COLORADO/WYOMING CHAPTER

of the

AMERICAN FISHERIES SOCIETY

2016 Annual Meeting
and
50th Anniversary

Laramie, Wyoming
March 1-3, 2016

PROGRAM

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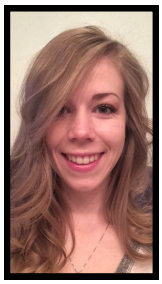

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Mandi Brandt

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Website
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Schedule at a Glance

Tuesday, March 1

Time	Event	Location
8:00 AM - 5:00 PM	Continuing Education - Communication in Science	Salon FG
9:00 AM - 12:00 PM	Continuing Education - Genomics and Ecology of Catostomid Hybrids	Salon C
12:00 PM - 1:00 PM	Lunch - on your own	
1:00 PM - 5:00 PM	Continuing Education - Morphological Characterics of Upper Colorado River Basin Catostomids and Their Hybrids	Salon C
5:00 PM - 7:00 PM	Registration	Lobby
6:00 PM - 10:00 PM	Welcome Social	UW Legacy Hall

Wednesday, March 2

7:00 AM - 5:00 PM	Registration	Lobby
7:00 AM - 5:00 PM	Presentation Download	Lobby - AV Table
8:10 AM - 8:20 AM	Opening remarks and presidential message by Bobby Compton	Salon DE
8:20 AM - 12:00 PM	Contributed Papers	Salon DE
12:00 PM - 1:30 PM	Lunch - on your own	
1:30 PM - 2:50 PM	Contributed Papers - Concurrent Sessions	Salon DE
2:50 PM - 4:30 PM	Poster Session	Lobby
5:00 PM - 6:30 PM	Student Mentoring Program and Job Fair	Laramie Train Depot
6:30 PM - 10:00 PM	Student Social	Laramie Train Depot

Thursday, March 3

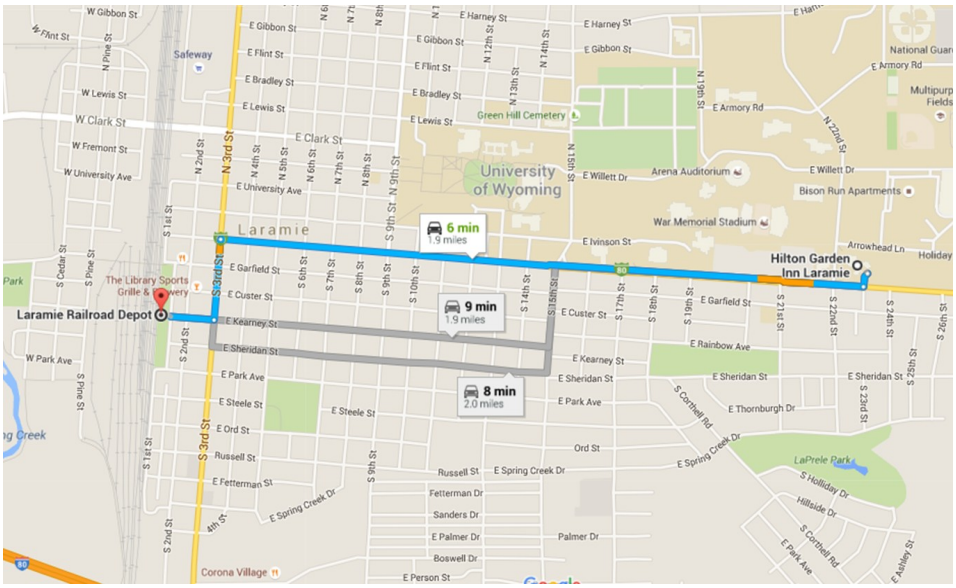
7:00 AM - 5:00 PM	Registration	Lobby
7:00 AM - 5:00 PM	Presentation Download	Lobby - AV Table
8:00 AM - 11:20 AM	Contributed Papers - Concurrent Sessions	Salon DE
11:30 AM - 1:00 PM	Business Meeting Luncheon	Salon ABC
1:00 PM - 3:00 PM	Contributed Papers	Salon DE
3:00 PM - 5:00 PM	50th Anniversary Symposium	Salon DE
6:00 PM - 10:00 PM	Banquet	Salon ABC

Socials

Welcome Social - Come kick off the annual meeting from 6PM - 10PM on Tuesday, March 1 at the UW Legacy Hall located in the Marian H. Rochelle Gateway Center (across S. 22nd Street from the Hilton Hotel). Free beer and a light meal will be provided.

Student Social - Hosted by the University of Wyoming Student Subunit

When: Wednesday, March 2
Location: Laramie Train Depot (see map below)
Transportation: Shuttle will run from the Hilton to the Train Depot and back from 4:30 PM to 10:00 PM
5:00 PM - 5:20 PM: Mentor-Mentee Presentation: program participants will talk about their experiences from the past year
5:20 PM - 6:30 PM: Mentoring Job Fair
6:30 PM - 10:00 PM: Pizza buffet and free beer



Banquet - The Banquet will be held on Thursday from 6:00 PM to 10:00 PM in Salon A-C. Free beer will be provided. Everyone is invited to the social, auction, and raffle. A banquet ticket is required for the dinner. Dinner will be served at 6:30 PM.

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

AGENDA

Wednesday, March 2

8:10 - 8:20 **Bobby Compton** Opening Remarks and Presidential Message

Session 1:Desert and Plains
Room: Salon DE
Moderator: Diana Miller, CO/WY AFS President 2011-2012

8:20 - 8:40 **Pamela Sponholtz (professional)** Improving Rio Grande Sucker and Rio Grande Chub habitat on Baca National Wildlife Refuge

8:40 - 9:00 **Paul Gerrity (professional)** Burbot life history strategies in the Torrey Creek drainage, Wyoming

9:00 - 9:20 **Anna Senecal (professional)** 100 years of small-scale, anthropogenic change contribute to assemblage shifts in a free-flowing river

9:20 - 9:40 **Kevin Thompson (professional)** Genetic contribution of native and introduced catostomids to larval drift in experimental and control streams of the Gunnison River Basin, Colorado

9:40 - 10:00 **Kurt Fausch (professional)** Groundwater depletion in the western Great Plains is projected to dry 250 km of stream fish habitat in the next 45 years

10:00 - 10:20 BREAK

Session 2: Native Invertebrate and Amphibian Management
Room: Salon DE
Moderator: Dan Brauch, CO/WY AFS President 2014-2015

10:20 - 10:40 **David Stewart (professional)** Are native fish management areas efficient conservation surrogates for amphibians, mussels, and reptiles?

10:40 - 11:00 **Philip Mathias (professional)** Update: Wyoming's native freshwater mussel surveys

11:00 - 11:20 **Michelle Larson (student)** Influence of specific electrical conductivity on native and invasive snail growth rate and mortality

11:20 - 11:40 **Boyd Wright (professional)** From tadpoles to egg masses: a boreal toad translocation success story

11:40 - 12:00 **Melanie Murphy (professional)** Applications of eDNA for biodiversity monitoring

12:00 - 1:30 LUNCH - on your own

	Session 3A: Fish Culture and Reservoir Management	***Session 3B: Innovations in Restoration and Management***
	Room: Salon D	***Room: Salon E***
	Moderator: Hilda Sexauer, CO/WY President 2005-2006	***Moderator: Matt Kondratieff, CO/WY President 2007-2008***
1:30 - 1:50	**Lars Alsager (professional)** Tiger musky rearing at Wyoming Game and Fish Department's Speas Fish Hatchery	**Michael Mazur (professional)** Motion sensing camera creel of Bull Lake
1:50 - 2:10	**Kerrie Berger (professional)** Increasing hatching space at a Wyoming fish rearing station: costs and implications	**Joe Parsons (professional)** Advances in drone technology for river restoration
2:10 - 2:30	**Matt Starr (professional)** Aquaculture technology: Tools used in the intensive partial reuse recirculating aquaculture system at the Wyoming Game and Fish Department's Dubois Fish Hatchery	**David Bidelspach (professional)** MCDA, risk and design optimization for river restoration and diversion projects
2:30 - 2:50	**Steve Gale (professional)** Grayrocks Reservoir - a management story with highs and lows	**Lusha Tronstad (professional)** Comparing quantitative methods of collecting invertebrates in prairie streams
2:50 - 3:10	BREAK	
3:10 - 4:30	Poster Session - Lobby	
5:00 - 6:30	Student Mentoring Program and Job Fair - Laramie Train Depot	
6:30 - 10:00	Student Social - Laramie Train Depot	

Thursday, March 3

	Session 4A: Habitat	***Session 4B: Native Species***
	Room: Salon D	***Room: Salon E***
	Moderator: Paula Guenther, CO/WY President 2000-2001	***Moderator: Anita Martinez, CO/WY President 2004-2005***
8:00 - 8:20	**Jim Wasseen (professional)** Wyoming Landscape Conservation Initiative: an approach to landscape scale conservation in Southwest Wyoming	**Darren Rhea (professional)** Seasonal movements among fragmented populations of Colorado River Cutthroat Trout in the Cottonwood Creek drainage
8:20 - 8:40	**Christina Barrineau (professional)** Reconnecting and restoring habitats in the Lower Encampment River	**Joe Skorupski (professional)** To stock or not to stock? A tale of Shovelnose Sturgeon reintroduction in the Bighorn and Nowood Rivers
8:40 - 9:00	**Betsy Morgan (professional)** An evaluation of obstacles and management practices for establishing vegetation along the Encampment River	**Christopher Kennedy (professional)** History of the fisheries of Rocky Mountain National Park
9:00 - 9:20	**Jeff Streeter (professional)** Removing fish barriers on the Upper Encampment River	**Jason Burckhardt (professional)** A multi-jurisdictional effort to remove nonnative trout and restore native Yellowstone Cutthroat Trout in the upper Soda Butte Creek Drainage, Montana and Wyoming
9:20 - 9:40	No presentation scheduled	**Kristin Broms (professional)** Spatial monitoring design for plains fishes in the South Platte River Basin
9:40 - 10:00	BREAK	

Session 5 - Student Research I
Room: Salon DE
Moderator: Ryan Fitzpatrick, CO/WY AFS President 2012-2013

10:00 - 10:20	**Brian Avila (student)** Evaluation of resistant Rainbow Trout fry stocking in Colorado
10:20 - 10:40	**Richard Walker (student)** Does oil and natural gas development and hydrology interact to affect fish populations?
10:40 - 11:00	**Bryan Maitland (student)** Culverts in forested watersheds: impacts and restoration methods for native freshwater fishes
11:00 - 11:20	**Jessica Dugan (student)** Species habitat associations and top predator trophic position at sites with natural and added habitats in the Laramie River, Wyoming
11:30 - 1:00	Business Meeting Luncheon - Salon ABC

Session 6: Student Research II
Room: Salon DE
Moderator: Dave Zafft, CO/WY AFS President 2003-2004

1:00 - 1:20 **Cheyenne Owens (student)** The influence of diet on the growth and behavior of Snake River Cutthroat Trout (Oncorhynchus clarkii behnkei)

1:20 - 1:40 **Tyler Swarr (student)** PIT tag retention, survival, and effects on swimming performance for a Great Plains Darter (Etheostoma cragini)

1:40 - 2:00 **Liz Mandeville (student)** Population genetic structure in native and introduced Catostomus species in the Upper Colorado River basin

2:00 - 2:20 **Caitlin Peterson (student)** Division of thermal communities in Wyoming streams into management clusters

2:20 - 2:40 **Jordan Anderson (student)** Evidence of endocrine disruption at several municipal wastewater treatment plants within the South Platte watershed, Colorado

50th Anniversary Symposium

Moderator: Bill Bradshaw

3:00 - 3:05 **Bill Bradshaw** Introduction of Symposium CO/WY AFS President 1996-1997

3:05 - 3:20 **Steve Facciani** 1st Decade CO/WY AFS President 1974-1975

3:20 - 3:35 **Bob Wiley** 2nd Decade CO/WY AFS President 1978-1979

3:35 - 3:50 **Wayne Hubert** 3rd Decade CO/WY AFS President 1988-1989

3:50 - 4:05 **Lori Martin** Women in AFS, CO/WY AFS President 2006-2007

4:05 - 4:20 **Patrick Martinez** 4th Decade CO/WY AFS President 1997-1998

4:20 - 4:35 **Ann Widmer** 5th Decade CO/WY AFS President 2010-2011

4:35 - 5:00 Questions/Answers

6:00 - 10:00 Banquet - Salon ABC

50th Anniversary •1966-2016
CO/WY Chapter
OF THE AMERICAN FISHERIES SOCIETY

50th Anniversary Symposium

The 50th Anniversary retrospective symposium will present the chapter's history as well as the challenges and changes within our chapter, fisheries management, and research over that time. It will examine the history and perspectives of women in AFS and the fisheries profession. Speakers will share their personal AFS experiences and highlights through the decades.

CO/WY AFS - The 1st Decade

Steve Facciani

Steve Facciani worked for the Wyoming Game and Fish Department as a Fisheries Biologist (1968-1976), Assistant Chief of Fisheries (1976-1989), Chief of Fisheries (1989-1996), and Deputy Director (1996-2001). He is retired and now lives in Saratoga (during the best part of the year) enjoying the fruits of the labor for all those years. Steve will talk about the state of the art in fisheries management (mainly in Wyoming) during the first decade of this organization, and what steps were taken to meet the challenges during that time. He also looks forward to a lively discussion on the evolution of fisheries management in both states.

CO/WY AFS - The 2nd Decade

Bob Wiley

The first seeds of Bob's fisheries career were distributed by George Allen in 1961 when he encouraged his fisheries students to become AFS members and to pay attention to the fisheries people they met. Summer of 1962 found him in Pinedale, WY as a summer fisheries biologist working on the Green River rotenone treatment just before the closure of Flaming Gorge Dam; that summer's experience launched a 41 year career in Wyoming fisheries management and was the guidebook to meeting many well-known fisheries scientists through those 41 years. Bob hopes to contribute interesting, useful, and perhaps even entertaining information based on 50 plus years of AFS experience and what he considers valuable and sometimes unique information from listening to 5 five mentors, people he considered special in his fisheries lifetime. His final thoughts—when attending an AFS Governing Board Meeting, offer your opinion on issues of interest; as a Chapter, Division, or Section president, never hesitate to contribute to discussions.

CO/WY AFS - The 3rd Decade

Wayne Hubert

Wayne Hubert worked as an aquatic biologist for the Tennessee Valley Authority (1972-1979) and as a research scientist for the Iowa Cooperative Fisheries Research Unit (1979-1982) and Wyoming Cooperative Fish and Wildlife Research Unit (1982-2010). He currently works part time as a consulting fisheries scientist. Wayne will discuss the differences in the Colorado-Wyoming Chapter of the American Fisheries Society between the early 1980s and now with a focus on advances in professionalism.

Women in AFS

Lori Martin

Lori Martin is the Grand Junction area Aquatic Biologist for Colorado Parks and Wildlife. She earned Bachelor and Master of Science degrees in Biology from the University of Colorado. Lori has served as President for both the Colorado-Wyoming Chapter of the American Fisheries Society, as well as the Western Division of the American Fisheries Society (AFS). In her presentation, she will glance back at the women pioneers that have shaped AFS and the CO/WY AFS Chapter. We will also visit the perspectives of women currently engaged in AFS, and glimpse into the future focusing on strategies to recruit and retain under-represented groups in our fisheries profession.

CO/WY AFS - The 4th Decade

Patrick Martinez

Patrick Martinez began his career with the Colorado Division of Wildlife as a Fishery Biologist in 1984 and he retired from that agency as an Aquatic Researcher in 2010. From there, he went on to work another three years for the U.S. Fish & Wildlife Service as the Nonnative Fish Coordinator for the Upper Colorado River Endangered Fish Recovery Program. Pat's presentation characterizes the CO/WY AFS Chapter's activities from 1997-2006 by reviewing the annual meeting locations, dates, themes, continuing education courses, and prominent EXCOM issues and achievements captured in the ANGLER newsletter. He wraps up his presentation by sharing his personal AFS highlights and perspectives during this decade.

CO/WY AFS - The 5th Decade

Ann Widmer

Ann Widmer is a fisheries biologist and quantitative ecologist with SWCA Environmental Consultants in Denver specializing in research and mitigation planning. She works throughout the western United States on issues affecting a number of species conservation interest, including fish, birds and bats. She is representing the last decade of the chapter's leadership. Her presentation will review the big tasks and questions this decade of chapter presidents has faced, emerging topics in research and management that have been shared at chapter meetings, and the benefits of chapter membership.

POSTERS

Dan Issak (professional) "A thermal map for western Wyoming rivers and streams"

Nick Salinas (professional) "Spawning movement of Bluehead Sucker *Catostomus discobolus* and Flannelmouth Sucker *C. latipinnis* in Roubideau Creek, Gunnison River Basin, CO"

Katie McBaine (student) "Trophic ecology of Burbot *Lota lota* and Iiplications for sampling"

Lindsy Ciepeila (student) "Estimating spatial heterogeneity and temporal stability of strontium isotope signatures for use in tracking fish movements"

Peter Starr (professional) "Raising Tiger Muskie *Esox masquinongy* x *Esox lucius* at the Wyoming Game and Fish Department's Speas Fish Hatchery"

Greg Anderson (professional) "Daniel Fish Hatchery, a historical perspective"

Darrel E. Snyder (professional) "Guide to cyprinid fish larvae and early juveniles of the Upper Colorado River Basin with computer-interactive key"

Gabriel Barrile (student) "Boreal toad habitat selection and survival in relation to grazing intensity and disease prevalence"

Kyle Christianson (student) "Using eDNA to detect *Mysis diluviana* in lentic systems"

Tyler Firkus (student) "Thermal regimes in the South Platte River and the influence on fish reproduction"

Brian Hickerson (student) "Locating potential reintroduction and refugia sites for Hornyhead Chub using GIS"

Alex LeCheminant (student) "Movement dynamics and survival of hatchery-reared Colorado River Cutthroat Trout post-stocking"

Andrew Annear (student) "Stable isotope quantification of resource use by crayfish in the Laramie River to inform lotic food web analyses"

Greg Lehr (professional) "Chemical treatment of fish eggs with the Masterflex L/S digital pump system and the fabrication of perforated PVC drip trays"

2016 CO/WY AFS
Contributed Paper Abstracts (in order of presentation)

Improving Rio Grande Sucker and Rio Grande Chub habitat on Baca National Wildlife Refuge

Pamela Sponholtz, U.S. Fish and Wildlife Service, Colorado Fish and Wildlife Conservation Office, 134 Union Blvd, Lakewood, CO 80033, 303-236-4216, pamela_sponholtz@fws.gov

Jason Kline, SWCA Environmental Consultants, 295 Interlocken Blvd, Suite 300, Broomfield, CO 80021, 520-269-9424, jkline@swca.com

Corinna Hanson, U.S. Fish and Wildlife Service, Baca National Wildlife Refuge, Baca National Wildlife Refuge, Crestone, CO 81131, 719-256-5527, corinna_hanson@fws.gov

Paul Jones, Colorado Parks and Wildlife, 300 W. New York Ave., Gunnison, CO 81230, 970-275-9617, paul.jones@co.state.us

Abstract: The U.S. Fish and Wildlife Service (USFWS) established the Baca National Wildlife Refuge (Baca) in the San Luis Valley in 2003. For 120 years the property was managed as a working cattle ranch which created over 340 irrigation diversion structures and subsequently eliminated much of the riparian vegetation. In 2006, Rio Grande sucker and Rio Grande chub were documented on the Baca, verifying only the second known native population in Colorado. In 2014, both species were petitioned for protection under the Endangered Species Act. The USFWS and Colorado Parks and Wildlife (CPW) are working together to secure and enhance these populations through habitat restoration and replacement of structures creating fish passage issues and entrainment into lateral canals. In 2015, SWCA Environmental mapped the fish habitat in the creeks and ditches, and identified structures creating fish passage issues. At the same time, USFWS developed population estimates for fish below several perched culverts and high population numbers suggested that habitats below these structures were important fish habitat. Funding was secured through the Fish Passage Program to replace structures that were preventing upstream movement and design includes protecting these downstream pool habitats. In 2016, two of the perched culverts will be replaced, and SWCA, USFWS, and CPW will conduct a PIT tag study using remote antennas to assess fish movement through existing and newly replaced structures.

Burbot life history strategies in the Torrey Creek drainage, Wyoming

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Jeff Glaid, Montana Cooperative Fishery Research Unit, Montana State University, Department of Ecology, 301 Lewis Hall, Bozeman, Montana 59717, jeffrey.glaid@msu.montana.edu

Christopher Guy, Montana Cooperative Fishery Research Unit, Montana State University, Department of Ecology, 301 Lewis Hall, Bozeman, Montana 59717, cguy@montana.edu

Abstract: Burbot (Lota lota) within the Wind River basin occupy the southwestern-most portion of the species' native range, and are a Species of Greatest Conservation Need in Wyoming. This project focused on Burbot ecology within the Torrey Creek drainage, which contains one of four Burbot stocks within the basin. A combination of monthly mark/recapture electrofishing estimates, monitoring of PIT-tagged fish, and age, growth, and age-at-reproductive maturity analyses were used to learn more about stock ecology. Abundance of Burbot > age-1 was 135 (95% confidence interval between 122 and 278 individuals; Huggins' closed population capture-recapture model) in Torrey Creek upstream from Trail Lake from June – October 2013. High numbers of age-0 Burbot were also captured in Torrey Creek upstream from Trail Lake during September and October 2013. Higher proportions of smaller and younger Burbot were captured in Torrey Creek than Trail Lake. The proportion of mature fish was similar between Torrey Creek and Trail Lake; however, mean length and age of mature female Burbot in Torrey Creek significantly differed from and were less than mature female Burbot in Trail Lake. Although statistical comparisons were not possible because of low sample sizes, similar trends were observed in mature male Burbot. PIT-tagged Burbot were most active from early-February through early-March 2014 (the presumed spawning period), and were relatively sedentary from September - November 2013 and April - October 2014. Some PIT-tagged Trail Lake Burbot (36%) moved into Torrey Creek and were observed in the same areas as PIT-tagged Torrey Creek Burbot during the spawning period, indicating interchange between lake- and stream-resident fish. Based on likely spawning movements of adult fish and high catch rates of age-0 Burbot, Torrey Creek upstream from Trail Lake is an important spawning and nursery area and should be a high priority conservation area for the Torrey Creek drainage Burbot stock.

100 years of small-scale, anthropogenic change contribute to assemblage shifts in a free-flowing river

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Wayne Hubert, U.S. Geological Survey Cooperative Fish and Wildlife Research Unit, University of Wyoming, 1000 E. University Avenue, University of Wyoming, Laramie, WY, 82071, WHubert@uwyo.edu

Abstract: Wyoming's Powder River is generally thought to be an example of a pristine, free-flowing river system. While the River hosts a largely native fish assemblage and remains unimpounded over its 1,146-km course to the Yellowstone River confluence, the hydrologic regime has been altered through diversion for agriculture and natural gas extraction. In most cases, assemblage shifts are thought of in terms of new species introductions or native species declines. Increasingly though, gross increases in native species, dubbed "native invaders" are being documented. The Powder River is one such example. Analysis of Powder River fish collection between the years of 1896 and 2008 indicate shifts in presence/absence and relative abundances of fish species, both native and introduced. Notable changes include increases in sand shiner Notropis stramineus and plains killifish Fundulus zebrinus, and decreases in sturgeon chub Macrhybopsis gelida. Differences in reproductive strategies may account for changes in assemblage structure with those species exhibiting adhesive ova generally increasing, and those with buoyant, drifting ova in decline. Similar assemblage shifts have been noted in other, more heavily-impacted, prairie river systems. Although the Powder River may be "the best of what remains," cumulative, landscape-level impacts may contribute to an environment that favors one reproductive strategy over another.

Genetic contribution of native and introduced catostomids to larval drift in experimental and control streams of the Gunnison River Basin, Colorado

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Michael R. Schwemm, Southwestern Aquatic Resources and Recovery Center

Thomas F. Turner, Biology and Museum of Southwestern Biology, University of New Mexico

Megan O. Osborne, Biology and Museum of Southwestern Biology, University of New Mexico

Evan W. Carson, Biology and Museum of Southwestern Biology, University of New Mexico

Abstract: Non-native suckers, especially White Sucker Catostomus commersonii, threaten the Colorado River Basin natives Bluehead Sucker C. discobolus and Flannelmouth Sucker C. latipinnis in part through hybridization. We conducted a baseline genetic assessment of catostomid larvae in two geographically proximate streams, Cottonwood and Potter creeks, one of which (Cottonwood) will be subject to exclusion of non-native suckers and their hybrids (via fish trap) during the spring spawn in 2016 and 2017. Diagnostic microsatellite markers were used to characterize interspecific hybridization among native and non-native catostomids in these two

streams in 2014 and 2015. Baseline admixture analyses revealed that the streams differed in species composition and levels of interspecific hybridization. Genetic characterization showed that the prospective treatment stream (Cottonwood) was composed primarily of non-native White Sucker, native Flannelmouth Sucker, and hybrids between these species. In contrast, larval drift in the proposed control stream contained primarily native Flannelmouth and Bluehead Suckers, with relatively few hybrids between these species. These results provide a baseline of the level of hybridization among species prior to non-native and hybrid exclusion from spawning, and additionally suggest that Cottonwood Creek will serve well as a treatment stream.

Groundwater depletion in the western Great Plains is projected to dry 250 km of stream fish habitat in the next 45 years

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Harry Crockett, Colorado Parks and Wildlife Department, 317 W. Prospect Street, Fort Collins, CO 80526, harry.crockett@state.co.us

Abstract: Across the western Great Plains of North America, groundwater pumping for irrigated agriculture has depleted regional aquifers that sustain surface flow for native fishes. This loss of surface flow and subsequent fragmentation of fish habitat has contributed to population declines for 70% of endemic fishes. We used a network of observation wells distributed across portions of Colorado, Kansas, and Nebraska to measure changes in depth to water table (DTWT) over the High Plains Aquifer during 1950-2010. Based on DTWT values, we estimated the spatial distribution of stream segments that maintained connectivity to the aquifer and therefore surface flow to support fishes. We then used the relationship between time and DTWT to project future losses in aquifer-connected stream segments. Model results indicate >500 km of stream habitat in the Republican River watershed disappeared during 1950-2010 as aquifer levels fell, and an additional 250 km will be lost by 2060 if withdrawal practices are not modified or reduced. Based on relating a multivariate analysis of fish assemblages to stream length, we predict continued change from relatively diverse fish communities to homogeneous ones consisting of only a few of the same species, especially in headwater basins such as those in Colorado.

Are native fish management areas effecient conservation surrogates for amphibians, mussels, and reptiles?

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Abstract: Development of native fish management areas is a proactive approach to conserving native fish. Yet the potential of fish to be used as surrogates of the distribution patterns of other aquatic groups has not been explored. In this study we examined the ability of native fish management areas to also serve as management areas for amphibians, mussels, and reptiles. Our approach was to determine how many species of the other aquatic groups would be protected using native fish management areas. The Zonation software was used to identify watersheds/ habitats that have high conservation value for fish, mussels, and amphibians and reptiles. We identified many high ranking watersheds for native fish that included a number of other aquatic species. However, agreement and similarity among watersheds identified as having the highest conservation potential was low among aquatic groups (mean = 25% congruence), largely because different landscape factors influenced the distribution of fish, amphibians, reptiles and mussels. Incorporating nonnative and human threat cost layers did not have a significant effect on watershed rankings. We find that the utility of native fish management areas as surrogates for regional biodiversity may be limited due to the low agreement among aquatic groups and watersheds that have high group-specific conservation value.

Update: Wyoming's Native Freshwater Mussel Surveys

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Abstract: Seven of North America's native freshwater mussel species can be found in Wyoming. Much knowledge has been gained about these seven species since 2011 through U.S. Fish and Wildlife Service (USWFWS) State Wildlife Grant (SWG) and Wyoming Governor's ESA funded native mussel surveys. Wyoming is a headwaters state that is divided into Atlantic and Pacific ocean drainages. Anodonta californiensis (California

Floater) and Margaritifera falcata (Western Pearlshell) can be found west of the continental divide, while the Anodontoides ferussacianus (Cylindrical Papershell), Lampsilis cardium (Plain Pocketbook), Lampsilis siliquoidea (Fatmucket), Lasmigona complanata (White Heelsplitter), and Pyganodon grandis (Giant Floater) are all found east of the continental divide. Survey techniques were developed in 2011 that used timed visual and tactile searches to look and feel for native mussels; stream channel parameters were also measured (i.e. width, depth, substrate). After five field seasons of statewide native mussel surveys, much work is still needed to determine each species' statewide distribution and to refine each species' Native Species Status (NSS) rank for future revisions of Wyoming's State Wildlife Action Plan (SWAP). Refined distributions and for all but L. cardium and P. grandis have been developed and several range expansions have been documented since the 2010 SWAP. Specific NSS ranks have been assigned and approved by the Wyoming Game and Fish Commission for every species except P. grandis, which will remain with an NSS unknown in Wyoming's 2017 SWAP revision.

Influence of specific electrical conductivity on native and invasive snail growth rate and mortality

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Abstract: The invasive New Zealand mudsnail (Potamopyrgus antipodarum) tolerates a wide range of abiotic environmental conditions including temperature and salinity, but little is known on the tolerance of low specific electrical conductivity (EC) on this invasive snail and coexisting native snails. I assessed the lower critical thresholds in EC for two native snails (Fossaria sp. and Pyrgulopsis idahoensis) and P. antipodarum by placing one of each snail species into a single experimental chamber (500 mL cup) with 400 mL of treatment solution. I created five treatment solutions with different EC levels (50, 100, 200, 400 and 800 µS/cm) by diluting artesian well water with distilled water. At the end of eight weeks, I assessed growth rate and mortality for each snail species. P. antipodarum showed significant differences in growth with lower growth rates at low EC levels while both native snails showed no significant differences in growth. P. antipodarum showed significant differences in mortality among treatments with higher than expected mortality in the 50 µS/cm solution and lower than expected mortality in the 400 and 800 µS/cm solutions. No significant differences in mortality were found for either native species. The lack of any significant differences in growth or mortality for the two native snails indicates higher tolerance of these snails to low EC which may enable these snails to residue in areas of the river that are less hospitable to P. antipodarum.

From Tadpoles to Egg Masses: A Boreal Toad Translocation Success Story

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Abstract: The boreal toad, Anaxyrus boreas boreas, has been in steady decline across its native range for several decades. This decline is chiefly attributed to the vast spread of the chytrid fungus, Batrachchochytrium dendrobatidis (B.d.) , which upon arrival may completely eliminate successful breeding at a site within a relatively short time period. One management tool that has been utilized to counteract this alarming loss of breeding sites is translocation. For the boreal toad, translocation involves moving groups of individuals from existing wild populations or captive broodstocks into new habitats. However, relatively few translocation efforts have been attempted and only one has realized a high level of success (i.e. multiple year classes present and successful natural reproduction). This successful boreal toad translocation site is an ephemeral pond located in the Cache la Poudre watershed of northern, Colorado. The translocation project was initiated in 2006 when tadpoles were introduced into the site. Such tadpole introductions were continued from 2008 to 2013. Recruitment of adults was first documented in 2010 and the adult male population continued to increase in abundance through 2014. A major milestone was achieved in 2014 when five egg masses were documented at the site, and again in 2015 when six egg masses were documented at the site. As B.d continues its spread, successful translocations will likely be a critical tool to maintaining boreal toad genetic diversity on the landscape, while scientists continue to explore possibilities for minimizing the spread of the chytrid fungus, and reducing its impacts at breeding sites. This project provides insight into the characteristics of a suitable translocation site and early indicators of translocation success.

Applications of eDNA for biodiversity monitoring

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Abstract: Environmental DNA (eDNA), shed DNA in the environment, is an emerging technique that can be leveraged to monitor biodiversity to meet wildlife management goals. Aquatic eDNA is particularly useful for monitoring amphibian, fish and invertebrate organisms. As a technique, eDNA is extremely reliable, detects presence for less than 3 weeks under tested conditions, and had higher detection rates than visual surveys. To introduce eDNA to wildlife managers and researchers, we will present a background on how eDNA works, protocols for eDNA collection, and relative costs. We will present a set of case studies using visual DNA: development of eDNA quantitative PCR, amphibian detection in plains systems, amphibian detection in forested systems, relating fish presence with amphibian presence (both using eDNA methods) and potential for eDNA for water quality monitoring. We are able to detect amphibians with high probability of detection, particularly when there was evidence of breeding. In addition, we find that chorus frogs are less likely to occur with the presence of fish. In addition, identification of macroinvertebrates for water quality monitoring is promising. We find the eDNA methods are highly reliable for most situations, but certainly not a substitution for visual surveys. We discuss under what conditions eDNA surveys may be most useful to meet research and management goals.

Tiger Musky Rearing at Wyoming Game and Fish Department's Speas Fish Hatchery

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Abstract: Wyoming Game and Fish Department's Speas Fish Hatchery began rearing Tiger Musky in 2013. Over the years the Tiger Musky program has grown due to the successful rearing at Speas Fish Hatchery. With photoperiod manipulation Speas has seen growth of nearly two inches a month which has made this program a quick annual program that has seen great results. The presentation will include information regarding rearing, management uses, and multi-state consortium that the program be successful.

Increasing hatching space at a Wyoming fish rearing station: costs and implications

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Abstract: Traditionally, the Wigwam Rearing Station, located in North Central Wyoming, has been a station reliant on fingerling transfers from other facilities to meet annual production requests. Limitations of hatching space across the fish culture section created a need for increased hatching space at Wigwam. Budget constraints prevent the construction of a new hatchery facility. Fish culture personnel used a minimal budget and some creative thinking to help solve the problem.

Aquaculture technology: Tools used in the intensive partial reuse recirculating aquaculture system at the Wyoming Game and Fish Department's Dubois Fish Hatchery

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Abstract: For nearly 60 years, The Dubois Fish Hatchery utilized linear raceways and 1600 gallons per minute of fresh spring and creek water to raise trout for sportsmen and women to pursue throughout the state. In 2000 however, whirling disease was found in the hatchery water supply, initiating a major renovation of the aging facility. This presentation will detail some of the challenges personnel faced in redesigning the facility, and touch on equipment and culture related techniques used at the Dubois Hatchery to maximize production on a very limited water supply.

Grayrocks Reservoir – A management story with highs and lows

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Abstract: Grayrocks Reservoir is a 3,547-acre impoundment located on the Laramie River, 16 miles northeast of Wheatland, WY. Construction started in 1977 and the reservoir filled in April 1983. When full, the reservoir is seven miles long by one mile wide, with a maximum capacity of 146,880 acre-feet. Fish stocking began in 1980 with Walleye, Channel Catfish, and Largemouth Bass. Smallmouth Bass, Black Crappie, and Yellow Perch were added in 1981. Gizzard Shad and Spottail Shiner were stocked in the early 1980s to provide a forage base. Tiger muskie were stocked 1983 through 1991 and again in 2012. The only fish currently stocked annually are Walleye. Creel surveys are conducted roughly every 4-5 years at Grayrocks Reservoir. Dates of historical programmed creel surveys are 1984, 1989, 1994, 1999, 2004, and 2012. Estimated number of anglers was at its highest in 1989 and then declined, along with water levels through 2004. Grayrocks Reservoir's popularity stems from the Walleye fishing and with improved water levels, angler use and pressure in 2012 was similar to past programmed creel surveys. In addition to creel surveys, Grayrocks Reservoir has an extensive sampling history. Walleye have been the most abundant and sought after game fish in the reservoir since 1989. As such, fisheries management activities, goals, and objectives have centered on the Walleye population. However, the fishery has recently changed, as the 2012 creel survey was the first time Walleye did not represent the largest proportion of fish caught by anglers. Smallmouth Bass represented about 40% of the total estimated catch in 2012 and Walleye 33%. Future threats such as illegal or unintentional fish introductions or establishment of other aquatic invasive species may have negative impacts. Case in point, during 2012 and 2013 anglers reported catching Northern Pike from Grayrocks Reservoir. Otoliths were collected from one harvested Northern Pike and efforts using otolith microchemistry were used to assist with identifying

the source for this introduced species. The establishment of Northern Pike in Grayrocks Reservoir would alter the current predator/prey dynamics of the fishery and would add a new chapter to the reservoir's management story.

Motion sensing camera creel of Bull Lake

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Abstract: The traditional subsistence ice fisheries on the Wind River Indian Reservation are unregulated for tribal members. Therefor basic fisheries management information regarding fishing effort and success for these traditional fisheries is limited. Anecdotal evidence from Bull Lake fisher surveys suggests a decline in fishing quantity and quality over the last couple of decades at this popular ice fishery. Motion sensing cameras were used to help acquire basic ice fishing demographic information to track fishing effort. Access to the lake was bi-modal with the majority of activity in the early afternoon followed by another significant peak after traditional work hours. The majority of fishers only visited the lake once during the season for an average time of 4 hours. Similarly, most fishers utilized ATV/UTVs suggesting that fishing pressure was distributed relatively evenly across most of the lake.

Advances in drone technology for river restoration

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Dave Jeffers, Outside Loop

Abstract: Drone technology has become increasingly available and affordable in recent years. Drone use in the Upper North Platte River Valley started out an avenue to "tell the story" and gain landowner trust and involvement with river restoration efforts. With advances in software, drones are now becoming more useful than the videos they produce. Monitoring, surveying, photography, and 3D mapping are becoming affordable options for pre and post project evaluation for river restoration projects.

MCDA, Risk and Design Optimization for River Restoration and Diversion Projects

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Abstract: The communication between Engineers, Scientists and most other humans related to river restoration and diversion projects has often time been a limiting factor in reaching an optimal implementation of complex river projects. This talk is to introduce a framework to analyze multiple goals and objectives qualitatively to reach an

optimized quantitative outcome for the stakeholders to use as a basis for discussion and interaction. This quantitative assessment of qualitative inputs limit communication errors related to personality differences with stakeholders. This framework is generically referred to as a multi criteria decision analysis or MCDA. The framework presented is neither new, nor revolutionary, does not require proprietary software, but it is currently being emphasized anew by many river restoration practitioners to provide better basis for design, communication of risk and decision making related to design optimization.

This MCDA framework will be discussed, related to natural channel design, three-dimensional stream design, limiting factors analysis for fisheries, flood risk, geomorphic assessment, river resiliency, cost analysis, changing points of diversion and stakeholder involvement. Design/existing risk and design optimization will also be defined and presented for discussion. The presentation will briefly discuss the use of a MCDA in conjunction with four CO/WY example river/fisheries projects. This presentation will end with a MCDA led mock stakeholder involvement exercise that will require audience interaction or significant awkwardness will result. As the presenter will be an engineer, it is hoped for that many scientist will find the time to attend this presentation to provide input and comment related to the MCDA framework.

Comparing quantitative methods of collecting invertebrates in prairie streams

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Abstract: Aquatic invertebrates are excellent animals to use for monitoring aquatic ecosystem quality; however, choosing a sampling method can be difficult. All samplers have advantages and disadvantages, and finding the sampler that minimizes bias and fulfills the objectives is crucial. Hester-Dendy substrates are artificial multiplate samplers that are suspended in the water to collect invertebrates, but previous studies demonstrated that they bias results toward certain insect orders. Hess samplers consist of a tube where all the invertebrates within the sampler are collected in the downstream net. I compared aquatic invertebrates collected using Hester-Dendy samplers and a Hess sampler in the Niobrara River for five years. Hess samplers collected more non-insect invertebrates compared to Hester-Dendy samplers (ANOVA; $p < 0.001$), but a similar number of insects ($p = 0.11$). Hester-Dendy and Hess samplers collected a similar number of true flies, caddisflies, beetles, dragonflies and damselflies, and mollusks (ANOVA, $p > 0.1$). Conversely, Hester-Dendy samplers collected more mayflies ($p > 0.001$), and Hess samples contained more annelids ($p = 0.06$) and crustaceans ($p < 0.001$). Bioassessment metrics calculated from Hess samples had higher taxa richness, and more mayflies, stoneflies and caddisflies compared to Hester-Dendy samples (T-test, $p < 0.001$). Hess samples are better at representing the natural density and richness of aquatic invertebrates in prairie streams compared to Hester-

Dendy samples. Choosing a sampling method is difficult, and the costs and benefits must be weighed carefully.

Seasonal movements among fragmented populations of Colorado River cutthroat trout in the Cottonwood Creek Drainage

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Abstract: We used radio telemetry to evaluate seasonal movements among fragmented populations of Colorado River cutthroat trout (CRC) in Cottonwood Creek, a tributary to the Green River. Movements of CRC within study segments followed a similar pattern throughout the year, though the frequency and distance varied among the groups. Cutthroat trout inhabiting the upper segment of South Cottonwood Creek moved the greatest distances throughout the year, while CRC within North Cottonwood Creek moved the least. Movements of CRC inhabiting different segments of both creeks did not overlap at any point throughout the year, indicating that fragmented habitats within the Cottonwood Creek drainage have likely affected metapopulation dynamics. Recommendations to restore, and limit further fragmentation of habitats within the drainage will help reconnect populations.

To stock or not to stock? A tale of Shovelnose Sturgeon reintroduction in the Bighorn and Nowood Rivers

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Abstract: Shovelnose sturgeon historically occupied the Bighorn, Powder, and North Platte rivers in Wyoming. However, the construction of large dams resulted in their extirpation from the North Platte and Bighorn rivers. In the mid-1990s, WGFD developed a plan for the reintroduction of shovelnose sturgeon into the Bighorn River with the goal of establishing a self-sustaining population. Larval and juvenile sturgeon have been stocked in the Bighorn and Nowood rivers during 11 of the past 20 years. Angler reports and FMCY sampling efforts confirm that some are surviving to adulthood; however, the potential for this population to sustain itself without supplemental stocking remains unknown. The goal of this project is to determine whether natural reproduction is occurring in the Bighorn and Nowood rivers. Specific objectives are (1) identify potential spawning sites and seasonal habitat use of adult sturgeon in the Bighorn and Nowood rivers, (2) monitor for presence of embryonic and larval sturgeon downstream of identified potential spawning sites and (3) model embryonic and larval sturgeon

development and drift rates to determine locations of larval settlement. Field work to accomplish these objectives began in 2015. Twenty-six adult sturgeon were implanted with radio transmitters during the spring and tracked through the fall, identifying two confirmed and one potential spawning location and three distinct seasonal movement patterns. Preliminary efforts to sample drifting embryonic sturgeon also took place in 2015. Field work planned for 2016 will focus on deploying the remaining 25 radio transmitters in adult sturgeon, conducting more intensive larval drift sampling at several locations, and collecting data to model drift dynamics of embryonic sturgeon across a range of discharges.

History of the Fisheries of Rocky Mountain National Park

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Abstract: Over the course of 12 years historical records were researched to assemble a history of the fisheries of Rocky Mountain National Park (RMNP). Primary sources such as agency reports and fish stocking records were used to obtain most information; however, an abundance of information was also obtained from secondary sources such as local newspapers and oral histories of early Estes Park and Grand Lake residents.

The fish known to be native to the area which would become RMNP were cutthroat trout, suckers and sculpins. These fish were only historically found in the lower reaches of what would become RMNP due to waterfalls and cascades which served as fish migration barriers. Fish stocking in the area began in 1886 and continued with the State of Colorado stocking tens of thousands of fish on an annual basis. In the early 1900s fish hatcheries were constructed in gateway communities of Estes Park and Grand Lake. These hatcheries produced hundreds of thousands of fish annually. The majority of these fish were non-native trout species which were stocked into historically fishless waters. The extensive stocking of fish for recreational fishing altered aquatic landscapes and nearly extirpated native species.

The first formal guidance on management of fish resources provided by the National Park Service came in 1936 and encouraged the stocking of native fish, discouraged the stocking of non-native fish and prohibited stocking of fishless waters. In 1968 fisheries management shifted from an emphasis on recreational fishing to that of recovery of native fish species. The stocking of fish ceased; however, between 1886 and 1968 over 20 million fish had been stocked into RMNP waters. By this time almost all RMNP waters were inhabited by non-native fish species. Under the new management policy 17 native trout reclamation projects have been conducted.

A multi-jurisdictional effort to remove nonnative trout and restore native Yellowstone Cutthroat Trout (Oncorhynchus clarkii bouvieri) in the upper Soda Butte Creek Drainage, Montana and Wyoming.

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Abstract: Yellowstone Cutthroat Trout (Oncorhynchus clarkii bouvieri; YCT) are native to the Lamar River watershed and are considered a sensitive species throughout their range. YCT are also an important resource ecologically and recreationally to the Greater Yellowstone Ecosystem. YCT populations have dramatically declined with only 44% of their historic range currently occupied, and only 22% of this range supporting core conservation populations. The greatest threat to the persistence of extant YCT populations is the presence of nonnative salmonids which compete with, prey upon, and hybridize with YCT. Brook Trout (BKT; Salvelinus fontinalis) were introduced in the Soda Butte Creek drainage as a sport fish early in the 20th century and for decades were relegated to one small tributary due to poor water quality associated with mining activities in the drainage. Mining reclamation in the early 1990s facilitated the expansion of the BKT. Electrofishing suppression of BKT in Soda Butte Creek ensued for the next two decades but the distribution of BKT continued to increase. In 2015, Montana Fish Wildlife and Parks, the Wyoming Game and Fish Department, Yellowstone National Park, and the Shoshone and Custer-Gallatin National Forest collaborated to remove BKT from Soda Butte Creek using the chemical rotenone. This project was an effort to prevent the proliferation of BKT in the Lamar River watershed and will secure the core conservation population of YCT in Soda Butte Creek.

Spatial monitoring design for plains fishes in the South Platte River Basin

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Abstract: Static design-based approaches to sampling, such as stratified random sampling, generalized random tessellation sampling (GRTS), or space-filling designs, are common methods to select sampling locations when little previous data exists. In contrast, adaptive sampling designs are an underutilized model-based approach to monitoring of ecological systems. Popularized through environmental monitoring

schemes, they use the information from data that have already been collected for more efficient sampling going forward. Spatially explicit optimal adaptive monitoring designs have only recently been used in ecological studies. We describe the components of an optimal adaptive sampling design and then demonstrate them using a Colorado Parks and Wildlife monitoring program for plains fishes in the South Platte River basin. We develop a design criterion for the multi-species occupancy modeling framework that does not depend on the response variable directly. New optimally selected sampling locations are identified by minimizing this design criterion annually. We compare our optimal designs to random designs to illustrate the reduction in uncertainty.

Wyoming Landscape Conservation Initiative: an approach to landscape scale conservation in Southwest Wyoming

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Abstract: The Wyoming Landscape Conservation Initiative (WLCI) was announced in February 2007 as a long-term, science-based effort with the goal to assess, conserve, and enhance fish and wildlife habitats while facilitating responsible development through local collaboration and partnerships. The concept for the WLCI began in the spring of 2006 as Federal and State fish and wildlife managers identified the need for a landscape-scale approach to ensure healthy wildlife populations in areas with ongoing and proposed energy development. The accomplishment of landscape scale goals and objectives is highly dependent on maintaining working relationships with multiple partners and agencies. Collaboration takes place through the efforts of multiple WLCI teams that are tasked with sharing information, prioritizing projects, and identifying greatest conservation needs and gaps in available science. This collaborative approach exercised by WLCI is unique as it provides a means to address multiple concerns at a scale that covers all activities on the landscape, incorporates multiple needs in project implementation, and can leverage resources that might not be available to single agency projects. Work in the 19 million acre WLCI area focuses specifically on activities that promote and maintain the health of sagebrush, mountain shrub, aspen, riparian, and aquatic communities.

Reconnecting and Restoring Habitats in the Lower Encampment River

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Abstract: The Encampment River flows north from the Continental Divide in Colorado into the Sierra Madre Range in southeastern Wyoming. As the river exits the mountains, it flows through a wide valley dominated by irrigated hay meadows and cottonwood galleries. Within this lower segment, the Encampment River is characterized by unstable reaches with accelerated bank erosion, channel degradation and aggradation, and poor connections with floodplain habitats. The legacy effects of tie drives, mining, channel dredging, and land use have led to the present-day channel and riparian habitat conditions. Today, the effects of beetle kill in forested headwaters, climatic extremes, and altered stream flows exacerbate channel instability. In addition, concrete and cobble push-up dam diversions limit seasonal wild trout movements in the lower watershed. Over the last 5 years, the Wyoming Game and Fish Department, Trout Unlimited, and Saratoga-Encampment-Rawlins Conservation District have partnered with the Wyoming Landscape Conservation Initiative and many other partners to lead concentrated efforts for reconnecting and restoring stream habitat, riparian corridors, and fish passage throughout the lower watershed. To date, the partnership has restored over one mile of river and riparian corridor and replaced two cobble push-up dams with fish-friendly diversion structures. Over the next five years, the partners aim to restore two additional river miles, replace two cobble push-up dams, and create fish passage at a concrete diversion dam. These efforts will reconnect habitats for wild trout, and further strengthen relationships with local businesses, water users, landowners, and anglers.

An Evaluation of Obstacles and Management Practices for Establishing Vegetation Along the Encampment River

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Abstract: In recent years, the Wyoming Game and Fish Department has partnered with numerous landowners and agencies to initiate restoration projects on the Encampment River in southeast Wyoming. These projects have been directed towards enhancing instream and riparian habitats. Part of improving riparian function includes expanding the presence of native shrubs and trees along the riparian corridor. Besides serving as habitat and resources for organisms, riparian vegetation provides support to newly constructed banks and helps dissipate energy during high flows. Long-term goals of riparian work include initiating projects and management activities to improve age class diversity and floodplain connectivity. WGFD has partnered with Stantec Consulting to establish experimental vegetation plots on a section of the Encampment River directly downstream from the town of Riverside. The first experiment aims to determine if

native shrubs and trees can establish above bankfull while the second focuses to understand sediment deposition surrounding plots of vegetation. Large cobble, steep banks, and ungulate browsing are continuous obstacles and present unique challenges requiring adaptations to current management techniques. Results and insight from this process coupled with adaptive management and monitoring during the post restoration phase will have vast implications for the establishment of vegetation along the Encampment River.

Removing fish barriers on the Upper Encampment River

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Abstract: Starting in 2011 four fish barriers have been removed from the East Fork of the Encampment River and Coon Creek, a tributary to the East Fork. Three of the barriers were derelict hydrology weirs originally used to determine runoff rates in sub-drainages after timber harvest. Removing these barriers sometimes in designated Forest Service Roadless Areas was challenging. Unlike the Lower Encampment River, here stream channels are stable. Removing these barriers provides insurance to the fishery from catastrophic events including wild fires, drought, and climate change by increasing the potential of natural re-population of wild trout and native fishes. The reconnected headwaters also may increase access to spawning and juvenile rearing habitats, while improving wilderness aesthetics.Moving sediment through the system is enhanced by barrier removal. The barriers were removed, stream banks contoured and native plants reestablished. The US Forest Service, the Wyoming Game and Fish Department, and the Wyoming Wildlife and Natural Resource Trust collaborated with Trout Unlimited to make these efforts a success. Removing barriers in the Upper Encampment dovetails with channel restoration and habitat enhancement efforts currently undertaken on the Lower Encampment to address watershed health, water quality and fish habitat.

Evaluation of resistant Rainbow Trout fry stocking in Colorado

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Abstract: Following the establishment of whirling disease in Colorado, Colorado Parks and Wildlife developed a resistant Rainbow Trout for stocking known as the HxC. The HxC is a cross of the Colorado River Rainbow (CRR) and German Rainbow (GR). It was hoped that the HxC would exhibit the survival and reproduction of the CRR, overcome potential disadvantages associated with domesticity of the GR, and maintain genetic resistance to whirling disease. One disadvantage to stocking HxC is the potential for backcrossing that could decrease whirling disease resistance. Stocking pure GR was not considered a viable option because it was thought that they would not survive well in a natural environment. However, in a laboratory study the two strains showed few physiological differences, indicating that the GR may be a candidate for stocking in whirling disease endemic streams. We undertook a laboratory and field experiment to compare fry survival between the two strains. The field experiment was conducted in three drainages (Poudre River, Middle Fork of the South Platte River, and Colorado River) and 3 streams were selected in each drainage. One-mile reaches of each stream were stocked in August 2014 with 5,000 HxC, identified with coded wire tags, and 5,000 untagged GR. In October 2014, April 2015 and August 2015 population estimates were conducted, providing apparent survival for each strain. Two laboratory experiments were conducted. In the first, a 50:50 mix of HxC and GR were stocked into large open mesocosms with one wild brown trout predator. Survival was estimated over a 24-hour time period. The second experiment was similar but we added treatments with or without cover. Data collected for the field experiment revealed that apparent survival is influence by strain, stream, and their interaction. Laboratory data revealed that there was no difference in survival between the strains when confronted with brown trout predation. Our results indicate that the GR may be a viable alternative for stocking in whirling disease endemic streams.

Does Oil and Natural Gas Development and Hydrology Interact to affect Fish Populations?

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Abstract: Managers and ecologists are under increased pressure to quantify and understand how stressors, natural or anthropogenic, interact to affect environmental change. Oil and natural gas (ONG) development has expanded at an unprecedented rate and our understanding of how stressors associated with these activities affect aquatic ecosystems is limited. Hydrology is also a strong regulator of stream ecosystems. Energy development and altered hydrology have been shown to individually affect streams; however less is known regarding how these stressors interact to affect ecological change. The objective of this study was to assess interactions between ONG development and hydrology on fish populations. Specifically, we examined changes in abundance of Mottled Sculpin (Cottus bairdii), Mountain Sucker (Catostomus platyrhynchus), and Colorado River Cutthroat Trout (Oncorhynchus clarki pleuriticus) across 60 sites in the Wyoming Range between 2012 and 2015. Preliminary results suggest fish abundances may shift through time in relation to interactions of ONG development and hydrology. By understanding interactions between anthropogenic and natural stressors we can better inform managers of best management practices needed to reduce negative effects in stream ecosystems.

Culverts in forested watersheds: impacts and restoration methods for native freshwater fishes

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Abstract: Growing anthropogenic development in response to rising demands for natural resources is a major concern for freshwater fish, particularly in resource rich regions such as the northern boreal forest. Expanding networks of industrial resource roads have resulted in the installation of thousands of culverted road crossings that can degrade habitat and disrupt connectivity for freshwater fishes. Herein, we first describe the extent to which culverts are impacting stream fish communities in the boreal forest by means of a comparative field study. We then describe the management utility of a novel optimization-analysis tool to prioritize problem culverts for restoration by incorporating region-specific parameter estimates of budgetary constraints, barrier passibility, and species-specific life history information. Results from the field study suggest that in addition to effecting fish passage and stream connectivity, alterations to instream fish habitat from culverts may be driving large-scale changes in stream fish communities in the boreal forest, necessitating immediate management action. Optimization-model outputs indicate that for Arctic Grayling (Thymallus arcticus) and Bull Trout (Salvelinus confluentus), a large proportion (~61-83%) of isolated habitat can be reconnected with a low investment (~$200K to $500K). This study provides important evidence supporting the utility of this optimization-based method for prioritizing conservation efforts for freshwater fish in low-gradient forested watersheds.

Species habitat associations and top predator trophic position at sites with natural and added habitats in the Laramie River, Wyoming

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Abstract: In low gradient, sand-dominated rivers, substrate provides little cover or foraging sites for fish. In these systems, instream habitat is important but can make up a small proportion (~6%) of the river. River restoration projects often augment instream habitat by adding wood and rock structures to improve habitat for important large-bodied gamefishes, especially salmonids. While salmonids typically utilize and benefit from added habitat, less is known about the use of such habitat by small-bodied fishes. Wyoming's high plains rivers east of the Continental Divide were historically dominated by small-bodied nongame fishes and lacked large-bodied predators but now contain naturalized populations of nonnative Brown Trout (Salmo trutta). Large brown trout are piscivorous and have the potential to complicate restoration efforts through increased predation on native small-bodied fishes. This study evaluated fish habitat use in the Laramie River (Wyoming, USA) at sites with and without added habitat structures consisting of large wood and rock riprap. We found that all species avoided open water and most species were positively associated with multiple habitats, including both natural and added habitat types. Small-bodied fishes in particular showed stronger preference for natural wood compared to added wood structures. Bayesian mixing models were used to estimate relationships between species abundance and the following habitat variables: mean depth, mean velocity, substrate composition, and habitat types (wood, macrophytes, undercut, added wood, riprap). Subsequent model selection was done using the deviance information criterion (DIC). For top predators and small-bodied fishes, models that included the five habitat types best explained abundances. For large White Suckers (Catostomus commersonii), the model that included stream parameters best explained abundance. Finally, nitrogen and carbon stable isotope ratios were determined to examine top predator trophic position and ultimate carbon sources at two sites. Brown Trout trophic position and carbon isotope ratios were similar and suggested brown trout predation on small-bodied nongame fishes is buffered by presence of other prey subsidies, especially crayfish and terrestrial inputs.

The influence of diet on the growth and behavior of Snake River Cutthroat Trout (Oncorhynchus clarkii behnkei)

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Abstract: Cutthroat Trout (Oncorhynchus clarkii) are raised for restoration stocking and to provide boutique sport fishing opportunities. Because of limited Cutthroat-specific culture information, Cutthroat Trout have been raised using diets and techniques developed for Rainbow Trout (O. mykiss), resulting in inconsistent growth performance. There is also evidence that intensive culturing may diminish anti-predator behavior in salmonids, which has not been tested in Cutthroat Trout. The purpose of this study was to identify existing commercial-type diet formulations to maximize growth rates in juvenile Snake River Cutthroat Trout (O. c. behnkei; SRCT; > 100 mm TL), and to investigate how these formulations may influence anti-predator behavior.

A 6-month feeding trial was conducted in a partial recirculating system on juvenile SRCT fed six different feed formulations. Two control diets were chosen for this study (Skretting Classic Trout and Skretting Steelhead), along with three commercial-type (CT) formulations with varying crude protein (CP) and crude lipid (CL) levels (40 CP:12CL, 45CP:16CL, and 45CP:24CL) and one experimental formulation (40CP:16CL diet with lysine, methionine and threonine balanced to match the 45CP:16CL diet – BFTC Experimental). At the conclusion of the feeding trial, individuals were grouped by diet and size class and exposed to a novel avian predator model (Great Blue Heron, Ardea herodias).

Diet significantly ($P<0.05$) affected final average fish weight, with fish fed Skretting Steelhead, BFTC Experimental, and CT 45:24 weighing significantly more than fish fed CT 40:12. Proximate composition was also altered by diet, with fish fed CT 45:24 having significantly higher crude energy levels than fish fed CT 40:12 and Skretting Classic Trout. When exposed to the simulated predator, fish darting distance and freezing duration were significantly affected by diet type. Fish fed CT 40:12 and BTFC Experimental darted significantly farther than fish fed Skretting Classic Trout, and fish fed CT 45:16 froze for longer intervals than those fed CT 45:24 and Skretting Steelhead. Overall, the results indicate that diets with greater than 40% protein and 12% lipid provide the greatest growth in juvenile SRCT. Additionally, hatchery reared SRCT do exhibit anti-predator behaviors, with particular diet formulations impacting the intensity of the anti-predator behavior.

PIT tag retention, survival, and effects on swimming performance for a Great Plains Darter (Etheostoma cragini)

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Abstract: Darters endemic to North America include many imperiled species and developing passive monitoring methods would be beneficial to their conservation. PIT tags are often used to monitor larger fish species, however, fisheries biologists have been hesitant to use PIT tags on Darter species because of their small size (40 – 70 mm TL) and relatively small peritoneal cavity. No study has determined the effect of PIT tags on the swimming performance of a Darter species and few Darter species have been PIT tagged. To address this lack of information, constant acceleration trials (CAT) were used to study the swimming responses of Arkansas Darters (Etheostoma cragini) subjected to one of the following treatments: control (no surgery or tag), sham (surgery and suture), and PIT tag (8 mm x 1.4 mm intra-peritoneal PIT tag and suture). Swimming performance was measured immediately before tagging, 1 day post-tagging, and 7-8 days post-tagging. Retention and survival were monitored for up to 160 days after tagging. Maximum swimming speeds did not differ between control, sham, and PIT tag treatments (repeated measures ANOVA, $P > 0.05$). Additionally, there were no significant differences between pre- and 1, or 7-8 days post-tagging maximum swimming velocities for the tagged and sham surgery treatments. Tag retention for swum fish was 100% and survival ranged from 87% (tag) to 100% (sham and control). Mortalities in tagged fish were thought to have occurred to due accidental injury caused by the suturing process. A pilot study was also conducted on tag retention and survival for sutured versus non-sutured darters; retention was 100% for both groups and survival was 94% and 100%, respectively. The combined survival of tagged fish that were swum and pilot study fish was 97%. Based on these results, 8-mm PIT tags appear acceptable as an individual-based monitoring method for Darters. It is recommended to only tag Darters larger than 48 mm TL and to not use sutures to reduce the likelihood of injury to the fish.

Population genetic structure in native and introduced Catostomus species in the Upper Colorado River basin

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Abstract: Native Catostomus species (suckers) in the Upper Colorado River basin are of conservation concern due to hybridization with non-native species and declines in population sizes. Previous genetic analyses have shown that outcomes of hybridization are extremely diverse across rivers, and that hybridization outcomes differ depending on which species hybridize. To provide context for hybridization outcomes across an extremely large area, the Upper Colorado River basin, we have also analyzed within-species genetic variation. Our analyses allow us to better understand genetic differentiation and patterns of genetic diversity across the sampled area for bluehead, flannelmouth, mountain, Utah, longnose, and white suckers. For bluehead, flannelmouth, and mountain suckers, which were sampled only in their native ranges, genetic structure corresponds roughly to geography. The greatest within-species genetic variation is between fish from different basins. Within a river basin, populations that are closer together are more similar genetically, while populations that are geographically distant from one another are also more strongly genetically differentiated. Our results are also informative about potential origins of introduced white and longnose suckers, and suggest that at least two independent introductions have occurred for each non-native species present in the Upper Colorado River basin. Genetic analysis also allows us to compare genetic diversity across populations of native and introduced species, to better understand how much genetic variation exists across the range of each species. Knowledge of the population genetic structure of both native and introduced species will help to inform conservation efforts by management agencies.

Division of thermal communities in Wyoming streas into management clusters

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Abstract: Temperature is a significant determinant of fish distribution due to its impact on fish metabolism, reproduction, and behavior. Because surface water thermal regimes are highly vulnerable to anthropogenic influence, states must establish management standards in order to maintain thermal conditions suitable for aquatic life. The objective of this study is to evaluate the Wyoming surface water temperature standards and propose revisions where needed. We will present our approach for developing temperature standards to adequately protect Wyoming aquatic life, focusing on our division of fish communities into multiple thermal management guilds based upon their statewide distribution. We will also discuss our development of the allowable thermal maxima used to define each guild. An improved understanding of

Wyoming fish species' thermal requirements will allow for better management of Wyoming surface waters.

Evidence of endocrine disruption at several municipal wastewater treatment plants within the South Platte watershed, Colorado

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Abstract: Endocrine disrupting contaminants (EDCs) are a large group of chemicals that disrupt normal endocrine function in living organisms. Concern over these chemicals has grown due to an increasing number of studies that have indicated that many of these contaminants are widespread and have induced measurable effects in both terrestrial and aquatic animals. The goal of this study was to gain a better understanding of the distribution of EDCs in the South Platte watershed, with a focus on estrogen mimics. Male fathead minnows, Pimephales promelas, were caged above and below 10 municipal wastewater treatment plants on streams and rivers of the South Platte watershed, Colorado. Caging efforts were focused at municipal wastewater treatment plants because they are a common point source for EDC pollution, and little is known about the endocrine disrupting capacity of effluents coming from many of Colorado's treatment plants. Cages were left for one week at which point they were removed and fish were euthanized for liver and gonad extraction. Liver tissue was analyzed for the presence of RNA which codes for vitellogenin, an egg yolk precursor protein that can be used as a biomarker for endocrine disruption. All caged fish were analyzed for vitellogenin RNA. Initial results showed that treatment plants in Fort Collins and Longmont induced significant vitellogenin production, while three other treatment plants induced only a small effect, or no effect at all. Wild fish were also collected at one treatment plant and the vitellogenin production by those fish was significantly less than that of the caged fish, indicating that wild fish may be able to avoid effects from treatment plants or that they have adapted to living within treatment plant effluents.

Contributed Poster Abstracts

A thermal map for western Wyoming rivers and streams

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Abstract: As part of a broader West-wide effort, the NorWeST project has aggregated and organized temperature data from Wyoming streams and rivers into an open-access database that consists of 607 summers of monitoring effort at 343 sites. Those data were used with spatial-statistical network models (see SSN/STARS website: www.fs.fed.us/rm/boise/AWAE/projects/SpatialStreamNetworks.shtml) to develop an accurate stream temperature model (R2 = 0.90%; RMSE = 1.0˚C), which was then used to predict 30 high-resolution (1 kilometer) historical and future climate scenarios for western Wyoming. This poster depicts a historical scenario of the mean August temperature from 1993-2011 for 37,000 kilometers of stream mapped to the 1:100,000-scale NHDPlus hydrography layer that was trimmed to exclude intermittent reaches and those >15% slope. NorWeST scenarios are available in user-friendly digital formats (e.g., ArcGIS shapefiles and .pdf files) from the project website (www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html). Daily summaries (min/max/mean) of the temperature data used to develop the model are available through the website if permission was given for their distribution. By providing open access to stream temperature information in user-friendly formats, the NorWeST project is facilitating coordination of monitoring activities among organizations, better conservation planning, and new research on temperature dynamics and thermal ecology. A high-resolution version of the Wyoming stream temperature map can be downloaded here: http://www.fs.fed.us/rm/boise/AWAE/projects/stream_temp/downloads/15NorWeST_WesternWyomingStreamTemperatureMap.pdf

Spawning Movement of Bluehead Sucker Catostomus discobolus and Flannelmouth Sucker C. latipinnis in Roubideau Creek, Gunnison River Basin, CO

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Abstract: A permanent PIT-tag passive interrogation array was used to track movement of tagged native suckers into and out of Roubideau Creek, a tributary of the Gunnison

River in southwest Colorado. Movement and water temperature analyses revealed that both Bluehead Sucker Catostomus discobolus and Flannelmouth Sucker C. latipinnis utilize the creek for extended periods over a wide range of temperatures. There is much more overlap in the timing of upstream movement for these native suckers than previously reported. Similar to previous reports, Flannelmouth Suckers showed earlier movement out of the creek than Bluehead Suckers, thus demonstrating a shorter average time of residence. Average weekly stream temperatures were similar between Roubideau Creek and the Gunnison River throughout the time of peak sucker use of Roubideau Creek for spawning.

Trophic Ecology of Burbot Lota lota and Implications for Sampling

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Abstract: Burbot Lota lota is an apex piscivore that was illegally introduced in the 1990s to the Green River drainage, Wyoming. The rapid expansion of Burbot in the Green River has increased concern for the conservation and management of fishes throughout the drainage. However, relatively little is known about the trophic ecology of Burbot in systems where they are non-native. If Burbot are highly piscivorous, as we hypothesize, they may influence catch data in hoop nets due to predation on other fish sampled in the gear. Predator avoidance behaviors may also influence catch of non-game fishes in passive gears; thereby, biasing catch data. Our objectives were to 1) characterize diet composition of Burbot, 2) identify differences in diet composition as a function of three sampling gears (i.e., night electrofishing, small mesh hoop net, and large mesh hoop net), and 3) evaluate the influence of Burbot on the catch rate of other fishes using hoop nets. Diet composition was characterized using frequency of occurrence, abundance, and percent by weight to identify the importance of each prey type to Burbot. Diet composition was compared across gears to identify the influence of gear on diet. Catch rates of non-Burbot species using hoop nets were compared to identify how piscivorous fish influence catch of entrainment gear. Fish made up 80% of the diet of Burbot greater than 350 mm during the fall. The greatest number of species was found in diet of Burbot sampled with small mesh hoop nets. Burbot diet was different between small mesh hoop nets and night electrofishing for

Redside Shiner Richardsonius balteatus, White Sucker Catostomus commersonii × Flannelmouth Sucker hybrid C. latipinnis, Burbot, and Mottled Sculpin Cottus bairdii. Abundance of non-Burbot species was less for hoop nets containing Burbot. Our results highlight how gear influences diet studies and addresses the influence of piscivorous fish on the catch rate of other fishes.

Estimating spatial heterogeneity and temporal stability of strontium isotope signatures for use in tracking fish movements

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Abstract: Over the last decade techniques for analyzing environmental chemical and isotopic signatures in otoliths have transformed the way researchers are able to track fish movement. Studies which use these techniques rely on large spatial heterogeneity and high temporal stability of isotopic signatures. The level of spatial heterogeneity and stability of isotopic signatures varies across systems and is rarely understood prior to commencing a study due to the costly nature of collecting samples. Therefore, there is a need to understand the temporal stability of isotopic signatures and develop a cost effective tool to estimate the spatial heterogeneity of isotopic signatures across watersheds prior to sample initiation. Using the Upper North Platte River Drainage located in south-central Wyoming, as a model system, our primary objective was to explore the dynamics driving seasonal and annual stability in strontium isotope signatures and assess the feasibility of using bedrock geology as a predictive tool to estimate spatial heterogeneity of strontium isotopic signatures within the Upper North Platte River Drainage. Our results provide insight for future studies hoping to use strontium stable isotopes to assess fish movement.

Raising Tiger Muskie (Esox masquinongy x Esox lucius) at The Wyoming Game and Fish Department's Speas Fish Hatchery

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Bret Barngrover

Abstract: Over the past three years the Speas Fish Hatchery has raised Tiger Muskie to be distributed in Wyoming waters as well as distributed in neighboring states. Similar rearing techniques were used to for each year class of Tiger Muskie. Each year fish length, feed conversion, and mortality was recorded to be compared to previous years. It was found that Tiger Muskie raised in 2014 grew similar to Tiger Muskie raised in 2013. Growth rates on Tiger Muskie that were raised in 2015 did not perform as well as

previous years, this is likely due to increased numbers of Tiger Muskie in limited rearing space causing higher densities in tanks.

Daniel Fish Hatchery, A Historical Perspective

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Abstract: The Daniel Fish Hatchery has been culturing salmonids for over 97 years. A look back at its physical and administrative history will give insight to changes in the public and governmental views that have guided and managed activities. This reflection will give future generations of fish culturist and administrators the background necessary to move forward.

In 1915, the need for a fish hatchery at or near Pinedale was realized, to provide fish for many lakes and streams in the area. The Daniel Fish Hatchery was completed in April 1918. The facility was expanded in 1923, reconstructed in 1966 and an addition added in 1999.

Until the mid 1940's, Daniel Fish Hatchery was administered by the state for the propagation of fish to provide fry and fingerlings for sustenance and sport fisheries. After World War II, many hatcheries across the nation saw the beginning of modern organization of wildlife and fisheries departments and the modernization of fish culture facilities. The decades of the 1950's, 60's and 70's saw attitudes of fishermen change from sustenance, to an emphasis on sport fishing. Use of the facility for native cutthroat restoration projects began in the mid 1970's. This focus continues to play an important role in guiding activities at the hatchery.

The facility serves as a restoration hatchery, providing spawning, egg incubation and rearing for the Colorado River cutthroat trout. Offspring from this stock is used to maintain existing genetically pure populations and reestablish extirpated populations in suitable native drainages.

Fisheries management in Wyoming is based on biological requirements and public input. Fish culturists must recognize and understand these parameters to rear fish in the best interest of the resource and the people of Wyoming.

Many generations of fish culturists have passed through this facility. Historical documentation of the facility will provide future culturists with information and knowledge needed to continue utilizing the facility to its full potential.

Guide to cyprinid fish larvae and early juveniles of the Upper Colorado River Basin with computer-interactive key

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Abstract: Use of collections of fish larvae and young-of-the-year juveniles to help document fish spawning sites and seasons or assess larval production, transport, distribution, nursery habitat, survival, and other aspects of early life history, requires diagnostic criteria to accurately distinguish target species from all similar appearing taxa in the waters sampled. To facilitate identification of larvae and early juveniles of the five native (three endangered) and ten (most) of the non-native Cyprinidae in the Upper Colorado River Basin (UCRB), developmental series of reared and collected specimens were studied for differences in size relative to developmental state, morphology, meristics, and pigmentation. The results, including detailed descriptive species accounts, comparative summary tables, and instructions for downloading and using the associated computer-interactive key, are documented in an Upper Colorado River Endangered Fish Recovery Program final report available at http://warnercnr.colostate.edu/lfl-downloadable-keys-guides-and-bibliography. The guide manuscript portion of the report is planned for formal publication through Colorado Parks and Wildlife to complement a previously published guide to larvae and early juveniles of UCRB catostomids (Snyder and Muth 2004, CDOW Technical Publication 42). Together, these two guides complete a long series of descriptive investigations begun over 35 years ago with publication of Contributions to a Guide to the Cypriniform Fish Larvae of the Upper Colorado River System in Colorado (Snyder 1981, Bureau of Land Management Biological Sciences Series No. 3, Denver).

Boreal Toad habitat selection and survival in relation to grazing intensity and disease prevalence

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Abstract: In recent decades, many amphibian populations have declined worldwide. Human-induced habitat disturbance and alteration have been cited as a dominate causes, which can interact with other stressors such as climate change and disease. In the majority of cases, however, mechanisms underlying declines are considered enigmatic; therefore, developing a better understanding of the individual and interactive factors threatening amphibians will be critical to prevent further population declines and species extinctions. To investigate the possible effects of multiple stressors on amphibians, we will assess how livestock grazing individually and in conjunction with disease may affect boreal toad (Anaxyrus boreas) movement, habitat selection, and survival in the Bridger-Teton National Forest in western Wyoming. In 2015, we used radio-telemetry to study the summer movements and habitat use of 61 adult boreal toads (40 male and 21 female) across sites varying in grazing intensity. Additionally, we swabbed individuals for disease and inserted passive integrated transponder (PIT) tags into 302 adult toads. We will analyze habitat selection at the micro- and macro-scales by comparing sites used by radio-tracked toads with paired and randomly selected sites. In 2016 and 2017, we will conduct recapture surveys to evaluate toad survival rates. We will also test swab samples for Batrachochytrium dendrobatidis (Bd) to evaluate disease status of boreal toads across several drainages. Findings from this study will provide valuable information to several agencies working to improve management of toad populations in Wyoming. More broadly, by assessing how multiple stressors may interact to influence amphibian behavior, ecology, and habitat quality, our study design may provide a framework for future research evaluating causative factors in amphibian declines.

Using eDNA to detect Mysis diluviana in lentic systems

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Abstract: Opossum Shrimp (Mysis diluviana; Mysis) were introduced into at least 55 Colorado waters between 1969 and 1975. It is unknown how many of these waters Mysis currently inhabit, or how many downstream waters they have invaded. Mysis are an elusive, temperature- and light-sensitive organism that exhibits daily vertical migrations. The current sampling protocol for Mysis requires vertical tows with a 1-m diameter plankton net from a boat at night during the new moon. This method can be difficult to employ in remote locations or in waters that are too shallow to sample with vertical tows (< 10 m deep). This poster presents a new method for detecting Mysis using Environmental DNA (eDNA). Environmental DNA is a highly sensitive and cost-effective method for detecting rare or elusive organisms. It had never been applied to Mysis. Our method involved filtering 3 L of water through a 1.5-µm glass microfiber filter collected from the deepest part of the lake with a Van Dorn water bottle. Samples were processed by the National Genomics Center for Wildlife and Fish Conservation in Missoula, Montana. A total of nine waters were sampled for Mysis utilizing standard net sampling and eDNA. Seven of these waters had been stocked with Mysis, one water was located downstream of a stocked reservoir, and one water was never stocked with Mysis. The eDNA method produced no false negatives and no false positives, when compared with results of our standard net sampling. We also compared results from samples taken from the surface, at 1-m below the thermocline, and near the bottom in Dillon Reservoir, CO. Near bottom samples contained up to 40 times more eDNA than either the surface or near thermocline samples, but Mysis DNA was detected in all samples. The lowest Mysis density in our study set was 3.0 Mysis/m2 (Big Creek Reservoir, CO). Ongoing research is evaluating detection probability in lower density Mysis waters, but eDNA appears to be a very promising tool for determining presence/absence of Mysis.

Thermal regimes in the South Platte River and the influence on fish reproduction

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Abstract: During winter, water management practices, land use, and climate change can warm stream temperatures above ambient levels, but the effects of warmer temperatures on native fish reproduction are largely unknown. I examined the spawning success of native johnny darters (Etheostoma nigrum) and fathead minnows (Pimephales promelas) in the South Platte River downstream of the effluent discharge from a wastewater treatment plant in Denver, Colorado. In laboratory experiments, I exposed both species to three winter temperature regimes for four months with simulated spring warming. Temperature regimes were based on typical South Platte

River temperatures below the effluent discharge (16˚ and 20˚C) and the winter maximum temperature standard set by the state of Colorado (12˚C) over the winter months. Johnny darters spawned at all three temperature regimes during December and January, but did not spawn again in the spring. Fathead minnows spawned under the 16˚ and 20˚C temperature regimes but not the 12˚C temperature regime during the winter. Fathead minnows that had not spawned in the winter at 12˚C did spawn during the simulated spring warm-up period. Fathead minnows that had spawned during the winter at 16˚ and 20˚C spawned again in the spring, but had reduced egg production. Real-time PCR analysis showed elevated vitellogenin mRNA expression in fathead minnows at 16˚ and 20˚C during winter spawning that dropped off after winter spawning ceased, while fathead minnows at 12˚C maintained consistent vitellogenin expression over time, supporting the spawning data. These results suggest that elevated water temperatures resulting from effluent discharge in the South Platte River have the potential to promote spawning by some native fishes during the winter, and suggests that actions should be taken to assess possible population-level effects of elevated winter temperatures within the affected stream reach.

Locating Potential Reintroduction and Refugia sites for Hornyhead Chub using GIS

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Abstract: The first step in any conservation effort is locating sites with the highest probability of a successful outcome. In the case of fish reintroduction this means evaluating all potential reintroduction sites to locate those sites most likely to result in population establishment and persistence. Empirically ruling out potential reintroduction sites using past sampling history and landscape scale characteristics with GIS analysis can help direct fine-scale habitat evaluation efforts in the field. Landscape scale characteristics, such as stream gradient, site elevation, watershed area and land cover, may be particularly useful in locating suitable sites for species with specific habitat requirements. Glacial relict Hornyhead Chub (Nocomis biguttatus) populations are greatly restricted in distribution, are in need of reintroduction efforts, and have specific habitat requirements. We evaluated potential reintroduction and refugia sites for glacial relict Hornyhead Chub within the North Platte River basin using landscape scale characteristics and past sampling history in GIS. Our results will guide field based Hornyhead Chub reintroduction site evaluation efforts within the North Platte River basin.

Movement dynamics and survival of hatchery-reared Colorado River Cutthroat Trout post-stocking

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Abstract: Colorado River cutthroat trout (CRC) have experienced significant declines in distribution and abundance throughout their range. In Wyoming, introduction of non-native salmonids that hybridize and compete for resources are a limiting factor. Management strategies used by Wyoming Game and Fish Department to mitigate deleterious interactions with non-native salmonids often include the construction of a fish barrier, followed by the removal of non-native species and reintroduction of CRC from a captive brood source. LaBarge Creek Watershed (LCW), located in the Wyoming Range, Western Wyoming, has been subject to such management practices since 1999. Despite successful removal of non-native fish and consistent stocking efforts since 2007, limited to no establishment has been observed to date. We hypothesize that rearing history, timing of stocking events, and size of fish at stocking are working in conjunction with a suite of physical habitat variables to drive large scale post stocking emigration and or mass mortality events. We aim to present an initial examination of proposed methods for monitoring post-stocking fish movement and mortality as they are possibly effected by differing stocking strategies and environmental triggers. Our results aim to define an optimal stocking strategy while identifying physical habitat limitations in order to contribute to translocation success in LCW.

Stable isotope quantification of resource use by crayfish in the Laramie River to inform lotic food web analyses

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Abstract: Stable isotopes are useful for assessing the functional role of species within food webs, as C isotope ratios can trace the origin of an organism's energy sources, and N isotope ratios can reveal an organism's trophic position. However, this approach

requires an understanding of the isotopic variability of species within food webs of interest. Crayfish are an important component of food webs in the Laramie River, yet niche attributes like trophic breadth and ontogenetic diet shifts are poorly explored for this generalist species. Because crayfish predators, such as Brown Trout, are size-selective, it is important to know if the isotopic signature of crayfish varies with crayfish size. Herein, we evaluate the isotopic niche of crayfish collected from the Laramie River in the fall of 2015 through stable isotope analysis of C and N to characterize their trophic function. We will compare the trophic position and diet breadth among size classes of crayfish which will provide evidence of ontogenetic niche shifts. This information will allow researchers to target the appropriate size group of crayfish when calculating stable isotope mixing models and niche metrics for food web analyses.

Chemical treatment of fish eggs with the Masterflex L/S digital pump system and the fabrication of perforated PVC drip trays

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Abstract: Chemical treatments of fish eggs with formalin and peroxide was implemented for the mitigation of fungal growth and prevention of fish disease, respectively. Green and eyed egg chemical treatments are conducted with chicken waterers by multiple fish hatcheries with the Wyoming Game and Fish Department. This presentation will highlight the utilization of a Masterflex L/S digital pump system to administer formalin to 6 drip incubators and 6 jar incubators at Ten Sleep Fish Hatchery. We will discuss how the Masterflex L/S digital pump system is plumbed into the influent of each incubator. We will weigh costs, benefits and limitations of our current system of chemically treating green and eyed fish eggs. Furthermore, we will outline the process of converting our drip trays from wooden frames with a mess screen bottom to PVC. The conversion to PVC drip trays will increase the longevity and stability of the eggs trays.