

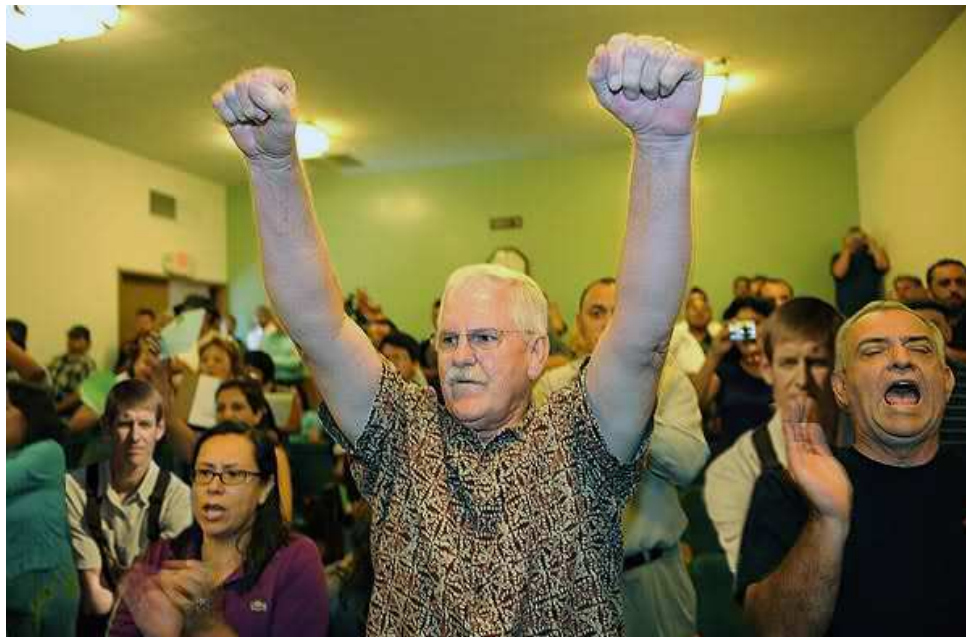
MONTANA CHAPTER

OF THE
AMERICAN FISHERIES SOCIETY
45TH ANNUAL MEETING



PROGRAM GUIDE

Successfully Navigating the Social and Political Realm of Conservation



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.

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(Confederated Salish and Kootenai Tribes)



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Acknowledgements

Thanks to all of the members of MCAFS Executive Committee for their help and guidance in setting up this year's meeting. Thanks to all of the plenary speakers for making time to present to the MCAFS, in particular those who traveled great distances to join us. Thanks to all committee chairs, student subunits (raffle and volunteering), speakers, moderators and sponsors for helping make this meeting happen. Also thanks to Scott Opitz for coordinating volunteers. You have all helped put on a meeting that will be enjoyed and valued by the MCAFS members.

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Successfully Navigating the Social and Political Realm of Conservation

Welcome to the 45th annual meeting of the Montana Chapter of the American Fisheries Society. I expect that all attendees have an expectation in mind for the meeting, whether that is socializing, **RUNNING FOR CHAPTER PRESIDENT**, or enjoying the presentations. This year's plenary topic is fitting for our day-to-day work. I wonder how many of you looked at the picture on the cover, and instantly relived a similar public meeting? That was the reaction I had when I saw the picture. These reactions uncover the unfortunate truth, that science is not always the dominant force affecting natural resources. The following paragraphs provide an introduction for the plenary session, outlining what I hope members will get out of it. Mostly, I hope you take something away that helps you better manage the aquatic resources of Montana.

Although the role of society and politics in conservation is often paramount, little training has historically been provided for natural resource professionals in the disciplines of psychology, sociology, or political science. The success of any conservation project may hinge more on social and political issues than technical aspects. Biologists, researchers and managers often learn "the hard way" how to successfully work through the social and political realm of conservation through many years of trial and error. That said many natural resource professionals have become adept at working in this realm.

Recognizing that the social and political landscape is complicated and enigmatic, expectations of cook-book approaches are unrealistic. Rather, the intent of the 2012 annual meeting is to increase the awareness of chapter members, and provide tools to better operate within the social and political realm of conservation.

In the end, I hope that that the plenary session provides members with a better awareness of the social and political side of conservation. The plenary session will provide members with exposure to ideas, techniques, and case histories to increase effectiveness in the social and political realm; ultimately increasing the effectiveness of conservation efforts within the state.

Sincerely,

Travis Horton

Schedule at a Glance

| Date/ Time | Event | Location |
|-----------------------|----------------------|--------------------------|
| Monday, Feb 6 | | |
| 12:00-4:00 | EXCOM meeting | Helena Room |
| Tuesday, Feb 7 | | |
| 12:00 | Registration | Pre-function Area |
| 1:00-5:00 | Continuing education | Legislative and Judicial |

| Date/ Time | Event | Location |
|-------------------|---|-----------------|
| 6:00-9:00 | Lake trout working group | Lewis Room |
| 6:00-9:00 | Welcome social with drinks and hors d'oeuvres | Capitol Room |

Wednesday, Feb 8

| | | |
|------------|---|---|
| 7:00 | Registration | Pre-function Area |
| 8:00 | Plenary session: Successfully navigating the social and political realm of conservation | Ball Room |
| 10:05 | Break | Capitol Room |
| 10:25 | Plenary session | Ball Room |
| 11:45 | Buffet lunch | Capitol Room |
| 1:00 | Clark Fork symposium | Ballroom |
| 3:20 | Break | Capitol Room |
| 3:35 | Clark Fork symposium continued | Ballroom |
| 5:00-6:00 | Committee caucuses | Helena, Senate, Montana, Governor and Clark rooms |
| 6:00 | Poster session and vendor trade show (presenters in attendance 6:00-6:45) | Capitol Room |
| 6:00-10:00 | Plenary speaker appreciation social | Capitol Room |

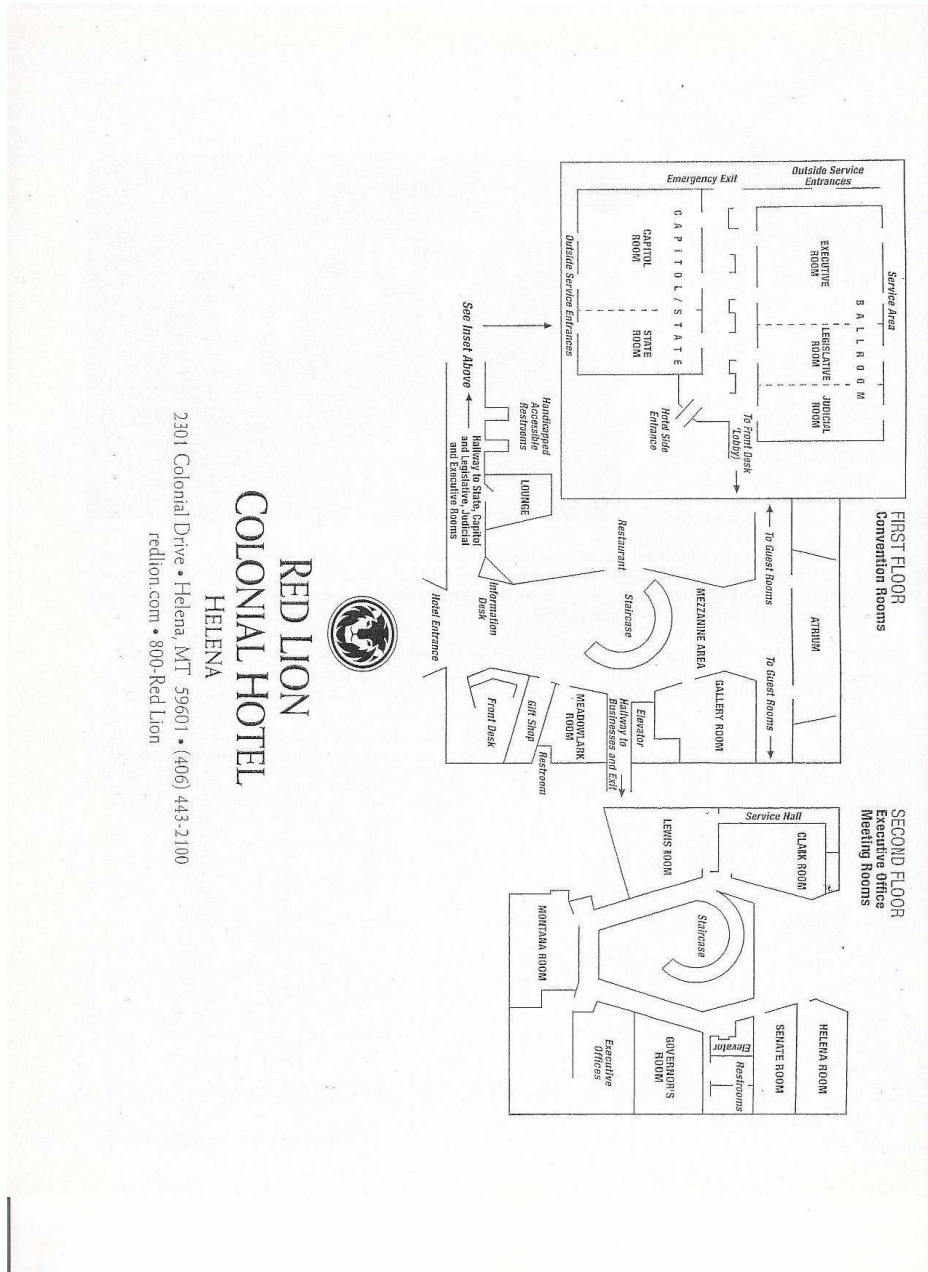
Thursday, Feb 9

| | | |
|-----------|--|-------------------|
| 7:00 | Registration | Pre-function Area |
| 8:00 | Contributed papers | Ball Room |
| 9:50 | Break | Capitol Room |
| 10:10 | Contributed papers | Ball Room |
| 12:10 | Business luncheon (buffet) | Capitol Room |
| 2:10 | Contributed papers | Ball Room |
| 3:30 | Break | Capitol Room |
| 3:50 | Contributed papers | Ball Room |
| 5:10 | End session | |
| 5:10-6:00 | Student mentoring social | Natatorium |
| 5:10-6:00 | MT Association of Fish and Wildlife biologists meeting | Clark Room |
| 6:00-7:00 | Evening social with drinks and hors d'oeuvres | Capitol Room |
| 7:00 | Awards banquet and raffle | Capitol Room |

| Date/ Time | Event | Location |
|------------|-------|----------|
|------------|-------|----------|

Friday, Feb 10

| | | |
|-------|--------------------|--------------|
| 8:00 | Contributed papers | Ball Room |
| 10:25 | Break | Capitol Room |
| 10:45 | Contributed papers | Ball Room |
| 12:05 | Adjourn | |



Continuing Education Agenda
The Conservation Professional's Guide to Working with People

Presented by
Dr. Scott Bonar
Arizona Cooperative Fish and Wildlife Research Unit
The University of Arizona

Tuesday, February 7, 2012
Red Lion Colonial Inn, Helena, Montana

1:00 Welcome and introductions

Successful natural resource management is much more than good science; it requires working with landowners, meeting deadlines, securing funding, supervising staff, and cooperating with politicians. The ability to work effectively with people is as important for the conservation professional as it is for the police officer, the school teacher, or the lawyer. Yet skills for managing human interactions are rarely taught in academic science programs, leaving many conservation professionals woefully unprepared for the daily realities of their jobs.

In this workshop, Scott Bonar will discuss selected skills presented in his book *The Conservation Professional's Guide to Working with People*, which was described as “reassuring, wise and entertaining guidance” by Paul R. Ehrlich, Stanford University professor and author of *The Population Bomb* and *One with Nineveh* and “a guidepost” that “should be a part of college curricula in every natural resources program” by Dr. Mamie Parker, Assistant Director of the U.S. Fish and Wildlife Service. The workshop will explore how natural resource professionals can develop skills and increase their effectiveness using strategies and techniques grounded in social psychology, negotiation, influence, conflict resolution, time management, and a wide range of other fields. Those who are already good at working with people will learn new tips, while those who are petrified by the thought of conducting public meetings, requesting funding, or working with constituents will find helpful, commonsense advice about how to get started and gain confidence. In Tuesday's session we will focus on verbal judo, negotiation and defense against dirty tricks in the workshop. In the Plenary, we will focus on how and when to influence people.

5:00 Adjourn

**THE 45TH ANNUAL MEETING OF THE MONTANA CHAPTER OF THE AMERICAN
FISHERIES SOCIETY**
Agenda

Wednesday February 8

Plenary Session

Moderator: Steve Dalbey, (Montana Fish, Wildlife & Parks)

8:00 Welcome and introduction of plenary topic (Craig Barfoot and Travis Horton)

- 8:10** **Introduction to the basics of human dimensions**, Alexander Zale (USGS, Montana Cooperative Fishery Research Unit)
- 8:45** **Diverse values and relevance of native species in wildlife management: perspectives for wildlife managers**, Mark Gamblin (Idaho Department of Fish and Game)
- 9:10** **The conservation professional's guide to working with people**, Scott Bonar (USGS, Arizona Cooperative Fish and Wildlife Research Unit)
- 10:05** **Break**
- 10:25** **Techniques for success when working with the media**, Ron Aasheim (Montana Fish, Wildlife & Parks)
- 10:40** **The ultimate trump card: biology or politics?** Mike Phillips (Turner Endangered Species Fund)
- 11:10** **Morning panel discussion**
- 11:45** **Buffet lunch**
- Symposium: Restoration of the Upper Clark Fork River: Plans and Progress**
Moderator: Tom McMahon (Montana State University)
- 1:00** **Symposium introduction**

Historical Perspective

- 1:05** **The Upper Clark Fork River Basin: A quasi-scientific, anecdotal history of use, abuse and reuse**, Matt Vincent (Clark Fork Watershed Education Program)
- 1:25** **Making the case for restoration: the Clark Fork River NRD litigation, Montana v. ARCO, its settlements and aftermath**, Rob Collins (Montana Department of Justice)
- 1:45** **Scientific strategies used during the late 1980s to define the biological response to mining activities in the Clark Fork River**, Aida M Farag (U.S. Geological Survey)

Current Status and Trends

- 2:05** **Water quality trends and biological responses in Silver Bow Creek and Upper Clark Fork River**, Trevor Selch (Montana Fish, Wildlife & Parks)
- 2:25** **Distribution, abundance and recovery status of fishes in Silver Bow Creek**, Joe Naughton* (Montana State University), Robert E. Gresswell (U.S. Geological Survey) and Thomas E. McMahon (Montana State University)

- 2:45** **Distribution and abundance of trout in the Upper Clark Fork River: Changes in Time?** Jason Lindstrom* and Brad Liermann (Montana Fish, Wildlife & Parks)
- 3:00** **Limiting factors for trout in the Upper Clark Fork River superfund site: movement, survival, and habitat use,** Mariah Mayfield*, Thomas E. McMahon and Jay Rotella (Montana State University)

3:20 **Break**

The Future

- 3:35** **Remediation of the Silver Bow Creek and the Upper Clark Fork River-human health helping fishery health,** Joel Chavez* and Brian Bartkowiak (Montana Department of Environmental Quality)
- 3:55** **Dam's gone,** David Schmetterling (Montana Fish, Wildlife & Parks)
- 4:15** **Upper Clark Fork River restoration: an angler's perspective,** Casey Hackathorn (Trout Unlimited)
- 4:30** **Strategies for fishery restoration in the Upper Clark Fork River basin,** Pat Saffel (Montana Fish, Wildlife & Parks)
- 4:45** **Panel discussion of restoration plans**
- 5:00** **End of session**
- 5:00** **Committee caucuses**
- 6:00** **Poster session (presenters in attendance 6:00-6:45)**
- 6:00-10:00** **Plenary speaker appreciation social**

Thursday, February 9

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

Contributed Papers (An * indicates presenter)

Moderator: Chris Guy (Montana Coop Fishery Research Unit)

- 8:10** **A 3-Year experimental removal of lake trout in Swan Lake, MT,** Leo R. Rosenthal (Montana Fish, Wildlife & Parks)
- 8:30** **Cost-effectiveness of gill netting strategies for suppressing non-native lake trout in Swan Lake, Montana,** John M. Syslo*, Christopher S. Guy (Montana

Coop Fishery Research Unit), and Benjamin S. Cox (Oregon Department of Fish and Wildlife)

8:50 Identifying movement patterns and spawning areas of invasive lake trout *Salvelinus namaycush* in Yellowstone Lake, Robert E. Gresswell* (U.S. Geological Survey), Cory D. Suski (University of Illinois), Michael Parsley (U.S. Geological Survey), Brian Ertel, Patricia Bigelow, Todd Koel (Yellowstone National Park), Andy J. Danylchuk (University of Massachusetts), and Steven J. Cooke (Carleton University)

9:10 Feasibility assessment for translocation of imperiled bull trout populations in Glacier National Park, Ben T. Galloway* (Montana State University), Clint C. Muhlfeld (U.S. Geological Survey), Christopher S. Guy (Montana Coop Fishery Research Unit), Christopher C. Downs (Glacier National Park), Wade A. Fredenberg (U.S. Fish and Wildlife Service)

9:30 Of mysivores and piscivores: phenotypic, life history, and diet divergence with depth in Flathead lake trout, Craig P. Stafford* (University of Montana), Megan V. McPhee (University of Alaska Fairbanks), Lisa A. Eby (University of Montana), and Frew W. Allendorf (University of Montana)

9:50 Break

Moderator: Trevor Selch (Montana Fish, Wildlife & Parks)

10:10 Using genetic markers to reconnect a metapopulation of bull trout, Joseph M. DosSantos*, Shana R. Bernall (Avista Utilities), Patrick W. DeHaan, Lawrence L. Lockard, and William R. Ardren (U.S. Fish and Wildlife Service)

10:30 Estimation of reproductive success for bull trout transported above mainstem Clark Fork River dams, Shana Bernall* (Avista Utilities) and Patrick DeHaan (U.S. Fish and Wildlife Service)

10:50 Trout hybridization in the Lamar River drainage: trends and potential mechanisms, Patrick Della Croce*, Geoffrey C. Poole (Montana State University) and Andre B. C. Thees (Leibniz University Hannover)

11:10 An examination of genetic diversity in isolated cutthroat populations of the Flathead River basin, Montana, Kellie Carim* (University of Montana), Craig Barfoot (Confederated Salish-Kootenai Tribes) and Lisa Eby (University of Montana)

11:30 Juvenile salmon ecology, habitat use and growth in a large Alaskan river floodplain dominated by beavers, Rachel L. Malison* and Jack A. Stanford (Flathead Lake Biological Station)

11:50 **Advances in bathymetric mapping data collection, analysis and dissemination**, Adam Petersen (Montana Fish, Wildlife & Parks)

12:10 **Business Luncheon**

Contributed Papers

Moderator: Matt Jaeger (Montana Fish, Wildlife & Parks)

2:10 **Burbot *Lota lota* recruitment in the lower Missouri River during the historic flows of 2011**, Tyler Haddix*, Landon Holte, John Hunziker and Dave Fuller (Montana Fish, Wildlife & Parks)

2:30 **Pallid sturgeon use of the Missouri and Milk rivers in 2011**, Dave Fuller* and Tyler Haddix (Montana Fish, Wildlife & Parks)

2:50 **Population connectivity of three prairie cyprinids in the Yellowstone River and its tributaries**, Michael B. Duncan*, Robert G. Bramblett, and Alexander V. Zale (Montana Coop Fishery Research Unit)

3:10 **Effects of hypoxia on growth, behavior, and mortality of *Scaphirhynchus* and *Polyodon* larvae**, Hilary G. Billman*, Christopher S. Guy (Montana Coop Fishery Research Unit), Kevin M. Kappenman, Jason Ilgen, and Molly A. H. Webb (U.S. Fish and Wildlife Service)

3:30 **Break**

Contributed Papers

Moderator: Jim Olsen (Montana Fish, Wildlife & Parks)

3:50 **Estimating trout movements in a river network using strontium isoscapes**, Clint C. Muhlfeld* (U.S. Geological Survey), Simon R. Thorrold (Woods Hole Oceanographic Institution), Thomas E. McMahon (Montana State University) and Brian Marotz (Montana Fish, Wildlife & Parks)

4:10 **Using a spatially explicit stream temperature model to assess potential effects of climate warming on bull trout habitats**, Leslie A. Jones*, Clint C. Muhlfeld (U.S. Geological Survey), Lucy A. Marshall (Montana State University), Brian L. McGlynn (Montana State University), and Jeffrey L. Kershner (U.S. Geological Survey)

4:30 **Using PIT tags to assess seasonal and annual movements of native and nonnative trout**, Bradley B. Shepard* (Wildlife Conservation Society), Robert Al-Chokhachy, Robert Gresswell (U.S. Geological Survey), Alexander Zale (U.S. Geological Survey), Scott Opitz, Carol Endicott (Montana Fish, Wildlife & Parks), and Clint Sestrich (U.S. Forest Service)

- 4:50** **Evaluating success and failure of reintroducing the western pearlshell mussel (*Margaritifera falcata*) into streams in the Blackfoot River watershed: monitoring, testing and future implications**, David M. Stagliano* (Montana Natural Heritage Program) and Ron W. Pierce (Montana Fish, Wildlife & Parks)
- 5:10** **End of session**
- 5:10** **MT Association of Fish and Wildlife Biologists meeting**
- 5:10** **Student mentoring social**
- 6:00** **Social hour**
- 7:00** **Banquet dinner and raffle**

Friday, February 10

Contributed Papers

Moderator: Carol Endicott (Montana Fish, Wildlife & Parks)

- 8:00** **Welcome and announcements:**
- 8:05** **The Columbia River treaty between Canada and the United States could change established dam operations and Montana’s headwater reservoir and river fisheries**, Brian Marotz* (Montana Fish, Wildlife & Parks) and John Marsh (Confederated Salish and Kootenai Tribes)
- 8:25** **Conservation efforts of BPA**, Mark D. Reller* and Cecilia Brown (Bonneville Power Administration)
- 8:45** **An evaluation of walleye stocking programs in Fresno and Nelson reservoirs**, Cody J. Nagel (Montana Fish, Wildlife & Parks)
- 9:05** **Parental male effects on landlocked fall Chinook salmon progeny survival**, Matthew M. Wipf* (Montana Fish, Wildlife & Parks) and Michael E. Barnes (South Dakota Game, Fish, and Parks)
- 9:25** **Metal in the mountains: A fish community mercury assessment with implications for human and wildlife risk in Glacier National Park**, Christopher C. Downs* (Glacier National Park), Craig Stafford and Heiko Langer (University of Montana)
- 9:45** **From phosphorus to fish: beneficial use of excess nutrients**, Mark Reinsel* (Apex Engineering) and Bruce Kania (Floating Island International, Inc.)

10:05 **Latest-generation floating islands eliminate stratification and provide fish spawning habitat**, Bruce Kania* (Floating Island International, Inc.) and Mark Reinsel (Apex Engineering)

10:25 **Break**

Contributed Papers

Moderator: Peter Brown (Montana State University)

10:45 **Climate change effects on stream and river temperatures across the northwest U.S. from 1980–2009**, Daniel J. Isaak*, Sherry Wollrab, Dona Horan and Gwynne Chandler (U.S. Forest Service)

11:05 **WHERE'S THE BEEF? Why 20 years of predicted global warming effects on fish distributions remain unsubstantiated**, Daniel J. Isaak* and Bruce E. Rieman (U.S. Forest Service)

11:25 **Evaluating the factors associated with the distribution of Yellowstone cutthroat trout: a rangewide analysis**, Robert Al-Chokhachy*, Bob Gresswell, Steve Hostetler (U.S. Geological Survey) and Bradley B. Shepard (Wildlife Conservation Society)

11:45 **Thermal tolerance of meltwater Stonefly *Lednia tumana* nymphs from an alpine stream in Waterton-Glacier International Peace Park, Montana, USA**, Hilary G. Billman* (Montana State University) J. Joseph Giersch, Clint C. Muhlfeld (U.S. Geological Survey), Kevin M. Kappenman and Molly A. H. Webb (U.S. Fish and Wildlife Service)

12:05 **Adjourn**

Posters:

Lake Helena willow bank stabilization demonstration, Jeff Ryan (*Montana Department of Environmental Quality*)

If you build it, fish will climb it, Kristi Webb (*Steigers Corporation*) and L. Brent Mabbott (*PPL Montana*)

Do growth rates in Snake River cutthroat trout and cutthroat trout X rainbow trout hybrids differ? Taylor Wilcox (*University of Montana*) and Lisa Eby (*University of Montana*)

Hydrogeomorphic characteristics of bull trout spawning habitat, Northwestern Montana, Jared R. Bean, Andrew C. Wilcox, William W. Woessner (*University of Montana*) and Clint C. Muhlfeld (*U.S. Geological Survey*)

Limiting factors, thermal refuges, and connectivity in the Smith River system, T. David Ritter, Alexander Zale (*Montana Coop Fishery Research Unit*), George Liknes (*Montana Fish, Wildlife & Parks*)

Nesting ecology of spiny softshell turtles (*Apalone spinifera hartwegi*) on the Missouri River, MT, Brian J. Tornabene, Robert G. Bramblett (*Montana State University*), Steve Leathe (PPL Montana), and Alexander Zale (*Montana Coop Fishery Research Unit*)

Dietary assessment of Yellowstone cutthroat trout in Yellowstone Lake, Yellowstone National Park, Cameron T. Clevidence, John M. Syslo, Christopher S. Guy (*Montana Coop Fishery Research Unit*) Brian D. Ertel and Kole P. Stewart (*Yellowstone National Park*)

A large-scale field assessment using underwater epoxy to permanently install sensors for full year temperature monitoring in mountain streams, Dona L. Horan, Sherry Wollrab, Daniel J. Isaak and Brett B. Roper (*U.S. Forest Service*)

Westslope cutthroat and rainbow trout species-diagnostic SNP assays developed from next-generation RAD sequencing, Stephen J. Amish, Paul A. Hohenlohe (*University of Idaho*), Sally Painter (*University of Montana*), Robb F. Leary (*Montana Fish, Wildlife & Parks*), Clint Muhlfeld (*U.S. Geological Survey*), Fred W. Allendorf and Gordon Luikart (*University of Montana*)

Managing for a destination family fishery at Tongue River Reservoir, Caleb Bollman (*Montana Fish, Wildlife & Parks*)

Structural differences between the Yellowstone and Missouri River fish assemblages, Michael B. Duncan, Robert G. Bramblett, Alexander V. Zale (*Montana Coop Fishery Research Unit*) and Tyler Haddix (*Montana Fish, Wildlife & Parks*)

Preliminary and potential effects of the 2011 oil spill on the Yellowstone River fish assemblage, Ann Marie Reinhold, Michael B. Duncan, Robert G. Bramblett, and Alexander V. Zale (*Montana Coop Fishery Research Unit*)

Plenary Speaker Abstracts and Biographies



INTRODUCTION TO THE BASICS OF HUMAN DIMENSIONS

DR. ALEXANDER ZALE

Unit Leader, USGS

Montana Cooperative Fishery Research Unit

301 Lewis Hall

Montana State University

Bozeman, MT 59715

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Basic social sciences concepts that help explain human behavior include values, beliefs, attitudes, norms, behavioral intentions, behaviors, motivations, and satisfactions. I will define these, provide examples, and illustrate their utility in human dimensions of fish and wildlife management.

DIVERSE VALUES AND RELEVANCE OF NATIVE SPECIES IN WILDLIFE MANAGEMENT: PERSPECTIVES FOR WILDLIFE MANAGERS



MARK GAMBLIN

Regional Supervisor, Southeast Region

Idaho Fish and Game

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Pocatello, ID 83204

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Native species, including wild trout, are increasingly important in North American public wildlife resource management policy, programs, and resource allocation decisions. Wild trout management policy and programs should reflect the values and expectations of the society we serve. In practice, that responsibility is a challenge for state wildlife management agencies as the demand for natural resources increases and our society evolves from its agrarian-utilitarian roots. Maintaining relevance of wildlife management policy and programs in our evolving society will be essential for the continued success of fisheries and wildlife management in North America. I suggest that the continued success of North American wildlife management in general and native species in particular will rely on making the objectives of wildlife conservation and

stewardship relevant to American society. That relevance will require that conservation objectives are clearly explained to be in the best interest of the individual.

THE CONSERVATION PROFESSIONAL'S GUIDE TO WORKING WITH PEOPLE



SCOTT BONAR, Ph.D.

*Unit Leader, USGS,
Arizona Cooperative Fish and Wildlife Research Unit
School of Natural Resources
104 Biosciences East
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Successful natural resource management is much more than good science; it requires working with landowners, meeting deadlines, securing funding, supervising staff, and cooperating with politicians. The ability to work effectively with people is as important for the conservation professional as it is for the police officer, the school teacher, or the lawyer. Yet skills for managing human interactions are rarely taught in academic science programs, leaving many conservation professionals woefully unprepared for the daily realities of their jobs.

In this plenary, Scott Bonar will discuss selected skills presented in his book *The Conservation Professional's Guide to Working with People*, which was described as “reassuring, wise and entertaining guidance” by Paul R. Ehrlich, Stanford University professor and author of *The Population Bomb* and *One with Nineveh* and “a guidepost” that “should be a part of college curricula in every natural resources program” by Dr. Mamie Parker, Assistant Director of the U.S. Fish and Wildlife Service. The book explores how natural resource professionals can develop skills and increase their effectiveness using strategies and techniques grounded in social psychology, negotiation, influence, conflict resolution, time management, and a wide range of other fields. Those who are already good at working with people will learn new tips, while those who are petrified by the thought of conducting public meetings, requesting funding, or working with constituents will find helpful, common sense advice about how to get started and gain confidence.

TECHNIQUES FOR SUCCESS WHEN WORKING WITH THE MEDIA



RON AASHEIM
Communications and Education Chief
Montana Fish, Wildlife & Parks
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Helena, MT 59601
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Incomplete and inaccurate information are often the biggest problems resource managers face in dealing with contentious issues and difficult decisions. Good professional relationships with the media can help solve that problem. We'll discuss ways to build and improve those relationships by offering ideas on: building trust; providing information to the media; ways to help the media do their jobs and things to be aware of when working with the media. Bottom line...the more the public knows about what we are doing and why the more effective we will be as resource managers.



THE ULTIMATE TRUMP CARD: BIOLOGY OR POLITICS?

MIKE PHILLIPS
Executive Director, Turner Endangered Species Fund
State Representative (2006 – 2012), House District 66
1123 Research Drive,
Bozeman, MT 59718
Mike.Phillips@tedturner.com

Abstract: Montana legislators routinely consider issues that include complex scientific aspects. From issues as disparate as energy policy to wolf management, Montana's elected officials are expected to develop sufficient scholarship on scientific matters to support an informed vote on relevant legislation. This is an especially daunting challenge because Montana's "citizen's legislature" typically consists of individuals who are not trained in the sciences and have full-time occupations outside the legislature. The biennial calendar of the state's legislature adds another element to the challenge since the volume of work to accomplish every other year is nearly overwhelming. Consequently, for some issues the tension between science and politics is

palpable. Through several case studies this talk explores that tension and concludes that politics more often play a greater role in final decisions than science.

Plenary Presentations and Panel Discussion Moderator



Steve Dalbey

*Fisheries Program Manager North Eastern Region
Montana Fish, Wildlife & Parks*

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Glasgow, MT 59230

sdalbey@mt.gov

Steve is currently the Fisheries Program Manager for MFWP in North Eastern Montana. Steve's career with MFWP started in 1989 as the Bighorn River Ranger; a position created in response to complaints of overcrowding from river recreationalists. A graduate of MSU Steve's 20-year career in fisheries has included stints in every region in Montana except R2. Prior to moving to Glasgow, Steve worked for 10-years as Fisheries Biologist on the Upper Missouri River Reservoir System where he dealt extensively with the social/political conflicts surrounding walleye management on Canyon Ferry, Hauser and Holter Reservoirs.

A native of Eastern Montana, Steve has spent much of his career working with the public to better understand the complexities of fisheries management. Steve and his staff recently completed a new 10-year fisheries management plan for Fort Peck Reservoir and are integral participants in the pallid sturgeon recovery program.

"It is no longer enough to establish what counts as good science; it is equally important to address what science is good for and whom it benefits" **Sheila Jasanoff**

Contributed Paper Abstracts (In order of presentation)

The Upper Clark Fork River basin: a quasi-scientific, anecdotal history of use, abuse and reuse

Matt Vincent, Director, *Clark Fork Watershed Education Program (Cfwep.Org)*

The Upper Clark Fork River Basin (UCFRB) is the northeastern headwaters of the Columbia River, America's second largest river; as well as the largest contiguous complex of Superfund sites in the U.S. A historical recount of the damages that rendered the river basin the latter is necessary in order to fully understand the vast scale of remediation/restoration past, present and future. Butte and Anaconda in the basin's headwaters region has a storied and in the environmental case, infamous past as a former copper mining and smelting camp of world significance in the late 1800s-early 1900s. In the absence of any significant regulations, the Clark Fork River and two of its headwaters tributaries (Silver Bow and Warm Springs Creeks) were effectively utilized as an industrial sewer until the passage of the Clean Water Act in 1972. This presentation details the environmental conditions of and damages to the watershed from its use by original peoples prior to European settlement to the present, with particular emphasis placed on the period from 1864 to 1980.

Making the case for restoration: the Clark Fork River NRD litigation, Montana v. ARCO: its settlements and aftermath

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The Clark Fork River (CFR) and Silver Bow Creek (SBC), and their fisheries, suffered greatly from Butte and Anaconda area mining contamination for more than 100 years prior to the filing of the natural resource damage (NRD) lawsuit, Montana v. ARCO, and continues to suffer, but to a significant lesser degree due to the ongoing Superfund cleanup and NRD restoration of these sites. The NRD litigation was filed in December 1983 and was not finally resolved until 2008. During those intervening 25 years the State, including its NRD Program, DEQ and DFWP, were involved in extensive litigation, including many years of discovery, a trial lasting for about one year, and settlement negotiations that lasted for more than 12 years. As a result of this litigation, and companion litigation filed on behalf of EPA, three major settlements were reached in the form of consent decrees (CDs) that were filed in United States District Court, and about \$500 million, including about \$230 in NRD, was recovered by the State and EPA to clean up the mining contamination and restore the Upper Clark Fork River Basin. During this period of time, the State conducted or funded numerous fishery studies to support the State's position in the lawsuit, and, since the first of the three settlements in 1999, the money damages recovered have been used to fund, among other things, numerous addition studies and various restoration projects on the CFR, SBC and their tributaries. A number of these funded studies and projects will be further described by others at this symposium. Mr. Collins' presentation will deal with the lawsuit, its background and the law involved, various facets of the litigation, the settlements and generally how the money recovered has been or is being spent.

Scientific strategies used during the late 1980s to define the biological response to mining activities in the Clark Fork River.

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Although the discharge of Silverbow Creek is only 0.4% of the total discharge of the Clark Fork, enough metal contamination was transported out of its watershed to contaminate the sediments throughout the river system. Before the 1900s, Evermann (1892) seined the Clark Fork River near Deer Lodge and found no fish. He stated that the River, “is said to have been well supplied with trout and other fish, but none has been seen since the concentrators began operations.” In the 1950s, ponds were completed to contain smelter wastes and mine tailings but sedimentary wastes could bypass the ponds during high flow events. During the late 1980s researchers had documented elevated concentrations of trace metals in the water column and observed fish kills in the Clark Fork River. However, definitively linking these results to a causative agent (e.g. trace metals from historic mining) was a complex task. This was complicated further by the need to identify biologic exposure versus effects. Yet, it was essential to define the cause and extent of effects on the fishery in the Clark Fork River to recover funds for remediation/restoration efforts and to provide comparative data for future monitoring efforts. Both field and laboratory experiments, along with species diversity, population, dietary, behavioral, toxicity and mechanistic studies were used to unravel the complex nature of exposure versus effects in the Clark Fork River.

Water quality trends and biological responses in Silver Bow Creek and Upper Clark Fork River

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A century of mining left the headwaters of the Clark Fork River virtually devoid of aquatic life and formed the largest contiguous complex of superfund sites in the United States. However in recent decades, hundreds of millions of dollars have been spent on remediation and restoration efforts to return the watershed to a functioning aquatic ecosystem that supports trout. Although extensive cleanup has occurred on Silver bow Creek (SBC), high concentrations of zinc and copper persist in the watershed and often exceed acute aquatic life standards after rain events. These events were initially documented pre-remediation during caged fish studies conducted between 1986-1989, where copper and zinc levels in SBC were found to be 580 and 101 times acute aquatic life standards. Acutely toxic concentrations of metals lead to extensive fish kills on the Clark Fork River from 1983-1985 and 1988-1991. Post-restoration monitoring conducted in 2002 discovered longnose suckers and slimy sculpins in the Rocker section of SBC. By 2007, trout began to show up in fall sampling efforts, and by 2010 trout were found in all sampling sections of the Creek. In 2007-2008, copper and zinc concentrations are substantially lower, although they still exceed aquatic life standards in sections below the Metro Storm Drain and in Durant canyon (an un-remediated section) after rain events. Moreover, acutely toxic levels of ammonia and low dissolved oxygen conditions persist downstream of the Butte waste-water treatment plant, further inhibiting fish survival. Water quality and benthic macroinvertebrate monitoring trends will also be discussed.

Distribution, abundance, and recovery status of fishes in Silver Bow Creek

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Superfund remediation has lowered metal concentrations in Silver Bow Creek. Six fish species are now present, including westslope cutthroat and brook trout. However, continued hypoxia and ammonium pollution from sewage effluent may impede recovery of fishes. To evaluate reestablishment of self-sustaining trout populations, we monitored fish movement and abundance in Silver Bow Creek from July 2009 through December 2011. A total of 3,277 fish were PIT-tagged, and broad-scale (3-8 km) movements were monitored at five pass-through antenna sites. To evaluate fish distribution patterns, spatially continuous electrofishing surveys were completed in 2009 (18 km), 2010 (34 km), and 2011 (38 km); six mobile-antenna surveys (28-38 km) were conducted during the study period. Concentrations of heavy metals, ammonium, and dissolved oxygen (DO) were monitored in corresponding stream sections. Each summer we observed severe hypoxia ($\text{DO} \leq 2.1 \text{ mg} \cdot \text{l}^{-1}$) over 2-10 km of the mainstem, and ammonium ($\text{NH}_3\text{-N}$) concentrations as high as $4.5 \text{ mg} \cdot \text{l}^{-1}$. Both trout species were sparse in seasonal hypoxic areas but suckers were common. Cutthroat trout abundance increased in mainstem sections each year and their movements were extensive. Mainstem cutthroat trout grew rapidly and length-frequency data indicates they were larger than tributary residents. Synthesis of movement, size frequency, and abundance data indicates that lowered metal concentrations have allowed cutthroat trout to recolonize Silver Bow Creek despite continued summertime hypoxia. Cutthroat trout found in Silver Bow Creek appear to be exhibiting fluvial-adfluvial behavioral traits. Results underscore the role of movement in connecting physically and temporally isolated habitat resources in stream networks.

Distribution and abundance of trout in the Upper Clark Fork River: changes in time?

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The Upper Clark Fork has a long history of human impacts to the native and recreational fisheries found in the drainage. Most notable of these impacts is the mining and smelting that occurred in the Butte and Anaconda areas that severely degraded water quality throughout the basin. While some historic fisheries data was collected in the Upper Clark Fork, long term monitoring and assessment data was limited, largely due to impending lawsuits and the effect additional data could have had on litigation. Lawsuits were aimed at acquiring settlement funds to remediate and restore the Clark Fork River system. With a settlement near completion, Montana Fish, Wildlife & Parks began a large scale effort in 2009 to replicate past data collected in 1987 to assess the current state of the Upper Clark Fork River fishery and determine whether significant change had occurred in the fishery over that 22 year period. This effort entailed

completing mark-recapture estimates via electrofishing throughout the entire reach of the Upper Clark Fork River from the Warm Springs Ponds to near Rock Creek, approximately 100 river miles. The results of the surveys indicate that fish abundance and species composition was relatively similar in most reaches of the Clark Fork River in 2009 to what was observed in 1987. Notable exceptions were observed in sections located nearest the Warm Springs Ponds, where markedly lower densities of brown trout were observed in 2009 than in 1987. Brown trout densities appear to still be lower throughout the Upper Clark Fork River than expected, particularly in comparison to fish densities observed in other regional fisheries. Densities appear to be particularly low in the reach between Drummond and Rock Creek and may be due to limiting factors other than contaminants associated with upstream mining activities.

Limiting factors for trout in the Upper Clark Fork River superfund site: movement, survival, and habitat use

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Large-scale heavy metal contamination of the upper Clark Fork River from mining deposits has created significant damage to aquatic habitat in the drainage. Trout are present in the system, with abundances lower than expected. The objectives of this study were to identify critical habitat areas and to identify conditions continuing to limit both native and non-native trout populations, with the focus on the lingering environmental effects caused by high heavy metal concentrations. Radiotelemetry of 269 brown trout *Salmo trutta*, westslope cutthroat trout *Onchorhynchus clarkii lewisi*, rainbow trout *O. mykiss*, cutthroat/rainbow hybrids, and bull trout *Salvelinus confluentus* from 2009 to 2011 was used to determine seasonal movement and survival in relation to heavy metals and other environmental factors, and to identify critical spawning and seasonal rearing areas. Survival analysis, using Program MARK, estimates that salmonids experience the highest mortality rates during the spring and summer months in the upper reaches of river and tributaries. Elevated mortality rates in the spring and summer may indicate fish reactions to poor water quality, such as increased heavy metal concentrations and water temperatures. We observed very little movement of trout, except in relation to spawning migrations. Brown trout spawning occurs in numerous tributaries throughout the basin and in the upper reaches of the mainstem. Cutthroat trout spawn only in tributaries, and they are often smaller and more degraded by land-use practices than brown trout spawning tributaries. The results from this study will help to identify areas in need of remediation for all species of trout.

Remediation of the Silver Bow Creek and the Upper Clark Fork River-human health helping fishery health

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Montana Department of Environmental Quality is the lead in implementing the combined remediation/restoration of two National Priority Listed Superfund Sites. Cleanup of Silver Bow Creek had been ongoing since 1999 and is expected to be complete 2014. The Cleanup of the Upper Clark Fork River is just beginning with remediation occurring on the Clark Fork River in Deer Lodge, MT in 2011/2012. During this presentation, Joel Chavez will be presenting and overview of the remediation that has occurred on Silver Bow Creek and Brian Bartkowiak will be presenting an overview of the remediation that will be occurring on the Upper Clark Fork River. Both of these cleanups focus on protection of human health. However this presentation will focus on how cleanup for human health improves the fisheries of the Upper Clark Fork Basin.

Dam's gone

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The removal of Milltown Dam commenced in 2006, after a century of impacts to the watershed. The last vestiges of the dam were extracted from the confluence of the Blackfoot and Clark Fork rivers in 2009. The dam that once annually blocked the migrations of 10's of thousands of fish, limited downstream fish movements, created a reservoir that fostered illegally introduced northern pike and was a source of heavy metal inputs to the river below is gone and over 2 million cubic yards of sediments removed. The removal of the dam reversed many of its effects immediately. Connectivity was restored for all fish species and the benefits on other wildlife occurred in months. Many of the changes in the coming years will be subtle, like the expression of life history tactics that were selected against, to more dramatic changes including the conversion of the reservoir from a lentic fish community dominated by non-native, illegally introduced fishes to a lotic system comprised of primarily native, non-game fishes. Monitoring these changes will occur on a watershed scale and the activities range from in situ bioassays, to population and community monitoring. Dam removal may pose challenges to native trout conservation in a riverine system with primarily non-native trout species, or it may ultimately be the only way to guarantee success. Hybridization, and numerical increases in non-native trout may doom some populations of native trout, but the large-scale effects of dam removal are permanent and transcend the deleterious effects on any one species.

Upper Clark Fork River restoration: an angler's perspective

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Despite flowing through the largest Superfund site in the country, the Upper Clark Fork River has a loyal following of anglers who seek the solitude and large brown trout that go hand in hand with fishing this impaired cold-water river. The downside is an unpredictable fishery with generally low densities that can drastically fluctuate season to season and is largely devoid of native trout. The opportunity to restore a native fishery to over 100 miles of accessible mainstem river along with the support of invested anglers from surrounding communities led Trout Unlimited to hire a full time coordinator to engage this unique challenge. To date, Trout Unlimited has focused its restoration efforts in the watershed on improving fish passage and

reducing ditch entrainment loss in tributaries in an effort to restore fluvial populations of westslope cutthroat trout and overall fish population densities in both tributaries and the mainstem river. Our fish passage program entails locating, surveying and evaluating diversion dams for fish passage, prioritizing potential projects in multiple tributaries, and developing priority projects with irrigators and agencies. Projects goals include improvement or replacement of diversion structures that impair fish passage and prevention of entrainment loss through screening. The long-term goal is for a connected native fishery throughout the watershed and a robust

Strategies for fishery restoration in the Upper Clark Fork River basin

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Recent settlement of natural resource damage and superfund negotiations related to mining has made a lot of money available and mobilized efforts to restore the Upper Clark Fork River ecosystem. Restoration of the Clark Fork River's trout fishery is included in this effort. Developing fishery management and habitat restoration goals, strategies and priorities are necessary to effectively use this money. Much of the fisheries data needed were either not available or decades old, however. Therefore, a multi-faceted data collection effort was initiated: tributary habitat and fish populations were inventoried, fish movement studies were conducted, and mainstem trout population data were updated throughout the basin. Biological data were used to prioritize areas for restoration projects in a way that considered fishery management goals and the basin wide habitat restoration strategy. A plan was completed by Montana Fish, Wildlife & Parks and Natural Resource Damage Program for use by agency and non-governmental organizations (NGOs) as a guide for pursuing restoration projects and understanding how they contribute to fishery goals in the basin. New information is becoming available and is being incorporated to improve our strategies and modify priorities when appropriate. A committee including agencies and NGOs has been formed to implement fishery and other aquatic restoration in the basin. In this presentation, I will describe the process of developing the restoration strategy and highlight outcomes of the plan.

A 3-year experimental removal of lake trout in Swan Lake, MT

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The Swan Valley has historically been home to a stable, healthy bull trout population. However, in 1998 anglers began to occasionally catch adult sized (20-30 inch) lake trout from Swan Lake and the Swan River. This caused alarm because lake trout are not native and are notorious for rapidly expanding and dominating fish communities in lakes with *Mysis* shrimp, at the expense of bull trout and kokanee salmon. In 2003, the level of concern was compounded when biologists gillnetted juvenile lake trout from Swan Lake during standard low-intensity sampling efforts, indicating that wild reproduction was occurring. Since 2003, lake trout catch by anglers as well as during Montana Fish, Wildlife & Parks (FWP) biological sampling has continued to increase, indicating that the population is likely expanding. In June of 2009, FWP approved plans for a three-year experimental removal of lake trout in Swan Lake. The project was initiated as a

feasibility study to determine if targeted gillnetting can be an effective way to reduce lake trout numbers while minimizing bycatch of other fish species. From 2009-2011 over 21,000 lake trout were removed from Swan Lake. Lake trout mortality rates appear to be high relative to other lake trout suppression projects. Additionally, lake trout catch per unit effort during netting activities decreased from 2010 to 2011, indicating that netting efforts were effective at reducing year to year cohort strength. Inadvertent bycatch of other fish species was relatively low, however concerns regarding bycatch of bull trout still exist. Based on the results of this assessment and other relevant considerations, FWP, with recommendations from the Swan Valley Bull Trout Working Group, will consider whether these actions are appropriate or if other changes are warranted in fisheries management of Swan Lake and the lake trout population.

Cost-effectiveness of gill netting strategies for suppressing non-native lake trout in Swan Lake, Montana

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The mechanical removal of non-native lake trout has become a common management endeavor for large lakes in the Intermountain West. Eradication is not a likely outcome given current technology; therefore, management goals may best be quantified as the greatest reduction in lake trout abundance possible for a given time frame and cost. An experimental lake trout removal program occurred in Swan Lake, Montana, from 2008 through 2011. We used data from this removal to develop a density-dependent population model to assess the efficacy of 41 management scenarios. Each scenario was a temporal combination of netting actions, where one of four actions could occur in a given year (i.e., no netting, targeting subadults, targeting spawning adults, or targeting subadults and spawning adults). For each scenario, we assessed the percent reduction in abundance relative to an unharvested population after 5, 10, 20, 30, 40, and 175 years as a function of cost. Reductions in abundance generally increased as a function of annual cost; however, substantial variation existed in the reduction that can be achieved for a given cost. For example, the most expensive scenario (harvesting subadults and spawning adults every year) resulted in the greatest decline in abundance after 10 years (reduction of 0.986; 0.968-0.995 95% CI). However, other scenarios (e.g., alternating harvest of both subadults and spawning adults with harvest of spawning adults only) produced similar results with a 35% reduction in cost. Managers have several options for the long-term suppression of lake trout in Swan Lake depending on goals and funding.

Identifying movement patterns and spawning areas of invasive lake trout *Salvelinus namaycush* in Yellowstone Lake

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Although the lake trout *Salvelinus namaycush* suppression program in Yellowstone Lake has been successful at removing large numbers of these predaceous invaders, the number of lake trout captured continues to increase. It is apparent that targeted removal of adult lake trout can have positive effects on population suppression, and capture of adult lake trout can be increased by focusing removal efforts on regularly used travel corridors or spawning areas. Furthermore, destroying lake trout embryos on spawning grounds could be applied synergistically with methods that target free-swimming individuals (e.g. gill nets) in order to maximize suppression of lake trout. Efforts to increase direct removal with gill nets and utilize techniques for destroying lake trout embryos and larvae require knowledge regarding lake trout movement patterns and accurate information concerning the location of spawning areas. To this end, we initiated a collaborative effort of federal and academic scientists with additional funding support from a consortium of four NGOs to identify movement patterns and spawning areas of invasive lake trout in Yellowstone Lake.

This pilot study included implanting acoustic transmitters in 141 lake trout and deploying 40 acoustic receivers in 2011. Data were downloaded from the receivers three times in September and October. Preliminary analysis has provided evidence concerning movement corridors and distribution patterns that confirm previous hypotheses and yield intriguing insights.

Feasibility assessment for translocation of imperiled bull trout populations in Glacier National Park

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Native bull trout populations are at risk of extirpation in several lakes in Glacier National Park (GNP) due to the invasion and establishment of non-native lake trout. This research project was designed to assess the feasibility of conserving specific genetic lineages of bull trout through translocation. We evaluated spawning, rearing, foraging, and overwintering habitats and aquatic biota in four isolated headwater lakes (Camas Lake, Lake Evangeline, Grace Lake, and Lake Ellen Wilson) and three streams (Camas, Logging, and Lincoln). Camas Creek is mostly composed of pool (38%) and glide (28%) habitats with gravel substrate (38%). Logging Creek is mostly composed of riffle habitat (65%) with mainly large gravel (30%) and cobble substrates (32%). Both systems contain non-native Yellowstone cutthroat trout. Lincoln Creek is composed mostly of pool (36%) and riffle (38%) habitats with less large gravel (11%) and small gravel (14%) substrates than Camas and Logging creeks; furthermore, non-native brook trout are present in the system. Future work will assess thermal characteristics of lake and stream environments, assess plankton and invertebrate communities, and compare the genetic composition and demographic status of potential donor stocks. The combined results will be used to prioritize and plan the potential translocation strategy for bull trout within drainages in GNP. Furthermore, this project will provide a broader understanding of the feasibility of applying this approach elsewhere.

**Of mysivores and piscivores:
Phenotypic, life history, and diet divergence with depth in Flathead lake trout**

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We compared habitat use, diet, morphology, life history, and microsatellite genotypes between shallow and deep-captured lake trout in an introduced population from Flathead Lake, Montana. Stable isotopes demonstrated that individual fish exhibited depth fidelity. Lake trout 451-600 mm TL exhibited morphological divergence between depth groups wherein deep fish had deeper bodies and larger eyes. Further, these fish exhibit a dwarf life history and feed heavily on *Mysis diluviana*. In many regards these dwarfs are analogous to the humper morphotype from the

native range, while the shallow fish mimic the lean morphotype from which the Flathead Lake population was derived. Lack of genetic divergence between depth groups suggests a strong role for environment in producing the observed ecotypic variation.

Using genetic markers to reconnect a metapopulation of bull trout

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Genetic markers were used to evaluate the impacts of three mainstem dams that have long fragmented an important migratory corridor for a large metapopulation of bull trout in the Lake Pend Oreille/Clark Fork River system, Idaho and Montana. Populations in the study area were characterized by a low effective number of breeders ($N_b < 50$ for 34 of 39 populations) and a significant degree of genetic variation among populations ($F_{ST} = 0.132$) at 12 microsatellite loci. Population assignments of 290 adult bull trout collected below mainstem dams provided evidence that many of these fish ($n = 197$) originated in populations above the dams and were unable to complete their spawning migrations. A baseline genetic dataset was used to establish a real-time genotyping protocol to assist with trap-and-transport fish passage above these mainstem dams. Prior to the establishment of this genotyping protocol (2001 to 2003) 109 adult bull trout were transported above Cabinet Gorge Dam only. Based on genetic assignments and transport criteria, 203 fish were passed upstream above one or more dams between 2004 and 2010. This protocol has helped re-establish connectivity in a fragmented system providing increased numbers of spawning adults for numerically depressed populations above these mainstem dams a decade before the first upstream passage facility will become operational. Other passage facilities are now in the planning/design phase justified in large part by this ongoing genetic analysis and it's on the ground implementation.

Estimation of reproductive success for bull trout transported above mainstem Clark Fork River Dams

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Upstream migrations of adfluvial bull trout *Salvelinus confluentus* populations in the lower Clark Fork River have been impacted by mainstem dams since as early as 1913. In an effort to reconnect these migratory populations an upstream transport program was developed in 2001. Genetic testing of fin tissue samples was used to determine the most likely tributary of origin of adult bull trout captured below Cabinet Gorge Dam, beginning in 2004, and this assignment to tributary was used to make transport decisions. From 2001 through 2011, a total of 368 adult bull trout have been passed upstream of mainstem dams on the river. To verify the reproductive success of transported fish a parentage study was initiated in 2008. Fin tissue samples were taken

from juvenile bull trout captured in two tributaries to the lower Clark Fork River in 2008, 2009 and 2010, along with any adult bull trout captured in the study area including all transported fish. By comparing the genotypes of these fish using microsatellite markers we were able to assign a proportion of these juvenile bull trout to either one or both parents. Out of a total of 1,361 juvenile bull trout sampled, 28.4 percent were assigned to at least one transport parent. Therefore; over 70 percent of the offspring were produced by fluvial bull trout that matured in the Reservoirs or upstream. Additional information on size of spawning adults, consecutive versus alternate year spawning and number of mating pairs was also derived during this analysis.

Trout hybridization in the Lamar River drainage: trends and potential mechanisms

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The Lamar River drainage (Yellowstone NP) is habitat to one of the last genetically pure populations of Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*, YCT) despite the fact that rainbow trout (*O. mykiss*, RBT) were introduced to the drainage in the late 1930s and have since then threatened the genetic integrity of native YCT. Rose Creek (a tributary to the Lamar River) has long been suspected of being a source of RBT genes and in 2005 genetic analyses conducted on Rose Creek showed the simultaneous presence in the system of YCT, RBT, and F-1 hybrids. When the study was repeated in 2010, only YCT and back-crosses were found and there was no evidence of RBT or F-1 hybrids. The goal of this study is to shed light on the mechanisms (e.g., genetically driven differences among fish with respect to their fitness) that determined the temporal patterns of RBT genes abundance and distribution observed in Rose Creek. To reach our goal we are currently combining the field data from Rose Creek with a novel computer simulation model that simulates the life cycle and tracks the genetic composition of individual fish within a population over time. Using inverse modeling via a genetic algorithm, we are identifying model parameter sets (e.g. combinations of fitness and propensity to crossbreed for pure and hybridized fish) that are consistent with the temporal patterns of abundance and distribution of rainbow trout genes observed on Rose Creek.

An examination of genetic diversity in isolated cutthroat populations of the Flathead River basin, Montana

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The primary threat to westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) is hybridization with introduced rainbow trout (*Oncorhynchus mykiss*). Research shows that isolation management is currently the most successful method of protecting cutthroat from negative interactions with invasive species. Yet, isolation management also comes with tradeoffs

including reduced population viability and loss of genetic diversity. Theoretical models for maintaining genetic diversity in isolated trout populations recommend a minimum 8km of stream habitat based on fish densities and effective population size. When considering isolation and its tradeoffs, testing these models and quantifying risks is necessary to inform conservation decision-making. We compared genetic diversity in cutthroat trout across 16 polymorphic microsatellite loci in two connected streams and 12 streams of varying length and time since isolation in the Flathead River Basin of western Montana. As expected, isolated populations in smaller streams have lower genetic diversity. However the amount of genetic diversity lost within isolated populations varied greatly, independent of time since isolation. To gain a better understanding of how maintenance of genetic diversity may change through time, we also compared the 12 anthropogenically isolated populations to eight geologically isolated populations of varying length from the Flathead River Basin across the same 16 loci. Insights from this comparison will help managers adjust expectations for long-term maintenance of genetic diversity under isolation. Finally, results of this study have direct implications for management of trout across watersheds of the Rocky Mountains, as well as to genetic theory that can be applied broadly across taxa.

Juvenile salmon ecology, habitat use and growth in a large Alaskan river floodplain dominated by beavers.

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Beavers (*Castor canadensis*) modify stream habitat, creating lentic patches distributed throughout large alluvial river floodplains. We examined the influence of beavers on the ecology and growth of juvenile salmon in free-flowing spring brooks, beaver influenced spring brooks and different successional stages of beaver ponds (early: recently dammed spring brooks, mid: ponds embedded in meadows, and late: embedded in spruce forests), within an Alaskan river. We hypothesized that beavers increase production of juvenile salmonids in the parafluvial zone of large river floodplains, because beavers construct ponds that stimulate the growth of juvenile salmon. We sampled using minnow traps and a combination of elastomer and pit tags, as well as pit tag antennae. In the Kwethluk River floodplain, where 55 % of all aquatic habitats have been modified by beavers, juvenile salmon can occur in all habitat types. However, densities vary and are highest in spring brooks and progressively lower in early, mid and late successional beaver ponds. Movement between ponds and spring brooks is restricted at base flow but possible during flood events. Growth rates differ by habitat type with the highest rates occurring in beaver ponds, lowest in beaver influenced spring brooks, with non-influenced spring brooks falling intermediate. Differences in growth rates result in larger juveniles being produced in beaver ponds. Our results show that beavers increase production because juvenile salmon grow faster and larger, but beavers also block orthofluvial habitat from use. We are currently evaluating the tradeoff between increased growth rates vs. loss of habitat for rearing.

Advances in bathymetric mapping data collection, analysis and dissemination

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Bathymetric maps, or lake contour maps, have long been used by fishery professionals in the management of lentic fisheries for the purposes of determining lake volume for chemical rehabilitation, calculating fish stocking quotas, and assessing benthic habitats and fish distribution. Recent advances in GPS, sonar, and GIS technologies have enabled researchers to increase the speed, efficiency and accuracy of bathymetric mapping efforts. In 2011 Fish, Wildlife & Parks Data Services Section piloted a GPS-enabled sonar transducer capable of storing location and depth data at a rate of once per second for speeds up to 35 miles per hour. We will discuss best management practices for collection and analysis of bathymetric data using this and other technologies. We will also explore public and internal data dissemination options, including deployment to personal mobile devices such as smart phones and GPS. Dissemination of fisheries and bathymetric data using current technologies has potential to improve fisheries management options by increasing the efficiency of sampling and/or control efforts. Displaying contour data and other available fisheries management data to the public using current technologies also has potential to increase public awareness of management issues and participation in outdoor recreation activities.

Burbot *Lota lota* recruitment in the lower Missouri River during the historic flows of 2011

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Populations of burbot *Lota lota* in the large rivers of Eastern Montana are thought to have declined over the past several decades. Anthropogenic changes to the rivers systems such as dams, which alter fish migration as well as the temperature, sediment, nutrient and discharge regimes, in addition to over harvest, are all possible sources of the apparent decline. Standardized sampling of benthic fishes of the Missouri River downstream of Fort Peck Dam has occurred for the past eight years. Although adult burbot are frequently captured in various gears, very few young-of-the-year (YOY) burbot were collected prior to 2011. However, during 2011 a substantial number of YOY burbot were captured in benthic trawls throughout the sampling season. Although the specific reasons for the relatively high recruitment of YOY burbot during 2011 are unknown, it was likely influenced by the historic flows that occurred during the spring and summer months. Further monitoring will be needed to assess whether the age-0 recruitment of 2011 translates into adult recruitment. These findings support the hypothesis that mimicking naturalized hydrological conditions of large prairie rivers will aid in restoring native fish communities.

Pallid sturgeon use of the Missouri and Milk rivers in 2011

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Suppression of the thermal regime in association with regulated flows through Fort Peck Dam have been implicated as major factors impeding spawning and recruitment of pallid sturgeon in

the Missouri River downstream from the dam (USFWS 2000). To increase the likelihood of spawning and recruitment success for pallid sturgeon, releases of warmer water from Fort Peck Dam through the spillway were proposed as a reasonable and prudent alternative in the Missouri River Biological Opinion (USFWS 2000). In 2011, record-setting snowfall coupled with record spring rains resulted in rapid filling of Fort Peck Reservoir above full pool and subsequent, releasing water over the Fort Peck Spillway. The 2011 water year represented the first deviation from baseline conditions in over a decade. Thirty-one telemetered wild adult pallid sturgeon (2 gravid females, 4 non-gravid females, 25 males) were tracked in the Missouri, Milk and Yellowstone rivers. Nearly 50% of these fish, including a gravid female, migrated at least 200 km up the Missouri River during the spawning season as opposed to 0-5% during the prior ten years. Five of these individuals migrated into the Milk River. Fish began migrating into the Missouri River following a mid-April pulse of water from the Milk River and continued to migrate into the Missouri River through May when discharges were ~20,000-30,000 cfs. Larval fish sampling resulted in a total of 54 paddlefish in the Milk River and 27 paddlefish, 37 shovelnose sturgeon and 1 genetically confirmed pallid sturgeon from the Missouri River. This is the first documentation of pallid sturgeon spawning in the Missouri River below Fort Peck Dam and the first genetically confirmed wild pallid sturgeon larvae in the upper basin. The documentation of use, spawning and reproduction in the Missouri River shows that the Missouri River is used by pallid sturgeon if flow regimes are suitable.

Population connectivity of three prairie cyprinids in the Yellowstone River and its tributaries

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Habitat connectivity is an important determinant of population stability and viability especially for migratory species that exhibit a variety of life history strategies. The importance of connectivity is even more pronounced for species living in harsh environments where isolation from large, less variable habitat patches regularly occurs. Prairie streams experience highly variable seasonal and interannual conditions that may create instability in local fish populations. We used otolith microchemistry to gain a better understanding of population connectivity of selected fishes in the lower Yellowstone River and its tributaries. To determine fish movements, we compared $^{87}\text{Sr}:$ ^{86}Sr otolith profiles from western silvery minnows *Hybognathus argyritis*, flathead chubs *Platygobio gracilis*, and sand shiners *Notropis stramineus* to the water chemistry of the lower Yellowstone River and its tributaries. The Yellowstone River supported migrant and resident fish of all three species. Most of the fish collected in the Powder River were migrants from the Yellowstone River. Nearly all the sand shiners collected in small tributaries were residents. Both resident and migrant western silvery minnows and flathead chubs were collected in small tributaries. However, migratory conspecifics tended to be larger than residents indicating that these habitats may support multiple life histories. This is the first evidence of interacting mainstem and tributary minnow stocks in prairie streams. Management and conservation of these populations therefore requires an integrated landscape-level approach rather than a stream-by-stream strategy.

Effects of hypoxia on growth, behavior, and mortality of *Scaphirhynchus* and *Polyodon* larvae

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Natural recruitment of paddlefish *Polyodon spathula* and shovelnose sturgeon *Scaphirhynchus platyrhynchus* larvae has been documented in the upper Missouri River, USA; however, pallid sturgeon *Scaphirhynchus albus* larvae, which exist in sympatry with paddlefish and shovelnose sturgeon, are not recruiting to the adult wild population. Reservoir headwater habitat is hypothesized to be the mechanism of larval pallid sturgeon recruitment failure. Based on empirical conditions in the headwater habitat of Fort Peck Reservoir, Montana, USA, we designed controlled laboratory experiments to determine the effects of dissolved oxygen concentration at three treatment levels (1.5 mg/L (10% saturation), 2.5 mg/L (20% saturation), and 5.5 mg/L (control; 70% saturation)) on the growth, behavior, and mortality of paddlefish, shovelnose sturgeon, and pallid sturgeon larvae at two ages (immediate post-hatch (IPH) and 40-days post hatch (DPH)). Post-treatment IPH larvae were longer than pre-treatment individuals (all P -values < 0.05), and length differed significantly among treatments for IPH larvae of all three species (all P -values < 0.05). There was no effect of treatment on length for 40-DPH larvae of any species (all P -values > 0.05). Natural behavior of larvae was suppressed at the 1.5 mg/L and 2.5 mg/L treatments for each species at both age groups. There was a significant treatment effect on larval mortality in the 1.5 mg/L treatment among species and ages (P < 0.01), but there was no effect of treatment at 2.5 mg/L. Additionally, the results demonstrated a significant interaction between age, species, and treatment (P < 0.01), indicating that there were age and species effects on larval mortality at specific treatments. These findings provide important information on how dissolved oxygen conditions in a reservoir headwater environment affect paddlefish, shovelnose sturgeon, and pallid sturgeon larvae.

Estimating trout movements in a river network using strontium isoscapes

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We used natural variation in the strontium concentration (Sr:Ca) and isotope composition ($^{87}\text{Sr}:$ ^{86}Sr) of stream waters and corresponding values recorded in otoliths of westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) to examine movements during their life history in a large river network. We found significant spatial differences in Sr:Ca and $^{87}\text{Sr}:$ ^{86}Sr values (strontium isoscapes) within and among numerous spawning and rearing streams that remained relatively constant seasonally. Both Sr:Ca and $^{87}\text{Sr}:$ ^{86}Sr values in the otoliths of juveniles collected from nine natal streams were highly correlated with those values in the ambient water. Strontium isoscapes measured along the axis of otolith growth revealed that almost half of the juveniles had moved at least some distance from their natal streams. Finally, otolith Sr profiles from three post-spawning adults confirmed homing to natal streams and use of non-overlapping habitats over their migratory lifetimes. Our study demonstrates that otolith geochemistry records movements of cutthroat trout through Sr isoscapes and therefore provides a method that compliments and extends the utility of conventional tagging techniques in understanding life history strategies and conservation needs of freshwater fishes in river networks.

Using a spatially explicit stream temperature model to assess potential effects of climate warming on bull trout habitats

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Understanding how species and habitats are likely to respond to climate warming is critical in developing effective conservation and management strategies for freshwater systems. We compiled stream temperature records from 199 sites in the Flathead River Basin (FRB), Montana, USA, and parameterized non-spatial and spatial statistical models to predict temperatures at a 22 meter resolution along the stream network. A spatially explicit hierarchical model was used to predict summer thermal regimes for bull trout *spawning and rearing* (SR; <13°C) and *foraging, migrating and overwintering* (FMO; <14°C) habitats. Model results indicate that stream temperatures were strongly related to geomorphic (elevation and slope), climatic (air temperature), and lake warming covariates. These covariates explained 82% of the variation in August mean stream temperatures. Climate change simulations were used to quantify potential exceedance of thermal regimes associated with increasing air temperature trends. Analysis of a conservative climate change simulation (ECHAM A2 GCM) suggests that approximately 47% of suitable bull trout summer habitat could be thermally exceeded by 2059 and 83% could become thermally unsuitable by 2099. Model predictions suggest that a warming climate will result in warmer water temperatures and a significant loss of thermally suitable bull trout habitats. These results illustrate the importance of using fine-scale spatially explicit stream temperature models to explain the local variations of thermal regimes in guiding conservation and management actions.

Using PIT tags to assess seasonal and annual movements of native and nonnative trout

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Currently, information on the spatial and temporal scale of habitats used by native fish populations is relatively scarce, and invasion rates and distances for nonnative fish are poorly documented. To this end, we initiated a study in the upper Shields River basin to assess seasonal and annual movements of native Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*; YCT) and nonnative brook trout (*Salvelinus fontinalis*; BKT) using electrofishing and passive integrated transponder (PIT) tags. This information will be critical for decisions concerning the use of barriers to prevent further invasion of habitats occupied by YCT. During 2011, we PIT-tagged 377 YCT and 71 BKT in a portion of the Shields River main stem and three tributary streams. We subsequently used hand-held, mobile, and fixed-station PIT-tag readers to relocate individual fish. BKT continue to invade habitats occupied by YCT in the upper Shields basin. Furthermore, 12% and 6% of YCT tagged in two streams during the summer moved out of those streams between July and November; we do not yet know whether any of these fish will move back into these streams in the future. Relocating PIT-tagged fish using mobile PIT-tag readers was difficult during the summer, but relatively easy during the early winter. PIT-tag technology was useful for assessing movements of native and nonnative trout; however, more work is needed to increase the efficiency of mobile PIT-tag readers and to evaluate efficiencies of all PIT-tag readers.

Evaluating success and failure of reintroducing the western pearlshell mussel (*Margaritifera falcata*) into streams in the Blackfoot River Watershed: monitoring, testing and future implications

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The first western pearlshell translocation project in Montana occurred July 2010 at three tributary streams in the Blackfoot River Watershed. In 2011, we reported that short-term survival rates across all sites post-transplant (2 weeks) were poor (11%) and long-term survival (12 months) even worse (0%). A mussel cleansing protocol was blamed for the low survival, in particular, the 2% bleach dip or potentially thermal stress. We narrowed mortality down to these factors because mussels (n=200) that were handled, held in-stream and replaced back to their original locations without the bleach dip had 100% survival. We set up experimental trials in August 2011 designed to evaluate these mortality agents. From the Clearwater River donor site (17.8°C, 143µs/cm), we collected 75

pearlshells of various sizes (average TL= 55mm) and randomly assigned them to three experimental groups: control, bleach and thermal. We replicated handling procedures performed in 2010, except the control and thermal groups were not given the 2% bleach dip and the thermal group was transported ~20 river miles upstream in the Clearwater River (12.8°C, 95µs/cm) to replicate translocation. Revisits 24 and 48 hours later revealed behavior differences between the control and bleach groups (response to stimulus) and the eventual death of all 25 mussels in the bleach group between 72 and 144 hours. The thermal group acclimated back to the donor site had 100% survival; as did the control group. Future translocation efforts aiding the pearlshell's recolonization of restored streams will eliminate portions of the transfer protocol that resulted in mortality.

The Columbia River Treaty between Canada and the United States could change established dam operations and Montana's headwater reservoir and river fisheries.

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The Columbia River Treaty was implemented in 1964 to mandate the construction and operation of Transboundary Columbia dams for flood control and power generation in Canada and the United States (U.S.). In 2014, the two countries have the opportunity give notice of their intent to extend, modify, or terminate the treaty. Without notice in 2014, treaty provisions that address flood control will sunset in 2024, 60 years after initiation. Because of this, system flood control is central to ongoing analyses that will inform a report from the US Army Corps of Engineers and Bonneville Power Administration to the US State Department in 2013. Canada expects the U.S. to maximize flood control using domestic dams before additional storage is requested from Canada. The U.S. wants to pay Canada less for power generation derived from internationally coordinated dam operations designed to recover fish species protected under the Endangered Species Act, because of reduced power revenue potential. Initial model analyses indicate that headwater reservoirs, including Hungry Horse and Libby dams in Northwest Montana, might need to be drawn down further to meet new flood control requirements. These changes could reverse benefits to fisheries achieved by the “Montana Operation” that, after two decades of research and lawsuits, were fully implemented for the first time in 2009. A three-phased system modeling analysis is ongoing to balance power generation, flood management, and ecosystem-based functions throughout the Columbia River Basin. Results to date demonstrate that Montana, the tribes and the fisheries resource have much at stake.

Conservation efforts by Bonneville Power Administration

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The 2012 MTAFS session title is “Successfully Navigation the Social & Political Realm of Conservation”. Bonneville Power has been an active partner in conservation in Montana since the passage of the North West Power Act in 1980 (SEE FOOTNOTE) . During this tenure the BPA has funded directly, or in partnership with the Northwest Power and Conservation Council,

a significant number of projects in Montana to protect, mitigate and enhance fish and wildlife. These projects encompass a wide range of scale, from acquisition of single conservation easements to projects such as the Thompson-Fisher conservation easement that protected 142,000 acres from future development. In addition to conservation easements and fee acquisitions a wide variety of habitat projects both terrestrial and in-stream have been accomplished. Our presentation will elaborate on the scope and magnitude of these projects and examine a broad range of social and political issues encountered in the process and how BPA and its many partners were able to resolve issues and successfully complete projects.

Footnote:

839(6). to protect, mitigate and enhance the fish and wildlife, including related spawning grounds and habitat, of the Columbia River and its tributaries, particularly anadromous fish which are of significant importance to the social and economic well-being of the Pacific Northwest and the Nation and which are dependent on suitable environmental conditions substantially obtainable from the management and operation of Federal Columbia River Power System and other power generating facilities on the Columbia River and its tributaries. [Northwest Power Act, §2(6), 94 Stat. 2698.] (94 Stat. 2698, 16 USC §839)

<http://www.nwcouncil.org/library/poweract/default.htm#intro>

An evaluation of walleye stocking programs in Fresno and Nelson reservoirs

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Walleye *Sander vitreus* continue to gain popularity among Montana residents. Anglers continue to demand increased angling opportunities for walleye and increased hatchery stocking in existing walleye waters. The prevailing opinion among many walleye advocates is that that “you cannot stock too many walleyes”. The creation of the Fort Peck Hatchery in 2006 nearly doubled Montana’s walleye production capacity. The two warm water hatcheries (Miles City and Fort Peck) have the potential to raise 5 million fingerlings and 37 million fry annually. Fresno and Nelson Reservoir, located in the Milk River drainage on the Montana Hi-line, have been managed as walleye fisheries since the mid 1950’s. The size, number, and frequency of walleye stocked in both reservoirs varied considerably prior to the completion of the Fort Peck Hatchery. However, since 2006 both reservoirs have received ~100,000 fingerlings annually with limited biological justification for these stocking rates. Fingerlings stocked since 2006 have been marked with Oxytetracycline (OTC) to assess survival and evaluate the proportion of hatchery walleye to naturally produced fish. On average (2007-2011), 43% of the walleye collected from Fresno Reservoir and 24% from Nelson Reservoir were marked OTC positive (hatchery reared). Since 2007, walleye relative abundance in Fresno has increased from 15 to 23.8 walleye/net, whereas walleye relative abundance in Nelson Reservoir has remained unchanged at 12 walleye/net. Although these two reservoirs are similar in size and are allocated the same number of walleye fingerlings annually, they’ve responded differently to the current walleye stocking strategy.

Parental male effects on landlocked fall Chinook salmon progeny survival

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The Lake Oahe, South Dakota, population of landlocked fall Chinook salmon *Oncorhynchus tshawytscha* is maintained entirely by hatchery propagation and exhibits relatively poor egg survival during hatchery incubation. This study was undertaken to determine the influence of male gametes on embryo survival. Spawn from an individual female was subdivided and subsequently fertilized with milt from four discrete males. This was repeated with three additional females using the milt from the same four males. This entire procedure was then replicated three times, using four new females and four new males each time, for a total of 16 males and 16 females. The eggs from each unique cross were then incubated discretely. There was no significant effect of spawning males on subsequent embryo survival to the eyed stage of egg development. Swim-up fry length and weight were also not significantly affected by male parentage. Survival did vary significantly among spawn from individual females as did swim-up fry length and weight. These results indicate that embryo survival during hatchery rearing is largely a function of initial egg quality from spawning females and that genetic conservation spawning protocols can be performed with minimal impact on subsequent embryo survival.

Metal in the mountains: A fish community mercury assessment with implications for human and wildlife risk in Glacier National Park

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We sampled lakes in Glacier National Park in 2010 to characterize fish species composition, as well as mercury (Hg) and selenium (Se) concentrations. The greatest number of species tested for Hg was in Logging Lake, which will serve as a useful baseline for Hg contamination in the park. A subset of the fishes collected for Hg assessment was also analyzed for Se. Testing revealed that Hg generally increased with fish size within a species and varied among species even after considering fish size. Piscivorous fishes, particularly larger individuals, often had Hg concentrations at levels sufficient to be of public health concern. The wildlife risk assessment (utilizing both the fish Hg and species composition data from St. Mary and Logging lakes) suggests that the consumption of relatively small, lightly contaminated fishes generally does not pose a major threat to piscivorous wildlife based on current wildlife thresholds. Northern pikeminnow *Ptychocheilus oregonensis* from Logging Lake represented the worst case scenario in the wildlife risk assessment and often exceeded protective thresholds for piscivorous wildlife. However, the Hg risk to wildlife from northern pikeminnow is presumably reduced by the consumption of a variety of less contaminated fishes, and this species has a limited distribution in the park. Further, results of the wildlife assessment suggest that the Hg consumption risk may

be further reduced by the protective effect of Se. Our Se results represent the first testing of this element in park fishes, providing baseline data for risk assessment and future studies.

From phosphorus to fish: beneficial use of excess nutrients

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The U.S. EPA is implementing new, more stringent TMDL standards across the nation in response to water quality issues including harmful algae blooms, hyper-eutrophication of lakes and increases in game fish mortality. Estimates project that compliance with new standards may cost Montana municipalities as much as \$1 billion over the next decade. Floating Island International is interested in transitioning phosphorus from water into biofilm into fish, and then harvesting fish to keep pace with nutrient inflow rates. One of our goals was to measure the fish harvest that could be achieved by introducing and managing substrate and circulation/aeration technology in the form of floating islands. A related goal was to use phosphorus as a marker nutrient and track the potential ability to comply with new TMDL standards. A third goal was to track the impact on other water quality parameters such as water clarity, temperature, dissolved oxygen levels and benthic organic accretion. A 6.5-acre lake fed by the Billings Bench irrigation ditch was the primary study site. During a four-month period in the summer and fall of 2011, fish growth rates, catch rates and fish productivity were measured at the study site based on fish tagging, otolith and scale aging, and harvest of 1,928 northern yellow perch, black crappie and Yellowstone cutthroat trout. An average catch rate of one fish per two minutes of fishing time was achieved at the study site. Fish harvest of 110 pounds per month kept pace with calculated phosphorus inflow rates during the study period, which implies that today's federally mandated clean water standards can potentially be achieved via fishery enhancement stewardship strategies.

Latest-generation floating islands eliminate stratification and provide fish spawning habitat

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Because the temperature of many lower-altitude waterways is increasing due to climate change, the ability to cost-effectively reduce water temperature and increase dissolved oxygen concentrations may be critical for species of concern such as cutthroat trout. During 2010 and 2011, tests were run at the Shepherd Research Center (25 miles east of Billings, Montana) tracking efficacy of an ambient-pressure airlift diffuser system, which is the latest addition to a floating island system to maximize water circulation, to destratify water and homogenize temperatures in a 6.5-acre lake. An additional test tracked the ability of cutthroat trout eggs to hatch in an artificial streambed created within the floating island. Indications are that low-

pressure air diffusion represents a realistic option to maintain trout survival zones during mid- to late summer, and to maintain dissolved oxygen levels in excess of 6.5 mg/L year-round. An additional benefit is that distinct trout species may be protected from hybridization and disease exposure due to the new ability this modular fish hatchery provides to establish and sustain populations in landlocked waterways. Further measurement tracking site imprintation on hatch fry is recommended, as well as testing of other salmonid species.

Climate change effects on stream and river temperatures across the northwest U.S. from 1980–2009

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Thermal regimes in rivers and streams are fundamentally important to aquatic ecosystems and are expected to change in response to climate forcing as the Earth's temperature warms. Description and attribution of stream temperature changes are key to understanding how these ecosystems may be affected by climate change, but difficult given the rarity of long-term monitoring data. We assembled 18 temperature time-series from sites on regulated and unregulated streams in the northwest U.S. to describe historical trends from 1980–2009 and assess thermal consistency between these stream categories. Statistically significant temperature trends were detected across seven sites on unregulated streams during all seasons of the year, with a cooling trend apparent during the spring and warming trends during the summer, fall, and winter. The amount of warming more than compensated for spring cooling to cause a net temperature increase, and rates of warming were highest during the summer (raw trend = 0.17°C/decade; reconstructed trend = 0.22°C/decade). Air temperature was the dominant factor explaining long-term stream temperature trends (82–94% of trends) and inter-annual variability (48–86% of variability), except during the summer when discharge accounted for approximately half (52%) of the inter-annual variation in stream temperatures. Seasonal temperature trends at eleven sites on regulated streams were qualitatively similar to those at unregulated sites if two sites managed to reduce summer and fall temperatures were excluded from the analysis. However, these trends were never statistically significant due to greater variation among sites that resulted from local water management policies and effects of upstream reservoirs. Despite serious deficiencies in the stream temperature monitoring record, our results suggest many streams in the northwest U.S. are exhibiting a regionally coherent response to climate forcing. More extensive monitoring efforts are needed as are techniques for short-term sensitivity analysis and reconstructing historical temperature trends so that spatial and temporal patterns of warming can be better understood. Efforts are also needed to develop a comprehensive regional stream temperature database and temperature model that could facilitate more precise climate vulnerability assessments and prioritization strategies. Such strategies will be needed as continued temperature increases this century place increasing stress on important regional salmon and trout populations and make efforts to conserve these species more difficult.

WHERE'S THE BEEF? Why 20 Years of Predicted Global Warming Effects on Fish Distributions Remain Unsubstantiated

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Environmental changes associated with anthropogenic climate change are predicted to substantially degrade global biodiversity during the 21st century. This concern motivated development of numerous bioclimatic models during the last 20 years to forecast potential effects on stream fishes. Despite generally dire forecasts for many species of concern and significant resource commitments to maintaining these species, biological validation of predictions has rarely occurred and the accuracy of forecast declines is unknown. Moreover, validation is difficult because current bioclimatic models yield predictions that are either untestable or so imprecise that definitive answers will not be obtained within timescales useful for many management decisions (e.g., 10 - 20 years). Here, we develop a general framework for making stream-specific predictions of isotherm shift rates (ISRs) based on a key assumption inherent to all bioclimatic models: that a critical temperature isotherm delimits population and species boundaries and that biological distributions will track these isotherms moving to higher elevations or latitudes as the climate warms. Implementing the framework on individual streams requires only stream slope measurements from a GIS and easily collected biological and temperature survey data. Generic ISR curves developed for streams with lapse rates (~0.4 °C/100m elevation gain) and long-term warming rates (~0.1 – 0.2 °C/decade) observed in the Rocky Mountain region suggest isotherms are currently shifting at 1 – 10 km/decade and will move 4 – 40 km by the year 2050. Fish populations and species with greater mobility or large ranges may be able to adjust their distributions and track suitable isotherms if migratory corridors are not blocked, but other fishes will be vulnerable to temperature changes. Headwater populations with < 10 km of thermally suitable habitat that lack elevational refugia are at greatest risk and could be extirpated by 2050 as warming continues. A power analysis suggests the ability to detect trends in biological distributions will be greatest where ISRs are largest and streams exhibit low inter-annual temperature variance, but even in optimal areas, monitoring for a minimum of 20 years may be required for trend detection. Although initiation of new monitoring efforts will be useful, resurveys of historical fish survey sites should be a priority to determine the rates at which biological distributions are shifting. Documenting these shifts is critical information for developing more accurate climate risk assessments and for providing managers the evidence needed to make difficult decisions regarding where resources are committed to preserve populations.

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 effort to develop rangewide status assessments for Yellowstone cutthroat trout, however, these data have not been used to investigate the physical and biological factors that influence the current distribution of the subspecies. To address this need, we developed a stream temperature model for the range of Yellowstone cutthroat trout, and then use this model within multiple modeling approaches to better understand how landscape attributes, natural and anthropogenic disturbance, and climate are associated with the distribution of Yellowstone cutthroat trout. The results from our modeling suggest disturbance, land use, and land cover as the strongest predictors influencing the distribution of Yellowstone cutthroat trout. The impacts of climate varied considerably across management unit, suggesting that historical factors (e.g., land use) and non-native species have likely played a larger role in describing where Yellowstone cutthroat trout are distributed currently; our results describing factors influencing the distribution of Yellowstone cutthroat trout were consistent across the different models. We place our results in the context of anticipated climate changes in the Greater Yellowstone Ecosystem as a means to highlight how these factors may change in the future. Overall, our results provide insight into the factors associated with Yellowstone cutthroat trout distribution, highlight potential gaps in currently available data, and can help direct conservation strategies for this native cutthroat trout in the near future.

Thermal tolerance of meltwater stonefly *Lednia tumana* nymphs from an alpine stream in Waterton-Glacier International Peace Park, Montana, USA

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Global climate change threatens to negatively impact the structure, function, and diversity of aquatic ecosystems worldwide. In alpine systems, the thermal tolerances of stream invertebrates can be assessed to better understand the potential impacts of rising ambient temperatures and continued loss of glaciers and snowpack on alpine stream ecosystems. This study determined the Critical Thermal Maximum (CTM) and Lethal Temperature Maximum (LTM) of the meltwater stonefly *Lednia tumana* – a species limited to glacial and snowmelt-driven alpine streams in the Waterton-Glacier International Peace Park area and candidate for listing under the U.S. Endangered Species Act. *L. tumana* nymphs were collected from Lunch Creek in Glacier National Park, Montana, USA and transported to a laboratory at The University of Montana Flathead Lake Biological Station, Polson, Montana. At each of two acclimation temperatures,

8.5°C and 15°C, nymphs were placed in a controlled water bath which increased water temperature at a constant rate of 0.3°C per minute. The average LTM (\pm SD) was 32.3°C (\pm 0.28) and 31.05°C (\pm 0.78) at the 8.5°C and 15°C acclimation temperatures, respectively. The CTM and LTM metrics were lower at the 15°C acclimation temperature than the 8.5°C acclimation temperature, but these differences were not statistically significant ($P > 0.05$). The predicted chronic temperature maxima were 20.6°C and 20.2°C for the 8.5°C and 15°C acclimation temperatures, respectively. Although more research on the effects of chronic exposures to rising stream temperatures is needed, results of this study can be used to assess the potential effects of warming water temperatures on *L. tumana* and other aquatic macroinvertebrates in similar alpine ecosystems threatened by climate change-induced glacier and snow loss.

POSTERS

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' was 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 installation has performed very well against considerable wave action and some ice flows. The technique also has application for river/stream restoration projects and has been done at a number of sites in Montana and Alaska.

If you build it, fish will climb it

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If you build it, they will come. It turns out this is true, even for fish. In 2010, PPL Montana built an upstream fish passage facility at Thompson Falls Dam located on the Clark Fork River. The ladder was opened in spring 2011 and 1,805 fish representing 11 species, including two bull trout, ascended between March 17 and October 17. All fish that ascended the ladder were worked up (measurements recorded and fin clipped/PIT tagged) prior to being released upstream in the reservoir. The 2011 spring flows at Thompson Falls Dam peaked near June 9 around 115,000 cfs. The ladder was not operational between May 25 and June 21, between June 24 and July 10, or between July 14 and August 21 due to high flows, debris accumulation in the ladder,

and repairs required at the dam. The greatest influx of fish occurred immediately following the reopening of the ladder on August 22. Prior to August 22, the ladder had been out of operation for about 1 month for debris clearing and other repairs needed following the spring freshet. Approximately 85 percent (n=1,535) of all fish captured at the ladder ascended the ladder between August 22 and August 29. With the overall success of fish ascending the ladder, including the target species, bull trout, PPL Montana looks forward to continue to monitor upstream fish passage at the ladder and evaluate fish movement, timing, and behavior as it relates to river conditions and ladder operations.

Do growth rates in Snake River cutthroat trout and cutthroat trout X rainbow trout hybrids differ?

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Hybridization between native cutthroat trout (*Oncorhynchus clarkii*) and introduced, non-native rainbow trout (*Oncorhynchus mykiss*) has spread throughout the Intermountain West. Understanding the ecological implications of hybridization on the production and persistence of populations is needed to inform conservation decisions. Hybridization may affect individual growth rates, which are related to key demographic parameters such as age of maturity, survival, and fecundity. Previous research suggests that hybrids have higher growth rates than cutthroat trout, but these findings are often complicated by a landscape position where hybrids reproduce and grow at lower elevation sites with higher productivity than sympatric cutthroat trout. This study examines growth rates of Snake River cutthroat trout (*O. clarki bouvieri*) and back-crossed hybrids (hybrid index score ≤ 0.5) in the Gros Ventre River, WY, where all fish spawn and forage in the same river habitat. We used 14 diagnostic microsatellite loci to determine level of hybridization, and calculated growth rates using scales and a Fraser-Lee method of back calculation for approximately 60 fish across a range of hybrid index score values and sizes. Our preliminary data suggest that differences among fish across hybrid index scores are not large and fall within the variability among individuals with similar levels of introgression.

“Hydrogeomorphic characteristics of bull trout spawning habitat, Northwestern Montana” Primary investigator: Jared R. Bean¹

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At various spatial scales, groundwater and geomorphology are commonly cited as important factors in bull trout spawning site selection and successful fry emergence. However, questions about the interrelation of form, process, and habitat suitability remain. Understanding the hydrologic and physical processes creating favorable bull trout spawning habitat will inform

habitat protection and rehabilitation efforts. We hypothesized that at the reach-scale, bull trout spawning sites are associated with downwelling hyporheic flow, upwelling groundwater flow, and relatively low Shields stress. Hyporheic and groundwater flows as well as reach- and valley-scale geomorphology were characterized in high-density spawning reaches of four streams in and around Glacier National Park during the summer and fall of 2011. Networks of in-stream and floodplain piezometers, some of which were outfitted with stage and temperature data loggers, were installed and used to gauge surface water – groundwater interactions. Topographic surveying characterized the geomorphic form of the streambed and provided a spatial reference system from which to create floodplain water table maps from piezometer data. Grain size data were also collected, and hydraulic modeling is being conducted to assess the interrelations of shear stress, bed mobility, spawning site selection, and intragravel flow rate variability. Observations and preliminary results from Ole Creek, a tributary of the Middle Fork of the Flathead River, will be presented.

Limiting factors, thermal refuges, and connectivity in the Smith River system

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The Smith River is a popular recreational sportfishery in western Montana, but salmonid abundances there are relatively low and believed to be potentially limited by high summer water temperatures and low discharges resulting from irrigation withdrawals and land-management practices. Smith River tributaries may serve as thermal refuges during summer and also as important spawning and nursery areas. If so, then maintaining connectivity between the mainstem river and its tributaries would be a management priority. Such use would also help identify deficiencies in the mainstem that could potentially be corrected through habitat or water management. Moreover, an understanding of salmonid habitat use and management in a thermally stressed and dewatered system could help identify potential global climate change adaptation management strategies and tactics. Our goal is to identify limiting factors in the Smith River system and evaluate the importance of its tributaries as spawning and nursery areas and thermal refuges. Our focus is on the lower reaches of Tenderfoot Creek, a largely undeveloped major tributary to the Smith River. Five PIT-tag stations have been installed throughout the lower 8.5 miles of Tenderfoot Creek. This PIT-tag detection network has monitored the seasonal movements of about 500 tagged fish. Abundances have been estimated by depletion electrofishing surveys, mark-recapture studies, and snorkeling. Fish abundance was high in areas of low temperature, and mountain whitefish and brook trout exhibited distinct spatial patterns throughout the study reach. Fall spawning surveys resulted in the location of 47 brown trout redds and observation of thousands of mountain whitefish, providing evidence that Tenderfoot Creek serves as an important spawning area. We are currently examining the relationships among fish movement and abundance and stream temperature and discharge, as well as abundances of juvenile fish in Tenderfoot Creek.

Nesting ecology of spiny softshell turtles (*Apalone spinifera hartwegi*) on the Missouri River, MT

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Little is known about the nesting behavior and habitat of the western spiny softshell (*Apalone spinifera hartwegi*) in Montana where they are at the northern extent of their range and are a state Species of Concern. Our objective was to document nesting behavior, habitat, and timing in a 97-kilometer reach of the Missouri River. We radio-tagged 47 female turtles and attempted to locate nesting areas using telemetry, visual surveys from jet boat and on foot, and by observation from shore-based blinds. We located 22 nests; 13 were on islands, 9 were aggregated, and 2 were depredated. Nesting occurred following the peak river stage from about July 7 to July 21. Eighteen nests were in mixed gravel and 4 nests were in sand substrates. Distance from water's edge to the nest ranged from 1.9 m to 27 m and height of nest above the water surface elevation ranged from 0.25 m to 1.9 m. Vegetation at nest sites was sparse, ranging from 0 to 15 percent vegetative cover. Emergence of hatchlings was documented for 13 nests and occurred from about September 1 to September 20. All 13 successful nests were in gravel substrate; we did not document any emergence from nests in sand. Lack of emergence from sand nests may be related to the cumulative thermal regime in the nest chamber during the period from peak discharge until the onset of freezing in autumn. In 2012, we will investigate the thermal environment in gravel and sand nesting substrates.

Dietary assessment of Yellowstone cutthroat trout in Yellowstone Lake, Yellowstone National Park

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The Yellowstone cutthroat trout (YCT, *Oncorhynchus clarkii bouvieri*) population in Yellowstone Lake is the largest inland cutthroat trout population in the world. An intensive monitoring program has been in place for the YCT population since the middle of the 20th century; however, diet data have been assessed only sporadically through time. Our objective was to assess YCT diet throughout the ice-free season to determine the relative importance of

prey items. Fish were captured by gill nets and trap nets during the 2011 season. Diets were sampled in three seasons: pre-stratified (before 1 August), stratified (1 August – 20 September), and post-stratified (after 20 September). Stomach contents were assessed by frequency of occurrence and mean proportion by weight (MPW) for each taxonomic group. Ontogenetic shifts in diet occur for many fish species; therefore, diet was also assessed by 100-mm length groups. Preliminary results indicated amphipods are the most important prey item in both the pre-stratified and stratified seasons for all ontogenetic length groups. Amphipods composed 0.73 and 0.79 MPW for pre-stratification and stratified seasons, respectively. Chironomids were important in the pre-stratified season (0.14 MPW) and were less important during the stratified season (0.03 MPW). Conversely, *Daphnia* spp. composed a larger proportion of the diet in the stratified season (0.09 MPW) than in the pre-stratified season (< 0.01 MPW). These data will allow for diet comparisons to previous years and contribute to an ongoing study evaluating diet overlap between Yellowstone cutthroat trout and introduced lake trout.

A large-scale field assessment using underwater epoxy to permanently install sensors for full year temperature monitoring in mountain streams

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Stream temperature regimes are fundamentally important to understanding pattern and process in aquatic communities. Modern digital sensors can provide accurate and repeated temperature measurements that span multiple years, but are rarely deployed for more than a few summer months in mountain streams due to logistical constraints with seasonal stream access and concerns that large annual floods will destroy sensors. We developed a rapidly applied protocol (sensor installation takes ~20 minutes) that uses underwater epoxy to attach sensors to large rocks that makes full year stream temperature monitoring feasible and cost effective. Initial field trials during the winter of 2009/2010 suggested temperature measurements were not biased by attachment to rocks and 82% of epoxied sensors (9 of 11) were retained through spring floods. A larger scale field assessment was initiated during the summer of 2010 wherein 300 temperature sensors were deployed in streams ranging in channel slope from 0.1% - 16% across the northwest U.S. Eighty-six of these sites were checked for sensor retention after the large spring flood in 2011 and 74% (64 of 86) of sensors remained in place recording stream temperatures. Retention success was inversely related to channel slope and averaged 85% where slopes were < 3% that are typical of most fish-bearing streams. Our results indicate that the underwater epoxy technique is viable for installing temperature sensors in a wide range of mountain streams where large substrates and suitable attachment sites are common. Moreover, the technique reduces the cost of temperature monitoring by reducing the number of site visits to $\leq 1/\text{year}$ rather than the current norm of 2/year for summer data and 5 years of temperature measurements may be obtained for \$130 in equipment costs (primarily the cost of the sensor) given current memory and battery capacities of temperature sensors. More than 400 additional stream sites were instrumented with temperature sensors using underwater epoxy during the summer and fall of 2011 to continue expanding the regional temperature monitoring network. Data from this network will contribute in future years to improved understanding of stream thermal regimes, alterations associated with climate change, and the thermal ecology of aquatic organisms.

Westslope cutthroat and rainbow trout species-diagnostic SNP assays developed from next-generation RAD sequencing

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Hybridization with introduced rainbow trout threatens native westslope cutthroat trout populations. Understanding the genetic effects of hybridization and introgression requires a large set of high-throughput, diagnostic genetic markers to inform conservation and management. Recently, we identified several thousand candidate single nucleotide polymorphism (SNP) markers based on RAD sequencing of 11 westslope cutthroat trout and 13 rainbow trout individuals. Here we used flanking sequence for 56 of these candidate SNP markers to design microfluidic qPCR assays. We validated the assays on a total of 92 individuals from 22 populations and seven hatchery strains. Forty-six assays (82%) amplified consistently and allowed easy identification of westslope cutthroat and rainbow trout alleles as well as heterozygote controls. The 46 SNPs will provide high power for early detection of population admixture and improved identification of individual hybrids. This technique shows promise as a low-cost, reliable, and relatively rapid method for developing and testing SNP markers for non-model organisms with limited genomic resources.

Managing for a destination family fishery at Tongue River Reservoir

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Tongue River Reservoir is a popular eastern Montana destination for families seeking boating, camping, and fishing recreational opportunities. Due to the importance of the Tongue River Reservoir fishery, an intensive monitoring program utilizing gill nets and seines has been in place for several decades. Species specific management objectives for Tongue River Reservoir are: (1) 20% of sampled adult crappie from gill nets are > 250 mm (10 inches), (2) Two walleye per overnight gill-net set, and (3) Maintain viable populations of other game fish species. In meeting these objectives Montana Fish, Wildlife & Parks ensures that quality sport fishing opportunities are available at Tongue River Reservoir. The management goal of 20% of adult crappie greater than 250 mm (10 in) has not been met since 1998, but abundance and size of available fish continue to offer quality angling. The management goal of two walleye per gill net has been met consistently over the years, 1989-2010. Stable populations of other game fish are providing additional angling opportunity at Tongue River Reservoir.

Structural differences between the Yellowstone and Missouri River fish assemblages

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Anthropogenic disturbances have altered many large rivers worldwide. The Yellowstone and Missouri rivers in Montana provide a unique opportunity to evaluate how a large mainstem dam affects fish assemblage structure and the establishment and proliferation of nonnative species. We sampled the fish assemblages of both rivers with fyke nets to evaluate differences in fish abundance and determine if the Yellowstone River supported more native and nonnative species than the Missouri River. We collected 80,937 fish in the Yellowstone River ($N = 49$ sampling reaches) and 36,244 in the Missouri River ($N = 93$ reaches) from 2008 to 2010. Mean catch per unit effort was greater in the Yellowstone River (224 fish/net-night) than in the Missouri River (49 fish/net-night). Much of the difference was the result of large catches of native cyprinids in the Yellowstone River, which were uncommon in the Missouri River. We captured more native ($N = 24$) and nonnative ($N = 15$) species in the Yellowstone River than in the Missouri River ($N = 23$ native species, $N = 14$ nonnative species), despite twice the sampling effort on the Missouri River. However, nonnative fish comprised only 1.1% of the total catch in the Yellowstone River as opposed to 4.4% in the Missouri River. We also observed higher relative abundances of degradation-tolerant and coldwater species in the Missouri River. Therefore, naturally-functioning rivers may sustain more nonnative species and higher densities of native fish than altered rivers while preserving the structure and function of the native fish assemblage.

Preliminary and potential effects of the 2011 oil spill on the Yellowstone River fish assemblage

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About 42,000 gallons of crude oil spilled into the Yellowstone River near Laurel, Montana, when an oil pipeline in the riverbed ruptured during peak runoff on July 1, 2011. The Yellowstone River fish assemblage may be adversely affected because exposure to aromatic hydrocarbons found in crude oil can lead to decreased growth and increased embryo and juvenile mortality of fish. We extensively sampled the lower Yellowstone River from 2008 to 2010 to comprehensively assess the fish assemblage during both runoff and baseflow conditions. We repeated selected sampling in 2011 to evaluate immediate effects of the oil exposure on the fish assemblage. During runoff, longnose sucker *Catostomus catostomus* catch per unit effort decreased downstream of the spill site. During baseflow, fewer flathead chub *Platygobio gracilis* and western silvery minnow *Hybognathus argyritis* young-of-year were present. Lesions were present on some adult longnose suckers and other large bodied fish. Additional, latent consequences of oil exposure may affect recruitment or spawning in 2012 or later.

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