Restoring the West 2014

Down by the River: Managing for Resilient Riparian Corridors

October 21 & 22, 2014
Utah State University
Logan, Utah
www.restoringthewest.org

2014 Restoring the West Conference

Planning Committee Roster

Darren McAvoy, USU Forestry Extension
Mike Kuhns, USU Department of Wildland Resources & Forestry Extension
Mary O'Brien, Utah Forests Program Director, Grand Canyon Trust
Brett Roper, USDA Forest Service Fish & Aquatic Ecology Unit
Nancy Mesner, Associate Professor, Dept. of Watershed Sciences, Extension
Specialist in Water Quality
Paul Rogers, Western Aspen Alliance
Nate Hough-Snee, USU PhD student, Ecology Center & Dept. of Watershed
Sciences
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Agenda

Tuesday, October 21, 2014
USU Eccles Conference Center

7:30 - 9:00 a.m.	**Registration Open**
8:30 - 8:35 a.m.	**Welcome**, Dean Chris Luecke, Quinney College of Natural Resources, Utah State University, Logan, Utah
8:35 - 8:40 a.m.	**Conference Overview**, Darren McAvoy, Forestry Extension Associate, Utah State University, Logan, Utah
8:40 - 9:20 a.m.	**The Colorado River: Supply and Demand,** David Merritt, Riparian Plant Ecologist, Rocky Mountain Research Station, USDA Forest Service, Fort Collins, Colorado
9:20 - 10:00 a.m.	**Climate Change and Riparian Forest Communities, Implications for Small Streams in the Upper Colorado River Basin**, Lindsay Reynolds, Research Scientist, Colorado STate University and the US Geological Survey, Fort Collins, Colorado
10:00 - 10:30 a.m.	**Break**
10:30 - 11:00 a.m.	**Managing Livestock Grazing for Riparian Recovery in Northeastern Nevada,** Carol Evans, Fishery Biologist, Elko District Office, Bureau of Land Management, Elko, Nevada
11:00 - 11:30 a.m.	**Grazing to Promote Riparian Health on a Private Ranch in Nevada,** Agee Smith, Co-Owner, Cottonwood Ranch, Wells, Nevada
11:30 - 12:00 p.m.	**Building Riparian Resilience through Collaboration,** Mary O'Brien, Utah Forests Program Director, Grand Canyon Trust, Moab, Utah
12:00 - 1:30 p.m.	**Poster Session and Lunch**
1:30 - 2:00 p.m.	**Assessment and Monitoring Tools for Riparian Areas,** Mark Petersen, Director of Water Quality Programs, Utah Farm Bureau, Salt Lake City, Utah
2:00 - 2:30 p.m.	**Riparian Forest Dynamics and Management Challenges on Mediterranean-Climate Rivers,** John Stella, Associate Professor, College of Environmental Sciences and Forestry, State University of New York, Syracuse, New York
2:30 - 3:00 p.m.	**Identifying, Restoring and Protecting Critical Coldwater Refugia in the high desert Owyhee Subbasin in southwestern Idaho,** Pam Harrington, Restoration Coordinator, Trout Unlimited, Boise, Idaho
3:00 - 3:30 p.m.	**Break**
3:30 - 4:00 p.m.	**A Riparian Conservation Network to Develop Ecological Resilience,** Alexander Fremier, Assistant Professor, School of the Environment, Washington State University, Pullman, Washington
4:00 - 4:30 p.m.	**Partnering with Beaver to Improve Fish Habitat: An Example of Cheap and Cheerful Restoration to Provide a Population Benefit to an Endangered Species,** Nick Bouwes, Ecologist/Owner, Eco Logical Research, Inc., Providence, Utah
4:30 p.m.	Adjourn
5:30 p.m. - 7:30 p.m.	**Reception at Cafe Sabor 600 W Center St.- Free shuttle leaving in front of University Inn at 5:20. Return trips to USU will occur as needed.**

Wednesday, October 22, 2014
USU Eccles Conference Center

8:00 a.m.	**Registration Open**
8:30 - 8:35 a.m.	**Welcome,** Nate Hough-Snee, Department of Watershed Sciences, Utah State University Conference Overview, housekeeping
8:35 - 9:15 a.m.	**Restoring Riparian Ecosystems with Large Predators: the Yellowstone Experience,** Robert Beschta, Professor Emeritus, Dept. of Forest Ecosystems and Society, Oregon State University, Corvallis, Oregon
9:15 - 9:45 a.m.	**Riverscapes and Mindscapes: Using Inventory, Monitoring, and Biogeography to Explore Riparian Management Domains in the West,** Daniel Sarr, Inventory and Monitoring Coordinator, Klamath Network, National Park Service, Ashland, Oregon
9:45 - 10:15 a.m.	**Understanding Challenges in Managing Riparian Systems at a Landscape Scale,** Christy Meredith, PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO), USDA Forest Service, Logan, Utah
10:15 - 10:45 a.m.	**Break**
10:45 a.m. - 11:15 a.m	**Effects of the 2011 Flood on Missouri River Cottonwood Forests: Implications for Restoration,** Mark Dixon, Associate Professor, Dept. of Biology, University of South Dakota, Vermillion, South Dakota
11:15 a.m. - 12:00 p.m. **Up and coming research from graduate student scientists**	**Riparian Vegetation Guilds: Applications to Small Streams of the Interior Pacific Northwest,** Nate Hough-Snee, PhD Student, Dept. of Watershed Sciences, Utah State University, Logan, Utah **The Emergence of Reservoir Deltas in the Regulated Missouri River: Opportunities for Cottonwood Forest Restoration,** Malia Volke, PhD Candidate, Dept. of Natural Resource Management, South Dakota State University, Brookings, South Dakota
12:00 p.m. - 1:00 p.m.	**Lunch**
1:00 p.m. -1:30 p.m.	**A Prioritized Procedure for Determining Stream and Riparian Area Existing and Desired Conditions on Public and Private Lands Subject to Ungulate Use,** Greg Bevenger, WyoHydro Professional Hydrology Services, Meeteetse, Wyoming
1:30 - 2:00 p.m.	**Regulated Rivers: Hydropower Relicensing, Climate Change, and Stream Habitats in the American West,** Sarah Null, Assistant Professor, Department of Watershed Sciences, Utah State University, Logan, Utah
2:00 - 2:30 p.m.	**Modeling the Capacity of Riverscapes to Support Dam-Building Beaver: Utah Statewide Implementation,** William Wallace (Wally) McFarlane, Research Associate, Dept. of Watershed Sciences, Utah State University
2:30 to 3:00 p.m.	**Impacts of Riparian Invasive Plant Species to Native Fauna,** Casey Burns, State Biologist, Natural Resources Conservation Service, Salt Lake City, Utah
3:00 to 3:30 p.m.	**Break**
3:30 to 4:00 p.m.	**Monitoring Channel and Vegetation along the Free-Flowing Yampa River,** Michael Scott, Research Ecologist, Fort Collins Science Center, Fort Collins, Colorado
4:00 to 5:00 p.m. **Closing keynote / CNR seminar talk**	**Evidence-Based Evaluation of Hydrologic Reconnection of Floodplain Wetlands: Lower Columbia River and Estuary,** Heida Diefenderfer, Senior Research Scientist, Marine Sciences Laboratory, Pacific Northwest National Laboratory, Sequim, Washington
5:00 p.m.	**Adjourn**

Speaker Abstracts

In order of presentation

The Colorado River: Supply and Demand

David Merritt, Riparian Plant Ecologist, Rocky Mountain Research Station, USDA Forest Service, Fort Collins, Colorado

The Colorado River, the master drainage of the arid west, provides water to 40 million people and its waters are used to irrigate nearly six million acres of land. The changes to the Colorado River since the European missionaries, trappers and settlers first arrived, include some of the earliest transbasin diversions in the West, storage capacity that surpasses average annual flow in the basin, mainstem dams that are some of the most massive human made structures on Earth, and intensified conflict between ecological processes and growing demand for fresh water for growing southwestern cites.

Over the past decades, recognition of the ecological costs of human water development have led to major efforts to restore sites and segments within the basin. I will summarize a few of these efforts from the headwaters of the Colorado to the delta in Mexico, sharing common themes and challenges. I will also present a framework for using information from sites across the basin to inform and monitor restoration work and to forecast outcomes of alternative flow management scenarios and riparian response to projected climate change scenarios.

David M. Merritt, PhD, Riparian Plant Ecologist, USFS Watershed, Fish, Wildlife, Air and Rare Plants
NRRC, 2150 Centre Ave., Bldg A, Suite 368 Fort Collins, CO 80526, dmmerritt@fs.fed.us

David Merritt is a riparian plant ecologist with the National Watershed, Fish and Wildlife Program of the US Forest Service and adjunct faculty at Colorado State University. The main focus of his current work is to understand the role of river flow regime in structuring riparian plant communities, maintaining diversity, and supporting the beneficial functions of riparian ecosystems. David has focused on developing regionally consistent and robust approaches to quantifying and evaluating trade-offs and risks in water extraction and flow management for ecological services. In his current position, David serves as a liaison between research and the National Forest managers on water-resource related issues -- primarily environmental flows.

Climate Change and Riparian Forest Communities: Implications for Small Streams in the Upper Colorado River Basin

Lindsay Reynolds, Research Scientist, Colorado State University and the US Geological Survey, Fort Collins, Colorado
Patrick Shafroth, U.S. Geological Survey, Fort Collins Science Center, Fort Collins, Colorado
N. LeRoy Poff, Department of Biology, Colorado State University, Fort Collins, Colorado

Climate change is projected to have an enormous effect on water resources in the western US, with cascading effects on river-dependent organisms. Recent studies show that increasing drought will lead to reduced water in many rivers in the southwestern US. For example, streamflow in the warm season has declined over the last century in the western US and is projected to continue decreasing over the next 100 years. In arid and semi-arid regions of the western US, it is likely that some perennial streams will shift to intermittent flow in response to climate-driven changes in runoff and evapotranspiration. We addressed the following two questions: (1) how will small stream low flows be affected by warmer conditions in the Upper Colorado River Basin (UCRB) and

(2) how will riparian vegetation respond? To address these questions we (1) modeled stream low flow metrics on ungaged streams in the UCRB and (2) sampled riparian vegetation along a hydrologic gradient (perennial to intermittent) to develop statistical relationships between flow parameters and biotic responses. We found the majority of perennial and weakly intermittent streams that are threatened under warmer conditions to be small, high elevation streams. Further, with our field vegetation data we are able to suggest how riparian plant communities will shift in the future and how managers can draw from these results for restoration planning in the context of climate change.

Lindsay Reynolds, Department of Biology, Colorado State University and U.S. Geological Survey, Fort Collins Science Center, 2150 Centre Ave., Bldg C, Fort Collins, CO, 80526, reynoldsl@usgs.gov

Lindsay Reynolds is a riparian ecologist whose research centers on plants, ecohydrology, climate change and invasions. She received her B.A. in Environmental and Evolutionary Biology from Dartmouth College in 2003 and her Ph.D. in Ecology from Colorado State University (CSU) in 2009. She is currently a Research Scientist in the Biology Department at CSU and the USGS Fort Collins Science Center. Recently, she has focused on how river hydrology and geomorphology influence adjacent plant communities, often in the context of future climate changes, river regulation and exotic species invasions in western North America.

Managing Livestock Grazing for Riparian Recovery in Northeastern Nevada
Carol Evans, Fishery Biologist, Elko District Office, Bureau of Land Management, Elko, Nevada

The Elko District Bureau of Land Management (BLM), located in Northeastern Nevada, has a long and well documented history of managing livestock grazing for recovery of stream and riparian habitats. Field surveys which include permanent photo and data collection stations were established on more than 1,000 miles of perennial streams beginning in 1977. Virtually all of these waterways have been re-surveyed at least four or five times at intervals of three to ten years between the late 1970's and today. Over the course of last 30 plus years, BLM personal have been working with livestock permittees and other partners to develop and apply prescriptive livestock grazing protocols for improvement of stream and riparian habitat conditions for native fish and other species of wildlife. Like many agencies and offices all over the west, we started managing riparian areas by constructing small exclosures in the 1980's and excluding all livestock. By the 1990's, we were learning how to apply principles of managing time and timing of grazing over a larger area. In more recent years, we have come to understand the importance of managing both uplands and riparian areas at a watershed scale and of incorporating principles of adaptive management into grazing plans. Our long-term database, combined with use of remote sensing techniques for monitoring, has allowed us to tell a compelling story of how riparian systems have changed over time in response to livestock grazing practices and to changes in the environment. Although this is still a story in progress, grazing practices which promote functionality at a watershed scale are yielding impressive results in terms of water quality, water retention and storage, habitat for wildlife and even sustainability for livestock operations during periods of drought. Such an approach seems critical in the context of rapid social, environmental and political change.

Carol Evans, Tuscarora Field Office, Elko District, Bureau of Land Management, 3900 E. Idaho St., Elko, NV, 89801, cevans@blm.gov

I am currently a fisheries biologist with the Bureau of Land Management in Elko, Nevada. I received both my B.S. and M.S. degrees in resource management from the University of Nevada, Reno. Although I have been with BLM in Elko for most of the past 25 years, I have worked for the U.S. Forest Service, the U.S. Fish and Wildlife Service

and for private industry. My passion is building partnerships and finding innovative ways to solve resource problems.

Grazing to Promote Riparian Health on a Private Ranch in Nevada
Agee Smith, Co-Owner, Cottonwood Ranch, Wells, Nevada

In 1995 Cottonwood Ranch changed its management and grazing program. It started using Holistic Resource Management as a way of thinking and managing that take a more holistic approach. It takes into consideration and works with the people, land, animals and plants (above and below ground).
It has been an 18-year learning journey that continues to evolve. Agee will show before and after slides, especially of their riparian success, and discuss the journey that they have been on.

Agee Smith, HC 62 Box 1300, Wells, NV 89835, ageesmith51@gmail.com

Agee is the managing partner of Cottonwood Ranch and has basically managed the ranch for 36 years. Agee was raised on Cottonwood, attended the local rural school, and then went into Wells, Nevada to attend high school. After high school graduation, he went to University of Nevada, Reno for a year and a half before joining the Marine Corps in 1971 for two years. He graduated from UNR with a Bachelor of Animal Science in 1977, then came back to the ranch to work and run the deer hunting operation in the Fall. Always interested in learning more, Agee continues his education with classes, workshops, and seminars. He has participated in the following: Ranching for Profit School, And Executive Link through RFP, Holistic Resource Management courses, Low Cost Cow/Calf Production School, Bud Williams' Low-Stress Livestock Handling, Lost River Grazing Academy, BEHAVE training by Fred Provenza at Utah State University, Nevada and Colorado Range Management Schools, many times, Trial and Error: What works, what doesn't. Agee also has an eclectic passion for reading about and learning history.

Building Riparian Resilience through Collaboration
Mary O'Brien, Utah Forests Program Director, Grand Canyon Trust, Moab, Utah

At the 2013 Restoring the West conference, Jerry Franklin spoke about restoring frequent-fire forests, and noted, "Collaborative groups may represent the most important interface between the American public and federal land management agencies." The same holds true of collaborative groups focused on building riparian resilience. Five significant collaborations have been undertaken in Utah in recent years, focused primarily on the contentious issues of livestock and wild ungulate grazing, and/or aspen restoration. In four, consensus has been reached despite initial differences. The fifth consensus collaboration is newly-formed. Commonalities contributing to the success of these five collaborations will be examined in this presentation, as well as particular challenges. The Utah Forests Restoration Working Group, which developed recommendations for restoring aspen on national forests in Utah in 2012, is now beginning development of guidelines for restoration of woody riparian vegetation. The 2014 Restoring the West conference is timely for this collaborative group.

Mary O'Brien, Botanist; Grand Canyon Trust; HC 64 Box 2604, Castle Valley, UT, maryobrien10@gmail.com

Mary O'Brien (Botany), Forests Program Director of Grand Canyon Trust, has worked as a staff scientist with conservation advocacy groups for the past 34 years, and has been with Grand Canyon Trust for the past 15 years. With Grand Canyon Trust, she has largely focused on helping colleague organizations jointly develop alternatives for proposed forest plan amendments and projects throughout the Dixie, Fishlake and Manti-La Sal

NFs (southern and central Utah).

Assessment and Monitoring Tools for Riparian Areas
Mark Petersen, Director of Water Quality Programs, Utah Farm Bureau, Salt Lake City, Utah

In 1996, the Bureau of Land Management and US Forest Service, in partnership with the Natural Resources Conservation Service, created a national riparian strategy called "Accelerating Cooperative Riparian Restoration and Management." An interagency, interdisciplinary team, the National Riparian Service Team (RNST), based in Prineville, Oregon, was established to implement the Strategy. To assist with implementation of the Strategy, a Riparian Coordination Network (RCN) has been established with Riparian Service Teams in each of the western states, Canada, and Mexico. The RNST and RCN has adopted as foundational tools, the Proper Functioning Condition (PFC) riparian assessment protocol, a methodology for assessing the functionality and health of riparian areas, and the Multiple Indicator Monitoring (MIM) protocol, a methodology for monitoring use and management impacts on stream channels and riparian vegetation. The PFC methodology provides a consistent approach for assessing the physical functioning of riparian areas through consideration of hydrology, vegetation, soil and landform attributes. MIM is a monitoring methodology that allows for statistical analysis of a comprehensive group of interrelated indicators, including three short-term and seven long-term indicators. This presentation gives a brief introduction to these two useful tools for assessing and monitoring riparian areas. Training opportunities provided by national and state Riparian Service Teams to help practitioners become proficient in the proper use of these tools are also mentioned.

Mark M. Petersen, Owner and Senior Scientist, Petersen Environmental Consulting, 1763 W 1915 S, Syracuse, UT 84075, petersenmm@comcast.net

Mark Petersen is Owner and Senior Scientist of Petersen Environmental Consulting. He earned degrees in Range Ecology and Watershed Science from Utah State University. He had a successful 32 year career with USDA Natural Resources Conservation Service as a Hydrologist, District Conservationist, Area and State Rangeland Specialist, and State Watershed Planning Specialist, which included being Program Lead for Riparian and Water Quality Programs. For the last 15 years as Senior Scientist for Petersen Environmental Consulting, he has contracted with Utah Farm Bureau to assist farmers and ranchers with environmental issues such as water quality, sensitive species, and riparian issues. Mark is Co-Lead of the Utah Riparian Service Team and has been a member of the Team for over 20 years. He has taught numerous workshops on both the Riparian Proper Functioning Condition (PFC) and Riparian Multiple Indicator Monitoring (MIM) protocols. He has lead Interdisciplinary Teams to conduct riparian PFC assessments for hundreds of miles of stream and riparian areas, and has helped implement MIM on both public and private lands.

Riparian Forest Dynamics and Management Challenges on Mediterranean-Climate Rivers
John Stella, Associate Professor, Forest and Natural Resources Management, State University of New York, Syracuse, New York

In populous, water-limited regions, humans have profoundly altered the river and floodplain environment to satisfy society's demands for water, power, navigation and safety. River management also profoundly alters riparian forests, which respond to changes in disturbance regimes and sediment dynamics. In parallel studies, we compare forest and floodplain development along two of the most heavily modified rivers in mediterranean-climate regions, the middle Sacramento (California, USA) and the lower Rhône (SE France). The Sacramento was dammed in 1942 and is now managed for irrigation, hydropower and flood control. The Rhône channel

was channelized for navigation prior to 1900, and since then has been dammed and diverted at 18 sites for hydropower and irrigation. We conducted extensive riparian forest inventories and sampled fine sediment depth in regulated reaches within both systems, and compared pre- versus post-dam patterns of deposition and linked forest development. We sampled 441 plots (500 m² each) along 160 km of the Sacramento, and 88 plots (1256 m²) stratified by management epoch (pre-channelization, pre-dam, post-dam) along 160 km of the Rhône. On the Sacramento, forest composition showed shifting tree species dominance across a chronosequence of aerial photo dates over 110 years. The transition from willow to cottonwood (*Populus*) occurred within 20 years, and the transition to mixed forest started after 50-60 years. On the lower Rhône, 15% of the current riparian forest occupies old floodplain land pre-dating the 19th century riverbank engineering projects, 38% occupies post-channelization and pre-dam surfaces, and 47% colonized land that emerged after dam construction and reduction in river base flows between the 1950s and 1980s. Compared to younger, post-dam forests, the pre-dam stands occupy higher geomorphic surfaces, are more species rich, and have a much more extensive shrub and vine stratum (20-50% cover overall). The shift from *Populus* dominance to other species began approximately a decade earlier on the Rhône compared to the Sacramento. Both rivers showed a strong understory presence on young floodplains by *Acer negundo* (box elder), which is non-native and invasive in Europe, suggesting similar processes of colonization and propagation in both systems. Overall, the Sacramento can serve as a predictive reference system for the Rhône, where significant restoration efforts are underway to improve riparian structure and function in diverted river reaches.

John C. Stella, Associate Professor, Department of Forest and Natural Resources Management, SUNY College of Environmental Science and Forestry, Syracuse, One Forestry Drive, Syracuse, NY, 13210, stella@esf.edu

John Stella is field ecologist and Associate Professor of Forest and Natural Resources Management at State University of New York College of Environmental Science and Forestry (SUNY-ESF), and holds an Adjunct appointment (Geography) in the Maxwell School at Syracuse University. His research interests focus on riparian and stream ecology, dendroecology, plant ecohydrology and stable isotope biogeochemistry, and restoration ecology. He earned his Ph.D. in Ecosystem Science from the University of California, Berkeley (Dept. of Environmental Science, Policy and Management). His research sites are located in semi-arid regions of California and the U.S. Southwest, Mediterranean Europe, and the Adirondack mountains of New York. More information about his research is available at http://www.esf.edu/fnrm/stella/

Identifying, Restoring and Protecting Critical Coldwater Refugia in the High Desert Owyhee Subbasin
Pam Harrington, Restoration Coordinator, Trout Unlimited, Boise, Idaho

Trout Unlimited (TU) has developed a new Home Waters project to improve redband habitat in the Owyhee Watershed of Nevada, Idaho, and Oregon. In this high desert landscape, identifying coldwater refugia areas and protecting them is critical to improving the habitat for redband trout.

TU uses landscape-scale thermography and climate change modeling data to locate and prioritize cold water refugia and guide on-the-ground restoration actions.

• Review key linkages b/w redband populations and riparian habitat conditions
• Develop stream temperature and riparian vegetation measures of redband trout habitat that can be used for broad-scale assessment and monitoring
• Develop linkages between landscape-scale measures of stream temperature and riparian vegetation and redband trout distribution and abundance

• Integrate landscape-scale measures of stream temperature and riparian vegetation into TU's Conservation Success Index as a tool that can help inform strategic redband trout conservation

The modeling tools target where landowner knowledge is sought and working together we improve water availability for redband trout as well as cattle operations.

Pam Harrington, Restoration Coordinator, Trout Unlimited, 910 W. Main Street, Suite 342 Boise, ID 83702, pharrington@tu.org

Pam Harrington has been restoring trout habitat with Trout Unlimited since 2006. Serving as TU's Southwest Idaho Restoration Coordinator she worked in the forested mountains on abandoned minelands projects and now she focused on the high desert of the Owyhees, restoring streams on operating cattle ranches.

Before coming to Trout Unlimited, Pam worked for the Idaho Department of Environmental Quality in the Water Program. She managed the 319 grants program for the Boise Regional Office and funded water quality improvement projects. Pam has a BS in Environmental Health and has worked for large corporations, state government and now a nonprofit to round out her career.

A Riparian Conservation Network to Develop Ecological Resilience

Alexander K. Fremier, Assistant Professor, School of the Environment, Washington State University, Pullman, Washington
Michael Kiparsky, Associate Director, Wheeler Institute for Water Law & Policy, University of California, Berkeley, California
J. Michael Scott, Professor Emeritus, College of Natural Resources, University of Idaho, Moscow, Idaho

One of the most significant challenges to species conservation in the 21st century is how to foster species long-term survival in increasingly fragmented and dynamic environments of the Anthropocene. Going forward, land management actions must consider resilience – the ability of species survive through peak climatic-related events, habitat fragmentation and/or habitat loss. Habitat connectivity is a key attribute of resilience; yet, re-building connectivity has proven a difficult restoration task. Here, we propose building habitat connectivity through further coordinated efforts to protect and restore riparian ecosystems. Increased efforts to protect streamside areas further society's acknowledgement that these lands provide key ecosystem services and can help further connect current protected areas to promote survival. We provide evidence that a riparian area network has the potential to connect existing protected areas, that significant riparian area conservation is already occurring and needs to be further coordinated, and that this solution is scalable through policy and administrative coordination rather than the initiation of new legislation.

Alexander K. Fremier, Assistant Professor, School of the Environment, Washington State University, Pullman, WA 99164-2812, alex.fremier@wsu.edu

Alexander K. Fremier is an Assistant Professor in the School of the Environment at Washington State University. Dr. Fremier is a trained ecologist with interests in coupling ecological and geomorphic processes to better understand ecosystem transformation.

Michael Kiparsky is Associate Director of the Wheeler Institute for Water Law and Policy at Berkeley Law. Dr. Kiparsky has worked on both technical and policy aspects of water resources management, and his overarching professional interest lies at the intersection between the two.

J. Michael Scott is a Professor Emeritus and Distinguish Professor at the College of Natural Resources at the University of Idaho. Dr. Scott has devoted a lifetime to the study and conservation of the world's rarest species.

Partnering with Beaver to Improve Fish Habitat: An Example of Cheap and Cheerful Restoration to Provide a Population Benefit to an Endangered Species
Nick Bouwes, Ecologist/Owner, Eco Logical Research, Inc., Providence, Utah

Anthropogenic activities such as timber harvest, agriculture, and grazing have greatly altered the habitat of salmon and steelhead in streams of western North America. Perhaps equally as important but rarely mentioned as a major impact to fish habitat is the great reduction of beaver. Beaver were distributed in high densities across much of North America prior to European settlement, however intense trapping more than century ago nearly exterminated beaver in several regions. Although salmonids have coexisted with beaver for millions of years, skepticism exists about the benefits dam building activities play. In fact, removal of beaver dams from streams is still a management activity employed in some states to try to improve salmonid fisheries. Thus, it is not surprising that using dam building beavers as a means of restoring streams is uncommon. Channel incision is a degraded state of fish habitat that is found ubiquitously throughout the world. We have suggested that beaver dams and beaver dam analogs can greatly accelerate the recovery of incised channels. We conducted a watershed scale experiment where we built beaver dam analogs to encouraged beavers to build dams to improve fish habitat in an incised stream. We observed several rapid changes to the stream environment following restoration. We also found survival, abundance, and production of juvenile steelhead increased following these changes. We believe management of streams that include beaver as part of the environment will benefit salmonid populations.

Nick Bouwes, Ecologist/Owner, Eco Logical Research, Inc., Providence, Utah, 84321, nbouwes@gmail.com

Nick Bouwes is owner of environmental consulting firm Eco Logical Research and adjunct faculty in the Watershed Sciences Department at Utah State University. He received his MS and PhD at USU, and for the past 20 years has been working on endangered fish recovery efforts in the Western US.

Restoring Riparian Ecosystems with Large Predators: the Yellowstone Experience
Robert Beschta, Professor Emeritus, Dept. of Forest Ecosystems and Society, Oregon State University, Corvallis, Oregon

Large predators can help shape the structure and functioning of terrestrial ecosystems. While various studies in national parks scattered across the western United States and Canada have shown the loss of large predators (e.g., wolves, cougar) allowed native ungulates (e.g., elk, mule deer) to greatly alter the structure and functioning of ecosystems via increased herbivory, studies of trophic effects of reintroduced/recolonized large predators have been relatively rare, with Yellowstone National Park being a major exception. The reintroduction of wolves into Yellowstone National Park in 1995-97, after a 70 year absence, allowed for studies of trophic cascades of a restored large predator guild upon elk and woody species such as aspen, cottonwoods, willows, and berry-producing shrubs. Overall, these studies indicate that the reintroduction of wolves triggered a trophic cascade, in conjunction with bottom-up forces, with increasing recruitment (i.e., growth of woody plants into tall shrubs or trees) of browse species in riparian areas. This situation represent a fundamental change in plant community dynamics in comparison to previous decades of browsing suppression--when wolves were absent. Although wolf reintroduction has resulted in substantial initial effects to both plants and animals, the Yellowstone ecosystem still appears to be in the early stages of ecosystem recovery. In other areas of western North America where

large carnivores have been previously extirpated or displaced, their recovery may be necessary for assisting in the ecological restoration of large herbivore altered ecosystems.

Robert Beschta, Professor Emeritus, Dept. of Forest Ecosystems and Society, Oregon State University, Corvallis, OR, 97331, robert.beschta@oregonstate.edu

Robert Beschta is professor emeritus in the department of Forest Ecosystems and Society at Oregon State University. Much of his research has been directed at trying to understand the effects of alternative land uses upon riparian plant communities, hydrologic processes, and stream systems. Over the last 15 years, he has been involved in studies trying to assess apex predator effects, via their presence or absence, on plant communities and riparian ecosystems. These efforts have generally involved retrospective assessments of ecosystem trends following the displacement/extirpation of an apex predator, as well as ecosystem changes underway in areas where the missing predator has returned.

Riverscapes and Mindscapes: Using Inventory, Monitoring, and Biogeography to Explore Riparian Management Domains in the West
Daniel Sarr, Ecologist, U.S. Geological Survey- Grand Canyon Monitoring and Research Center, Flagstaff, Arizona
Nate Hough-Snee, Utah State University, Ecology Center and Department of Watershed Sciences, Logan, Utah

The western United States is among the most geographically diverse regions in the world. This heterogeneous landscape has fascinated biogeographers and explorers for centuries, yet poses daunting challenges for environmental managers in search of generalizable frameworks for understanding riparian plant composition, diversity, and resilience. Numerous studies of the last two decades have demonstrated that riparian ecosystems are governed by a complex array of factors that can be viewed hierarchically from large scale biogeographic patterns through less coarse watershed-scale gradients to local scale drivers of hydrology, geomorphology, and biotic and abiotic disturbance. Increasingly, humans influence all levels of the hierarchy. Environmental managers often accumulate management paradigms from institutional knowledge and histories, on-the-job experience and other diverse sources. Consequently, "management domains" presently used in riparian ecosystems may be ad hoc accumulations of knowledge that align haphazardly with biogeographic or other environmental boundaries. Here we discuss the concept of riparian management domains to prompt discussion of how to better align ecological and management boundaries. We will review recent research that compares within-site and among-site patterns in riparian biodiversity. Much of this research has helped to distinguish which elements of riparian ecosystems show a strong biogeographic structure from those that tend to be governed primarily by local environmental and biotic effects. We will also review first principles of riparian biogeography and highlight the value of place-based inventory and monitoring to inform place-based riparian management and restoration and to advance human understanding of riparian ecosystems across the American West.

Daniel Sarr, U.S. Geological Survey- Grand Canyon Monitoring and Research Center, 2255 N. Gemini, Flagstaff, AZ 86001, dsarr@usgs.gov

Daniel is an applied ecologist with background in riparian ecology and restoration, forest science, and biodiversity assessment. Daniel is a Research Ecologist with the US Geological Survey's Grand Canyon Monitoring and Research Center. He is new to the Colorado Plateau, having come from the poison-oak-clad hills of S. Oregon, where he established and led the National Park Service's Klamath Network Inventory and Monitoring program for 13 years. Daniel holds a B.S. in Biology from Humboldt State University, an M.A. in Aquatic and Population Biology from University of California, Santa Barbara, and a Ph.D. in Forest Science from Oregon State University.

His M.A. and Ph.D. theses explored environmental controls on plant species distribution and diversity in riparian ecosystems of the Sierra Nevada, California and western Oregon, respectively. Prior to returning for his doctoral studies, Daniel worked for the Inyo National Forest, the Colorado Natural Heritage Program, and The Nature Conservancy. In 2008, Daniel ventured to Ireland, where he conducted wetland research at Burren National Park on a Fulbright Fellowship.

Understanding Challenges in Managing Riparian Systems at a Landscape Scale

Christy Meredith, PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO), USDA Forest Service, Logan, Utah
Brett B. Roper, Fish and Aquatic Ecology Unit, USDA Forest Service, Logan, Utah
Eric K. Archer, PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO), USDA Forest Service, Logan, Utah

As societies increasingly use more water and other natural resources, the ability of managers to conserve aquatic biota will depend on whether habitat can be maintained or restored. However, managers must be able to track the status and trend of these aquatic systems if they are to be accountable to the goal of maintaining habitat conditions. This can be particularly challenging given that natural landscape and geomorphic characteristics can also have a strongly influence on expected stream conditions. Within the Interior Columbia River Basin and over the last decade, the PACFISH INFISH Biological Opinion Effectiveness Monitoring Program (PIBO EMP) is trying to answer the question; "Are key biological and physical components of aquatic and riparian communities being improved, degraded, or restored within the range of anadromous salmonids (*Oncorhynchus* sp.) and bull trout (*Salvelinus confluentus*)?" This program has sampled over 1300 stream reaches spatially distributed within the Basin. We assess status and trend by incorporating techniques that account for variation due to natural landscape and geomorphic characters. We have found that stream habitat conditions have been improving over the last 15 years but that the status of stream conditions vary greatly across the study area. Low-transport stream reaches in dry climates and stream reaches close to roads have been among the slowest to respond to management. Results indicate that long-term data sets, exceeding the duration of many sampling programs, are needed to detect trends in most aspects of habitat condition.

Christy Meredith, PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO), USDA Forest Service, 860 North 1200 East, Logan, UT 84321, csmeredith@fs.fed.us

Christy Meredith graduated with a PhD in Ecology from Utah State University in 2012. Her main research interest is how geomorphic, landscape, and anthropogenic factors affect the distribution and life histories of aquatic organisms within stream systems. She currently is a data analyst for the PACFISH INFISH Biological Opinion Program, where she develops quantitative methods to examine the status and trend of habitat conditions for listed species of salmonids in the interior Columbia River Basin. In her spare time she enjoys rock climbing, nature photography, and drinking microbrews.

Effects of the 2011 Flood on Missouri River Cottonwood Forests: Implications for Restoration

Mark Dixon, Associate Professor, Dept. of Biology, University of South Dakota, Vermillion, South Dakota

Flow regulation has significantly altered hydrological, geomorphic, and ecological processes on the Missouri River. Cumulative effects are evident in reductions in plains cottonwood (*Populus deltoides*) recruitment, altered forest age structure and species composition, losses of sandbar and shallow water habitat, and declines in sandbar-nesting birds and large river fishes. Although a national scientific panel recommended restoration

of fluvial geomorphic processes to address these problems, management constraints have limited process-based restoration. Record runoff in 2011 exceeded reservoir capacity on the upper Missouri, leading to the highest flows in 59 years and exceptionally long flood durations (up to 3 months). We assessed the effects of this "large infrequent disturbance" by comparing pre- (2006-2009) to post-flood (2012) changes in riparian forests along six segments of the Missouri River. Live shrub and tree density declined sharply within young forest stands (<30 years). Higher proportions of non-native (*Elaeagnus angustifolia*) and upland (*Juniperus virginiana*) trees showed evidence of recent mortality than did the native cottonwood. Sandbar area increased sharply from 2006-2012 and area of young forests declined, with particularly strong declines in sapling stands that had established following the previous post-dam record flow releases in 1997. Cottonwood recruitment was widespread in 2012, but most seedling patches were on sandbars in the active channel, rather than on overbank sites. Physical and operational constraints within the regulated Missouri River limited the restorative effects of the 2011 flood and are likely to limit future forest recovery. Process-based restoration of ecosystem structure and function would require restoration of flow and sediment regimes that more closely mimic historical conditions, as well as overcoming the physical legacies of decades of flow regulation.

Mark Dixon, Associate Professor, Dept. of Biology, College of Arts & Sciences, University of South Dakota, Vermillion, SD 57069, mark.dixon@usd.edu

Mark Dixon is an Associate Professor in the Department of Biology at the University of South Dakota, where he has worked since 2006. His research and that of his students focuses on the factors that influence landscape and floodplain forest dynamics along rivers. His most recent work, in collaboration with Carter Johnson and Mike Scott, examines the effects of the 2011 flood on cottonwood recruitment, floodplain vegetation, and landbird abundance along multiple segments of the regulated Missouri River. Prior to his position at USD, Mark studied the San Pedro River as a postdoctoral research associate with Julie Stromberg at Arizona State University. He received his PhD (2001) in Zoology from the University of Wisconsin, his MS (1994) in Wildlife Ecology from South Dakota State University, and his BS (1987) in Animal Ecology from Iowa State University.

Riparian Vegetation Guilds: Applications to Small Streams of the Interior Pacific Northwest

Nate Hough-Snee, Nate Hough-Snee, PhD Student: Restoration Ecology, Ecology Center and Department of Watershed Sciences, Utah State University, Logan, Utah
Brian Laub, Dept. of Watershed Sciences, Utah State University, Logan, Utah
David M. Merritt, Riparian Plant Ecologist, Rocky Mountain Research Station, USDA Forest Service, Fort Collins, Colorado
Brett B. Roper, Fish and Aquatic Ecology Unit, USDA Forest Service, Logan, Utah
A. Lexine Long, Ecologist, Colorado Plateau Research Station, U.S. Geological Survey, Flagstaff, Arizona
Lloyd L. Nackley, Environmental Horticulture, Plant Sciences Dept. UC Davis, Davis, California
Joseph M. Wheaton, Assistant Professor, Department of Watershed Sciences, Utah State University, Logan, Utah

Riparian flow guilds have been proposed as a method of measuring riparian ecosystem integrity in large alluvial rivers, especially rivers with regulated or overallocated instream flows, or strong potential for flows to be reduced by climate change. The riparian flow guild concept identifies groups of species with similar life-history strategies that result from similar physiological requirements and morphological attributes. These trait-based riparian guilds respond to common environmental stressors within the riparian environment such as flooding, drying, and soil moisture availability. In smaller streams however, where hillslopes often directly connect to stream corridors, fluvial and hydrologic processes may work in tandem with riparian and watershed

management to influence guild abundance. Here, we build on the concept of riparian flow guilds by identifying riparian disturbance guilds - riparian guilds whose functional and morphological attributes correspond to multiple disturbance or resource axes. We used 26 environmental tolerance and morphological attributes in 30 species to identify five riparian disturbance guilds: a tall, deeply-rooted coniferous tree guild, a rapidly-growing, drought-plastic shrub guild, a low-stature hydrophytic shrub guild, vegetative reproduction guild, and a short-statured, shade-tolerant, understory shrub guild. We modeled these guilds' presence and abundance, finding that each guild responded to a variety of climatic, disturbance, and watershed management attributes. Each guild corresponded to climatic and watershed disturbance attributes that were related to the traits most characteristic of that guild. Most notably, we found that complimentary coexisting guilds or mutually exclusive guilds were strong predictors of guild presence and abundance. From these observations, we conclude that riparian disturbance guilds respond not only to environmental variability tied to each guilds attributes, but also niche partitioning in which different life history strategies can coexist under comparable disturbance regimes.

Nate Hough-Snee, PhD Student: Restoration Ecology, Ecology Center and Dept. of Watershed Sciences, Utah State University, 5210 Old Main Hill Logan, UT 84322-5210, nate@natehough-snee.org

Nate Hough-Snee is a broadly-trained riparian ecologist earning his PhD within Dr. Joe Wheaton's Ecogeomorphology and Topographic Analysis Lab in Utah State University's Department of Watershed Sciences. Nate's riparian landscape research strives to understand drivers of riparian vegetation communities across the American West, including climate, watershed management, and restoration. Additionally, he studies riparian ecosystems through restoration and field trials to understand how biotic, hydrologic, and geomorphic processes interact to shape riparian functional plant diversity. Prior to his current post, Nate attended the University of Washington (B.A. 2008; M.S. 2010) and worked for the US Forest Service, among others. Nate currently serves as the executive vice-president of the Society of Wetland Scientists' Pacific Northwest Chapter and is an avid care bear collector.

The Emergence of Reservoir Deltas in the Regulated Missouri River: Opportunities for Cottonwood Forest Restoration
Malia Volke, Graduate Research Assistant and Ph.D. Candidate, Dept. of Natural Resource Management, South Dakota State University, Brookings, South Dakota

Most of the world's large river flows are regulated by dams, altering the processes that sustain riparian ecosystem biodiversity and function. Numerous studies have documented declines in riparian vegetation extent and diversity along regulated rivers. Many reservoirs in large river systems, now decades old, are beginning to show their ages by the appearance of expanding delta formations at river/reservoir and tributary/reservoir junctions. These deltas are novel habitats that were not present in the former river system, and are governed by both river flow and sediment regimes and managed reservoir level fluctuations. Although largely unstudied, available evidence suggests that these delta habitats may support native riparian vegetation that is in decline elsewhere along regulated rivers. The delta formed at the confluence of the White River and Fort Randall Reservoir on the Missouri River in South Dakota represents a novel habitat where riparian forest has expanded during the post-dam era; however, expansion may be curtailed at times by high stages of Fort Randall Reservoir that cause forest mortality. Time-series analysis of riverine cross-sections indicated that there has been a trend of channel and floodplain aggradation within the post-dam delta, facilitating expansion of delta surfaces into and above the reservoir pool. Likewise, GIS analysis of historic aerial photography showed that forest area on the delta increased by about 50 percent during the post-dam era. Field inventories determined that a heterogeneous mixture of riparian forest exists within the White River delta, and that these

forests are similar in structure and composition to those along natural river reaches. Current research will improve understanding of: (1) the contribution of novel deltas to biodiversity along regulated rivers and (2) how reservoir management and restoration efforts could improve rates of native riparian vegetation expansion and survival in novel delta habitats along regulated rivers.

Malia Volke, Graduate Research Assistant and Ph.D. Candidate, Dept. of Natural Resource Management, South Dakota State University, Brookings, SD 57006, malia.volke@sdstate.edu

Malia Volke is a Ph.D. Candidate in the Department of Natural Resource Management at South Dakota State University. She is broadly interested in how riparian plant communities respond to disturbance, particularly flow regulation. Her research focuses on cottonwood forest dynamics on reservoir deltas along the Missouri River. She is advised by Dr. Carter Johnson and collaborates with other scientists on research related to the recovery of the Missouri River cottonwood forest ecosystem. Malia received a B.S. in Ecology from the University of Idaho.

A Prioritized Procedure for Determining Stream and Riparian Area Existing and Desired Conditions on Public and Private Lands Subject to Ungulate Use
Greg Bevenger, WyoHydro Professional Hydrology Services, Meeteetse, Wyoming

There are 30,000 miles of streams and rivers in Utah. There are concerns with sediment, hydrologic function, riparian cover, and in-stream habitat on many of these. Some of these concerns are due to grazing by domestic and wild ungulates. Administering ungulate grazing to ensure overall desired stream and riparian area conditions are being achieved is problematic without first having good data on existing physical condition. Only after current and necessary physical condition are known and determined can interdisciplinary identification of overall desired condition, and the departure between existing and overall desired condition, be determined. Acquisition of existing physical condition information and subsequent determination of overall desired condition is not a simple proposition, nor is collection and determination immediate. This is in part due to the vastness of lands available to ungulate grazing and the linear extent of streams and rivers across them. This presentation proposes a procedure for prioritizing and determining physical stream and riparian area existing and necessary condition, and subsequent overall desired condition. The proposal contains a monitoring strategy for assessing whether necessary physical condition, a pre-requisite to achieving overall desired condition, is being achieved.

The procedure prioritizes assessment and monitoring by focusing only on stream and valley types most susceptible to ungulate grazing. Step 1 is the determination of current stream and riparian successional state and functioning condition. Step 2 is the identification of necessary stream and riparian area successional state and functioning condition, and adjustment of current management if necessary. Step 3 involves monitoring to determine if necessary stream and riparian area successional state and functioning condition are being maintained or achieved. Step 4 is the determination, once necessary successional state and functioning condition are being maintained or achieved, of overall desired condition and, if necessary, adjustment of management accordingly.

Gregory S. Bevenger, WyoHydro Professional Hydrology Services, PO Box 516, Meeteetse, WY 82433, wyohydro@live.com

Greg Bevenger is a professional hydrologist, registered with the American Institute of Hydrology (98-H-1488). He recently retired from the USDA Forest Service, where he was serving as Regional Hydrologist for the

Intermountain Region (2011-2014). Prior to that he was Forest Hydrologist on the Shoshone National Forest in Wyoming (1988-2011), Forest Hydrologist on the Daniel Boone National Forest and Hydrologist with the Northeast Experiment Station in Kentucky (1987-1988), District Hydrologist on the Medicine Bow National Forest in Wyoming (1979-1987), and Soil Scientist with the Soil Conservation Service in Utah (1978-1979). During his 36-year civil service career Greg worked in watershed assessment and restoration, riparian area management, water rights, water and air quality, support to other land management program areas such as livestock grazing and timber harvest, and watershed and air program management and administration. Greg is currently the owner of WyoHydro Professional Hydrology Services, a sole proprietorship specializing in rural and wildland hydrology

Regulated Rivers: Hydropower Relicensing, Climate Change, and Stream Habitats in the American West

Sarah E. Null, Assistant Professor, Department of Watershed Sciences, Utah State University, Logan, Utah

Hydropower relicensing provides an opportunity to evaluate tradeoffs between water (and water quality) for the environment and water for hydropower in regulated rivers. Climate change is currently not considered with hydropower relicensing, although it is anticipated to change hydropower generation, instream water quantity, and water quality. Coupled hydroclimate modeling was used to evaluate changes in hydropower generation, instream flows, stream temperatures, and riparian systems in California's Sierra Nevada Mountains with projected hydropower operations and climate warming. Modeling suggests that climate warming will reduce hydropower generation, and competition for water for hydropower, environmental flows, and other competing water uses will likely increase. Stream temperatures are anticipated to rise, although managing the hypolimnion (cold water pool) of large reservoirs for downstream temperature management shows promise for maintaining cold water habitats throughout this century. The spring snowmelt recession is fundamental for maintaining both stream channel shape and riparian ecosystems, although both hydropower generation and climate warming (snowfall shifting to rainfall) change the timing, magnitude, and rate of change of the snowmelt recession. This research shows that considering climate change for the 30-50 year duration of hydropower licenses would establish more robust hydropower generation operation conditions, in turn improving mechanisms to maintain instream and riparian systems in regulated rivers.

Sarah Null, Assistant Professor, Department of Watershed Sciences, 5210 Old Main Hill
Logan, UT 84322-5210, sarah.null@usu.edu

Dr. Sarah E. Null, Assistant Professor at Utah State University, is a water resources systems modeler. Her research program addresses re-operation of water systems to improve efficiency, climate change impacts on water resources, water quality management to improve habitat for aquatic species, and dam removal. Field studies, mathematical models, and systems analysis are methods she uses to improve understanding of systems and explore promising solutions to problems. She is an early career scientist with 10 years of experience researching and modeling water resources management, and has multi-disciplinary research experience working with ecologists, biologists, engineers, geologists, climatologists, sociologists, economists, and geographers.

Modeling the Capacity of Riverscapes to Support Dam-Building Beaver: Utah Statewide Implementation

William W. Macfarlane, Research Associate, Department of Watershed Sciences, Utah State University, Logan, Utah
Joseph M. Wheaton, Assistant Professor, Department of Watershed Sciences, Utah State University, Logan, Utah
Martha L. Jensen, Masters Student, Department of Watershed Sciences, Utah State University, Logan, Utah

Beaver dam-building activities lead to a cascade of hydrologic, geomorphic, and ecologic feedbacks that increase stream and riparian complexity and benefit aquatic and terrestrial biota. As a result, beaver are increasingly being used as a key component of stream and riparian restoration strategies. However, predictive spatial models resolving where within a drainage network beaver dams can be built and sustained are lacking. Moreover, a capacity model approach alone is not enough because many places that beaver might build a dam are in direct conflict with humans (e.g., damming of culverts or irrigation canals and flooding of roads). The Beaver Restoration Assessment Tool (BRAT) was developed to fill this void and serves as a decision support and planning tool intended to help resource managers, restoration practitioners, wildlife biologists and researchers assess the potential for beaver as a stream conservation and restoration agent over large regions. In 2012-2013 we developed the beaver dam building capacity model portion of the tool and tested it in a pilot project in the Escalante and Logan watersheds. Results from the pilot study indicated that the model was effective at predicting beaver dam capacity across diverse physiographic settings. The project described herein improves upon and extends the pilot project to include Utah statewide coverage. The current project also develops and tests the decision support and planning components of the tool thus accounting for where beaver may pose potential nuisance problems, where 'Living with Beaver' strategies may be needed, where re-colonization and/or reintroduction is most appropriate and identifies potential conservation and restoration areas for beaver. By combining the capacity and decision support approaches, resource managers have the necessary planning information to estimate where and at what level re-introduction of beaver and/or conservation is appropriate.

William (Wally) W. Macfarlane, Research Associate, Department of Watershed Sciences, Utah State University, 5210 Old Main Hill Logan, Utah 84322-5210, wally.macfarlane@gmail.com

Wally Macfarlane is a Senior Research Associate at the Ecogeomorphology and Topographic Analysis Lab, Department of Watershed Sciences, at Utah State University. Wally received his B.S. in Environmental Studies at Utah State University in 1996 and his M.S. in Environmental Science at Bard College, in 1999. Wally is a Certified GIS Professional, with nearly 15 years of experience developing innovative GIS and remote sensing based solutions to ecological issues worldwide. Currently he is working on developing improved ways to delineate, characterize and restore riparian and riverine ecosystems across the western US. Wally is particularly interested in the next generation of 'cheap and cheerful' restoration approaches such as partnering with beaver for sustainable stream and riparian restoration.

Impacts of Riparian Invasive Plant Species to Native Fauna
Casey Burns, State Biologist, Natural Resource Conservation Service, Salt Lake City, Utah

Native wildlife coevolved with native plants for millennia. Non-native plants may be present in a greater distribution than ever before and may be disrupting the natural dynamics of ecosystems more than ever. Forty two percent of threatened and endangered (T&E) wildlife species and 68% of T&E plants are harmed by non-native plant competition and indirect habitat effects. The impacts to wildlife from non-native plants are often assumed to be negative, but the ecological mechanisms are difficult to study. This presentation will provide a synthesis of the facts, explore the rumors, and try to set the record straight. Evidence of herbivory on and invertebrate use of native versus non-native plants generally shows greater use and wildlife diversity on native plants. The impacts to ecosystem processes such as, stream dynamics and the hydrologic cycle, are more complex and difficult to determine, but evidence does show some negative effects. Instances where non-native plants are benign or beneficial to wildlife do exist and circumstances where non-native plant treatment is not practical are common. Impacts to wildlife from tamarisk, Russian olive, phragmites, arundo, and other riparian and wetland invasive plants may be significant and will be detailed. The USDA Natural Resources

Conservation Service (NRCS) is available for planning and funding assistance on non-native plant treatment and management.

Casey Burns, State Biologist, USDA Natural Resources Conservation Service, 125 South State Street, Room 4010 Salt Lake City, UT 84138-1100, casey.burns@ut.usda.gov

Casey grew up in California, Norway, Minnesota, Pennsylvania, and Massachusetts. He attended Drury University in Springfield, MO and obtained B.A. degrees in Biology and Environmental Studies and then graduated from University of Missouri – St. Louis with a M.S. in Conservation Biology. Casey toiled for three years with the Bureau of Land Management (BLM) in Barstow, CA as a Wildlife Biologist. After this, Casey worked for seven years as a Biologist with NRCS in southern California focusing on habitat restoration, invasive plant control, streambank bioengineering, native landscaping, pollinator enhancement, and emergency watershed projects. In 2010, Casey began working as the NRCS State Biologist in Salt Lake City, UT, where his priorities now include sage-grouse conservation, pollinator enhancement, wetland and riparian management and restoration, and environmental compliance. Casey has a wonderful wife and a delightful baby boy.

Toward Monitoring Channel and Vegetation along the Free-Flowing Yampa River
Michael Scott, Research Ecologist, Fort Collins Science Center, Fort Collins, Colorado

Much of what we know about large river ecosystems comes from work on regulated rivers. The scarcity of quantitative information about pre-development conditions on these rivers restricts understanding of the full range of ecological responses to regulation and constrains predictions of future regulated-river behavior in the context of climate change, continued water development, management and restoration efforts. River regulation in the Colorado River basin has changed the magnitude and timing of water and sediment delivery to downstream reaches. Channel narrowing is a widely documented morphological adjustment of stream channels to natural or anthropogenic changes in stream flow and sediment flux, including establishment of vegetation on formerly active channel features. The Yampa River is perceived as one of the least regulated rivers in the Colorado River basin. We examine the degree to which the Yampa has been altered by water development. Further, we mapped geomorphic features and compared riparian vegetation across three distinct channel planforms. Of seven major Colorado River tributaries, the Yampa is the fifth largest in terms of virgin mean annual discharge. However, it is has the second smallest degree of flow regulation, expressed as the percent of virgin mean annual discharge capable of being stored, and retains a high degree of flow variability. Analyses indicate significant differences in plant species cover and composition among channel types ($p=0.001$). Significant differences in vegetation also were related at a finer scale to specific geomorphic surfaces (e.g., active channel, active floodplain), reflecting distinct geomorphic processes and physical environmental conditions. Finally, there were no significant changes in vegetation cover or frequency on specific active bar surfaces over four years implicating the importance of flow variability. This information provides a baseline for gauging future channel change and can be used to tailor change-detection monitoring to hypothesized geomorphic and vegetation changes in specific hydrogeomorphic settings.

Michael Scott, Research Ecologist, Fort Collins Science Center, 2150 Centre Ave Bldg C, Fort Collins, CO 80526, scottm@usgs.gov

Michael Scott received his Ph.D. in Forest Ecology from Michigan State University. He did Post-doctoral work at the University of Georgia and was a Research Associate at Oregon State University. He was a Research Ecologist for the U.S. Geological Survey in Fort Collins, Colorado for 25 years and is now a USGS Riparian

Ecologist, Emeritus and adjunct faculty in the Watershed Sciences Department, Utah State University. Enduring research interests include the biology and ecology of cottonwood and how stream flow, channel change, and vegetation dynamics interact to create and sustain western riparian ecosystems. Mike has conducted basic and applied research on cottonwood ecosystems of the upper Missouri River in Montana for over 20 years and more recently has been involved in developing long-term riparian monitoring protocols for large river in the Colorado River basin.

Evidence-Based Evaluation of Hydrologic Reconnection of Floodplain Wetlands: Lower Columbia River and Estuary

Heida Diefenderfer, Senior Research Scientist, Marine Sciences Laboratory, Pacific Northwest National Laboratory, Sequim, Washington

The Columbia Estuary Ecosystem Restoration Program on the 1468-km2 river floodplain was developed over the past decade to provide habitat for threatened and endangered salmon of the Columbia Basin during migration to the Pacific Ocean. Water levels and floodplain habitat availability in the Lower Columbia River and estuary (LCRE) are influenced by tides, river flow, hydropower operations, water withdrawals, dikes, culverts, tide gates, and coastal processes. The removal of barriers to fish passage and macrodetritus export by hydrological reconnection of floodplain habitats along 234 river kilometers is catalyzing changes in physical and biological indicators, which we have measured at >60 reference and >10 restoration sites in research begun in 2004. Key elements of the restoration program are a conceptual model, prioritization, status-and-trends monitoring, database development, adaptive management, and critical uncertainties and effectiveness research. We investigated and quantified ecosystem controlling factors on water surface elevation, channel morphology, microtopography, inundation, large woody debris, and the composition and distribution of tidal estuarine and freshwater plant communities. We used a sum exceedance value metric to describe the influence of spatially varying water level regimes on Populus balsamifera riparian forests, Picea sitchensis swamps, Salix and Cornus sericea wetlands, and brackish and freshwater marshes. Building on these analyses, we recently proposed a system zonation that is based on discrete transitions in the hydrologic regime. The Estuary is comprised of a lower reach with salinity intrusion, the energy minimum, and an upper reach without salinity intrusion. The Tidal River is also comprised of three reaches, in which water levels are increasingly dominated by river flow instead of tides. Our recently completed programmatic evidence-based evaluation of effectiveness used 11 causal criteria to evaluate 10 analyses synthesized under 7 lines of evidence. The evaluation showed that large-scale wetland restoration benefits salmon through cumulative net ecosystem improvement.

Heida Diefenderfer, Senior Research Scientist, Marine Sciences Laboratory, Pacific Northwest National Laboratory, 1529 West Sequim Bay Road Sequim, Washington 98382, Heida.Diefenderfer@pnnl.gov

Dr. Heida Diefenderfer has been a restoration ecologist with the Battelle Memorial Institute at the U.S. Department of Energy's Pacific Northwest National Laboratory Marine Sciences Laboratory since 2000. She leads and otherwise contributes to several research teams. Her research emphasizes ecology, geomorphology and hydrology focused on problems in the conservation and restoration of river floodplain and coastal ecosystems.

Poster Abstracts

In alphabetical order by presenting author's last name, presenting
author in italics

Spatially Understanding Utah's Water Resources as a Foundation for Aquatic Restoration

Tim Beach, Dr. Sarah Null, Nancy Mesner, Utah State University, Logan, Utah

Successful restoration of the arid West requires a basic knowledge of available water resources, withdrawals, and management. Utah, being the second driest state in the country, is continuing their efforts to restore impaired water systems and improve on water scarcity problems. Because of a fast-growing population, the diversity of Utah's landscape and regulations that govern water throughout the state, understanding the region's water hydrologic condition can be difficult. A majority of this information is stored in databases, represented by only numbers and statistics. In an effort to better conceptualize this data and increase the spatial understanding of Utah's water, a set of maps have been produced. These maps were created using ESRI's ArcMap and include major lakes and rivers, average annual precipitation, average annual streamflow, total urban withdrawals, total agricultural withdrawals and management. Observing the resulting information from multiple maps at once can lead to spatial inferences and additional questions regarding aquatic restoration throughout the state. These maps can help identify areas that require current and future restoration in Utah.

Tim Beach, Utah State University, 5200 Old Main Hill, Logan, UT, 84322, USA, Phone: 435-994-4474, tim.beach@aggiemail.usu.edu

Addressing the Legacy Effect of Low Large Woody Debris Volumes in Wadeable Streams: HDLWD, a Low Impact, Inexpensive Approach

Stephen N. Bennett, Joseph Wheaton, Reid Camp, Watershed Sciences Department, Utah State University, Logan, Utah, and Nick Bouwes, Eco Logical Research Inc., Providence, Utah

A common assessment of many Pacific Northwest streams is that they have low instream complexity due to reduced large woody debris (LWD) and degraded riparian areas. A traditional approach to addressing this problem has been to use heavy machinery to install expensive LWD structures (> $50-100/m) that are engineered to be stable. In contrast, we are testing a hand-based approach called high density large woody debris (HDLWD) for adding LWD in high densities (e.g., 20-50 m between structures) that is inexpensive (< $5-10/m), and can be built with minimal disturbance to recovering riparian areas. We use a hydraulic post driver to drive 4-6 cm diameter x 1.5 m long, non-treated, wooden fence posts into the stream bottom and banks to secure hand-placed LWD in place. In contrast to many traditional engineered structures, we expect LWD to remain on these structures for 1-5 years, making them dynamic by design. We have built almost 550 structures covering 12 km in wadeable streams within an Intensively Monitored Watershed in southeast Washington. We developed a set of a priori hypotheses about the hydraulic and geomorphic responses the HDLWD would create and are testing these with a variety of survey methods including topographic surveys and rapid habitat surveys. We are still assessing the long-term effectiveness of the structures but we have already observed many of our hypothesized responses including: the creation of eddy pools, scour pools, undercut banks, a variety of bar types, and wood movement and trapping by the structures. After two spring flow events (2013 and 2014) 92% of the structures are remaining. The HDLWD method appears to provide an inexpensive, highly

adaptable, and low impact method for addressing the legacy deficit of LWD in many small to medium sized streams until riparian areas fully recover.

Stephen N. Bennett, Watershed Sciences Department, Utah State University, 5210 Old Main Hill, Logan, UT, 84322-5210. 435-757-5668. Bennett.ecological@gmail.com

Determining the Effectiveness of Best Management Practices to Reduce Nutrient Loading from Cattle Grazed Pastures in Utah
Nicki Devanny, Nancy Mesner, and Dr. Niel Allen, Utah State University, Logan, Utah

The Utah Statewide Nonpoint Source Management Plan includes a list of recommended best management practices (BMPs) to reduce nonpoint source runoff pollution. These BMPs consist of management techniques and structural landscape designs for a variety of land uses. Here in Utah there is a lack of local data documenting the effects of agricultural BMPs to reduce nutrient runoff at a field scale. In this study, I evaluate structural BMPs designed specifically to reduce nitrogen and phosphorus levels from cattle grazing areas. Using a Before After Control Impact (BACI) design, I am collecting instream, surface, and groundwater samples to measure changes in nutrient loads resulting from a suite of BMPs implemented at a cattle grazing operation in Wallsburg, UT. 'Before' sampling began in April 2014 and occurred every other week through August 2014, BMPs are being implemented in September 2014, and then 'after' sampling will be conducted every other week from April 2015 to August 2015. I am running chemical analyses on the water samples for total phosphorus, dissolved total phosphorus, soluble reactive phosphorus, total nitrogen, dissolved total nitrogen, nitrate/nitrite, and ammonium. The results will be used towards development of locally relevant loading coefficients for theses various forms of nutrients, and also assess the success of BMPs in the intermountain west climate of Utah.
Using the collected site data, I am also building a field scale, process-based model using the Soil and Water Analysis Tool (SWAT). This model will be used to determine nutrient loading coefficients for other sites within the Main Creek watershed, and also to verify nutrient loading reductions estimated in the Deer Creek Reservoir Total Maximum Daily Load (TMDL) study.

Nicki Devanny, Utah State University, 5210 Old Main Hill, Logan, UT 84322, Phone: 435-797-2580, Email: njdevanny@gmail.com

Filling an Important Data Gap: Valley Bottom Mapping, Riparian Condition Assessment and Geomorphic River Classification of the Colorado Plateau Ecoregion
Martha L. Jensen, William W. Macfarlane, Joseph M. Wheaton, Phaedra Budy, Department of Watershed Sciences, Utah State University, Logan, UT and Justin Jimenez, BLM Utah State Office, Salt Lake City, UT

Riparian areas of the Colorado Plateau Ecoregion (CPE) are among the most productive and diverse ecosystems present in this semiarid region. These small but vital ecosystems support a myriad of aquatic and terrestrial species while simultaneously providing valuable ecosystem services. Maintenance of these important ecosystems requires accurate delineation and characterization. Nevertheless, accurate and comprehensive riparian zone mapping currently does not exist. This project aims to accurately delineate valley bottoms, while characterizing riparian areas and rivers throughout the CPE. The resulting valley bottom mapping, riparian area delineation, riparian condition assessment, and geomorphic river classifications will provide a comprehensive CPE-wide inventory of the distribution and condition of riverine riparian areas. This riparian inventory will serve as an important baseline tool for threat abatement, and for monitoring ecological responses to natural

and anthropogenic actions and change.

Martha L. Jensen, Department of Watershed Sciences, 5210 Old Main Hill, Utah State University, Logan, UT 84322-5210, 435-512-4678, martaljensen@gmail.com

Rapid Stream Riparian Assessment Protocol: A New Approach to Assessing Riparian Habitat

Allison L. Jones, Wild Utah Project, Salt lake City, Utah and Peter B. Stacey, University of New Mexico, Albuquerque, New Mexico

A recent collaboration of regional scientists developed and field-tested a new ecological health assessment tool that is relevant to most of the lower elevation stream and riparian habitat of the intermountain West. The Rapid Stream-Riparian Assessment Protocol determines health and function of lower elevation stream reaches and larger river tributaries, by rapidly evaluating the current health of streams and adjacent riparian areas. The method uses a series of simple but scientifically-based indicators to measure how much the stream system differs from what would be expected under unaltered (reference) conditions. This method utilizes a whole ecosystem approach, and considers water quality, fluvial geomorphology, condition of the aquatic habitat for fish and invertebrates, structure and productivity of terrestrial vegetation, and quality of wildlife habitat. Because it is based upon quantitative measures and can be completed by trained personnel and volunteers in a short time, RSRA can be used to survey numerous reaches throughout an entire watershed, as well as to monitor the effectiveness of restoration programs at both the local project and watershed levels.   This method therefore provides the opportunity to populate the RSRA on-line database, built for this purpose, that will not only allow us to determine and rank which systems are in the worst condition, but it also will allow us to measure over time the success of restoration efforts. This poster presentation will report on Citizen-based stream monitoring, using this new protocol, which is underway in various parts of the Colorado Plateau, and the implications for stream restoration efforts.

Allison Jones, Wild Utah Project, 824 South 400 West, Suite B-117, Salt Lake City, UT 84101, USA, Phone: 801-328-3550, Email: allison@wildutahproject.org

Comparing Channel Classification Frameworks to Better Inform Watershed Management
Alan Kasprak[1], Nate Hough-Snee[1,2], Reid Camp[1], Tim Beechie[3], Gary Brierley[4], Martha L. Jensen[1], Joseph M. Wheaton[1,2], Hiroo Imaki[2], and Gary O'Brien[1]

1. Department of Watershed Sciences, Utah State University, Logan, Utah, 84322-5210, USA
2. Ecology Center, Utah State University, Logan, Utah, 84322-5210, USA
3. Watershed Program, Fish Ecology Division, Northwest Fisheries Science Center, NOAA Fisheries, Seattle, Washington, 98112, USA
4. School of Environment, University of Auckland, Auckland, New Zealand

Channel classification frameworks provide a means for understanding the distribution of channel types across a watershed and drawing linkages between the geomorphic form of a river and the processes acting to shape the channel. Moreover, classification is frequently employed by watershed managers to distinguish natural and altered streams and set restoration priorities for the latter. In classifying channels, watershed managers have a large number of potential frameworks to choose from; yet there is little information about which frameworks perform best at various scales, and perhaps more importantly, how consistent the results of classification are

between frameworks. Here we apply four classification methods across a physiographically-diverse basin in the interior Columbia River Watershed. We compare the results of Natural Channel Design classification, the River Styles Framework, a semi-automated machine learning classification termed Natural Channel Classification, and a statistical clustering classification. We find moderate agreement between Natural Channel Classification and Natural Channel Design, likely in part due to their use of reach-scale channel planform as a driving variable in classification. There is less agreement between these two metrics and the River Styles Framework, likely an effect of River Styles lending more weight to broader, valley-scale confinement as a driving classification variable. We also examine the relative effort and level of expertise necessary to complete each classification and note that where classification results differ, inferences about channel departure from natural conditions can be drawn. The results of this work will allow watershed managers to better choose and employ channel classification, along with providing an improved understanding of classification results in prioritizing channel restoration.

Alan Kasprak, Graduate Research Assistant, Department of Watershed Sciences, 5210 Old Main Hill Logan, UT, 84322-5210, USA, phone: 508.320.1186, akasprak@aggiemail.usu.edu

Mid-channel Bar Maintenance on Gravel Bed Rivers with Large Fine Sediment Loads
Rebecca B. Manners, University of Montana, Missoula, Montana, and John C. Schmidt, Utah State University, Logan, Utah

In the western US, climate change, water development, and the encroachment of non-native species during the past century contributed to changes in channel morphology. Reaches with mid-channel bars or islands narrowed and simplified first, and to a greater degree than other settings on gravel bed rivers with large fine sediment loads. Maintenance of mid-channel bars, and their associated secondary channels on these rivers, requires regular transport of the fine sediment load through the reach. A reduction in the transport capacity, resulting from reduced flows or the expansion of vegetation, for example, results in the accumulation of fine sediment and inevitably leads to secondary channel abandonment (i.e., channel narrowing). Working in the Yampa Canyon in western Colorado, we identify the mechanisms that maintain, or conversely degrade, the mid-channel bar and secondary channel by maintaining (or not) the throughput of fine sediment. A novel observation-based model built from repeat LiDAR and a 2D hydraulic model of three recent flood events, applied to historical topographic, vegetation, and hydrologic conditions, provides a robust series of observations on the processes by which a secondary channel narrowed and filled in with fine sediment during the past 50 years. The streamwise location of the bifurcation point at the upstream end of the bar where the flow divides dictated the relationship between flood magnitude and fine sediment accumulation or evacuation. The elevation and roughness (i.e., vegetation coverage and density) of the mid-channel bar determined the location of the bifurcation during floods with a different recurrence. When the mid-channel bar was low, with little vegetation, floods with a two-year recurrence or less could evacuate fine sediment from the area. As vegetation established and the fine sediment on the mid-channel bar grew vertically and laterally, the bifurcation location for the two-year flood was pushed further upstream. Reduced momentum across the bar resulted in fine sediment deposition, not erosion. As a result, it took larger and larger floods to evacuate fine sediment. Therefore, fine sediment became a more permanent feature across a larger part of the bar, supporting greater new vegetation recruitment. Increasing cyclicity of large and small floods in the latter half of the study period also promoted plant establishment. Fine sediment deposition occurs over a wider range of flows within vegetation than outside. Synthesizing our robust historical reconstruction and observations from other multi-thread settings in the Yampa Canyon, we build a conceptual model of mid-channel bar maintenance that identifies aspects of the flood regime based on valley geometry and channel morphology

necessary to maintain multiple channels. This model furthers our fundamental understanding of the multi-thread planform and may more efficiently guide the management of rivers.

Rebecca B. Manners, University of Montana, Department of Geosciences, 32 Campus Drive #1296, Missoula, MT 59812, Phone: 813-240-6382, Email: Rebecca.Manners@umontana.edu

A Preliminary Traits Database for Southwest Riparian Plant Species: Information for Modeling, Monitoring, Research, and Restoration

Emily Palmquist[1], David Merritt[2], Daniel Sarr[1], and Barbara Ralston[1]
1: US Geological Survey, Southwest Biological Science Center, Grand Canyon Monitoring and Research Center, Flagstaff, Arizona
2: US Forest Service, Watershed, Fish, Wildlife, Air, and Rare Plants, Fort Collins, Colorado

Riparian plant species distributions are largely shaped by their ability to withstand, avoid, or take advantage of fluvial processes and the strong environmental gradients they create. All research on and management of riparian ecosystems benefits from quantitative information about the physiological and morphological traits of riparian plants that control where on the riparian landscape each species can exist. Although the USDA PLANTS database contains information on many species, there are information gaps for common western riparian species, such as Tamarix spp., Baccharis emoryi, Equisetum hymale, Pluchea sericea, and Prosopis glandulosa, as well as less common, but important, components of the riparian flora such as Baccharis sergiloides, Schoenoplectus americanus, Isocoma acradenia, and Alhagi maurorum. Additionally, PLANTS does not include all traits that are useful for managing riparian ecosystems, such a species ability to reproduce vegetatively, maximum rooting depth, and phenology. These information gaps hinder efficient and effective research, modeling, and restoration of major river systems in the west, including the Colorado River through Grand Canyon.

In order to address these data gaps, we have compiled a traits database for plant species recorded along the Colorado River through Grand Canyon during riparian sampling in 2012 and 2013. We utilized information available on the PLANTS database, in published literature, and in reports.   When published traits information did not exist, we consulted with regional riparian botanists to gain their professional judgment of traits values. We started with over 20 traits and then analyzed our traits dataset for colinearity and redundancy, resulting in a final dataset of nine physiological and morphological traits for each of 114 southwestern riparian plant species. We selected traits we considered important to growth in an aridland riparian environment subject to river regulations, but that are applicable to many riparian areas throughout the West: anaerobic tolerance, drought tolerance, salinity tolerance, shade tolerance, bloom period, height at maturity, minimum root depth, ability to reproduce vegetatively, and seed size. These data can be used to inform vegetation response models, plan restoration projects, conduct research on patterns and distributions of species traits within a riparian system, and more. The database will continue to be modified and updated as more quantitative data become available and as new species are added. Currently, published quantitative data are limited for many species, so expert opinion has been used to fill in some gaps. Ideally, the information from experts will be confirmed or replaced by quantitative data in the future. Ultimately, we intend for this database to be a public resource.

Emily Palmquist, US Geological Survey, Southwest Biological Science Center, Grand Canyon Monitoring and Research Center, 2255 N. Gemini Dr., Flagstaff, AZ, 86001, USA. 928.556.7393, epalmquist@usgs.gov

20-Year Trends for Riparian Birds in Utah

Theresa L. Pope, Utah Division of Wildlife Resources, Springville, Utah

Riparian systems make up < 1% of land area in Utah, but riparian systems are arguably the habitat in greatest conservation need. Over 70% of Utah's birds use riparian habitat, yet little was known about population status and trends of these species when Utah DWR initiated a 20-year riparian monitoring project. To get baseline data and evaluate trends, Utah DWR conducted point counts at 37 riparian sites across Utah from 1992 to 2011. I estimated statewide density of 38 species for each year of the study using the Conventional Distance Sampling and Multiple Covariate Distance Sampling (MCDS) engines in DISTANCE. We estimated trends using a Bayesian framework that provides estimated probability of a 25% change in density over 25 years. The variable affecting detection that appeared most often in the best-supported MCDS models was 'Year.' Yellow warbler (*Setophaga petechia*) had the greatest density with 4.5/ha (95% CI: 4.3 - 4.6), followed by Spotted Towhee (*Pipilo maculatus*) with 1.6ha (95% CI: 1.6 - 1.7) and Warbling Vireo (*Vireo gilvus*) with 1.6/ha (95% CI: 1.6 - 1.7). Although there were annual fluctuations in density, Bayesian trend analyses indicated only 4 species had strong ($0.7 < P < 0.9$) or very strong ($P \geq 0.9$) evidence of a 25% decline over 25 years; whereas 9 species had evidence of an increasing trend. Species with declining trends were Black-billed Magpie (*Pica hudsonia*), American Goldfinch (*Spinus tristis*), American Robin (*Turdus migratorius*), and House Wren (*Troglodytes aedon*). These trends were generally consistent with Breeding Bird Survey trends for Utah during the same time period. It is encouraging that riparian bird populations in Utah are not declining at alarming rates. Nonetheless, protecting and restoring riparian systems remains important for keeping population trends steady in the face of drought, fire, exotic species, and human activity, all of which may be exacerbated by climate change.

Terri Pope, UDWR, 1115 N Main, Springville, UT, 84663, USA, 385-321-3289, tpope@utah.gov

Partnering With Beaver in River Restoration: Case Studies from Oregon and Utah
Elijah Portugal: Fluvial Habitat Center, Watershed Sciences Department, Utah State University, Logan Utah Nate Hough-Snee: Watershed Sciences Department, Utah State University, Logan, Utah, Kent Sorenson: Habitat division, Utah Division of Wildlife Resources, Ogden, Utah, Andrea Karoglanian: Wildlife Division, Confederated Tribes of Warm Springs, Warm Springs, Oregon, Joe Wheaton: Watershed Sciences Department, Utah State University, Logan, Utah, Nick Bouwes: Eco Logical Research Inc., Providence, Utah

Increasingly, the river restoration community recognizes the important role that North American beaver (*Castor Canadensis*) historically and currently play in structuring and maintaining riverine ecosystems. Because of this, restoration practioners and river scientists are, "partnering with beaver" in river rehabilitation and restoration projects throughout the west. Essentially, the natural dam building activities of beaver increase instream geomorphic complexity and increase and enhance floodplain connectivity which supports a productive and healthy riparian community. By mimicking and supporting the dam building activities of beaver, restoration practioners seek to speed the rate of geomorphic recovery of degraded rivers, particularly rivers that are currently in an incised condition. Here we showcase two case studies from eastern Oregon and northern Utah to provide examples of collaborative river restoration projects that utilize beaver. Emphasis is placed on the geomorphic and hydrologic assessments used to inform restoration design, monitoring and implementation.

Elijah Portugal: Fluvial Habitat Center, Watershed Sciences Department, Utah State University: 5210 Old Main Hill, NR 210 Logan, UT 84322-5210, elijahwp@gmail.com

Developing Riparian Ecological Site Descriptions
Sarah Quistberg, Rangeland Management Specialist, USDA-Natural Resources Conservation Service, Ogden,

Utah

Riparian complexes have largely been neglected in the development of ecological site descriptions. Recent development by the NRCS of the "Lotic Riparian Complex Ecological Site Descriptions: Guidelines for Development" and an interagency riparian work group sponsored by the NRCS has renewed interest in developing ecological sites for riparian complexes. The task of describing riparian corridors has been undertaken by different agencies over several decades. NRCS is bringing together past work and utilizing it to create ecological site descriptions and state and transition models that describe the complexity and resiliency of riparian corridors. Information will be presented on riparian ecological sites developed in Utah.

Sarah Quistberg, USDA-NRCS, 2871 S Commerce Way, Ogden, UT, 84401, 801-629-0575, sarah.quistberg@ut.usda.gov

Describing Post-wildfire Geomorphic Response Using the River Styles Framework
Keelin R. Schaffrath and Patrick Belmont, Utah State University, Logan, Utah

Wildfires have profound, highly variable impacts on erosion, sediment transport, and stream channel morphology. Climate change and fuel management actions have altered the current fire regime relative to the historic fire regime. The Twitchell Canyon fire burned 45,000 acres in Fishlake National Forest, near the town of Beaver, UT in July 2010. Over 30% of the area burned at high severity and monsoonal thunderstorms in the summer of 2011 resulted in massive debris flows and sheetflow erosion that have potentially altered the main stream channels in the burned area. We present the results of a reach-scale geomorphic analysis for pre- and post-fire conditions, based on the River Styles classification framework. Pre-fire classifications indicate that most channels are variable sinuosity with continuous floodplain. Post-fire classifications indicate a massive influx of sediment with a shift in River Styles classifications to accommodate that sediment. We have also calculated the probability and volume of post-fire debris flows that may be acting either as sources of sediment or barriers to sediment flux. Both models consider slope, percent of basin burned at high severity, average intensity of a defined thunderstorm, and generalized soil properties (% clay content and organic matter). Evidence of debris flow activity was observed in the two main creeks that we present (Shingle and Fish Creeks) and the model predicted high probability of debris flows for all of the sub-basins in each watershed. We have not verified models results for volume estimations but we use those volumes as relative measures of the size of barrier that a debris flow may have created in the main channels of Fish and Shingle Creeks, where a barrier refers to a barrier to sediment and movement or streamflow. We use the barriers to explain the observed changes to the River Styles classifications.

Department of Watershed Science, 5210 Old Main Hill, Utah State University, Logan, UT 84322-5210, USA, Phone: 970-988-8323, keelin@aggiemail.usu.edu

Assessing Ungulates' Role in Riparian Hummocking on Three National Forests in Southern Utah
Collin Smith, Whitman College (Geology-Environmental Studies), Walla Walla, Washington

Very little research has been conducted on the role of ungulates in the development of hummocks. This survey evaluates over twenty-five hummocked and non-hummocked wet meadows and riparian areas on the Dixie, Fishlake and Manti-La Sal National Forests in southern Utah. The survey explores the variability in location, morphology, and vegetation communities of hummocked areas in order to better understand the mechanisms of formation at play. A better understanding of hummock formation, exacerbation and decay

will better direct how federal land managers approach wetland protection and mitigation. The study outlines types of hummocks observed on the forests. It then identifies indicators that a hummocked area is formed or exacerbated by ungulates. Indicators of ungulate influence include truncation of soil horizons, elongated and serpentine-shaped hummocks, and shearing on the sides of hummocks,. The lack of suitable ungrazed reference areas compounds the difficulty of determining ungulate impact, however the study uses locations where exclosures or lighter grazing regimes present different hummock morphology.

Collin Smith, Whitman College, 280 Boyer Avenue, Walla Walla, WA 99362, (352) 672-0541, smithcw@ whitman.edu

Mobile Photo Monitoring: Crowdsourcing for Riparian Restoration
Nancy Mesner, Brian Greene, *Eric Sodja*, Utah State University Water Quality Extension, Logan, Utah

Riparian ecosystems are a vital part of watershed health, but monitoring of restoration projects in riparian corridors is often lacking because of poor record keeping and missing data. One of the most common forms of restoration monitoring is the collection of photo-points, yet critical metadata is often not collected or properly stored with the photo. Both professionals monitoring Best Management Practices and citizen scientists engaged in monitoring need a way to efficiently and effectively collect, store, and share accurate photo point monitoring records. The USU Water Quality Extension's "Utah Water Watch" program has developed an app to allow photo-point monitoring of riparian ecosystems by professionals and volunteers across the state. This app allows streamlined and consistent monitoring of riparian areas with minimal training using a familiar smartphone interface. This not only increases the completeness of the records, but increases the number of people who can accurately conduct photo point monitoring.
The app includes inputs for date, time, location, comments, and photographs / videos (both up- and down-stream) linked to cardinal directions and geo-referenced position. These data can be uploaded to a server database managed by USU Water Quality Extension, and then made available to professionals looking for information about specific watersheds or restoration projects. The images can be used to identify locations where processes of interest are occurring such as reestablishment of stream bank vegetation, erosion, or channel alteration. These complete records of photo point monitoring with the associated metadata can serve as critical benchmarks for researchers and resource management professionals evaluating the success of restoration projects.

Eric Sodja, Utah State University Water Quality Extension, 5210 Old Main Hill, Logan, UT 84322-5210, 801-678-9873, e.sodja816@gmail.com

Matching Watershed and Otolith Microchemistry to Establish Natal Origins of an Endangered Lake Sucker
Paedra Budy USGS – UCFWRU, USU- Dept. of Watershed Sciences, Utah and *Deanna Strohm*, Graduate Research Assistant, USU-Dept. of Watershed Sciences, Utah

Anthropogenic changes to the landscape, such as stream fragmentation, revised flow regimes, channelization, sediment loading, and introduced non-native species, have resulted in high rates of decline in freshwater species. Many desert species, such as the June sucker (*Chasmistes liorus*), are currently listed as endangered. Managers have increasingly turned to habitat restoration as a key component to recovery plans. For endangered species, one of the primary outcomes of habitat restoration is that it should result in successful reproduction and recruitment of individuals into the adult population. The June sucker is potamodromous, demonstrating migrations from a lake habitat, Utah Lake, UT, into degraded tributary habitats to spawn.

Confirmation of natural recruitment as a function of habitat restoration can only be achieved by establishing natal origins.

Recent research has proven the validity of otolith microchemistry, a technique that analyzes small quantities of elements, to trace potamodromous fish to their natal tributaries. Previous studies have documented that localized habitats in terms of microchemistry are reflected in otolith composition, thereby potentially making this a valuable way of determining fish origins. The primary goal of this study is to use otolith microchemistry to establish natal origins of June sucker. To accomplish this we will first quantify the chemical signatures among tributary spawning habitats. Second, determine if the otolith microchemistry signatures from June sucker otoliths can be used to determine natal origins. Lastly, we will develop a statistical model that is capable of classifying fish to their respective tributary based the element:calcium ratios in the otolith microchemistry.

The data obtained from this study will advance the current understanding of the June sucker recruitment dynamics and result in a fundamental improvement in our ability to determine where natural recruitment into the adult spawning population is occurring. In addition, this knowledge may help evaluate factors limiting recruitment in Utah Lake tributaries, identify future restoration localities, and assist effectiveness monitoring of spawning habitat restoration efforts.

Deanna Strohm, Utah State University, 158 BNR, Logan, UT, (248) 762-0290, strohmde@gmail.com

Nathaniel Todea, State Hydraulic Engineer, *Casey Burns,* State Biologist, Natural Resources Conservation Service, Salt Lake City, Utah

A rapid assessment of a 214 mile portion of the Sevier River in Utah was completed in 2009-2010. Aerial photo interpretation, remote sensing data, hydraulic models, and bankfull estimates were used to document stream characteristics and function using the Stream Visual Assessment Protocol (SVAP2) and Proper Functioning Condition (PFC) methodology. Predictions of Rosgen's stream classification and valley types using Interferometric Synthetic Aperture Radar (IFSAR) data were used with field verification and stream gage analysis. Stream order was a useful analysis tool to view the dynamics of the stream when large uncontrolled tributaries enter the system. Treatment priorities were derived from proper functioning condition ratings, trend, and geographic location. The use of geomorphic indices predicted through remote sensing, hydraulic modeling, and ecologic factors saved time and allowed this comprehensive large scale stream assessment to be completed with limited resources. The assessment provided alternative conservation practices including fencing and watering facility, brush management (tamarisk removal), streambank protection (revetments and willow plantings), riparian herbaceous cover (direct seed), wetland restoration (earthwork connectivity,), and wetland creation (dike setback, streambank). The total cost for installation of all the proposed practices is estimated to be 76 million dollars.

Nathaniel Todea, State Hydraulic Engineer, NRCS, Salt Lake City, UT, 801-524-4573, nathaniel.todea@ut.usda.gov

Streamflow Data and its Application to Understanding an Evolving Flow Regime on the Green River
Alex Walker, Jack Schmidt, Peter Wilcock, Watershed Resources Department, Utah State University, Logan, Utah

Since 1895, stream flow data has been collected at Green River, UT by the USGS. Complementary

data such as total yearly flows and streamflow reconstructions are also available for this site. We present a synthesis and analysis of these datasets to describe the changing annual flow in the Green River over the last century, showing the effects of climatic cycling and anthropogenic influences on the frequency, magnitude and timing of flows in the Green River. Limits to the use of gage data exist, particularly spatially. To combat this, streamflow data from the San Rafael River (a tributary) was analyzed for an assessment of its contribution to flows. Significant decreases in the magnitude of peak flows have been observed on the Green River during the 20th century. Installation of Flaming Gorge Dam does appear to have limited peak flows from the Green River, though within a greater climatic shift. Implementation of releases from the dam under the Endangered Species Act beginning in 1985 did not reverse the trend of decreasing peak flows since 1900.

Alex Walker, Department of Watershed Sciences, 5210 Old Main Hill, Utah State University, Logan, UT 84322-5210, USA, 425-367-9270, alexander@aggiemail.usu.edu

Revegetation Following Channel Restoration in Cobble-Bed Stream Systems: Riparian Research on The Encampment River, Carbon County, Wyoming
Randy Walsh, Stantec Consulting, Fort Collins, Colorado, and Christina Barrineau, Wyoming Game and Fish Department, Laramie, Wyoming

The geomorphology of a river valley and characteristics of a river channel influence the frequency, duration, and intensity of flooding. Periodic flooding and bank inundation influences the size and structure of the stream channel and the characteristics of the riparian vegetation. Land use changes within many watersheds – including drainages of the Upper Platte Valley of southern Wyoming - have resulted in river systems that exhibit reduced dynamics, simplified gradients, and disconnected landscape components. A primary goal of ecological river restoration is to assist in the recovery of degraded stream systems by strengthening the hydrological, geomorphological, and ecological processes that sustain their integrity and resilience while working to achieve the desired future conditions defined for the landscape.

The Wyoming Game & Fish Department (WGFD), Trout Unlimited (TU) and the Saratoga-Encampment-Rawlins Conservation District (SERCD) have invested significant resources restoring, enhancing, and improving the Encampment River, its fishery, and the greater watershed. While restoration projects have been successful in meeting many important objectives, revegetation efforts along the constructed reaches has proven difficult due to the coarse cobble substrate native to the system. In addition, constructed banks retain very few fine sediments, as these tend to migrate when the substrate is moved and graded. In response to these challenges, a research project was initiated in 2013 which examines methods and materials to improve riparian revegetation along constructed reaches, and to evaluate both ecological and geomorphological responses to these revegetation efforts. This presentation will discuss this ongoing research effort, present preliminary results, and discuss the applicability of these findings to similar systems in the Intermountain West.

Randy Walsh, Stantec Consulting, 2950 E. Harmony Rd., Suite 290, Fort Collins, CO 80528, USA, 970-449-8626, randy.walsh@stantec.com
Christina Barrineau, Wyoming Game and Fish Department, 528 S. Adams St., Laramie, WY 82070, USA, 307-745-5180, christina.barrineau@wyo.gov

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