of the fire occurred in the headwaters of the Black, Little Colorado and San Francisco River watersheds; directly impacting 514 miles of perennial streams, and over 1,200 miles of intermittent and ephemeral drainages. It was recognized that given the severe impacts to many of the subwatersheds within the Wallow Fire, that alterations to riparian areas and post-fire stream flows would significantly impact aquatic habitats, aquatic species, and water quality. The ASNFs also recognized the importance of monitoring both the impacts and subsequent recovery of aquatic habitat and water quality after the Wallow Fire. Therefore, after the Wallow Fire occurred in 2011 the ASNFs purchased approximately 50 "Tidbit v2 Temperature Data Loggers" from Onset Computer Corporation. Installation of the loggers began in 2012, and has continued through the summer of 2016. This study was limited to selected Apache Trout streams and evaluated current water temperatures to determine potential impacts to Apache Trout and whether current conditions are suitable for the reintroduction of the species. Data collected in 2015 and 2016 did show that current water temperatures in some streams could be negatively impacting Apache Trout and limiting habitat conditions for the species.

END OF POSTER SESSION

THURSDAY 17 NOVEMBER 2016

2016-11-17 08:00-10:00 General Session III: Eliza Gilbert, Moderator

2016-11-17 08:00:00: **Reproductive success of Bonytail (Gila elegans) reared in off-channel habitats**

Osborne, Megan[1], Sanchez, Alyssa V[1], Turner, Thomas[1]. (1-University of New Mexico).

Bonytail (*Gila elegans*), once a prominent species in the Colorado River, has experienced the most dramatic declines of the Colorado's four "big river" fishes due to the introduction of non-natives, installation of mainstem dams, and water development. Bonytail is listed as an endangered species, is considered functionally extinct in the wild, and efforts to reestablish a population of Bonytail have been unsuccessful. An alternative management strategy was proposed in 2003; utilizing isolated backwaters for reproduction and rearing of several species, including Bonytail. It is critical to monitor and understand the effects of democratic factors, including breeding behaviors, on genetic diversity in fish reared in isolated habitats. In 2016, Nevada Egg and North Nine Mile backwaters, were stocked with 100 male and 100 female adults. Larvae

and age-0 fish were collected over the course of the summer. All fish were genotyped at 18 microsatellite loci to facilitate parentage analysis, obtain estimates of genetic diversity and effective size. Results included that 77% of males and 64% of females contributed progeny, and the majority of these individuals mated multiply. Genetic effective size was 134 in Nevada Egg, and overall, results were similar to that seen in 2014 and 2015.

2016-11-17 08:15:00: **Environmental and biological responses to incremental decreases in spring discharge: examples from the Great Basin and Mojave deserts, USA**

Sada, Donald W.*[1], Schumer, Rina[1], Hausner, Mark[1], Morrison, Ryan[1], Stone, Mark[1]. (1-Desert Research Institute, 2-Desert Research Institute, 3-Desert Research Institute, 4-Colorado State University, 5-University of New Mexico).

Most spring have been altered by human activity, often causing extinction and extirpation of rare taxa. However, little is known about the ecological effects of disturbance. We assessed the effects of incremental decreases in spring discharge through field experiments and numerically modeling to: (1) quantifying changes in physical habitat and benthic macroinvertebrate habitat availability; (2) determine the effect on thermal patterns; and (3) delineate tipping points for environmental metrics, microhabitat availability, and changes in benthic macroinvertebrate community structure that exhibit a non-linear response to decreased flow. Tipping points for most habitat metrics, microhabitat availability for individual species, and in benthic macroinvertebrate community structure were associated with decreases less than 20 percent. A thermal tipping point was also observed with approximately a 30 percent decrease, and its occurrence was a function of distance from the spring source and seasonality. This work indicates that spring-fed environments and aquatic communities are highly sensitive to decreasing discharge, which can be attributed to factors such as surface diversion, groundwater depletion, and climate change.

La mayoría de las manantiales han estado alteradas por la actividad humana, causando frecuentemente la extinción y la extirpación de especies escasas. Sin embargo, se sabe poco de los efectos ecológicos de la perturbación. Nosotros evaluamos los efectos de la disminución incremental de la descarga manantial usando experimentos de terreno y modelos numéricos para (1) cuantificar los cambios a hábitats físicos y la disponibilidad de los hábitats bentónicos para los macroinvertebrados, (2) determinar el efecto a los patrones térmicos, (3) delinear el punto de inflexión de las medidas medioambientales, la disponibilidad de microhábitats y los cambios en la estructura de la comunidad de los macroinvertebrados bentónicos que muestran una reacción no-linear a la disminución de la descarga. Los puntos de inflexión de la mayoría de las medidas de los hábitats, la disponibilidad de microhábitats para especies individuos y de la estructura de las comunidades de los macroinvertebrados bentónicos fueron asociados con reducciones de descarga de menos de 20 por ciento. Un punto de inflexión térmico fue observado además con una reducción de aproximadamente 30 por ciento y su ocurrencia fue una función de la distancia de la fuente de la manantial y su estacionalidad. Este trabajo indica que los medioambientes con fuentes manantiales y las comunidades acuáticos están bastantes susceptibles a una descarga disminuida, lo cual se puede atribuir a factores tales como el desvío superficial de agua, el agotamiento del agua subterránea y el cambio climático.

2016-11-17 08:30:00: **Evaluating the relationship of temperature and growth of larval Colorado River catostomids through otolith aging and stable isotopes ($\delta^{18}O$)**

Barkalow, Adam L. *[1], Turner, Tom F. [1], Atudorei, Nicu-Viorel[1], Newsome, Seth D. [1], Mckinstry, Mark C. [2], Platania, Steve P.. (1-Univeristy of New Mexico, 2-U.S. Bureau of Reclamation, 3-American Southwest Ichthyological Researchers).

It is well understood, through laboratory experiments, that growth rates of larval catostomids are related to environmental temperature. However, assessing the relationship between growth and temperature of riverine larvae is confounded by larval movement (e.g., via drift and diel movements) and because larvae can use thermally heterogeneous mesohabitats. Isotopic analysis of otoliths from larval Colorado River catastomids could facilitate better understanding of thermal ecology of wild caught larvae. Isotope ratio mass spectrometry (IRMS) is a technique that reveals integral aspects of an individuals' life history that are often difficult or impossible to assess with traditional sampling methods. Analysis of oxygen isotope ratio ($\delta^{18}O$) of an otolith is a validated method for evaluating the environmental temperature experienced by a fish. Here we present a method of obtaining the oxygen isotope ratio of individual larval otoliths and compare $\delta^{18}O$ results with daily growth rates of the same fish. For our preliminary analysis we used specimens of two Colorado River catostomids, Flannelmouth Sucker *Catostomus latipinnis* and Bluehead Sucker *Pantosteus discobolus* collected within 160 river kilometers of the lower Grand Canyon in 2015.

2016-11-17 08:45:00: **Razorback and Flannelmouth Sucker hybrid hatch rates and larval survival**

Wolters, Pilar[*1]. Gibb, Alice2, Ward, David[3], Rogowski, David[1] (1-Arizona Game and Fish Department, 2-Northern Arizona University, 3- U.S. Geological Survey, Grand Canyon Monitoring and Research Center, Southwest Biological Science Center, Flagstaff, AZ).

Prior to the construction of large dams, the endangered Razorback Sucker *Xyrauchen texanus* once made long spawning migrations through the Grand Canyon to the upper basin of the Colorado River. Historically, hybridization between Razorback Sucker and Flannelmouth Sucker *Catostomus latipinnis* rarely occurred because of separation in spawning location and timing of the two species. As a result of modification of the river by dams, we are seeing an increase in hybridization between Razorback and Flannelmouth suckers. To enhance management of the endangered Razorback Sucker, the Arizona Game and Fish Department in collaboration with Grand Canyon Research and Monitoring Center-USGS, and Northern Arizona University is conducting a study to develop field identification tools for hybrid suckers, and evaluate sucker hybrid viability. Gametes were stripped and mixed to make four treatments: 1) female Razorback x male Flannelmouth, 2) female Flannelmouth x male Razorback, 3) Flannelmouth, and 4) Razorback. Each combination was reared in replicate among four tanks. We compared hatch rates and larval survival of the four treatments to determine if there were any significant differences between hybrids and pure fish. If hybrid offspring are fully viable, it has very important ramifications for species definitions, listing status, and recovery of razorback suckers throughout the Colorado River basin.

2016-11-17 09:00:00: **Muddy River Blue Tilapia *Oreochromis aureus* Eradication Progress (A Cautiously Optimistic Tale of Successful Native Species Recovery in a Southwestern Stream)**

Rehm, Amos[*1], Mecham, Jake[1], Stevenson, Raymond[1], Senger, Brandon[1], Simons, Lee[2]. (1-Nevada Department of Wildlife, 2-US Forest Service (formerly US Fish and Wildlife Service)).

The Muddy River originates as a series of thermal springs near Moapa, Nevada which support the endemic and endangered Moapa Dace *Moapa coriacea* as well as the Moapa variant of the White River Springfish *Crenichthys baileyi moapae*. These springs coalesce into the main stem, which supports a geographically distinct population of the endangered Virgin River Chub *Gila seminuda* and the Moapa Speckled Dace *Rhinichthys osculus moapae*. In the early 1990s Blue Tilapia *Oreochromis aureus* became established in the system, and precipitous declines in native fish populations were documented shortly thereafter. After considerable efforts were invested to successfully eradicate Blue Tilapia in the headwater springs, a Cooperative Recovery Initiative (CRI) grant was obtained to extend eradication efforts downstream into the main stem and encourage recovery of native fish species in the Muddy River. This report summarizes the successes (and challenges) of the first year's significant progress, including rotenone treatment of a 4 km segment of the river and attempts to re-establish the native fish assemblage of the Muddy River.

2016-11-17 09:15:00: **Investigating spawning methods for two native Southwestern fishes: implications for potential live bait use**

Stahr, Kristopher J.[*1]. (1-Arizona Game and Fish Department, Research Branch).

Live baitfishing is an economically and socially important form of recreational fishing in the United States. However, the majority of baitfish used in the Southwest are non-native and can negatively affect aquatic ecosystems (including native fishes). In addition, anglers regularly released unused live baitfish, and baitfish can now be transported easily using equipment readily available to sportsman. Thus an imperative need exists for baitfish that do not possess the risk to native fish and aquatic ecosystems that non-native baitfish do. Therefore, the objective of this study is to investigate different methods of spawning for two native Southwestern fishes in Arizona (Sonora suckers *Catostomus insignis* and longfin dace *Agosia chrysogaster* and evaluate those species for potential live bait use. The first phase of this project focused on culture methods of Sonora suckers. In early spring 2016, twenty-three Sonora suckers were collected and transported to the Department's Aquatic Research and Conservation Center (ARCC) for spawning. Fish were injected OvaPrim® hormone, and several fish developed eggs and milt. Two pairs of fish ripened enough to spawn and eggs and milt were physically stripped and fertilized. Eggs were allowed to incubate within hatching jars and the majority of fish hatched after six days. Overall, our preliminary results indicate that Sonora suckers may be feasible for large-scale production. The next phase of this project is focused on developing spawning methods for longfin dace, and to continue refinement of spawning methods for Sonora suckers.

2016-11-17 09:30:00: **Molecular clock and events implicated in the divergence time within the endemic *Gila eremica* lineage in Sonora, northwest México**

Ballesteros-Cordova, Carlos A.*[1], Varela-Romero, Alejandro[1], Ruiz-Campos, Gorgonio[2], Findley, Lloyd [3], Grijalva-Chon, José Manuel[1], Gutíerrez-Millán, Luis Enrique. (1-DICTUS / Universidad de Sonora, 2-Universidad Autónoma de Baja California, 3-CIAD-Guaymas).

The Desert Chub *Gila eremica* DeMarais, 1991, is an endemic species in Sonora Northwest Mexico. The recent morphological characterization of the *Gila eremica* lineage, revealed the isolated populations of *Gila* cf. *eremica* recently discovered from the Arroyo El Tigre sub-basin in the Matape basin, divergent respect to populations of nominal *G. eremica*. Moreover, the phylogenetic relationships of the lineage showed the newly discovered populations in a clade of specific identity, sharing a putative common ancestor with the populations from the Matape River basin. The geographical and topological location of *G*. cf. *eremica* populations in La Balandrona and La Pirinola Canyons at southward Sierra El Aguaje mountains, suggest the rise of the Sierra Santa Ursula (ca. 23.5 and 8.5 Mya) as a possible cause of disconnection between Arroyo El Tigre and Matape River sub-basin. The relaxed molecular clock presented here, derived from *Gila turneri* (12 Mya) as the calibration point of the tree (lognormal mean = 1.5, lognormal SD = 0.55), showed that populations of the *G. eremica* lineage diverged from *Gila purpurea* ca.15.60 Mya (~20.42-12.91 Mya) during the early or middle Miocene. The results suggest that divergence of *G. eremica* populations from the Sonora and Matape River basins occurred ca. 7.63 Mya (~13.36-3.85 Mya, in the middle or late Miocene), probably promoted for the final rise of the Sierra Mazatan in the middle Miocene (ca. 12.4 Mya). According to our results, *Gila* cf. *eremica* populations diverged from *Gila eremica* populations of the Matape River basin ca. 5.60 Mya (~11.03-2.37 Mya), during the middle/late Miocene or early Pliocene, agreeing with the hypothesis of the rising of the Sierra Santa Ursula as cause of disconnection between hydrologic systems. The divergence times of lineages obtained here, fits with geological events related to the formation of the Sierra Madre Occidental, the Basin and Range, and the Gulf of California Extensional Province during the Miocene in Sonora.

La Carpa del Desierto *Gila eremica* DeMarais, 1991, es una especie endémica para Sonora en el Noroeste de México. La reciente caracterización morfológica del linaje de *Gila eremica*, reveló a las poblaciones aisladas de *Gila* cf. *eremica* recientemente descubiertas en la subcuenca del Arroyo El Tigre en la cuenca del Río Mátape divergentes respecto a las poblaciones de la *G. eremica* nominal. Por otra parte, las relaciones filogenéticas del linaje mostraron a las nuevas poblaciones descubiertas en un clado de identidad específica compartiendo un putativo ancestro en común con las poblaciones de la cuenca del Río Mátape. La ubicación geográfica y topológica de las poblaciones de *G*. cf. *eremica* en los cañones La Balandrona y La Pirinola al Sur de la Sierra El Aguaje, sugiere al surgimiento de la Sierra Santa Ursula (ca. 23.5 y8.5 Ma) como una posible causa de desconexión entre el Arroyo El Tigre y la subcuenca del Río Mátape. El reloj molecular relajado presentado aquí, derivado de *Gila turneri* (12 Ma) como el punto de calibración del árbol (lognormal promedio = 1.5, lognormal DS = 0.55), mostró que las poblaciones del linaje de *G. eremica* divergieron de *Gila purpurea* aproximadamente hace 15.60 Ma (~20.42-12.91 Ma) durante el Mioceno medio o temprano. Los resultados sugieren que la divergencia de las poblaciones de *G. eremica* de las cuencas de los ríos Sonora y Mátape ocurrió aproximadamente hace 7.63 Ma (~13.36-3.85 Ma en el Mioceno medio o tardío), probablemente promovida por la elevación final de la Sierra Mazatán en el Mioceno medio (ca. 12.4 Ma). De acuerdo con nuestros resultados, las poblaciones de *Gila* cf. *eremica* divergieron de las poblaciones de *Gila eremica* de la cuenca del Río Mátape hace aproximadamente 5.60 Ma (~11.03-2.37 Ma), durante el Mioceno medio/tardío o Plioceno temprano, concordando con la hipótesis del surgimiento de la Sierra Santa Ursula como la causa de desconexión entre estos sistemas hidrológicos. Los tiempos de divergencia obtenidos aquí, concuerdan con eventos geológicos relacionas a la formación de la Sierra Madre Occidental, El Basin and Range y la Provincia Extensional del Golfo de California durante el Mioceno en Sonora.

2016-11-17 09:45:00: **Swimming Performance of Three *Gila Species*: *Gila elegans*, *G. cypha*, and *G. robusta***

Chandos, Amy*[1], Young, Kirk [2], O'Neill, Matt[2], Ward, David[3], Montgomery, Wilson[1]. (1-Northern Arizona University, Biological Sciences Department, 2-Arizona Game and Fish, 3-Grand Canyon Monitoring and Research Center).

The Colorado River is one of the most visibly altered aquatic systems in the South Western United States. Due to the altered flow regimes, lower average temperatures, and the introduction of highly successful non-native aquatic species, many native fish species have experienced severe population declines or complete extirpation. Species such as Bonytail *Gila elegans*, Humpback Chub *G. cypha*, and Roundtail chub *G. robusta* are tallied among these species, and reintroduction efforts have been relatively unsuccessful. To examine the effects of temperature on the swimming performance of *G. elegans*, *G. cypha*, and *G. robusta* juvenile fish obtained from the US Fish and Wildlife Dexter National Fish Hatchery and Technology were acclimated to 10° C, 20° C, and 30° C. Fish were then placed in a Brett- type respirometer and underwent a stepped velocity test to determine the critical swimming speed (Ucrit). Ucrit is defined as the swimming velocity that a fish can sustain for a given period of time. The Ucrit was compared between all three species. This talk will evaluate the effects of temperature on swimming performance of juvenile *G. elegans*, *G. cypha*, and *G. robusta*.

2016-11-17 10:00:00 **BREAK**

2016-11-17 10:15-12:00 General Session IV: Preston Bean, Moderator

2016-11-17 10:15:00: **Assessing passage success of warner suckers at a newly constructed, sucker-friendly fishway in southeastern Oregon**

Scheerer, Paul[*1], Brandt, Troy[2]. (1-Oregon Department of Fish and Wildlife, 2-River Design Group).

The Warner sucker (*Catostomus warnerensis*) is endemic to the Warner Valley, an endorheic subbasin of the Great Basin in southeastern Oregon and northwestern Nevada. This species was historically abundant and its historical range includes three permanent lakes, several ephemeral lakes, and three major tributary drainages. Warner sucker abundance and distribution has declined over the past century and it was federally listed as threatened in 1985, due to habitat fragmentation and threats posed by the proliferation of piscivorous non-native game fishes. Recent recovery actions have focused on improving/providing passage at aging irrigation diversion dams that are common on tributaries in the drainage. In 2015-2016, we assessed passage success and hydraulics at a newly constructed sucker-friendly fishway at the Dyke Diversion on Twentymile Creek. The new fishway is 57 ft long with ten pools/cells, has 0.5 ft weir drops for redband trout passage, 1 ft square orifices for Warner sucker passage, and a simulated streambed floor (cobble). It was designed for a passage window of April-July, maximum orifice velocity of 4 ft/s, range of flows between 35-148 cfs, minimum pool depth of 4 ft, and a slope <4%. We PIT tagged adult suckers and monitored passage in 2015 and 2016 using fixed PIT-tag arrays located at the upper and lower fishway orifices, at the tail of the pool located downstream of the fishway, and at the riffle located upstream of the pool impounded by the irrigation diversion dam. Additionally, we measured hydraulic conditions in the fishway at various stream discharges. We documented sucker passage success in both years and developed recommendations to improve upon the initial design.

2016-11-17 10:30:00: **Fish Asian Tapeworm in an Endangered Southwestern Fish: Assessing Infections Using a Non-lethal Molecular Screening Tool**

Campbell, Meredith[*1], Caldwell, Colleen A.[2], Wilson, Wade[3], Lewis, Teresa D.[4]. (1-Department of Fish Wildlife and Conservation Ecology, New Mexico State University, 2-U.S. Geological Survey, New Mexico Cooperative Fish and Wildlife Research Unit, 3-U.S. Fish and Wildlife Service, Southwestern ARRC Research Unit, 4-U.S. Fish and Wildlife Service, Midwest Fisheries Center).

The current standard for positive identification of fish Asian tapeworm *Schyzocotyle acheilognathi* infection is necropsy and visual examination of the gut via microscopy, a method which is not ideal for assessing parasitic infection in endangered fish. This research aimed to determine whether collecting anogenital swabs for genetic material could replace terminal sampling of fish. An experiment was conducted in which infected captive Humpback Chub *Gila cypha* were swabbed and necropsied to assess presence/absence of infection. DNA was extracted from the swabs, and PCR was used to amplify *S. acheilognathi* COXI mtDNA. Mean primer set sensitivity was 52% percent while mean specificity was 79% percent. Even with moderately-low sensitivity, the non-lethality of this methodology may offset decreased sensitivity, especially for rare fish. Sequencing revealed that the moderate specificity is a result of the primer detecting residual environmental DNA, not decreased species fidelity. Primer sensitivity may be a function of the swabbing process and parasite developmental stage. Swabs were collected from wild populations of Humpback Chub for *S. acheilognathi* and revealed average infection prevalence of 13%, and relative infection frequency of 6.6 - 21.4%. This non-lethal molecular diagnostic tool will provide managers with a viable alternative to the current terminal standard for assessing infection and quantifying prevalence in endangered hatchery and wild fish populations.

2016-11-17 10:45:00: **Exploratory Analysis of Hydrograph Parameters for Rio Grande Silvery Minnow Spawning, Recruitment, and Population Viability**

Porter, Michael[*1]. (1-US Army Corps of Engineers).

The Rio Grande silvery minnow (*Hybognathus amarus*) was a formerly widespread endemic fish species, now restricted to 160 miles of the Rio Grande in New Mexico. Water management on the Rio Grande over the past 100 years has changed the hydrology and channel geomorphology. Inundated floodplains provide spawning and nursery habitat for many fish species, including silvery minnows. Water management and drought have reduced the magnitude of the spring snowmelt hydrograph and the associated connectivity between the river and the floodplain. The availability of inundated floodplain habitat can have important implications for fish reproduction, recruitment, and population viability. The objective of this study is to

better understand annual silvery minnow spawning and recruitment in response to environmental flow parameters. A functional data analysis approach using R statistical software was used to identify the relative hydrograph parameters (magnitude, frequency, duration, timing, rate-of-change) associated with increased silvery minnow recruitment rates and population indices. This analysis will support adaptive management by refining recruitment flow parameters for better informed water management strategies.

2016-11-17 11:00:00: **Are Gila Topminnow Still In Danger of Extinction?**

Robinson, Anthony T.*[1]. (1-AZ Game & Fish Dept.).

Gila topminnow, *Poeciliopsis occidentalis*, status has improved since the recovery plan was finalized in 1984. At that time, Gila topminnow was present in 15 localities: 9 natural and 6 repatriated populations. Gila topminnow were stocked into over a hundred sites in the 1980s, and by 1989, it was thought the species could be reclassified as threatened. However, drought and nonnative species caused most of the populations established in the 1980's to disappear. By 1998, when a draft revised recovery plan was completed, there were 44 populations: 14 natural; 18 repatriated into wild locations, and 12 captive. Repatriations have continued, and there are now 88 locations with Gila topminnow; but 16 of those were stocked in the last three years. Therefore, 72 populations have persisted for more than three years: 11 natural; 31 wild repatriations, 30 captive. Each of the five recognized genetic management has multiple replicates: 21 Monkey/Cottonwood Springs, 18 Bylas Springs, 13 Cienega Creek, 11 Lower Santa Cruz, and 9 Sharp Spring. Further, the 72 populations are widely spread across the Gila River basin: 9 in the Gila River Basin above Coolidge Dam, 19 in the Salt River Drainage, 6 in the Agua Fria drainage, 8 in the San Pedro River drainage, 23 in the Santa Cruz River drainage, and 7 at conservation facilities. Therefore, because each genetic management unit has multiple replicates, and the 72-88 populations are widely distributed across the Gila River Basin, the risk of extinction is extremely low. Reclassifying the species as threatened is warranted.

2016-11-17 11:15:00: **Exploring the fishes and deep history of the North Fork Pit River, California**

Reid, Stewart B.*[1], Forrest, Neneekah[2], Fierro, Marissa[3]. (1-Western Fishes, 2-Hewisedawi, 3-Pit River Tribe).

The North Fork Pit River is the historical outlet of Goose Lake and, as such, forms the northernmost headwaters of the Sacramento River Drainage. Goose Lake itself has not overflowed since the late 1800's. This project, initiated in 2016, is a collaboration between the Pit River Tribes and Western Fishes with the goal of establishing the historical, current and potential fish fauna of the North Fork Pit River to aid with management and promote greater awareness of the role the river has played in tribal life. The project combines current fish surveys with examination of historical records from earlier surveys, museum records, and travelers' diaries. The second primary goal of the project is to survey and document traditional ecological knowledge (TEK) of fishes and ecological conditions, both in the local tribal community and inferred from ethnographic accounts, language and traditional stories. Native fishes include Pit-Klamath Brook Lamprey, *Entosphenus lethophagus* ; Sacramento Pikeminnow, *Ptychocheilus grandis* ; Hardhead, *Mylopharodon conocephalus* ; Northern Roach, *Lavinia mitrulus* ; Pit-Goose Tui Chub, *Siphateles thalassinus* ; Speckled Dace, *Rhinichthys osculus* ; Western Sucker, *Catostomus occidentalis lacuanserinus* ; Pit Sculpin, *Cottus pitensis* ; and Redband Trout, *Oncorhynchus mykiss ssp.*.

2016-11-17 11:30:00: **Upper Colorado Basin Area Report**

Badame, Paul*[1]. (1-Utah Divison Wildlife Resources).

Activities continue in an effort to improve the status of many native fishes of the Upper Colorado River Basin. These activities are guided principally by four programs: the Upper Colorado River Endangered Fish Recovery Program, the San Juan River Basin Recovery Implementation Program, the Range-wide Conservation Agreement for the Colorado River Cutthroat Trout, *Oncorhynchus clarkii pleuriticus*, and the Range-wide Conservation Agreement and Strategy for the "Three Species" (roundtail chub, *Gila robusta*, bluehead sucker, *Catostomus discobolus*, and flannelmouth sucker, *C. latipinnis*). The two recovery programs, which collectively work towards the recovery of Colorado pikeminnow, *Ptychocheilus lucius*, razorback sucker, *Xyrauchen texanus*, bonytail, *G. elegans*, and humpback chub, *G. cypha*, use the protection of in-stream flow, habitat restoration, nonnative fish control, propagation, life history monitoring, and information and education to bring benefits to the four "big river fishes." A species status assessment for razorback suckers is near completion and the process to update humpback chub recovery goals continues. Tasks to assist the species under Conservation Agreements included multiple remote sensing projects in tributaries throughout the basin; tamarisk control and watershed habitat restoration efforts are occurring on the San Rafael, Price, and White Rivers; distribution and density monitoring throughout their ranges; and renovation of trout streams and reintroduction of the Colorado River cutthroat trout continues in Colorado, Utah, and Wyoming.

2016-11-17 11:45:00: **Razorback Sucker *Xyrauchen texanus* in Lake Mead and Lake Powell Inflows**

Kegerries, Ron[*1], Albrecht, Bradon[1], McKinstry, Mark[1]. (1-BIO-WEST, Inc., 2-BIO-WEST, Inc., 3-U.S. Bureau of Reclamation).

Endangered Razorback Sucker *Xyrauchen texanus* populations have been reduced throughout their historic range during the last century. Dramatic changes in habitat through altered flow regimes, anthropogenic modifications, and the introduction of nonnative fishes have limited recruitment. However, studies in Lake Mead since 1996, have tracked wild spawning and natural recruitment near inflow areas. Telemetry efforts at the Colorado River inflow area documented movement of sonic-tagged Razorback Suckers between Lake Mead and the Colorado River within the Grand Canyon. Additional larval and small-bodied fish sampling has documented reproduction within the Grand Canyon; however, in-river recruitment has not been documented. Similar Razorback Sucker investigations at the San Juan and Colorado rivers inflow areas of Lake Powell have also documented the presence of adult and larval Razorback Sucker in both areas. Given the results from Lakes Mead and Powell, we propose that inflow areas provide important, and perhaps necessary, habitat for natural Razorback Sucker recruitment and reproduction under current conditions. Thus, inflow areas, along with adjacent lacustrine and riverine habitats may be important locations for Razorback Sucker conservation and recovery efforts.

2016-11-17 12:00 **Lunch on your own**

2016-11-17 13:15-17:00 General Session V: Stephanie Coleman, Moderator

2016-11-17 13:15:00: **The origination time of the Devils Hole pupfish**

Martin, Andrew[*1]. (1-University of Colorado Boulder, Ecology and Evolutionary Biology).

Estimated originated dates for the Devils Hole pupfish, *Cyprinodon diabolis*, based on molecular data vary among studies by almost four-orders of magnitude, from about 100 years to a million years. The uncertainty reflects differences in data, methods, assumptions, and bias among studies. Here, I review the estimates and discuss the uncertainty in the context of why knowledge of origination time is important for understanding and conserving biodiversity.

2016-11-17 13:30:00: **Population dynamics of razorback sucker, *Xyrauchen texanus*, in the Green River basin, Utah and Colorado, 2011–2013**

Zelasko, Koreen A.[*1], Bestgen, Kevin R.[1], White, Gary C.[2]. (1-Colorado State University, Department of Fish, Wildlife, and Conservation Biology, Larval Fish Laboratory, 2-Colorado State University, Department of Fish, Wildlife, and Conservation Biology).

Population dynamics of Upper Colorado River Basin (UCRB) Razorback Sucker, *Xyrauchen texanus*, a species federally listed as endangered, were unknown for many years because limited recapture data precluded a structured monitoring effort. However, recent increases in Razorback Sucker captures allowed survival rate estimation for propagated individuals stocked into the UCRB from 1996–2005 and 2004–2007, and identification of hatchery characteristics and stocking protocols that affected survival. Razorback Sucker survival rate and population abundance estimates were next generated specifically for the Green River basin using data from endangered Colorado Pikeminnow, *Ptychocheilus lucius*, abundance estimation sampling from 2006–2008. This study built on our previous results and employed Razorback Sucker capture data collected during Colorado Pikeminnow sampling from 2011–2013. We used multi-state, robust design models in Program MARK with Huggins' closed captures to estimate Razorback Sucker abundance, as well as survival, transition, capture, and recapture rates among four reaches and nearly 700 river km of the Green River basin: upstream middle Green River, intermediate Desolation-Gray canyons, downstream lower Green River, and tributary White River, which flows into the Green River between the upstream and intermediate reaches. In our top-ranked estimating model, Razorback Sucker survival varied by time (year) and was almost twice as high from 2011–2012 (0.65, 95% confidence interval [CI]: 0.48–0.80) than from 2012–2013 (0.35, 95% CI: 0.26–0.46). Fish movement (transition rate) out of the upstream middle Green River was low or zero. Transition rates for other reaches indicated most movement was upstream (e.g., Desolation-Gray canyons to middle Green River [0.21, 95% CI: 0.11–0.38] and lower Green River to Desolation-Gray canyons [0.23, 95% CI: 0.12–0.40]). Abundance for the entire study area was similar across years (mean: 22,933, range: 21,099–24,010), but varied considerably by reach. Highest estimated mean abundance was in Desolation-Gray canyons (8,732, range: 6,922–11,741 annually), a reach where Razorback Suckers were only stocked in 2006 and where survival was estimated to be near zero in our previous analysis; that reach is located between heavily stocked middle and lower Green River reaches. Mean abundance was 5,865 in middle Green and generally increased during the study period (range: 3,633–8,592), and was 7,604 in lower Green but decreased during the study period (range: 3,459–11,068). No Razorback Suckers have ever been stocked

into the White River, but mean estimated abundance across study years was 731 (range: 28–1,514 annually) and the transition rate from the Desolation-Gray reach to White River was 0.13 (95% CI: 0.04–0.33), demonstrating population expansion. No Razorback Suckers were stocked and few were recaptured in the Yampa River, an upstream tributary to the Green River, so abundance estimates were not possible. Low capture probabilities (0.02, on average, across reaches and years), primarily due to sampling efforts that did not specifically target Razorback Suckers, continued to hinder our ability to produce precise abundance estimates – a task imperative to evaluating success of recovery actions. However, precision of Razorback Sucker abundance estimates improved as captures of the species increased in the UCRB, and this study, along with our previous analyses, will improve understanding of Razorback Sucker population dynamics and aid managers in allocating monitoring and recovery resources.

2016-11-17 13:45:00: **Examination of microbiota associated with external lesions on native and endangered fishes of the San Juan River, NM and UT**

Diver, Tracy*[1], Wilson, Wade[1], Schleicher, Benjamin[2]. (1-Southwestern Native Aquatic Resources and Recovery Center, US Fish and Wildlife Service, 2-Colorado River Fisheries Project, US Fish and Wildlife Service).

Relatively little is known about how the severity and duration of pathogenic outbreaks affect fish populations; yet, health can often be directly linked to and dependent on the integrity of ecosystems. Recent field surveys have identified the occurrence of lesions on non-native, native, and endangered fishes in the San Juan River, NM and UT. Severity of lesions range from minor, irritant-like abrasions to gaping infected wounds. Infections appear to be pathogenic in origin; however, it is difficult to determine without further examination. We conducted a pilot study to examine the microbiota associated with fish exhibiting lesions. Bacterial swabs were collected in the field and then cultured in vitro. Isolated colonies were extracted and then sequenced using universal bacterial primers. Sequence data was compared to files accessioned to the National Center for Biotechnology Information to examine potential candidates causing pathogenicity.

2016-11-17 14:00:00: **Reproduction under heat stress: inhibition of gonadal steroidogenesis and oogenesis in female pupfish at high temperature**

Lema, Sean C.*[1], Bock, Samantha L.[1], Chow, Michelle I.[1], May, Darran [2], Dittman, Andrew H.[3]. (1-California Polytechnic State Univ., Biological Sciences Department, 2-Univ. of Washington Seattle, School of Aquatic and Fisheries Sciences, 3-NOAA Northwest Fisheries Science Center).

The ability of desert fishes to cope with increasingly extreme temperatures may be critical to their continued persistence under a changing global climate. Moderate thermal conditions often stimulate reproduction in temperate fishes, but exposure to high temperatures can impair gametogenesis or, in extreme cases, trigger gonadal sex reversal. *Cyprinodon* pupfishes have the highest recorded thermal range for reproduction among teleost fishes. Even so, reproductive performance in some pupfishes has been observed to decline above approximately 32-34°C. Here, we examined how high water temperature (34-35°C) affected reproductive endocrinology in *Cyprinodon* pupfishes, with the hypothesis that exposure to high temperatures would alter hormone pathways in patterns indicative of impaired steroidogenesis and gametogenesis. In one experiment, adult *C. variegatus* pupfish were maintained at either 25°C or 35°C for 14-15 days. Both females and males at 35°C had a smaller gonadosomatic index (GSI) than same sex pupfish at 25°C. Females at 35°C showed lower relative levels of mRNAs encoding receptors for the gonadotropin hormones follicle-stimulating hormone (*fshr*) and luteinizing hormone (*lhr*) in gonadal tissues, as well as lower mRNA levels for cholesterol side chain cleavage enzyme (*p450scc*) and steroid acute regulatory protein (star), two proteins involved in the initial steps of cholesterol conversion to steroid hormones. Females at 35°C also had depressed ovarian gene transcript abundance for ovarian aromatase (*cyp19a1a*) – an enzyme that converts testosterone to estradiol. Similar to females, males exposed to 35°C exhibited lower relative levels of *lhr* and *p450scc* mRNAs in the testis than males at 25°C. In a second experiment, adult Amargosa pupfish, *C. nevadensis amargosae*, from two allopatric populations - Tecopa Bore and the Amargosa River - were acclimated in captivity to 24°C or 34°C for 88 days. Gene transcripts encoding receptors for the gonadotropin *fshr* and *lhr* receptors were again observed to be lower in the gonads of both sexes at 34°C compared to fish at 24°C. Tecopa Bore females exposed to 34°C also exhibited lower ovarian mRNA abundance for P450 aromatase, as well as depressed levels of mRNAs encoding vitellogenin yolk proteins and choriogenin egg envelope proteins in the liver. Combined, the results from these two experiments suggest that female *C. n. amargosae* exposed to stable temperature environments of 34-35°C may experience reduced gonadal estrogen synthesis and impaired oogenesis. Despite the phenomenal thermal range exhibited by these two *Cyprinodon* taxa, our findings imply that fish may experience impaired reproductive performance at 34-35°C, even though these temperatures are well within the range of thermal tolerance for these species.

2016-11-17 14:15:00: **Using genetics to characterize native fish response to disturbance: a case study from the Upper Gila River basin**

Pilger, Tyler J[*1], Gido, Keith B[2], Propst, David L[1], Whitney, James E[3], Turner, Thomas F[1]. (1-Museum of Southwestern Biology, University of New Mexico, 2-Kansas State University, Division of Biology, 3-Pittsburg State University, Department of Biology).

Wildfires are important disturbance events for terrestrial and aquatic ecosystems throughout the Western U.S. Wildfire related ash and debris flows can strongly influence fish communities yet there is little empirical data on their influence on genetic diversity and spatial structuring. Population genetic monitoring beginning in 2010 was used to characterize genetic summary statistics for six native fish species and evaluate genetic responses to ash/debris laden floods resulting from a series of three catastrophic wildfires (2011, 2012, and 2013) in the Upper Gila Basin of New Mexico. Three species exhibited declines in diversity (heterozygosity and/or allelic richness) and decreased numbers of breeders (linkage disequilibrium effective size) over the course of the study, whereas other species were more resistant to loss of diversity. Species also exhibited substantial changes in allele frequencies over time indicated by low variance effective size estimates. In conjunction with temporal changes in genetic structure (F_{ST}), these data suggest substantial demographic changes occurred for several species. By comparing temporal changes in genetic diversity and structure spanning pre-disturbance through recovery phases, we developed a conceptual framework that makes explicit predictions concerning the trajectory of genetic summary statistics. Applying our framework across species revealed differences in relative roles of dispersal and local compensatory reproduction to resilience and recovery following large disturbances.

2016-11-17 14:30:00: **June Sucker Post-stocking Evaluation**

Goldsmith, Wesley [*1], Marsh, Paul[1], Kesner, Brian[1], Ehlo, Chase[1]. (1-Marsh and Associates).

June sucker, *Chasmistes liorus*, is an endangered species endemic to Utah Lake, Utah. Through anthropogenic disturbances and introduction of non-native fishes, June sucker populations drastically declined. Population augmentation is currently the main component of the June Sucker Recovery Implementation Program, but post-stocking survival of hatchery reared June sucker is not fully understood. Twenty-four June sucker (twelve each of age 1 and age 2 individuals) were surgically implanted with acoustic tags and released on 3 June 2016 along with two cohorts of PIT tagged fish (1,470 age 1 and 1,466 age 2). After 60 days of active and passive tracking, fish were classified as alive, a mortality, or lost to the study. Of the twelve age 1 fish, one was alive, three were mortalities, and eight were lost to the study. Of the twelve age 2 fish, five were alive, one was a mortality, and six were lost to the study. In addition to acoustic telemetry, PIT scanning was also employed in an effort to evaluate post-stocking survival. Thirty submersible PIT scanning units were placed throughout the lake at random locations and in known high traffic areas. Scanners contacted 742 individual June sucker, of which 176 had a stocking record. Of the fish with stocking records 59.7% were stocked in 2011 and had an average total length of 309 mm. Both acoustic telemetry and remote PIT scanning is an effective method of evaluating post-stocking survival of June sucker. Based on these data, we recommend stocking age 2 June sucker for the continued conservation and eventual recovery of the species.

2016-11-17 14:45:00: **Status of the Relict Leopard Frog and Plans for Future Management**

Haley, Ross D.[*1], Jaeger, Jef R.[2], Rivera, Rebeca[2], Burroughs, Michael[3], Sjoberg, Jon C.[4], Sredl, Michael J.. (1-National Park Service, 2-School of Life Sciences, University of Nevada, Las Vegas, 3-U.S. Fish and Wildlife Service, 4-Nevada Department of Wildlife, 5-Arizona Game and Fish Department).

By the late 20th century, *Rana* (*Lithobates*) *onca* was restricted to eight historical sites in two areas of southern Nevada, with an estimated 1100 frogs in existence. Speculation on the causes for population declines focused on loss or degradation of habitat, introduction of predators, and epizootic disease. The species was petitioned for listing in 2002, with the U.S. Fish and Wildlife Service (USFWS) determining that listing was warranted but precluded by higher priorities. Prior to the petition, an interagency and volunteer conservation team had formed and was already conducting management actions. By 2005, the team had developed a formal conservation agreement and strategy (CAS). Management actions have predominately focused on monitoring populations, establishing new, experimental populations, and conducting small-scale projects to improve, maintain or create habitat. Under multidistrict litigation, the USFWS recently conducted a Species Status Assessment and once again, chose not to list the species. We summarize more than a decade of management actions conducted under the CAS, and describe stressors and threats. Since systematic management began, remnant historical populations have been monitored and maintained and translocation efforts have established *R. onca* at numerous experimental sites. Overall, management actions have substantially increased the number of sites occupied by *R. onca*, and monitoring indicates an increasing trend in relative abundance and a modest overall increase in global population size. The CAS was a 10 year multi-agency agreement which expired in July of 2015. A new agreement has been drafted and submitted for agency review and signature to facilitate and guide management actions for the next 10 years.

2016-11-17 15:00:00: **Guide to larval and early juvenile cyprinids of the middle and lower Pecos River (New Mexico and Texas)**

Brandenburg, W. Howard[*1], Snyder, Darrel E.[2], Platania, Steven P.[1]. (1-American Southwest Ichthyological Researchers L.L.C., 2-Larval Fish Laboratory, Department of Fish, Wildlife, and Conservation Biology, Colorado State University).

The Pecos River, the largest tributary of the Rio Grande, has a diverse but declining assemblage of native cyprinids, including numerous pelagic-spawning species. Anthropogenic alterations to the river (e.g., flow manipulation, river channelization, non-native introductions, and river fragmentation) have negatively impacted native fish abundance and distribution, which has led to extirpations, range reductions, and federal/state protections. The pelagic-spawners have been among the most adversely affected by the degradation of this riverine ecosystem. Conservation activities and species management of these fishes are limited by significant gaps in knowledge about threats affecting their early life stages. An essential tool being developed for fish biologists is an illustrated identification guide, and accompanying computer-interactive key, which describes the early ontogeny of cyprinids found in the middle and lower Pecos River (New Mexico and Texas). Using over 36 morphometric, 18 meristic, and 49 pigmentation characters, along with a suite of size-to-development relationships, the comprehensive guide (to be completed by December 2017) will provide a foundation for robust species identification of the smallest and most vulnerable life stages. The guide will also help facilitate future research and monitoring of the distribution, abundance, reproductive success, and early recruitment of Pecos River cyprinids, which will further the knowledge of larval fishes and their ecology in the desert Southwest.

2016-11-17 15:15:00: **Documented Presence of All Life Stages of Humpback Chub *Gila cypha* within the Lower Colorado River of the Grand Canyon**

Mohn, Harrison E. [*1], Albrecht, Brandon [1], McKinstry, Mark[2], Kegerries, Ron [1], Gilbert, Eliza [3], Platania, Steven P. , Rogers, Ron[1]. (1-BIO-WEST, Inc., 2-U.S. Bureau of Reclamation, 3-American Southwest Ichthyological Researchers, LLC).

Small-bodied and larval fish sampling trips were conducted between 2014 and 2016 in the Colorado River in the Grand Canyon with the goal of determining the presence of Razorback Sucker *Xyrauchen texanus* and other native fishes. Completely randomized sites were sampled by seining approximately seven times a year in relatively slow, near-shore habitats. While Razorback Suckers have not been collected as juveniles thus far (they have been collected as larvae), ongoing research has now documented the presence of larvae, juvenile, and adult Humpback Chub in the lower canyon (Lava Falls to below Pearce Ferry). Larvae and juvenile fish were captured most often, with the occasional catch of chub larger than 150 mm total length. Larval and juvenile Humpback Chub were found in higher abundance at certain sites than others, which were sometimes, but not always, rocky habitats. Within the Upper Colorado River Basin, research shows larvae drift very little and tend to remain in shoreline habitat near population centers. Within tributaries of the Grand Canyon, larvae tend to largely remain within these tributaries and utilize warm-water habitats; drift to the mainstem is expected to be comparatively rare. Research by others suggests that adult Humpback Chub are ‘weak swimmers' compared with other native fauna and are more apt to make localized movements to adequate spawning areas, rather than longer-distance migrations. Given this past research and based on our data from 2014–2016, we suggest that the lower Grand Canyon may be sustaining the Humpback Chub in unexpected abundance and distribution.

2016-11-17 15:30:00: **Streamflow Complexity Associations with Northern Leatherside Chub in an Upper Snake River Basin Tributary**

Dauwalter, Daniel C.[*1], Walrath, John D.[1], Fesenmyer, Kurt A.[1]. (1-Trout Unlimited).

The northern leatherside chub *Lepidomeda copei* is a species of conservation concern that purportedly has been impacted by anthropogenic activities. Microhabitat studies have shown the species to select areas with complex streamflows in addition to other habitat features. While several studies have evaluated the influence of instream habitat on northern leatherside chub at the reach-scale, few have explicitly evaluated associations with habitat complexity at this scale despite field observations suggesting its importance. We studied the effect of reach-scale complexity in streamflow, water depth, substrate, and cover, in addition to other habitat factors, on northern leatherside chub occurrence in the Goose Creek watershed of the Upper Snake River Basin. Of the habitat complexity measures we evaluated, streamflow complexity (SD of velocity) in the reach was the predominant factor associated with the species' occurrence. Multiple regression revealed that streamflow complexity increased in larger streams and in the presence of beaver dams, but was negatively associated with streambank condition and percent fine substrates. Our study suggests that streamflow complexity across multiple spatial scales is important to the distribution of northern leatherside chub and that land and wildlife management will play an important role in future conservation efforts for the species.

2016-11-17 15:45:00: **Use of High-Definition Video Technology to Acquaint the Public with Cryptic Desert Fishes of the Southern Nevada/Death Valley Region**

Ulrich, Taylor L.*[1], Bonar, Scott A.[2], Sheehy, Cody M.[3], Bogner, David[3]. (1-Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 2-U.S. Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 3-CALS Communications and Cyber Technologies, University of Arizona).

Desert fishes are cryptic, and infrequently seen by the public. Apathy of the public toward these fishes and their ecosystems hinders their conservation. Fortunately, advanced technological means to acquaint the public with these species is becoming increasingly common. We are creating low-cost educational videography presentations featuring the unique and often rare desert fishes of Nevada and Death Valley. Here we provide examples of high-definition underwater and aerial footage possible with current low-cost, advanced technology. Techniques used to collect this footage are specifically tailored to be used by field biologists when creating educational presentations. Furthermore, we outline marketing and educational research methods we are investigating to maximize presentation effectiveness. Low cost technology can provide spectacular visual results and could potentially serve as an effective tool to acquaint the public with rare desert fishes.

2016-11-17 16:00:00: **Videography Presentations to Educate the Public about Arizona trouts**

Hannifan, Jaqueline K*[1], Caballero-Reynolds, Marci L[1], Ulrich, Taylor L[2], Bonar, Scott A[3]. (1-Doris Duke Conservation Scholars Program Collaborative, University of Arizona, 2-Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, 3-U.S. Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona).

Gila, *Oncorhynchus gilae*, and Apache, *Oncorhynchus apache*, trout are critically threatened species that can be found in various streams of the Southwest. The general public is often unaware that these species exist due to many factors including a dissociation of fish and desert environments and limited availability of high quality footage. Surface and underwater videography was utilized to create an educational video on Gila and Apache trout to be displayed at a Coronado National Forest visitor center and other locations. We captured high definition quality footage with low cost equipment with the intention of enabling natural resource managers to produce similar conservation videos easily in the future. To evaluate what aspects make a conservation video most effective, the footage was shown in a public space. By analyzing which images people viewed the most, we were able to understand how we might produce more engaging presentations. Macro images, contrasting colors, texture, and movement held audience attention the longest. These results allowed us to draw conclusions about which factors and characteristics of the film contributed to optimal audience engagement. Well- designed videos will better acquaint people with species that are not commonly seen, thus aiding in their conservation.

2016-11-17 16:15:00: **Discovery of the Mexican Blindcat, *Prietella phreatophila*, in the U.S.**

Hendrickson, Dean A.*[1], Jackson, Jack[2], Sprouse, Peter[3], Howard, Sarah[2], Garrett, Gary P.[1], Krejca, Jean K., Cohen, Adam E.[1], Fenolio, Dante[4]. (1-University of Texas at Austin, Biodiversity Collections, 2-U.S. National Park Service, Amistad National Recreation Area, 3-Zara Environmental, LLC, Buda, Texas, 4-San Antonio Zoo, Conservation and Research Program).

A natural population of the Mexican blindcat, *Prietella phreatophila* Carranza 1954, previously known only from México, was documented in 2016 from a cave in the Amistad National Recreation Area in Texas. Occurrence of the species in Texas is consistent with other indicators of international interconnections of aquifers in this region under the Río Grande. Long listed as Endangered by the Mexican government, it was also listed by the U.S. Fish and Wildlife Service as Endangered in 1970, and so the Texas population is fully protected under the Endangered Species Act as Endangered. As a result of the extremely low detectability of the species and very limited access to its habitat to sample, it is likely that the range of the species in both countries is broader than physical sampling of specimens has revealed. Here we review all previous knowledge of the species and its habitat and provide a reassessment of its overall conservation status and threats, most notably including aquifer depletion and contamination in both the Mexican and U.S. portions of its known range.

2016-11-17 16:30:00: **Pecos River food webs: investigating impacts of salinization, non-native species, and other environmental changes**

Pease, Allison A.*[1], East, Jessica L.[2], Breaux, Jared H.[3], Vaughan, Cassie M.[4]. (1-Dept. of Natural Resources Management, Texas Tech University, 2-Texas Cooperative Fish and Wildlife Research Unit, Texas Tech University, 3-South Carolina Department of Natural Resources, 4-Department of Biology, University of Texas at Tyler).

The Pecos River is impacted by threats common in semi-arid regions including diminished discharge, increased salinity, and non-native invasive species. We assessed variation in local food webs along the longitudinal gradient of the main-stem Pecos River by estimating carbon sources, trophic positions, and assemblage-wide trophic structure for aquatic consumers at twelve sites using stable isotope analysis. We collected additional specimens of Gulf Killifish, *Fundulus grandis*, in order

to investigate the feeding ecology of this non-native species in the Lower Pecos. In Pecos River food webs, consumer richness, food-chain length, and assemblage-wide niche breadth were inversely related to specific conductivity. Mixing models revealed differences in sources of dietary carbon supporting fish production along the longitudinal fluvial gradient, with a shift toward reliance on algal production in the salinized reaches of the river. Trophic niche breadth was greatest for assemblages in less degraded sites with higher fish species richness. Local food webs in salinized sites were dominated by euryhaline species and had shorter food chains and narrower assemblage-wide niche breadths. Stomach contents analysis revealed that *F. grandis* were piscivorous, consuming more fish prey than has been reported from native coastal ecosystems. Our results suggest that salinization and altered flow regimes in portions of the Pecos River constrain the diversity of consumers and trophic resources in local food webs. The non-native, piscivorous *F. grandis* also potentially threatens native species in these reaches.

2016-11-17 16:45:00: **From Manuscript to Management: Development of a New Assisted Rearing Program for Endangered Klamath Suckers**

Day, Julie*[1], Barnes, Ron[2], Groves, Kirk[1], Weissenfluh, Darrick[1]. (1-Klamath Falls Fish and Wildlife Office, 2-Gone Fishing, LLC).

Decades of inadequately abated natural and anthropogenic threats coupled with competing and often controversial water needs have resulted in the compromised status and endangered listing of numerous freshwater fishes, many of which are now artificially propagated in hatcheries. However, low survival of hatchery-reared fish is a commonly reported problem for many programs, particularly those being implemented in systems with substantial non-native predator populations. Extensive sampling for shortnose (*Chasmistes brevirostris*) and Lost River sucker (*Deltistes luxatus*) in the Klamath River Basin have failed to detect any new adult recruitment for at least two decades, elevating concern that senescence of the population will result in the demise of the species and prompting an investigation into propagation. Balancing the risks of interfering with natural ecological and evolutionary processes for the good of the species requires a substantial investment in recognizing synergies within the existing knowledge base prior to moving forward with program design. As such, the Klamath Falls Fish and Wildlife Office is developing a new assisted rearing program designed to address the need to minimize human intervention in the rearing process and alleviate risks associated with domestication. Wild-spawned fish are collected in relatively low numbers as larvae or young juveniles and reared in a series of earthen ponds that are operated as semi-natural mesocosms, and success to date has been promising. We provide an overview of how key concepts identified in academic literature are incorporated into management actions associated with this program, and an update on the evolution of local, community-based pre-outreach strategies.

2016-11-17 17:00-18:30 **Business Meeting** - Alvarado Ballroom (ABCD)

2016-11-17 19:00-22:00 **Banquet** - Alvarado Ballroom (EFGH)

FRIDAY, 18 NOVEMBER 2016

2016-11-18 08:00:00 **Presentation and Awards**

2016-11-118 08:00-12:00 General Session VI: Tony Robinson, Moderator

2016-11-18 08:15:00: **Devils Hole pupfish, *Cyprinodon diabolis*: status and recent research in 2016**

Goldstein, Jeffrey*[1], Chaudoin, Ambre[1], Wilson, Kevin[1], Wullschleger, John[1], Lee, Corey[2], Feuerbacher, Olin, Oliver, Luke[3], Senger, Brandon[4]. (1-National Park Service, 2-US Fish and Wildlife Service, 3-Great Basin Institute, 4-Nevada Department of Wildlife).

Managing agencies in collaboration with academic institutions continue studying the ecosystem at Devils Hole to help guide management decisions for the recovery of the endangered Devils Hole pupfish, *Cyprinodon diabolis*. The National Park Service (NPS), U. S. Fish and Wildlife Service (FWS), and the Nevada Department of Wildlife (NDOW) continue to monitor ecosystem and population dynamics at Devils Hole through the Long Term Ecosystem Monitoring Plan (LTEMP). The number of observable pupfish increased from 131 observable fish in the fall of 2015 to 144 observable fish in the fall of 2016. The number of observable fish during the spring 2016 count was 115. Six peer reviewed manuscripts regarding Devils Hole were published in 2016 on a variety of topics such as climate change, biogeochemistry, and genetics. On 30

June 2016, 5.28 cm of rain fell within 90 minutes (3.02 cm in the first 20 minutes) creating a flood that deposited 2.4 m^3 of material onto the shallow shelf of Devils Hole. To prevent the exposure of the material to air during low tide, 0.3 m^3 (12.5%) of that material was relocated to the 5 m shelf through self-contained underwater breathing apparatus (SCUBA). A revegetation project to mitigate further soil erosion of the disturbed terrestrial area surrounding Devils Hole will begin this upcoming spring. Continued research at Devils Hole has enhanced the decision making abilities of managing agencies by providing more scientifically supported recovery actions for the ecosystem and fish.

2016-11-18 08:30:00: **Why Catch-Per-Unit-Effort is Insufficient as an Index of Abundance for the White Sands Pupfish (*Cyprinodon tularosa*)**

Peterson, Damon*[1], Caldwell, Colleen A.[2]. (1-Department of Biology, New Mexico State University, 2-U.S. Geological Survey, New Mexico Cooperative Fish and Wildlife Research Unit).

An important goal amongst researchers and managers is to accurately quantify population parameters to detect shifts in survival and abundance. Some organisms represent a monitoring challenge when they are locally abundant, short-lived, and alter their reproductive strategy as environmental conditions vary. Here, we present evidence that the use of minnow traps combined with a commonly calculated index of abundance for pupfish (i.e., catch-per-unit-effort CPUE) can be affected by basic methodological choices such as trap soak time (i.e., effort) as well as the timing and location of trap placement. We investigated movement into and out of torpedo-shaped (Gee) traps by White Sands pupfish (*Cyprinodon tularosa*) and the effect movement would have on CPUE. White Sands pupfish exited traps at frequencies that were nearly equivalent to the rate of entering, suggesting total catch and thereby CPUE, are strongly influenced by factors that determine the probability of an animal exiting the trap. In addition, CPUE was weakly correlated with a more robust estimate of abundance (Lincoln-Peterson estimator) suggesting CPUE is not a good index for abundance especially when trap soak times are variable. We recommend the use of capture-recapture protocols to account for differences in capture probabilities due to factors unrelated to abundance such as habitat and capture effort.

2016-11-18 08:45:00: **Native Fish Introductions in Las Cienegas and San Pedro Riparian National Conservation Areas**

Mosher, Kent R.*[1], Love-Chezem, Tiffany[1], Robinson, Anthony T.[1]. (1-Arizona Game and Fish Department).

During 2011 through 2016, Arizona Game and Fish Department, in partnership with Bureau of Land Management and U.S. Fish and Wildlife Service, completed 37 stockings of endangered native fish into 17 ponds and springs within Las Cienegas and San Pedro Riparian National Conservation Areas. The project involved the creation or renovation of several ponds, installation of livestock and bullfrog exclusion fences, and the introduction of native species into both pond and natural spring systems. Native fish translocated included Gila topminnow *Poeciliopsis occidentalis* (13 sites), desert pupfish *Cyprinodon macularius* (8 sites), and Gila chub *Gila intermedia* (1 site). Sites were monitored annually using minnow traps, dip nets, and seines to determine if populations established. Survey results indicate that Gila topminnow have established populations at 6 locations and desert pupfish at 2 locations. Gila topminnow failed to establish at 3 locations and desert pupfish at 2 locations likely due to limited suitable habitat available, flooding, or negative interactions with other species. Population establishment is still to be determined at several stocking locations. Additional native fish stockings and augmentations will likely occur as managers continue to monitor populations and newly created sites become available.

2016-11-18 09:00:00: **Bonneville Basin Area Report**

Mellon, Cassie D*[1]. (1-Bureau of Land Management).

The 2016 Bonneville Basin Area Report will provide an overview of activities and accomplishments for native aquatic species in the Bonneville Basin. This will include an update on June sucker *Chasmistes liorus*, least chub *Iotichthys phlegethontis*, northern leatherside *Lepidomeda copei*, Bonneville cutthroat trout *Oncorhynchus clarkii utah*, bluehead sucker *Catostomus discobolus*, and southern leatherside, *Lepidomeda aliciae*. Conservation activities include habitat restoration, reintroduction, and passage improvement while dealing with drought and climate change. There may even be a story about the intrepid boreal toad *Anaxyrus boreas* and its movements through the desert.

2016-11-18 09:15:00: **Distinct morphologies and cloudy mitochondrial DNA: Divergence and incomplete lineage sorting of whitefish in a high desert mountain lake**

Miller, Becky A.[1], Houston, Derek D.[1], Shiozawa, Dennis K.[1], Evans, R. Paul[1]. (1-National Institutes of Health, 2-Iowa State University, 3-Brigham Young University, 4-Brigham Young University).

Evolutionary trajectories of fish species are impacted by the complex geologic and climatic events that influence the way organisms interact with their environment. The mountain whitefish (*Prosopium williamsoni*) is widely distributed throughout several western North American drainage basins. Relatives to the mountain whitefish are the Bear Lake whitefish (*Prosopium abyssicola*), Bonneville cisco (*Prosopium gemmifer*), and Bonneville whitefish (*Prosopium spilonotus*). All three are endemic to Bear Lake, which straddles the Utah and Idaho border near Wyoming. It is late Pleistocene in age, but some authors consider the Bonneville cisco to be a descendent of a Prosopium in Pliocene Lake Idaho. Mitochondrial DNA sequence data was used to evaluate range-wide genetic diversity of mountain whitefish and the Bear Lake relatives. Phylogenic analysis did not resolve relationships among drainage basins, although whitefish from some major drainage basins form well-resolved clades (e.g., Green River, Lahontan Basin, Missouri River). The three Prosopium species endemic to Bear Lake also exhibit incompletely resolved phylogenetic relationships, but this appears to be due to their relatively recent divergence in Bear Lake. They also exhibit incomplete lineage sorting. The Bear Lake endemic whitefish render *P. williamsoni* paraphyletic, thus calling into question the taxonomy of the group.

2016-11-18 09:30:00: **Opportunities and Challenges in the Recovery of Desert Dace, *Eremichthys acros***

Gilmore, Todd[1], Soldier Meadows Working Group, [1], Soldier Meadows Working Group, [2], Soldier Meadows Working Group, [3], Soldier Meadows Working Group, [4]. (1-US Fish and Wildlife Service, 2-Bureau of Land Management, 3-Nevada Department of Wildlife, 4-Nevada Natural Heritage Program).

Desert dace, *Eremichthys acros*, are endemic to thermal spring systems in Soldier Meadow, Humboldt County, Nevada. Desert dace is the only member of the genus *Eremichthys* of the Cyprinidae family and has the highest temperature tolerance of any minnow in western North America. At the time of listing in 1985, desert dace was primarily known from private lands where the diversion of spring outflows into irrigation ditches for agricultural activities and nonnative fish were identified as the primary threats to the species. When the final recovery plan was published in 1997, a more substantial proportion of the species' range was on public lands managed by the Bureau of Land Management (BLM), where additional threats related to increased recreational use had been identified. Neither the listing rule nor the recovery plan specifically mentions threats from livestock, feral horses or burros, but these animals have since become identified as a potential threat to the species and its habitat. A number of these threats are being addressed by BLM management actions including designation of the Black Rock Desert-High Rock Canyon-Emigrant Trails National Conservation Area, designation as an Area of Critical Environmental Concern, and additional planning documents. Other conservation and management actions that have been implemented to date include nonnative fish eradication efforts, fish barriers, and fencing around an occupied spring system. While there is still much to be accomplished, the Soldier Meadows Working Group (a group of federal and state partners charged with recovery of desert dace), are busy working to implement recovery actions to benefit desert dace.

2016-11-18 09:45:00: **Effects of elevated carbon dioxide on fish populations within the Little Colorado River in Grand Canyon**

Ward, David Lance[*1], Vaage, Ben[1], Sheehan, Kenneth[1], Nelson, Clay[1]. (1-U.S. Geological Survey, Grand Canyon Monitoring and Research Center, Southwest Biological Science Center, Flagstaff, AZ).

At base flow, water in the lower 21 km of the Little Colorado River in Grand Canyon comes from springs which are naturally high in carbon dioxide. The effects of high carbon dioxide may structure the fish community and influence recruitment dynamics of endangered humpback chub *Gila cypha*. We evaluated the effects of elevated carbon dioxide levels on native and nonnative fishes found in the Little Colorado River to determine the potential impacts carbon dioxide may have on the fish population. Laboratory toxicity trials and field evaluations of humpback chub eggs and larvae were conducted. Humpback chub eggs hatched and larval humpback chub survived above the chute falls complex (rkm 14) at carbon dioxide levels much higher than expected (up to 30 mg/l). Laboratory evaluations of lethal carbon dioxide levels for native and nonnative fishes indicate carbon dioxide tolerances of native and nonnative species are much higher (>60 mg/l) than carbon dioxide levels measured in the lower 16 kilometers of the Little Colorado River. Rainbow trout *Oncorhynchus mykiss* and smallmouth bass *Micropterus doloimeu* had the lowest tolerance to elevated carbon dioxide levels (90-100 mg/l) while black bullhead *Ameiurus melas* and fathead minnow *Pimephales promelas* had the highest tolerance (200 mg/l). Humpback chub tolerance was intermediate (140 mg/l). We conclude that carbon dioxide dynamics in the Little Colorado River in Grand Canyon are unlikely to have significant effects on the existing fish populations within the lower 16 km of the Little Colorado River.

2016-11-18 10:00:00: **Development and Feild Testing of eDNA markers for Spikedace and Loach Minnow**

Paroz, Yvette*[1], Franklin, Thomas[3], Robinson, Tony[2], Dysthe, Joseph[3], Young, Michael[3], Carim, Kellie. (1-US Forest Service- Region 3, 2-Arizona Game and Fish Department, 3-US Forest Service - Rocky Mountain Research Station).

Environmental DNA markers (eDNA) have been developed for many fish species are are proving to be an efficient and sensitive method for monitoring species distributions, especially in lotic systems. In collaboration with many local partners, U.S.F.S. Rocky Mountain Research Station has developed eDNA markers for spikedace *Meda fulgida* and loach minnow *Tiaroga cobitis*. Both species endemic to the Gila River basin of Arizona and New Mexico and federally listed as Endagered and have substantially declined from their historic range. Initial testing of the sensitivity of these markers indicates that they may have utility for detecting spikedace and loach minnow in the wild, even at low densities.

2016-11-18 10:15:00: **Short and Long Term Risk Reduction for Green Sunfish *Lepomis cyanellus* in Lees Ferry Reach of the Colorado River in Glen Canyon National Recreation Area**

Trammell, Melissa*[1], Ward, David L.[2], Hyde, Ken[1]. (1-National Park Service, 2-USGS Grand Canyon Monitoring and Research Center).

In November 2015, Green Sunfish (*Lepomis cyanellus*) were eradicated from the Upper and Lower Sloughs adjacent to the Colorado River mainstem in Glen Canyon National Recreation Area (GCNRA) with rotenone in partnership with Arizona Game and Fish Department (AGFD) and U.S. Fish and Wildlife Service (FWS). The population found in 2015 and the subsequent work on its eradication resulted foregoing a High Flow Event (HFE) from Glen Canyon Dam that would have normally occurred in November 2015. After two monitoring trips in June and July 2016 which captured no Green Sunfish (GSF), in August 2016 they were found to have re-invaded the sloughs. We developed a phased response involving mechanical removal, and a proposed experimental ammonia treatment in the isolated 1/3 acre Upper Slough; few GSF were captured in the Lower Slough in 2016. Previous work by Ward et al. (2013) demonstrated that ammonia can be an effective non-native fish control tool, but it is not yet registered as a piscicide. The treatment is planned for the first week in November, if Arizona Department of Environmental Quality approves the experimental use of ammonia. If no permit is received, intense mechanical removal with multiple passes over several days will be conducted. Mechanical removal is not expected to eliminate the Green Sunfish but is expected to reduce abundance down to minimum acceptable risk levels, estimated to be 300 GSF less than 50 mm TL, before an HFE in mid-November. To avoid both the risks of establishing GSF downstream and foregoing another HFE in the future, we have committed to conducting NEPA compliance to evaluate a full range of alternatives for a long term risk reduction action to minimize the potential of GSF or other warm-water nonnative fish to establish populations in the Lees Ferry reach of GLCA. The compliance and implementation is planned for completion by October 2017.

2016-11-18 10:30:00: **Flood stages for life stages: assessing the effectiveness of habitat restoration and water management to promote Rio Grande silvery minnow recovery**

Strohm, Deanna*[1], Valdez, Riich[1], Richard, Ken[2]. (1-SWCA Environmental Consultants, 2-New Mexico Interstate Stream Commisison).

Habitat restoration and water management are two of four primary conservation principles the U.S. Fish and Wildlife Service requires to promote recovery of endangered Rio Grande silvery minnow (*Hybognathus amarus*; silvery minnow). As part of a collaborative adaptive management plan, the New Mexico Interstate Stream Commission (NMISC) coordinated an experimental water release (>2,000 cfs, May 16 – June 19, 2016) in the Middle Rio Grande River to assess the timing, magnitude, and duration of flows necessary to inundate restored floodplain habitat and promote silvery minnow recruitment. During spring 2016, SWCA Environmental Consultants, on behalf of the NMISC, sampled six select restoration sites in the Albuquerque and Isleta Reaches of the Middle Rio Grande to monitor and quantify habitat restoration and flow management success for all silvery minnow life stages. Across restoration sites, silvery minnow were the second most abundant adult species and most abundant larval species we collected (18 % adult and 93% larval in Albuquerque Reach; 8% adult and 73 % larval in Isleta reach), and we documented the presence of silvery minnow eggs at four of six restoration sites. During these increased flows, we collected silvery minnow adults beginning on our first sampling date (May 21, 2016) through our last sampling date (June 17, 2016) silvery minnow larvae from June 1, 2016 through our last sampling date, and silvery minnow eggs from our first sampling date through May 30, 2016. Thus, we demonstrate that restored floodplains provide habitat for all silvery minnow life stages, and specifically, important nursery habitat for early life stages when fishes naturally experience the highest rates of mortality. From this study, we can guide future monitoring efforts to better quantify important habitat features and design adaptive water management strategies to maximize restoration success and annual silvery minnow recruitment in the Middle Rio Grande system.

2016-11-18 10:45:00: **Evolving nonnative fish control efforts in the middle Green River**

Staffeldt, Richard[*1], Schelly, Robert[1], Breen, Matthew[1]. (1-Utah Division of Wildlife, 2-Utah Division of Wildlife, 3-Utah Division of Wildlife).

A growing complement of nonnative fish species in the upper Colorado River basin (UCRB) presents one of the most serious threats to imperiled native fishes. Out of more than 50 species of nonnative fishes, three predatory species are of major concern and have been the focus of intensive mechanical removal efforts: Smallmouth Bass (*Micropterus dolomieu*), Walleye (*Sander vitreu*s), and Northern Pike (*Esox lucius*). Over the last 15 years, these efforts have been increased in scope and honed for efficiency throughout the UCRB. Here we consider the effectiveness of nonnative fish control by the Utah Division of Wildlife Resources in the middle Green River for each of these piscivorous species. Smallmouth Bass captures have decreased markedly since 2013, presumably due to multiple years of environmental conditions unfavorable to Smallmouth Bass recruitment (high spring peak flows, cooler spring/summer temperatures), combined with our targeting of "hotspots" and disruption of known spawning grounds. Walleye are an emerging threat in the system, and have become the focus of dedicated removal efforts since 2014; annual captures have remained steady in recent years. Currently riverine recruitment is limited, despite identification of a spawning area in 2015 located in Dinosaur National Monument. Steps are being taken to eliminate local reservoir sources of Walleye (rotenone treatments, screening). Adult Northern Pike have been effectively targeted with early spring fyke-netting while attempting to spawn in backwaters, tributaries, and off-channel wetlands, with the exception of a successful cohort following extended spring peak flows in 2011. This talk will evaluate the effectiveness of our nonnative mechanical removal methods based on trends in capture rates in recent years.

2016-11-18 11:00:00: **Management of a New Assisted Rearing Program for Endangered Klamath Lake Suckers**

Groves, Kirk[*1], Barnes, Ron[2], Day, Julie[1], Weissenfluh, Darrick[1]. (1-Klamath Falls Fish and Wildlife Office, 2-Gone Fishing, LLC).

The U.S. Fish and Wildlife Service (USFWS) initiated a new Sucker Assisted Rearing Program (SARP) in 2015 with the goal of collecting and rearing 8,000-10,000 endangered Lost River (*Deltistes luxatus*) and shortnose suckers (*Chasmistes brevirostris*) for release into the Upper Klamath Lake system. Unlike many captive propagation programs, SARP is designed to minimize the need for human intervention in the rearing process by catching and rearing wild-spawned larvae in lieu of direct gamete collections, limiting the amount of time fish spend in artificial holding environments, and avoiding the use of intensive fish culture methods to the extent possible. The priority objective for this program is to maximize the likelihood of fish survival upon release. Larvae are transported to a private rearing facility leased and operated by USFWS where they receive health and behavioral evaluations before being stocked into lined earthen ponds supplied with geothermal water that are managed to mimic conditions fish would experience in the wild. Here we present results from the first year of collection and husbandry activities, rearing facility expansion process, and year-two objectives. Collections and rearing were largely successful in 2016 and efforts will increase in 2017 with the assistance of Bureau of Reclamation and The Klamath Tribes biologists. The newly redesigned facility was completed in fall 2016 and triples our husbandry capacity to better suit the program as well as manage it in a manner that affords opportunities for modification as the program evolves. This will allow SARP to rear suckers in low densities, minimize stress, provide enrichment, and investigate experimental fish health treatments.

2016-11-18 11:15:00: **Historical changes of a native fish assemblage in an unregulated western river: a case study of nonnative fish invasion.**

Hawkins, John[*1], Walford, Camerob[1], Wick, Edmund[2]. (1-Colorado State University-Larval Fish Lab).

The Yampa River, located in northwestern Colorado, flows 205 miles to confluence with the Green River, a major tributary to the Colorado River. It descends from 12,000 to 5,087 ft. elevation and drains > 8,000 mi2 of the Southern Rockies and portions of the Wyoming Basin. The Yampa River is one of the few western rivers with a natural flow regime and is often cited as the last remaining unregulated river in the Upper Colorado River Basin. Although largely unregulated, it has two relatively small reservoirs at high elevations on the mainstream (Stagecoach and Catamount) and several other reservoirs on tributaries, all of which contain introduced sportfish. Persistent, but low levels of nonnative fish escapement from those reservoirs had minimal effect on the riverine fish assemblage for years after reservoirs were built. Sampling in the early 1980s revealed a largely intact native assemblage with native taxa comprising over 70% of the large-bodied portion of the fish community. In the mid-1990s, after Northern Pike, *Esox lucius*, and Smallmouth Bass, *Micropterus dolomieu*, escaped and established reproducing populations in the Yampa River, we observed drastic changes to the riverine fish assemblage. By 2000, the fish assemblage had changed to the point that natives comprised less than 4% of the fish community in most reaches. We describe the historical and current fish assemblages in the Yampa River, the invasion sequence for Northern Pike and Smallmouth Bass, and how restoration management is informed by understanding how certain reaches have maintained native fishes even in the presence of predatory nonnatives.

2016-11-18 11:30:00: **Stream and Riparian Habitat Citizen Science: Impacting Natural Resource Management and K-12 Students**

Bieber Stanley, Rosa*[1], Shaw, Daniel[1]. (1-Bosque School, 2-Bosque School).

We have participated in two citizen science programs, the Bosque Ecosystem Monitoring Program (BEMP) and New Mexico Watershed Watch (NMWW) that have both informed management decisions of the Rio Grande, its tributaries, and its riparian forest. Furthermore, there have been substantive academic gains for K-12 students involved in these programs. We present how such programs are created, sustained over decades, and funded. In particular we present student findings related to personal care products detected in the Rio Grande as a way to engage K-12 students in understanding impacts of waste water effluent on fisheries habitat.

2016-11-18 11:45:00: **Spatial and temporal variation in genetic composition of larval drift of catostomid suckers**

Schwemm, Michael R. *[1], Carson, Evan W.[1], Thompson, Kevin G.[2], Osborne, Megan J.[1], Turner, Thomas F.[1]. (1-Biology Department and Museum of Southwestern Biology, University of New Mexico, 2-Colorado Department of Natural Resources, Colorado Parks and Wildlife).

Interspecific hybridization is common in catostomid suckers and can present a challenge to management when native and non-native species co-occur. In the Gunnison River basin of western Colorado, native bluehead and flannelmouth suckers interbreed not only with each other but also with introduced longnose and white suckers. Although occurrence of adult hybrids is well documented in this system, little is known about representation of hybrids among larvae. We used species-specific microsatellite markers (N = 4-6) to survey spatial (between streams) and temporal (within streams) variation in the genetic contribution of native and non-native catostomid suckers to larval drift in Cottonwood and Potter creeks, two geographically proximate tributaries to the Gunnison River. Representation of native, non-native, and hybrid sucker larvae differed significantly within and between streams in 2014 and in 2015. In 2014, larvae sampled in Cottonwood Creek (n = 79) were dominated by non-native white sucker (43%), native flannelmouth sucker (13%), and their hybrids (41%). Samples from Potter Creek (n = 157), in contrast, were mostly bluehead sucker (54%), flannelmouth sucker (32%), and their hybrids (14%). In 2015, bluehead sucker represented 100% of larvae sampled in Potter Creek (n =84) and 76% of samples from Cottonwood Creek (n =124). Remaining larvae from Cottonwood in 2015 included near-equal proportions of native flannelmouth sucker (6%), non-native white sucker (10%), and hybrids (8%), with most hybrids represented by advanced backcrosses between bluehead and white suckers (in the direction of bluehead sucker). Implications for management are discussed.

2016-11-17 12:00:00: **Lunch**—on your own

2016-11-18 13:15-17:00 General Session VII: Megan Osborne, Moderator

2016-11-18 13:15:00: **Genetic Considerations for Recovery Criteria and Tasks for Gila trout, *Oncorhynchus gilae***

Turner, Thomas F. *[1]. (1-University of New Mexico Evolution and Ecology of Fishes Discussion Group).

The Gila trout recovery plan is currently undergoing revision. Since the last revision in 2003, an enormous amount of genetic data have been collected that could inform and help refine recovery criteria and tasks. We formed a discussion group of students, academics and resource managers to ask how genetic information could be better incorporated into the new recovery plan. We identified and addressed three major issues: hybridization and introgression, maintenance of genetic diversity in the face of loss due to disturbance, and genetic effects of a hatchery program for conservation of the species. We began by acknowledging that current levels of genetic diversity and genetic effective size in the species are below oft-cited thresholds (e.g., the 50/500 rule), and focused on balancing risks of introgressive hybridization against acute and chronic loss of genetic diversity using a decision-tree approach. We identified opportunities for restoration of demographic connectivity and gene flow among lineages as a potentially important strategy for maintenance of diversity and vitality, but also realized that the impact of this strategy depends on securing appropriately sited and contiguous stream networks for recovery action. Finally, we evaluated risks and opportunities offered by conservation hatchery programs. Overall, we are optimistic that genetic information will be incorporated in a meaningful way to guide actions toward recovery and conservation of this iconic trout species.

2016-11-18 13:30:00: **The plight of the Rio Grande shiner, *Notropis jemezanus*, in the lower Rio**

Grande along the Texas/Mexico border

Conway, Kevin*[1], Osborne, Megan[2], Portnoy, David[3]. (1-Texas A&M University, 2-University of New Mexico, 3-Texas A&M University - Corpus Christi).

The Rio Grande shiner (*Notropis jemezanus*) is endemic to the Rio Grande drainage of the southwestern United States and Mexico. It has been extirpated from the main stem of the Rio Grande in New Mexico and exhibits a fragmented range in the upper Pecos in New Mexico and the main stem of the Rio Grande along the Texas/Mexico border. We provide an overview of US museum holdings for *N. jemezanus* and report on recent sampling efforts for *N. jemezanus* along the main stem Rio Grande from the Big Bend region downstream to Laredo. Examination of museum voucher specimens indicates that records of *N. jemezanus* from the lower Pecos River and Devils River in Texas are based on mis-identification of *Notropis megalops*. Recent field efforts by our group have failed to produce individuals of *N. jemezanus* though a small number of individuals have been collected recently by Texas Parks and Wildlife employees from both the Big Bend region (inside of Big Bend National Park) and from downstream of Eagle Pass. The Rio Grande shiner is now rare and we predict that the future of this species will be bleak without immediate conservation intervention.

2016-11-18 13:45:00: **Post-stocking fate of bonytail *Gila elegans* in a lower Colorado River reservoir**

Kesner, Brian*[1], Humphrey, Kristen[1], Marsh, Paul[1]. (1-Marsh and Associates, LLC).

Bonytail *Gila elegans*, federally listed as endangered, is considered functionally extirpated from its historical range, and its presence in the Colorado River now relies entirely on stocking programs. Lake Havasu, Arizona, California, and Nevada, is one of the few release locations for hatchery fish where individuals are occasionally captured. Only a handful of these captures occurred more than a year after release. A multi-year research project was implemented on Lake Havasu in which the post-stocking distribution, habitat use, and mortality of bonytail were assessed using acoustic telemetry and remote passive integrated transponder (PIT) scanning. Out of a total of 85 telemetry-tagged bonytail throughout the entirety of the 3-year study, 44 were determined mortalities, and 35 were permanently lost to the study (never contacted again). The majority of these lost fish (83%) were last located within the study area and were not contacted by submersible ultrasonic receivers specifically placed in locations to detect fish leaving the study area. Most remote PIT scanning contacts (at least 55%) occurred within the first 2 weeks post-stocking. Trammel netting efforts during the multi-agency Native Fish Routine Monitoring “Roundup” resulted in the capture of eight bonytail in February 2014, one of which was inside the digestive tract of a largemouth bass, and no bonytail were captured in 2015 or 2016. Predation was a major threat to bonytail survival at all release sites, and piscivorous birds likely accounted for a large proportion of mortality in telemetry-tagged fish. Tags recovered on land and under roosting sites and observed capture events provided direct evidence of bird predation. Few fish survived long enough after release to determine habitat selectivity, although fish were documented to utilize bulrush Scirpus. Off-channel locations where the potential for fish to leave the study area is minimized, such as Regional Park Moabi and Laughlin Lagoon, are ideal sites to track survival through both telemetry and remote PIT scanning efforts. Survival of stocked fish may be increased by choosing stocking locations based on availability of cover such as submergent, emergent and shoreline vegetation, large boulders, man-made structures, and turbidity to reduce the impact of piscivorous birds.

2016-11-18 14:00:00: **Conservation Implications of a Newly Formed Waterfall at the River-Reservoir Interface of Lake Powell**

Cathcart, Nathan[1], Cheek, Christopher A[1], McKinstry, Mark C.[1], Peter, MacKinnon D.[1], Gido, Keith B.[1]. (1-Kansas State University, Division of Biology, 2-Purdue University, Department of Fish and Wildlife, 3-U.S. Bureau of Reclamation, 4-Utah State University, 5-Kansas State University, Division of Biology).

The connectivity of the Colorado River Basin, like most western riverscapes, has been drastically altered by water development. The introduction of nonnative fishes and removal of native species coincided with impoundment. Downstream effects of dam construction are well known to negatively affect river channel morphology, habitat connectivity and the hydrological regime. However, upstream effects of large reservoirs on fish populations are poorly documented. We designed a study to illustrate how reservoir construction, drought, and endangered fish management have combined to create a contemporary dilemma for water resource managers stemming from the recent formation of a waterfall in the transitional area between the San Juan River and Lake Powell. We used passive integrated transponder (PIT) antennas stationed downstream of the waterfall in 2015 combined with fish sampling gears to assess fish abundance from March through July. We detected 524 unique PIT tags including 499 Razorback Sucker (*Xyrauchen texanus*), 15 Colorado Pikeminnow (*Ptychocheilus lucius*), six Channel Catfish (*Ictalurus punctatus*), three Flannelmouth Sucker (*Catostomus latipinnis*), and one Bonytail (*Gila elegans*). Razorback Sucker primarily originated from stocking or tagging events in the San Juan River basin but some detection originated in the upper Colorado River basin and Lake Powell. Results show the waterfall is a barrier to endangered fishes but also prevents nonnative fishes from entering the system. Trans-basin

connectivity is unlikely without mechanical alteration, fish passage construction, or manual movement of fish. The presence of so many adult Razorback Sucker and past findings of larval fish in the area suggest proper management could turn Lake Powell from an ecological sink into a source habitat. The challenge of recovering migratory endangered species in the west will likely have to reconcile habitat connectivity with prolonged drought and less water storage.

2016-11-18 14:15:00: **Estimating levels of introgression between Gila trout (*Oncorhynchus gilae*) and rainbow trout (*O. mykiss*) using next-generation sequencing data**

Camak, David*[1], Turner, Thomas F.[1]. (1-University of New Mexico, 2-University of New Mexico).

Gila trout (*Oncorhynchus gilae*) is a federally protected species in the family Salmonidae and is confined to headwater streams in the Gila and San Francisco Rivers in New Mexico and Arizona. Currently, there are five recognized relict and genetically distinct lineages of Gila trout found in the Upper Gila River (Main Diamond, South Diamond, Whiskey, and Iron Creeks) and San Francisco River (Spruce Creek) drainages based on various genetic markers. Understanding levels of introgression is crucial for management and conservation of genetic diversity. Previous genetic data suggested admixture with Gila trout individuals from the Iron Creek lineage and rainbow trout (*O. mykiss*), via illegal stocking or movement over barriers. Despite shared allozyme and microsatellite alleles between Iron Creek and rainbow trout, mtDNA analyses indicate no shared haplotypes. Gila and rainbow trout are close relatives that shared a common ancestor about 2 million years ago. Shared alleles could result from common recent ancestry rather than introgression. We used next-generation sequencing and SNP genotyping in an effort to increase resolution of genetic variation and gain a better insight into levels of introgression between Gila and rainbow trout lineages. About thirty individuals from each relict Gila trout lineage and source rainbow trout lineages were sequenced and genotyped. Preliminary results are consistent with previous data, indicating five distinct Gila trout lineages with varying levels of diversity within each lineage. Between the five relict Gila trout lineages and rainbow trout, there was no indication of phylogenetic incongruence, suggesting that introgression has not been substantial among the lineages. However, preliminary results are based on averages across/within lineages, which may underrepresent hybrid origins, especially if introgression has been low.

2016-11-18 14:30:00: **Relationship between American Fisheries Society standard fish sampling techniques and environmental DNA (eDNA) for characterizing fish presence, relative abundance, biomass, and species composition in Arizona standing waters**

Perez, Christina R.*[1], Bonar, Scott A.[1], Edwards, Taylor[2], Stewart, Bill [3], Amberg, Jon[4], Ladell, Bridget, Rees, Chris[5], Gill, Curt[6]. (1-University of Arizona, 2-University of Arizona Genetics Core, 3-Bureau of Reclamation, 4-U.S. Geological Survey Upper Midwest Environmental Sciences Center, 5-U.S. Fish and Wildlife, 6-Arizona Game and Fish).

Recently, examination of deoxyribonucleic acids in water samples (environmental DNA or eDNA) has shown promise for identifying fish species present in water bodies. We compared fish presence, relative abundance (catch per unit effort), biomass (biomass per unit effort), and species composition measured through eDNA methods and established American Fisheries Society (AFS) standard sampling methods in a large Arizona reservoir (Theodore Roosevelt Lake) and 12 small (<24 ha) waterbodies. We observed no relationship between relative abundance and biomass of Largemouth Bass and Gizzard Shad measured by established methods and their DNA copies at individual sites or by lake section in Lake Roosevelt, but did find a relationship for the overall reservoir. Furthermore, eDNA reflected the relative proportions of Largemouth Bass and Bluegill in total electrofishing catch composition in some, but not all of 12 small Arizona waterbodies. The ease of eDNA sampling over established fish sampling makes it appealing to natural resource managers. However, further evaluation and refinement of eDNA techniques are necessary to identify its limitations and benefits in fish monitoring programs.

2016-11-18 14:45:00: **Desert Fishes Research and Management in Texas during 2015 and 2016**

Bean, Megan G.*[1], Garrett, Gary P.[2], Edwards, Robert J.[3]. (1-Texas Parks and Wildlife Department, 2-The University of Texas at Austin, 3-The University of Texas Rio Grande Valley).

Updates on desert fishes research, conservation, and habitat restoration projects from 2015-2016 will be provided. Mexican Blind Catfish, *Prietella phraetophila*, was discovered in the Amistad National Recreation Area. It is the first record of the species on the northern side of the Rio Grande. West Texas Shiner, *Notropis megalotis*, was recently described from tributaries of the Rio Grande in Texas and Mexico. A study is underway to evaluate habitat use by age-0 Rio Grande Blue Sucker as well as factors affecting recruitment in this population. An evaluation of the trout population in McKittrick Creek in Guadalupe Mountains National Park was conducted to determine the presence of genetic evidence for the historic occurrence of Rio Grande Cutthroat Trout, *Oncorhynchus clarkii virginalis*, where Rainbow Trout, *Oncorhynchus mykiss*, were subsequently introduced. A study to evaluate the current distribution and population genetic structure of Rio Grande Shiner, *Notropis jemezanus*, is ongoing. Surveys of freshwater mussel distributions, abundances, and community

compositions are underway in the Rio Grande. Monitoring of Pecos Pupfish, *Cyprinodon pecosensis*, and Devils River Minnow, *Dionda diaboli*, are continuing in the Pecos and Devils Rivers, respectively. A conservation easement to protect the lower reaches of the McKittrick Creek watershed is currently being negotiated. Habitat restoration in Terlingua Creek is being implemented and includes reestablishing riparian hardwood communities and hydraulic processes.

2016-11-18 15:00:00: **Humpback Chub – range expansion in the lower Grand Canyon or better sampling?**

Rogowski, David L.*[1]. (1-Arizona Game and Fish Department).

The Humpback Chub, *Gila cypha* is an endangered fish endemic to the Colorado River Basin. Standardized long term monitoring of the Colorado River between Glen Canyon Dam and Lake Mead has been occurring since about 2000 by various entities. Nighttime boat electrofishing has been the primary method of sampling native and nonnative fish during this monitoring. Most of this monitoring occurred between river mile zero at Lees Ferry and Diamond Creek, river mile 225. Below Diamond Creek the Colorado River was essentially part of Lake Mead for many years. In more recent years with declining water levels the Colorado River has extended well past Diamond Creek to Pearce Ferry (RM 281.4) and beyond. Subsequently Arizona Game and Fish Department monitoring has extended to Pearce Ferry in recent years (2011-current). While electrofishing has not been very successful at capturing adult Humpback Chub, we do capture a small number of chub and with the recent (2016) addition of riverwide hoop net sampling we have documented Humpback Chub in the Western Grand Canyon. Additionally these Humpback Chub captured in the Western Grand (> RM 220) Canyon were not recaptures, whereas around 80% of Humpback Chub captured around the Little Colorado River inflow area were recaptures. This suggests that perhaps Humpback Chub in Western Grand Canyon are not utilizing the Little Colorado River for reproduction and might constitute a new "aggregation".

2016-11-18 15:15:00: **Molecular markers support specific status of *Gila robusta* and *G. nigra* in Fossil Creek, AZ**

Dowling, Thomas E*[1], Marsh, Paul C[2], Clarkson, Robert W[1]. (1-Wayne State University, 2-Marsh & Associates, 3-US Bureau of Reclamation (retired)).

There has been considerable debate over the specific status of chubs (genus Gila) in the Gila River basin of AZ-NM, especially headwater chub (*Gila nigra*) and roundtail chub (*G. robusta*). These two taxa have been difficult to discriminate with morphology and also show high levels of genetic divergence among local populations but not species. These species are rarely geographic proximate, with one example being Fossil Creek, a spring-fed tributary of the Verde River that was managed extensively for hydropower generation beginning in the early 20th century. The creek was chemically treated in 2005 to eradicate non-native fishes and native fishes salvaged. A barrier was installed in the lower reach of the stream, flows were restored, and native fishes repatriated. Here we report results of designed to examine genetic consequences of these management activities on *G. robusta* and *G. nigra*. This was achieved by comparing patterns of microsatellite and mtDNA variation from a temporal and longitudinal series of post-project samples collected from above and below barrier falls. Our data demonstrate that *G. robusta* has become more common downstream of the falls over time, with G. nigra becoming rare; however, *G. nigra* is able to persist upstream of the barrier in the absence of *G. robust*a. Results are consistent with continued recognition of *Gila robusta* and *G. nigra* as distinct species, with specific implications for the conservation and management of these forms.

2016-11-18 15:30:00: **Management of floodplain wetlands for endangered fish recovery in the middle Green River, Utah**

Speas, David W*[1], Jones, Tildon[1], Breen, Matthew[1]. (1-Bureau of Reclamation, 2-U.S. Fish and Wildlife Service, 3-Utah Division of Wildlife Resources).

Spring peak releases from Flaming Gorge Dam in northeastern Utah are timed with emergence of razorback sucker *Xyrauchen texanus* larvae in the middle Green River. When combined with flows from the Yampa River, these peak releases provide larvae access to floodplain wetlands where they experience excellent potential for growth and survival. 2016 was the fifth consecutive year of implementation of these larval triggered flows, which have resulted in mean production of 479 wild-spawned young-of-year razorback sucker per year from Stewart Lake, a managed wetland near Jensen, Utah. Such production from a naturalized setting in the Green River is significant, and moreover the Stewart Lake experience has afforded researchers and managers insight into basic requirements for successful rearing of entrained razorback sucker larvae in floodplain wetlands. These requirements include the ability to control wetland water levels prior to, during and after the entrainment period, the ability to exclude non-native fish from rearing habitats, and the ability to harvest or provide access to the river for young-of-year fish. Opportunities are being explored to apply such measures to additional floodplain wetlands with the hope of increasing abundance of wild-spawned razorback sucker in the middle Green River.

2016-11-18 15:45:00: **Ecological resilience in a restored desert spring**

Paulson, Abbey*[1]. (1-University of Colorado - Boulder).

The success of ecological restoration is often gauged by the change in community composition in relation to a target state. Community trajectory during succession, and the associated ecological outcome, can be influenced by abiotic and biotic variables, including environmental filtering, interspecific competition and predation, priority effects, and habitat partitioning. We conducted a twelve-month chronosequence study in a desert spring (South Scruggs, Ash Meadows National Wildlife Refuge) to follow community change over time during and after restoration. We used environmental DNA and metagenetic surveying to estimate whole eukaryotic communities in the restored spring, and three adjacent reference springs that defined the restoration target. The restored spring exhibited rapid recovery of alpha diversity, and a community trajectory directed towards the composition found in the reference springs. Our results suggest environmental selection of the ecological community in this restored desert spring, highlight the importance of nearby sources of dispersing individuals in restored or disturbed freshwater systems, and demonstrate the applicability of molecular methods for restoration monitoring.

2016-11-18 16:00:00: **Assessing the Range-wide Genetic Diversity of Relict Dace (Relictus solitarius), a Desert Endemic Minnow Influenced by Pluvial Drainage Patterns, Holocene Desiccation, and Anthropogenic Activities**

Houston, Derek D.*[1], Evans, R. Paul[2], Shiozawa, Dennis K.[3]. (1-Iowa State University, Department of Natural Resource Ecology and Management, 2-Brigham Young University, Department of Microbiology and Molecular Biology, 3-Brigham Young University, Department of Biology).

Desert fishes often represent unique evolutionary lineages confined to fragmented habitats. The relict dace (*Relictus solitarius*) is a desert endemic minnow with a native range that is restricted to isolated spring systems in eastern Nevada. The spring systems in which relict dace now reside are the remnants of pluvial lakes that existed during the Pleistocene Epoch, and are contained within four valleys (Butte, Goshute, Ruby, and Steptoe). Relict dace are the only native fish in the area, but largemouth bass and speckled dace have been introduced to water bodies in Ruby Valley. We used DNA sequence data to evaluate rangewide genetic diversity of relict dace, and to determine whether introgressive hybridization has occurred in areas where speckled dace have been introduced. Our results show that limited introgressive hybridization has taken place in one population, but other relict dace populations in Ruby Valley remain genetically distinct from speckled dace. Rangewide, relict dace populations exhibit pronounced genetic diversity. Initial diversification coincided with pluvial drainage systems, but isolation of populations occurred as pluvial drainages were disrupted and springs became isolated with the onset of Holocene desiccation. Relict dace populations are all genetically distinct, and meet criteria for consideration as evolutionary significant units. These populations should be managed in a way that maximizes the preservation of species-wide genetic diversity, particularly given the increasing demands and influences of anthropogenic activities on aquatic resources in western North American deserts.

2016-11-18 16:15:00: **Differential effect of temperature on larval Razorback Sucker and Flannelmouth Sucker growth - could temperature be limiting larval Razorback Sucker recruitment?**

Clark Barkalow, Stephani, L.[1], Platania, Steven, P.[1], Kennedy, Jennifer, L.[1], Gilbert, Eliza, I.[1]. (1-American Southwest Icthyological Researchers).

Razorback Suckers spawn and produce larvae in both the San Juan River and the Colorado River in Grand Canyon but there is little evidence larvae recruit to juveniles in either system. Predation by non-native fishes has long been cited as a major barrier to recruitment, though both systems have a relatively low non-native obligate piscivorous fish burden. Thus other factors must limit Razorback Sucker larvae recruitment. In both of these systems Flannelmouth Suckers are abundant. Flannelmouth Suckers spawn at a similar time as Razorback Suckers and recruitment of larvae to juveniles is consistently documented. One hypothesis as to the differential recruitment success is that there is a differential effect of water temperature on growth. In 2011, larvae were collected from the San Juan River once a week between 22 April and 29 July. Species, age (days), and growth rate of a subset of larvae was determined by counting daily growth rings in otoliths and calculating accumulated standard length from date of hatch to date of capture. We first applied a simple linear regression to these data to determine how much variation in growth rate could be accounted for by temperature (measured as mean growing degrees days, accumulated between hatch and capture). Water temperature explained little variation in growth rates ($R^{2M=}$ = 0.009 and 0.088 for Flannelmouth Suckers and Razorback Suckers, respectively). We then used an analysis of variance modeling approach. A three-way interaction between species, age, and water temperature was significant (P = 0.002) for predicting standard length of fishes. Although the specific characteristics of this interaction are still under investigation, the result indicates that within the same thermal environment, growth of Razorback Suckers differed from

that of Flannelmouth Suckers. Understanding the interaction between temperature and growth of Razorback Suckers in habitats where Flannelmouth Sucker larvae successfully recruit to juveniles is imperative for assessing recruitment limitations of Razorback Suckers and will provide for cross basin comparisons.

2016-11-18 16:30:00: **Hydrological Disturbances Regimes in Aravaipa Canyon, Arizona: Impacts on Native and Non-Native Fish Communities**

Reinthal, Peter*[1], Gwinn, Jessica[2]. (1-University of Arizona, Dept Ecology and Evolutionary Biology, 2-Fish and Wildlife Service Arizona Ecological Services).

Aravaipa Creek is the preeminent native fish assemblages remaining in the Gila Basin and is home to two or three federally listed endangered or candidate fish species. Hydrologic baseflow and periodic cyclonic and monsoonal flooding events are needed to ensure that (1) diversity and variability of aquatic habitats are maintained for the seven native fish species, and (2) populations of exotic species continue at low abundance or are eventually removed from the system. Variability in flow is considered necessary for both the long term perseverance and survival of native fishes and the periodic extrication of exotic individuals from the system. Here we present data from a 50 year monitoring period for Aravaipa fishes that examines short and long-term variation in fish populations. Native species show considerable variability in population abundance and there is a positive relationship between baseflow and native fish populations, but exotic fish populations do not show the same response. After periodic flooding, populations of exotic species are, to a large extent, significantly reduced. Variability is important for the persistence of the native fish populations. In contrast, lack of flow variability results in an increase in nonnative fishes. These results are critical for a scientific evaluation of a water extraction model (Opportune Extraction Model, [OEM]) for the extraction flood flows that some consider surplus to meet biological, hydrological, and physical processes for protection of the wilderness area.

2016-11-18 16:45:00: **Genetic status and broodstock maintenance of the endangered Pahranagat Roundtail Chub, *Gila robusta jordani*, of the lower Colorado River basin**

Wilson, Wade*[1], Diver, Tracy[1], Bohn, Sandra[1]. (1-USFWS, Southwestern ARRC, 2-USFWS, Southwestern ARRC, 3-USFWS, Southwestern ARRC).

The Pahranagat Roundtail Chub (*Gila robusta jordani*) is currently restricted to springs and associated outflows in the Pahranagat Valley (Lincoln County, NV), where its entire range consists of approximately 3.5 km (2.2 mi) of the Pahranagat River and an additional 2.5 km (1.6 mi) of a cement-lined irrigation channel (Pahranagat Ditch). Assessments of census size are dated, but estimated to be on the order of several hundred individuals. The U.S. Fish and Wildlife Service established a refuge stock, which is maintained at the Southwestern Native Aquatic Resources and Recovery Center (Southwestern ARRC; Dexter, NM), as part of recovery actions outlined in the original recovery plan. In addition, a refuge population is managed at the Key Pittman Wildlife Management Area (WMA) in the Pahranagat Valley. To obtain a genetic diversity baseline to aid the genetic management of the species, this project genotyped 576 individuals from the refuge population at Southwestern ARRC and 70 wild individuals at 18 microsatellite loci. Results (e.g., heterozygosity and allelic richness) and future genetic management plans will be discussed.

2016-11-18 18:00-20:00 **Student Networking Session** (Franciscan Ballroom)

SATURDAY, 19 NOVEMBER 2016

2016-11-19 08:00 -17:00 **Acoma Field Trip**—Hotel Albuquerque Entrance Room- Grand Sala