Fisheries Abstracts 2012 Joint Annual Meeting

Status of the Lees Ferry rainbow trout fishery, Colorado River, Arizona 1991-2011.

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Oral Presentation

Standardized long-term monitoring and research programs provide critical information in adaptive management situations. These long-term datasets provide a baseline with which to compare changes in population trends in response to fishery management objectives as well as hydroelectric operations. Since 1991, Arizona Game and Fish Department (AGFD) has conducted electrofishing surveys in the Lees Ferry reach of the Colorado River (RM -15.5-0) downstream from Glen Canyon Dam. Rainbow trout relative abundance (fish/minute) from 1991–2010 averaged 3.1 ± 0.52, with 2011 being the highest abundance on record 6.98 ± 1.36. Relative condition (Kn) from 1991–2011 averaged 80.4 ± 0.61, while mean length was 220.1 ± 10.80. Mean length in 2011 was 146.6 ± 1.27, substantially lower than the long term average. In addition to recurring electrofishing surveys, AGFD has conducted angler surveys to estimate angler catch rates at Lees Ferry since 1963. Angler catch rates exhibited similar trends to electrofishing surveys, with catch rates (fish/hour) of 1.5 ±0.08 in 2011 compared to the long-term average (1963–2010) of 0.65 ± 0.05. Increased juvenile fish abundance observed in 2011 may be a direct result of altered flow regime and subsequent increase in habitat availability during equalization flows aimed at increasing water storage in Lake Mead. Continued monitoring of the Lees Ferry rainbow trout fishery will allow the evaluation of population trends following reduction in discharge and resultant decrease in habitat availability after equalization flows have ceased.

Status and distribution of headwater chub in Pine Creek

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Oral Presentation

Previous research has visually observed headwater chub in lower portions of Pine Creek upstream of the confluence with the East Verde River near Payson, AZ. However, no headwater chub have been observed near Tonto Natural Bridge. An intensive sampling regime designed to determine the status and distribution of headwater chub in Pine Creek was conducted September 2011 from the Tonto Natural Bridge to the confluence of the East Verde River. Four types of hoop nets; large, small, circular collapsible, and square collapsible, were randomly employed throughout Pine Creek. A total of 29 headwater chub were captured ranging between 70 and 190 mm TL, suggesting a robust population with multiple year classes exists in Pine Creek. However, all headwater chub were captured in the lowermost portion of the area sampled. Green sunfish were abundantly captured throughout Pine Creek and may be influencing the distribution of headwater chub within the Creek. Future restoration efforts to reduce the impacts of green sunfish and other non-native species would likely enhance the headwater chub population currently within Pine Creek, especially considering natural barriers exist throughout the area.

The Desert Fish Habitat Partnership

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Oral Presentation

The Desert Fish Habitat Partnership (DFHP) is a National Fish Habitat Partnership under the National Fish Habitat Action Plan. The DFHP is focused on protection, restoration, and enhancement of fish habitat. The DFHP is partnership driven, non-regulatory and voluntary, and science based. DFHP's purpose is to conserve aquatic habitat in the arid West for desert fishes and the American people by protecting, restoring, and enhancing these unique habitats and in cooperation with, and in support of, state fish and wildlife agencies, federal agencies, Native American tribes, conservation organizations, and individuals. This presentation will showcase how the DFHP became a National Fish Habitat Partnership, what the DFHP does, and why there is a need for the DFHP. It will also provide highlights on desert fish habitat projects and review how projects are selected.

Chihuahuan desert toad association with habitat

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Oral Presentation

Shrub encroachment has dramatically altered historic desert grasslands with negative repercussions to the ecosystem. Little is known how this change in ecotype has impacted amphibian populations. We studied habitat associations of five toad species in the Chihuahuan Desert of southern New Mexico, USA. We used amphibian call surveys at 36 ephemeral water bodies. Vegetation types in a 712 m buffer zone around each site were tabulated. Habitat types were categorized as creosote, grassland, gravel, mesquite, playa and succulents. We performed canonical correspondence analysis and logistic regression to relate species to habitat types. Mesquite habitat and habitat dominated by grass or creosote were negatively related. *Bufo [Anaxyrus] cognatus*, *Spea bombifrons* and *S. multiplicata* positively affiliated with each other. Mesquite and succulents significantly influenced toad occurrence. *B. cognatus* and *S. bombifrons* were positively affiliated with mesquite and negatively with grass cover, *Bufo debilis* was negatively associated with succulents, and *Scaphiopus couchii* was positively related to mesquite and succulents and negatively associated with creosote. *S. multiplicata* did not show any significant habitat affiliation. Although shrub encroachment has been shown to negatively impact fauna and flora, we did not find any evidence of negative repercussions for the toad community.

Comparing standard fish data using a web-accessible database

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Oral Presentation

Recently, the American Fisheries Society developed standard methods to sample freshwater fish populations, publishing them in 2009 in the book *Standard Methods for Sampling North American Freshwater Fishes*. This project involved 284 scientists from 107 different organizations across Canada, Mexico and the United States. Data collected using standard methods gives biologists the ability to compare data across regions or time. Here we discuss recent progress on an on-line web-accessible database program to compare fish growth, condition, length-frequency, and catch per unit effort data collected using AFS standard methods. Development of this database is a collaborative effort among AFS, the US Geological Survey, the National Park Service, the U.S. Forest Service, the University of Arizona, and the University of Guadalajara, Mexico. The database (1) provides on-line summaries of 4,092 data sets of condition, length-frequency, CPUE and growth indices of common freshwater fishes, collected using standard gears from 42 states and provinces across North America, (2) allows entry of new data collected using standardized methods, so averages of commonly-used fishery indices can be updated, and (3) allows queries, graphical, and tabular output of the data summaries so they can be easily accessed and integrated into projects across North America. Users will be able to compare condition, growth and abundance of fish collected in a particular waterbody with regional and rangewide averages and percentiles, thus increasing resource information in a variety of areas. The database is programmed in a PHP-based Drupal framework.

Relationship between food type and growth and survival of larval hybrid Devils Hole pupfish

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Oral Presentation

We examined growth and survival of larval hybrid Devils Hole pupfish, *Cyprinidon diabolis* x *Cyprinidon nevadensis mionectes,* fed different food types. Foods included Rio Grande Silvery Minnow flake food and prominent elements of the Devils Hole algal and invertebrate communities, including monospecific cultures and combinations of cyanobacteria Cyanophyta, green algae *Spirogyra spp.*, ostracods Ostracoda, amphipods *Hyallela azteca*, diatoms Bacillariophyta, and copepods Cyclopoida. I quantified survival, growth, and lifespan of larval hybrids among 14 food treatments. Larvae fed flake food had significantly higher survival and lifespan than those fed natural food types. Of the natural food types, larvae fed algae or cyanobacteria in monospecific cultures or in combination with invertebrates had the highest survival and lifespan. Pure invertebrate treatments yielded the lowest survival and lifespan. No significant difference in total length at 14 days was found among treatments. I also developed

methods for laboratory propagation of hybrid Devils Hole pupfish and produced 500 hybrid pupfish larvae over a period of eight months by conducting a weekly 30% water change in parental aquaria lowering water temperature from 28°C to 23°C, then gradually raising it back to 28°C over 48 h. My methods for hybrid propagation employed temperatures suitable for Amargosa pupfish reproduction. Further information on the reproductive requirements of pure-strain Devils Hole pupfish is needed in order to modify my techniques for use with pure-strain Devils Hole pupfish.

Factors influencing rainbow trout spatial distribution patterns in a large regulated river

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Oral Presentation

The Lees Ferry and mainstem long-term fish monitoring programs in the Colorado River were designed to determine annual trends in catch-per-unit-effort (CPUE; fish/hr), size, and distribution of fishes vulnerable to electrofishing in order to help managers evaluate experiments and policies. The Lees Ferry program is aimed at monitoring the rainbow trout *Oncorhynchus mykiss* tailwater fishery, and has been conducted since 1991. This project covers the area from Glen Canyon Dam to the Lees Ferry boat ramp (River mile [RM] -15 to 0). The mainstem fish monitoring program has occurred since 2000, which includes areas between the Lees Ferry boat ramp and Lake Mead (RM 0 to 280). Data from both projects were combined to show system-wide patterns. Rainbow trout patterns show an exponential decay trend in relative abundance with longitudinal distance downstream. Mean water temperatures increased with downstream distance, but are generally within the optimal temperature range for rainbow trout. Food limitations and reduced ability to sight feed in downstream reaches (due to higher turbidity below the Little Colorado River) are two factors which likely influence rainbow trout spatial distribution patterns.

Media assessment for *Nannochloropsis salina* algae cultures

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Poster

The algae *N. salina* is used for the production of alternative bio-fuel. However, it is important to find cost-effective methods in order to make this venture economically feasible. *N. salina* is typically grown using the expensive F/2 nutrient media. This media consist of 5 stock solutions; Sodium Nitrate, Sodium Phosphate, Sodium Silicate, Trace Metals and Vitamins. We evaluate what the effects of leaving out specific stock solutions are on the growth of the algae culture. We quantify the growth rate by measuring cell densities/μL^{-1} using a Haemocytometer. We found that *N. salina* can be cultured using a media that excludes the stock solutions containing Sodium Silicate, Trace Metals and Vitamins and possibly reducing Sodium Phosphate. By reducing the stock nutrients in the media to mainly Sodium Nitrate we can reduce the cost for initiating and maintaining a healthy culture. A future approach would compare cultures grown with Sodium Nitrate and reduced Sodium Phosphate and one with the full media.

Using otolith microchemistry to assess the success of native sport fish restoration projects and determine the source and status of an illegal sport fish introduction in Wyoming

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Oral Presentation

The application of stable isotope analysis to fisheries management and ecology has grown exponentially over the last decade. Otolith tissues provide a unique opportunity to apply isotope techniques to fisheries management and ecology because they are faithful recorders of the environmental and elemental conditions where fish live. Changes in these conditions are permanently recorded in otoliths and recent technological advances now allow us to efficiently and inexpensively use isotope analysis to reveal the life history information recorded in this tissue. The isotopes of strontium have been particularly informative because they often create unique signatures that vary by the type and age of rock formations. As water flows over rocks or percolates through the ground it acquires this signature and is then recorded in the otoliths of fish. If fish move or are moved between streams, rivers, or watersheds that have different strontium isotope signatures, we can detect this by analyzing an otolith's microchemistry. In 2009, I began a project with the Wyoming Game & Fish Department to assess the success of three native sport fish restoration projects where the means to differentiate hatchery from wild origin fish had not been performed at the time of stocking (i.e. food dye, tags, or fin clips). The success of our method led to the development of another project to determine the source and status of an illegal sport fish introduction into a popular trout fishery in northwestern Wyoming where we have been able to identify the timing and source of illegally stocked walleye and determine their reproductive status in the reservoir. Information from these studies is being used to assist fisheries biologists at the Wyoming Game & Fish Department in making future management decisions.

Apache and Gila trout recovery challenges: what has changed since 1973?

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Oral Presentation

Abstract: Apache trout and Gila trout, both native to Arizona, were federally listed as endangered through the Endangered Species Act in 1973. When listed, the destruction, drastic modification, or severe curtailment of their habitat, and predation and hybridization with introduced trout, were the primary threats to each species. In the 1970s and 1980s, proposals submitted to the Federal Register to petition a down-list for each species from endangered to threatened status expanded the factors that could impact native trout to include forest fires, flash floods, and droughts. Now, in 2011, both species are listed as threatened and some additional circumstances are actually impacting the recovery *process*: the tools used for their recovery, both mechanical and regulatory. Artificial barriers built to protect headwater recovery populations have been problematic with frequent failures. Chemicals used to remove introduced trout have varied in potency, and recently have become highly controversial because of health and

ecological impacts. Regulatory procedures to restore native trout populations have entered new levels of bureaucracy under the National Environmental Policy Act, the Wilderness Act and the Wild and Scenic Rivers Act, and with competing priorities among agencies. This presentation explores the current and complex factors influencing native trout recovery in Arizona and the implications to recovery progress.

Using remote systems to assess relationships between environmental conditions and reproductive behavior in Devils Hole pupfish

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Oral Presentation

The highly endangered Devils Hole pupfish, *Cyprinodon diabolis*, lives in a single warm-pool of unknown depth within Death Valley National Park, California/Nevada. Over the past few years, *C. diabolis* has reached record-low numbers, spurring renewed conservation and recovery efforts. Although factors that influence spawning may be important in regulating *C. diabolis* population size, much is still unknown about the reproductive ecology of this notoriously difficult-to-breed species. Over 11 months, February-December 2010, we monitored spawning behavior of *C. diabolis* and associated environmental conditions within Devils Hole. A solar-powered video surveillance system, incorporating both above-water and underwater cameras, provided continuous monitoring of the shallow spawning shelf. Datalogging meters continuously recorded dissolved oxygen, temperature, and sunlight intensity across the shelf. Monthly in-person surveys recorded time-lapse algal and substrate cover across the spawning shelf. The in-person surveys additionally provided a comparison between newer video methods vs traditional survey methods in monitoring fish behavior, with the underwater camera delivering the most reliable data of *C. diabolis* spawning occurrences throughout the year. Based on data obtained with the underwater camera, relationships between spawning and associated environmental conditions exemplify the largely seasonal spawning activity of *C. diabolis.* Additionally, our experiences highlight some of the successes and limitations of remote-monitoring equipment, and how these instruments might be more broadly applied within the aquatic sciences research arena. The results from this study will hopefully provide information important for designing *C. diabolis* captive breeding programs.

Invader variability in raceway ponds for production of marine algae *Nannochloropsis salina*

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Poster

Algae production ponds have received a lot of attention as they can potentially mitigate effects of climate change. Algae are being produced for biodiesel, animal feed and other valuable byproducts. However, other organisms invading these ponds (algae competitors and predators) can cause the system to crash. The marine microalgae *Nannochloropsis salina* is cultured and

maintained in a four outdoor raceways (pond like structures), in Las Cruces, NM, for year round algae research. Identifying the invaders in a source culture is essential for maintain optimum cell density and avoiding culture crashes. The early detection of foreign algae, protozoa and other predator species through the use of microscopy is a key component of raceway maintenance. The collection and analysis of raceway samples was conducted on a weekly basis. A collapse in invaders was observed in all four raceways in early February 2011, while *Nannochloropsis* persisted. This decline of invaders was probably due to sub-zero temperatures. *Nannochloropsis* cultures stayed stable throughout the year. Future research should focus on environmental factors that maintain healthy algae cultures while minimizing invader growth.

Movement patterns of Humpback chub (*Gila cypha*) in the Little Colorado River, Grand Canyon, AZ

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Poster

The Arizona Game and Fish department has been remotely detecting Passive Integrated Transponder (PIT) tags in large-bodied native fish using stationary antennas in the Little Colorado River (LCR) near Grand Canyon since 2004. Remote detection may help address questions of humpback chub movement and population dynamics within the LCR. This method allows researchers to: 1) identify a tagged fish's location without handling them, 2) detect fish that may avoid other gear types, and 3) gather data during periods of the year when regularly scheduled field activities are not being conducted. Excessive handling of native fish has been identified as an issue of concern in the Colorado River ecosystem in Grand Canyon. Three antennas were placed throughout the perennial section of the lower LCR in a swim-through, window-type configuration. The antennas were attached in a perpendicular orientation to shore. Remote stations consist of a 61 cm square antenna which is attached to a modified PIT tag scanner and powered by 12 volt batteries charged with solar panels. Scanners record PIT tags within approximately 30.5 cm of the antenna and record the time and date for each detection. The data suggested a reduction in humpback chub movement from late morning to early afternoon under low turbidity conditions. This pattern of behavior is likely a life history trait to minimize encounters, under low turbidity conditions, with both avian and predatory fish.

Aquatic insects in the diets of non-native fish species, red shiner (*Cyprinella lutrensis*) and green sunfish (*Lepomis cyanellus*), from tributaries of the Gila River watershed, Arizona – competition with native species?

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Oral Presentation

The Gila River watershed, Arizona has many perennial streams with native fish assemblages that have been impacted through the introduction of exotic fish species. Through the introduction of

non-native fish species, the community assemblages and ecosystem structure and function have been altered. Little attention has been paid to the dietary habits of the non-native species in this area, but should their diets overlap with that of the native species, it raises a concern that native species could be adversely affected. This study examined diet by evaluating the stomach contents of two common non-native fish species, red shiner (*Cyprinella lutrensis)* and green sunfish (*Lepomis cyanellus)* from streams with large native fish communities. Over 300 red shiners were sampled from four sites on Aravaipa Creek, and over 150 green sunfish were sampled from multiple sites along Bonita Creek. Individual fish were measured, weighed, and the stomachs were dissected. Insects from the stomach were identified to the lowest taxonomic group possible and compared to the diets of native fish species as found by Minkley et al., 1981. We found dietary overlap among native and non-native fish species. Common insects that were similar among groups were Mayflies (Ephemeroptera, Baetidae) and Caddisflies (Trichoptera, Hydropsychidae). These findings indicate that there are similarities in diet and that close monitoring and possible intervention may be needed.

Rio Cebolla brown trout removals . . . many hours, many fish, many more years?

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Oral Presentation

The Rio Cebolla, located in the Jemez Mountains, New Mexico contains populations of Brown trout, *Salmo trutta* and restored Rio Grande cutthroat trout, *Oncorhynchus clarki virginalis*. Since 2005, the Rio Cebolla has been electrofished annually by personnel from NM Dept.Game and Fish and Santa Fe National Forest in order to evaluate the effectiveness and cost of mechanical removal versus chemical renovations. The removal area was divided into 5 segments, from McKinney Pond (lower terminus) to water source totaling 4.2 miles. A total of 789,369 electrofishing seconds (219.3 hrs) has resulted in 7,327 brown trout removed from the system. Mean length of removed brown trout has not changed significantly. The number of brown trout removed in sections 3, 4 and 5 has decreased during 2005-2011, while in section 2 the number of brown trout removed have stayed relatively the same. Brown trout captured in Section 1 have increased significantly and McKinney pond is believed to be contributing to the increase. Removal methods for brown trout within McKinney pond are limited; the pond is too small and shallow for effective boat electrofishing, too large for backpack electrofishers, and available gill nets fail to capture smaller fish. Complete removal of brown trout from the Rio Cebolla, using mechanical methods is not likely; however, continued suppression of brown trout populations is a possibility if McKinney pond can be addressed.

Implementation of the Safe Harbor Agreement for topminnow and pupfish in Arizona

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Oral Presentation

The Arizona Game and Fish Department has entered into a Safe Harbor Agreement (SHA) with the U.S. Fish and Wildlife Service for the management of four endangered native fishes, the Gila topminnow *Poeciliopsis o. occidentalis*, Yaqui topminnow *P. o. sonoriensis*, desert pupfish *Cyprinodon macularius*, and Rio Sonoyta pupfish *C. eremus*. The SHA allows the State to enroll non-federal waters for the conservation of these species. Shortly after completion of the SHA, it was decided to prioritize larger, high-quality habitats, due to their potential for greater productivity, and due to the associated monitoring obligations and limited manpower. Currently, 12 ponds have been enrolled, with another 12 sites in various stages of enrollment. Backyard pond owners continue to show strong interest in enrolling in the SHA program. These owners are interested in native species for several reasons, foremost being their desire to assist with the conservation of native species, and the use of native species as vector control agents. At this time, smaller sites are not a practical option, but programs to utilize these sites are currently under development. The use of topminnow and pupfish for mosquito control by public health agencies is also being explored. The Safe Harbor has assisted recovery by: creating duplicate populations of remaining topminnow and pupfish lineages; establishing and fostering partnerships between nontraditional groups and individuals for the conservation of the species; reducing the use of mosquitofish as a vector control agent; and educating interested public on the plight of native fishes and their conservation.

Modeling Angler Behavior as a Part of the Management System: Synthesizing a Multi-disciplinary Literature

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Oral Presentation

It is often said that managing fisheries is managing people. This truism implies that fisheries science inherently involves disciplines that focus on fish and their population dynamics, humans and their behaviour, and policy and decision making. This is particularly true for recreational fisheries, where the human behavioural motivation and human response to management actions may be more difficult to predict than in commercial fisheries. We provide a synthesis of the multi-disciplinary literature on modelling recreational angler behaviour to inform management of recreational fisheries. We begin by defining the recreational fisheries systems in an interdisciplinary manner. We then assess the literature for empirical evidence of disciplinary crossover. Using bibliometric data, we provide evidence that there is little disciplinary crossover, particularly between fisheries biology, including applied ecology, and quantitative social science including economics. We identify critical barriers to disciplinary crossover, such as database indexing issues and nomenclature. Next, we provide a review of critical contributions to the literature, and locate these contributions within our interdisciplinary conceptualization of the recreational fisheries system. This synthesis is intended to be a cross disciplinary bridge to facilitate access to the broader literature on modelling angler behaviour, with the ultimate goal of improving recreational fisheries management.

Detection, disease characteristics, and control of non-tuberculosis mycobacteria in hybrid Devils Hole pupfish

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Oral Presentation

Non-tuberculosis mycobacteria (NTM) are important pathogens of both humans and aquatic organisms. Mycobacteriosis of fishes, sometimes termed "piscine tuberculosis" (PT), is a chronic disease of brackish, fresh, and saltwater fishes. An NTM species was isolated and cultured from hybrid Devils Hole pupfish, *Cyprinodon diabolis* X *C. nevadensis mionectes*. Clinical signs of PT in these fish included spinal curvature, swollen abdomen, emaciation, and lethargy. In advanced disease, dermal lesions were often present. PT was uniformly fatal in fish that developed skin lesions. Pathology showed granulomatous lesions could occur in any organ, but were most common in the spleen, kidneys, and liver. Vertical transmission of PT occurred despite removal of eggs from parental aquaria for incubation and hatching. PT was not effectively controlled by surface disinfection of eggs using either iodine at 100 mg/L or formalin at 1,667 mg/L of water. Incubation of the eggs in water containing the antibiotics chloramphenicol at 50 mg/L or trimethoprim sulfamethoxazole at 25 mg/L resulted in significantly reduced vertical transmission, and was successful in creating mycobacterium-free stocks. Longevity was also significantly increased in these fish. The antibiotics cephalexin at 6.6 mg/L and erythromycin at 12.5 mg/L were largely ineffective in preventing vertical transmission. Disinfection with iodine prior to antibiotic administration further enhanced the effectiveness of chloramphenicol and trimethoprim sulfamethoxazole in elimination of culturable mycobacteria from eggs, but this treatment significantly reduced 15 d survival of larvae. Neither the number of mycobacterium-positive eggs nor 15 d survival was affected by disinfection with formalin before antibiotic administration.

Using fyke net capture data to assess daily trends in abundance of spawning Rio Grande silvery minnow *Hybognathus amarus*

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Poster

Assessments of assumptions underlying catch per unit effort (CPUE) data are necessary to determine if catch data provides a reliable relative abundance metric. Rio Grande silvery minnow *Hybognathus amarus* were collected with fyke nets from seasonally flooded habitats of the Rio Grande in New Mexico to determine habitat use by the species during spring runoff in May and June of 2008 and 2009. Catch per unit effort was calculated as fish/h to assess relative abundance among sites and sampling dates due to differences between the durations of samples in 2008 and 2009. The assumption that the number of fish captured with fyke nets is proportional to effort was assessed by using a multiple regression model. Catch per unit effort was also compared over the course of a day to determine if diel differences in catch rate exist. Catch of Rio Grande silvery minnow increased with fyke net soak time during 2008 and 2009 ($P < 0.0001$); however the proportion of the variability explained by the model was greater for 2009

(adjusted R^2 = 0.66) than for 2008 (adjusted R^2 = 0.48). CPUE did not differ among 24-h collections at high-(mean = 8.24 fish/h; $X^2_{0.05,5}$ = 1.68, P = 0.891) or at low-density (mean = 0.12 fish/h; $X^2_{0.05,5}$ = 8.633, P = 0.125) sites. These results indicate that fyke net catches of Rio Grande silvery minnow is proportional to soak time, and calculation of CPUE as fish/h may be used to compare relative abundance of the species among and between fyke net samples collected from seasonally flooded habitats.

Status and trends of White Sands pupfish (*Cyprinodon tularosa*) throughout its range on two DoD installations

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Oral Presentation

The White Sands pupfish is endemic to the Tularosa Basin of southern New Mexico and represents a living relic when Lake Otero partially filled the Tularosa Basin during the Pleistocene. The species is distributed among populations on two Department of Defense (DoD) installations within the Tularosa Basin and has been petitioned for federal listing. The distribution for the populations includes Salt Creek and Malpais Springs on White Sands Missile Range (WSMR). A refuge population for the Salt Creek population was established in the Lost River on Holloman Air Force Base (HAFB). Population monitoring since 1994 and recent habitat analysis has demonstrated a species highly resilient to habitat variability in salinity and temperature with salinities ranging from brackish to hyper-saline (> 100 ppt) and maximum summer temperatures of 40^{o}C (diel temperature range of 18^{o}C). While the Salt Creek population appears stable, the Malpais Spring population appears to be in decline which may be related to habitat changes that followed feral horse removal over a decade ago. Habitat analysis of HAFB populations during extreme drought (2010-2011) revealed high fragmentation with a loss of nearly 47% of habitat when compared to pre-drought conditions. Land and water use on the DoD installations could pose additional risk to the species if these are overlaid by extreme climatic events.

Behavior modification in bonytail chub (*Gila elegans*) exposed to treated municipal effluent: Changes in cover-seeking, spacing, and activity level behavior.

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Oral Presentation

Endangered bonytail chub (*Gila elegans*) were exposed for 2.5 years to secondarily-treated municipal wastewater previously shown to containing low-levels of known endocrine disrupting

compounds. We examined both exposed and control fish to compare the following parameters: growth, cover-seeking, behavioral reaction to disturbance, spacing, activity level and chasing/paired swimming event. Fish in raceways containing municipal effluent grew heavier than fish in control raceways. Bonytail chub in treatment raceways were also found to be out of cover more often when disturbed, less clumped outside of cover, and more active than fish in control raceways. There was no difference in the number of chasing/paired swimming events between fish in raceways. Behavioral responses in fish exposed to municipal effluent have the potential to adversely affect wild bonytail chub, especially if they have to combat a variety of environmental stressors and disturbances.

Comparative Invertebrate Community Structure and Food Web Dynamics in an Upland Acid Mine Drainage Watershed, Patagonia Mountains, Southeastern Arizona

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Oral Presentation

Mine drainages in the Patagonia Mountains, Arizona are of concern because acidic, metal-laden water empties into Sonoita Creek, with native fish assemblages and Patagonia Lake, a popular sport fishery. In this study we examined pre- and post-monsoon stream community structure, water quality, and food web dynamics using stable isotopes in three streams with varying degrees of abiotic impairment; (1) Alum Gulch has high metal levels and low pH, (2) Humboldt Canyon has low metal levels and low pH, and (3) Middle Harshaw Creek has low metal levels and neutral pH. Impaired stream reaches were found to have invertebrate community structure alterations and food web disruption. Alum Gulch had a decrease in both abundance and diversity of macroinvertebrates, especially pollution sensitive taxa. Harshaw Creek had the greatest diversity of macroinvertebrates and increased food web complexity. Humboldt Canyon was intermediate in diversity. Carbon and nitrogen isotopic results indicate a loss of lower trophic levels in metal impaired streams

Response of Apache Trout to Mechanical Removal of Brown Trout

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Oral Presentation

In an ongoing effort to remove brown trout from streams which hold critical populations of Apache trout, the Arizona Fish and Wildlife Conservation Office with assistance from the White Mountain Apache Tribe conducted mechanical removal of brown trout from Crooked Creek, Little Bonito Creek, and Squaw Creek which are located on the Fort Apache Indian Reservation. Brown trout still reside in these three streams in which chemical renovations failed, and co-inhabit these streams with Apache trout. Removal efforts were conducted on Crooked Creek in 2003-04, 2006-11, Little Bonito Creek in 2003, 2006-11 and on Squaw Creek in 2006-11. We evaluated whether several years of mechanical removal could reduce or eliminate brown trout populations and reduce mean brown trout length. Apache trout abundance and size structure in

response to decreased predation and competition was examined. In addition we evaluated the effectiveness of multiple-pass electrofishing in reducing brown trout abundance.

The Wallow Fire's immediate impacts on fish populations in Arizona

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Oral Presentation

This summer's record-breaking Wallow fire in the White Mountains of Arizona spanned 538,049 acres, including watersheds with habitat for thirteen of Arizona's native fish species; seven of which are listed under the Endangered Species Act. The Wallow fire BAER (Burned Area Emergency Response) team identified nine fisheries VARs (Values-At-Risk) of the seven ESA listed fish species, facing threats including modifications in aquatic habitat, declining water quality, changes in streamside vegetation, and fish migration barrier failures. Immediately after the post-fire monsoon season, 24 of the 27 native fish population VAR locations identified by BAER were surveyed, with 12 showing significant losses in fish numbers, of which 3 were possibly extirpated. Overall loss of genetic resources was low, because the majority of fire-affected populations were replicates. Some declines in fish populations present opportunities to manage for desired conditions, through removing brook trout from Rudd creek, removing Apache trout hybrids from KP creek, and re-establishing roundtail chub in the Black River.

Relationships of biotic and abiotic factors with benthic organisms in a desert wetland

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Oral Presentation

In this study, we relate the structure of the benthic macroinvertebrate community to biotic and abiotic factors in a sinkhole complex at *Bitter Lake National Wildlife Refuge* (*BLNWR*) in Roswell, New Mexico. We provide management recommendation to protect threatened and endangered invertebrate species. The structure of the sinkholes is unique and best sampling methods needed to be determined. In July of 2011, we performed five sampling methods in six sinkholes: glow-stick jug, Hester-Dendy plates, pump sampler, sled and Ekman grab. The sinkholes were selected to account for a large range of salinity, turbidity, chlorophyll *a* concentration and fish density. We used ANOVA and determined that the use of glow-stick jug and Hester-Dendy plates best represent the benthic community in sinkholes. Furthermore, salinity and fish density seem to most influence benthic abundance and composition as determined by regression analysis. In May of 2012, we will collect and identify benthic macroinvertebrate specimens, record physical attributes, measure water chemistry, chlorophyll *a* content, zooplankton and fish abundance in 40 sinkholes to further investigate what factors drive the benthic community and in particular, threatened and endangered benthic invertebrates.

The effects of salinity on larval growth rates in Southwestern toads *Spea multiplicata* and *S. bombifrons*

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Poster

As global climate change becomes of greater concern, the ecological changes it creates pose a number of threats to world amphibian populations. One of these threats is increased water salinity. Previous research has demonstrated that increased salinity results in negative impacts on development and survival in several amphibian species. However, research of the effects of climate change on desert amphibians is lacking. Here, we assess the effect of salinity on larval survival and growth rates of two desert anurans, *Spea multiplicata* and *S. bombifrons*. Larvae were exposed to two salinity concentrations (0.3 ppt and 3 ppt) with snout-vent length recorded once weekly over a thirteen week period. Repeated-measures ANOVA was conducted to compare our treatments. Our results indicate that increased salinity has no significant impact on larval survivorship in *S. multiplicata* or *S. bombifrons*. In general, *S. bombifrons* larvae were larger than *S. multiplicata* ($p<0.0001$). Salinity did not impact growth of *S. bombifrons*, however, *S. multiplicata* larvae were significantly larger in the 3 ppt treatments after 3 weeks ($p<0.0001$). Higher salinity might be an indicator for declining water levels, causing an increased growth in some desert anurans.

Status, distribution, and evaluation of headwater chub in the East Verde River

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Oral Presentation

Previous survey efforts in the East Verde River near Payson, AZ, have been sporadic and opportunistic, but have resulted in observations of a robust population of headwater chub (*Gila nigra*). As part of the Arizona Game and Fish Department's (AGFD) Conservation and Mitigation Program, we completed an inventory of a 47-km portion of the stream to determine, among other objectives, headwater chub size distribution and prevalence throughout the sampling area using various types of netting gear. Analyses revealed catch rates of headwater chub and rainbow trout (*Oncorhynchus mykiss*) were highest in the upper 17-km of the stream. Multiple size classes of headwater chub were also observed, suggesting a robust population exists despite the presence of a potential non-native competitor. We also conducted a mark-recapture experiment in a 2-km portion of the stream to estimate headwater chub population size and capture probability. Results of the hierarchical Bayesian modeling estimated 1,457 (1,212 – 1,804) headwater chub in this portion of the stream, with an estimated capture probability of 0.24 (0.19 – 0.30). These results suggest AGFD's rainbow trout stocking program is having a minimal impact to the headwater chub population found within the East Verde River. Other non-native species, however, may be inhibiting the population in downstream portions of the stream.

How do we make trout stockings in streams more efficient?

MEYER, KELLY. Richard Dreyer, Arizona Game and Fish Department, 2878 E. White Mountain Blvd, Pinetop, AZ 85935.

Oral Presentation

Streams that are stocked with catchable trout provide better catch rates and angler satisfaction than other waters during July and August when most anglers are fishing. These fisheries traditionally have low rate of return to creel so we wanted to look at ways to make our stockings more efficient. We did creel surveys on two put and take streams in the White Mountain of Arizona over two different summers. In East Fork of the Black River we found the following: trout did not persist long after stocking (less than 1% surviving two months after stocking), return rate to creel was similar in early (23%) and late summer (22%), and large trout (2 to the lb) returned to creel eight time higher rate than smaller trout (4 to the lb). In a study in the Little Colorado River we found Apache trout and rainbow trout returned at similar rates to creel (28 and 34% respectively) and fish stocked at a well known location returned twice as well (50%) as fished spread out the stream (25%). Optimizing return rate of catchables in streams can be done by stocking or developing deeper pools, stocking in fewer more publicized locations and stocking larger trout. Future studies are needed to determine the optimum size of trout to stock and to determine length of time of persistence of stocked trout under different water temperatures and conditions.

From minority to majority: increased abundance of flannelmouth sucker (*Catostomus latipinnis)* in Colorado River, Grand Canyon.

OSTERHOUDT, ROBIN, and Aaron Bunch. Arizona Game and Fish Department, Research Branch, 506 N. Grant Street, Suite L, Flagstaff, AZ 86004.

Poster

The Grand Canyon long-term fish monitoring program was designed to determine annual trends in catch-per-unit-effort (CPUE; fish/hr) and distribution of Colorado River fishes vulnerable to electrofishing. Standardized monitoring between Lees Ferry (River Mile [RM] 0) and Pearce Ferry (RM 280.5) of the Colorado River in the Grand Canyon has occurred since 2000. During May 2011 sampling, flannelmouth sucker *Catostomus latipinnis* comprised 39% of species total catch as compared to 8% of species total catch from years 2000-2003. Mean CPUE for flannelmouth sucker has shown over a fiftyfold increase in relative abundance from 1.1±0.4 fish/hr in 2000 to 56.6±8.5 fish/hr in 2011. Since 2004, an increase in catch rates has suggested successful recruitment of flannelmouth sucker to adulthood. We hypothesize that an increase in water temperature likely increased recruitment, which is most prevalent further downstream (RM's 180-261). Nonnative fish removals during 2003-2006 likely reduced predation on young-of-the-year and juvenile flannelmouth sucker, which could have contributed to successful recruitment. The magnitude of increased catch rates in 2011 may have been further influenced by higher discharge from Glen Canyon Dam (GCD) which could have amplified flannelmouth sucker accessibility to electrofishing due to the expansion of structured habitat along shorelines.

37 days: from chaos to completion of a temporary fish barrier in Fossil Creek

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Oral Presentation

In 2004, 9.5 miles of Fossil Creek in north-central Arizona was restored to benefit native aquatic species. A cooperative effort by the Forest Service, Bureau of Reclamation, Fish and Wildlife Service, and Arizona Game and Fish Department, the project involved construction of a fish barrier within the Mazatzal Wilderness, salvage of native fishes, treatment of the stream with a piscicide to remove nonnative fish, and repatriation of the natives. The project was tied to both the decommissioning of the Childs-Irving Hydroelectric project and required mitigation for the Central Arizona Project. During summer 2011, nonnative smallmouth bass were detected above the fish barrier. An unusually large flood had deposited rocks and boulders below the barrier, allowing fish to migrate over it. Personnel from the four cooperating agencies met and developed recommendations and an action plan to: (1) contain the bass to the shortest possible section of the creek, (2) remove the invading bass, and (3) repair the original fish barrier in the wilderness. Amazingly quick action (by agency standards!) was taken to plan and construct a temporary barrier to contain the invading bass. In just 37 days from confirmation of the invaders, the structure was completed. This was only possible through a massive cooperative effort among the four agencies, other permitting agencies, and volunteers. This presentation describes the steps involved in permitting and constructing the temporary barrier, and future actions needed to keep this nationally-important aquatic system restored to natural function.

Manipulating pH and its effects on growth and lipid accumulation in marine microalgae *Nannochloropsis salina* and invaders

******* PARDEE, RENEE (Undergraduate), HEBERTO CHAPARRO (Undergraduate), ZACHARY BRECHEISEN (Undergraduate), Levi Chavez (Undergraduate), ******* Meridith Bartley (Graduate), Wiebke J. Boeing, New Mexico State University, Department of Fish, Wildlife and Conservation Ecology, P.O. Box 30003, Las Cruces, NM, 88003.

Poster

In the global search for renewable resources and clean fuel, algae-based biodiesel is drawing more and more interest. Biodiesel can be synthesized from the lipids produced by the fast growing microalgae *Nannochloropsis*. We are presenting the results of an experiment designed to test interactions of pH levels with growth, lipid accumulation and invading organisms. In a first experiment, we grew *N. salina* at six different pH levels (pH 5, 6, 7, 8, 9 and 10) in aquaria. *Nannochloropsis* cultures crashed at pH values 5 and 10. Algae had a maximum growth rate at pH 8 and 9 and invasion of undesired organisms (predators, competitors) was lowest at pH 6. In a second experiment, *Nannochloropsis* was grown in aquaria until carrying capacity was reached. After reaching steady state, pH was changed to 7, 8 and 9 using buffer solutions and the control was left unchanged in order to stress *Nannochloropsis* to different degrees and trigger lipid accumulation. Lipid accumulation after 2 weeks was higher when changing pH values as compared to the controls. Utilizing this information we can create and model more efficient bio-diesel production systems in the future.

History and "rebirth" of Phantom Lake Spring

PAROZ, YVETTE. U.S. Bureau of Reclamation, Mike Montagne U.S. Fish and Wildlife Service.

Oral Presentation

The Phantom Lake Spring Ciénega, Toyavale, Texas supports an assemblage of five aquatic species of concern: two endangered fishes, Comanche Springs pupfish (*Cyprinodon elegans*) and Pecos gambusia (*Gambusia nobilis*); and three candidate invertebrates, Phantom springsnail (*Tryonia cheatumi*), Phantom Cave snail (*Cochliopa texana*), and diminutive amphipod (*Gammarus hyalleloides*). Spring flow from Phantom Lake Spring has been continually declining since measurements began being recorded in the 1940s. Corresponding aquifer levels in Phantom Cave have dropped 2.5 feet in elevation in the last 10 years. Flow from the cave spring ceased in approximately 2001. The aquatic habitat in the small spring pool at Phantom has been maintained by a pumping system since 2001. The agencies have been working together on an ad-hoc, emergency basis to maintain the habitat at Phantom Lake Spring over the past decade. In order to minimize extinction risk of the unique taxa found in the Phantom Lake Springs Ciénega the partners have competed a project to create new, more natural ciénega and increased the amount of habitat available, thus increasing the carrying capacity and population sizes of the five aquatic species of concern.

2011 update on humpback chub (*Gila cypha*) translocations and monitoring above lower atomizer falls in the Little Colorado River, Arizona

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Oral Presentation

As part of the humpback chub (*Gila cypha*, HBC) recovery efforts, between 2003 and 2011, the U.S. Fish and Wildlife Service has translocated 1,924 HBC (50-136 mm TL) from the lower reaches of the Little Colorado River (LCR) to above Chute Falls, a travertine structure approximately 14.1 km above the LCR confluence with the Colorado River. In 2011, 96 HBC (78-130 mm) captured below 10.6 km were given passive integrated transponder (PIT) tags and translocated via helicopter to a release site 16.2 km above the confluence in the Little Colorado River. Between 2006 and 2010, mark-recapture efforts were conducted in the LCR above Lower Atomizer Falls (13.57 km), largely in order to track the fate of the translocated HBC. In 2010 and 2011, sampling was reduced to one trip each year due to very low capture rates. These low capture rates are likely due to habitat alteration, possibly caused by sedimentation following the extended spring 2010 freshet, pushing many translocated HBC downstream. In June 2011, the adult HBC ($\geq$ 200 mm) population estimates above Lower Atomizer Falls saw a slight increase from 2010. Using extrapolated capture probabilities for HBC $\geq$ 200 mm, the estimated adult HBC population between Lower Atomizer Falls and Chute Falls is 71 (SE = 3) individuals with 52 (SE = 6) estimated residing above Chute Falls. Future efforts will include additional translocations and monitoring to observe survival, growth, and to detect reproduction in this translocated population.

Habitat variables associated with stream temperature resiliency in the White Mountains of Arizona with implications for Apache trout distribution in response to climate change

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Oral Presentation

The distribution of Apache trout, *Oncorhynchus apache*, a threatened species endemic to eastern Arizona, and that of other Southwestern coldwater species may be compressed due to increased stream temperatures associated with climate change. Knowledge of habitat conditions which best buffer stream temperatures against increase and fluctuation may help preserve current Apache trout distribution. Our goal is to use a stream temperature model, ground-truthed with field data from various streams in Eastern Arizona, to predict how increases in air temperature may affect temperatures of streams containing Apache trout. We are using the Stream Segment Temperature Model (SSTEMP) to predict the effects of stream habitat variables on water temperatures, and how planned management activities will affect stream temperatures. SSTEMP uses the time of year, location of study, and meteorological data to compute the solar radiation available at a specific point on the surface of the Earth. It reduces the estimate by accounting for topography and riparian vegetation on-site that can block radiation in order to predict downstream temperatures. The model may lead to a better understanding of which factors (e.g., vegetation density and type, topography, groundwater) control stream temperatures, how these factors affect stream temperatures, and how different management actions can moderate water temperature increases. A comprehensive understanding of which parameters most affect stream temperature is needed both to manage existing populations of Apache trout, and to help identify suitable stocking locations.

Biogeochemical analyses of food web dynamics and heavy metal contamination in Aravaipa Creek, Arizona.

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Oral Presentation

The fish community of Aravaipa Creek, Arizona, with seven native species including the threatened species *Meda fulgida* and *Tiaroga cobitis*, is considered the foremost remnant assemblage of the imperiled Gila River basin fauna. This study presents distributional patterning from fish and invertebrate surveys coupled with high-precision analyses of lead (^{208}Pb, ^{207}Pb, and ^{206}Pb), carbon (δ13C ‰) and nitrogen (δ15N ‰) isotopes. Combining data sets shows the levels, sources and mechanisms of deposition of metal contamination in fishes and macroinvertebrates in context of the trophic interactions. We find fish and macroinvertebrate assemblages to have high levels of lead contamination in *Catostomus insignis*, *Gila robusta* and predatory macroinvertebrates. The major source of metal bioaccumulation is the Grand Reef mine tailings. Remediation efforts of inputs from the Klondyke tailings, while limiting Klondyke sources into the watershed, have not eliminated metal contamination as a threat to Aravaipa fishes. Distinct trophic interactions reveal the mechanisms of metal accumulation

within the Aravaipa food web. Invertebrates play a key role as both food and contaminant source for the Aravaipa fishes. Future studies should take into account the interactive nature of distribution patterns and food web dynamics among trophic levels to understand control and variability of native fish populations.

Mechanical Removal of Northern Pike in a Small Put and Take Trout Fishery in Northern Arizona

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Oral Presentation

Ashurst Lake is a relatively small (about 160 surface acres) reservoir in northern Arizona and has historically been one of the most popular trout fisheries in the Flagstaff area. Northern Pike were illegally introduced into the lake around 1996 and dominated the fishery by 2009. Creel data collected prior to the illegal introduction of northern pike in 1995 and 1996 showed angler use of approximately 25,000 angler days per year. In 2009 a creel census survey was conducted. The angler use had fallen to approximately 5,400 angler days and only 5,434 of the 43,762 stocked catchable rainbow trout were harvested (12% return to creel). Fish sampling in April 2010 showed a population of large fat northern pike and little carryover of stocked trout. Using an estimated cost of $2.50 per trout stocked, approximately $92,000 of stocked trout was consumed by northern pike in 2009. During late March and early April 2011 203 northern pike were mechanical removed from the lake using gill nets over 7 days. A creel census conducted after the mechanical removal showed an increase in angler use and a more than 2 fold increase in the return to creel of stocked rainbow trout. Although mechanical removal of Northern Pike has failed to succeed in meeting the removal criteria set by biologist in many other systems nation-wide, it can have a short-termed benefit to small put and take trout fisheries.

Habitat requirements for two catostomids in an Arizona stream.

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Oral Presentation

Species-specific habitat segregation is common in desert streams. However, several species may have similar habitat requirements or may be forced to use the same areas and resources during periods of low or high flow. The characterization of habitat use and overlap among species in desert streams can provide important information to assess effects of ecosystem management strategies, anthropogenic impacts, or interspecific interactions. Desert and Sonoran suckers (*Catostomus clarkii* and *Catostomus insignis*, respectively) are relatively common native fishes in southwestern streams. They have a relatively wide distribution and can live under a variety of environmental conditions. Using fish collection data obtained using prepositioned electrofishing techniques and data on habitat variables, we investigated differences in habitat requirements for these two species in a perennial stream in central Arizona. Both catostomids were usually found

in swift-running waters over gravel- to boulder-sized substrates; however, Sonora suckers were typically found in warmer waters (Max. 28˚C) than desert suckers (Max. 23˚C). We hypothesize that differences in temperature preferences among both species could result in observed spatial segregation.

Arizona's revised process for piscicide treatments, from planning to implementation.

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Poster

Following the recommendations from the Arizona 2011 Rotenone Review Advisory Committee, the Arizona Game and Fish Department will be revising its current process to plan and implement piscicide treatments in the state. Revisions to this process adopt the various steps identified in the 2010 American Fisheries Society Standard Operating Procedures for Rotenone applications and the new reporting requirements under Arizona's Pesticide General Permit, administered by the Arizona Department of Environmental Quality. Arizona's revised process for piscicide treatments also increase the number of opportunities for public notification, comment, and the option to petition the Arizona Game and Fish Commission for an appeal on a treatment decision. The revised process was developed and recommended by various stakeholders in the Advisory Committee, including Department staff.

Translocation and monitoring of humpback chub (*Gila cypha*) in Havasu Creek, Grand Canyon National Park

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Oral Presentation

As part of a cooperative effort to expand the range of endangered humpback chub (*Gila cypha*) and potentially develop a second tributary spawning location within Grand Canyon, the National Park Service, Arizona Game and Fish Department and the U.S. Fish and Wildlife Service initiated baseline surveys in Havasu Creek in 2010. In June 2011 just prior to translocation, 8 large, untagged HBC were found for the first time in Havasu Creek. Translocation of 243 small fish occurred below Beaver Falls (4 miles upstream) in June 2011. Carbon dioxide readings were significantly lower than their natal stream, the Little Colorado River, allowing the fish to be quickly acclimated and released downstream of Beaver Falls. In October 2011, native speckled dace (*Rhinichthys osculus*) dominated the catch (N=236), followed by humpback chub (N=109) and bluehead sucker (*Catostomus discobolus*, N=106). The only nonnative fish captured was rainbow trout (*Oncoryhynchus mykiss*, N=28). Of the 109 humpback chub captured during this survey, 8 unique fish had no PIT tag. The mean size (257 mm ± 6.63) of these fish exceeded 200mm, making it likely that they were non-translocated individuals. Nearly 78% of the total humpback chub captured during this monitoring effort were found in the same pool in which they were introduced in June 2011. In addition, preliminary growth analysis (n=22) of the recaptured translocated humpback chub indicated high growth rates between May and October (mean = 13 mm/30 days). This suggests high retention of translocated individuals and that resources are available for humpback chub survival.

Habitat And Fish Density Changes On Six Streams In The Black River Watershed: Post-Wallow Wildfire And Monsoon Season

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Oral Presentation

The Wallow Wildfire of 2011 burned 83% of the Black River watershed. The Black River supports a large portion of Arizona's Apache trout habitat as well as a vital sportfishery. Habitat surveys were carried out on historic GAWS (General Aquatic Wildlife Survey) sites. Six streams of varying soil burn severity and fish mortality were sampled because of existing previous data from ten to two years old. Three of the sampled streams, North Fork of the East Fork Black River, Soldier Creek and Conklin Creek showed no significant negative effects from the fire. East Fork Black River is now 16% more embedded and the stream banks are 25% less stable. On the West Fork Black River, embeddedness increased 13% and canopy cover decreased 16%. Both the East Fork and West Fork Black River showed some fish reduction in the lower reaches. Fish Creek is 38% more embedded than pre-fire, has 21% less canopy cover and had a very high rate of fish mortality. Overall, statistically significant fish mortality and negative changes in habitat did occur, but did not always correlate to BAER (Burn Area Emergency Response) team predictions for watersheds at risk.

Population Estimates of humpback chub (*Gila cypha*), bluehead sucker (*Catostomus discobolus*) and flannelmouth sucker (*Catostomus litipinnis*) in the Little Colorado River, Grand Canyon, AZ

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Oral Presentation

Since 2000, a series of two-pass, closed mark-recapture efforts have been conducted in the spring and in the fall in the Little Colorado River (LCR) to track the abundance of humpback chub and native suckers. Results indicate that during spring 2011 the estimated abundance of humpback chub ≥ 150 mm in the lower 13.57 km of the LCR was 5,779 (SE = 433). Of these fish, it was estimated that 4,735 (SE = 420) were ≥ 200 mm. These numbers indicate a decrease from estimates obtained in 2010, but an overall increasing trend in abundance since 2007. Also in spring 2011, there were an estimated 31,309 (SE = 7,394) bluehead sucker and 5,326 (SE = 1,407) flannelmouth sucker ≥150 mm. These numbers represent a declining trend for bluehead sucker since 2008 and an increasing trend for flannelmouth sucker since 2007. Preliminary results during the fall of 2011 indicate that there were 5,410 (SE = 927) humpback chub ≥150 mm. Of these fish, it was estimated that 2,825 (SE = 691) were ≥ 200 mm. The overall results suggest that warmer water temperatures in the Colorado River during the mid 2000s may have benefitted native fish.

East Verde River headwater chub age determination

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Oral Presentation

Determining age in fisheries is important to understand growth, age structure, and evaluate the effect of changes in the environment. Estimates of age of headwater chub were analyzed from thin cross sections of sagittal otoliths from 32 specimens collected in the East Verde River, Arizona. A robust population consisting of multiple year classes of headwater chub appeared to exist in the upper reaches of the East Verde River based upon recent survey data. Otolith ages were assigned by three independent readers and any discrepancy was decided with a concert read. Ages of headwater chub based on otoliths varied from 0 to 5, while lengths ranged from 68 mm to 228 mm. Back-calculation of length-at-age was examined and incorporated into a von-Bertalanffy growth model using Wang (1998) methodology. Also, an age-length key was developed for East Verde River headwater chub and applied to all other headwater chub captured but not sacrificed during our sampling surveys. Analyses confirmed the field survey data suggesting the population of headwater chub in the East Verde River is robust. Similar analyses of age and growth are proposed for other headwater chub streams that will provide thorough assessments of the populations found within, which will help guide future management activities.

Influence of temperature on growth of *Nannochloropsis salina* in algae production ponds and invasion of undesired organisms

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Poster

Of the many exigent ecological issues of the modern day, the need to transition from finite to renewable energy resources is one of the most important. This does not only affect the ability of the human species to sustain itself in a long term sense but also the overall health of the natural world. Growing algae in production ponds and then harvesting its lipids, which can be converted to biodiesel, is a promising venture that has received a lot of attention. Here, we investigate how different temperatures impact the marine algae *Nannochloropsis salina*, which is a model species in algae production ponds, as well as algae competitors and predators invading these ponds. *Nannochloropsis* was grown in 10-gallon aquaria at 15, 20, 25, 30, and 35 °C using six replicates. We measured absorbance at 750 nm with a spectrophotometer to measure algae density. Additionally we counted *Nannochloropsis* cells using a hemocytometer and invasive orgamisms a Sedwick-Rafter chamber. Optimal growth of *N. salina* occurs at temperatures between 20 and 25°C. Undesired organisms were minimized at colder temperatures. Optimum growing conditions for algae in production ponds are essential information to make algae biodiesel become economically realistic.

The Wallow Fire and its impacts to the Apache trout recovery program

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Oral Presentation

The 2011 Wallow Fire burned approximately 540,000 acres in Eastern Arizona and Western New Mexico. Within the fire perimeter were several Apache trout recovery populations, either populations previously established or streams identified by the Recovery Plan as areas to target for restoration. While the short term and long term biological effects to Apache trout will not be completely known for some time, I will discuss how our long term recovery strategy of representation, redundancy, resiliency, and restoration can still pass the five factor threat analysis that the Endangered Species Act uses to determine to list, or in this case to delist a species. While the fire did have an affect on a few populations of Apache trout, I will also discuss some of positives of this fire such as reduced fuel loads, reduction of nonnative fishes, and providing increased knowledge about artificial barriers used to isolate populations of Apache trout from nonnative trouts.

An evaluation of liquid ammonia as a new candidate piscicide

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Oral Presentation

Attempts to remove nonnative fish from areas with native fish are common, but success is limited because very few tools are available for managing invasive aquatic species. Ammonia is known to be toxic to a wide variety of aquatic organisms but is also the natural byproduct of fish metabolism and naturally present in the environment at low levels. Our objective is to determine the feasibility of using of ammonia as a tool for removal of invasive aquatic species by evaluating its effectiveness and persistence in the environment in a natural pond setting. A suite of common nonnative fishes including smallmouth bass *Micropterus dolomieu*, largemouth bass Micropterus salmoides, Common Carp *Cyprinus Carpio*, green sunfish Lepomis cyanellus, fathead minnow *Pimephales promelas*, red shiner *Cyprinella lutrensis*, mosquitofish *Gambusia affinis*, black bullhead *Ameiurus melas*, channel catfish *Ictalurus punctatus*, flathead catfish *Pylodictis olivaris*, bullfrog tadpoles *Rana catesbeiana*, and crayfish *Orconectes virilis* were introduced into two experimental outdoor ponds located at the Rocky Mountain Research Station in flagstaff, AZ. Each pond was treated with ammonium hydroxide (29%) at 0.5 ml of ammonia per gallon of water. Water quality was monitored for 35 days to determine how fast the natural bacteria in the environment converted the ammonia to non-toxic nitrate. After 35-days all water in both ponds were drained and no fish, crayfish or tadpoles were found to have survived the treatment, but red ear slider turtles *Trachemys scripta* and hatchling mud turtles *kinosternon baurii* remained alive and appeared unaffected

Spatial variation in the aquatic macroinvertebrate community of Aravaipa Creek, Arizona.

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Oral Presentation

Our study, conducted in fall 2011, examined the drift macroinvertebrate communities of Aravaipa Creek, AZ. We sampled above versus below the canyon to compare headwater and downstream assemblages and included two sample collection durations (15 minutes and 1 hour). Our results found striking differences in (1) the drift assemblage versus benthic invertebrates, (2) the upper canyon versus lower canyon assemblages, (3) the assemblages collected at different sampling intervals and (4) the drift assemblages in comparison to previous studies by Minckley et al. from over 30 years ago. Compared to benthos, drift communities were lacking in visual invertebrate predators such as Hemiptera, Odonata and Coleoptera. Lower canyon samples were found to have a greater abundance and diversity of invertebrates than upper canyon samples. One hour sampling intervals versus 15 minute intervals also had greater abundance and diversity of taxa. Stoneflies (Plecoptera) were missing from our drift samples compared to the previous study.

The Central Arizona Chapter of the Society for Conservation Biology

WOLKIS, DUSTIN, Arizona State University

Oral Presentation

The Central Arizona Chapter is the longest running local chapter in the Society for Conservation Biology. Based out of Arizona State University (ASU), the Central Arizona Chapter of the Society for Conservation Biology (CACSCB) is a student run organization dedicated to advancing the science of conserving biological diversity by connecting members of the community with conservation organizations, field work experience opportunities, and environmental experts. CACSCB has been extensively involved with the McDowell-Sonoran Conservancy, one of the largest urban nature preserves in America, by assisting in their plant and mammal inventories. Other involvement includes working with the Arizona Game and Fish Department (AZGFD) to survey the impact of land use change on antelope jackrabbit (*Lepus alleni*) populations in two Southern Arizona locations. Additionally, our meetings provide opportunities for members of the community to interact with specialists in the field. CACSCB recognizes the need for young scientists interested in conservation to gain field experience that the academic institution may not be able to provide. Overall, this student run organization helps its members develop a critical eye for conservation issues and their impacts on the environment, society, and politics.

Stream temperature and discharge within currently occupied Rio Grande cutthroat trout streams: identifying streams at risk from climate change

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Poster

Climate change is expected to have negative impacts on native western salmonids. For Rio Grande cutthroat trout, a recent addition to the ESA's candidate species list, the fragmented and

isolated distribution of remaining populations imposes significant risks to its future persistence as temperatures increase and precipitation patterns change. To increase the knowledge of thermal and hydrological regimes within currently occupied Rio Grande cutthroat trout habitat, year round stream temperature, air temperature, and hydrological (summer baseflow) monitoring was initiated in May 2010 at over 70 sites located within Rio Grande cutthroat trout populations. As of October 2011, stream temperature monitoring has yielded over 30,000 days of stream temperature readings, concomitant air temperature readings, and over 140 stream discharge measurements. Stream temperatures within much of the subspecies currently occupied habitat were below stressful thermal limits for cutthroat trout. Temperatures in 2011, however, were significantly warmer than those in 2010. Summer baseflow fluctuated between the two years but the majority (72% of 54 sites in 2010 and 74% of 90 sites in 2011) of sampled streams had discharge levels less than 1.0 cfs. Altered temperature and precipitation patterns will likely compress populations from both upstream and downstream directions as most Rio Grande cutthroat trout are found near the upper limit of occupiable habitat. Data from this study (through 2013) will be used to quantify risks and predict habitat changes for Rio Grande cutthroat trout populations throughout their range.