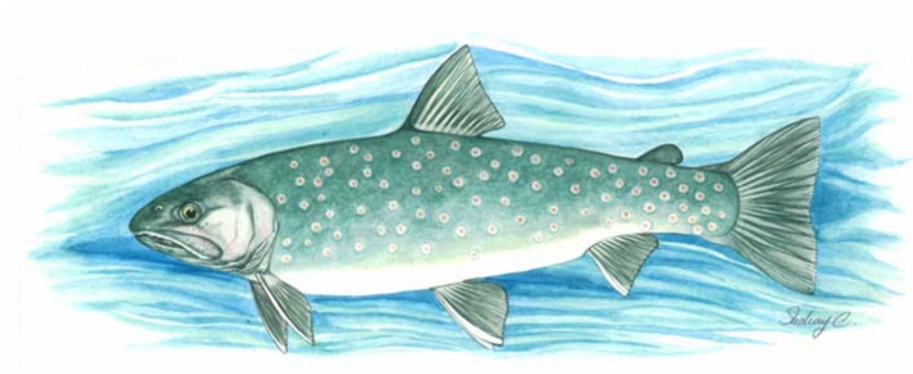
MONTANA CHAPTER

OF THE

AMERICAN FISHERIES SOCIETY

44TH ANNUAL MEETING



Bull trout illustration by Sashay Camel

PROGRAM GUIDE

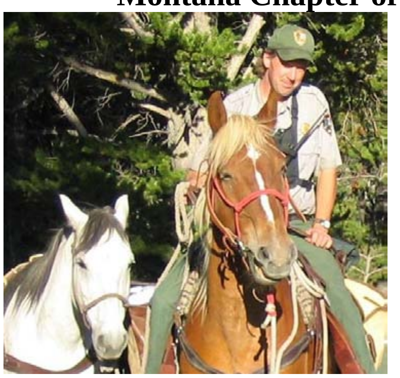
SAVING ALL THE PIECES IN AN ALTERED FISHSCAPE: THE CHALLENGES AND PRACTICALITIES OF BALANCING NATIVE FISH CONSERVATION WITH ANGLING OPPORTUNITIES FOR INTRODUCED SPORT FISHES.

About AFS and the Montana Chapter

The American Fisheries Society (AFS), founded in 1870, is the oldest and largest professional society representing fisheries scientists. Our mission is to improve the conservation and sustainability of fishery resources and aquatic ecosystems by advancing fisheries and aquatic science and promoting the development of fisheries professionals. AFS promotes scientific research and enlightened management of resources for optimum use and enjoyment by the public. We also encourage a comprehensive education for fisheries scientists and continuing on-the-job training. The AFS publishes some of the world's leading fisheries research journals and organizes scientific meetings where new results are reported and discussed. In addition to these primary functions, the Society has many other programs in areas such as professional certification, international affairs, public affairs, and public information.

The Montana Chapter of the AFS was formed in 1967 and our membership is currently composed of approximately 300 fisheries professionals affiliated with state and federal agencies, universities, and private industry across the state. This is the major gathering of the year for fisheries professionals of all affiliations from across the state. It is a great opportunity to learn about what is happening in the management and conservation of fisheries resources in Montana and explore timely issues.

Montana Chapter of the American Fisheries Society Officers



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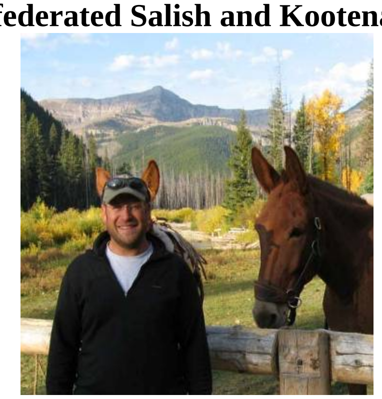

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THE 44TH ANNUAL MEETING
OF THE
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SAVING ALL THE PIECES IN AN ALTERED FISHSCAPE: THE CHALLENGES AND PRACTICALITIES OF BALANCING NATIVE FISH CONSERVATION WITH ANGLING OPPORTUNITIES FOR INTRODUCED SPORT FISHES

February 8-11, 2011
Heritage Inn
Great Falls, Montana

Acknowledgements

I owe a great many thanks to the chapter officers (past and present) for answering a multitude of questions along the way and for helping with meeting organization. I cannot express my gratitude enough to the invited speakers who gave selflessly of their time and, in some instances, traveled long distances to present at the meeting. Many thanks also to Lisa Eby for moderating the plenary panel. Thanks also to the CS&KT Fisheries Program and staff for assistance and for providing support to participate in the chapter at this level. A special appreciation is warranted for the student subunits on behalf of their volunteer work and for all of their work on the raffle and banquet entertainment. Thanks also to the committee chairs for your continued work on behalf of Montana's aquatic resources. Last, but not least, a deep appreciation is owed to all the presenters, moderators, sponsors, vendors, donors, and other contributors who made the meeting possible.

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Saving all the pieces in an altered fishscape: the challenges and practicalities of balancing native fish conservation with angling opportunities for introduced sport fishes

Welcome to the 44th annual meeting of the Montana Chapter of the American Fisheries Society. It's a pleasure and an honor to once again share a week with the outstanding professionals that comprise our organization. I hope that this year's meeting will be as educational, thought-provoking, and entertaining as previous meetings, and I have very little doubt about that given the caliber of people that make up our chapter.

I admittedly struggled with this year's theme; my initial thoughts were to use the meeting as a previously unavailable opportunity to invite speakers to discuss some of my strongest natural resource interests, which are much broader than fisheries biology. I wanted to focus on some of the great people and history associated with our tremendous (but sometimes uneven) conservation and sporting legacy. This proud history is diverse and interesting, with opportunities for stories about great conservation leaders and the lesser known people and actions behind our rich inheritance. But then I began thinking about today's pressing issues, and decided that instead of looking back, I needed to look to the present and center the theme on one of the many important issues we currently face as scientists and natural resource stewards. This led me to ask: What are the big challenges we face, and how might these challenges influence the legacy we will leave future generations? Some of the struggles I was seeing play out around the state gave me an answer to the first part of the question, and led to idea for the resultant meeting theme.

The subject of conserving native fish in the presence of introduced sport fishes strikes me as one of the greatest fish management challenges in the West. This topic won't go away and will remain with us well into the foreseeable future. It's a troublesome issue with no easy answers or solutions and, at times, it's fraught with disagreement among professionals (not too mention the public), especially given the sometimes diverse constituents and conflicting goals and funding sources that influence and guide fisheries management decisions. Even when we managers and researchers agree that a conflict exists among species, and should be addressed, we often have insufficient tools to overcome technological, financial and social hurdles.

So, in the end, I came full circle with the meeting theme. Earlier I said one of my primary interests is the history of our conservation and sporting legacy; well, the issues surrounding the theme are very much a part of that legacy. Many of the introduced species that make native fish conservation problematic today were introduced by the same people that fought tirelessly on behalf of our land legacy. Our predecessors probably didn't anticipate the challenges they were giving us in managing this mixed inheritance. Unfortunately, there's no easy way forward, but we must keep talking or neither the resource nor the people involved will benefit. This year we are fortunate to have 10 outstanding speakers representing a diversity of backgrounds joining us in a conversation on issues related to the theme. I'd like to extend my greatest appreciation to them for helping us examine some of the issues. Thanks and welcome to Great Falls.

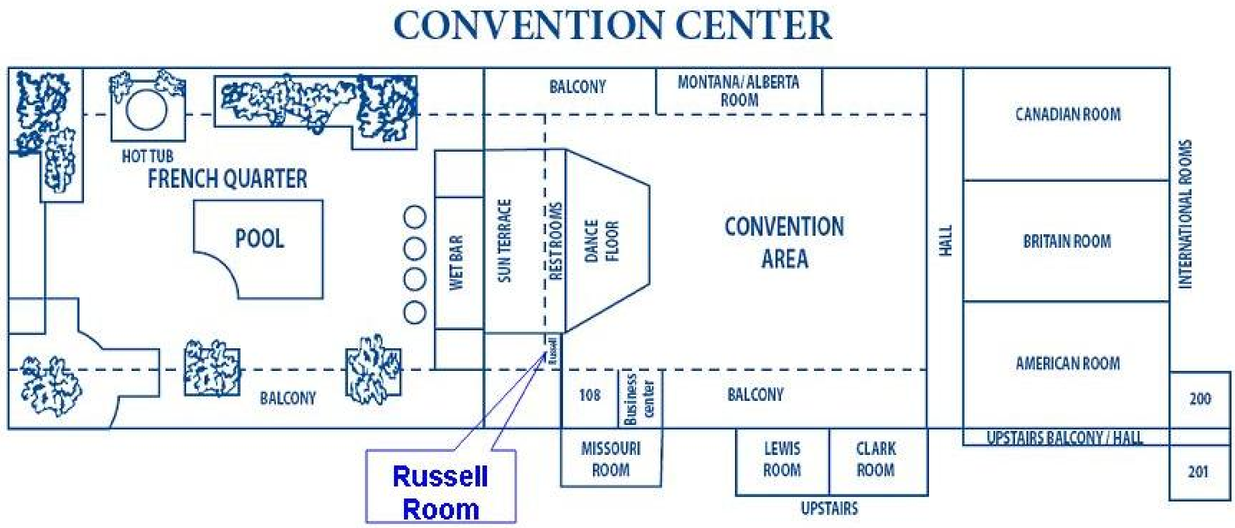
Sincerely,

Craig Barfoot

Schedule at a Glance

Date/ Time	Event	Location
Monday, February 7		
12:00-4:00	EXCOM meeting	Russell Room
Tuesday, February 8		
7:30	Registration	Lobby Entrance
8:30-5:00	Continuing Education	International Rooms (A,B,C)
10:15	Break	Convention Area
12:15- 1:30	Lunch	Convention Area
1:30-5:00	Continuing Education	International Rooms (A,B,C)
6:00-9:00	Lake Trout Working Group	Montana/Alberta Room
6:00-9:00	Welcome social with drinks and hors d'oeuvres	Convention Area
Wednesday, February 9		
7:00	Registration	Lobby Entrance
8:00	Trade Show Ongoing	Convention Area
8:00	Plenary Session: Saving all the pieces in an altered fishscape: the challenges and practicalities of balancing native fish conservation with angling opportunities for introduced sport fishes	International Rooms (A,B,C)
10:05	Break	Convention Area
10:25	Plenary Session	International Rooms (A,B,C)
12:00	Buffet Lunch	Convention Area
1:30	Plenary Session	International Rooms (A,B,C)
3:05	Break	Convention Area
3:25	Plenary Session	International Rooms (A,B,C)
4:30-5:30	Committee Caucuses	Missouri, Lewis, Clark, 200, 201
6:00	Poster Session (Presenters in attendance 6:00-6:45)	Convention Area
6:00-10:00	Plenary Speaker Appreciation Social	Convention Area

Date/ Time	Event	Location
Thursday, February 10		
7:00	Registration	Lobby Entrance
8:00	Contributed Papers	International Rooms (A,B,C)
9:50	Break	Convention Area
10:10	Symposium: Build it and they may come—but does it really matter?	International Rooms (A,B,C)
12:10	Business Luncheon (Buffet)	Convention Area
2:10	Contributed Papers: Climate Change	International Rooms (A,B,C)
3:10	Break	Convention Area
3:30	Contributed Papers	International Rooms (A,B,C)
4:50	End Session	
5:00-6:00	Student Mentoring Session	Montana/Alberta Room
5:00-6:00	MT Association of Fish and Wildlife Biologists	Lewis and Clark
6:00-7:00	Evening Social with Drinks and hors d'oeuvres	Convention Area
7:00	Awards Banquet and Raffle	Convention Area
Friday, February 11		
8:00	Contributed Papers	International Rooms Canadian (C)
9:45	Break	Convention Area
10:05	Contributed Papers	International Rooms Canadian (C)
8:00	Contributed Papers	International Rooms American and Britain (A, B)
9:45	Break	Convention Area
10:05	Contributed Papers	International Rooms American and Britain (A, B)
12:05	Adjourn	


CONVENTION CENTER
BALCONY
MONTANA/ALBERTA ROOM
CANADIAN ROOM
HOT TUB
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INTERNATIONAL ROOMS
AMERICAN ROOM
Russell
108
Business center
BALCONY
BALCONY
200
UPSTAIRS BALCONY / HALL
MISSOURI ROOM
LEWIS ROOM
CLARK ROOM
UPSTAIRS
201
Russell Room

Continuing Education Agenda

Collaboration and Conflict Resolution in Natural Resource Management

Presented by
Matthew McKinney
Center for Natural Resources & Environmental Policy
The University of Montana

Tuesday, February 8, 2011
Heritage Inn, Great Falls, Montana

8:30 **Welcome and Introductions**

8:45 **Basic Approaches to Conflict and Cooperation**
Exercise: Win As Much As You Can
Review Homework # 1: Conflict Management Styles

10:15 Break

10:30 **Multi-party Negotiation: Theory and Methods**

11:30 **Prepare for Multi-party Negotiation Simulation**
Create Small Groups
Review Homework # 2: General Instructions
Assign Confidential Roles

12:15 Lunch - provided [with people playing the same role]

1:30 **Multi-party Negotiation Simulation on Instream Flow Protection**

3:00 **Debrief**

3:30 **Problem-solving Session**
Review Homework # 3: Problems People Want to Talk About

4:45 **Review and Evaluation**

5:00 **Adjourn**

THE 44TH ANNUAL MEETING OF THE MONTANA CHAPTER OF THE AMERICAN FISHERIES SOCIETY

Agenda

Wednesday February 9

Plenary Session
Moderator: Lisa Eby (University of Montana)

8:10 ***Bull trout and systemic change in Western Montana: the hidden origins of our ecological crisis,*** Thompson Smith (Confederated Salish and Kootenai Tribes)

8:45 ***Rainbow Trout and American Fisheries Management: How did we get here and what have we learned?*** Anders Halverson (University of Colorado Center of the American West)

9:20 ***The Voyage of Discoveries in the Rugged Sierra Madre Occidental of Mexico: The Biodiversity and Conservation of Newly Discovered Trout Species,*** Richard Mayden (Saint Louis University)

10:05 **Break**

10:25 ***Taimen and taimen conservation efforts: blending science and economics to establish a viable catch and release taimen fishery as an alternative to more destructive resource extraction industries within the Eg Uur watershed,*** Dan Vermillion (Montana Fish, Wildlife and Parks Commission)

11:10 ***Attitudes, opinions, and perceptions of Montanans regarding Montana's native fish,*** Mike Lewis (Montana Fish, Wildlife & Parks)

11:30 **Morning Panel Discussion**

12:00 **Buffet Lunch**

1:30 ***A pragmatic approach for conserving native fish AND providing angling opportunities on common biological and social landscapes,*** Bruce Rich (Montana Fish, Wildlife & Parks)

1:50 ***Fun to catch, fun to study, fun to respect – The conservation-minded angler's perspective on going native,*** Bruce Farling (Montana Trout Unlimited)

2:10 ***Trash Fish to Trophy - How Bull Trout Have Spruced Up Their Image, With Support from the ESA,*** Wade Fredenberg (U.S. Fish and Wildlife Service)

2:30 ***A strategy for conserving native fish in our national parks,*** Todd Koel (National Park Service)

2:50 *__Using science to make fish conservation decisions__* Bradley B. Shepard (B.B. Shepard and Associates)

3:05 Break

3:25 Afternoon Panel Discussion

4:30 End Session

4:30 Committee Caucuses

6:00 Poster Session (Presenters in Attendance 6:00-6:40)

6:00 Plenary Speaker Appreciation Social

Thursday, February 10

8:00 Welcome and Announcements: Todd Koel (National Park Service)

Contributed Papers (An * indicates presenter)
Moderator: Bob Bramblett (Montana State University)

8:10 ***Systems Analysis of Introgressive Hybridization among Trout: assessing Crossing, Fitness, Dispersal Rates, and Landscape Connectivity as Drivers of Genetic Structure in Hybridized Populations,*** Patrick Della Croce* and Geoffrey Poole (Montana State University)

8:30 ***A proposal to examine individual differences and among-population differences in dispersal in introduced populations of westslope cutthroat trout,*** Tessa Andrews*, Bradley B. Shepard, Alexander Zale, and Steven Kalinowski (Montana State University)

8:50 ***Conservation Genetics of Sauger in the Upper Missouri River Drainage,*** Daniel M. Bingham*, Robb F. Leary, Sally Painter, and Fred W. Allendorf (University of Montana)

9:10 ***Genetic Population Structure of Bull Trout in the East Fork Bitterroot River, Montana,*** Leslie G. Nyce*, Lisa Eby (University of Montana), Chris Clancy (Montana Fish, Wildlife and Parks), and Robb Leary (Montana Fish, Wildlife and Parks, University of Montana)

9:30 ***Conservation of westslope cutthroat trout in the presence of rainbow trout introgression while considering life history and a watershed-level approach to management,*** Matthew P. Corsi*, Lisa Eby (University of Montana), Paul Spruell

(Southern Utah University), and Craig Barfoot (Confederated Salish and Kootenai Tribes)

9:50 **Break**

Build it and they may come – but does it really matter?
Moderator: Mark Lere (Montana Fish, Wildlife and Parks)

10:10 ***Reconnecting a small population of migratory westslope cutthroat trout in a complicated drainage: Can we do it, or tell if it worked?*** Chris Clancy (Montana Fish, Wildlife and Parks)

10:30 ***Water: Is it working?*** Scott Opitz (Montana Fish, Wildlife and Parks)

10:50 **Stream restoration over two decades: Wild trout response to conservation strategies in the Blackfoot River Basin, Montana,** Kellie Carim* (University of Montana) and Ron Pierce (Montana Fish, Wildlife and Parks)

11:10 ***Fisheries Response to Big Hole Arctic Grayling Habitat Enhancement Projects,*** Austin McCullough* and James Magee (Montana Fish, Wildlife and Parks)

11:30 ***Stream restoration, non-native salmonid suppression, and transporting adult bull trout in an effort to enhance populations of bull trout in the East Fork Bull River,*** Jon Hanson (Montana Fish, Wildlife and Parks)

11:50 ***Efficacy of stream habitat restoration to influence distribution and abundance of native and exotic syntopic salmonids,*** David A. Schmetterling (Montana Fish, Wildlife, and Parks)

12:10 **Business Luncheon**

Contributed Papers: Climate Change
Moderator: Matt Corsi (University of Montana)

2:10 ***Monitoring and modeling stream temperature patterns associated with climate change across the northwest US,*** Daniel J. Isaak* (U.S. Forest Service), Erin E. Petersen (CSIRO Division of Mathematics, Informatics, and Statistics), Brett B. Roper (U.S. Forest Service), Jason B. Dunham (U.S. Geological Survey), Jay Ver Hoef (NOAA), Charles H. Luce, Erik Archer, David Nagel, Donna Horan, Sharon Parkes, and Gwynne Chandler (U.S. Forest Service)

2:30 ***Climate change links fate of glaciers and rare alpine aquatic invertebrates,*** J. Joseph Giersch*, Clint C. Muhlfeld, (U.S. Geological Survey) and F. Richard Hauer (University of Montana)

2:50 ***Potential impacts of climate warming on aquatic ecosystems in the Northern Rockies: implications for native species conservation,*** Clint C. Muhlfeld*, Leslie Jones, and Jeffrey Kershner (U.S. Geological Survey)

3:10 **Break**

Contributed Papers
Moderator: Vincent S. D'Angelo (U.S. Geological Survey)

3:30 ***The effect of spawning location on the distribution patterns, habitat use, and survival of Snake River finespotted cutthroat trout,*** Kristen Homel* (Montana State University) and Robert E. Gresswell (U.S. Geological Survey)

3:50 ***Seasonal effects of ammonia and dissolved oxygen concentration on salmonid and catostomid distribution in Silver Bow Creek, Montana,*** Joseph P. Naughton* (Montana State University) and Robert E. Gresswell (U.S. Geological Survey)

4:10 ***Assessment of Altered Rearing Environments on Survival and Performance of Hatchery-Reared Trout: Implications for Development of Conservation Hatcheries for Improving Outplanting Survival of Cutthroat Trout Used in Reintroduction Programs,*** Clinton J. Smith*, Thomas McMahon (Montana State University), Molly A. Webb (U.S. Fish and Wildlife Service), and Matthew C. Boyer (Montana Fish, Wildlife, and Parks)

4:30 ***Predicting the spatial distribution of postfire debris flows and their impacts on native trout populations in headwater streams,*** Edwin (Ted) R. Sedell* (Montana State University) and Robert E. Gresswell (U.S. Geological Survey)

4:50 **End of Session**

5:00 **MT Association of Fish and Wildlife Biologists meeting**

5:00 **Student Mentoring Session**

6:00 **Social Hour**

7:00 **Banquet Dinner and Raffle!**

Friday, February 11

Contributed Papers
Moderator: Amber Steed (Montana Fish, Wildlife and Parks)

8:00 **Welcome and Announcements:** Todd Koel (National Park Service)

8:05 ***Environmental factors associated with the variability in bull trout population abundance: implications for conservation,*** Robert Al-Chokhachy*, Clint Muhlfeld (U.S. Geological Survey), and Wade Fredenberg (U.S. Fish and Wildlife Service)

8:25 ***Factors Influencing the Distribution of Bull Trout and Westslope Cutthroat Trout west of the Continental Divide in Glacier National Park*** Vincent S. D'Angelo*, Clint Muhlfeld (U.S. Geological Survey), and Vicki J. Watson (University of Montana)

8:45 ***Small Effective Number in Upper Flathead River Bull Trout, Salvelinus confluentus,*** Robb F. Leary* (Montana Fish, Wildlife and Parks, University of Montana), Matthew C. Boyer (Montana Fish, Wildlife and Parks), and Fred W. Allendorf (University of Montana)

9:05 ***Assessing the impacts of river regulation on native bull trout (Salvelinus confluentus) and westslope cutthroat trout (Oncorhynchus clarkii lewisi) habitats in the upper Flathead River, Montana, USA,*** Brian Marotz*, (Montana Fish, Wildlife and Parks), Clint Muhlfeld, and Leslie Jones (U.S. Geological Survey)

9:25 ***A multimedia information and education tool on the importance of bull trout and the relationship between bull trout and the Salish and Pend d'Oreille people,*** Germaine White, Les Evarts* (Confederated Salish and Kootenai Tribes), and David Rockwell (CW Consulting)

9:45 **Break**

Contributed Papers
Moderator: Clint Muhlfeld (U.S. Geological Survey)

10:05 ***Suppression of Non-native Salmonid Species to Benefit Migratory Bull Trout in an Open System: Lessons Learned from an Effort Performed on the Lower East Fork Bull River,*** Sean Moran* and Josh Storaasli (Avista Corporation)

10:25 ***Thompson Falls Fish Ladder - 48 Steps to Bull Trout Restoration on the Clark Fork River,*** Brent Mabbott*, Jon Jourdonnais (PPL Montana), and Ginger Gillin (GEI Consultants, Inc.)

10:45 ***The Use of Barriers to Protect Westslope Cutthroat Trout Populations from Genetic Introgression and Competition by Nonnative Salmonids,*** David C. Moser* (Montana Fish, Wildlife and Parks), Bradley B. Shepard (Montana Fish, Wildlife and Parks, retired), and Lee M. Nelson (Montana Fish, Wildlife and Parks)

11:05 ***Dams Influence Patterns of Hybridization between Native Westslope Cutthroat Trout and Nonnative Rainbow trout,*** Shana Bernall* (Avista Corporation), and William Ardren (U.S. Fish and Wildlife Service)

11:25 ***Yellowstone Cutthroat Trout Conservation in Lower Deer Creek: Population Replication, Nonnative Suppression, Barrier Construction, and Piscicide,*** Carol Endicott* and Jeremiah Wood (Montana Fish, Wildlife and Parks)

11:45 ***Westslope cutthroat trout restoration in the South Fork Flathead River drainage: conservation biology in practice,*** Matthew C. Boyer*, Gary Michael, Mark Schnee, Lynda Fried, and Kris Tempel (Montana Fish, Wildlife and Parks)

12:05 **Adjourn!**

Contributed Papers
Moderator: Mark Novak (Natural Resources Conservation Service)

8:00 **Welcome and Announcements:** Craig Barfoot (Confederated Salish and Kootenai Tribes)

8:05 ***Variable spawning movements and recruitment implications for walleye (Sander vitreus) in a snowmelt driven, run-of-the-river reservoir,*** Chris Horn (Montana Fish, Wildlife and Parks)

8:25 ***Larval Paddlefish and Shovelnose Sturgeon in the Flow-Regulated Missouri River Below Fort Peck Dam, Milk River, and Yellowstone River,*** David B. Fuller*, Ryan Lott (Montana Fish, Wildlife and Parks) and Patrick J. Braaten (U.S. Geological Survey)

8:45 ***The Influence of Milk River Spring Flows on the Fish Community of the Lower Missouri River System,*** Tyler Haddix*, David Fuller, Landon Holte, John Hunziker, and Ryan Lott (Montana Fish, Wildlife, and Parks)

9:05 ***Western Pearlshell Mussel Translocation Project in the Blackfoot River Watershed: How not to treat mussels prior to relocation,*** David M. Stagliano* (Montana Natural Heritage Program) and Ron W. Pierce (Montana Fish, Wildlife, and Parks)

9:25 ***Lake Helena Willow Bank Stabilization Demonstration,*** Jeff Ryan* (Montana Department of Environmental Quality)

9:45 **Break**

Contributed Papers
Moderator: Ryan Lott (Montana Fish, Wildlife and Parks)

10:05 ***Quantifying habitats for large brown trout provided by different flows to make instream flow recommendations in Rush Creek, Mono County, California,*** Ross Taylor (Ross Taylor and Associates), Ken Knudson (KNK Aquatic Ecology), and Bradley B. Shepard* (B.B. Shepard and Associates)

10:25 ***Use of a seismic air gun to reduce survival of salmonid embryos: a pilot study,*** Benjamin S. Cox* (Idaho Cooperative Fish and Wildlife Research Unit, Andrew M. Dux (Idaho Department of Fish and Game), Michael C. Quist (U.S. Geological Survey), and Christopher S. Guy (U.S. Geological Survey)

10:45 ***Fish populations on the Bitterroot National Forest 10 years after the 2000 wildfires,*** Michael Jakober *, Robert Brassfield (Bitterroot National Forest), Chris Clancy. Leslie Nyce (Montana Fish, Wildlife and Parks), and Clint Sestrich (Kootenai National Forest)

11:05 ***Montana In-Lieu Fee Aquatic Resource Mitigation Program: First Aid for Death by a Thousand Cuts,*** Patrick A. Byorth (Trout Unlimited, Inc.)

11:25 ***Broad-scale genetic and compositional monitoring of fish populations: a proof of concept in the interior Columbia River and upper Missouri River basins,*** Michael K. Young *, Kevin S. McKelvey, and Michael K. Schwartz (Rocky Mountain Research Station)

11:45 ***Genomics and the future of fisheries management,*** Gordon Luikart*, Stephen J. Amish, Fred W. Allendorf, (University of Montana) and Robb F. Leary (Montana Fish, Wildlife and Parks, University of Montana)

12:05 **Adjourn!**

Posters:

Evaluating the factors associated with the distribution of Yellowstone cutthroat trout: a rangewide analysis, Robert Al-Chokhachy*, (U.S. Geological Survey), Bradley B. Shepard (Montana Cooperative Fishery Research Unit), Bob Gresswell, and Steve Hostetler (U.S. Geological Survey)

Cutthroat trout and brook trout population dynamics in Sheppard Creek in response to nine years of varying brook trout suppression effort (i.e. Has ethnic cleansing of 9,400 brook trout made any difference?), Beth Gardner* (Flathead National Forest)

Pallid Sturgeon Population Assessment Project, Landon Holte*, John Hunziker, and Tyler Haddix (Montana Fish, Wildlife and Parks)

Massive air and stream temperature sensor networks for studying microclimatic variation in mountain landscapes of the northwest U.S., Daniel J. Isaak* (U.S. Forest Service), Jason B.

Dunham (U.S. Geological Survey), Brett B. Roper, Zachary A. Holden, Charles H. Luce (U.S. Forest Service)

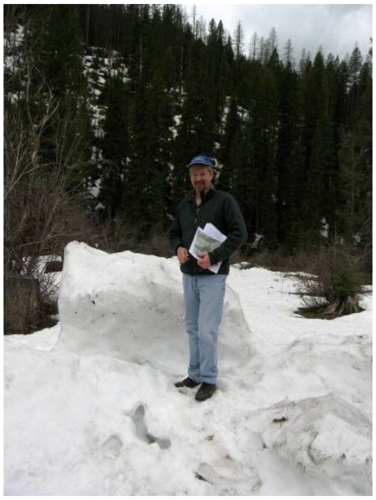
Reliability, Utility, and Political Relevance of State Generated Reference Stream Data in Western Montana, Jonathan Leiman (University of Montana)

Binomial confidence interval construction as a cost saving measure in hybridization studies, John H. Powell*, (Montana State University), Robb F. Leary (Montana Fish, Wildlife and Parks, University of Montana), and Steven Kalinowski (Montana State University)

Importance of Seasonally Inundated Secondary Channels for Yellowstone River Fish, Ann Marie Reinhold*, Robert Bramblett, and Alexander Zale (Montana Fish State University)

Climate change impact on salmonid spawning site stability in low-gradient streams: a central Idaho example Daniele Tonina (University of Idaho) and Jim McKean (US Forest Service)

Plenary Speaker Abstracts and Biographies



Bull Trout and Systemic Change in Western Montana: the Hidden Origins of Our Ecological Crisis

THOMPSON SMITH
Salish-Pend d'Oreille Culture Committee
Confederated Salish and Kootenai Tribes
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Abstract: On June 5, 1998, at the confluence of the Clearwater and Blackfoot Rivers, then Secretary of the Interior Bruce Babbitt announced the listing of all bull trout populations in the Columbia and Klamath basins as a threatened species under the Endangered Species Act. That moment twelve years ago marked the belated beginning of more serious and aggressive government efforts to save and restore *Salvelinus confluentus*. It also officially acknowledged the decimation of this once abundant fish throughout its range in the lower 48 states. To fully understand the environmental history of bull trout in western Montana, however, we must also understand the human history of the region. For the destruction of bull trout was inextricably bound up with the displacement of native peoples and the marginalization of tribal ways of life. For the Salish and Pend d'Oreille people, whose aboriginal territories coincided with bull trout habitat in western Montana, this fish was a surprisingly crucial component of one of the most sustainable human cultures the world has ever seen. For thousands of years, in fact, bull trout were so abundant that many places in the tribal landscape were named for this fish — including such key sites as the confluence of Rattlesnake Creek and the Clark Fork River (Place of the Small Bull Trout), the confluence of the Blackfoot and Clark Fork Rivers (Place of the Big Bull Trout), Silver Bow Creek (Place Where Bull Trout Were Shot in the Head), and Monture Creek (Bull Trout Creek). But in the span of less than a century, these places were rendered virtually devoid of bull trout, particularly the large adfluvial populations that once migrated upstream in vast numbers from Lake Pend Oreille in northern Idaho. Blocked by dams, choked by mine waste, their spawning beds gouged and silted by logging and log drives, fished with explosives, faced with competition and predation by introduced species, the bull trout had, by the second half of the twentieth century, retreated to a few pristine redoubts. The history of bull trout is a history of systemic transformation, of the displacement of one economic and ecological system by another. As fisheries scientists and program managers attempt to protect this remarkable and critically imperiled fish, it is important to explore how this happened, and how the past may help guide us to a more sustainable future. Drawing from a rich blend of scientific literature, tribal oral histories, and archival research (including dozens of historic images), this talk is based on the speaker's essay, "Aay u Sqelix□^{w}: A History of Bull Trout and the Salish and Pend d'Oreille People," written for the interactive DVD *Explore the River: Bull Trout, Native People, and the Jocko River* (Lincoln: The University of Nebraska Press, forthcoming 2011).

Biography: Thompson Smith has worked on history and geography projects for the Salish-Pend d'Oreille Culture Committee, a department of the Confederated Salish and Kootenai Tribes, since 1991. Projects have included "The Salish People and the Lewis and Clark Expedition" (The University of Nebraska Press, 2005). Smith is the author of "Aay u Sqélix□^{w}: A History of Bull Trout and the Salish and Pend d'Oreille People," to be published as part of the Tribes' interactive DVD, directed by Germaine White and created by David Rockwell, "Explore the River: Bull Trout, Tribal People, and the Jocko River" (The University of Nebraska Press, forthcoming 2011). Smith also wrote some 40 essays on the history of fire and the Salish and Pend d'Oreille people for the Tribes' interactive DVD, also directed by White and created by Rockwell, "Fire on the Land: Native Peoples and Fire in the Northern Rockies" (The University of Nebraska Press, 2007). Smith wrote, produced, and directed, with Roy Bigcrane, the award-winning documentary film "The Place of the Falling Waters" (Native Voices Public Television Workshop and Salish Kootenai College, 1991). Smith received his BA, MA, and M.Phil. in American Studies from Yale University, where he is now completing his doctoral dissertation.

Rainbow Trout and American Fisheries Management: How did we get here and what have we learned?

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Abstract: Rainbow trout (*Oncorhynchus mykiss*) are the most intensively stocked fish in the United States, and state and federal hatcheries produce more of them today than ever. In 2004, about 100 million of these fish weighing 25 million pounds were introduced into the country's fresh waters. At the same time, in the name of restoring native fish and other fauna, these same agencies are devoting an increasing amount of their resources to removing rainbow trout from waters to which they are not native. Both stocking and removal of these fish frequently generate intense conflict. However, both sides in the accompanying debates often seem to justify their positions in terms of science and the law, while the individual and cultural values that initially generated the conflict remain unexamined or acknowledged. I will discuss the cultural and historical origins of the hatchery and stocking movement in the United States in the late 19th century and the reasons rainbow trout became such a popular fish among fisheries managers and anglers alike. I will trace these themes through the 20th century, emphasizing effects on native fish, and will discuss the ways in which they pertain to fisheries management issues today.

Biography: Anders Halverson received his Ph.D. in Ecology and Evolutionary Biology from Yale University. As a research associate at the University of Colorado's Center of the American West, he received a grant from the National Science Foundation to write a book about current and historical issues in freshwater fisheries management. The product was *An Entirely Synthetic Fish: How Rainbow Trout Beguiled America and Overran the World*. Since it was published in March, 2010, the book has received critical acclaim. The *Washington Post* called it "an absorbing cautionary tale of ecological trial and error," and *Science* declared that it "entertainingly introduces some of the most tangled questions in conservation biology." Anders currently lives in Boulder, Colorado, with his wife and three sons. He is working on his next book.

The Voyage of Discoveries in the Rugged Sierra Madre Occidental of Mexico: The Biodiversity and Conservation of Newly Discovered Trout Species

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Abstract: Resident freshwater trout of *Oncorhynchus* form a significant component of the biodiversity in streams, rivers and lakes of western North America. While trout from the western United States and Canada have received extensive systematic and population genetic investigation, the full range of diversity of native trout endemic to the Sierra Madre Occidental (SMO) of northern Mexico has gone largely unknown and ignored. Only recently has this native diversity received any serious investigation in terms of collecting, biological investigations, and morphological and molecular studies. Over the last 12 years our the binational group *Truchas Mexicanas* has been studying the native trout diversity in Mexico and herein we propose systematic relationships among a series of new trout species to be recognized, managed, and conserved . In this study we present the first phylogenetic hypothesis for this native fauna based on mtDNA sequence data. We place the recovered lineages in a geographic context and use these hypotheses for understanding the native diversity. Stocking of non-native *Oncorhynchus* threatens the native fauna through hybridization in some regions. A consortium of biologists from Mexico and the USA are diligently working to advise governmental agencies to enable information-based management of the native trout. However, this is a very large, time-consuming, and expensive task to protect these species from imperilment as ground-waters are diminishing, human populations are expanding, and significant promotion of hatchery trout continues in Mexico. It is hoped that *Truchas Mexicanas* can recruit needed physical, mental, and financial assistance in developing long-term strategies for the continued existence of this fauna.

Biography: Dr. Richard Mayden is a Professor of Biology and the W. S. Barnickle Endowed Chair of Natural Sciences in the Department of Biology St. Louis University. He received a B.S. in Ecology, Ethology, and Evolution from the University of Illinois, a M.A. in Zoology from Southern Illinois University and a M.Ph. and Ph.D. in Systematics and Ecology from the University of Kansas. His research interests and specialties include Systematics, morphology, evolution, taxonomy, ecology, and biogeography of North American fishes; biodiversity; conservation biology; species concepts and speciation; phylogenetics in comparative biology; phylogenetic treatment of morphological and molecular data; museum conservation, preservation, and database practices; GIS and biodiversity and conservation. In addition to North America, his field research is focused on species and ecosystems in southeast Asia, Chile, Kazakstan, Russia, Turkmenistan, and Mexico. Along with numerous collaborators in the USA and Mexico he is involved with a large-scale and long-term study of Mexican trout species and the aquatic biodiversity of the northwestern Sierra Madre Occidental of Mexico. He additionally oversees the Cypriniformes Tree of Life International Collaborative research initiative that involves scientists from around the world (Visit www.cypriniformes.org to learn more), and maintains an active research laboratory involving undergraduate, graduate students and postdoctoral researchers studying the systematics, ecology, and biogeography of freshwater fish species.

Taimen and taimen conservation efforts: blending science and economics to establish a viable catch and release taimen fishery as an alternative to more destructive resource extraction industries within the Eg Uur watershed

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Abstract: In 1995, Dan Vermillion and his brothers opened the first fly-fishing only operation in Mongolia for Taimen. As the world's largest salmonid, Taimen reach 60 plus inches in length and have topped the scales at 200 pounds. Taimen once had the largest distribution of all the salmonids. Today, as a result of pollution, habitat destruction, and overfishing, the Taimen is struggling to survive in its last remaining watersheds. Through his experiences as a guide and lodge owner in Mongolia, Dan has developed a passion for conserving some of the world's most productive Taimen habitat. This passion led Dan to form the world's first Taimen Conservation Project in the Eg Ur watershed in Mongolia. The Taimen Conservation Fund received an innovative grant from the Global Environmental Facility and a Development Marketplace award from the Honorable James Wolfensohn as President of the World Bank. The Taimen Conservation Fund, and its corresponding 501(c) (3) non-profit the Tributary Fund, have successfully preserved the Taimen in the Eg Ur, constructed a Buddhist monastery as the cultural basis for preserving the Taimen, and have contributed to the sustainable economic development within the Eg Ur watershed. This conservation project will hopefully be replicated throughout Mongolia and hopes to serve as a model for future projects in Bhutan and India.

Biography: Dan Vermillion was raised on the banks of Yellowstone River in Montana. After spending years guiding some of the world's most exotic and famed fisheries, Dan formed

Sweetwater Travel with his brothers, Jeff and Pat Vermillion. Sweetwater Travel is based in Livingston Montana and owns and operates fishing camps in Mongolia, Brazil, Alaska, British Columbia, and Montana. He is also the Commissioner for southwestern Montana for Montana Fish, Wildlife, and Parks

Attitudes, opinions, and perceptions of Montanans regarding Montana's native fish

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Abstract: This presentation will present results from a 2001 survey of residential households in Montana concerning Montana's native fish. The purpose of the study was to provide Montana Fish, Wildlife & Parks with information to support agency outreach efforts aimed at better informing the public about Montana's all-important populations of native fish. Specific information sought in the study included awareness of Montana's native fish, opinions concerning the management of Montana's native fish, and perceptions of the most urgent issues facing the conservation of Montana's native fish.

Biography: Mike Lewis is currently the Human Dimensions Unit Supervisor for Montana Fish, Wildlife & Parks (FWP). Human dimensions is the people aspect of managing natural resources. The HD Unit within FWP focuses on what people think and do regarding Montana's fish, wildlife and park resources; understanding why; and, incorporating that insight into policy, planning, and management decision making processes. Mike has been with FWP for the past 11 years. Prior to that he worked for the Minnesota Department of Natural Resources as a planner and at the University of Minnesota (Department of Natural Resources) as a research fellow. Mike was born in Bozeman and currently resides in Helena, Montana with his wife and three daughters.

A pragmatic approach for conserving native fish AND providing angling opportunities on common biological and social landscapes

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Abstract: Bruce will use a variety of case studies to discuss some of the challenges before us in trying to conserve native fish and at the same time provide quality fishing (and EEK!...even harvest opportunity) for native and introduced fish on Montana's diverse landscapes. No, not up on the mountains versus out on the prairie… but on the biological and social landscapes. In the discussion, past and present direction of fisheries management in Montana will be described, but most importantly, how we might be successful in 'having our fish and eating them too' in the future.

Biography: Bruce has a B.S. in Fisheries Management from THE Ohio State University and a M.S. in Fishery Resources from the University of Idaho. He has been working professionally in fisheries since 1982 when his first job was at the Hebron Fish Hatchery in central Ohio raising various warmwater species AND some Rainbow trout. He then worked as a Fisheries Management Unit Leader for the Ohio Division of Wildlife in SE Ohio and as a Wild Steelhead and Chinook Salmon research biologist and regional fisheries management biologist for Idaho Fish & Game. In 1996 Bruce and his family moved to Bozeman where he was the regional fishery manager for Montana Fish, Wildlife & Parks for over 13 years, and since February of last year he has been the Chief of Fisheries for FWP in Helena. Bruce is a AFS life member and has been an active member for over 30 years, including stints as President of the Palouse Student Subunit and 2 years on ex-comm for the Idaho Chapter.

Fun to catch, fun to study, fun to respect – the conservation-minded angler and native fish conservation

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Abstract: Jeezus, I mean a trout's a damn trout.

- Overheard at a public meeting on native trout conservation in Kalispell

The value some anglers place on native species, as well as their views on better balancing native fish conservation with management of popular introduced species has changed significantly in recent years. This value shift among Trout Unlimited members probably results from a mix of social considerations, including the organization's roots in progressive fishery management, as well as the diminished need society has for consumptive fisheries. Most importantly, Trout Unlimited members and other conservation-minded anglers have become more supportive of native fish conservation because of improved knowledge as well as an incremental – and almost imperceptible – shift in how they value a fishery, especially as it embodies culture, heritage, recreation, scientific curiosity, recreation, economics, esthetics and ethics.

Biography: Bruce Farling is in his 18th year as executive director of Montana Trout Unlimited. Previous to that he was conservation director for six years for the Clark Fork Coalition, a regional watershed conservation group. Mr. Farling also worked for the U.S. Forest Service for 10 years, including nine years in Montana and Idaho working in wilderness management. He has a B.S. from the University of Oregon in Environmental Sciences and completed course work towards an M.A. in the University of Montana School of Journalism. In 2009, Trout magazine named him one of the 10 most influential people in the 50-year history of Trout Unlimited.

Trash Fish to Trophy - How Bull Trout Have Spruced Up Their Image, With Support from the ESA

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Abstract: For nearly 10,000 years bull trout have been an apex predator, dominating much of the freshwater habitat of the Pacific Northwest. The enlightened age of angling that began in the late 1800's attempted to sort bull trout into the "trash fish" bin of history. As George Colpitts opined, in 1994: "The bull trout's failings – its image as a cowardly and lethargic sport fish, its flesh termed "insipid", and its character blighted by a reputation for cannibalism – targeted it, among other species, for eradication by conservationists intent upon creating a perfect underwater world." As the 20th century progressed, some of the bloom went off the pretenders that were being promoted to replace bull trout in the angling hierarchy; other species were often overhyped, but under-delivered in terms of their biological capabilities as well as sporting and eating qualities. Bull trout, still around and still largely underappreciated, began a resurrection of sorts in the 1970's. Forward-thinking biologists such as Montana's Joe Huston inspired a new generation of scientists, working with mitigation in mind instead of sport fish enhancement. This scenario was repeated elsewhere, including B.C. and Alberta. The more scientists looked, the greater the appreciation became for the unique attributes of bull trout, culminating in 1998 with their listing as threatened under the Endangered Species Act. Groups such as the "*Salvelinus confluentus* Curiosity Society" and "Friends of the Bull Trout" sprang up and today, a bull trout reawakening is occurring amongst the public. Aided by digital photography and the internet, bull trout are increasingly being added to anglers "bucket" lists. If bull trout can weather the swarm of introduced competitors and predators and keep cool during climate change, they could have a secure future in the Columbia River headwaters as an increasingly rare and valuable species further championed by anglers.

Biography: Wade is an inbred (post-F1) Montanan and received B.S. and M.S. degrees in Fish and Wildlife Management from Montana State University in 1978 and 1980. During the next twelve years he was employed by Montana Fish, Wildlife and Parks in Billings where he worked on the Bighorn and Musselshell Rivers and in Bozeman (home of the reigning Big Sky Football Champion Bobcats) where he had the good fortune to guide management on the Madison and Gallatin Rivers. He sold out to the Feds in 1992, and has been in Kalispell ever since, where he has held a variety of progressively irresponsible Native Fish and Bull Trout Coordinator duties for the U.S. Fish and Wildlife Service. He has been stunned at how many of his same-age peers have recently moved toward the ranks of the retired (retread), but through it all has maintained an inquisitive mind and a passion for Montana's fish.

A strategy for conserving native fish in our national parks

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Abstract: Montana's national parks lie at the core of large protected wilderness areas. Despite widespread stocking of nonnative species for many decades (through mid-1900s), the remoteness of many park waters allowed for the persistence of genetically unaltered native fish populations. However, the patterns of fish distribution have not been static. Invasion of interconnected habitats and anthropogenic (illegal) introductions continues to expand the range and increase the abundances of nonnative fish. Further native fish loss will only be curtailed by aggressive conservation actions. At Yellowstone National Park, a hierarchical series of desired conditions were developed for native fish. Within an adaptive management (ADM) framework, long term monitoring of performance metrics will be used to determine success or failure of the conservation actions. Assessment and research by peers will guide required changes in the conservation actions applied and/or in the desired condition to be achieved. Uncertainty inherent in the ADM approach provided unique challenges when assessing resource impacts during a NEPA compliance process. In addition, other long-standing regulatory processes do not facilitate a true ADM approach as they often require specific, prior knowledge of actions to be taken and areas/amounts of resources to be impacted.

Biography: For the past decade Todd Koel has served as leader of the Fisheries & Aquatic Sciences Program at Yellowstone National Park. In this position Koel supervises a large staff and guides activities related to native fish preservation and restoration, with an emphasis on the cutthroat trout of Yellowstone Lake. Koel also serves as the Safety Coordinator for his division, the Yellowstone Center for Resources. Koel holds affiliate and graduate faculty status at Montana State University, University of Wyoming, and the University of North Texas. Through collaborations with faculty and USGS researchers at these schools, Koel is able to promote graduate student involvement and play an active role in applied research within Yellowstone. To date Koel has published 16 peer-reviewed science articles and authored numerous technical

reports. Reports are written in a style suitable for science partners and the public alike, including donors of private funding provided to his program via the Yellowstone Park Foundation.
A native of northern Minnesota, Koel received his Ph.D. in Zoology from North Dakota State University in 1997. After teaching at colleges in Minnesota and North Dakota, he served as Riverine Fish Ecologist and Interim Field Station Director for the Illinois Natural History Survey at Havana. He later worked for the Minnesota DNR at Lake City, where he led the Fish Component of the USGS Long Term Resource Monitoring Program for the Upper Mississippi River System. When not working on conservation of cutthroat trout, Koel spends most of his time with his family (including four young boys) or roaming the backcountry of the Greater Yellowstone Ecosystem with his two mules Ned and Ted.

Using science to make fish conservation decisions

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Abstract: Fish managers represent the citizens as stewards of our fish resources. As our representatives, fish managers have an obligation to clearly communicate all information used to make management decisions. Scientific information plays a critical role in this decision-making process; however, decision-makers must also consider political, social, and economic information in their decisions. Successful conservation of native fish species requires long-term commitments of public resources and a relatively high level of uncertainty. In order to deal with this uncertainty in our decision-making we must first acknowledge it exists. To do that we must evaluate, and communicate to the public, the levels of uncertainty in scientific, political, social, and economic information that are used to make each management decision. Two ways to deal with these uncertainties are to diversify conservation strategies and apply adaptive management procedures. Scientific research and monitoring are necessary for adaptive management and can be used to reduce uncertainty. We must strategically implement and evaluate different conservation strategies and then share and apply what we learn by monitoring them.

Biography: Brad received a BS in Fish and Wildlife Management from MSU in 1975, a MS in Fishery Resources from the University of Idaho in 1982, and a PhD in Fish and Wildlife Biology from MSU in 2010. He worked for Montana Fish, Wildlife and Parks (FWP) from 1977 to 1978 and from 1981 to 2010 and retired from FWP in 2010. While employed by FWP Brad worked as a Fisheries Biologist from 1982 to 2010 in Kalispell, Libby, Dillon, Bozeman, and Livingston. While at FWP he served as the Cutthroat Trout Conservation Coordinator, liaison for fish research between FWP and Montana Cooperative Fishery Research Unit, contract research fish biologist, cooperative fish biologist with USDA Forest Service Beaverhead National Forest, and district fish biologist in Livingston. Brad now works part-time as a private fisheries consultant and is also doing research through the Montana Cooperative Fishery Research Unit at MSU.

Plenary Presentations Moderator and Panel Discussion

Dr. Lisa Eby is an Associate Professor of Aquatic Vertebrate Ecology at The University of Montana. She received her B.S. in Zoology and M.S. in Limnology and Oceanography from the University of Wisconsin in Madison and Ph.D. in Aquatic Ecology from Duke University. After working briefly as a postdoctoral researcher at Arizona State University, she was hired by the Wildlife Biology Program and the College of Forestry and Conservation. She currently teaches Fish Biology, Fisheries, Research Design and graduate seminars in Aquatic Ecology. Since arriving in Montana, her lab's research has primarily focused around how disturbance and landscape structure influences fish and amphibian populations, as well as the impacts of exotic species on native trout.

Contributed Paper Abstracts (In order of presentation)

Systems Analysis of Introgressive Hybridization among Trout: assessing Crossing, Fitness, Dispersal Rates, and Landscape Connectivity as Drivers of Genetic Structure in Hybridized Populations

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Introgressive hybridization with introduced rainbow trout (*Oncorhynchus mykiss*) is one of the major threats to cutthroat trout (*O. clarkii*) across their entire native range and has been the topic of fisheries research for decades in the northern Rocky Mountains, USA. Although large datasets have been collected to document the spread of introgression across stream networks, these datasets are not typically used to assess the importance of different mechanisms that drive the spread of non-native genes across stream networks. In the last year, we developed a novel,

system-level simulation model aimed at investigating and quantifying the relative importance of the four drivers critical to the spread of non-native genes across heterogeneous landscapes, namely: i) *propensity to crossbreed;* ii) *fitness;* iii) *dispersal rates,* and; iv) *landscape connectivity*. We are conducting analyses designed to detect the sensitivity of different aspects of introgression (such as rate of spread and changes in introgression levels at single locations over time) to the four aforementioned drivers of gene movement. The results of these analyses suggest that each driver affects patterns of introgression across networks in a different way. Thus, patterns of introgression measured in the field might hold clues to the relative importance of each driver as a control on the overall spread of introgression, therefore increasing our ability to effectively manage the spread of non-native genes in river networks.

A proposal to examine individual differences and among-population differences in dispersal in introduced populations of westslope cutthroat trout

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Dispersal can have a substantial impact on individuals, populations, and species, yet we know little about the causes and effects of dispersal in westslope cutthroat trout (WCT). As a warming planet further changes environments, the long-term persistence of WCT will depend on individuals' ability to change behavior (phenotypic plasticity), and the potential of populations to evolve. We have proposed a research project that will examine the variation in dispersal among populations *and* among individuals. The researchers have previously introduced embryos from five populations of WCT to common habitats. To date, over 1200 fish have been sampled at least once, tagged for future identification, and genotyped. The researchers have submitted a grant proposal to the National Science Foundation to continue to follow dispersal in this system using portable PIT tag antennas and electrofishing. Analysis of the available data shows that populations display different dispersal patterns. In addition to population differences, research to date in this system shows substantial individual differences in dispersal behavior. Multiple hypotheses have been proposed to explain individual variation in cutthroat trout dispersal, but no consensus has been reached. A comprehensive model is necessary to understand how an individual's genotype and environment interact to affect dispersal. In conclusion, the researchers hope to use past and future population sampling data, already completed genetic analysis, and future habitat sampling to test hypotheses about why populations of WCT display different dispersal patterns and why individual dispersal differs so substantially within one system.

Conservation Genetics of Sauger in the Upper Missouri River Drainage

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We analyzed 11 microsatellite loci to determine the genetic population structure of sauger, *Sander canadensis*, and the threat of hybridization with widely introduced, non-native walleye, *S. vitreus*, in the upper Missouri River drainage. We found substantial genetic variation within and little genetic differences among most samples. Exceptions were the samples from the

Bighorn River drainage and upper Yellowstone River drainage that were quite divergent between themselves and all other samples. The Bighorn and upper Yellowstone samples also had reduced genetic variation compared to other samples. Transfer of sauger between the Bighorn and upper Yellowstone into other portions of the upper Missouri drainage, therefore, is not recommended. We detected only eighteen hybrids between sauger and walleye out of 925 individuals analyzed. All but three of the hybrids were post F_1. Thus, the samples did not come from hybrid swarms. Only one hybrid was detected in the Missouri River, and all others were detected in the largely unaltered Yellowstone River drainage near the confluence with the Tongue River despite a 90% higher rate of stocking in the Missouri River drainage. The near absence of hybrids despite massive walleye stocking is surprising. It might be due to environmental or intrinsic natural selection against hybrids. The presence of hybrids could still be harmful because their production represents wasted reproductive effort.

Genetic Population Structure of Bull Trout in the East Fork Bitterroot River, Montana

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Investigating the genetic population structure of bull trout *Salvelinus confluentus* can be useful for developing biologically sound conservation and management strategies. We focused on the East Fork Bitterroot River (East Fork) drainage because it is a connected, core conservation area for bull trout that contains a migratory life history component. Non-lethal fin samples were collected from 17 sites: nine East Fork tributaries, the main stem East Fork, and seven other tributaries across the Bitterroot drainage. Considering all the samples, principal component analysis of allele frequencies at 15 microsatellite loci indicated the East Fork samples formed a distinct cluster compared to other tributaries sampled. Within the East Fork drainage, there was significant divergence among samples with pairwise F_{st} ranging from 0.016 to 0.188. Based on multiple locus genotypes, most individuals assigned to their tributary of capture with over 90% probability, suggesting the tributaries contain genetically divergent populations. The main stem East Fork sample tended to form its own group, but some fish collected from it also assigned to tributaries. These data suggest the East Fork may contain a mixture of individuals produced from spawning in the upper main stem and migrants from different tributaries. The main stem East Fork appears to be an integral component for maintaining the migratory form of bull trout in the drainage and serves as a vehicle for potential genetic exchange among tributary populations. Thus, conservation and management efforts in the drainage need to simultaneously focus on the tributaries and the main stem East Fork.

Conservation of westslope cutthroat trout in the presence of rainbow trout introgression while considering life history and a watershed-level approach to management

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Management of native westslope cutthroat trout (WCT) is a difficult issue, especially where productive sport fisheries comprised of nonnative fishes complicate watershed-wide conservation efforts. Hybridization with nonnative rainbow trout (RBT) is possibly one of the greatest contributors to WCT decline throughout their range. We collected 62 population genetic samples from WCT and RBT populations in the Jocko River watershed, MT in 2005-2009 to describe the distribution of WCT x RBT hybrids. We detected at least one RBT allele in at least

one individual at 51 sample locations. Although we detected a signal of widespread introgression, sample proportions of RBT alleles were below 5% in 43 (69%) of the population samples, despite the long term presence of RBT in the drainage. Patterns of introgression were driven primarily by distance from the source of RBT, but elevation is likely an important driver as well. The next step in developing a conservation strategy is to understand life history diversity of WCT, RBT, and hybrid populations. We developed length-fecundity relationships using 119 adult females collected at two upstream migration traps and by electrofishing prior to spawning in several locations. We also assessed migration timing differences between WCT and hybrids using arrival date in migration traps. Preliminary results suggest hybrids with >20% RBT alleles tend to arrive in migration traps earlier and have reduced fecundity than individuals with fewer RBT alleles. Given these life history differences, it seems important to reduce further potential for introgression wherever possible. By using a suite of management tools and a watershed approach to setting conservation guidelines, opportunities may exist in the Jocko River watershed to balance conservation of unhybridized populations of WCT and mildly introgressed WCT populations (with high conservation value) with maintenance of a viable sport fishery for WCT, RBT, hybrid trout, and other salmonid species.

Reconnecting a small population of migratory westslope cutthroat trout in a complicated drainage: Can we do it, or tell if it worked?

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In 2001, radio telemetry indicated that adult westslope cutthroat were ascending Skalkaho Creek during the spawning period despite diversion dams that appeared to be barriers. Surveys revealed that significant numbers of westslope cutthroat, bull trout and brown trout were being entrained in irrigation ditches from the creek. We have attempted to assist post spawning downstream movement of adult and juvenile westslope cutthroat trout by minimizing entrainment in 5 ditches. During 2004, three irrigation ditches from Skalkaho Creek were screened. In 2008, two large irrigation ditches from the Bitterroot River that intercept Skalkaho Creek were siphoned under the creek. Two graduate projects verified that the screens were effective and siphons should lessen mortality of adult cutthroat trout. Remaining issues are a dewatered reach, an abundant brown trout population in lower Skalkaho Creek and possibly water temperature in the Bitterroot River. While no focused monitoring project has been ongoing during this time period, four different sampling efforts have been undertaken to assess the effectiveness of the projects. Two efforts at pre and post- project electrofishing in Skalkaho Creek have shown mixed results. Pre and post-project screw trapping indicates little change and sampling in the Bitterroot River near Skalkaho Creek is inconclusive. The difficulty of collecting high quality monitoring data to assess restoration efforts for small populations of migratory fish in altered streams will be discussed.

Water: Is it working?

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The Yellowstone River population of Yellowstone cutthroat trout is reliant on tributary streams for successful spawning and recruitment. Water is a limiting factor in redd viability and fry migration in the upper Yellowstone River system. Historically many of these tributaries have been severely dewatered through irrigation. At times, as much as 96% of the in-stream flow had been diverted. As a result many Yellowstone cutthroat trout redds were severely impacted and at times there were no flows to allow emergent fry to migrate downstream to the Yellowstone River. Montana Fish, Wildlife & Parks began leasing water in Locke, Big, Cedar, Mill, and Mol Heron Creeks in order to keep redds viable and allow for fry migration back to the Yellowstone in late August. The success of these leases has been evaluated through the use of redd counts, fry trapping, and population monitoring in long-term sampling sections of the Yellowstone River. The leases have been successful in improving redd viability and producing fry that migrate to river. There is some evidence that river populations have been positively affected by recruitment from these tributaries during low water or drought cycles. While water leasing can be viewed as expensive and it is difficult to show population impacts in a larger system there is evidence that water leases have been successful in Yellowstone cutthroat trout conservation.

Stream restoration over two decades: Wild trout response to conservation strategies in the Blackfoot River Basin, Montana

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Over the past century, anthropogenic habitat degradation has resulted in salmonid declines across the American West. We examined the response of wild trout to reach-scale stream improvement projects from 1989–2010, primarily on private ranchlands in the Blackfoot River Basin, Montana. We estimated population densities to evaluate the response of age 1+ native and nonnative trout to improvements on 18 streams. Three years after project completion total trout density across all streams increased 51% from pre-treatment conditions ($p=0.034$) and was no longer statistically different from reference streams ($p=0.19$). Improvements on nine of 18 streams were followed by statistically significant increasing trends in total trout density. Although not statistically significant, we observed sustained increases in trout densities on six additional streams post-treatment. Generally, the most common species prior to stream restoration sustained the largest increases following restoration. However, several streams have displayed a community level shift from nonnative to native species within seven years of treatment. Overall, stream improvements are contributing to the expansion of native fish populations across tributaries and the main-stem of the lower Blackfoot River. Our unique long-term data set suggests that long-term success of stream restoration depends most heavily on maintaining efforts that mediate human impacts to aquatic systems. The overall success of stream restoration across the Blackfoot River Basin can be attributed to the landscape approach to conservation, the collaborative efforts between stakeholders, and scientific monitoring which is used to adapt management and conservation strategies.

Fisheries Response to Big Hole Arctic Grayling Habitat Enhancement Projects

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The Upper Missouri River Distinct Population Segment of Arctic grayling (*Thymallus arcticus)* is classified as a "Candidate" species under the Endangered Species Act. The upper Big Hole River is currently home to the last known strictly fluvial Arctic grayling population in the contiguous United States. Declines in the Big Hole population's distribution and abundance have led to numerous conservation, research and management actions. In 2004, a habitat improvement project was implemented on Steel Creek by constructing a riparian fence and transplanting willows to stabilize stream banks and enhance native vegetation. Mean number of grayling captured during one-pass electrofishing surveys for the five year period following project completion (2005 – 2009; N = 60) nearly tripled from the five years prior (2000 – 2004; N = 22). Mean capture of burbot *(Lota lota)* and eastern brook trout *(Salvelinus fontinalis)* also increased considerably from pre-project (N = 19 & 198, respectively) to post-project surveys (N = 56 & 363, respectively). In 2006, a new channel of Rock Creek was constructed to improve habitat and relocate its mouth upstream of an irrigation diversion that would provide connectivity with the Big Hole River. Despite reestablishing connectivity and improving habitat, fisheries monitoring efforts (trapping, PIT antenna, spring/fall electrofishing), have located only one grayling within Rock Creek since project completion. Abundance of burbot and eastern brook trout also remain at low abundance. Because grayling did not naturally colonize Rock creek, remote site incubators are being used to reestablish grayling.

Stream restoration, non-native salmonid suppression, and transporting adult bull trout in an effort to enhance populations of bull trout in the East Fork Bull River

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Three major management strategies to enhance bull trout have occurred in the East Fork Bull River (EFBR) during the last ten years. Habitat restoration, adult bull trout transport, and non-native suppression efforts are being employed to increase densities of native fishes. In 2001 four hundred meters of the EFBR was rechanneled with an appropriate meander pattern and included large woody debris, j-hooks, and other restoration structures to add stability and provide fish habitat. These actions were aimed at improving habitat conditions for bull trout and westslope cutthroat trout. Fish population monitoring demonstrated a decrease in brown, brook, bull and westslope cutthroat trout in 2002, while following years show a six year increase in brown and brook trout densities. From 2001-2004 a mean of 36 adult bull trout were transported over Cabinet Gorge dam into Bull River bay annually. Beginning in 2005 an average of 9 bull trout have been moved over Cabinet Gorge dam into the Bull River bay. Bull trout redd counts during this time period illustrate the contribution of transported fish to the EFBR, while density estimates are varied. From 2007 to 2009 5,480 non-native brown, brook, and rainbow trout were removed through electrofishing and selective passage at fish traps in the EFBR. Positive responses including a significant increase of 279% for juvenile bull trout density and a 75% decrease in brown trout density was seen in 2009. Results have been mixed for each action and all are intertwined, although some appear to have more immediate preferred impacts.

Efficacy of stream habitat restoration to influence distribution and abundance of native and exotic syntopic salmonids

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Stream “restoration” is an industry in the US and the world. Much of stream restoration occurs in order to help or enhance populations of targeted native fishes (often a single species) in degraded habitats. Despite the popularity, restoration goals are seldom set, the limiting factors are frequently not accurately identified and little monitoring occurs. Even fewer studies objectively report results. Riparian areas in the semi-arid west are critical habitats for a variety of species and protection and restoration of these unique and precious lands is justifiably the goal in many conservation plans. Although degraded streams may be empirically obvious, the factors that limit fish production are often not well understood. In many cases projects occur in areas that contain non native fishes; typically syntopic salmonids. The reason that many exotic salmonids are successful is that they are physiological and phenotypically similar their syntopic counterparts. The goal of many projects is to alter the habitat favoring the natives- this implies that habitat is mediating these species interactions. Subtle changes in habitat alone is rarely effective at influencing species composition. Fish distributions and abundances are influenced by large-scale regional trends, yet many restoration projects occur on an inappropriate scale.

Indeed, the benefits of stream restoration likely transcend the perceived benefits to a single targeted species. A holistic view of the benefits of stream restoration are necessary to evaluate project success and failure and inform the public and practitioners of the benefits.

Monitoring and modeling stream temperature patterns associated with climate change across the northwest US

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A warming climate may bring unprecedented changes to stream and river ecosystems, with temperature considerations being of utmost importance, given that most aquatic organisms are ectothermic. Previous broad-scale assessments of climate impacts to streams have been limited by inadequate stream temperature data and have often relied on imprecise air temperature-elevation relationships as surrogates. Large regional databases of stream temperature observations are becoming available for the northwest US and can be used to address a host of research and management issues associated with climate change. For example, regional temperature databases are being used with new spatial statistical methodologies to develop models that can accurately predict stream temperatures for all reaches of fish-bearing streams under a variety of climate scenarios. These temperature models will be valuable tools for performing climate vulnerability assessments and for providing spatially explicit maps of

thermal habitats for different species. A regional stream temperature monitoring network is evolving that now consists of more than 1,500 sites where full-year data are being collected by numerous resource agencies. Data from these monitoring efforts can be applied to describe long-term trends, to understand short-term sensitivities of streams to climate forcing, to perform historical reconstructions that provide site-specific trend estimates, and to better define thermal criteria associated with species distributions, abundance, and developmental phenologies. In short, the ability to accurately measure and model stream temperature regimes across the region is rapidly improving and significant advancements in our understanding of stream thermal ecology are expected in future years.

Climate change links fate of glaciers and rare alpine aquatic invertebrates

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Climate warming in the mid- to high-latitudes and high-elevation mountainous regions is occurring more rapidly than anywhere else on Earth, causing extensive loss of glaciers and snowpack. However, little is known about the effects of climate change on high-elevation species, especially aquatic invertebrates. Here, we show a strong linkage between regional climate change and the fundamental niches of rare mountaintop aquatic invertebrates, including the meltwater stonefly *Lednia tumana* - endemic to Waterton-Glacier International Peace Park, Canada and USA. *L. tumana* has been petitioned for listing under the U.S. Endangered Species Act (ESA) due to climate-change-induced glacier loss, yet little is known on specifically how climate impacts may threaten this rare species and many other enigmatic alpine aquatic species worldwide. During 14 years of research, we documented that *L. tumana* inhabits a narrow distribution, restricted to short sections (~500 m) of cold, alpine streams directly below glaciers, permanent snowfields, and springs. Our simulation models suggest that climate change threatens the stability of these sensitive habitats and the persistence of *L. tumana* and other rare stream invertebrates, including several species of caddisflies (Trichoptera: Rhyacophilidae and Apataniidae), an ESA-petitioned stonefly (*Zapada glacier*), and a groundwater dwelling amphipod (*Stygobromus glacialis*), through the loss of glaciers and snowfields. Mountaintop aquatic invertebrates exhibit severe climate-related range-restrictions and are ideal early-warning indicators of thermal and hydrological modification that may be associated with climate warming in mountain ecosystems. Research on alpine invertebrates is needed to avoid extinctions and to predict effects of extirpation on ecosystem integrity and function worldwide.

Potential impacts of climate warming on aquatic ecosystems in the Northern Rockies: implications for native species conservation

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Climate change is rapidly altering aquatic ecosystems worldwide. Warming in the mid- to high-latitudes is occurring at two to three times the rate of the global average, and in high-elevation mountainous regions recent data show increased magnitude and rate of warming with extensive loss of glaciers and snowpack. These changes are likely to shift patterns in distribution, abundance, and phenology of many cold-water dependent species. Therefore, we partnered with scientists from the Forest Service and Trout Unlimited to examine how climate change may be impacting aquatic ecosystems throughout the interior western United States. Trend data indicate that the Northern Rocky Mountains are experiencing earlier and more rapid snowmelt in the spring, warmer drier summers, increased winter flooding, and loss of permanent snow and ice masses. Our regional downscaled climate models suggest that these changes in the hydrological cycle will likely continue to warm perennial streams, thereby threatening the suitability of habitats used by native salmonids, including the threatened bull trout *Salvelinus confluentus*, and rare alpine invertebrates, such as the ESA-petitioned endemic stonefly *L. tumana*. Furthermore, these changes may provide habitat conditions that favor introduced species, such as rainbow trout which hybridize with native westslope cutthroat trout *Oncorhynchus clarkii lewisi*. It is increasingly urgent to assess and monitor the status of species living in mountainous aquatic systems in order to fully understand their basic ecological requirements and use this information to model the potential impacts of climate warming across spatial scales from local to global.

The effect of spawning location on the distribution patterns, habitat use, and survival of Snake River finespotted cutthroat trout

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Potamodromous cutthroat trout express multiple life-history strategies that appear to be directly related to the physical habitat in which they evolved. Although there is a substantial amount of information concerning the habitat use and distribution patterns of cutthroat trout that live in lakes and ascend tributaries to spawn, information about populations in lotic environments is less abundant, and most studies have focused on the migration and spawning dynamics of cutthroat trout moving into tributaries to spawn. In larger river systems, however, spatiotemporal relationships between physical characteristics of the habitat and life-history organization of cutthroat trout may be more complicated. To better understand the life-history organization and habitat use of Snake River finespotted cutthroat trout *Oncorhynchus clarkii behnkei* in the upper Snake River, we implanted radio transmitters in 248 cutthroat trout and monitored distribution, habitat use, and spawning patterns for 12 months. Distribution patterns of spawners were spatially structured during the year spawning occurred. Habitat use and survival also differed among individuals from each spawning area. In an effort to explain patterns of habitat use, we are currently examining spatial relationships among available habitat, areas used for spawning, and the timing of life history events. This information will benefit efforts to conserve the life-history diversity of Snake River finespotted cutthroat trout in the upper Snake River and assure persistence of this unique native trout.

Seasonal effects of ammonia and dissolved oxygen concentration on salmonid and catostomid distribution in Silver Bow Creek, Montana

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Fish populations of Silver Bow Creek downstream from Butte, Montana were extirpated by more than a century of contamination from local mining and municipal wastes. Major portions of the watershed were designated as Superfund sites, and remediation of the stream has been ongoing for more than a decade. Six species of fish are now present in the stream, including three in the family Salmonidae. To evaluate the success of remediation in reestablishing stream fish populations, we conducted spatially continuous electrofishing and mobile antenna surveys of PIT-tagged fish in 28 km of Silver Bow Creek and two tributary streams in July, August, and December of 2010. Stream temperatures and concentrations of heavy metals, ammonia, and dissolved oxygen (DO) were monitored in corresponding stream sections. Toxic metal concentrations and loads in the stream have been reduced; however, despite signs of improvement, water quality problems apparently continue to influence the distribution of individual fish taxa. Within 6 km of the Butte wastewater treatment plant outfall, ammonia concentrations reached toxic levels (NH_3-N = 2.8 mg/l) during each survey period and hypoxia (DO < 2 mg/l) was evident in July and August. Preliminary analysis suggests that salmonid abundance was substantially reduced in the hypoxic zones during the July and August surveys, but catostomid abundance did not appear to be affected. During December surveys, hypoxia was not detected, but ammonia concentrations remained elevated. Salmonid abundance patterns in December surveys were similar to July and August surveys, but catostomids increased in stream sections with elevated ammonia concentrations.

Assessment of Altered Rearing Environments on Survival and Performance of Hatchery-Reared Trout: Implications for Development of Conservation Hatcheries for Improving Outplanting Survival of Cutthroat Trout Used in Reintroduction Programs

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Fish reared in conventional hatchery environments may develop behavioral, morphological, and physiological features maladapted for survival and performance in the wild. To address this problem, conservation hatcheries employ a variety of techniques to improve outplant survival and fitness. This strategy is commonly used to aid recovery of anadromous salmonid species but has not been applied to artificial propagation of nonanadromous salmonids. Our objective was to test if different hatchery rearing environments could improve the survival and performance of westslope cutthroat trout used in reintroduction programs. In 60 day hatchery trials, we compared the survival, growth, and morphology of a slightly domesticated stock of westslope cutthroat trout to a highly domesticated stock of rainbow trout reared in either 'conventional' (no cover, hand-fed) or 'enriched' (overhead and submerged cover; remote, constant food delivery) environments. Survival and growth of westslope cutthroat was similar among rearing treatments; however, fish reared in enriched environments exhibited significantly lower aggression, higher fin condition (a measure of overall fish health) and improved cover seeking behavior (a measure of predator avoidance) ($P < 0.05$). Rainbow trout exhibited highest growth in the conventional treatment tanks, but all other responses were similar to that of cutthroat trout, suggesting that rearing environment affects performance more than degree of domestication. In 60 day outplanting trials in small ponds, hatchery rearing environment did not have a strong effect on survival of westslope cutthroat trout. However, fish from the enriched treatment had 16% greater fat reserves and exhibited 23% and 148% greater growth in length and weight, respectively, which may improve body condition for overwinter survival. Study results indicated that relatively simple changes in the hatchery rearing environment could lead to marked improvements in survival and performance potential of native trout after stocking.

Predicting the spatial distribution of postfire debris flows and their impacts on native trout populations in headwater streams

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Native trout populations have declined over the last century because of habitat fragmentation and degradation, and the introduction/invasion of nonnative species. Negative effects of predicted climate change, including increased water temperature, altered precipitation, and increased risk of wildland fire may further jeopardize persistence of native trout populations. Headwater streams may be especially susceptible to disturbances such as debris flow torrents. Because the probability of debris flow increases in landscapes that have recently burned, identifying susceptible areas before the occurrence of wildfire may provide information necessary to protect remnant headwater populations. Predicting the timing, extent, and severity of wildfires and subsequent precipitation and runoff events is difficult; however, it is possible to identify channels in stream networks that may be prone to debris flows. Therefore, we conducted fine-scale spatial analyses of debris flow potential in 12 high-elevation stream networks of the Colorado Rocky Mountains. We identified at-risk channels using models based on characteristic storm and burn scenarios and geographic information describing topographic, soil, and vegetation characteristics

and assessed the potential for catastrophic population disturbance given a variety of wildfire and post-wildfire storm scenarios. Results from GIS models suggest that populations in many watersheds occupy areas with a high probability of post-wildfire debris flows, but the extent of their distribution and location within the stream network may provide sufficient refuge to prevent local extirpation. Ultimately, these data can be used to develop comprehensive management strategies for restoration, protection, and post-disturbance remediation of headwater stream networks that support remnant populations of native fishes.

Environmental factors associated with the variability in bull trout population abundance: implications for conservation

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Large, temporal fluctuations in the abundance of populations can have substantial implications on long-term population persistence. Recent monitoring efforts for bull trout populations throughout their native range indicate that many bull trout populations exhibit considerable changes in abundance over relatively short time periods. Our understanding of the factors influencing these changes in abundance, however, remains to be limited, yet critical for effective management and conservation. Here we use available, long-term bull trout monitoring data to evaluate the range of temporal fluctuations observed across bull trout populations in the Pacific Northwest and the factors associated with changes in population abundance, including the potential impacts of climate, habitat suitability, spatial arrangement of populations, land use, and life-history diversity. Additionally, we evaluate how these factors influence the spatial autocorrelation between populations and consider these results in context of bull trout recovery. Our results indicate a wide range of temporal variability in abundance among populations and considerable variability in the extent of spatial autocorrelation. Overall, the observed large

fluctuations in bull trout abundance will likely have direct implications on the long-term persistence of bull trout populations and future management options.

Factors Influencing the Distribution of Bull Trout and Westslope Cutthroat Trout west of the Continental Divide in Glacier National Park

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The reported decline of native bull trout *Salvelinus confluentus* and westslope cutthroat trout *Oncorhynchus clarkii lewisi* populations west of the Continental Divide in Glacier National Park (GNP) prompted research to identify critical habitats and investigate factors influencing their distribution and relative abundance. We evaluated the association of six abiotic factors (stream width, elevation, gradient, large woody debris density, pool density, mean August stream temperature) and a biotic factor (the presence of nonnative lake trout, *Salvelinus namaycush*) with the occurrence and density of bull trout and westslope cutthroat trout in 79 stream reaches in five sub-drainages of the North Fork Flathead River in GNP. Logistic and linear regression models were used to quantify the influence of these independent variables on species occurrence (presence/absence) and density (≥age-1 fish/100m^2), and an information theoretic approach (AIC_c) was used to determine the most plausible combinations of variables in each case. The occurrence of westslope cutthroat trout was negatively associated with the presence of lake trout and positively associated with large woody debris and water temperature. Westslope cutthroat were detected throughout a wide range of mean summer (August) water temperatures (8.5 – 16^{o}C), stream widths and elevations, but were most abundant in narrow, complex reaches that were not connected to lakes supporting lake trout. Bull trout occurrence was positively related to stream width and negatively related to channel gradient and water temperature. Bull trout were most abundant in narrow (< 10 m) stream reaches with relatively cold August water temperatures (8 – 10^{o}C) and in stream reaches not affected by lake trout. The low densities and limited distribution of bull trout likely reflect their imperiled status in GNP, owing to the invasion and

establishment of nonnative lake trout from Flathead Lake. These data may be used to monitor critical habitats and populations, inform conservation and recovery programs, and guide suppression efforts to reduce the deleterious impacts of nonnative invasive fishes.

Small Effective Number in Upper Flathead River Bull Trout, *Salvelinus confluentus*

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Samples of bull trout were collected from two or more year classes from 12 streams in the upper Flathead River drainage. Genotypes from 15 microsatellite loci indicated that highly significant allele frequency differences existed between year classes within ten of the streams. The amount of divergence, as estimated by F_{ST}, between year classes from the same stream ranged from zero to 0.093 with a mean of 0.038. The amount of divergence between year classes from different streams ranged from 0.003 to 0.350 with a mean of 0.124. Thus, at times there was as much or more divergence between year classes within a stream than there was between year classes from different streams. Considering all the samples and loci, there were 421 Hardy-Weinberg comparisons. Out of these, 264 showed an excess of heterozygotes which is significantly more ($P<0.001$) than expected by chance. This heterozygote excess suggests most samples contained juveniles from a relatively small number of parents. We estimated the effective number of breeders (N_b) for each year class sample using the linkage disequilibrium method. N_b estimates ranged from 2.1 to 124.3 but, 22 out of 29 estimates were below 25 and only one was greater than 40. These results suggest that most of our samples contained fish produced from a few parents. There was no association (r^2=0.004) between redd counts and N_b. Thus, it appears that only a few mating pairs are highly successful at producing juveniles. We cannot rule out, however, that our results might be an artifact of nonrandom sampling.

Assessing the impacts of river regulation on native bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) habitats in the upper Flathead River, Montana, USA

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Hungry Horse Dam on the South Fork Flathead River, Montana, USA, has modified the natural flow regime for power generation, flood management, and flow augmentation for anadromous fish recovery in the Columbia River. Concern over the detrimental effects of dam operations on native resident fishes prompted research to quantify the impacts of alternative flow management strategies on threatened bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) habitats. Life-stage specific habitat suitability criteria were combined with a two-dimensional hydrodynamic habitat model to assess seasonal discharge effects on useable habitats. Telemetry data used to construct seasonal habitat suitability curves revealed that subadult bull trout (fish that emigrated from natal streams to the river system) move to shallow, low-velocity, shoreline areas at night, which are most sensitive to flow fluctuations. Habitat time series analyses comparing the natural flow regime (pre-dam, 1929-1952) to five post-dam flow management strategies (1953-2008) show that the current operating strategy, called the "Montana Operation", resembles natural flow conditions better than all other post-dam operations. Late summer flow augmentation for anadromous fish recovery, however, produces higher discharges than pre-dam conditions, which reduces the availability of useable habitat during this critical growing season. Our results suggest that past flow management policies that created sporadic streamflow fluctuations were likely detrimental to resident salmonids, and that natural flow management strategies will likely improve the chances of protecting key ecosystem processes and help to maintain and restore threatened bull trout and westslope cutthroat trout populations in the upper Columbia River Basin.

A multimedia information and education tool on the importance of bull trout and the relationship between bull trout and the Salish and Pend d'Oreille people

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The Confederated Salish and Kootenai Tribes have undertaken a large-scale watershed restoration project in an effort to benefit bull trout in the Jocko River drainage. An important component of this comprehensive project is education and outreach. In this presentation we will give an overview of a multimedia information and education project that describes the ecology and importance of bull trout, the relationship between bull trout and the Salish and Pend d'Oreille people, and the importance of educating the public on bull trout and other natural resource issues. The project is composed of an integrated set of educational materials that will include an interactive DVD entitled "Explore the River: Bull Trout, Tribal People and the Jocko River", a curriculum, a website, a storybook "Bull Trout's Gift", and an accompanying field journal to be published by the University of Nebraska Press.

Suppression of Non-native Salmonid Species to Benefit Migratory Bull Trout in an Open System: Lessons Learned from an Effort Performed on the Lower East Fork Bull River

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During relicensing of its Clark Fork River dams, Avista Corporation cooperatively developed and instituted the Native Salmonid Restoration Plan (NSRP). In part, the NSRP recommended addressing the impact non-natives have on native species. Due to documented impacts of brown trout redd superimposition and brook x bull trout hybridization, a non-native suppression effort was authorized for the lower East Fork Bull River (EFBR). This suppression employed electrofishing, selective passage at fish traps, and brown trout redd excavation to create a more favorable biological condition for native species in the lower EFBR. Specifically, the objective of a 90% reduction in one or more indices (numbers, density, or biomass) was established. To assuage public concern, non-natives greater than 150 mm were released in the lower Bull River. Concurrent programs included upstream passage of adult bull trout and habitat improvements. From 2007 through 2009, 10,938 salmonids were captured; of which 5,480 were non-native brown, brook, and rainbow trout (4,665 less than 150 mm were euthanized, while 815 longer fish were released in the lower Bull River). Comparison of salmonid indices after three years of suppression efforts showed that while non-natives were significantly reduced over most indices, the objective of a 90% reduction for non-natives from 2007 to 2009 was limited to two biomass comparisons. Positive responses from native species included a significant increase in native species' percent composition and an overall increase of 280% for juvenile bull trout density.

Difficulty in maintaining closure from adjacent sources of non-natives may necessitate future, smaller-scale, suppression efforts.

Thompson Falls Fish Ladder – 48 Steps to Bull Trout Restoration on the Clark Fork River

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The Thompson Falls Hydroelectric Project was constructed in the early 1900s, taking advantage of the natural falls along the Clark Fork River that gave the town of Thompson Falls, Montana its name. The hydropower complex consists of two dams and two powerhouses, owned and operated by PPL Montana. The dams at Thompson Falls have been a barrier to upstream fish migration since its construction. The waters of the Clark Fork River are habitat to bull trout (a Federally-listed threatened species) and the westslope cutthroat trout (a Montana Species of Special Concern), as well as other native and non-native fishes. The Clark Fork River is a tributary of the Columbia River, upstream of the upstream-most range of anadromous salmon. It was not until the recent advent of radio telemetry capable of tracking fish movements that the impacts of blocking the migration of non-anadromous fish began to be appreciated. In the early 2000's PPL Montana and Montana Fish, Wildlife, and Parks biologists found that large numbers of fish of many species had their upstream migrations blocked by the dams. An extensive radio telemetry study of migrating salmonids was conducted between 2003 and 2007. The fish tracking revealed that fish were migrating up to, and holding at the main dam, which is the upstream-most dam at the complex. Fish that were transported and released above the dam were migrating as much as 100 miles to upstream spawning tributaries, highlighting the large geographic impact of the blocked fish migrations. PPL Montana established an Interagency Technical Advisory Committee (TAC) to address fish passage issues at the Thompson Falls Project. Based on fish behavior studies and engineering review, the TAC came to a consensus decision that a full height fish ladder should be constructed on the right bank of the main dam to provide fish passage. GEI Consultants, Inc. designed a 48-pool fish ladder on the right abutment of the main dam with sampling facilities and attraction flows to restore upstream fish passage to this reach of the river. Construction of the upstream fish ladder began in July 2009 by COP

Construction Co. and was completed in 2010. Full fish ladder operation will begin in March, 2011. This paper discusses aspects of the ladder planning, design, construction, and operation.

The Use of Barriers to Protect Westslope Cutthroat Trout Populations from Genetic Introgression and Competition by Nonnative Salmonids

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An updated status assessment in 2009 was used to qualitatively evaluate populations and catalog threats to the persistence of WCT throughout Montana. These data summarize the miles of stream with protected populations and those at risk for hybridization and competition. Analysis of the database reveals that 11% of currently occupied habitats (4% of historical habitat) support WCT populations that are completely protected from hybridizing and competing species. The primary tool for protecting WCT from hybridization and competition is the construction of fish barriers. Where feasible, the installation of fish barriers generally requires balancing extinction risks due to isolation (e.g. demographic, genetic, and environmental catastrophe) with those due to connectivity (disease, hybridization, and competition). A driving force in barrier project site selection is the ability to adequately block upstream movement of non-native fishes during extreme flow events. This requirement has necessarily skewed barrier projects which protect non-hybridized WCT toward sections of stream less than 8 miles in length. Ideally, we should place a priority on identifying a continuum of projects including both small and moderate sized drainages which protect populations from genetic introgression as well as larger projects (> 25 miles) that provide connected populations of fishable and harvestable WCT with multiple life histories. To achieve this balance, fisheries professionals will likely have to accept low levels of genetic introgression in larger connected stream systems.

Dams Influence Patterns of Hybridization between Native Westslope Cutthroat Trout and Nonnative Rainbow trout

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Rainbow trout (RBT) introgression with native westslope cutthroat trout (WCT) in the lower Clark Fork River, MT and Lake Pend Oreille, ID basin has been previously documented, but a - basin wide baseline analysis comparing the number of rainbow alleles in these populations was necessary for making management decisions. In 2007, 42 collection sites were designated in 22 tributaries to the lower Clark Fork River or Lake Pend Oreille. Fin tissue samples were collected from 30 juvenile *Oncorhynchus* species at these sites which were located in lower and upper reaches of each tributary. In addition, fin tissue samples were collected from 100 adult *Oncorhynchus* captured below two mainstem dams on the lower Clark Fork River, Cabinet Gorge (CGD) and Noxon Rapids Dams (NRD). Using microsatellite loci RBT alleles were found at 48 percent of the 42 tributary collection sites. Sixty-seven percent of these sites were located in ID and 33 percent were in MT. Hybridization was more prominent in the lower reaches of these tributaries. WCT, RBT and hybrids between the two species were also documented below both mainstem dams. RBT alleles were documented in 43.9 percent of the fish captured below CGD and 52.8 percent of the fish collected below NRD. Using a few defining phenotypic characteristics biologists were able to reduce the percentage of RBT alleles in fish targeted for upstream transport to less than one percent.

Yellowstone Cutthroat Trout Conservation in Lower Deer Creek: Population Replication, Nonnative Suppression, Barrier Construction, and Piscicide

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Lower Deer Creek supports an isolated, unhybridized population of Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*) on the periphery the fish's remaining range in Montana.

Sympatry with brown trout (*Salmo trutta*) presented a long-term threat to the persistence of the population, but in 2005, capture of several rainbow trout (*O. mykiss*) × Yellowstone cutthroat trout hybrids elevated the level of concern, given the immediate and irreversible threat posed by hybridization. The potential for catastrophic disturbance associated with a massive wildfire the following year presented another factor with potential to reduce or eliminate the population. Initial conservation efforts included attempts to replicate the population in other locations to provide brood stock in the event of further hybridization or extirpation relating to the wildfire. A survey of potential barrier locations identified suitable sites for barrier construction, with modeling of the potential for the population to persist in the available habitat informing site selection. Continued fish survey efforts followed the continued invasion of hybrids, and allowed for removal of hybrids and suppression of brown trout. Barrier design involved hydraulic modeling and design innovations that eliminated the hydraulics with flat-fronted barriers shown to permit passage of fish. The resulting ogee or curved-front barrier modeled as presenting leap and velocity barriers at flows ranging from base flow to the 100-year flow event. Barrier construction occurred in fall of 2010. Remaining actions scheduled for 2011 will be salvage of Yellowstone cutthroat trout from Lower Deer Creek, followed piscicide treatment, and then return of salvaged fish.

Westslope cutthroat trout restoration in the South Fork Flathead River drainage: conservation biology in practice

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As applied to fisheries, the field of conservation biology draws from a wide range of disciplines to inform practical and sustainable management of aquatic resources. Consideration of multiple biological (evolutionary, ecological) and social (political, economic) issues is especially essential when restoration projects encompass broad geographic scales and involve multiple agencies and diverse user groups. Westslope cutthroat trout conservation efforts in the South Fork Flathead drainage provide an example of how basic principles in conservation biology can be used to achieve long term solutions for native fish restoration that incorporate human dimensions as well. This drainage comprises over half of the remaining interconnected habitat for nonhybridized westslope cutthroat trout range wide while providing outstanding fishing opportunities in a wilderness setting. To protect this resource, conservation efforts integrate the use of piscicide and genetic swamping to remove the threat of hybridization posed by introduced trout in 21 headwater lakes. Successes and challenges of this project are discussed as well as exciting new opportunities for applied research aimed at advancing our ability to conserve aquatic ecosystems.

Variable spawning movements and recruitment implications for walleye (*Sander vitreus*) in a snowmelt driven, run-of-the-river reservoir

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Annual snowmelt runoff is a major hydrologic event influencing aquatic habitats and organisms. We examined spawning migration patterns and year class strength of a recently established walleye population in Noxon Reservoir, a run-of-the-river hydroelectric impoundment in western MT, in conjunction with runoff. We used telemetry to observe walleye migration and standardized gillnetting to assess year class strength. Three telemetered groups (N = 45) were observed through spawning migrations in springs 2005, 2006 and 2008. There was substantial variation in migration patterns to the spawning grounds between years, and variation appeared related to runoff timing. Migrations were steady and predictable in 2005 and 2008, but early onset of runoff disrupted the 2006 migration. Disruptions were significant enough that spawning activities were abbreviated and even foregone by some individuals. We hypothesized that this would lead to a poor year class. Relative year class strength was then compared with runoff timing and magnitude from 2000 – 2008. This analysis is ongoing as we collect more walleye annually, but results do not support our hypothesis. There was little correlation between early or heavy runoff and year class strength. The 2005 and 2006 year classes were of similar strength, even though migrations of adults to spawning grounds were not. The 2002 and 2007 year classes appeared the strongest over our sample period, even though early onset of runoff occurred similarly to 2006. This suggests that even though runoff may influence adult spawning activities, other factors drive recruitment.

Larval Paddlefish and Shovelnose Sturgeon in the Flow-Regulated Missouri River Below Fort Peck Dam, Milk River, and Yellowstone River

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Paddlefish (*Polyodon spathula)* and shovelnose sturgeon (S*caphirhynchus platorynchus)* are large-river fishes that either reside in or make spawning migrations to the minimally affected Yellowstone River, the flow-regulated and thermally affected Missouri River, and the Milk River (a warm Missouri River tributary entering below Fort Peck Dam, but affected by dams and

irrigation practices). The objective of this study was to compare and contrast the temporal occurrence of paddlefish and shovelnose sturgeon larvae among the three river systems. Results are from long-term research (2001-2009) based on telemetry of adults and an intensive larval fish sampling regime. Larval paddlefish were present in the drift during all years in the Yellowstone and Missouri rivers, but absent in the Milk River during two years. The initial occurrence of larval paddlefish was about three weeks earlier in the Yellowstone River than Missouri and Milk rivers, and larval paddlefish were present for a longer duration in the Yellowstone River. Larval shovelnose sturgeon were absent from the Milk River during all years. Conversely, larval shovelnose sturgeon were sampled during all years from the Yellowstone and Missouri rivers. However, similar to larval paddlefish, the initial collections of larval shovelnose sturgeon occurred about three weeks earlier in the Yellowstone River than Missouri River, and larval sturgeon were present for a longer duration in the Yellowstone River. Results suggest river regulation and hypolimnetic releases through Fort Peck Dam delay spawning and reduce numbers of larval paddlefish and shovelnose sturgeon produced relative to the minimally affected Yellowstone River.

The Influence of Milk River Spring Flows on the Fish Community of the Lower Missouri River System

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The Milk River is an important tributary to native fishes of the lower Missouri River downstream of Fort Peck Dam. During 2010, discharge in the Milk River was generally higher and the duration of these high flows encompassed spawning periods for many native fish species since sampling regimes have been in place. These higher flows resulted in various responses from the native fish community in both the Milk and Missouri rivers. These responses included, increased larval fish production of various native species in both rivers and uncommon adult and juvenile migrations. Larval paddlefish *Polyodon spathula* abundance in the Milk River was the highest documented throughout ten years of sampling. In addition, pallid sturgeon *Scaphirhynchus albus* telemetry monitoring identified only the second wild adult pallid sturgeon using the Milk River. Furthermore, the first documentation of hatchery reared pallid sturgeon migrating from the Missouri River upstream into the Milk River occured. The Milk River also greatly influenced fishes spawning in the mainstem Missouri River. Shovelnose sturgeon *S. platorynchus* production in the Missouri River was also at a ten year high, likely due to the positieve influence of the larger quantity of warm-turbid water entering the thermally impacted waters below Fort Peck Dam. Young-of-the-year abundance of several other native fishes were also elevated in the Missouri River during 2010. These results highlight the importance of this tributary to the native fish community of the lower Missouri River system.

Western Pearlshell Mussel Translocation Project in the Blackfoot River Watershed: How not to treat mussels prior to relocation

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The first mussel translocation project in Montana occurred July 2010 at three tributary stream restoration sites in the Blackfoot River Watershed. After completing a Fish Health Screening and the EA process, 1,500 (500 per stream) western pearlshells were moved from the Clearwater River below Emily-A dam (19.5°C, 140µs/cm) to Chamberlain Creek (12.8°C, 83µs/cm), Grantier Spring (10.0°C, 280µs/cm) and Monture Creek (14.8°C, 160µs/cm). Extensive stream geomorphology data was collected at the donor and recipient streams, and water chemistry parameters were not significantly different from other streams containing western pearlshell populations. A fish health cleansing protocol and 10% population tagging was followed by a 24-48 hour holding period in a live car with spring water (12.5° C, 150µs/cm) prior to relocation. Mussels translocated to gravel run/glide sections of Chamberlain Creek and Monture Creek at 24 and 36 hours after removal from natal stream, respectively, appeared to have minimal (0.2%) initial mortality; while those transplanted into Grantier Spring Creek 48 hours later exhibited ~10% initial mortality. Mussels were transplanted in groups ranging from 50-200 individuals per habitat unit (4-8 units per stream), and one unit per stream was fenced as a predator deterrent. A revisit 5 days later detected substantial (>50%) mortality at Chamberlain and Monture Creeks, and an intensive revisit evaluation on August 13th documented 11% overall survival in Chamberlain and Monture Creeks and 8.7% overall survival in Grantier Spring. Because the survival/mortality rate among all streams was not significantly different, we believe the cause of death is linked to handling procedures, in particular the 2% bleach dip or thermal stress. Mussels (n=200) handled and held in the Clearwater River without the bleach dip and then replaced back to their original locations had 100% survival. Future translocation efforts aiding this species' recolonization will eliminate the bleach dip.

Lake Helena Willow Bank Stabilization Demonstration

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The Lake Helena shoreline erosion project is a demonstration of lake shoreline stabilization using bioengineering approach (no rock is used). The project uses a plant-based bioengineering technique (installing dormant willow stems) to stabilize shoreline that is eroding due to ice and wave action. The intention of the project is to restore natural lakeshore habitat to enhance the shoreline's capacity to resist erosion. The project serves as an experiment in the use of bioengineering on Lake Helena, as well as a demonstration for bioengineering in lakeshore protection for other landowners faced with similar problems. 100' of shoreline was installed with willow stems in 2010 and another 450' will be installed in the spring of 2011. Partners in this project include Tom Andersen (landowner), Jo Christensen (designer), DEQ, DNRC, FoxLogic LLC, PPL-MT, L&C Water Quality District, L&C CD, FWP, Bureau of Land Management, Lake Helena Irrigation District and numerous volunteers. To date, the first 100' of installation has performed very well against considerable wave action and some ice flows.

Quantifying habitats for large brown trout provided by different flows to make instream flow recommendations in Rush Creek, Mono County, California

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The California State Water Resources Control Board must balance how water is allocated to meet the needs of citizens and natural resources. In 1941, the Los Angeles Department of Water and Power (LADWP) completed the construction of infrastructure to store and export water from the Mono Basin, on the east side of the Sierra Nevada Mountains, to Los Angeles. Over the next five decades, these water exports caused significant negative ecological changes to Mono Lake and its tributary streams. In 1998, the Water Board established preliminary instream flows in Mono Lake tributaries to promote the recovery of Mono Lake, the stream channels, and the non-native, but naturally reproducing, trout fisheries. We were appointed by the Water Board to study these fisheries and evaluate the 1998 ordered flows and to recommend adjustments to these preliminary flows. Our study focused on a 14.3 km reach (average gradient: 1.6%) of Rush Creek, the largest of the four Mono Lake tributaries, from Grant Lake, a LADWP reservoir, to

Mono Lake. Earlier studies and negotiations identified large brown trout (> 330 mm) as the target species and size of interest. We used previous studies of habitat requirements for large brown trout, which we subsequently confirmed for Rush Creek using underwater observations and radio-tagged fish relocations of large brown trout, to develop habitat criteria. Our criteria for preferred habitats were deep (> 30 cm) water with slow velocities (< 21 cm/s). Since most slow velocity habitats and larger brown trout we observed were located in relatively close proximity to the streambed, we measured velocities 15 cm above the streambed. We also included availability of cover as a requirement for preferred winter habitat. We set 1.1 m^2 as a minimum area of trout habitat. We mapped all habitats that met these criteria (foraging habitats did not require cover and winter habitats did) at five different flows (15, 30, 45, 60 and 90 cfs) in four representative sample reaches of Rush Creek and compared the proportions of these preferred habitats provided by these different flows. We also incorporated a more traditional wetted perimeter method for riffles to account for potential food production at different flows. Results of mapping indicated that lower flows generally provided more habitats for large brown trout, primarily because lower flows reduced water velocities in this moderate-gradient stream. We integrated these mapped fish habitat data with a water temperature model and geomorphic studies to recommend annual flow regimes that would maintain ecological functions, including channel forming high flows, periodic riparian area inundation, and fish habitat (preferred depths, velocities, and temperatures), under different water availability scenarios.

Use of a seismic air gun to reduce survival of salmonid embryos: a pilot study.

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The detrimental impacts of nonnative lake trout in the western USA have prompted natural resource management agencies in several western states to implement lake trout suppression programs. Currently, these programs rely on mechanical removal methods (i.e., gill nets, trap nets, and angling) to capture sub-adult and adult lake trout. Lake trout population growth is highly sensitive to changes in survival from age 0 to age 1; thus targeting embryonic lake trout could be an effective strategy to supplement mechanical removal techniques utilized by lake trout suppression programs. We conducted a pilot study to explore the potential for using high-intensity sound to induce mortality in non-native lake trout with a relatively small (655.5 cm^3, 40 in^3) seismic air gun practical for use by a small agency crew. Lake trout embryos at multiple stages of development were exposed to a single blast of the seismic air gun at two depths (5 m and 15 m), and two distances from the air gun (0 m and 3 m). Control groups for each developmental stage, distance, and depth were treated identically, except that the air gun was not discharged. Mortality in lake trout embryos treated at 0.1 m from the air gun was higher than control groups at 74 and 156 thermal units (TU) °C at both depths. Mortality in lake trout embryos treated at 0.1 m from the air gun at 207 and 267 TU °C was higher than controls at the 15 m depth. Mortality at the 3 m distance did not differ from controls at any developmental stage or either depth. Although the relatively small air gun employed in this study may not be practical for use as a suppression tool at present, these preliminary data indicate seismic air guns may be a viable means to reduce survival of nonnative lake trout embryos.

Fish populations on the Bitterroot National Forest 10 years after the 2000 wildfires

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The 2000 wildfires burned 154 miles of streams on the Bitterroot National Forest (BNF) at moderate and high severity. Thunderstorms in 2001 triggered mudslides that altered numerous streams. In 2001-03, Sestrich (2005) investigated whether fire and mudslides favor recovery of nonnative trout over native westslope cutthroat trout *Oncorhynchus clarkii lewisii* and bull trout *Salvelinus confluentus*. Twenty-four streams with pre-fire population data were monitored with mark-recapture electrofishing. Sestrich found that westslope cutthroat trout and bull trout populations recovered more rapidly than brook trout *Salvelinus fontinalis*. Generally, brook trout populations had not recovered, particularly in mudslide-affected reaches. A section of Rye Creek was the exception. Brook trout increased 499% and replaced bull trout. Brown trout *Salmo trutta* were the primary invading species, invading 5 of the 24 streams by 2003. In 2004 – 2010, in the same streams, westslope cutthroat trout populations had grown, bull trout populations showed no consistent trends, and most brook trout populations remained suppressed. Population trends were less evident in streams burned at low and moderate severity. Westslope cutthroat trout populations remained steady or made small increases between 2004 and 2010, while most bull and brook trout populations showed no trends. In Sleeping Child Creek (burned at moderate severity and affected by mudslides) bull trout declined while brown trout increased. Our results indicate westslope cutthroat trout are resilient to fire and mudslides and populations grow throughout the first decade following disturbance, brown trout can be a troubling invader after disturbance, and brook trout often struggle to recover.

Montana In-Lieu Fee Aquatic Resource Mitigation Program: First Aid for Death by a Thousand Cuts

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Healthy wetlands, riparian areas, and floodplains maintain resiliency in aquatic ecosystems faced with a changing climate. Although the Clean Water Act require mitigation for impacts to

wetlands, impacts to streams have largely gone unmitigated resulting in "death by a thousand cuts." In May 2010, the Helena Office of the Corps of Engineers issued a Montana Stream Mitigation Procedure which established a requirement for quantifying acceptable mitigation for projects resulting in adverse impacts to a stream. In cooperation with the Department of Environmental Quality and the Environmental Protection Agency, Trout Unlimited is incubating a non-profit organization that will sponsor an In-Lieu Fee (ILF) Aquatic Resource Mitigation Program authorized to collect mitigation fees to fund qualified mitigation projects. We anticipate that by the end of 2012, the ILF program will provide an additional source of compensatory mitigation credits which in turn will create new funding to complete restoration projects throughout Montana. This year, we will develop the ILF program governed under a contract ("instrument") which allows the program to accept mitigation funds and responsibility in part for implementing and monitoring mitigation projects. The ILF program will be overseen by an Interagency Review Team, which will develop project performance criteria and provide feedback to the ILF sponsor regarding eligible mitigation projects. The ILF program offers restoration practitioners an additional funding source for eligible aquatic resource restoration and protection projects with a goal of offsetting the loss of our riparian wetlands and preserving resiliency in a changing climate.

Broad-scale genetic and compositional monitoring of fish populations: a proof of concept in the interior Columbia River and upper Missouri River basins

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Monitoring fish populations is essential for evaluating conservation efforts and the status and trends of individual species, but measuring abundance is time-consuming and problematic at large scales. Also, relations between fish populations and their surrogates, such as habitat characteristics, are often obscure. As an alternative, genetic assessment and monitoring offers promise as an indicator of population status and trends by providing information on genetic diversity, connectivity among populations, and the prevalence of hybridization with non-native species. We have undertaken intensive sampling of native and nonnative fishes and amphibians in streams monitored by the Pacfish/Infish Biological Opinion Monitoring Program, which includes a spatially comprehensive, random sample of subbasins in the interior Columbia River Basin and upper Missouri River Basin. We have also developed a panel of ~100 single nucleotide polymorphism markers for cutthroat trout, redband trout, and rainbow trout to describe patterns of hybridization and landscape genetic structure. If fully realized, analyses of tissues sampled from over 1500 streams in Montana, Idaho, eastern Oregon, and eastern Washington on federal lands should permit broad-scale evaluations of the status and distribution of much of the aquatic vertebrate fauna and enable detection of responses to climate change. Preliminary results of sampling at nearly 700 sites on almost 300 western Montana and northern Idaho streams indicate that westslope cutthroat trout occupy headwater sites in most of their historical range except in the Kootenai and Missouri River basins, brook trout are more widely distributed than previously recognized, and the taxonomic complexity of sculpins is underappreciated.

Genomics and the future of fisheries management

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We address the following question: How can new genetic technologies improve fisheries conservation and management? We review the range of research questions that molecular genetic approaches can now address, and discuss applications to fisheries. First, an increase in the number and chromosomal distribution of markers has improved our ability to identify locally adapted populations, allowing detection of resistance to pathogens and tolerance of higher stream temperatures. The discovery of more diagnostic markers between species and subspecies has improved our power to detect hybridization, identify genes influencing fitness of hybrids, and monitor the spread of "invasive" genes from nonnative species such as rainbow trout. Finally, for genetic restoration and transplants, we discuss approaches to track which source populations are most successful at achieving restoration goals such as augmentations ("genetic rescue") of small, isolated populations.

Poster Abstracts

. **Evaluating the factors associated with the distribution of Yellowstone cutthroat trout: a rangewide analysis**

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Understanding the factors associated with the current distribution of Yellowstone cutthroat trout is an imperative step in the design and implementation of future conservation and management strategies, particularly given emerging potential stressors associated with regional climate change. Despite substantial interagency efforts to develop range-wide status assessments for Yellowstone cutthroat trout, these data have not yet been used extensively to investigate the physical and biological factors that influence the current distribution of the subspecies. To address this need, we are developing a range-wide niche model for Yellowstone cutthroat trout using landscape attributes, natural and anthropogenic disturbance, climate, and the distribution of non-native fishes as predictor variables. We will be comparing models developed with these extensive range-wide data to models developed with finer-scale data within the Shields River Basin to address model inference and precision associated with scale of data collection. For both the range-wide and the Shields Basin analyses we will incorporate future climate data at the 15-km^2 scale, while for the Shields Basin analysis we will also use 1-km^2 climate data. These paired analyses will allow us to evaluate how climate might regulate the distribution of Yellowstone cutthroat trout over the foreseeable future, how the scale of fish and climate data may impinge on our model assessments, and how our interpretations are affected by spatial scale. Our results will provide insight into the factors associated with Yellowstone cutthroat trout distribution, highlight potential gaps in currently available data, and help direct conservation strategies for this native cutthroat trout in the near future, especially in light of predicted future climate warming.

Cutthroat trout and brook trout population dynamics in Sheppard Creek in response to nine years of varying brook trout suppression effort (i.e. Has ethnic cleansing of 9,400 brook trout made any difference?)

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Sheppard Creek contains one of the last remnant cutthroat trout populations in the Stillwater River basin of Northwest Montana. However, monitoring during the 1990's found that non-native brook trout had fully colonized this stream and cutthroat trout numbers were rapidly declining. The Flathead National Forest, along with several partners, installed a culvert barrier in 2001 and began brook trout suppression of 3.7 km of stream using electrofishing. This 3.7km length represents only 42% of fish habitat length above the barrier but it contains about 63% of the brook trout population. Effort has varied over the years, ranging from 2.4 pass removals over the entire length during the first few years, 0 removal following a wildfire, and more recently averaging 1 pass removal. A total of 9, 428 age 1+ brook trout have been removed since 2001. Capture efficiency for age 1+ brook trout averages 48%. Brook trout numbers rapidly decline each year of suppression but since many age 0 fish escape capture, the population can recover in just two years if suppression is suspended. Brook trout have not exhibited any significant change in total length, suggesting suppression has not been profound enough to impact growth rates. Still, even with this less-than-perfect suppression effort, cutthroat trout numbers have significantly increased ($p = 0.05$) from approximately 366 to 1,018 age 1+ fish in the project area. Cutthroat trout population response appears to lag 2 years behind brook trout suppression effort. Findings suggest that simply 1 pass brook trout removal on key portions of the stream may be sufficient to bolster an isolated cutthroat trout population.

Pallid Sturgeon Population Assessment Project

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Pallid sturgeon *Scaphirhynchus albus* were listed as endangered by the United States Fish and Wildlife Service (USFW) in 1990. To aid in recovery, juvenile hatchery reared Pallid Sturgeon have been stocked throughout the Missouri River since 1997. As a result, the United States Army Corps of Engineers and other federal and state agencies within the Missouri River Basin developed a standardized sampling program to monitor hatchery and wild pallid sturgeon as well as other native Missouri River fishes. The Pallid Sturgeon Population Assessment Program (PSPAP) is a large scale Project that that is designed to track changes through fishes abundance, growth and condition in relation to both environmental conditions and management actions. Of the programs target species, five are on Montana's Species of Special Concern List. The PSPAP encompasses much of the mainstem Missouri River from Fort Peck, MT to St Louis, MO along with portions of its major tributaries. From 2006 to 2010 the PSPAP crew has sampled fishes using a variety of gears, including otter trawls, trammel nets, mini fyke nets, beach seines, push trawls and trotlines. Throughout the five field seasons, over 160,000 fish have been sampled representing 48 different species. Crews have drifted and trawled approximately 1,000 miles of river and deployed 1,155 trotlines consisting of 23,100 hooks. Mini-fyke nets have accounted for approximately 79% (126,947) of the total catch. Although 765 pallid sturgeon have been captured using the Programs methods, all but one were of hatchery origin.

Massive air and stream temperature sensor networks for studying microclimatic variation in mountain landscapes of the northwest U.S.

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Climate change is motivating extensive research to understand potential responses in terrestrial and aquatic ecosystems. Ongoing efforts to downscale climate models are improving the resolution at which climate data are available, but outputs from even the latest regional climate models are coarse relative to the scales at which ecological processes operate and landscapes and natural resources are managed. Inexpensive digital temperature sensors and remote sensing technology now facilitate collecting large amounts of information for a variety of environmental attributes. Efforts are underway to coordinate and develop massive regional air and stream temperature sensor networks to understand climatic variation more precisely in mountainous landscapes. At present, air temperatures are being monitored at more than 1,000 sites in western Montana and northern Idaho, and full-year stream temperatures are being monitored at more than 1,500 sites in Montana, Idaho, Oregon, and Washington. Numerous agencies are collecting these data and have contributed their site locations and data to the development of this emerging regional network. Planned site installations may add another 500 stream temperature sites to the network in 2011. The collection of full year data at these sites, as well as the density and complimentary nature of the sensor networks, enables a range of research questions about fine-scale climate variation to be addressed. This research will provide valuable insights regarding aquatic ecosystem responses to climate change and contribute to a basic understanding of material and energy fluxes through river basins and mountain landscapes.

Reliability, Utility, and Political Relevance of State Generated Reference Stream Data in Western Montana

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The following master's thesis research project is being developed to examine the relationships between the science and policy that influence water resource management in Montana. Principally, the study will evaluate the *quality* of water quality data generated by the State of Montana, as well as the consumers of state generated water quality information. Data sets to be examined will be delineated by focusing on a specific ongoing project at the Montana Department of Environmental Quality (MT DEQ) known as the "Reference Stream Project" ("RefPro"). The structure of the RefPro is based on ecoregions, and by examining a particular sub-ecoregion within the RefPro database, existing water quality data sets and defined stakeholder groups can be readily accessed and analyzed. Research will be framed using two basic questions: (1) is the information that is being produced by the MT DEQ RefPro based on sufficient credible water quality data; and (2) is the data socially and politically relevant/useful to public and private consumers of water quality information? Question (1) will be addressed through a statistical analysis of existing MT DEQ metadata from the RefPro to determine data quality; and Question (2) will utilize social inquiry of stakeholders (i.e. a combination of surveying and interviewing) to evaluate applications of state generated water quality information. This two part assessment is being designed with the intention of helping to inform both governmental and non-governmental entities of the relationships between science and policy when considering water resource management; and also how knowledge of those relationships can help inform effective water quality management in Montana.

Binomial confidence interval construction as a cost saving measure in hybridization studies

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Understanding the patterns of introgression across a landscape is a crucial first step in developing management strategies for native fishes threatened by hybridization. However, the cost associated with collecting and analyzing samples limits the number of populations that can be screened annually. We have developed a two-stage analysis protocol for assessing hybridization between cutthroat trout (*Oncorhynchus clarkii* sp.), introduced conspecifics, and rainbow trout (*O. mykiss*) that requires only a few individuals to be genotyped in samples collected from highly hybridized populations. Simulations indicated that equivalence testing using Clopper-Pearson binomial confidence intervals enable the analysis of samples to proceed in two distinct stages. First, researchers could analyze five or fewer individuals to develop a rough estimate of the nonnative genetic contribution. Second, researchers could genotype the remainder of the fish in the sample if no hybrids are found in the initial analysis, or refinements to estimates of the nonnative genetic contribution are necessary. The simulations highlighted that while the precision of estimates of the proportion admixture in a hybrid swarm is a function of the number of amplified alleles, the probability of detecting hybrids in a non-hybrid swarm depends only on the number of genotyped fish. Therefore, maintaining current field collection sample sizes of 20 and 30 individuals is necessary despite the potential decrease in the number of genotyped samples in some populations. Finally, because this analysis did not account for potential additional labor costs, further analyses are needed to determine its true cost savings.

Importance of Seasonally Inundated Secondary Channels for Yellowstone River Fish

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Although the Yellowstone River remains the longest undammed river in the continental United States, it is nonetheless exposed to anthropogenic stressors such as bank stabilization. Bank stabilization results in decreased seasonal secondary channel formation and a reduction in the availability of shallow slow-velocity habitats during high flows. To determine the importance of these habitats, we used mini-fyke nets to sample seasonally inundated secondary channels and contiguous shallow slow-velocity habitats in the mainstem Yellowstone River from Park City to Sidney, Montana, in 2009 and 2010 during runoff (July 2009 and June and July 2010). We captured over 34,000 fish representing 34 species, 11 families, and several feeding and reproductive guilds. We captured significantly more fish in secondary channels than in the mainstem, indicating that the shallow slow-velocity habitats provided by secondary channels are important habitat for fish during early summer high-flow conditions. Moreover, the loss of these habitats resulting from bank stabilization may prove detrimental to the fish assemblages of the Yellowstone River.

Climate change impact on salmonid spawning site stability in low-gradient streams: a central Idaho example

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Climate change is often predicted to cause a significant perturbation to watershed hydrology. It has been generally associated with negative impacts on natural systems, especially in conjunction with conservation and protection of sensitive ecosystems. In the U.S., spawning habitats of threatened and endangered salmonid species are important areas that are potentially vulnerable to climate change through variations in flood timing and magnitude, water temperature, and sediment input. In this work, we used a numerical model to investigate whether changes in flow regime, of the type predicted by some climate change scenarios for mountain streams in the western U.S.A., would affect spawning site stability. We ran a two dimensional hydraulic model that simulated several flow regimes from low to bankfull stage and mapped grain mobility. We defined the model boundary conditions with high-resolution airborne bathymetric lidar surveys of an important spawning stream in central Idaho, USA. Our analyses showed that such unconfined low-gradient streams are not in great danger of extensive bed mobility, even at high flows. Consequently, in this landscape, alterations in flood timing due to climate change are unlikely to decrease the success rate of salmonid egg incubation by the mechanism of increased channel bed scour.

Things to do while you are in Great Falls

Pepper Paul's (Hamlin) Picks for Provocative & Palate-Pleasing Provisions on the Prairie

(2nd Edition, Revised 2011)

Steak & Fine Dining

Bar S Lounge & Supper Club	5100 North Star Blvd
Borries	1800 Smelter Avenue (Black Eagle)
Cattlemen's Cut Supper Club	369 Vaughn Frontage Road
Eddie's Supper Club	3725 2nd Avenue North
Jakers	1500 10th Avenue South
Willow Creek Steakhouse	Heritage Inn 1700 Fox Farm Road

Seafood

West Coast	Seattle, Washington
Otherwise see above	

Mexican

El Comedor	1120 25th Street South
Fiesta En Jalisco	1220 10th Avenue South
La Pastada Mexican	1709 9th Avenue South
On the Border	1400 Market Place Drive
Taco Treat & Amigo Lounge	1200 7th Street South

Oriental

3-D International	1825 Smelter Avenue (Black Eagle)
China Buffet	1626 10th Avenue South
Maple Garden	5401 9th Avenues South
New Peking	1525 3rd Street NW
Peking Garden West	801 Smelter Avenue NE

Italian

3-D International	1825 Smelter Avenue (Black Eagle)
Borries	1800 Smelter Avenue (Black Eagle)
Macaroni Grill	1420 Market Place Drive

Pizza

Boston's	1101 7th Street South
Howard's Southwest	1800 14th Street SW
Mackenzie River Pizza	500 River Drive South

Rikki's Pizza & Pasta	1220 9th Street South

General/Family

4 B's	4610 10th Avenue South
Applebee's	223 River Drive South
Bert & Ernie's	300 1st Avenue South
Chili's Grill & Bar	1420 Market Place Drive
Fudruckers	3315 10th Avenue South
Perkins	526 2nd Avenue North

Sports Bars & Eateries

Halftime Sportsbar	1199 Northwest Bypass
Max Casino & Sports Bar	Heritage Inn (1700 Fox Farm Road)
Sting Sports Bar & Grill	1121 5th Street South

Close By

Chili's	1420 Market Place Drive
Chinatown	1709 Alder Drive (Across from Heritage Inn)
Dairy Queen	1651 Fox Farm Road (Across from Heritage Inn)
Golden Corral	1624 Market Place Drive
Howard's Pizza SW	1800 14th Street SW
Macaroni Grill	1420 Market Place Drive
On The Border	1400 Market Place Drive
Quizno's	1601 Market Place Drive
Ryan's Station	721 6th Street SW
Subway	1601 Fox Farm Road (Across from Heritage Inn)
Taco Del Mar	1601 Market Place Drive
Willow Creek Steakhouse	Heritage Inn (1700 Fox Farm Road)

Specialties

Big Mouth BBQ	1720 10th Avenue South
Downtown DogHouse	#4 5th Street South
Ford's Drive Inn	1301 Central Avenue West
Goode's Q and Bayou Grill	613 15th Street North
Suki Café	1229 10th Avenvue South

Fast Food

Everything you can imagine	Just drive down 10th Avenue South

Casino & Food

Prospector Saloon & Gaming Parlor	907 Smelter Avenue
R & R Casino & Lounge	3801 10th Avenue South
8 Ball Inn & Casino	1020 17th Street South

Attractions, Tours & Points of Interest

Steve Leathe's Office	Located in the Historic Rainbow Dam Powerhouse
CM Russel Museaum	400 13th Street North
Lewis & Clark Interpretive Center	4201 Giant Springs Road
Paris Gibson Square Museum of Art	1400 1st Avenue North
The History Museum	422 2nd Street South
First Peoples Buffalo Jump	Northwest of Ulm

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