Proceedings of the Colorado-Wyoming Chapter of the American Fisheries Society

2013 Annual Meeting

February 25-27, 2013
Fort Collins, Colorado

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General Information

Registration

Registration will be open: Monday 5 pm – 7 pm, Tuesday 7 am – 5 pm, and Wednesday 7 am – 5 pm.

Presentation Download & Audio- Visual Preview

Presentations will be downloaded in the Fort Collins Room during the following times: Monday 5 pm – 7 pm, Tuesday 7 am – 5:30 pm, and Wednesday 7 am-2 pm. All presentations must be downloaded by 7:30 am the morning of the scheduled presentation. Please be considerate to the audio-visual volunteers and avoid last minute submissions.

Poster Session

Contributed posters will be displayed in Centennial Foyer throughout the meeting. Posters will be assembled Monday between 6pm and 8pm and dismantled following the banquet.

Continuing Education Workshop –

Title: "Instream Flow Principles and Water Law Concepts for Fishery Managers"

Date/ Location: February 25th, 10am – 5pm at the Fort Collins Marriott in Salon D

Instructors: Ken Kehmeier, Senior Aquatic Biologist, Colorado Parks and Wildlife, and Tom Annear, Water Management Supervisor Wyoming Game and Fish Department.

Guest speakers:

- Tim Monahan and Beth VanVurst, Office of the Colorado Attorney General. Tim and Beth will speak on the history of water law pertaining to fishery managers.
- Jay Skinner, Leader of the Colorado Parks and Wildlife Water Unit. Jay will speak on the methodologies of instream flow in Colorado.
- Linda Bassi, Colorado Water Conservation Water Board, Instream Flow Program. Linda will present an overview of the Colorado Instream Flow Program and its successes and failures.

Lunches will NOT be provided. Lunch break will be from 12-1 pm and a beverage/snack break approximately at 2:30pm. If you have any questions or need any clarifications contact Bobby Compton (970-217-8340) or Jesse Lepak (607-351-8310).

Auction and Raffle Display

Make sure to check out the great auction and raffle items on display in Salon F-H. Raffle tickets will be on sale throughout the meeting.

Business Luncheon

Business meeting luncheon will be held in Salon D from 11:30 – 1:00 pm on Wednesday. All Chapter members are encouraged to attend. Lunch is only available for those that pre-registered for this meeting.

Socials

Welcome Social

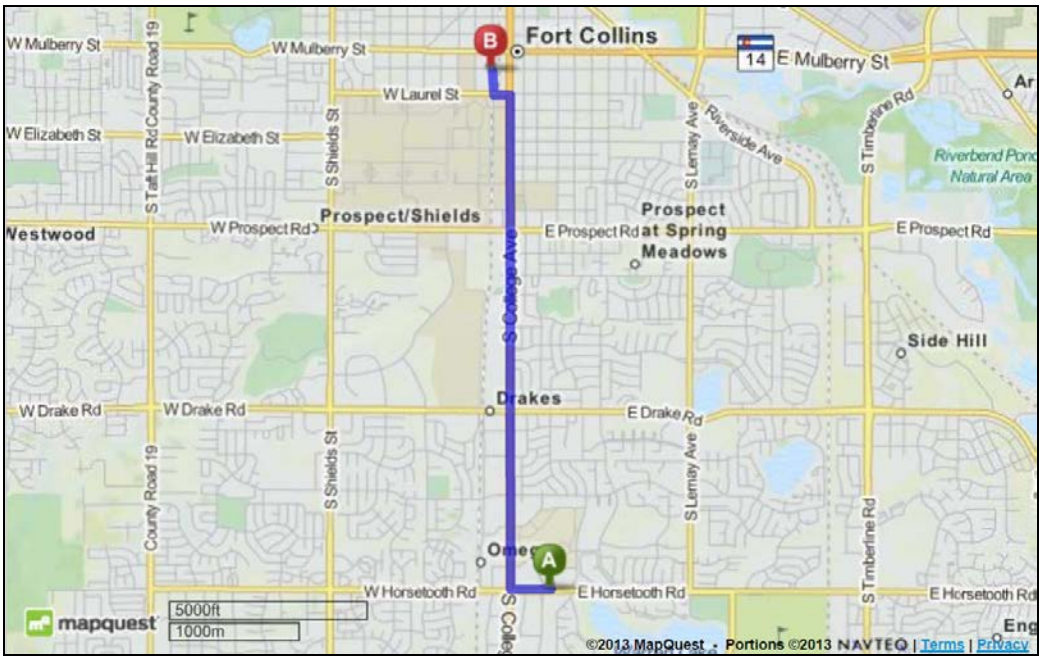
A Welcome Social will be held Monday evening from 6 pm – 10 pm in Salon D. Free beer and fajita bar will be provided. Cash bar is also available.

Student-Hosted Social

The student chapters will host a social on Tuesday evening from 6 pm - 10 pm at Avogadro's Number Restaurant (605 South Mason Street, Fort Collins, CO 80524). Everyone is welcome to attend this social. Shuttles will be provided for transportation to and from The Marriott.

Directions from the Marriott to Avogadro's Number Restaurant (3.2 miles):

From the Marriott Parking lot, take Horsetooth west to S College Avenue/US 287 N. Turn left onto W Laurel Street. Take first right onto S. Mason Street. Avogadro's Number Restaurant is on the left.



Banquet Social

The Banquet Social on Wednesday will be held from 6:00 pm – 10:00 pm. Free beer and a cash bar will be available. Everyone is invited to the social, auction, and raffle. A banquet ticket is required for the banquet buffet. Dinner will be served at 6:30 pm.

Monday, February 25th

10:00 AM-5:00 PM	Continuing education workshop (see page 4 for details)
5:00-7:00 PM	Registration and Presentation Download/Practice
6:00-10:00 PM	Welcome Social (see page 5 for details)
6:00-8:00 PM	Poster/Raffle Setup

Tuesday, February 26th

7:00 AM-5:00 PM	Registration
7:00 AM -5:30 PM	Presentation Download/ Audio Visual Preview
8:10-8:20 AM	Opening Remarks and Presidential Message by Ryan Fitzpatrick

Session 1: Trout Tales

Moderator: Jason Burckhardt, Wyoming Game and Fish Department

8:20-8:40 AM	**Jesse Lepak** (professional) "Tiger muskellunge predation on stocked sport fish intended for recreational fisheries"
8:40-9:00 AM	**Eric Fetherman** (professional) "Survival and Movement Rates of Brown Trout and Reintroduced, Whirling Disease Resistant Rainbow Trout in the Cache la Poudre River"
9:00-9:20 AM	**Clark Johnson** (student) "Quantifying Piscivory in Buffalo Bill Reservoir: Are the Wild *Oncorhynchus* Fisheries Sustainable?"
9:20-9:40 AM	**Jordan Anderson** (professional) "Temperature preferences and thermal tolerances of three stocks of Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*)"
9:40-10:00 AM	**Christopher Craft** (student) "Growth of rainbow trout fed diets with alternative protein sources"
10:00-10:20 AM	**Break**

Session 2: Three Species

Moderator: Jenn Logan, Colorado Parks and Wildlife

10:20-10:40 AM	**Erin Sobel** (professional) "Wyoming's Fish Passage Program on the Move"
10:40-11:00 AM	**Zack Underwood** (student)" If you've swum one sucker, have you swum them all? Comparative swimming performance of Rocky Mountain suckers"
11:00-11:20 AM	**Eric Gardunio** (student) "A flume-based approach to defining the anaerobic swimming capabilities of burbot and white suckers for barrier design"
11:20-11:40 AM	**Liz Mandeville** (student) "Genomic analysis of sucker hybridization"
11:40-12:00 AM	**Greg Fraser** (student) "Distribution and status of flannelmouth and bluehead suckers and roundtail chub in the White River drainage, Colorado"
12:00-1:30 AM	Lunch on your own

Session 3: Fish and Habitat Management

Moderator: Dan Kowalski, Colorado Parks and Wildlife

1:30-1:50pm	**Eriek Hansen** (professional) "Disturbed: a story about fish habitat patches in the Laramie River, Wyoming"
1:50-2:10 PM	**Matt Kondratieff** (professional) "Whitewater Parks and Their Influence on Fish Habitat Quality"
2:10-2:30 PM	**Devin Olsen** (student) "The Arctic char *Salvelinus alpinus* of Dillon Reservoir, Colorado: an evaluation of their present status and future management possibilities"
2:30-2:50 PM	**Paul Gerrity** (professional) "Status of the Wind River drainage, Wyoming sauger population"
2:50-3:10 PM	Break – Centennial Foyer

Session 4: Sharing Our Experiences - Stream Mitigation Banking

Moderator: David Bidelspach, Stantec Consulting Ltd

3:10-3:30 PM	**Greg Jennings** (professional) "Introduction to Mitigation Banking and Functional Assessment in CO/WY and other Regions"
3:30-3:50 PM	**Darrell Westmoreland** (professional) "A Stream Restoration Contractors Prospective on Fisheries Improvements and Mitigation Banking"
3:50-4:10 PM	**George Kelley** (professional) "The Future Concerns and Opportunities for Privatized Mitigation in Colorado and Wyoming as Funding to Improve Fisheries"

4:10-4:30 PM	**Dave Bidelspach** (professional) "Design Optimization to Improve functional Uplift and Return for Mitigation"
4:30-4:50 PM	**Sue Nall** (professional) "Regulations for Stream Mitigation Banking in CO/WY"
6:00-10:00 PM	**Student Social** – Avogadro's Number (see page 5)

Wednesday, February 27th

7:00 -5:00 PM	Registration
7:00-2:00 PM	Presentation Download/ Audio Visual Preview

Session 5: Minnow Mania

Moderator: Dr. Kevin Bestgen, Colorado State University

8:00-8:20 AM	**Ryan Fitzpatrick** (professional) "Preliminary results of a flathead chub (*Platygobio gracilis*) movement study in the Arkansas River basin, Colorado"
8:20-8:40 AM	**Ashley Ficke** (student) "A two-tiered approach towards establishing fish passage guidelines for plains and transition zone streams"
8:40-9:00 AM	**Daniel Gipson-Reinemer** (student) "Predicting climate-induced range shifts in river fishes"
9:00-9:20 AM	**Matt Haworth** (student) "Reproduction and recruitment dynamics of flathead chub *Platygobio gracilis* relative to flow regimes in Fountain Creek, Colorado"
9:20-9:40 AM	**Lindsy Ciepiela** (professional) "Western mosquito fish (*Gambusia affinis*) alters temperature selection of northern redbelly dace (*Phoxinus eos*) under laboratory conditions"
9:40-10:00 AM	**Break**

Session 6: Prairie Fish Squeezers

Moderator: Lindsy Ciepiela, Colorado Parks and Wildlife

10:10-10:30 AM	**Gordon Edwards** (professional) "Native fish conservation in Wyoming's eastern prairie streams - where do we go from here?"
10:30-10:50 AM	**Steve Gale** (professional) "Orangethroat Darter in Lodgepole Creek - Methodology Matters"

10:50-11:10 AM	**Ann Widmer** (professional) "Paired gear comparisons to evaluate effectiveness for monitoring Rio Grande silvery minnow in the main channel of the Middle Rio Grande, New Mexico"
11:10-11:30 AM	**Laura Burckhardt** (professional) "Sampling gear comparison in floodplain habitats in the Middle Rio Grande, New Mexico"
11:30-1:00 PM	**Chapter Business Lunch** in Salon D

Session 7: Stream Community Assessments

Moderator: Christopher Carroll, U.S. Forest Service

1:00-1:20 PM	**Adam Schwindt** (student) "Estrogen exposure disrupts population dynamics over three generations in the fathead minnow (*Pimephales promelas*)"
1:20-1:40 PM	**Jeff Wesner** (profession) "Trophic position of common freshwater fishes declines in the absence of a threatened species, northern leatherside chub (*Lepidomeda copei*)"
1:40-2:00 PM	**Kristen Pearson** (student) "Techniques for Evaluating the Detection Efficiency of a Large Scale PIT Tag Antenna Array"
2:00-2:20 PM	**Tom Fresques** (professional) "Colorado Pikeminnow Use of Two Small Tributary Streams in Southwest, Colorado"
2:20-2:40 PM	**Kevin Thompson** (professional) "Estimating boreal toad occurrence via stream sampling"
2:40-3:00 PM	**Break**

Session 8: Sharing Our Experiences - Stream Habitat Restoration

Moderator: Matt Kondratieff, Colorado Parks and Wildlife

3:00-3:20 PM	**Chuck Troendle** (professional) "The Impact of Beetle Kill on Streamflow Dynamics"
3:20-3:40 PM	**Branden Rosgen** (professional) "A Watershed-Based, Post-Fire Restoration Project: The Trail Creek Watershed, Colorado"
3:40-4:00 PM	**Dave Rosgen** (professional) "The Design and Construction of a Wild Trout Fishery as part of an Ecological Restoration Project in Idaho"
4:00-4:20 PM	**Eric Richer** (professional) "The effects of river regulation on fish habitat"
4:20-4:40 PM	**James Vincent and David Bidelspach** (professional) "Restoration Lessons Learns in CO/WY from Fish Hugger and a River Nerd"
4:40-5:00 PM	**Discussion**
6:00-10:00	**Banquet Social in Salon C & D**

Carlin Girard (student). "The Wyoming Range Fish Project: the impacts of energy development on native fish"

Darrell Snyder (professional). "Illustrations of Larval and Juvenile Development of the Mountain Whitefish"

Darrell Snyder (professional). "Illustrations of Larval and Juvenile Development of the Plains Topminnow"

Michael Bower (professional). "Willow architectures suggest heavy browsing pressure on a portion of the Bighorn National Forest"

Tiger muskellunge predation on stocked sport fish intended for recreational fisheries

Jesse M. Lepak (Presenter), Colorado Parks and Wildlife, jesse.lepak@state.co.us

C. Nathan Cathcart, Kansas State University

William L. Stacy, Illinois Natural History Survey, University of Illinois

Fish are stocked widely to enhance recreational fisheries, but often perform poorly relative to wild fish, and end up as forage for predators. Stable isotope and gut content analyses were used to evaluate tiger muskellunge [northern pike, *Esox lucius L.*, x muskellunge, *E. masquinongy* (Mitchell)] predation on stocked salmonids, *Oncorhynchus spp* relative to naturally reproducing white suckers, *Catostomus commersonii* (Lacepède), in five Colorado (USA) reservoirs. Results (using a Bayesian framework; MixSIR) indicated that tiger muskellunge consumed primarily stocked salmonids (53–84% by mass), which was supported by gut content analyses. Bioenergetic analyses indicated that from age-3 to age-14, tiger muskellunge representative of those in this study consumed approximately 367 stocked salmonids of a size vulnerable to angling. Managers may benefit from similar investigations in other regions considering multiple predators. Strategies are described to potentially increase survival of stocked fish in the presence of predators, and approaches to evaluate the effectiveness of these efforts.

Survival and movement rates of brown trout and reintroduced, whirling disease resistant rainbow trout in the Cache la Poudre River

Eric R. Fetherman (Presenter), Colorado Parks and Wildlife Eric.Fetherman@state.co.us

Dana L. Winkelman, U.S. Geological Survey, Colorado Cooperative Fish and Wildlife Research Unit

Kurt Davies, Colorado Parks and Wildlife, and

Brian W. Avila, U.S. Geological Survey, Colorado Cooperative Fish and Wildlife Research Unit

Brown trout removal was examined as a management option for increasing the survival and retention of whirling disease resistant rainbow trout strains introduced to the Cache la Poudre River, Colorado. Radio Frequency Identification (RFID) Passive Integrated Transponder (PIT) tag technology was used to track brown trout and two strains of rainbow trout (Hofer × Colorado River Rainbow [H×C] and Hofer × Harrison Lake Rainbow [H×H]) in a reach in which brown trout were removed (removal section; 0.6 mile) and in another in which they were not (control section; 0.8 mile). Brown trout removal occurred in August 2010. All brown trout removed were returned to the river fifteen miles downstream below The Narrows. The Narrows is a high gradient river reach and was thought to be a barrier to upstream movement. Brown trout upstream and downstream of the removal section were RFID PIT tagged during the removal operations. Brown trout upstream, downstream, and within the control section were also RFID PIT tagged. Following removal, two

thousand PIT tagged rainbow trout, one thousand each of the H×C and H×H strains, were stocked into both the removal and control sections. Paired RFID flat-bed loop antenna arrays were deployed at the upstream and downstream ends of both the removal and control sections (8 antennas) and were used to monitor movement of the PIT tagged fish. Antennas were paired to determine directionality of movement. Apparent survival (φ) and movement (ψ) probabilities were obtained using a multistate modeling approach in Program MARK. Results suggest that introduction of rainbow trout to sections where brown trout were not removed had a negative impact on the brown trout population. Although brown trout removal appears to have a positive effect immediately following introduction, there appears to be little benefit of removal on the long-term survival and retention of the introduced rainbow trout, primarily due to the movement and redistribution of fish over the winter.

Quantifying piscivory in Buffalo Bill Reservoir: Are the wild *Oncorhynchus* fisheries sustainable?

Clark Johnson (Presenter), Colorado State University, clarkfjohnson@gmail.com

Brett Johnson, Colorado State University

Jason Burckhardt and **Travis Neebling**, Wyoming Game and Fish Department

Buffalo Bill Reservoir in northwest Wyoming supports an entirely wild and self-sustaining trout fishery, with all stocking discontinued in 1995. The combination of a recent upsurge in lake trout (*Salvelinus namaycush*) abundance and an illicit introduction of walleye (*Sander vitreus*) have put Yellowstone cutthroat (*Oncorhynchus clarkii bouvieri*) and rainbow trout (*Oncorhynchus mykiss*) at risk of decline and possible extirpation. Previously, the Yellowstone cutthroat and rainbow trout were able to escape high predation rates due to lake trout seeking thermal refuge during warm summer months. Without thermal segregation from this new predator in the summer, it is feared that walleye will prey heavily on the *Oncorhynchus* species. Walleye have the potential to decimate populations of salmonids in western reservoirs. Field sampling for this investigation began in April 2012 to evaluate consumptive demand by lake trout and walleye, then determine possible management actions to permit a sustainable fishery for both Yellowstone cutthroat and rainbow trout. Using stable isotope and diet analyses coupled with age and growth data, we will generate bioenergetics models to determine the current state of the reservoir and recommend management actions that can be implemented by the Wyoming Game and Fish Department.

Temperature preferences and thermal tolerances of three stocks of Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*)

Jordan Anderson (Presenter), **Stephen Brinkman, and Kevin Rogers,** Colorado Parks and Wildlife, jrdn86@gmail.com

Temperature preferences, ultimate upper lethal temperatures and critical thermal maxima were measured for three stocks of young of the year Colorado River cutthroat trout representing an elevational gradient. Trapper Creek, Navajo River and Lake Nanita stocks are at 8,004, 9,064 and 10,784 ft above sea level, respectively. Available data suggest the different stocks were founded from a single stock about 80 years ago. The objective of the study was to determine whether

decades at different thermal regimes altered temperature preference and tolerance among the stocks. Selected temperatures decreased as the elevation of the stock increased. Average selected temperature was 15.6°C, 14.9°C and 13.9°C for Trapper Creek, Navajo River and Lake Nanita stocks, respectively. A similar trend was observed for the ultimate upper incipient lethal temperatures but not for critical thermal maxima. Ultimate upper incipient lethal temperatures after 7 days was 24.8°C, 23.9°C and 23.7°C for Trapper Creek, Navajo River and Lake Nanita stocks, respectively. Critical thermal maximum was 29.8°C, 29.1°C and 29.8°C for Trapper Creek, Navajo River and Lake Nanita stocks, respectively. The results suggest that cutthroat trout populations may be able to adapt to changing thermal regimes within the span of several decades.

Growth of rainbow trout fed diets with alternative protein sources

Christopher D. Craft (Presenter) and **Chrisopher Myrick,** Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Chris.Craft@colostate.edu

Worldwide aquaculture production continues to increase, yet rising feed costs, the biggest cost to the producer, may limit future growth potential. Fish meal is currently the preferred source of protein in many aquafeeds. However, the increasing price of fish meal has spurred the examination of other viable sources of protein. Using triplicate lots of 24 wk old rainbow trout (*Oncorhynchus mykiss*), we examined 10 experimental feeds, based upon 5 different mixtures of plant and animal-based protein ingredients. Each mixture was used to formulate a high-protein (45%) and a low-protein (40%) diet. Over a 12-week period, we examined the growth rates of the fish fed these diets to evaluate promising alternative protein sources. We observed high growth rates among fish fed all feeds, with the fish meal-based diets supporting two of the highest growth rates. Mean feed conversion ratios (FCR) of 0.96 and 0.93, and mean final wet weights of 424 and 440 g were observed for the high protein and low protein fish-based feeds, respectively. The fish consuming the plants-with-future-potential diet formulated to 40% protein had a mean final wet weight of 426 g, and those consuming the animal products diet had a mean final wet weight of 423 g. The worst performing diets included the novel plants diet (45% protein) and the plant products diet (45% protein) with mean final wet weights of 390 g and 382 g per fish, respectively. Mean feed conversion ratios ranged from 0.93 to 1.24 g of food consumed per g of biomass accumulated, and mean specific growth rates ranged from 1.73 to 1.91 % body weight per day. Among all growth metrics there was considerable statistical overlap among treatments, suggesting that these alternative protein sources perform favorably when compared to fish meal-based diets.

Wyoming's fish passage program on the move

Erin Sobel (Presenter), Wyoming Game and Fish Department, erin.sobel@wyo.gov

Wyoming waters provide ample fish habitat and great fishing, but Wyoming's waters are highly sought after for other uses too, for instance, cropland irrigation. There are thousands of irrigation headgates registered within the state of Wyoming, many of which restrict upstream movement, entrain thousands of fish into irrigation canals, or both. Habitat connectivity is crucial for fish movement and is often inhibited by diversion dams. One part of Wyoming's fish passage program involves gathering evaluation data concerning irrigation headgates and diversion dams affecting upstream passage. Collecting this data will help with the prioritization of future fish passage

improvement projects. This presentation will provide an overview of the Wyoming Game and Fish Department's Fish Passage Program, with emphasis on the inventory process from the office to the field and back, and examples of completed and future fish passage projects.

If you've swum one sucker, have you swum them all? Comparative swimming performance of Rocky Mountain suckers

Zachary Underwood (Presenter), Wyoming Cooperative Fish & Wildlife Research Unit, zunderwo@uwyo.edu

Dr. Christopher Myrick, Department of Fish, Wildlife, and Conservation Biology, Colorado State University

Robert Compton, Wyoming Game and Fish Department

The Rocky Mountain region harbors several native Catostomids, including several endemics. Several of these native suckers, including the bluehead (*Catostomus discobolus*; BHS), flannelmouth (*C. latipinnis*: FMS), and mountain suckers (*C. platyrhynchus*; MTS), have experienced significant population declines and are the subjects of focused conservation efforts. Limited habitat connectivity is a major impediment to the persistence of these species, but there is a paucity of information on the swimming ability of these species relative to fish passage designs. Because collecting sufficient numbers of these species for swimming studies may often be infeasible or ecologically detrimental, we compared the swimming performance of BHS, FMS, MTS, and longnose suckers (*C. catostomus*; LNS) to that of the more common white sucker (*C. commersonii*; WHS) to determine whether available white sucker swimming data could be used when designing fish passage structures for the other species we evaluated. We conducted both critical swimming velocity (Ucrit) and constant acceleration trials (CAT), and found significant differences in the Ucrit of several of the species, across a range of fish lengths. Bluehead sucker had the highest Ucrit (3.3 BL/s), followed by FMS (2.8 BL/s), LNS (2.6 BL/s), MTS (2.4 BL/s) and WHS (1.9 BL/s). Based on the least square means for Ucrit in BL/s, only BHS and LNS were significantly better swimmers than the other three species. During the CAT trials, we noted distinct behavioral differences in the ways that the different species responded to high current velocities. We concluded that white suckers are not an ideal experimental surrogate for other Rocky Mountain suckers because of their poorer swimming performance and different swimming behavior.

A laboratory study of the jumping capabilities of burbot and white suckers to define design criteria for vertical drop barriers

Eric Gardunio (Presenter) and **Chris Myrick**, Dept. Fish, Wildlife and Conservation Biology, Colorado State University, eigardun@gmail.com

This study focused on defining the limits of the anaerobic endurance of burbot (*Lota lota*) and white suckers (*Catostomus commersonii*) using constant acceleration and fixed velocity swimming tests conducted in large swimming flumes. Constant acceleration trials were used to define the velocity at gait transition (V-gt), or the point that fish switched to unsteady anaerobic swimming. Fixed velocity trials were then conducted at velocities greater than the V-gt to generate unbiased time-to-failure data. Linear regression models will be presented for both data sets that will define

both gait transition and endurance as a function of fish length, and trial velocity, while accounting for covariates. These data will be used to specify minimum velocity barrier lengths to prevent passage of a burbot or white sucker of a given size at a given velocity. A discussion of how to implement a velocity-component into a vertical drop barrier as well as an example of how to maintain necessary velocities across temporally variant flow conditions will also be presented.

Genomic analysis of sucker hybridization

Liz Mandeville (Presenter), **Tom Parchman, David McDonald,** and **Alex Buerkle,** University of Wyoming, emandevi@uwyo.edu.

Non-native white suckers are known to hybridize with native flannelmouth and bluehead suckers throughout the Upper Colorado River basin. We used genomic approaches to understand how genetic outcomes of hybridization vary by river drainage and hybridizing species pair. We generated DNA sequence data for 1400 individual suckers from Wyoming, Colorado, and Utah, and identified 2,787 variable nucleotides. We used these data to gain a fine-scale understanding of genetic variation within and among species, and to compare hybridization among drainages. We found that outcomes of hybridization vary substantially, both by river drainage and by hybridizing species pair. Our data suggest that hybrids range from F1 hybrids to extremely backcrossed individuals (which are likely indistinguishable morphologically from parental species). Additionally, direction of backcrossing and extent of introgression appear to vary by river drainage. For all drainages, extensive introgression is more common in flannelmouth x white sucker crosses than in bluehead x white sucker crosses. These results can improve sucker management by enabling biologists to integrate knowledge of the local genetic context for hybridization with the range of sucker phenotypes observed in the field.

Distribution and status of flannelmouth and bluehead suckers and roundtail chub in the White River drainage, CO.

Greg Fraser (Presenter), **Dr. Kevin Bestgen**, and **Dana Winkelman**, Colorado State University, fraserg@lamar.colostate.edu

Flannelmouth sucker *Catostomus latipinnis*, bluehead sucker *Catostomus discobolus* and roundtail chub *Gila robusta* (the three species) are native, big-river fishes in warmwater streams of the Colorado River Basin. Historic range of each species has declined over 50% in the last one hundred years due to introduction of non-native piscivores, mainstem impoundments that block migration routes, and alter habitat including stream flow and water temperature patterns, and hybridization of native catostomids with introduced white sucker. My research focuses on the distribution, movement, and timing of reproduction of the three species relative to streamflow and water temperature patterns. My study area is the upper White River, CO, from the Kenney Reservoir delta upstream to the confluence of the North Fork and South White River, including intervening tributaries. We are using remote RFID PIT tag antennas, larval sampling and thermal monitoring to evaluate the relationship between the life history traits and temperature. We are using tag-recapture information from adults and three remote RFID PIT tag antennas in tributaries to the White River to evaluate movement patterns and spawning site fidelity. Distribution of adults and larvae will provide data on the timing of reproduction and how it differs across the study site and among species. Thermographs placed throughout the basin will provide fine scale water temperature

data to correlate with spawning and movement patterns. My project will determine the status of the three species in the Upper White River, enhance our understanding of the role that temperature and flow play in the life history of these species, make predictions about the influence of climate change on distribution, movement and spawning and provide data to inform better decisions about the conservation of these taxa.

Disturbed: a story about fish habitat patches in the Laramie River, Wyoming

Eriek S. Hansen (Presenter) and **Frank Rahel**, University of Wyoming, ehansen8@uwyo.edu.

The intensity of floods caused by spring snowmelt can be highly variable among years in western rivers. To understand the effects of this annual disturbance on fish habitat we monitored three habitat patch types (aquatic macrophytes, wood, and pools) over 11 years in the Laramie River. During low flow conditions, we mapped the river channel and habitat patches using a GPS unit with sub-meter accuracy. Over this time period maximum discharge during spring runoff ranged from 2-64 m^3/s. Habitat patches measured during low flow conditions were highly variable, ranging from 397-2181 m^2 for macrophytes, 176-734 m^2 for wood, and 155-1177 m^2 for pools. The number and area of macrophyte patches were negatively correlated with maximum discharge, flood duration, and center mass timing of flow during the previous spring runoff. Conversely, the number and area of wood and pool patches were positively correlated with maximum discharge, flood duration, and center mass timing of flow. We created a locational probability map that related patch persistence across years to spring runoff conditions. The temporal dynamics of habitat patches influenced brown trout (*Salmo trutta*) populations with a positive correlation between fish abundance and the number and area of wood patches. Climate change is expected to alter hydrologic regimes by causing spring runoff to occur earlier with lower flood magnitudes and shorter flood durations. Understanding how disturbance structures fish habitat patches will help us model how habitats and fish assemblages may change with new hydrologic regimes.

Whitewater Parks and Their Influence on Fish Habitat Quality

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Brian Fox, Colorado State University

Dr. Kristoph Kinzli, Florida Gulf Coast University

Whitewater Parks (WWPs) have become a popular recreational amenity in the United States with Colorado being the epicenter for WWP design and development. WWPs consist of one or more instream structures that have the primary purpose of creating a hydraulic wave for recreational activities such as kayaking and tubing. The hydraulic wave is created by the constriction of flow into a steep chute resulting in a significant hydraulic jump as it flows into a large downstream pool. Little information exists describing how fish habitat is influenced by the presence of WWPs. Recent fish population sampling from pools located within WWP, habitat-enhanced, and natural stream reaches have indicated lower fish biomass and densities for deeper, larger-volume WWP pools than for shallower, smaller-volume habitat-enhanced and natural pools. This result was unexpected because several publications have documented a strong positive correlation between fish biomass/densities and maximum pool depth in streams. Possible explanations for why fish biomass and densities might be lower in WWP pools than expected include one or more of the

following: 1) WWP structures disrupt upstream fish passage thereby preventing re-colonization of pools from downstream, 2) WWP pool characteristics cause fish to avoid them, 3) WWPs negatively alter upstream riffle habitat for stream aquatic insects thereby reducing upstream food supplies, 4) recreational boater and tuber presence in the WWP reach cause fish to leave and 5) fish living in WWP pools are more vulnerable to overharvest from anglers than fish living in habitat-enhanced or natural pools. Fish passage, boater-presence and angler harvest issues will be addressed in separate studies. Pool hydraulic characteristics were assessed from within WWP, habitat-enhanced and natural reaches by collecting velocity profile measurements using an ADCP (Acoustic Doppler Current Profiler). Velocity profile measurements taken from habitat-enhanced and natural pools were stable in space and time while WWP pools were highly dynamic (unstable). A topographic survey of riffle characteristics revealed that riffle habitat within the WWP reach was almost completely eliminated, resulting in declining fish biomass and densities from WWP pools in the downstream direction, while habitat-enhanced and natural pools did not show a similar trend.

The Arctic char *Salvelinus alpinus* of Dillon Reservoir, Colorado: an evaluation of their present status and future management possibilities

Devin Olsen (Presenter) and **Brett Johnson**, Colorado State University, devin.olsen@colostate.edu

Douglas B. Silver, Red Kite Management

Throughout the West fisheries managers are challenged by trying to provide attractive and valuable fisheries in montane water bodies which are often oligotrophic and limited in fish production capacity. As a strategy to improve desirability, some waters are managed as boutique fisheries where unique species are introduced which are capable of attracting anglers from a wide radius who desire the opportunity to catch a novel species. Dillon Reservoir, in Summit County Colorado provides an example of a fishery with potential as a destination for Arctic char (*Salvelinus alpinus*). Due to high elevation, cladoceran suppression by *Mysis* shrimp (*Mysis diluviana*), nutrient abatement in the watershed, and high densities of competing white suckers (*Catostomus commersoni*), Dillon Reservoir's introduced salmonids grow slowly. Arctic char have recently been reintroduced to provide an opportunity to catch a species which is unavailable in the contiguous United States outside of Maine. We are currently studying this population of Arctic char with the objectives of 1) describing the current status of the Arctic char fishery and their role in the food web of Dillon Reservoir and 2) providing management scenarios aimed at maximizing Dillon Reservoir's potential as an Arctic char destination. We collected Arctic char in 2012 with a mix of gill netting targeted by hydroacoustic sampling and angling. Using diet data and stable isotope modeling analysis, the char's diet has consisted mainly of *Mysis* shrimp, *Pisidiidae* fingernail clams, and kokanee eggs. Analysis of otolith strontium isotope signatures combined with aging has also revealed natural reproduction in the population. Future work will employ population and bioenergetics modeling to provide stocking and harvest scenarios designed to maximize the Arctic char fishery at Dillon Reservoir.

Status of the Wind River drainage, Wyoming sauger population

Paul Gerrity (Presenter), Wyoming Game and Fish Department, paul.gerrity@wyo.gov

The Wind River drainage in Wyoming currently supports one of the most unique sauger populations throughout the range of the species. Saugers within the Wind River drainage occupy the highest known elevation, and are the slowest-growing and longest lived of any other population. Electrofishing population estimates conducted in 2009 and 2010 showed a 73% decline in sauger numbers since 2002. The decline was caused by a recent lack of recruitment, as 27% of the captured saugers were age-10 or older and juveniles were rarely observed. The cause of the decline in recruitment over the past decade is currently unknown because attempts to correlate environmental variables to catch curve residuals were unsuccessful. In an attempt to increase recruitment, the Shoshone and Arapaho tribes, U.S. Fish and Wildlife Service, and Wyoming Game and Fish Department began a supplemental stocking program in 2012. Additionally, studies are currently underway to learn more about the ecology of juvenile saugers and the environmental factors that influence sauger year class strength in the Wind River drainage.

Introduction to mitigation banking and ffunctional assessment in CO/WY and other regions

Greg Jennings (Presenter), Stantec Consulting Ltd., jenningsenv@gmail.com

Stream restoration as a form of mitigation for impact to streams and rivers has been accepted by various districts of the United States Army Corp of Engineers. Dr. Greg Jennings is a recognized national expert in river restoration and stream mitigation. He has assisted in creation of multiple mitigation banks and in-lieu fee programs in various states. The concept of mitigation requires the impacts to be less than or equal to the benefits of the mitigation proposed. In this talk Dr. Jennings will introduce the concept of mitigation banking and functional assessment for stream mitigation projects. Dr Jennings will propose a framework for mitigation that could be adopted in Colorado and Wyoming and serve as a future funding source for fisheries projects in the region.

A stream restoration contractors prospective on fisheries improvements and mitigation banking

Darrell Westmoreland, (Presenter), North State Environmental, darrell@nsenv.com

The implementation of mitigation for stream impacts has been slow in being accepted in the region and we need good examples of successful stream mitigation projects to farther develop this market. Mr. Westmoreland is the founder of North State Environmental the largest specialty stream restoration contractor in the nation with a small office located in Livermore, CO. Mr. Westmoreland will discuss lessons learned related to the construction of stream restoration for the purpose of mitigation and how he has actively added fish habitat to mitigation projects in a cost effective manner. Mr. Westmoreland will also discuss construction errors that resulted in loss of mitigation potential and habitat for stream restoration projects in various states.

The future concerns and opportunities for privatized mitigation in Colorado and Wyoming as funding to improve fisheries

George W. Kelly, (Presenter), Environmental Banc & Exchange, george@ebxusa.com

While stream restoration as a form of mitigation for impact to streams and rivers has been accepted by various districts of the United States Army Corp of Engineers, the implementation of mitigation for stream impacts has been slow in being accepted in the region. Much of this apprehension has been related to the lack of successful mitigation banks that have been done in the Colorado and Wyoming regions in the past. Privatized mitigation bankers have successfully implemented and monitored stream and river restoration projects for the purpose of mitigation in various states. Mr. Kelley is the director and founder of Environmental Banc and Exchange one of the largest environmental mitigation banks in the nation. Mr. Kelley will share his experiences with working with numerous agencies, landowners, municipalities, investors and private and public credit buyers in the implementation of stream mitigation projects. He will introduce the concept of a mitigation banking instrument and discuss his lessons learned about stream mitigation in emerging markets such as Colorado and Wyoming. Mr. Kelley will propose ideas for privatized mitigation that could be adopted in Colorado and Wyoming and serve as a future funding source for fisheries projects in the region.

Design Optimization to Improve functional Uplift and Return for Mitigation

David Bidelspach, (Presenter), Stantec Consulting Ltd., david.bidelspach@stantec.com

Optimization of grading is the process of using computer aided design software and building a continuous three-dimensional design surface. Over the past ten years, engineers at North Carolina State University and Stantec Consulting Ltd. have developed freeware that creates logical stream break-lines and works with most computer aided design software. The use of break-lines is the basis for being able to build a continuous three-dimensional stream channel surface. Over the past 10 years of doing three-dimensional design on over 100 stream restoration projects, the engineers construction cost estimates have been reduced by an average of greater than 20-25% of the construction budget. Optimization increases efficiencies during construction and doesn't have to be limited to only grading quantities as the optimized variable. There are four major reasons for optimizing stream design. The first reason is that a three dimensional design will not limit hydraulic modeling. Second, all channel design methodology, including natural channel design, rely on an iterative approach for optimization that is simplified by creating and modifying a three-dimensional surface. The third advantage of a three-dimensional stream design is simplification of construction preparation and site stakeout. Finally, an advantage of a three-dimensional stream design is that it allows the design surface to be loaded into global position system guided construction equipment, effectively increasing production rates while reducing construction costs. Finally, a couple examples of optimized stream restoration projects and techniques for stabilization will be discussed and highlighted. There will be a discussion of new innovations that have increased efficiencies over the past 10 years and a list of future innovations further increase efficiencies.

Regulations for Stream Mitigation Banking in CO/WY

Susan Bachini Nall (Presenter), Colorado West Regulatory Branch U.S. Army Corps of Engineers, susan.nall@usace.army.mil

USACOE will discuss changes in the 404 permitting process in Colorado. This discussion will also discuss how stream mitigation banking and mitigation banking instruments are received and perceived by the different USACOE districts within Colorado.

Preliminary results of a flathead chub (*Platygobio gracilis*) movement study in the Arkansas River basin, Colorado

Ryan Fitzpatrick (Presenter), Colorado Parks and Wildlife and Larval Fish Laboratory, ryan.fitzpatrick@state.co.us

Dr. Kevin Bestgen, Larval Fish Laboratory, Colorado State University

Understanding the spatial requirements for stream fish to complete their life cycle is critical to effective conservation efforts. Relatively little is known about the movements of plains fishes, even though multiple species in this guild are listed as threatened or endangered by the State of Colorado. We present preliminary results of an ongoing flathead chub movement study in a portion of the Arkansas River and adjoining tributary Fountain Creek, Colorado. A total of 13,648 12–mm half duplex PIT tags were implanted in flathead chub at six sites during 2011 and 2012. Tagged fish were detected throughout the study area in one of three ways. First, fish captured with electrofishing gear were scanned for presence of a PIT tag with a handheld wand. Tagged fish were also detected at each site using multiple passes with a 12-m or 2-m mobile PIT tag reading array. The long array could be floated through the main channel to detect fish in riffles and runs. The shorter array was used to detect fish along shoreline habitats, in large woody debris, and in pools. To date, 313 fish were detected using the handheld device and 1,679 fish have been detected using the mobile arrays. Fish movement based on tag recaptures was in both upstream and downstream directions from initial tagging sites. The maximum distances traveled were approximately 25-km upstream and 45-km downstream. We assessed PIT tag detection probabilities for both detection arrays by placing tags at various depths and allowing investigators who were blind to the locations of the tags to scan the test detection section of the stream. Analysis of these data is ongoing. A sentinel cage experiment was also conducted to examine survival and tag retention. After a 72 hr post-tagging interval, flathead chub tag retention and survival was 100%. Small PIT tags and mobile reading arrays appear to be a viable means to assess movement by plains fishes such as flathead chub. This study will ultimately provide guidance regarding the appropriate scale with which to conduct plains fish conservation efforts.

A two-tiered approach towards establishing fish passage guidelines for plains and transition zone streams

Ashley D. Ficke (Presenter) and **Christopher A. Myrick**, Department of Fish, Wildlife, and Conservation Biology, Colorado State University, ashleyduncanficke@gmail.com

Matthew C. Kondratieff, Aquatic Research Section, Colorado Parks and Wildlife

Although rock ramps have shown promise in passing small fishes, there is little standardization with respect to their design. We used a two-tiered approach to evaluate rock ramp performance in Colorado Front Range streams. First, we measured field performance of two morphologically distinct rock ramps (one slope ~5%, the other ~10%) in South Boulder Creek. Movement of brown

trout, rainbow trout, suckers, and longnose dace (n = 1153) across each structure was tracked with paired PIT tag antennae and compared to movement across a control reach. Of the tagged fish, 663 were subsequently detected at one or more of the antennae. More fish moved across the control site (n = 66) than across the low-slope (n = 31) or high-slope (n = 26) structures. Structural differences in the fishways appear to control rates and timing of upstream movement. The second tier of the approach used tests of a 33-ft long model fishway in the laboratory. Two substrate configurations were applied: closely-spaced cobbles, and widely-spaced cobbles. Hydraulic characteristics were measured for each configuration, and passage success of longnose dace, white sucker, and johnny darter were evaluated during 24-hour trials. Velocity and turbulence varied between the treatments and had variable effects on each species. Longnose sucker and longnose dace moved upstream in both configurations, but johnny darter only moved upstream in the closely-spaced configuration. Combined field and laboratory results like these can be used to provide information on how to standardize rock ramp designs to maximize upstream passage success.

Predicting climate-induced range shifts in river fishes

Daniel Gibson-Reinemer (Presenter) and **Frank Rahel**, Program in Ecology and Department of Zoology & Physiology, University of Wyoming, dibsonr@uwyo.edu

Ryan Fitzpatrick, Colorado Parks & Wildlife and Department of Fish, Wildlife, and Conservation Biology Colorado State University

Models of projected climate change suggest substantial warming is likely over the next decades, including the western United States. To keep pace with this warming, river fishes will need to shift their distribution upstream to remain within thermally suitable habitat. While many studies have documented climate-induced range shifts for a variety of taxa, none have documented range expansions in river fishes. A troubling explanation for this lack of range shifts may be that tracking suitable temperatures requires moving to unsuitable physical habitat in many rivers, especially along the transition zones of mountain ranges. Consequently, river fishes may be at greater risk from climate change than other taxa. We present preliminary results from a space-for-time substitution to examine how well river fishes may track climate change and to identify factors that may limit range expansions.

Reproduction and recruitment dynamics of flathead chub *Platygobio gracilis* relative to flow regimes in Fountain Creek, Colorado

Matt Haworth (Presenter) and **Dr. Kevin Bestgen**, Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Matt.Haworth@colostate.edu.

Flathead chub *Platygobio gracilis* are a North American cyprinid with a historic distribution spanning the Great Plains region from the Northwest Territories of Canada south to the Gulf of Mexico. A common species throughout much of this range, populations have declined regionally and in the United States are now considered abundant only in a portion of its historic distribution in the Dakotas, Nebraska, Montana, Wyoming, and Colorado. Once common in cool and warm water streams of the Arkansas River basin, Colorado, populations have declined and flathead chub is presently listed as a Species of Special Concern by the Colorado Division of Parks and Wildlife. A stronghold for the species exists in Fountain Creek, a Front Range tributary to the Arkansas River that is

scheduled to be a major delivery conduit in a municipal water project (Southern Delivery System [SDS]) to supply the City of Colorado Springs. To better understand the ecology of the species and potential effects of the SDS, we are investigating the reproduction and recruitment dynamics of flathead chub in Fountain Creek.

Throughout late spring and summer 2012 daily drift net and live egg samples were collected to document the duration and peak of spawning activity for flathead chub. Like many plains stream fishes, flathead chubs have an extended reproductive season, which began in May and ended in August, which is presumably an adaptation to the fluctuating and unpredictable plains stream environment, and ensures that reproduction efforts are not negated by a single catastrophic event. During late summer and early autumn, age-0 flathead chub were collected bi-weekly to identify recruitment patterns by back calculating hatch dates using daily growth increments in otoliths. Understanding how flow regimes influence reproduction and recruitment will contribute to the understanding of flathead chub ecology, provide insight into how flow manipulation may affect fishes in Fountain Creek, and inform recommendations for their conservation.

Western mosquito fish (*Gambusia affinis*) alters temperature selection of northern redbelly dace (*Phoxinus eos*) under laboratory conditions

Lindsy Ciepiela (Presenter), **Steve Brinkman, Ryan Fitzpatrick,** and **Harry Crockett** Colorado Parks and Wildlife, lrciepie@gmail.com.

Distribution of northern redbelly dace in Colorado has declined as a result of habitat degradation and changes in water quality. Remaining populations may be further threatened by the expansion of western mosquitofish; a non-native species which has been associated with declines and extirpations of native cyprinid populations throughout its introduced range. Tests were conducted to measure how presence of western mosquitofish affects the preferred temperature of northern redbelly dace. An annular temperature preference chamber was used to measure thermal preference of a northern redbelly dace singly, and in the presence of either western mosquitofish or other northern redbelly dace. When a single northern redbelly dace was exposed to a thermal gradient of 19.0-30.0°C it deviated, on average, 1.5°C (S.E. 0.8°C) from its preferred temperature compared to an average deviation of 3.3°C (S.E. 1.0 °C) in the presence of three western mosquitofish and an average deviation of 2.4 °C (S.E. 0.5°C) in the presence of three northern redbelly dace. Furthermore, a single northern redbelly dace spent 46% of observations within 1°C of its mean preferred temperature compared to 31% of observations within 1°C in the presence of other northern redbelly dace and only 19% of observations within 1°C in the presence of western mosquitofish. Northern redbelly dace strayed from their initial preferred temperature as they chased and pursued mosquitofish, a behavior not observed with other northern redbelly dace. The results of this study suggest that nonnative western mosquito fish may negatively impact native northern redbelly dace by displacing them from their preferred thermal regime.

Native fish conservation in Wyoming's eastern prairie streams – where do we go from here?

Gordon P. Edwards Jr. (Presenter), Wyoming Game and Fish Department, gordon.edwards@wyo.gov.

During 2008-2009, fish and habitat surveys were conducted in eastern Wyoming to refine understandings of Wyoming's most diverse native fish communities and their habitats, in order to promote their conservation. Sites were chosen on streams that were previously highlighted for high conservation value or to fill data gaps. Standardized and repeatable methods to quantify riparian and aquatic habitat conditions and sample fish were adapted from the Environmental Monitoring and Assessment Program. Ninety-eight surveys were completed in the Little Powder, Little Missouri, Belle Fourche, and Cheyenne rivers of northeast Wyoming, where six Species of Greatest Conservation Need (SGCN) were observed. In southeast Wyoming, 12 SGCN were observed during 69 surveys in the Niobrara River, Lower Laramie River, Horse Creek, and Lodgepole Creek drainages. Associations between habitat variables or other fish community characteristics and species presence/absence were identified. For example, in southeast Wyoming, brassy minnow, bigmouth shiner, and plains topminnow were most likely to be present at sites where non-native piscivores were absent. Plains topminnow was also observed most frequently when substrate was small and overhanging cover was uncommon. Differences in species-habitat associations surely exist among regions. Results helped produce outreach materials, provide management insights, facilitate monitoring, and enlighten future actions to conserve Wyoming's native fishes. Research and discussions continue in an effort to create a useful framework for prioritizing native fish conservation needs to aid in allocating resources wisely and ensure a bright future for Wyoming's native prairie fishes.

Orangethroat Darter in Lodgepole Creek - Methodology Matters

Steve Gale (Presenter), Wyoming Game & Fish Department, Steve.Gale@wyo.gov

According to the 2010 Wyoming Game & Fish Department's State Wildlife Action Plan (SWAP) the Native Species Status of orangethroat darter is considered unknown. The SWAP currently states the species is so rare that distribution has not been well defined. In addition, the SWAP recommends routine monitoring should be initiated in the Lodgepole Creek drainage to determine status of the orangethroat darter population. Surveys conducted in 2011 and 2012 were to address the SWAP as well as verify results from Lodgeopole Creek surveys conducted in 2009 where only one orangethroat darter was collected. Many assertions about the status of orangethroat darter in Lodgepole Creek were made in the SWAP based on data collected in 2009. Conclusions drawn from the 2009 surveys were that there had been a drastic decline in orangethroat darter numbers from 1993 to 2009 due to scarcity of preferred habitat (i.e., gravel substrate) in Lodgepole Creek. Site selection and sampling methodology played a role in the 2009 survey data collected. Data collected in 2011 and 2012 refute statements about orangethroat darter in the SWAP and refined our understanding of the abundance and distribution of orangethroat darter in Lodgepole Creek. Methodology matters when evaluating the status of important native non-game fish species, as illustrated by data collected in 2011 and 2012 confirming that orangethroat darter are actually thriving in approximately nine miles of Lodgepole Creek, where preferred habitat is still available.

Paired gear comparisons to evaluate effectiveness for monitoring Rio Grande silvery minnow in the main channel of the Middle Rio Grande, New Mexico

Ann M. Widmer (Presenter), **Eric J. Gonzales**, and **Laura Leslie Burckhardt**. SWCA Environmental Consultants, awidmer@swca.com

We used paired gear comparisons to validate four sampling gears (beach seine, backpack electrofisher, mini fyke nets, and bag seines) that may be used characterize the Middle Rio Grande fish community and monitor the endangered Rio Grande silvery minnow (*Hybognathus amarus*; silvery minnow). Data collected were used to characterize the proportion of the fish community and the silvery minnow population that may be missed or underrepresented by one gear type but collected by a second gear type. Sampling occurred in five 1-km stretches of the main channel during pre-runoff and fall base flow periods in the years 2010-2012. Indices compared among gear types were species detection across sites, average species richness, species composition of the catch, average catch per sample, silvery minnow catch-per-unit effort (CPE), and silvery minnow size distribution. The effectiveness of the backpack electrofisher and the beach seine was similar for detecting species and estimating species richness, and both generally captured more species per sample than the bag seines or fyke nets. The species composition (%) of samples varied among gear types and sampling occasions. Silvery minnow comprised a higher percentage of the catch for backpack electrofisher, fyke nets, and bag seine, than beach seines. However, beach seines collected a larger number of fish overall (mostly red shiner [*Cyprinella lutrensis*]), ultimately yielding an average silvery minnow CPE that was similar to (although not correlated with) CPE using a backpack electrofisher. No differences in the silvery minnow size distribution were detected among gear types.

Monitoring silvery minnow relative abundance in the main channel is currently conducted by the Collaborative Program using beach seines. The species richness and silvery minnow catch per unit effort data collected by beach seine and backpack electrofisher in the main channel were comparable, so it is not recommended that sampling with a backpack electrofisher be used to supplement the existing beach seine sampling. Fyke nets are not effective for monitoring silvery minnow abundance in the main channel and are only recommended for use when larger numbers of silvery minnow need to be collected to characterize population length structure, health indices, and other measures of individual fish. The study was funded by Middle Rio Grande Endangered Species Collaborative Program.

Fish community sampling gear comparison in floodplain habitats in the Middle Rio Grande, New Mexico

Laura Leslie Burckhardt (Presenter), **Ann M. Widmer**, and **Eric J. Gonzales**. SWCA Environmental Consultants, lleslie@swca.com

We conducted a study to (1) monitor abundance and characterize length structure of the Rio Grande silvery minnow (*Hybognathus amarus*; silvery minnow) on floodplains and side channel habitats in the Middle Rio Grande, New Mexico and (2) identify, evaluate, and validate sampling gear types that may be used to monitor the Middle Rio Grande fish community. Primary study objectives include using a paired gear approach to assess the relative efficiency of commonly used gear types in floodplain habitats for 1) monitoring the Middle Rio Grande fish community, 2) determining the silvery minnow population length structure, and 3) monitoring the relative abundance of silvery minnow. The study was conducted during different seasons (i.e., before spring runoff, during spring runoff, and during fall baseflow) in 2010, 2011, and 2012 to compare backpack electrofishing, beach seine, fyke net, and bag seine catches under different environmental conditions.

Results collected during the study indicate that in floodplain and side channel habitats the relative efficiency of gear types for sampling the Middle Rio Grande fish community and the silvery minnow varies among gear types depending on the parameter measured (e.g., species richness, detection, relative abundance, silvery minnow size), and time of year.

Sampling on the floodplain is not currently recommended for monitoring trends in silvery minnow abundance because the proportion of the population that uses floodplain habitats is not known and the availability of floodplain habitats varies among years. Thus, it may be more desirable to catch as many silvery minnow as possible (e.g., to characterize population age structure) than to produce the lowest coefficient of variation among samples. Fyke nets and the backpack electrofishing unit were most cost effective at collecting silvery minnow from these off-channel habitats. Used together (i.e., data pooled for collections by both gears at a site) these gears would produce a less biased estimate of the population length structure than either used alone.

Estrogen exposure disrupts population dynamics over three generations in the fathead minnow (*Pimephales promelas*)

Adam R. Schwindt (Presenter) and **Dana Winkelman,** Colorado State University, Department of Fish, Wildlife, and Conservation Biology ar.schwindt@gmail.com

Increased demands on freshwater ecosystems throughout the arid western USA are coincident with an increasing human population. For example, in northeastern Colorado flow in the South Platte River is up to 90% wastewater effluent most of the year. The effluent contains a complex mixture of chemicals that can disrupt hormone systems in fishes. One component of the effluent, 17a-ethinylestradiol (EE2) the synthetic estrogen in birth control, is known to disrupt fish reproduction. While the effects of EE2 on individuals are well known, the consequences for populations are just now being assessed. For these studies we evaluated the effects of EE2 exposure on fathead minnow (*Pimephales promelas*) populations over the course of three generations.

We constructed 28, 1100L aquatic mesocosms to house the fish populations at the CSU Foothills Fisheries Laboratory. In the F0 generation, each mesocosm received five male and five female fish exposed to nominal EE2 concentrations ranging from 0, 5, 10, and 20ng/L for 102 days (n=7). Survivorship and the numbers of eggs, embryos and offspring were collected. Following the mesocosm study the F1 fish were divided into two groups. One group continued to receive the concentration of EE2 in the mesocosm and in the other the exposure was stopped. F1 reproductive output was assessed after 203 days and survival was estimated in the F2 fish.

The effects of EE2 exposure differ depending on the life stage and exposure history. In the F0 generation EE2 reduced adult male survival but had little effect on reproduction. In the F1 generation, fish allowed to recover from EE2 exposure displayed reduced reproductive capacity. In F1 fish subjected to lifetime exposure no successful reproduction was evident. More striking were the effects on the F2 generation. Survival of the F2 fish whose parents were exposed early in life was significantly less than the F2 fish whose parents were exposed only as adults. The effects of EE2 on the F2 generation resulted from exposure through the parental germ line. EE2 exposure may cause population failure by several mechanisms and even though fish may no longer be directly exposed to EE2, effects are still evident.

Trophic position of common freshwater fishes declines in the absence of a threatened species, northern leatherside chub (*Lepidomeda copei*)

Jeff Wesner (Presenter), Colorado State University and US Geological Survey, FORT Science Centerjeffwesner@gmail.com

Mark Belk, Brigham Young University, Department of Biology

The structural properties of food webs have been a fundamental feature of basic ecological research for decades, yet their use in conservation ecology is rare. We used stable isotopes (baseline-corrected δ15N) to examine variation in trophic position and estimated food chain length of freshwater fishes across 14 sites in the Bear River drainage, WY, USA. This drainage is the focus of ongoing conservation of northern leatherside chub (*Lepidomeda copei*), a threatened fish, and we asked if either of these measures differed between sites with and without northern leatherside chub. Mean trophic position of individual fish species (one herbivore and four invertivores) varied between 0 to 3 trophic positions across sites, and declined at sites without northern leatherside chub (mean decline averaged across four species common to both leatherside and leatherside-free sites ± SE: -0.38 ± 0.12). This decline was strongest for a species that is ecologically similar to northern leatherside chub, redside shiner (*Richardsonius balteatus*: -0.63 ± 0.22). In contrast to patterns for individual species, there was no difference in food chain length between sites with and without northern leatherside chub. Importantly, habitat surveys from a previous study at 10 of these sites revealed no differences in habitat suitability for northern leatherside chub. Thus, our food web approach highlighted systematic differences among sites that were not apparent based on traditional species-habitat modeling. We outline possible mechanisms behind the shifts in trophic position, and argue that a food web perspective can complement traditional methods in conservation ecology and should be more widely incorporated into conservation efforts.

Techniques for Evaluating the Detection Efficiency of a Large Scale PIT Tag Antenna Array

Kristen Pearson (Presenter) and **Dana Winkelman**, USGS Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, kristen.pearson@colostate.edu

Evaluating the detection efficiency of remote PIT tag detection systems is essential to understanding the probability of detecting a marked individual. Accurately estimating detection probability is necessary to generate unbiased abundance and survival estimates which are of primary concern when monitoring fish and wildlife populations. In May of 2012, we assessed the detection efficiency of a multi-antenna array used to aid in long-term monitoring of the Little Colorado River aggregate population of the federally endangered humpback chub (*Gila cypha*). Overall detection efficiency, known as in situ efficiency, is the product of both path and antenna efficiencies. In situ efficiency was evaluated directly and indirectly using various techniques. Direct estimates were obtained through intensive hoop-net sampling efforts in which fish were captured, PIT tagged, released, and subsequently recaptured either upstream or downstream of the antenna array. Indirect estimates were determined by first evaluating the path covered by the antenna array and secondly by determining the probability of detecting the presence of a passing individual within the available detection path. In situ efficiencies for the antenna array were

estimated at 38% using the direct technique and 41% and 46%, respectively, using two indirect techniques. Because direct estimates better incorporate fish behavior, they are likely more representative of true detection probability. However, indirect estimates in our study were nearly equivalent, thus, providing potential surrogate techniques for evaluating the detection efficiency of this remote PIT tag detection system.

Colorado Pikeminnow Use of Two Small Tributary Streams in Southwest, Colorado

Tom Fresques (Presenter), USDOI, Bureau of Land Management, t1fresqu@blm.gov

Jim White, Colorado Parks & Wildlife

In Yellow Jacket Canyon, a small tributary stream located in the San Juan River basin, Montezuma County, Colorado, Bureau of Land Management biologists collected 11 sub-adult Colorado pikeminnow *Ptychocheilus lucius* from 2007-2010. Collection of these fish within this smaller tributary stream is significant given the distance of the sampling location to the mainstem San Juan River, sizes of Colorado pikeminnow collected, and documented association with mainstem river habitats. Upon discovery of use by these fish, Colorado Parks & Wildlife initiated additional sampling in Yellow Jacket Canyon and McElmo Creek which Yellow Jacket Canyon is tributary. In 2011, Colorado Parks & Wildlife placed two PIT tag array stations, one on Yellow Jacket Canyon, and one on McElmo Creek. We report here the use of these tributary streams by Colorado pikeminnow and suggest non-random use of these tributaries by this endangered species. These tributary streams may be of importance to recovery efforts for Colorado pikeminnow in the San Juan River basin.

Estimating boreal toad occurrence via stream sampling

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Paul Jones, Colorado Parks and Wildlife,

Larissa L. Bailey, Colorado State University, Department of Fish, Wildlife and Conservation Biology

Boreal toads within the southern Rocky Mountain have experienced dramatic declines in the past three decades: the species is currently petitioned for federal listing status, is 'endangered' in Colorado and New Mexico, and is a Native Species Status 1 in Wyoming. State and federal agencies in this region developed a Boreal Toad Conservation Plan in 2001, and one of the chief criteria used to assess the species status and evaluate future listing decisions, is the documentation of breeding populations in the mountainous regions within the toad's historic range. Addressing this criterion involves searching for breeding populations within large basins where the toad's status is unknown. We developed a study to: (1) determine if boreal toad occurrence along streams could be used to locate active breeding locations, (2) evaluate the efficiency of two detection methods, hoop nets and streamside visual searches, and (3) estimate how many surveys of a stream segment would be required to determine with reasonable confidence that the segment is unoccupied. We found that toads have a high probability of occupying stream segments that are adjacent to breeding locations ($\psi\hat{}$=0.95 (SE=0.07)) and occupancy declines quickly with distance from the breeding site, especially upstream (at 1.5km, $\psi\hat{}$ ≤0.05). Hoop nets were ineffective in our study, but enough toads were encountered using visual searches to obtain estimates of detection probabilities for this method.

Detection probabilities were negatively influenced by stream gradient and were substantially higher in drainages with larger known breeding populations (Large Population $\hat{p} \approx 0.75$, Small Population $\hat{p} \approx 0.15$). Using these estimated parameters, we determined the number of surveys needed to feel confident that the species is absent. Our results indicate that if boreal toads are encountered along a stream, it suggests there may be a breeding site within 1 km upstream or downstream of the detection location.

The Impact of Beetle Kill on Stream Flow Dynamics

C.A. Troendle (Presenter) and J.M. Nankervis, U.S. Forest Service, corvtroendle@msn.com

Numerous studies worldwide have documented that forest disturbance can have a significant impact on water yield from forest and wild lands. For the most part, the reported disturbance has been timber harvest but there are examples of documented response to other disturbances such as wind throw, fire, and insect mortality. In the Central Rocky Mountain Region, paired watershed experiments and plot studies have documented the effect of timber harvest on components of the water balance and water yield. This understanding provides a basis for comparison with existing anecdotal observations on the effects of fire and insect mortality. This presentation will review what we have learned about all forms of forest disturbance and subsequent changes in annual yield, peak flow rate, and flow duration. In addition, findings from our ongoing studies that document the significant impact of insect mortality on vegetation and on streamflow will also be presented. The catastrophic impact of insect related mortality on forest vegetation has been far more extensive than either past timber harvesting activities or our more recent experiences with fire, therefore the potential impact on water yield, channel morphology, and aquatic habitat may also be far more significant.

A Watershed-Based, Post-Fire Restoration Project: The Trail Creek Watershed, Colorado

Brandon Rosgen (Presenter) and **Dave Rosgen**, Wildland Hydrology, Brandon@wildlandhydrology.com

A master plan for restoration was developed for the Trail Creek Watershed to reduce the accelerated sediment yields following the Hayman Fire of 2002 on the South Platter River drainage. The design relies on the results of a watershed assessment following the *WARSSS* procedure that identified the processes that are disproportionately contributing sediment to the watershed and quantified the sediment loading by location and process. The watershed was delineated into 59 sub-watersheds that were prioritized by the processes contributing to the impaired river conditions, including loss of fish habitat. The results indicated that channel processes accounted for *≈84%* of the introduced sediment yield related to streambank erosion, which was accelerated by a dramatic increase in the frequency and magnitude of flooding due to the high burn intensity fire.

Knowing the peak flows will continue until the watershed is reforested, various restoration scenarios based on natural channel design principles were designed and implemented in 2011 and 2012. These scenarios reconnected incised streams to their floodplains; re-established stable stream types and riparian vegetation; closed and re-routed roads and trails; removed fish migration barriers; and improved fish habitat and diversity. Various instream structures were installed once the dimension, pattern and profile of the stable stream type was shaped. A variety of structures

were implemented, including Toe Wood, J–Hook Vanes, Cross Vanes, and Rock & Roll Log Structures. A relatively new approach converted headcut gullies in alluvial fans to braided stream types with sediment detention basins constructed to obtain the material to fill the gullies and raise the alluvial fan to re-establish the fan function. This approach prevented the excess sediment of the ephemeral tributary from entering Trail Creek and reduced the flood flow response by inducing infiltration on the fan surface and slowing water velocity from 6.0–7.0 ft/sec in the gullies to 0.5 ft/sec on the fan.

This work was designed and implemented primarily on the Pike and San Isabel National Forest. Funding was provided by Vail and Associates, National Forest Foundation and the Coalition for the Upper South Platte River (CUSP). A fisheries biologist with the Forest Service collected pre-project fish and macro-invertebrate data and post-project monitoring will continue.

The Design and Construction of a Wild Trout Fishery as part of an Ecological Restoration Project in Idaho

Dave Rosgen (Presenter) and **Brandon Rosgen**, Wildland Hydrology, Dave@wildlandhydrology.com

A large-scale restoration project was designed and implemented near Sun Valley, Idaho that incorporated multiple ecological objectives utilizing the Natural Channel Design approach. Ecological criteria were established based on a limiting factor analysis conducted by Ron Pierce (Montana Fisheries Biologist) for various organisms and their habitats, including large mammals, eagles, heron, waterfowl, songbirds and aquatic organisms. The watershed assessment also documented the major causes of river and riparian impairment. Land uses related to heavy long-term, season-long livestock grazing, poor irrigation practices, and direct channel impacts were responsible for the loss of physical and biological function.

The multiple objectives were to offset the limiting factors identified in the assessment phase; redirect land use practices to take care of the cause of impairment; reduce excess sediment from streambank erosion for both large and small streams; reduce water temperature; and convert the irrigation system from surfacing flooding to subterranean. Thirteen miles of stream channels were constructed on a previously abandoned surface to reconnect floodplains and to regain an instream flow regime with a new water management plan. Oxbow lakes, emergent wetlands and off-channel food plots were created, and the toe wood structure was implemented on newly constructed channels and for portions of the braided Big Wood River. A screened gravel substrate without fines from the excavation of the oxbows was placed on constructed glides for spawning material, and a separate mixture of cobble and gravel was placed in the created riffle, pool, and run bed features. Overall, a great diversity of habitats were created for mammals, birds, and aquatics, including adult, rearing, reproduction, food chains, and low flow, high flow and winter refugia. Invasive species were eliminated and native riparian vegetation was re-established on previously overgrazed lands.

Pre-calibration data was collected for fish biomass, macro-invertebrates, water flows and water temperature, ground water levels, riparian vegetation and habitat evaluation. Post-restoration monitoring is underway to replicate the pre-project condition, including active redd counts. Preliminary data shows a remarkable recruitment of rainbow and brown trout throughout the

project and active use of the constructed spawning redds, one week following their installation by fall spawners.

The effects of river regulation on fish habitat

Eric E. Richer (Presenter), Colorado Parks & Wildlife, eric.richer@state.co.us

Flow regulation is one of the most ubiquitous alterations imposed on rivers. Rivers are regulated by the construction and operation of dams, diversion of water from the channel, and addition of trans-basin water to the channel. River regulation affects the timing and magnitude of runoff, which can have adverse impacts on sediment continuity and habitat availability. The construction of dams can obstruct the flow of sediment to downstream reaches, impede fish passage, and affect water temperature. The effects of regulation will be compared for three Colorado rivers with varying degrees of alteration: the Cache la Poudre, Conejos, and Upper Colorado. These case studies will be used to evaluate the effects of altered hydrology and connectivity on fish habitat. Approaches for rehabilitating regulated rivers will be compared to highlight their advantages and limitations.

Restoration Lessons Learns in CO/WY from Fish Hugger and a River Nerd

James Vincent (Presenter) and **David Bidelspach** (Presenter), Stantec Consulting Ltd., James.Vincent@stantec.com

Natural Channel Design as a method for stream restoration is limited in many applications related to dynamic floodplain interactions and stream channels. Stable streams are defined to be in a state of dynamic equilibrium that in many cases can't be achieved due to limitations in project goals and objectives. Changes is the flow regime, sediment supply, slope and substrate can cause local channel instabilities that can lead to systematic reach wide instability and possible channel evolutions. Many stream restoration projects can be good examples and experimentations of the effect of changes in flow regimes that affect sedimentation and erosion rates. The changes in geomorphology have a significant impact on the biological components of stream systems and the fisheries. The major goal of stream restoration projects in North America are usually trying to create a stable restored channel that many times have unstable and conflicting boundary conditions. The use of reference reaches have been limited to idealized boundary conditions and in practice is not applicable to transition reaches, floodplain shear stress/scour and high bedload systems in the southeast. Other goals of stream restoration projects include limiting flood risk, increase public use, increase habitat, improved fisheries, property protection, mitigation and aesthetics. The dynamic equilibrium of a stable stream is not accepted in goals and objectives of many stream restoration projects. A process focused design for stream restoration will evaluate risk on multiple design flows that are at and above a bankfull stage. The low-flow channel dimensions are very important geomorphic features that can positively affect the stream temperature, drift, feeding lanes as well as channel stability. This presentation will discuss many lessons learned from evaluating the geomorphic potential and departure analysis of a disturbed river system and restored river systems that have failed. Finally a couple examples of stream restoration projects and techniques for stabilization will be discussed and highlighted, including a restoration project that was completed in 2010 that were designed for various salmonid species.

The Wyoming Range Fish Project: the impacts of energy development on native fish

Carlin Girard (Presenter) and **Annika Walters**, University of Wyoming Fisheries and Wildlife Cooperative Research Unit, cgirard1@uwyo.edu.

Native fish in the Upper Green River drainage in western Wyoming are a valued resource, and their populations are prioritized for conservation and improvement. As well, the region contains two of the nation's top-ten natural gas reserves (eia.gov 2009). The long history of oil and gas development along the Upper Green River has resulted in an ongoing struggle between development expansion and environmental conservation. Beginning in 2012, our research is evaluating the response of fish and aquatic habitat to the physical and chemical alterations associated with energy development.

Our study sites are located within the Labarge Oil and Gas Field in southwestern Wyoming. We are utilizing first and second order streams to compare fish distribution across a gradient from minimally to heavy impacted stream reaches. Specifically, we are evaluating the extent that hydrocarbon pollution, increased suspended sediment concentrations, and aquatic habitat alteration from surface disturbance and culverts has influenced three native fish species. Preliminary results show that energy development in Dry Piney Creek has contributed to local extirpations of Colorado River cutthroat trout, diminished sculpin populations, and possibly, population increases in mountain suckers. The goal of this research is to provide managers with focused information about species sensitivity to energy development impacts, and critical fish habitat prone to degradation.

Illustrations of Larval and Juvenile Development of the Mountain Whitefish.

Darrel E. Snyder (Presenter) and **C. Lynn Bjork**, Larval Fish Laboratory, Colorado State University darrel.snyder@colostate.edu.

The mountain whitefish *Prosopium williamsoni* (Salmonidae, subfamily Coregoninae) is native to much of western Canada and the United States, on both sides of the Continental Divide, from the Mackenzie River drainage in the Northwest Territory south to the Lahontan Basin in Nevada and the Upper Colorado River Basin in Colorado and Utah. In Colorado, it is native to the Yampa, White, and Green River drainages and has been introduced to upper reaches of the Colorado River and Cache la Poudre River drainages. In Wyoming, it is found in all basins west of the Powder River, North Platte River, and Great Divide basins. Reproductively, the mountain whitefish is a non-guarding, open-substrate lithophil, broadcasting its eggs over coarse gravel or cobble substrates. Demersal, non-adhesive, 3-4 mm eggs are spawned in fall, incubate at low temperatures for a few months in the substrate, and hatch in late winter or early spring.

Knowledge of the morphological ontogeny of a fish is often critical to species identification of collected early life stages and useful in understanding other aspects of its early life history–physiology, ecology, behavior, and environmental effects. The embryology of mountain whitefish has been moderately well described and illustrated, but prior to the report on which this

presentation is based, morphological development of mountain whitefish larvae and early juveniles had been barely described and was inadequately illustrated. Fortunately, identification of its larvae has not been a problem in Colorado and Wyoming, where it is currently the only representative of the whitefish subfamily, but that has not been the case in many other portions of its range. With this poster presentation, we document the early morphological development of mountain whitefish with several detailed, three-view illustrations from a recently hatched, 12.6 mm TL (total length) protolarva to a late, 43.5 mm TL young-of-the-year juvenile.

Illustrations of Larval and Juvenile Development of the Plains Topminnow.

Darrel E. Snyder (Presenter) and **C. Lynn Bjork**, Larval Fish Laboratory, Colorado State University darrel.snyder@colostate.edu.

The native range of the plains topminnow *Fundulus sciadicus (Fundulidae)* consists mostly of two disjunct regions in the Missouri River Basin–one confined to south-central Missouri and a much larger region covering much of Nebraska and extending into neighboring states including southeastern Wyoming (North Platte, South Platte, and Niobrara river drainages), and northeastern Colorado (South Platte River Drainage). Reproductively, the plains topminnow is a non-guarding, open-substrate phytophil, typically broadcasting its eggs over aquatic vegetation, including filamentous algae. Spawning occurs from mid-spring to mid-summer, at water temperatures of 18-25 °C. The eggs average 1.8 mm (range 1.6-2.2 mm) in diameter, have thin chorionic filaments for attachment to vegetation, and hatch in 8-14 days at 21-23 °C.

Knowledge of the morphological ontogeny of a fish is often critical to species identification of collected early life stages and useful in understanding other aspects of its early life history–physiology, ecology, behavior, and environmental effects. The embryonic development of the plains topminnow has been noted as similar to that described for the diamond killifish *Adinia xenica*, but prior to the report on which this presentation is based, and except for a few descriptive notes in the literature, the larvae and early juveniles had been neither described nor illustrated. With this poster presentation, we document morphological development of young plains topminnow with four detailed, three-view illustrations from a recently hatched, 6.2 mm TL (total length) flexion mesolarva to a recently transformed, fully scaled, 19.1 mm TL juvenile. The early larvae are distinguished from the northern plains killifish *F. kansae*, the only other fundulid found in Colorado and Wyoming, by much denser body pigmentation and essentially round rather than moderately oval eyes. Metalarvae and juveniles are distinguished from the northern plains killifish by a dorsal fin origin well behind (rather than over or before) the anal fin origin, fewer dorsal fin rays, and usually fewer anal fin rays; juvenile plains topminnow also have fewer scales and do not develop vertical stripes on the lateral body.

Willow architectures suggest heavy browsing pressure on a portion of the Bighorn National Forest

Michael R. Bower (Presenter), **Luke Decker**, and **Amy Nowakowski**, U.S. Forest Service, mbower@fs.fed.us

The shape or architecture of many shrubs respond to the level of ungulate herbivory. Keigley et al. (2002) developed methods to categorize such responses into four typical architecture types

corresponding to unique browsing histories. The four architectures include: 1) the 'uninterrupted' type indicative of light browsing, 2) the 'arrested' type indicative of heavy browsing, 3) the 'retrogressed' type indicative of a shift from light to heavy browsing, and 4) the 'released' type indicative of a shift from heavy to light browsing. We used these architecture types to characterize the degree of recent willow browsing pressure at 42 randomly located points within potential willow habitats for an approximately 60,000-ha area located on the southeast portion of the Bighorn National Forest. We characterized dominant architectures separately for four height classes (0–50 cm, 50–150 cm, 150–250 cm, and >250 cm) and for each willow species present. In general, we found evidence of heavy browsing pressure across our study area. We found no sites where a size class of any species was dominated by the 'uninterrupted' type. The dominant architecture type for both the 0–50 cm and 50–150 cm height classes was 'arrested' at 100% of the sites for all species, likely indicating widespread suppression of height growth in our study area. At some sites, taller height classes, including 'retrogressed' and 'released' types, were present, suggesting that browsing pressure must have been lower at some point in the past, allowing some plants to grow through the browse zone to attain a taller stature. The heavy browsing pressure indicated by our architecture-type classifications may indicate an ongoing willow recruitment limitation as shorter plants are not likely to gain height to replace taller plants as they die and reproduction of shorter plants may be curtailed by plant stress. Further research and monitoring is needed to identify the source and extent of heavy browsing and to better understand the complex interactions among factors influencing willow distribution on the Bighorn National Forest.