

2017 Upper Colorado River Basin Water Forum: Stories from the Field
Program with Abstracts and Biographies

November 1

8:00 Welcome

Cynthia Pemberton, Vice President for Academic Affairs, Colorado Mesa University

8:15 DAY 1 KEYNOTE ADDRESS

Brian Richter, President, Sustainable Waters

Abstract

Chasing Water in a Rapidly Changing World

During recent decades, the farming and urban communities dependent upon the waters of the Colorado River Basin have been confronted with the hard limits of their available and affordable water supplies. Present levels of use, and their impacts on river ecosystems throughout the basin, cannot be sustained, forcing the basin's dependents to consider new pathways toward sustainability. The CRB's communities are not alone in this challenge of water scarcity; shortages are now occurring in one-third of all river basins globally, affecting half of the world's population and three-quarters of all irrigated farms. Fortunately, there are many success stories that illustrate the opportunities for securing a more sustainable water future. Moving to new policies and practices will not be quick nor easy, but this presentation will highlight the evidence and stories that can guide our way forward.

Biography

Brian Richter has been a global leader in water science and conservation for more than 30 years. He is the president of Sustainable Waters, a global water education organization, where he promotes sustainable water use and management with governments, corporations, universities, and local communities. He previously served as Chief Scientist for the Global Water Program of The Nature Conservancy, an international conservation organization. Brian has consulted on more than 150 water projects worldwide. He serves as a water advisor to some of the world's largest corporations, investment banks, and the United Nations, and has testified before the U.S. Congress on multiple occasions. He also teaches a course on Water Sustainability at the University of Virginia.

Brian has developed numerous scientific tools and methods to support river protection and restoration efforts, including the *Indicators of Hydrologic Alteration* software that is being used by water managers and scientists worldwide. Brian was featured in a BBC documentary with David Attenborough on "How Many People Can Live on Planet Earth?" He has published many scientific papers on the importance of ecologically sustainable water management in international science journals; the impact rating of his peer-reviewed journal papers places him within the top 10% of all scientists worldwide. He co-authored a book with Sandra Postel entitled *Rivers for Life: Managing Water for People and Nature*. His latest book, *Chasing Water: A Guide for Moving from Scarcity to Sustainability*, has now been published in six languages.

9:15 Building a Better Understanding of Snow and Water Supply

Moderator: Aldis Strautins, National Weather Service

Biography

Aldis Strautins is the Service Hydrologist at the National Weather Service (NWS) office in Grand Junction, CO. As service hydrologist he provides leadership and management for the hydrology program including: hydrologic forecast and warning operations, service coordination and interagency support for eastern Utah and western Colorado. He also serves on NWS regional and national teams providing expertise for policy and software development. Aldis has been with the National Weather Service for 17 years.

Previous to the NWS he worked with a consortium of underground water districts in West Texas. Born and raised in Colorado, Aldis enjoys the many recreational opportunities water brings to the region.

Edward Kim, NASA Goddard Space Flight Center

Abstract

Stories from the Field: NASA's SnowEx Campaign in the Upper Colorado

Edward Kim¹, Charles Gatebe^{1,2}, Dorothy Hall^{1,3}, Jerry Newlin⁴, Amy Misakonis¹¹, Kelly Elders⁵, Hans Peter Marshall⁶, Chris Hiemstra⁷, Ludovic Brucker^{1,2}, Chris Crawford⁸, Do Hyuk Kang^{1,3}, Eugenia De Marco^{1,4}, Matt Beckley^{1,9}, Jared Entin¹⁰, and the SnowEx Team

¹NASA Goddard Space Flight Center, ²Univ. Space Research Assoc., ³Univ. of Maryland, ⁴ATA Aerospace, ⁵US Forest Service, ⁶Boise State Univ., ⁷Army Corp of Engineers/CRREL, ⁸US Geological Survey, ⁹SGT, ¹⁰NASA Headquarters, ¹¹Aerospace Corp.

Seasonal snow on earth is critically important globally for management of water resources, natural hazards, water security, and weather applications. The only practical way to observe the quantity of snow on a global scale is through satellites—i.e., a snow satellite mission. Yet, current techniques underestimate snow water equivalent (SWE) by as much as 50%, and model-based estimates have their own list of issues. Confounding these is the fact that forests hinder SWE measurement for as much as half of snow-covered terrestrial areas. So, understanding forest effects on snow observing is important for planning a future snow satellite mission. The consensus in the snow remote sensing community is that a multi-sensor approach is needed (combined with modeling to fill the gaps in space and time) because no single type of sensor is ideal under all conditions. What remains, then, is how best to combine and use the various sensors and models under different types of snow conditions and confounding factors.

NASA's SnowEx airborne campaign is designed to collect the measurements needed to determine the best combination of sensors and models to observe global snow. Year 1 (2016-17) focused on the distribution of snow-water equivalent (SWE) and the snow energy balance in a forested environment. The Year 1 sites were Grand Mesa and the Senator Beck Basin, both in the Upper Colorado River Basin.

This paper will describe the SnowEx Year 1 campaign, particularly the Feb 2017 deployment. Ground-based remote sensing and in situ data collection involved nearly 100 participants over three weeks, while the airborne campaign included nine sensors on five aircraft. The reasons for selecting these sites, the surprises provided by Mother Nature, and how we attempted to adjust, will be discussed.

Biography

Edward Kim received degrees in electrical engineering from MIT, and a joint electrical engineering and atmospheric sciences PhD from the University of Michigan in 1998. Since 1999, he has been with NASA's Goddard Space Flight Center, working on airborne and satellite remote-sensing of snow, soil moisture, and frozen soil, including multiple field campaigns in North America and Australia. He is the Project Scientist for NASA's SnowEx year1 airborne campaign, which focused on sites in western Colorado.

Abstract

Assessing the robustness of spring snowpack as a drought indicator in the Upper Colorado River Basin under future climate change

Ben Livneh^{1,2}, Andrew Badger², Jeff Lukas²

¹*Department of Civil, Environmental, and Architectural Engineering, University of Colorado, Boulder, CO, USA*

²*Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO, USA*

The Upper Colorado River Basin, like most of the West, has a snowmelt-dominated hydrology, with about 70-80% of the annual flow deriving from snow. Snow-water equivalent (SWE) at key dates during the year (e.g., April 1) is widely used in water resource planning because it is often the highest observed monthly value during the season. Among different types of drought indicators, snowpack data has been identified as the most useful and reliable drought indicator by regional water stakeholders. However, climate change is expected to cause more precipitation to fall as rain vs. snow, lower peak SWE values, and earlier snowmelt and peak runoff. Accordingly, the spring snowpack may not be as robust an indicator of water supply and drought in the future.

This issue becomes particularly acute in the Upper Colorado River Basin, where water demand is expected to increase significantly, with the additional demand coming mainly from municipal and industrial uses. This presentation will address the question: *How are the key indicators of drought in the Upper Colorado River Basin likely to change under a changing climate?*

We will assess the performance of the commonly-used snowpack-based drought indicators for water management decisions. Hydrologic simulations from climate projection models will be used to examine how a warming climate will affect the robustness of these drought indicators by mid-century using three metrics: hit/miss frequency, severity, and persistence.

1) What we were trying to do:

First, establish historical power of snowpack to predict streamflow. Second, to validate a historical model of this, and third, to apply the model to the future to understand how snow may diminish in its predictive power.

2) Something unexpected:

At this stage things are entirely complete. However, it seems like snowpack will retain more of its predictive power under future, warmer climate by mid-century, than expected.

3) What you learned about what happened:

So far, we've learned that future hydrology shows a higher frequency of drought conditions relative to present day drought thresholds. Further, we see with increased inter-annual variability in snowpacks that will lead to tougher decisions for water managers to make on a year-to-year basis.

Biography

Ben received his first 2 engineering degrees in at the University of Western Ontario (Canada), before earning his PhD in Civil Engineering with an emphasis on Hydrology at the University of Washington, which involved merging two land modeling paradigms that resulted in developing a Unified Land Model for the simulation of regional hydrology and landatmosphere interaction.

Following his PhD he published a widely-used hydrometeorological data set consisting of nearly 100 years of daily station observations of precipitation and temperature interpolated to a regular grid, in addition to accompanying hydrologic simulations of important states and fluxes.

Ben joined the Civil Engineering faculty at the University of Colorado in 2015 where he leads a research group that addresses a wide range of physical hydrology problems with major research themes including physically-based hydrologic model development, continental-scale hydrometeorological dataset development, land-cover/land-use change, and snow hydrology. Ben is a co-PI of the Western Water Assessment, he is a Fellow of the University of Colorado Cooperative Institute for Research in Environmental Sciences (CIRES), and holds an affiliation in the Atmospheric and Oceanic Sciences department.

10:00 Historical Perspective: How did first generation Colorado River negotiators understand hydrology?

Eric Kuhn, Colorado River District

Biography

Eric Kuhn is the General Manager of the Colorado River District, a position he has held since 1996. He earned his Bachelor's Degree in Engineering from the University of New Mexico and a Master's Degree in Business Administration from Pepperdine University in California. Prior to working for the Colorado River District, he served as an engineer officer aboard nuclear submarines in the U.S. Navy and worked as a nuclear start-up engineer for Bechtel Power Corp.

Eric started employment with the Colorado River District in 1981 as Assistant Secretary-Engineer. He has served on the Engineering Advisory Committee of the Upper Colorado River Compact Commission since 1981.

From 1994 through 2001, he served on the Colorado Water Conservation Board representing the Colorado River mainstem. In 2006, Eric was appointed by Governor Owens as an at-large representative on the Colorado Interbasin Compact Committee, a position he continues to hold.

Earlier this year, Eric announced his pending retirement from the Colorado River District and the search for a replacement is underway. It is anticipated he will continue working through the early part of 2018 during a transition period.

In the meantime, Eric is writing a book about how Colorado River hydrology and how the past and current understandings colored the Colorado River Compact of 1922 and present day policy issues.

10:30 Break

10:45 Bridging Science and Decision Making on Water Supply: Managing for Drought

Moderator: Steve Fletcher, Fire Mountain Canal and Reservoir Company

Biography

Steve was employed at Uncompahgre Valley Water Users Association in Delta & Montrose counties Uncompahgre Valley for 34 years. During that time, he served 9 years as Water Master and 5 years as the General Manager. During this time, he was directly involved in or in charge of securing funding for and piping or lining of over 140 miles of canal and laterals within the project. During the 5 years as Manager, he helped develop and implemented 5 Hydro-electric Facilities within the Project. Steve is currently the Manager of the Fire Mountain Canal and Reservoir Company in the North Fork Valley and Dam Tender for Paonia Reservoir. He is the Colorado State Director for the Four States Irrigation Council, Council member for the CMU Water Center Advisory Council and serves on the Gunnison Basin Round Table.

Abstract

How and why Upper Colorado River Basin water, land and fire managers choose to use drought tools (or not)

Preparing for and responding to drought requires integrating scientific information into complex decision making processes. In recognition of this challenge, regional drought early warning systems (DEWS) and related drought-information tools have been developed under the National Integrated Drought Information System (NIDIS). Despite the existence of many tools and information sources, however, the factors that influence if a tool(s) is (are) used, which tools are used, and how much benefit those tools provide remain poorly understood. Using the Upper Colorado River DEWS as a case study, this study investigated how water, land, and fire managers select from among many available tools.

The Upper Colorado River Basin (UCRB) was one of the first pilot areas, beginning in 2008, for implementation of a regional drought early warning system (DEWS) under the NIDIS program, which now supports eight regional DEWS. (The UCRB DEWS has recently been expanded and reconfigured into the Intermountain West DEWS). The selection of the UCRB for a pilot DEWS reflects the regional importance of drought monitoring for managing water supply for agriculture and other uses, and the need for effective decision support related to drought. New drought-information tools were developed specifically for the UCRB DEWS, and a number of others have been created since 2008, adding to the pre-existing toolkit for drought decision making. The various tools that are now available in the Upper Colorado River Basin region can be expected to be more or less suitable for different decision makers' needs. As a result, the broad decision context of this case study (managing drought) was fixed, but the information needs of users varied. This provided the opportunity to examine the varied choices decision makers make about which of the available tools to use or not use.

The research identified four broad categories of tool use that map to particular decision contexts. Water supply managers, land managers with rangeland management responsibilities, land managers focused on ecological health, and fire managers each use a suite of indicators and tools that match their particular decision context and timeframe at which they make decisions. Important differences also emerged in how respondents find out about tools, with water managers reporting strong inter-agency connections while land managers tend to rely on information from others within their agencies. Fire managers also play a key role in keeping others in the land management agencies informed about drought.

Biography

Amanda Cravens is a Research Social Scientist in the Social and Economic Analysis Branch at the U.S. Geological Survey's Fort Collins Science Center. Her interdisciplinary research interests include the translation of scientific information into decision making, policies and institutions that influence environmental management, and understanding the cognitive and social processes that make decision support tools work effectively. Her disciplinary training includes geography, law/institutional analysis, and the learning sciences. Her research spans resource areas, with recent and current projects focusing on coastal and marine spatial planning, the role of technical information in groundwater management, and human dimensions of ecological drought. She received her Ph.D. from Stanford's Emmett Interdisciplinary Program in Environment and Resources and an M.A. in Geography from the University of Canterbury in New Zealand. Prior to joining USGS, she was a postdoctoral Early Career Fellow at Stanford Law School.

Abstract

Characterizing Drought Risk Management, Information Use, and Response Strategies of Western Slope Water Managers

Rebecca Page and Lisa Dilling, Western Water Assessment, University of Colorado Boulder

Recent drought conditions, especially in 2002 and 2012, have tested the capacity of water supply systems across the Upper Colorado River Basin to cope with and recover from drought. With such droughts occurring at a time of growing water demands and likely long-term reductions in overall runoff, the broader community of water managers, drought-information providers, and researchers is increasingly interested in understanding how drought risk perceptions and management practices vary across the Upper Colorado River Basin's diverse water systems, and specifically understanding the role that drought-related information, such as snowpack monitoring, streamflow forecasts, and weather and climate outlooks, currently plays and could play in the future to support decisions that reservoir managers and water providers make throughout the water year.

Focusing on Colorado's Western Slope, this study seeks to a) understand perceived risks and concerns faced by water managers related to drought management, b) characterize how drought information is currently used and accessed by water-management entities, and c) identify likely response strategies, including accessing and using new drought information, that are available to water managers in the face of drought. This presentation will highlight preliminary findings from in-person interviews, document analysis, observations of planning meetings, and other interactions with seven water-management entities across the Western Slope. After summarizing perceived risks, vulnerabilities, and buffers to drought identified by study participants, we will present 'decision calendars' reconstructed from interview responses for each of the participants to highlight similarities and differences among participants' timing of key decisions made throughout the water year and use of monitoring and forecast information to inform those decisions. We will then discuss opportunities and barriers for Western Slope water entities to incorporate new information in decision making and expand drought response options. Finally, we will highlight anecdotes from study participants' past experiences managing risk during drought events, and insights into how past drought events have shaped their capacity to manage future drought risk.

The findings from this study will be used to inform and improve drought-information services across the Upper Colorado River Basin, such as the Colorado Climate Center's Drought Briefing webinars, that are under the umbrella of the new Intermountain West Drought Early Warning System (IMW DEWS), part of the National Integrated Drought Information System (NIDIS). Ultimately, we intend that our efforts will make drought monitoring and forecasting information more timely, useable, and relevant to those who are tasked with managing our basin's critical water supply in the face of increasing drought risks.

Biography

Rebecca Page is a Master's student in the Environmental Studies program at CU Boulder. Her academic research spans both theoretical and applied questions of when, why, and how communities and decision-makers adapt to climate variability and change. She is a graduate research student within the CU-Boulder's Western Water Assessment, where she studies drought risk decision-making and vulnerability perception among water managers in the Upper Colorado River Basin. Prior to pursuing graduate studies, she worked in the international development sector on a range of applied research and capacity building initiatives related to urban sustainability and climate change. From 2010-2011 she was a Fulbright Research Fellow in China, where she researched public participation in water quality monitoring. Rebecca received her B.A. in Environmental Studies and East Asian Studies from Oberlin College.

11:30 Water Supply Vulnerabilities to Climate Change

Moderator: Kirsten Kurath, Williams, Turner & Holmes, PC

Biography

Kirsten is a shareholder at the local law firm, Williams, Turner & Holmes, P.C., in Grand Junction. Kirsten's practice focuses on water law and she represents clients on a wide variety of water related issues including water court applications to adjudicate and to protect water rights. She has worked with energy companies, gravel pit operators, irrigation districts, special districts, water user associations, domestic water providers, farmers, ranchers, subdivision developers, and individuals on their water law related issues. Kirsten currently serves on the Advisory Council for the Hutchins Water Center at Colorado Mesa University.

Cort Lambson, Central Utah Water Conservancy District

Central Utah Water Conservancy District Climate Study

Laurna Kaatz, Denver Water

Abstract

Climate change implications for Denver's water supply

Frequently described as the "canary in the coal mine," the water sector has been one of the first to experience and begin preparing for the impacts of climate change. Water utilities have lead the way in developing and testing climate information in practice with the end goal of building resiliency and avoiding catastrophic disasters. A key aspect of this leadership is strong, collaborative partnerships resulting in the coproduction of knowledge and actionable science. In this sessions you will hear about the lessons learned and challenges encountered by Denver Water as the utility seeks to understand and prepare for a warmer future.

Biography

Laurna Kaatz is the climate science, policy, and adaptation program director for Denver Water. Her primary responsibility is to lead climate investigations and implement findings to inform planning, policy, and research. Laurna's work incorporates many areas of water resource planning, including climate and drought planning, operational and water rights analysis, and long range integrated resource planning. As incoming Chair of the Water Utility Climate Alliance, lead practitioner of the Decision Making under Deep Uncertainty Society, and Past President of AWRA CO Section, Laurna is extensively engaged in climate preparedness and resilience. Before her career at Denver Water, Laurna was a Professor of Physics at Sweet Briar College, and then went on to work as a climate science researcher with Aurora Water. Laurna has a Master's degree in physics and a Bachelor's in physics and mathematics, and is currently working on her PhD.

12:10 Lunch/ Poster Session – See poster abstracts and presenter biographies at the end of this document.

1:40 Beyond Snow: Vegetation Interactions with Water Supply

Moderator: Bruce Smith, Western Water and Land

Biography

Bruce has 29 years of experience in the environmental industry as a professional hydrologist. Mr. Smith's experience encompasses a broad range of environmental hydrological applications and investigations including surface water and groundwater hydrology, watershed studies, river restoration, water supply and treatment, contaminant hydrology, and active and abandoned mine lands. Bruce has extensive working knowledge and experience in assessing water quality and chemistry, groundwater/surface water interactions, aquifer contaminant distributions, passive water treatment, and hydrologic numerical modeling.

Tristan Weiss, Department of Ecosystem Science and Sustainability, Warner College of Natural Resources, Colorado State University

Abstract

River-connected mountain meadows: Assessing resilience and ecosystem services of headwater wetlands across a disturbance gradient

Tristan Weiss (M.Sc. Student)¹, Dr. Tim Covino^{1,2}, Dr. Ellen Wohl², Chuck Rhoades³, Timothy Fegels³, David Clow⁴

¹ *Department of Ecosystem Science and Sustainability, Warner College of Natural Resources, CSU*

² *Department of Geosciences, Warner College of Natural Resources, CSU*

³ *Rocky Mountain Research Station, United States Forest Service, Department of the Interior*

⁴ *Colorado Water Science Center, United State Geological Survey, Department of the Interior*

Mountain meadows are a remarkable feature of our Rocky Mountain headwaters. Spanning both sides of the continental divide and characterizing the valleys of nearly every mountain range on Earth, river-connected wet meadows have recently become recognized as ecological nexus points in post-glacierized landscapes. Although comprising less than 25% of channel length in Rocky mountain river networks, meadows such as these can store as much as 75% of the system's fluvial and floodplain carbon, making carbon source-sink dynamics in these meadows an important consideration in discerning regional carbon storage and cycling patterns. The unique characteristics of wet meadows make them crucial locations for water, sediment, carbon and nutrient storage. Cumulatively, these meadows likely provide crucial ecosystem services at the network scale; transforming water quality, attenuating floods and maintaining baseflows, and playing an important role in global inland-water carbon dynamics.

Despite these benefits, historical and contemporary land-use practices often result in the simplification of wet meadow systems, leading to a lower water table, and reductions in storage and hydrologic buffering capacity. In this recently established NSF-funded study, we are quantifying the hydrologic-carbon relationships across a gradient of valley confinement and wetness states as a function of land-use within Rocky Mountain National Park and Forest Service public lands. In this work, we aim to disentangle the nuanced balance between water flux-storage with the production and processing of fluvial carbon. Ongoing data analysis combines intensive hydrologic monitoring and geospatial analysis with water quality assays to explore seasonal shifts in fluvial storage and ecosystem processes linked to carbon.

The abundance of wildlife in these meadows and the countless interactions with enthusiastic tourists, avid fishermen, and devoted conservationists in these meadows has demonstrated that these meadows are a valuable and cherished feature of our Coloradan landscapes. But more than that, our preliminary findings suggest that relatively undisturbed meadows act as significant buffers of snowmelt and flood pulses, demonstrate high resilience to seasonal drying, and are more productive than their drier,

disturbed counterparts. In this presentation, I will introduce my personal experience with these headwater meadows as vital ecotones, present our findings from these highly productive landscapes as regions of water storage and processing, and discuss how our ongoing monitoring efforts can aid us in becoming better stewards of these fascinating habitats.

Biography

Born and raised in the Pacific Northwest, Tristan developed his love for rivers while improving native salmon habitat in Washington State. After working as a hydrologic research technician in Alaska exploring climate effects on trophic mismatch on the Arctic North Slope, Tristan came to Colorado State University to pursue his M.Sc. in Watershed Science. His current research interests include exploring hydrologic-biogeochemical interactions throughout river corridors in mountain systems. Working on an NSF-funded study in collaboration with the USGS and U.S. Forest Service, he is exploring how physical complexity of mountain valley bottoms influence seasonal fluxes of water, carbon, and nutrients, and the implications of these processes on ecosystem functioning.

Tom Ryan, Metropolitan Water District of Southern California

Abstract

Assessing the potential impacts of invasive species water use on the Lower Colorado River

In coordination with the Secretary of the Interior and as part of a process to address system-wide drought, the seven Colorado River Basin States (Basin States) have identified tamarisk management as an option to potentially augment the flow of the Colorado River.

In 2008, the Basin States executed a Memorandum of Understanding to coordinate tamarisk (salt cedar) management activities in the Basin. In 2009, the States then completed the Colorado River Basin Tamarisk and Russian Olive Assessment. This is a comprehensive assessment of tamarisk including: distribution, the state-of-the-science, ET, information on impacts, control and management techniques, restoration, and knowledge gaps for future research. A panel of scientists estimated the amount of water being consumed by tamarisk ET, and how much could potentially be saved by treatment and revegetation by native species. This presentation discusses the Assessment as background for a new management approach for potential water savings.

Another method to manage tamarisk is through biological control. Biocontrol is the introduction of an insect or other “natural enemy” that predate the invasive plant of concern. The insect selected for the control of tamarisk, the tamarisk leaf beetle (*Diorhabda* spp.), was tested by the U.S. Department of Agriculture for over 10 years. It was first released in 2001, expands its range each year, and can now be found throughout the Colorado Plateau and Texas. *Diorhabda* controls tamarisk by defoliating the plant multiple times over successive years.

1) What we were trying to do: Since 2006, the U.S. Bureau of Reclamation has been collecting baseline data on evapotranspiration (ET) and groundwater levels at a mature tamarisk forest in the Cibola National Wildlife Refuge located adjacent to the Colorado River south of Blythe, California. This data gathering was in anticipation of *Diorhabda* migration to the site, and the presumed subsequent defoliation of the tamarisk and associated changes to groundwater level. The project funding was ending and in 2010, the Basin States decided to continue funding the data collection until the arrival of *Diorhabda*.

2) What happened: Contracting issues delayed implementation, and in 2011, a fire in the project area removed approximately 2,000 acres of the instrumented tamarisk forest. This extreme event provided an opportunity to test the water savings approach identified in the Assessment. In 2012, the Basin States retained Utah State University to reinstrument the site and undertake a study to measure fluxes in ET

and groundwater levels at the now bare ground site, which was as if Diorhabda had already migrated through and defoliated it.

3) What was learned: The ET of the regrowing tamarisk forest and the groundwater levels of the site at the Cibola National Wildlife Refuge will be compared to the pre-fire baseline.

Biography

Tom Ryan is a Resource Specialist with the Metropolitan Water District of Southern California in Los Angeles. Tom has worked on Colorado River water resource issues at Metropolitan for over twenty years and developed the seven Colorado River Basin States' river augmentation programs related to weather modification and tamarisk management.

For five years Tom served as President of the North American Weather Modification Council and is the current Past-President of the international Weather Modification Association. He is an officer on the Board of Directors of the Tamarisk Coalition, located here in Grand Junction, and also serves on the Board of the Center for Snow and Avalanche Studies in Silverton, Colorado. Tom's degrees are from the University of California at Los Angeles. Prior to joining Metropolitan, Tom was a researcher at UCLA and the U.S. Forest Service, and an environmental planner at the U.S. Army Corps of Engineers.

Erin Cubley, Department of Ecology, Colorado State University

Abstract

Riparian plant guilds along the Dolores and San Miguel Rivers

Erin Cubley, David Cooper, and David Merritt, Colorado State University and the US Forest Service

Future climate change projections, coupled with increased anthropogenic water development, threaten riparian ecosystems by altering natural flow regimes. Changes in the timing, duration, magnitude, and frequency of streamflow can dramatically alter riparian vegetation and cause shifts in species composition and the provisioning of valuable ecosystem services and functions. Studies of riparian vegetation dynamics have typically focused on the response of individual species or cover classes, but these metrics can be difficult for making generalizations across rivers and the use of functional groups has emerged to predict vegetation response. The diversity of groups, or guilds, within a river reach is indicative of functional diversity, the range of traits that influence ecosystem functions, such as nutrient cycling, water use, and habitat availability. The aim of our study was to determine the diversity of riparian guilds across two river systems in Colorado that vary in climate, streamflow, and groundwater resources. We asked the following questions 1) How does guild diversity differ across our study rivers and along hydrologic gradients? 2) How will streamflow alterations from human development and climate change alter guild diversity across these rivers? Results from this research will demonstrate how river ecosystems could be altered by future changes in flow regimes and inform water managers on flow requirements for riparian vegetation in the Colorado River basin.

Biography

Erin received her BS in Environmental Conservation Studies from the University of New Hampshire in 2008. Her undergraduate studies were focused on wetland ecology and she conducted research on restoration techniques for the eastern oyster (*Crassostrea virginica*) in a tidal marsh. Following the completion of her BS, Erin worked for the US Peace Corps in Morocco and taught environmental education in the High Atlas Mountains in the native language, Berber. Before starting graduate studies, she worked as a raft guide on the Salmon River in Idaho and a ski instructor in Utah. Erin received her MS from Eastern Washington University where she studied the response of riparian vegetation following dam removal on the Elwha River. In the Cooper lab at Colorado State University, she is working with the Forest Service to evaluate conditions of riparian ecosystems in the western U.S in order to prioritize

efforts for protection and proposed water development.

2:45 Panel: Orchard Mesa Ditch Improvements to Benefit Endangered Fish and Water Users

Moderator: Chris Treese, Colorado River District

Biography

Chris Treese is the Manager of External Affairs for the Colorado River Water Conservation District, which covers most of western Colorado. Chris manages a department responsible for the River District's legislative and regulatory governmental relations in Denver and Washington, D.C., as well as the District's water education and public information efforts. In short, Chris describes his job responsibilities as everything you don't want lawyers and engineers doing, including the occasional moderator's role at Water Symposia.

Chris moved from Denver to the wetter, better side of Colorado in 1982 to be the boomtown economist for Union Oil's oil shale project. He and his wife, Amy, live in Glenwood Springs. When not working, Chris pretends his knees can still bike, rock climb, ski, and play ice hockey. Chris has Bachelors and Masters degrees in Economics, which he finds largely irrelevant to his current work.

Panel Abstract

Orchard Mesa Ditch Improvements to Benefit Endangered Fish and Water Users

This panel will provide information on recent improvements to the Orchard Mesa Irrigation District's irrigation infrastructure that reduce diversion volumes from the Colorado River, thereby benefitting critical habitat for endangered fish. Panelists will describe the project and discuss the results for the fish and for water users on the system. They will also share stories that demonstrate what hurdles had to be overcome in order to bring the project to completion.

Tom Chart, Upper Colorado River Endangered Fish Recovery Program

Biography

Tom is an East Coast native that fled for the West immediately following high school. He received undergraduate and graduate degrees in Fishery Biology from Colorado State University in the 1980's. His graduate studies exposed him to the native fishes and water related issues of the Colorado River system when he studied the initial effects of mainstem impoundment on the fish community of the White River in northwestern Colorado. He has worked for a variety of State and Federal agencies throughout his career, most recently accepting the position of Director of the Upper Colorado River Endangered Fish Recovery Program in 2009.

Brent Uilenberg, US Bureau of Reclamation

Biography

Education:

- B.S. Civil Engineering, South Dakota State University
- B.S. Geography, South Dakota State University
- A.S. Surveying, South Dakota State University

Professional Registration:

Professional Engineer, State of Colorado

Career History:

- Construction Engineer, Smith and Kangas Engineers, Boise, ID
- Planning Team Leader, Bureau of Reclamation, Grand Junction, CO
- Technical Services Division Manager, Bureau of Reclamation, Grand Junction, CO

Major current assignments:

Serve as Reclamation's representative on the Upper Colorado Recovery Implementation Program, Management Committee and the San Juan River Recovery Implementation Program, Coordination Committee.

Max Schmidt, Orchard Mesa Irrigation District

Biography

Max has been General Manager of the Orchard Mesa Irrigation District Grand Valley Project since 2009. His responsibilities include:

- Long and short-term operational and maintenance planning and application
- Contract and grant writing
- Supervising pumping and generation plants
- Supervising ditch riders and maintenance crews
- Public and government relations.

Prior to joining the Orchard Mesa Irrigation District, Max was a self-employed water consultant from 2006-2009, a Polyacrylamide and Water Consultant for DRI and the US Bureau of Reclamation from 2004-2006, and a Conservation Technician for the Natural Resources Conservation Service from 1988-2004.

3:30 Break

3:45 Panel: Revitalizing and Reconnecting Riverside Communities through Art, Civic Engagement and Commerce

Moderator: Stacy Beough, Tamarisk Coalition

Biography

Stacy has been the Executive Director of the Tamarisk Coalition since 2008. Prior to working with the Coalition she worked with a local government and their environmental compliance office, and served as the Executive Director of an environmental education nonprofit in Steamboat Springs. She holds a Bachelors of Arts from Illinois Wesleyan University in Environmental Studies and Art and a Masters of Public Administration from University of Colorado at Denver. Her diverse professional background includes nonprofit leadership and fundraising, local government budgeting, teaching environmental education, and directing youth recreation and art programs. Stacy volunteers on the Colorado Riverfront Commission and Foundation, is an organizer for the Grand Junction Giving Club, and is board treasurer for Many Rivers Brewing Company, a public benefit corporation with a mission to invest all profits to protect and enhance rivers.

Panel Abstract

Revitalizing and Reconnecting Riverside Communities through Art, Civic Engagement and Commerce

This panel, comprised of diverse individuals (e.g. community, business, and arts leaders), will explore ongoing efforts to revitalize and reconnect long-neglected lands located near the confluence of the Colorado and Gunnison rivers; Grand Junction's namesake. Panelists will speak to personal goals and experiences pertaining to the implementation of the area's broader community vision, including expected and unexpected challenges and opportunities.

History and Civic Engagement: This area, which serves as the gateway to the Grand Valley via Highway 50, extends from the 130-acre Las Colonias Park to the Riverside Community, located west of downtown. Over the last century, this land transitioned from an agricultural area home to migrant farm workers to an industrial site occupied, at various times, by a uranium mill, a landfill, and a large-scale auto salvage yard. The Department of Energy began clean-up of the site in the 1980s and the land was deeded to the City of Grand Junction in 1997 for public use. Subsequent to this transfer, countless

organizations and individuals have worked tirelessly to improve riverside habitat in this area, while also fostering access to recreational, arts, and business amenities.

Economic Development and Commerce: The City of Grand Junction recently began developing Las Colonias Park, which is located within the River District of the Greater Downtown Planning Area. Positioned within walking distance from shopping and businesses in the adjacent Rail and Central Downtown District, the River District also offers easy access to recreational amenities and active transportation commuter routes along the river. Development of Las Colonias has been a catalyst for private reinvestment and revitalization of the River and Rail Districts envisioned in the Greater Downtown Plan. In addition to Edgewater Brewery, which opened in 2013, several outdoor recreation businesses are considering office and manufacturing spaces along the riverfront through the development of Las Colonias Business Park. The Business Park, which will be housed on the eastern end of Las Colonias, encourages collaboration and creativity amongst industries, along with engagement and excitement for the outdoors with the general public. This Business Park will break ground in the fall of 2017 and will provide the momentum to finish Las Colonias Park improvements including a boat launch, dog park, and wetlands area.

Art and Education: A coalition of partners recently launched *Recreation Inspired by the Outdoors* (RIO), a program to promote connections to nature, while also encouraging healthy and safe lifestyles. Focused on the Riverside Community, this movement aims to inspire nature conservation and recreation promotion with area youth and their families. RIO leaders and participants, including those spearheading and installing murals along the Riverfront Trail, will discuss how their efforts have broadened support for the Colorado River, while also sparking greater community engagement and pride.

Brian Mahoney, Colorado Riverfront Commission and Foundation

Biography

Brian Mahoney was a founding member of the Riverfront Commission, Foundation, and Trust where he has served, in various capacities, including Board Chair of both the Commission and Foundation, from 1991 to the present. In addition to this service, Mr. Mahony was a past president of the Grand Junction Chamber of Commerce and Grand Junction Economic Partnership, and he is current board member at First Congregational Church. He is also a participant with various youth organizations.

An alumni of the University of Connecticut, Mr. Mahony was employed with Valley Insurance Agency for 20 years before serving as President of Moody-Valley Insurance from 1995 until his retirement in 2008. He has been married to his wife, Linda, since 1965.

Cindy Enos-Martinez, Rio Initiative and Riverside Community Center

Biography

A native of Mesa County, Cindy Enos-Martinez has served on numerous boards including eight years on the Grand Junction City Council, two years as mayor, four years on District 51 School Board and two years on the District's budget committee. In 2016, Ms. Enos-Martinez was appointed to the Colorado Supreme Court Hearing Board. After 32 years of service to Mesa County government, she is currently self employed as a private vendor for Division of Vocational Rehabilitation and is owner of Martinez Trucking. Ms. Enos-Martinez is a mother of two sons and two grandchildren as is an active mentor to students within the community.

Traci Wieland, City of Grand Junction

Biography

Traci Wieland is the Recreation Superintendent for the City of Grand Junction. She oversees all recreation programs, facilities, and events and is responsible for project management duties including master planning, grant writing, and new project development. Traci has been with the City of Grand

Junction for the past 17 years and has her Master's in Public Administration from the University of Colorado – Denver.

Thaddeus Shrader, Bonsai Design

Biography

Thaddeus is the CEO and owner of Bonsai Design, a world-class aerial adventure firm based in Grand Junction, CO. In 2008, Thaddeus retired as an airline captain to join his wife and brother-in-law in their start-up business. Thaddeus's big vision and endless optimism has facilitated Bonsai's exponential growth over the last twelve years, helping to position Bonsai as an industry leader in sustainable outdoor aerial adventure. Thaddeus spends his time in the office and field ensuring that Bonsai's clients can accomplish their dream of a custom course that showcases their unique property. The greatest gift Thaddeus brings to Bonsai is his willingness to think outside the box and say yes to the impossible- and then figure out how to make it happen. From component manufacturing to aerial adventure course design, Thaddeus continues to lead Bonsai in pushing the envelope in the industry. In his spare time, Thadd enjoys riding his mountain bike downhill, skiing with his family, and tinkering on projects in his garage with his three sons.

Jen Taylor, Mountain Khakis

Biography

Jen Taylor is currently the Brand Manager & Director of Creative Development for Mountain Khakis®. Beginning her entrepreneurial career at the age of 15 with the creation of an auto-detailing business, Jen later launched Mountain Sprouts®, an apparel brand with the mission to inspire kids and families to connect with nature. She also co-launched and executed the Remington Arms® heritage apparel brand, 1816®. After receiving her B.S. from the University of Denver in Environmental Science, Jen also worked in the mountain bike industry as Assistant General Manager of DT Swiss, USA, helping establish the Swiss company's US-based production and sales headquarters.

A mother of three, Jen is an active member of the Grand Junction community and is affiliated with more than 30 non-profit organizations. She is the co-founder of the Colorado Adrenaline Trail campaign and founder and organizer ex-officio of the Manufacturers of Outdoor Gear Outdoor Fest. She is a Board of Directors ex-officio for Colorado Discover Ability, president and Board of Directors ex-officio of Grand Valley Public Radio Company, and is officer and Board of Directors ex-officio of the Colorado Plateau Mountain Bike Trail Association. Ms. Taylor was the visionary, organizer, and fundraiser of the 'Lunch Loop Bike Park' in Grand Junction and has presented on the importance of bike park development and planning in connecting kids of all ages with the outdoors at regional, state & national conferences. Among her professional accolades to date, Jen has received four Polartec® APEX® Design Awards, was awarded the Boy Scouts of America 'Peak Vision Award', and sat on the Outdoor Industries Women's Council panel, "Pioneering Women in the Outdoor Industry".

4:45 Reception in the University Center Lounge, Adjacent to the Ballroom

November 2

8:00 DAY 2 KEYNOTE ADDRESS

John Fleck, Director of the University of New Mexico's Water Resources Program and author of *Water is for Fighting Over and Other Myths about Water in the West*

Abstract

The Colorado River: What we knew, when we knew it, and how we used it, and lessons for today

In a pair of reports published in the first decades of the 20th century, US Geological Survey hydrologist E.C. LaRue warned that there was less water in the Colorado River than the optimistic numbers used to negotiate the Colorado River Compact. LaRue was one of a number of technical experts who offered similar analyses. Their work was rarely directly disputed, but rather was largely sidelined, or simply ignored. The results are the overallocated Colorado River system we have today. The question of what we knew, when we knew it, and how we used it in the decision-making process has important lessons for today as we try to extricate ourselves from the problems created by our failure to listen to the LaRue's of the world.

Biography

John Fleck is Professor of Practice in Water Policy and Governance and Director of the University of New Mexico Water Resources Program. Much of his career was spent in journalism, focused since the 1980s on the interface between science and political and policy processes, with special emphasis on climate and water in the southwestern United States. He was the Water Resource program's writer-in-residence for three years before transitioning to academia full time in 2016. In the field of water resources, his primary interest is in nurturing the collaborative water governance needed to adapt to scarcity in the southwestern United States as populations grow while climate change reduces water supplies. That goal animates the Water Resources Program, where he and his colleagues work with graduate students who will become the region's future water managers. In both the Water Resources Program and the Department of Economics, he also works on translational activities – helping make the technical work done in academia of maximum benefit to political and policy processes.

9:00 Panel: State of the Colorado River and Implications for Upper Basin States

Moderator: Eric Kuhn, Colorado River District

Biography

Eric Kuhn is the General Manager of the Colorado River District, a position he has held since 1996. He earned his Bachelor's Degree in Engineering from the University of New Mexico and a Master's Degree in Business Administration from Pepperdine University in California. Prior to working for the Colorado River District, he served as an engineer officer aboard nuclear submarines in the U.S. Navy and worked as a nuclear start-up engineer for Bechtel Power Corp.

Eric started employment with the Colorado River District in 1981 as Assistant Secretary-Engineer. He has served on the Engineering Advisory Committee of the Upper Colorado River Compact Commission since 1981.

From 1994 through 2001, he served on the Colorado Water Conservation Board representing the Colorado River mainstem. In 2006, Eric was appointed by Governor Owens as an at-large representative on the Colorado Interbasin Compact Committee, a position he continues to hold.

Earlier this year, Eric announced his pending retirement from the Colorado River District and the search for a replacement is underway. It is anticipated he will continue working through the early part of 2018 during a transition period.

In the meantime, Eric is writing a book about how Colorado River hydrology and how the past and current understandings colored the Colorado River Compact of 1922 and present day policy issues.

Rebecca Mitchell, Director, Colorado Water Conservation Board

Biography

Rebecca Mitchell (Becky) serves as the Director of the Colorado Water Conservation Board (CWCB). She is an accomplished water leader with over 14 years of experience in the Colorado water sector and highly knowledgeable in the water laws of the State. Mitchell played a significant part in working with the State's Basin Roundtables, the Interbasin Compact Committee, the public at large and CWCB staff in producing Colorado's Water Plan. Becky has worked in the public and private sector as a consulting engineer; she received both her B.S. and M.S. from the Colorado School of Mines.

Steve Wolff, Administrator, Interstate Streams Division, Wyoming State Engineer's Office

Biography

Steve Wolff is the Administrator of the Interstate Streams Division in the Wyoming State Engineer's Office. The Division is responsible for overseeing Wyoming's rights and responsibilities relative to the seven interstate water compacts and three interstate water decrees the State is party to. Prior to assuming the role of administrator, Steve oversaw the Colorado River Program in the Division. Steve also currently serves as Wyoming's representative on a number of western water councils and interstate water management committees

Eric Millis, Director, Utah Division of Water Resources

Biography

Eric Millis is the director of the Utah Division of Water Resources and Utah's interstate streams commissioner since November 2013. Eric has worked for the Division for 29 years and served as the Division's development director, planning director, River Basin Planning Section chief and as an engineer in the Division's Investigation Section assisting applicants to the Board of Water Resources build water development projects. He is a graduate of Brigham Young University and a registered professional engineer.

Rolf Schmidt-Petersen, Acting Colorado Bureau Chief, New Mexico Interstate Stream Commission

Biography

Rolf Schmidt-Petersen has 27 years of experience in water resources management in both the private and public sectors and has worked for the State of New Mexico Interstate Stream Commission (NMISC) for about 18 years. He currently serves as the interim Colorado River Basin Manager and Rio Grande Basin Manager for the NMISC. In addition, he has served as New Mexico's Engineer Adviser to the Rio Grande Compact Commission for the past seven (7) years. His responsibilities include investigation, development, conservation, and protection of Colorado River Basin and Rio Grande Basin water resources and stream systems, interstate stream compact administration and compliance, and resolution of interstate and federal water resource issues affecting the State's water resources. Mr. Schmidt-Petersen has managed and/or overseen numerous water resources investigations; engaged in daily to multi-year water operations planning, permitting, and implementation activities; conducted numerous water rights related activities; worked to propose biological assessments and implement biological opinions; cost shared construction projects for the NMISC including levee reconstruction, river and drain maintenance, vegetation maintenance, habitat restoration, and endangered species hatcheries; and provided technical expert support for the state in litigation. The work has been conducted with a wide variety of partners including, but not limited to, the States of Colorado and

Texas, Reclamation, the BIA, the U.S. Army Corps of Engineers, the Service, Indian Pueblos and Tribes, cities, irrigation and conservancy districts, and acequia groups. He graduated from the New Mexico Institute of Mining & Technology in 1991 with a Master of Science degree in Hydrology.

10:20 Drought Contingency Planning: Connections between the Upper and Lower Basins and Mexico

Amy Haas, Deputy Executive Director and General Council, Upper Colorado River Commission

Abstract

The year 2000 marked the beginning of an 18-year drought on the Colorado River. Shortly thereafter, the two largest reservoirs on the river dropped precipitously: the water elevation at Lake Mead fell to unprecedented levels, threatening the city of Las Vegas' water supply, and Lake Powell experienced serious declines, as well. These critically low elevations at Lakes Powell and Mead, coupled with worst-case modeling and a basin study that projected a 9% reduction in flow by 2060 and an increase in drought frequency and duration, prompted then Interior Secretary Sally Jewell to convene the Seven Colorado River Basin States in 2013 with the entreaty that the States needed to come up with plans to address decreasing reservoir elevations, or else she would.

The Basin States heard this loudly and clearly and embarked on respective Upper and Lower Basin Drought Contingency Plans. At roughly the same time, the federal government and the Basin States began negotiations with the Republic of Mexico to extend the terms of Minute 319, a binational agreement executed pursuant to the 1944 Water Treaty Between the United States and Mexico, that requires Mexico to among other things accept shortages of its allocation of Colorado River water when reservoir elevations drop to specified levels. On September 27, 2017, the United States and Mexico signed Minute 323, which requires Mexico to continue to share in shortage, in addition to committing to additional drought contingency reductions contingent upon drought contingency planning measures undertaken in the Lower Basin. Thus, the domestic drought contingency planning efforts underway coupled with the efforts to be undertaken by Mexico under Minute 323 form the basis for Basin-wide drought contingency planning on the Colorado River.

Biography

Amy I. Haas is the Deputy Executive Director and General Counsel for the Upper Colorado River Commission. Previously, Amy worked both as General Counsel and Acting Director of the New Mexico Interstate Stream Commission. From March 2015 through May 2017, Amy served as New Mexico's Upper Colorado River Commissioner and its Colorado River Basin States Representative.

10:45 Break

11:00 Innovations in Agricultural Water Use

Moderator: Aaron Derwingson, The Nature Conservancy

Aaron Derwingson is the Agricultural Coordinator for The Nature Conservancy's Colorado River Program where he works in partnership with agricultural water users on pragmatic, solution-oriented approaches to meeting water needs for people and nature. Aaron works with agricultural producers and water managers to understand issues and opportunities to improve river health by adopting new water management and irrigation practices.

Aaron holds a Bachelor's degree in Biology from the University of Colorado and a Master's in Community and Regional Planning from the University of Oregon. Before joining The Nature Conservancy, Aaron worked at the Rio Grande Headwaters Land Trust helping protect important working lands, wildlife habitat, and water resources in Colorado's San Luis Valley.

Paul Kehmeier, Farmer and Field Trial Cooperator

Abstract

Efficient Irrigation and the Myth of Water Conservation: Misconceptions from the Field

Among the general public and some water professionals there is a belief that inefficient irrigation methods such as flood irrigation waste water. If agricultural producers would only convert to efficient irrigation methods more water would be available for other uses. Furthermore when farmers convert to efficient methods they may be able to lease their unused water to others and profit nicely from upgrading their systems.

This presentation will encourage participants to focus on the concept of consumptive use when it comes to discussions of irrigation and “wastefulness.” It will also point out some potentially undesirable consequences of the myth.

Biography

Paul Kehmeier farms on his family farm near Eckert, Colorado. His main crops are alfalfa and grass hay. He has been participating with CSU for several years in the study of deficit irrigation of alfalfa. Mr. Kehmeier holds a Masters of Science degree in Range Ecology. He is active on a variety of agricultural boards in his area.

Brendon Langenhuizen, SGM and Scott Jones, Eagle County Conservation District

Abstract

Eagle County Conservation District’s Irrigation Asset Inventory Program: an innovative approach for engaging the agricultural community

Project Overview and Background

The Eagle County Conservation District’s (ECCD) Irrigation Asset Inventory Program was identified as one of the Colorado River Basin’s Top Projects for the Eagle County sub-basin in the Basin Implementation Plan (BIP). This presentation will highlight the project development, implementation, results and lessons learned from the Irrigation Asset Inventory pilot project and how it can benefit other similar organizations in the Colorado River Basin

Colorado’s agricultural industry is at-risk for losing lands to competing water demands that will buy out and fallow these green spaces. Water policy advisers recognize that more input and engagement is needed from the agricultural community to help support this critical industry as our State and communities come to terms with meeting our water demands. Eagle County Conservation District decided to respond to these questions and step forward in connecting the dots they saw between the agricultural aging ditch infrastructure and regional entities looking to partner on water projects.

ECCD developed a project concept that offered free assessments and summary report on 25 ditch systems to identify top regional agricultural needs and regional issues. The project then connected the agricultural community to project assistance for implementing top infrastructure maintenance assistance that isn’t currently supported through the District or the NRCS services. The program focused on interviewing ditch owners followed by a tour and assessment of the ditch system structures from the diversion structure to the last lateral.

Project Challenges and Next Steps

There is a strong recognition among the agricultural community that the information collected as part of this project is sensitive. This presentation will review how ECCD obtained interest and buy-in from their members to participate in the program. The ECCD felt they have the support they need to successfully accomplish this mission within the geographical diversity of the ECCD and current good relations with community agricultural owners regardless of this concern. A balance of keeping sensitive information

private while still reporting on the project needs to regional funding partners was developed and found to be successful.

ECCD is now in the process of supporting the top ranked projects with funding partners and regional collaborative efforts.

Brendon Langenhuizen Biography

Brendon is SGM's Water Resources Team Leader in Glenwood Springs with ten years of experience focused on water rights engineering. Brendon specializes in water resource engineering including water rights engineering and water supply planning. His typical water rights projects include developing project-specific physical and legal water supply plans, watershed assessment plans, irrigation system design and support services and developing water policy processes. Brendon was a key researcher and author of the 2015 Colorado Basin Implementation Plan which was a State sponsored effort in the development of the Colorado Water Plan. Brendon enjoys living in Glenwood Springs where he can frequently raft and bike alongside the rivers he often is working on.

Brendon co-developed the concept and was the project manager for funding and implementing the Eagle County Conservation District's Irrigation Asset Inventory project, a first of its kind to proactively assess local agricultural infrastructure needs. The project was largely successful and has supported multiple ditches and owners in elevating the needs of the agricultural community to secure additional funding.

Scott Jones Biography

Scott was born and raised a rancher here in Eagle County and even skis on occasion. He currently manages a ranch on the Colorado River Road raising hay and cattle. He is also a competitive team roper and darned good country swing dancer.

Luke Gingerich, J-U-B Engineers

Abstract

Grand Valley Conserved Consumptive Use Pilot

Demand management has been identified as a critical component in Upper Basin Drought Contingency planning, potentially having major impacts on agricultural water users, including the Grand Valley Water Users Association (GVWUA). The GVWUA has been investigating agricultural demand management for several years culminating in the 2017 and 2018 Conserved Consumptive Use Pilot Projects. The objective of these Pilot Projects is to test the scalability and manageability of voluntary, temporary, and compensated water conservation through farm-based rotational fallowing. Mark Harris, General Manager of the GVWUA and Luke Gingerich P.E., CCUPP Project Co-Manager, will share results to date.

Biography

Luke Gingerich is the western Colorado Area Manager for J-U-B Engineers, Inc. Luke has a strong background in water resources and agricultural engineering, water rights, hydraulics, and consumptive use determinations. Luke is a leader in the area of agricultural water use and water conservation. He works extensively with government agencies, local, state and federal, as well as NGOs on drought planning and project implementation. Luke has extensive experience in conservation engineering including design of irrigation delivery and application systems, diversion structures, aquatic habitat improvement, and stream bank stabilization.

Jordan Nielson, Trout Unlimited

Abstract

System Conservation Projects on the Price River

It has long been argued that the Colorado River and its tributaries are over appropriated. The water and rights to it are also governed by individual states with differing laws that dictate beneficial uses. On top of that, the Colorado River Compact requires upper basin states to deliver water to lower basin states. In the face of prolonged drought, all of these things could create a recipe for long arduous legal battles over where Colorado River water can and should be used.

As a test for circumventing the need to use the courts to decide the fate of the Colorado River, the major municipalities in both the upper and lower basin states in conjunction with the US Bureau of Reclamation and the Upper Colorado River Commission joined to pilot a program to develop a market for Colorado River water. The market was based on reducing consumptive use of water using various strategies to mitigate for drought. Agriculture, as the largest water right holder and user in the basin seemed a natural fit for the test market. The Price River, one of the upper basin tributaries, tested the market in 2017. Testing a pilot water market has created positive results in Utah and a demand for further market expansion. However, shepherding water to a storage facility where it can be used remains a question to be answered at both the in-stream and policy level.

Biography

Jordan Nielson is a project manager for Trout Unlimited in the Price, Utah, area and works throughout the Utah Colorado River drainage. Jordan has worked in Utah on fisheries management, stream and watershed restoration, aquatic invasive species prevention, and now on water issues since 2008.

12:20 Lunch

1:30 How experiences on rivers can influence water policy

Moderator: Ken Neubecker, American Rivers

Biography

Ken is American Rivers Colorado Projects Director. He is also the Environmental Representative on the Colorado River Basin Roundtable, a member of the Hutchins Water Center at Colorado Mesa University Advisory Council and a past President of Colorado Trout Unlimited. He has been involved with water and river issues for over 25 years. Ken also teaches a class in Watershed Science and Land Use Policy at Colorado Mountain College.

Ken is a graduate of Lawrence University in Appleton, Wisconsin (BA, Geology) and the University of Colorado – Boulder (M.Ed., Experiential Education). Over the past 35 years Ken has worked as a professional land surveyor, naturalist, wilderness and river guide, writer, photographer, teacher and organizer. He lives in Garfield County, Colorado, with his wife, Paula Fothergill and their “river schnauzer” Gus.

Sara Porterfield, History Department, University of Colorado

Abstract

Experiencing Echo Park

As a historian, my “field work” is expected to take place in library archives where I paw through dusty boxes of correspondence, newspaper articles, and diaries in windowless and temperature-controlled rooms. But, as a historian who studies the history of the Colorado River Basin I have expanded my

sources to include the rivers of the Basin themselves. I came to my dissertation research through floating rivers; as a river guide on the Green, Yampa, and Colorado for twelve years, the lived experience of place drives what and how I write about the Colorado River Basin.

During the process of researching the roots of my recreational experience I discovered that what I—and many others—do for fun is an activity that has shaped not only the landscape of the Colorado River Basin, but also the development of American environmentalism. Both my research and my field work have centered on the Green and Yampa rivers of Dinosaur National Monument on the border of northwestern Colorado and southeastern Utah. Echo Park, located at the confluence of these two rivers and at the heart of the national monument, was the site of a heated battle over a proposed dam in the mid-1950s. In order to gain support for their anti-dam stance, the Sierra Club offered whitewater rafting trips through Dinosaur so that participants could gain the tactile experience of floating through wild desert canyons. These trips evoked the range of human emotions from awe to fear to wonder; it was these emotions, tied to the physical experience of river running, that prompted trip participants and those who saw films or read accounts of Dinosaur's rivers to take action. The physical and emotional experience of floating the Yampa and Green played a pivotal role in fueling the successful anti-dam campaign in what has come to be known as the American environmental movement's "finest hour to date." And it was, as I have discovered in the course of my research, the river runners, particularly the father-son team of Bus and Don Hatch, who led the defeat of Echo Park Dam through the physical and emotional experience of Dinosaur's rivers.

This experience has taught me that we need to bridge the gap between the academic and recreational worlds—two disciplines that have ignored each other for too long, to the detriment of both sides. My presentation will explore the relationship between whitewater rafting and environmental advocacy from the Echo Park controversy in the early 1950s to the passage of the Wild & Scenic Rivers Act in 1968. River runners have shaped, and continue to shape, the rivers of the American West, and recognizing the history of this advocacy can help recreationists be better informed and more effective advocates. Experiencing a place matters a great deal—both to the past and to the present.

Biography

Sara Porterfield's love of the Colorado River led her to her current life as a doctoral candidate at the University of Colorado at Boulder. Her work focuses on the environmental history of the American West and the Colorado River Basin, and her dissertation examines the Colorado's ties to rivers around the world through water policy, infrastructure, and recreation. Sara also works as a water educator, bringing the history of Western water use to diverse audiences to show how the past use of our water shapes the way we value and manage it today and how that informs future decisions. Her work has been published on *Real Clear Politics*, *The Dirtbag Diaries* podcast, and in *COLUMBIA: The Magazine of Northwest History*.

Nathan Fey, American Whitewater

Abstract

Recreation Advocates' role in water policymaking today

In the narrative of reclaiming the west, river recreation is a relatively new consideration, but recreation advocates have an immensely powerful perspective to bring to the policy table. As the era of building more dams needed for hydropower, agricultural, and municipal use persisted across the West, recreation advocates saw a need to protect the places we play and established new policies like the Wilderness and Wild & Scenic Rivers Acts; influenced by the belief that "You can't protect what you don't know". Today, that same belief holds true as the focus of conservation activism and advocacy shifts, towards more local, cooperative efforts to create policies and protective mechanisms that protect recreation while balancing certainty for all. Recreation advocates - informed by their experiences on the

river and their understanding of resource conditions that sustain public enjoyment – are working to bring science-based data to the policy-making table to help protect, and restore, resources needed to sustain healthy rivers for fish, wildlife, and people. Stories of how recreation advocates are defining their needs for water, and working with more traditional water interests to craft new policies to protect their needs are highlighted by ongoing efforts in Colorado’s Dolores, Yampa, and the upper Colorado rivers.

Biography

Nathan Fey is the Regional Director of American Whitewater’s (AW) River Stewardship Program in the Colorado River basin, and oversees AW’s Conservation, Access, and Safety Programs across the Southern Rockies. He plays an active role as an advisor to the Governor’s Office of Outdoor Recreation Industry, and in Outdoor Alliance Colorado, a statewide partnership that serves as a platform for paddlers, climbers, cyclists and skiers to coordinate their efforts to protect public lands, waters and snowscapes, and to ensure these places can be experienced in a meaningful and sustainable manner. Nathan is a 6th generation Coloradoan with a long list of reports, publications, and awards from around the state.

2:15 Having it all: Trying to meet diverse needs on shared streams

Moderator: Corey Baugh, Colorado Division of Water Resources

Biography

Corey has been a Water Commissioner with the Division of Water Resources since 2011. He is responsible for the administration of water rights and reservoir operations in some tributaries of the Lower Colorado River in Colorado, as well as maintaining gauging stations on the three large canal diversions of the Colorado River in the Grand Valley. He has a Master's Degree in Rangeland Ecology and Watershed Management from the University of Wyoming, where he researched fluctuating E. coli levels in the Greybull River (WY). Corey will be spending his free time coaching boys basketball, as well as enjoying the outdoors with his wife and two young boys.

Heather Lewin, Roaring Fork Conservancy

Abstract

A Rancher, a Scientist, and Angler and a Conservationist Walk into a Room.... How the Crystal River Management Plan is moving from paper to project

A rancher, a scientist, an angler and a conservationist walk into a room... “Wait a minute,” you say, “I’ve heard this one before! Something about water being for fighting, right? Remind me the punchline again?” Well, this isn’t the same old story with the same old punchline. Roaring Fork Conservancy (RFC), and our project partners are working with an empowered group of stakeholders to rewrite the story of water in the Roaring Fork Valley.

During the 2012 drought, the Crystal River experienced significantly low flows, to the tune of 1 cfs in the lower reach where the instream flow right is 100cfs. The Crystal Valley, a mecca for both ranching and recreation, was feeling the demand gap of the drought. Is it possible to look out for the interests of all water users, including the river? Enter Stream Management Planning: a new way of conducting river studies that listens to stakeholder concerns and works cooperatively to answer the tough questions about how to use and share valuable water resources. Published in 2016, Crystal River Management Plan, one of the first stream management plans in Colorado, is the product of 18 months of research and outreach.

Now, with much statewide focus on Stream Management Planning, implementation is the next big conversation. In many ways, a plan is only as good as its ability to facilitate real, on the ground change.

How do we bring that same rancher, scientist, angler, or conservationist from meeting and planning, to action and results? Partners from local, state and national organizations have come together to work in conjunction with interested stakeholders to pool institutional expertise, strengths and funds to pursue: agricultural non-diversion agreements, municipal ditch efficiencies, public river and riparian restoration projects, and invasive species removals. Sounds pretty chummy, right? Well... sometimes.

All of these projects have garnered support- sometimes in unexpected places, but also raised some concerns and opposition- both predictable and unforeseen. The challenging conversations and compromises don't stop just because the plan is written. In fact, in many ways, the plan is just the beginning. The journey of each project, like a river, develops with ever-evolving twists, turns, and obstacles. Navigating this process has involved, creativity, persistence, and teamwork. We will illuminate the highs and lows of the implementation process, from management plan to on-the-ground work. Because each time we walk into a room to discuss water with a rancher, a scientist, an angler and a conservationist- and maybe the occasional elected official, recreationist, or federal employee- we know something interesting is going to happen!

Biography

As Watershed Action Director at Roaring Fork Conservancy, Heather has coordinated projects including Comprehensive Lower Fryingpan Assessment, the 2015 Cattle Creek Stream Health Evaluation, and RFC's role in the Crystal River Management Plan. She helped RFC establish a presence on the Colorado Basin Roundtable and is a member of the Roaring Fork Watershed Collaborative steering committee. Heather completed a B.S. in Biology at Providence College, a graduate residency in Environmental Education at Teton Science Schools, and a M.S. in Environmental Science and Policy from Johns Hopkins University. She also sits on the board of Colorado Mountain College's Natural Resource Management Program.

Frank Kugel, Upper Gunnison Water Conservancy District

Abstract

Watershed Management Planning in the Upper Gunnison Basin

The Upper Gunnison River Water Conservancy District (UGRWCD) and its partners have been granted \$175,000 by the Colorado Water Conservation Board (CWCB), for Needs Assessments in Upper Gunnison tributary basins, as the first stage in a Watershed Management Planning process with a 2050 horizon. This describes that process.

What is 'watershed management planning'?

A statewide water planning process was initiated by Colorado's governor in 2013, to address a *projected mid-century gap between known water supply and anticipated new demand of as much 600,000 acre-feet of water* (~195 billion gallons). Most of that would be due to urban population growth, mainly along the Front Range, but it will put pressure on all Colorado water users.

The resulting Colorado Water Plan, adopted in 2015, incorporated Basin Water Plans to 2050 developed in Colorado's eight natural river basins plus the metropolitan area. The basin plans were developed by citizen-run Basin Roundables, and assembled in an overall State Water Plan by Colorado Water Conservation Board staff.

The impetus for carrying out the Colorado Water Plan has now moved to the local level, with water managers in all Colorado watersheds working with all water users to assess their own future water needs, preparatory to developing adaptive watershed management plans to address those needs consistent with all state concerns. The rest of this sheet describes the needs assessment process the UGRWCD board and staff will be working through with private and public partners on these assessments in the Upper Gunnison River tributary watersheds indicated on the adjacent map.

The Upper Gunnison Basin Watershed Management Planning Process

The overarching goal for the Upper Gunnison Basin Watershed Management Plan – consistent with the Gunnison Basin Plan – is **the protection and sustainable continuity of existing water uses** (agricultural, municipal, ecological and recreational) that are the foundation of our local economic and cultural lives, **in a time of diminishing water supply and increasing demand**. Other related goals, consistent with both the Gunnison Basin and State Water Plans, include maintenance and improvement of water quality, improvement of relationships between consumptive and nonconsumptive water users, improvement and maintenance of water-use infrastructure, and conservation and efficiency among all users.

Over the next several years, the UGRWCD will be working with water-user groups in each of the eight Upper Gunnison watersheds. Because each of these watersheds is unique, we are beginning with a needs assessment study for each watershed. These studies will begin with Ohio Creek, the East River and the Lake Fork.

Each watershed study begins with a needs-assessment inventory of currently known needs, and also anticipated needs and concerns out to mid-century that take into account these factors that are projected to change over the next three decades:

Growth: The State Demographer projects that the population of the Upper Gunnison Basin will increase by 50-100% by mid-century– from ~16,000 today to as much as 32,000. Statewide roughly the same range of increase is projected. Urban conservation will mitigate much of the increased demand, but some additional water will have to come from other sources.

Climate Change: Precipitation may stay roughly the same out to mid-century, but increased temperatures will cause more evaporation, transpiration and sublimation, reducing the amount of water in our watersheds as much as 20%. Stream flows in the Colorado River Basin are already 10% less for the 21st century to date than the late-20th century average.

Reconciling Ecosystem Needs with Agricultural and Domestic Uses: Consumptive water uses that remove water from streams impact nonconsumptive instream needs (quantity, quality and temperature to sustain aquatic life), situations that require creative and collaborative user efforts at the interface of watershed and stream management.

‘Big River’ Issues: The Upper Gunnison River watersheds are an important part of the headwaters for the Colorado River that eventually provides some or all domestic water for ~40 million mostly-metropolitan people, irrigation water for more than 4 million acres of high-value agricultural crops, and water-based recreation activities enjoyed by much of the nation. Growth and climate change factors throughout the region served by the Colorado River (including major cities outside the natural basin) may challenge historical allocations of the river’s water and force difficult changes on all users.

Process for Developing Needs Assessments for the Individual Watersheds

The UGRWCD will be the coordinating agency for the Watershed Management Planning processes, working with other water-related agencies and organizations within the Upper Gunnison Basin, including but not limited to:

- The Gunnison County Stockgrowers Association
- The seven municipal/domestic water suppliers in the Upper Gunnison Basin
- Trout Unlimited
- High Country Conservation Advocates
- Coal Creek Watershed Coalition
- Lake Fork Conservancy
- Recreational Industry organizations (rafting businesses, Crested Butte Mountain Resort, anglers’ organizations)
- All federal and state land management agencies where relevant (USFS, BLM, BuRec, NPS, USFWS, NRCS, CPW).

Needs Assessment Inventories for the eight watersheds will be the first phase of the overall planning process: How will we deal with diminished water supplies (already down about 10% in the 21st century)? Increased pressure on water supply? This process is estimated to take four years (completed in 2020). Although each watershed is unique in its mix of uses, natural flows and other variables, a similar process will be used in assessing needs in each watershed, as follows:

- *Identify and engage key watershed stakeholders (water users and other water-related interests).* A watershed coordinator who is familiar with the watershed and its user groups will contract with the UGRWCD to do this down-on-the-ground work, compiling individual assessments of the *current and future* needs of both the individuals willing to participate and their watersheds as a whole – taking into account the probable decline of water supply due to climate change and growth, within and beyond the watershed.
- *Identify information and data gaps*, and address them, utilizing consultants with expertise when necessary or desirable.
- *Develop pilot studies and demonstration projects in each watershed* to identify best practices for efficiency, conservation and reconciliation of instream and diversion needs.

The CWCB grant (up to \$175,000) will be combined with matching funds from the UGRWCD and other sources to carry out these needs assessments over the next several years.

A Point of Frequent Confusion - 'Watershed Management Plan' and 'Stream Management Plan': 'Watershed planning' covers all water functions from the time precipitation hits the ground until it leaves the watershed in a stream (or more subtly, as groundwater merging with groundwater from another watershed). Each 'Watershed Management Plan' will also include a 'Stream Management Plan,' which involves the environmental needs and recreational uses of the surface water flowing through the watershed. Given the preponderance in Upper Gunnison watersheds of agricultural use outside of the flowing streams, a major element in both watershed and stream planning will be balancing the environmental needs of the streams with the agricultural needs in the larger watershed.

The needs assessments will begin with the Ohio Creek, East River and Lake Fork watersheds. Lessons learned there will be utilized as assessments begin on the other watersheds.

Once all eight needs assessment inventories have been completed, the planning partners will begin work on an overall Upper Gunnison River Basin Watershed Management Plan, determining the funding needed to execute best-practice projects and programs to address water quantity and quality needs identified in each watershed's inventory, and seeking those funds from state, federal and local sources. Such a plan in place will be necessary to obtain state and federal assistance.

We must emphasize that this will be an 'adaptive management' planning process. All we know for sure is that relentless population growth and climate changes will make the future of water in the west different from the past, so what we are planning for is ways to make our water use as efficient as possible, our watershed and stream ecosystems as healthy as possible, and our approach to the future as fully and creatively aware as possible, in order to adapt to whatever the future brings us with as much of our current mix of water uses still operational as possible.

Biography

Frank Kugel is the General Manager of the Upper Gunnison River Water Conservancy District. He is a registered Professional Engineer with a Civil Engineering degree from the University of Colorado – Denver. Frank was involved in geotechnical and construction engineering in the Denver area before joining the Colorado Division of Water Resources as a Dam Safety Engineer. He served in the Denver and Durango offices of DWR before moving to Montrose where he ultimately became Division Engineer for Water Division 4 (the Gunnison, San Miguel and lower Dolores Basins). Frank joined the UGRWCD upon leaving DWR in 2006. Frank served for eight years as the Gunnison Basin representative on the board of the Colorado Water Resources and Power Development Authority. Frank is currently on the Gunnison Basin Roundtable and is chair of its Basin Implementation Planning Subcommittee.

David Graf, Colorado Parks and Wildlife

Abstract

Opportunity for Spill Management on the Dolores River in 2017: A Collaboration of 'Spill Science'

The Dolores River below McPhee Dam has been the focal point for native fish management since it was recognized that the Dolores represents a relatively intact assemblage of three large bodied, important native fish species: bluehead sucker, flannelmouth sucker, and the roundtail chub. Recognizing the importance of these species, and in general, a restricted water supply that affected aquatic habitat and viability for these fish, CPW and other partners have worked through years of collaborative stakeholder efforts -the Dolores River Instream Partnership ('DRIP'), the Dolores River Dialogue ('DRD'), the Lower Dolores River Working Group, and the 'A Way Forward' Process - to craft a process plan or process that will sustain these populations into the future by capturing opportunities for improving fish habitat or flow conditions when these opportunities exist. The Lower Dolores River '*Implementation, Monitoring, and Evaluation Plan for Native Fish*' (2014) was the result of many efforts by many partners. This Plan focuses on capturing opportunities for improvements when they occur, and in particular, monitoring and evaluating the benefits or uncertainties in a given year. The greatest opportunity to use flow management to improve native fish habitats occurs when there is excess water supply coming into McPhee Reservoir (excess to fill needs and out-of-basin diversions), which allows for a managed spill event during spring runoff into the Dolores River below the dam. Winter 2017 brought an ample water supply to the Dolores basin, and a spill of sufficient magnitude was projected to allow for flexibility in how the spill was operated. This talk describes the collaboration of scientific efforts that occurred in spring and summer of 2017 - including native fish monitoring, groundwater-fluvial interactions, riparian vegetation response, and geomorphic effects; the 'real world' issues associated with monitoring and evaluation of ecological factors affecting native fish; and some caveats about the findings from these efforts.

Biography

David Graf currently works as Regional Water Specialist for Colorado Parks and Wildlife in Grand Junction. In this capacity, he roughly splits time between overseeing a portfolio of CPW water rights used on State properties on the western slope, promoting water stewardship on behalf of aquatic species at roundtables and stream planning processes, and opportunistically, does help do some river science. He currently serves as CPW liaison to the Yampa-White-Green and Colorado Basin Roundtables, and serves as an Advisory Council member to the Water Center at CMU. He has prior experience in the private sector as a hydrologic consultant, and has taught high school math, built houses, and sold retail gear to sustain interests in a variety of outdoor activities.

Jason Turner, Colorado River Water Conservation District and Kristina Wynne, Bishop-Brodgen Associates

Abstract

"Learning by Doing" on the Upper Colorado

Learning by Doing is a unique partnership of East and West Slope stakeholders who have a mutual interest in protecting the aquatic environment in the Fraser, Williams Fork and Upper Colorado River basins and their tributaries in Grand County, Colorado. The Learning by Doing partnership is a product of the visionary Colorado River Cooperative Agreement and Windy Gap Firing Project Intergovernmental Agreement which provide for:

1. Resolution of historic conflicts and a holistic approach to resolving Colorado water disputes;
2. Cooperative, long-term efforts to improve the health of the Colorado River mainstem and its

tributaries.

The Learning by Doing partnership is committed to building a stable, permanent working relationship that respects the interests and legal responsibilities of each organization while protecting and, where possible, enhancing the aquatic environments in Grand County.

Our presentation will focus on how the Learning by Doing group was established and the lessons that have been learned thus far regarding group organization and operating practices. In addition, we will discuss how the Learning by Doing stakeholders collaborate to address immediate stream health needs, how we select and prioritize stream restoration projects and the successful recent completion of Fraser Flats River Habitat Project.

Kristina Wynne Biography

Kristina Wynne is a senior project manager and hydrologist at Bishop-Brogden Associates (BBA), located in Englewood, CO. Her duties at BBA include water rights evaluations, hydrologic and streamflow analyses, water use accounting, historical use studies, nonconsumptive needs analyses, and field investigations. Prior to working at BBA, Kristina worked for various governmental, research, and non-profit institutions including the USGS, the National Center for Atmospheric Research, the Pacific Institute, and Trees, Water, & People. She earned a Bachelor of Science degree in Environmental Science with an emphasis on water resources from Oklahoma State University and completed a Master of Arts degree in Physical Geography at the University of Colorado at Boulder. Her graduate work was focused on hydrology and fluvial geomorphology and her thesis examines the relationship between high flows and invasive macroinvertebrates in Boulder Creek, Colorado. Kristina is a Certified Professional Hydrologist with the American Institute of Hydrology. She served as the president of the Colorado Section of the American Water Resources Association from 2012-2013 and served as the secretary for the Water for People Rocky Mountain Region Committee from 2008-2010. She was also named as one of the Colorado Foundation for Water Education's 2015 Water Leaders.

Jason Turner Biography

Jason V. Turner is Senior Counsel for the Colorado River Water Conservation District. Prior to joining the Colorado River District in 2008, Mr. Turner was in private practice representing public and private clients in all manner of water transactions and water court litigation.

3:35 Closing Remarks

Posters

Adapting a Natural-Flow Regime Paradigm on the Lower Dolores River: A call for a nonconsumptive needs quantification study and stakeholder cooperation to create a more dynamic flow regime

Rica Fulton, University of Wyoming

Abstract

The Dolores River rises in the peaks of the San Juan Mountains in Southwest Colorado. A tributary to the Colorado River, the Dolores has been reduced to minimal flows in the face of population growth, infrastructure, climate change, and outdated allocation schemes. Despite its remote geography, the Dolores is called upon by vast acres of irrigation, growing municipalities, and Native American water right settlements; leading to overwhelmingly minimal flows the majority of the year, draining the rich ecosystem of the water it needs to survive. It is crucial to discuss the complexities regarding the recent management and allocation of the Dolores River, current operations, and projected flows in the face of climate change. In an attempt to mitigate for diminishing flows, the idea of a Natural Flow Regime will be explained as an important paradigm for preserving the dynamic nature of the river. It will be

recommended that within the existing Dolores River Dialogue stakeholder coalition a non-consumptive needs study be undertaken. An outcome of this analysis will provide water managers with a better understanding of the quantitative and dynamic needs of non-consumptive entities downstream of McPhee Dam in order to protect the Dolores' treasured natural systems.

Biography

Rica Fulton is from Southwest Colorado and has always loved exploring local desert rivers and Headwater Mountains. The Colorado Plateau inspired her to pursue a career in environmental studies therefore earning a Bachelor of Arts in Environmental Policy and GIS from Fort Lewis College in Durango, Colorado. After working for two years at a Geospatial firm in Portland, Oregon, a perpetual passion for the Colorado River brought her back to the Colorado Plateau. Rica is currently obtaining her Master of Arts in Geography, Water Resources, and Environment and Natural Resources at the University of Wyoming in Laramie, Wyoming studying Upper Colorado River ecological flow regimes and instream flows. Rica is an active participant of the University of Wyoming SCREE expedition, a 90-day rafting trip commemorating the impact of John Wesley Powell on the communities along the Colorado River. Rica also runs the non-profit, The Upper Green River Network, a Colorado Riverkeeper Affiliate program.

Assessing the Impacts of Drought and Wildfire on the Colorado Front Range

Aaron Heldmyer, Ben Livneh, and Balaji Rajagopalan, University of Colorado Boulder

Abstract

The effects of drought and wildfire disturbances on the quality and availability of water are far-reaching and often difficult to predict, this providing a challenge to simulate. Hydrologic models have been applied to quantify the impacts of drought and wildfire on human and environmental systems in the western U.S., yet quantifying the impacts on these systems remains a greater challenge. In this study, we explore modifications to a meso-scale hydrologic model to portray the effects of drought and wildfire disturbance to improve predictions of future water supply and suspended sediment loading in disturbed watersheds on the Colorado Front Range. Stochastic weather sequences trained on historical dry-periods are used to create a range of synthetic drought conditions. Connections between historical dry conditions and wildfires are then incorporated to identify potential fire scenarios. Finally, wildfire disturbance is simulated through modification of soil and vegetation characteristics based on historical in-situ and remotely sensed observations. The results from this study have implications for future water management in the West.

Biography

Aaron received his B.S. in Environmental Engineering from the Colorado School of Mines in 2014 and is currently pursuing a Ph.D. at the University of Colorado - Boulder. During his undergraduate career, he was a member of the McBride Honors Program, studied abroad in Newcastle, Australia, and received an Honors Enrichment Scholarship to intern at TechIDEAS, a software development company in Barcelona, during the summer of 2014. Additionally, he participated in research investigating the effects of tailored, reclaimed water on the irrigation of turfgrass as an undergraduate research assistant. After graduation, Aaron spent a year in Akita, Japan as an English teacher, while volunteering at Save the Water, Inc., a nonprofit dedicated to water contamination research. His current research involves assessing and predicting wildfire impact on water resources in the western United States. Aaron is originally from Grand Junction, CO, and enjoys travel, exercise, painting, and hiking in the great outdoors.

Colorado Flood Magnitude and Timing: An exploration of possible climate change impacts

Christopher Pack and Gigi Richard, Colorado Mesa University

Abstract

The objective of this project was to analyze flood data for select stream gages in Colorado to identify if there is a discernable shift in the magnitude-frequency relationships associated with increased temperatures in Colorado (~1985) and if that shift varies with the river's flood regime. Historical daily mean stream discharge data were downloaded from the U.S. Geological Survey website and run through The Nature Conservancy's Indicators of Hydrologic Alteration (IHA) software. The hydrologic data were assessed using the IHA software to determine the timing of pre- and post-1985 1-day, 3-day, 7-day maximum flows and Date of Maximum flows. The mean and variance of these values were calculated to conduct comparative analysis of the timing of peak flows and change in variability of peak flows for the two different time periods (pre- and post-1985).

Biography

Christopher Pack is a senior Environmental Sciences student at Colorado Mesa University also double minoring in Biology and Watershed Sciences. Chris has spent the last two summers on water related projects; 2017 as a field technician for the No Chico Brush Project installing monitoring equipment used in the research of irrigation water use efficiency and 2016 as a student intern with the Hutchins Water Center at CMU. Prior to attending CMU, Chris competed 20 years of honorable service in the U.S. Army, retiring in 2014.

Watershed monitoring across the snow transition zone: An east slope-west slope comparison

***Gigi Richard, Craig Moore and Ross Fischer, Colorado Mesa University;
Stephanie Kampf, John Hammond and Abby Eurich, Colorado State University***

Abstract

Through a new collaborative research effort between Colorado Mesa University and Colorado State University, we established hydrologic monitoring sites that span the gradient of snow conditions in Colorado from high elevations where snow lasts through the winter to lower elevation snowpack that is more sensitive to drought and warming temperatures. The initial phase of study established hydrologic monitoring watersheds in intermittent, transitional, and persistent snow zones on the east slope and west slope of the Rocky Mountains in Colorado, and uses this monitoring network to improve understanding of how snow accumulation and melt affect soil moisture and streamflow generation under different snow conditions. We monitored six small watersheds (three west slope, three east slope) (0.8 to 3.9 km²) that drain intermittent, transitional, and persistent snow zones. At each site, we measured: streamflow, snow depth, soil moisture, precipitation, air temperature, and snow water equivalent (SWE). In 2017 monitoring was expanded into the San Juan Mountains. In our first season of monitoring, the west slope persistent and transitional sites had more mid-winter melt and infiltration, shorter snowpack duration, and lower peak SWE than the east slope sites. With our ongoing watershed monitoring across a broad range of snow conditions in Colorado, we continue to learn about the factors that increase or decrease streamflow in the headwater streams that supply the state's major rivers.

Biography

Gigi Richard, PhD, received her Bachelor of Science in civil engineering from the Massachusetts Institute of Technology with a concentration in water resources and environmental engineering. Richard went on to earn her Master of Science and PhD in civil engineering from Colorado State University in the Hydraulic Engineering Program. An associate professor of geology and Faculty Director of the Water

Center at Colorado Mesa University, Richard created the Watershed Science Program at CMU and teaches Water Science, Environmental Geology and GIS courses. The Water Center at CMU facilitates education, outreach, research and dialogue on water issues in the Upper Colorado River Basin.

Richard's research on human impacts on rivers systems includes the study of downstream impacts of dams, levees and other human activities on rivers in Colorado, New Mexico and New Zealand. Her recent work has focused on better understanding the hydrology and morphology of intermittent streams in western Colorado, on the impacts of vegetation removal on channel morphology of the Colorado River and on the need for peak flows to maintain the channel form of the Yampa and Dolores Rivers in western Colorado.

A resident of Colorado for 25 years, Richard has experience in private engineering consulting and served on water quality and land use planning commissions in Summit County, Colo. in the early 1990s. Richard's passions include growing, cooking and eating delicious locally-grown produce as well as hiking, biking and exploring the world.

Colorado Agricultural Meteorological nETwork — CoAgMET: Recent Updates and Future Plans

Zach Schwalbe, Colorado Climate Center

Abstract

The Colorado Climate Center's many roles in the state of Colorado include running the Colorado Agricultural Meteorological Network (CoAgMET, Colorado's Mesonet), drought monitoring, with a focus on the Upper Colorado River Basin supported by NOAA's National Integrated Drought Information System (NIDIS), and running the Community Collaborative Rail, Hail and Snow (CoCoRaHS) Network. CoAgMET is a network of 75 weather stations with a primary purpose of collecting the variables responsible for computing Reference Evapotranspiration in Ag areas. The CoAgMET network will soon be quite substantial as 11 new stations, all in W. Colorado are scheduled for installation this fall. Our new mapping system and high resolution data (5-minute updates) will make it quite easy and fun to track weather changes in the irrigated W. Slope river valleys.

Biography

Zach Schwalbe manages the CoAgMET network and the Colorado Climate Center while assisting on drought monitoring activities and climate data analyses. Zach got his start at the Climate Center working with the CoCoRaHS Network while attending Colorado State University as a Watershed Science student. After graduating, Zach stayed on with the Climate Center, eventually trading out a manual rain gauge for remote automated weather stations. When not traveling this beautiful state for work, Zach likes relax at home and travel the beautiful state for recreation, enjoying all the amazing activities Colorado has to offer.

Applying remotely-sensed cottonwood cover data to evaluate groundwater fluctuations in riparian floodplain aquifers in Southwest Colorado

Zach Sforzo, Gary L. Gianniny, Cynthia E. Dott, and William Scott White, Fort Lewis College

Abstract

Quantifying water availability has become imperative to understanding riparian ecosystems and maintaining water resources in the southwest. Here we investigate the possibility of using remotely sensed riparian woody vegetation cover values as a proxy for floodplain aquifer variation. On the Dolores River in southwestern Colorado, narrow-leaf cottonwood (*Populus angustifolia*) has decreased in both canopy cover and annual growth during periods of drought due to its intense reliance on floodplain aquifers (Dott et al., 2016; Coble and Kolb, 2012). This study uses data from a regulated

section of the Dolores River, where percent cover values for *P. angustifolia* have been measured on the ground since 1989, and groundwater levels have been monitored since 2010 (Dott et al., 2016). River discharge and riparian aquifer groundwater levels in this system co-vary. GIS analysis of remotely sensed images is an effective technique to quantify inter-annual variation in canopy cover in riparian systems (Kamp, et al. 2013; Qi, et al. 2000). So far, we have tested the efficiency of cover values derived from National Agriculture Imagery Program (NAIP) color infrared (CIR) imagery by comparing it to cover values obtained by ground measurement at our study site. Next, we are working on quantifying and illustrating the correlation between groundwater levels and canopy cover values. Ultimately, we will determine whether; 1) the GIS-derived cover values prove to be an effective method when compared to traditional vegetation cover methods, 2) the correlation between groundwater levels and cottonwood cover can be used as a proxy to estimate groundwater levels for years without well data on the Dolores River, 3) this correlation can be used to estimate groundwater levels of other downstream river sections on the Dolores River. This technique of using remotely sensed cover values of woody vegetation as a proxy for groundwater availability may have implications for historical investigations of past droughts, and predictive power for the impacts of decreased water availability in the future.

Biography

Zach Sforzo is a senior at Fort Lewis College receiving his B.S. in geology and GIS Certificate in December 2017. Zach grew up in the Rocky Mountains near Vail, Colorado and received an A.A. from Colorado Mountain College in Edwards, Colorado before attending Fort Lewis College in 2015. Zach uses his GIS and geology background to tutor other students through the Native American Center at Fort Lewis College and his primary foci include groundwater geology, hydrology, GIS and GIST, geological engineering, sequence stratigraphy, and petroleum geology. Zach Sforzo is the President of the American Association of Petroleum Geologists Student Chapter at FLC and through this he strives to provide his colleagues with industry field trips, subject talks from professionals, and overall networking opportunities for students with professionals and alumni. After graduation, Zach plans to experience the geology industry before attending graduate school.

Earlier snowmelt may alter mountain water resources through the timing of plant growth

Wilmer, C., Steltzer H., Wales S., Falco, N., Wainwright, H., Henderson, A., Patterson, L., Enquist, B., Wang, S., Hao, Z., Karaoz, U., Wu, Y., Brodie, E., Williams, K., Fort Lewis College and Rocky Mountain Biological Laboratory

Abstract

Earlier snowmelt in mountain watersheds is a manifestation of climate warming and increased dust deposition, the latter of which is associated with a sharp decrease in snow albedo. The date of snowmelt is a key driver of plant emergence phenology, i.e. the timing of first leaf growth. Advanced snowmelt can trigger some species to emerge earlier, leading growth to become decoupled from favorable atmospheric temperatures, nutrient pulses, and well-established biotic interactions. Ultimately, early summer emergence may leave plants vulnerable to foreshadowing drought.

In the East River watershed near Crested Butte, Colorado, our multidisciplinary team (<http://watershed.lbl.gov/community-observatory>) monitored green-up, flowering, and senescence of numerous plant species at six meadow sites along an elevation gradient (9100-11700 ft/ 2774-3566 m). Phenological observations in 2017 began shortly after snowmelt in early May (lower montane and lower subalpine life zones) and late June (upper subalpine and alpine life zones). Observations of individual plants for all species were coupled with plot-level microclimate and surface greenness monitoring across four sites. Species at montane and lower subalpine sites emerged 1-2 months earlier than at upper subalpine and alpine sites. These species and site specific measurements were compared to remote sensing observations of greenness and confirmed that earlier emergence exposes plants to longer periods of water scarcity between snowmelt and the onset of monsoon rains (foreshadowing drought).

In parallel, we are developing a DNA-based barcoding of plants in order to create an inventory for these species-rich mountain meadows as well as connecting above-ground plant traits with below-ground root traits. Our results from this year inform our understanding of leaf expansion and its relationship to first flowering dates. We will further develop insights by initiating early snowmelt manipulations at four of these sites in spring 2018. We predict that at lower elevation sites, snowmelt will shift plant growth and water use seasonally, decreasing the water resources typically available at these sites. Alternatively, higher elevation sites will be constrained by temperature and greater snow depth, limiting the effect of earlier snowmelt on plant growth and water use.

Chelsea Wilmer Biography

Chelsea recently graduated from Fort Lewis College with a degree in Environmental and Organismal Biology and has taken a special interest into the biogeochemical interactions associated with plants. She has been working as a research assistant for Heidi Steltzer in Crested Butte, Co for just over a year and hopes to carry the work she's been doing into a masters program.

Heidi Steltzer Biography

Heidi Steltzer, Ph.D. Heidi is an environmental scientist, an explorer, and a science storyteller, sharing her passion for science with others. She goes where others don't go, and is bravely working to say what others aren't saying about science, leadership and climate change. She is an Associate Professor at Fort Lewis College, Colorado. She studies how environmental changes affect mountain watersheds and Arctic systems and their link to our well-being. Heidi's research has been published in *Nature* and featured in the media, including the *New York Times*. Find her on twitter and Instagram @heidimountains, Facebook @heidisteltzermountains.

Exhibitors

- Colorado River Research Group - <http://www.coloradoriverresearchgroup.org/>
- Mesa County Noxious Weed & Pest Management - <http://www.mesacounty.us/pest/contact-U.s.aspx>
- Middle Colorado Watershed Council - <https://www.midcowatershed.org/>
- Trout Unlimited Colorado River Program - <https://www.tu.org/tu-programs/western-water>
- Upper Colorado River Basin Endangered Fish Recovery Program - <http://www.coloradoriverrecovery.org/>

Sponsors

- Ute Water Conservancy District - <https://www.utewater.org/>
- Colorado Water Conservation Board - <http://cwcb.state.co.us/Pages/CWCBHome.aspx>
- Walton Family Foundation - <http://www.waltonfamilyfoundation.org/>
- City of Grand Junction - <http://www.gjcity.org/>
- Colorado River District - <http://www.coloradoriverdistrict.org/>
- SGM - <http://www.sgm-inc.com/>
- WestWater Engineering - <http://westwaterco.com/>
- Western Water and Land - <http://www.westernwaterandland.com/>