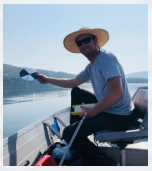


John Babcock, Project Hydrogeologist, Water & Environmental Technologies
John Babcock is a hydrogeologist with Water & Environmental Technologies (WET) in Butte, MT. He has worked in the environmental field since 2000, conducting numerous water quality studies on streams, ponds, lakes and reservoirs throughout Montana and the Western US. He is also heavily involved with groundwater monitoring and stormwater management, and has conducted annual sampling at Little Bitterroot Lake since 2008. In his free time, John enjoys exploring the outdoors with his two sons, and honing his skills at the local curling rink.

Little Bitterroot Lake Association - 20 Years of Collaborative Science
The Little Bitterroot Lake Association was formed in 1988 with the purpose of preserving the recreational value of Little Bitterroot Lake, maintaining its aesthetic integrity, and educating users about the value of the lake as a recreational resource. Since 1999, water quality monitoring has been conducted on the lake and surrounding watershed to provide a baseline of nutrient data, analyze trends, and help prioritize management decisions that may affect the water quality of the lake. Sampling has primarily included nutrients, chlorophyll-*a* in water and benthic substrate, field parameters, and depth profiles to evaluate stratification. Additional sampling has also been conducted for metals, sediment, radioactive elements, and aquatic invasive species as water quality issues emerge. This presentation will discuss the water quality status of Little Bitterroot Lake and trends over the past 20 years of monitoring, including recent sampling and prevention measures for aquatic invasive species. This talk also showcases the unique collaboration between members of the lake association, the community of Marion, regional scientists, and the Marion elementary school.

Tom Bansak, Assistant Director, Flathead Lake Biological Station (Moderator)
Starting at FLBS in 1996 as a graduate student studying river ecology on the Middle Fork Flathead, Tom has since led research activities on large, pristine salmon rivers in Northern British Columbia and Southeast Alaska, conducted water quality investigations around NW Montana, constructed environmental sensor networks on Flathead Lake and the Middle Fork Flathead River, and been active in the battle against Aquatic Invasive Species. At the Bio Station, Tom is also an educator. He gives presentations to any and every type of audience (i.e.. K-12 school groups; university students; professional, community and service groups; and anyone who will listen). Tom also oversees the Bio Station's development activities. Tom and his family live at the base of the Swan Mountains near Bigfork, spending a lot of time hiking, paddling rivers, skiing and shoveling snow.

Carla Belski, Community Services Coordinator, City of Whitefish
Carla has a bachelor's degree in Environmental Studies from the University of California at Santa Cruz. She has diverse experience in natural resource and recreation management including six years as a Wilderness Ranger with the US Forest Service, twelve years as the founding director for the Bob Marshall Wilderness Foundation, and three years with Whitefish Legacy Partners. In her role with the City, Carla manages City Beach, the Aquatic Invasive Species Watercraft Inspection Program, volunteers, events, and projects on the City's bicycle and pedestrian trail system. She is a grant writer and City representative on the Whitefish Trail Operations Committee.

Aquatic Invasive Species (AIS) risk management at a local level: The Whitefish AIS Management Program
Since 2013, the Whitefish Lake Institute has recommended a local AIS Management Program to the City of Whitefish to prevent the introduction and spread of AIS to local lakes. Each year, the City has approved the program and provided a funding commitment. The program focuses on early detection monitoring for dreissenid mussels and Eurasian watermilfoil (EWM) via microscopy and/or eDNA analysis, macrophyte surveys, control and eradication of EWM in Beaver Lake, a watercraft inspection and decontamination program, and an annual program report. In 2017, the watercraft inspection program amplified based on the Montana FWP announcement in late 2016 of Dreissenid mussel larvae found east of the Continental Divide. The City passed an Ordinance requiring watercraft to be inspected prior to launch in Whitefish Lake and signed an MOU with the State of Montana for program operations. Watercraft inspection stations expanded at the two access points; City Beach and Whitefish Lake State Park. The staffed inspection season runs from May 1-September 30 with an on-line self-certification for non-motorized hand launched vessels, and for all watercraft during the non-staffed season. Due to congestion and traffic pattern issues at the launches, the program expedites the inspection process by offering exit seals to watercraft users as they leave the lake. Users with an intact seal can then re-enter Whitefish Lake without the need for a full inspection. A preventative decontamination station at an off-site location services high-risk watercraft defined through an approved algorithm.

Mark Bostrom, Division Administrator, Conservation and Resource Development Division (CARDD), DNRC
As Administrator of the Conservation and Resource Development Division at DNRC, Mark leads a small division devoted to improving natural resources and related infrastructure throughout the state. He attended Western State College and received a Bachelor of Arts degree in Business Administration in 1987. His early professional work was in environmental analytical laboratories in Colorado and Utah. Mark moved to Helena Montana in 2003 where he began working with the Department of Environmental Quality as its first Quality Assurance Officer and later as Bureau Chief for Water Quality Planning. He has been with DNRC since 2014. Mark has also served on the Board of directors of two non-profits, the Montana Watershed Coordination Council, which he led through incorporation and achievement of non-profit status as the organization's first Board Chair, and more recently as a director with the Blackfoot Challenge.

Forms of Organizations – From NGOs to subdivisions of Government
State agencies, Counties, Cities, Boards, Commissions, Districts, 501(c)3's, 501(c)4's, and even 501(c)12's! With so many forms of organizations having interest in natural resources, it can be beneficial to understand the "101" of their origins in law. This presentation will not be an exhaustive review of all possible forms of organizations. Rather, it will focus on the most common forms I've worked with in my 15 years with the State of Montana and by using DNRC as a starting point. The conference will provide an excellent opportunity to engage stakeholders and citizens on this important information. Content will follow the thread of a Title 2 state agency (DNRC), its relationship to Conservation Districts, five of its administrative attachments (FBC, UC3, MISC, RRC, GCC) and contractual relationships that may exist to all with various forms of private entities.

Sam Bourret, Fisheries biologist, Montana Fish, Wildlife & Parks
Sam is a fisheries biologist with Montana Fish, Wildlife & Parks who is interested in native species conservation, illegal fish introductions, and using geochemistry to reconstruct fish life history.

How fish otoliths can be used as a forensic tool
Illegal fish introductions create some of the most challenging problems for resource managers because of their potential to harm existing recreational fisheries and their impact on species of conservation concern. Determining the origin of a suspected illegal fish introduction can aid managers in preventing the colonization and subsequent ecosystem impacts of introduced species. Naturally occurring elements and isotopes in fish otoliths have been used to understand fish migration, stock composition, and natal origin for over twenty years. This presentation will describe how fish otoliths can reveal important information about illegally introduced fish.

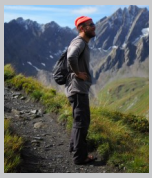
Edward Cameron, Ph.D. Global Climate Change Strategist, Climate Solutions (Keynote)
Dr. Edward Cameron is a specialist in climate change and human rights. For over two decades he has worked with governments, philanthropies, companies, civil society, academia, and across the UN family to build a just and sustainable world. He served with the European Union, the government of the Maldives, the World Bank, the World Resources Institute, and recently five years as Managing Director at BSR, a global private-sector facing non-profit, working with close to three hundred multinational corporations to reduce greenhouse gas emissions and enhance climate resilience. Dr. Cameron holds a Ph.D. in business, economics, and social sciences, having conducted 10 years of doctoral research on climate justice. He currently works as a senior advisor to the Red Cross Red Crescent Movement, the Government of Ireland, the Global Commission on Adaptation, and The Asia Foundation. He lives in Manchester, VT with his wife and two sons. (Cont.)

A just and sustainable world: Building low-carbon, climate-resilient and inclusive economies

Climate change represents an immediate and far-reaching threat to jobs, homes, health, human rights and lives. It also represents a material risk to economic development, undermining our efforts to build prosperous societies that work for all. However, the transition to a low carbon, climate resilient, and inclusive world has begun. The landmark Paris Agreement provides a blueprint for this transition and close to 200 governments around the globe have responded with ambitious climate policies. The private sector is also rising to the challenge, with over 6000 companies, representing more than $30 trillion in market value, now making commitments to reduce greenhouse gas emissions and build societal resilience. This keynote presentation will examine climate risk, assess both public and private responses, and illustrate how each of us can contribute to building a just and sustainable world.

Kate Cassidy, Registered Sanitarian, Flathead County Health (Panelist)

Kate is a University of Montana graduate with a Bachelor of Science in Microbiology. While attending the U of M, she was on a work study program at the Missoula City-County Health Department in the Air Quality Program, where she started her career in public health. After graduation she worked on several EPA super fund projects using microbes for remediation (bioremediation), one including the Berkeley Pit in Butte. She has been a Registered Sanitarian for 15 years, 12 of those with Flathead County in the Environmental Health Department.



Bryce Christiaens, Weed District Manager, Missoula County Weed District (Moderator)

Bryce has been working on invasive species issues for 18 years, beginning as a research technician for the University of Montana's Conservation Lands Program. He has been the weed district manager for the Missoula County Weed District since 2011 and currently serves as the Chair for the Montana Invasive Species Council.

Holly Church, Education Coordinator, Flathead Lake Biological Station

Holly designs curriculum to be used in the classrooms and/or at the biological station, conducts field trips for visiting school groups, teaches lessons in classrooms at schools in the Flathead Valley, and coordinates the logistics of the summer session courses. When Holly is not engaged in educational activities for the biological station, she works as laboratory technician extracting and processing DNA and RNA samples collected in ocean and freshwater habitats.

Creating New AIS Teaching Material to Meet the Next Generation Science Standards (Poster)

Holly Church and Monica Elser

Educators at the Flathead Lake Biological Station are creating new teaching material related to aquatic invasive species that will meet Montana's new science standards as well as the Next Generation Science Standards. They are working with middle school teachers, scientists and community members to develop the material and test it in various classrooms. They will work with a local non-profit (the Flathead Lakers) to train volunteers to deliver this material in area classrooms. The lessons will use innovative teaching strategies that are being encouraged through the Next Generation Science Standards.

Matthew Church, Associate Professor, Aquatic Microbial Ecology, Flathead Lake Biological Station

Church is a microbial ecologist interested in the role of microorganisms in catalyzing the movement of energy and material through aquatic ecosystems. He seeks to link the ecological dynamics of specific microorganisms to ecosystem processes, including transformations of nitrogen, phosphorus, and carbon. A major focus of his group has been elucidating the role of marine microbes in driving components of the nitrogen cycling, including targeting the ecological dynamics of organisms involved in nitrogen fixation, nitrification, and nitrogen assimilation. As part of this work, they link the diversity and physiological activities of specific groups of microorganisms to rates of elemental cycling, and evaluate sensitivities of these processes and microbes to temporal and spatial changes in aquatic habitats.

Variability and dynamics of microbial abundance, diversity, and activity in Flathead Lake

Matthew J. Church, John Ranieri, Emma K. Wear, Tyler Tappenbeck, Shawn P. Devlin, James J. Elser

Despite decades of studies on the ecology and hydrographic dynamics of Flathead Lake in northwestern Montana, to date, there is limited information available on microorganisms that inhabit this oligotrophic lake. Over the past two years, the FLBS has conducted time-series sampling at Mid-Lake Deep, the long-term field site of the Flathead Monitoring Program, to quantify microbial abundances, examine time-varying patterns in microbial photophysiology, and elucidate temporal variability in the diversity of planktonic bacteria. Our results highlight pronounced seasonal forcing of microbial dynamics. In particular, flow cytometric quantification of non-pigmented picoplankton (<3 μm), cyanobacteria, and photosynthetic picoeukaryotes revealed that convective overturn of the lake in the late Fall vertically homogenizes populations of these organisms. With the onset of stratification in the spring, abundances of photosynthetic picoplankton increased rapidly in the epilimnetic waters. Cellular abundances in the epilimnetic waters averaged 6.7×10^5 cells mL^{-1} with non-pigmented bacteria consistently dominating (94%) microbial abundances. Cyanobacteria averaged 3.5×10^4 cells mL^{-1}, demonstrating maximal abundances in the dimly-lit subsurface waters during the summer months. Such physical forcing of the lake also influences the emergent photophysiology of lake microbes. Moreover, amplification and sequencing of 16S rRNA genes provided additional insight into seasonal variability in the phylogenetic composition and diversity of resident bacterial communities. Overall, the results highlight the utility of time-series observations for insight into the dynamics of microorganisms in this seasonally modified, oligotrophic lake.

Anna Cook, High School Student, Whitefish High School

A junior at Whitefish High School, Anna loves everything outdoors Montana has to offer, she plays soccer, runs track, and skis. She partakes in the FREEFLOW field science and ecology club, is an officer for the DECA business club, and plans to major in Environmental Sciences at Eastern Washington University.

Water quality changes on Riverside Park Stormwater Pond (Poster)

Anna Cook and Ian Lacey

We have gathered water quality data from the Riverside stormwater retention pond in Whitefish, MT twice using a Hydrolab MS5. Although the pond has now frozen over, our experimentation will continue throughout the winter. By comparing water quality in fish tanks, we will be able to more closely monitor and witness the effect that floating islands have on storm water. We are using three fish tanks, all filled with stormwater from the retention pond. Tank 1 will serve as a control and will have no floating island and no aeration; tank 2 will have a floating island, but no aeration, and tank 3 will have a floating island and an aeration system. Our goal is to compare the water quality and biofilm growth in the three tanks. The comparison of tanks 1 and 2 will show the effects of floating islands on their own, and comparing 2 and 3 will highlight the effects of aeration. Once the pond is no longer frozen, we'll resume testing outdoors, and likely continue our indoor test so we can collect as much data as possible.

Lori Curtis, Science & Education Director, Whitefish Lake Institute

Lori is the author of the *Flathead Watershed Sourcebook: A Guide to an Extraordinary Place*, a book and companion website that illustrates the natural and cultural histories of the Flathead Watershed, while detailing biodiversity, water quality, land management, agricultural production, and economics. It is used by educators in grade schools through colleges throughout Montana. She was editor of *Voices of Our Lakes,* a co-coordinator of the of the *Montana Lake Book third edition,* co-authored the *Whitefish Water Resources Report: A Status of the Whitefish Lake Watershed* (2015) and was lead author on the *Investigation of Septic Leachate to the Shoreline Area of Whitefish Lake (2012).* Lori has a Master of Science in Environmental Studies from Green Mountain College where she is a Master's Instructor and Thesis Advisor. She serves as chair of the Upper Columbia Conservation Commission and as a Supervisor on the Flathead Conservation District. (cont.)

Giving citizens a voice in water quality stewardship (Poster)

With rapidly increasing pressures from human development on limited water resources, the Whitefish Lake Institute (WLI) last year focused its outreach efforts on engaging community members in urgently needed water quality stewardship. It is citizens who hold the power to make a difference in the health of our water. In 2015, WLI scientists developed the first ever status report on the Whitefish Lake Watershed which will benefit resource managers long into the future. However, communicating decades of research, complex water quality issues, and several hundred pages of scientific information to a community audience would be a daunting task. We therefore developed a communications project to enable meaningful connections and engaging communications amongst resource managers and community members. The goal of the project was to unite the community by giving individuals an opportunity to define and take ownership in the changes that need to be made. The resulting product was "Voices of Our Lake," written by community members describing their history with—and personal connection to—Whitefish Lake and the surrounding area. Woven throughout its pages are key results from WLI's status report paired with citizens' concerns and actionable measures they can take to protect their water quality.

Hilary Devlin, Education and Outreach Coordinator, Flathead Lakers

Hilary originally hails from the lakes region of northern Wisconsin. She earned a bachelor's degree in Marine and Environmental Science and a master's degree in Ecology at the University of St. Andrews in Scotland. Hilary served as Director of the Youth Conservation Corps for a regional Conservation Alliance in Maine, where she conducted outreach to raise awareness about and solve nonpoint source water pollution problems. She also has experience as a research station supervisor, lab manager and a scientific journal copy editor. She loves introducing her three young sons to the marvels of the natural world. She is an avid birdwatcher and enjoys fly fishing, gardening, and hiking.

Citizen science and stewardship actions to protect Flathead Lake and watershed

Hilary Devlin and Constanza von der Pahlen

The Flathead Lakers implement stewardship and outreach/education programs to engage landowners along rivers and lakes to take actions to protect or improve water quality in Flathead Lake and its watershed. This talk will highlight two programs, a new Citizen Science program and long-term Flathead River to Lake Initiative stewardship project. The *Flathead Lake Citizen Science Initiative*, a new collaborative program with the Flathead Lake Biological Station, engages citizens in water quality monitoring and other research topics throughout Flathead region. Citizens participate in meaningful projects that improve their understanding of Flathead Lake and watershed, and contribute to great science. The initiative's first project, the Flathead Lake Secchi Dip-in, engaged over 60 individuals, including kids, grandkids, university students, retirees, and summer and local residents. Participants measured water clarity at 65 different sites around Flathead Lake in late July and early August. The *Flathead River to Lake Initiative* is a successful collaborative effort to conserve and restore our Flathead River natural heritage. The Flathead Lakers created this partnership in 2000 by bringing together government agencies, conservation groups, and landowners to identify, conserve and restore critical lands - floodplains, wetlands, riparian forests, shallow groundwater, and prime agricultural soils. These 'critical lands' provide multiple benefits, from ecological services such as protecting water quality, native fish and wildlife habitat, to recreation, scenic beauty and productive farm lands. The Initiative has protected 6,000 critical lands, most of the floodplain of the Flathead River - our initial focus area – and additional lands throughout the Flathead Watershed.

Shawn Devlin, Ph.D. Aquatic Biologist, Assistant Research Professor, Flathead Lake Biological Station

Dr. Devlin also serves as Whitefish Lake Institute's part-time Aquatic Ecologist. His research has focused on trophic interactions, long term data, littoral zone dynamics, ecosystem modeling, and benthic microbial function. He is a proud resident of Ferndale, MT, where he lives on Two Bucket Farm with his wife and three boys!

Lake Ecology 101: How biology, chemistry and physics interact to shape how lakes function (Conference Workshop)

This short course in Lake Ecology will address how lake ecosystems are shaped by physical, chemical and biological processes. Core limnological concepts such as primary production, food webs and fisheries will be examined in context of the feedbacks, controls, and interactions between major physical drivers, biogeochemistry and biota. The course will also address current major threats to Montana lakes such as eutrophication and invasive species by delving into how these threats alter interactive physical, chemical, and biological regulatory mechanisms.

A tale of two lakes: The similarities, differences, and meaningful trends between Flathead and Whitefish Lake long term datasets

It was the best of lakes. It was the… well… best of lakes! Long-term data collection has proved to be an invaluable resources for understanding temporal dynamics in ecological systems. Data trends and patterns identified over long periods of time are integrative, highly meaningful, and offer deep insight to how stochastic, pulsed, and pressed influences manifest within systems. Flathead Lake and Whitefish Lake both have extraordinary long term data sets focusing on limnological measurements of chemistry and biology. These two datasets offer a nearly unparalleled opportunity to investigate trends and properties independently to assess within lake variability through time, but also together to determine if variations and changes through time are occurring at the regional scale. The long term data shows that each lake has undergone changes in nutrient loading over time, however the magnitude is lake dependent. Here, we examine Flathead Lake and Whitefish Lakes' long term datasets for co-variation, correlation and time dependent trends to gain insights to regional wide controls of lake systems.

Chris Downs, Supervisor Fisheries Biologist/Program Manager, Glacier National Park

Chris has been the Fisheries Program Manager for Glacier National Park since 2009. Prior to joining GNP, Downs was Aquatic Program Leader for the Avista Mitigation Program, Idaho Dept. of Fish and Game from 2000 through 2007, Senior Fisheries Research Biologist, Idaho Dept. of Fish and Game from 1997 through 1999, Fisheries Research Associate, Montana State University from 1995 through1997. He has a BS in Natural Resource Management from the University of Massachusetts –Amherst and an MS in Fish and Wildlife Management from Montana State University-Bozeman.

Dealing with uncertain outcomes by diversifying management approaches

Christopher C. Downs[1] and Jonathan McCubbins; Clint C. Muhlfeld and Vincent D'Angelo

Physical habitat stressors such as habitat degradation, population fragmentation, and climate change act synergistically with biological stressors such as invasive fish to put unprecedented pressure on some native fish species. Case in point, the expansion of invasive lake trout within the Flathead Basin has dramatically reduced the ability of protected areas with largely pristine physical habitat, such as Glacier National Park, to serve as refuges for native species like bull trout. We are applying a holistic, multi-pronged strategy of restoration, isolation, monitoring, and population replication to maximize the ability of Glacier's landscape to provide secure habitat for bull trout and other native fish species into the future. This program is relatively unique due to its comprehensive nature and its implementation in a backcountry Wilderness setting. The program requires a close linkage of research and management, while navigating competing/complex policy mandates and public opinion, as well as challenges in implementing field tasks that would be considered straight-forward in a front-country, non-Wilderness setting. The talk presents a variety of approaches utilized that may aid others working to address similar resource challenges.

James Elser, Ph.D., Director, Flathead Lake Biological Station

James Elser is Bierman Professor of Ecology of the University of Montana and since March 2016 has been Director of UM's Flathead Lake Biological Station at Yellow Bay. He also holds a part-time research faculty position in the School of Life Sciences at Arizona State University. Trained as a limnologist, Dr. Elser is best known for his work in developing and testing the theory of ecological stoichiometry, the study of the balance of energy and multiple chemical elements in ecological systems. Currently, Dr. Elser's research focuses most intensively on Flathead Lake as well as mountain lakes of western Montana and western China. Previous field sites have included the Experimental Lakes Area in Ontario, Canada; lakes of the Arctic and of Patagonia; grasslands of Inner Mongolia; and desert springs in Mexico's Chihuahuan Desert. From 2012-2017 he served as leader of the NSF-funded Phosphorus Sustainability Research Coordination Network and currently is the director of the Sustainable Phosphorus Alliance, a member organization designed to facilitate the implementation of P sustain-

(cont.)

Advancement of Science (AAAS) as well as a foreign member of the Norwegian Academy of Arts and Sciences. In 2012 Dr. Elser received the G.E. Hutchinson Medal of the Association for the Sciences of Limnology and Oceanography (ASLO), the world's largest scientific association dedicated to aquatic sciences. In 2014-2016 he served as ASLO's President. Dr. Elser holds a Ph.D. from the University of California (Davis), an MS degree from the University of Tennessee, and a BS degree from the University of Notre Dame.

The state of (some) Montana lakes (Plenary)

According to Wikipedia, there are 3323 named lakes and reservoirs in Montana. These water bodies contribute enormously to the well-being of Montana's citizens, both economically and culturally. This talk will review the water quality status of Montana's lakes relative to those elsewhere (they're doing pretty well!) as well as ongoing dynamics in Montana's largest (and best?) lake, Flathead Lake. Jim Elser will also discuss the future of Montana's lakes in the face of ongoing challenges, including invasive species and climate change. In doing so he will introduce you to some of Montana's newest lakes, those appearing in the wake of glacier retreat in Glacier National Park. He calls upon Montana's limnologists and natural resource managers to work together to advance our understanding of these dynamics so that we might mitigate adverse impacts and assure that future Montanans can continue to enjoy our collective legacy of lakes.

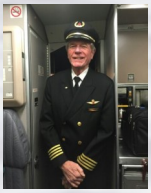
A glimpse of fading glaciers: impacts on life in mountain regions (Community Presentation)

Jim Elser & Erich Peitszch

Alpine glaciers, such as the glaciers in Glacier National Park, have been landscape features for thousands of years. They play integral roles in mountain regions. They are essentially frozen reservoirs of water that release cold water in late summer when streams might otherwise have low flows or no flows. Sustaining and cooling streams are functions that several known species of aquatic insects, such as the meltwater and western glacier stoneflies, have come to rely upon. Native fish species, such as cutthroat trout, have evolved in the presence of sustained cold-water inputs from glaciers and are threatened by hybridization facilitated by warmer stream temperatures. In some places, glacier meltwater provides drinking water for communities. Glacier meltwater also sustains farms and fuels recreation (boating and fishing). Thus, local economies and livelihoods are connected to glacial inputs in many ways. As alpine glaciers continue to retreat in coming decades, there will be a reduction in water input at the same time that demand is rising. Finally, shrinking glaciers are creating novel aquatic environments in the alpine zone in the form of new streams and lakes. Processes ongoing in these novel ecosystems are virtually unknown yet they likely shape the quality of water as it starts its journey from alpine headwaters to your kitchen faucet. USGS scientist Erich Peitzsch will provide an overview of ongoing changes in alpine glaciers and snow cover both globally and locally as well as of the associated landscape changes that are unfolding. Dr. Elser will then describe some impacts of these changes on mountain streams and lakes, including novel studies of "newborn" lakes in Glacier National Park.

Monica Elser, Education Liaison, Flathead Lake Biological Station

Monica Elser is the Head of Sustainability Education with the Broader Impacts Group at the University of Montana and the Education Liaison at the Flathead Lake Biological Research Station. Monica spent many years engaged in limnological research and published her work in a wide range of scientific journals. She moved out of science research and into working to enhance science and sustainability science education within the K-12 community. She has since published her work with students and teachers in a variety of education journals. (see Holly Church for abstract)



Dan Handlin, Member, Little Bitterroot Lake Association

Dan started his 50 years of flying experience in 1966 at Logan County Airport in Lincoln, Illinois. He took his dream of flying and playing college football to the Air Force Academy, where he graduated in 1973 in the top of his USAF Pilot Training Class. A few years later still in his twenties he became a C-141 Aircraft Commander Flight Examiner and Squadron Flight Safety Officer. His career has been in 17 different cockpits, ranging from Aeronica Champ to Airbus 320. Dan also completed a 27 year USAF career, both active and reserve duty retiring in 2001. Dan lived in the Twin Cities of Minneapolis/Saint Paul for 16 years. During that time, he watched the lakes of Minnesota become devastated by aquatic invasive species. Boat launches became so infested with milfoil that a machine had to cut a path to get the boats out. After moving to Little Bitterroot Lake in Montana, he spearheaded an aggressive charge to drive our focus and energy to combat AIS. He joined the Little Bitterroot Lake Association Board of Directors in 2017 and has been instrumental in the protection of the lake ever since.

Changing our World - One lake at a time: The Little Bitterroot Lake story

The Little Bitterroot Lake Association (LBLA) recognizes that to defend against Aquatic Invasive Species (AIS) two things must happen: 1) Establish partnerships in order to efficiently and effectively use our resources; and 2) Build and recruit major new localized defensive resources. LBLA has developed a Local Boaters Active Defense Program that turns today's passive boaters into tomorrow's active boaters in four stages. The first stage is to *observe* other watercraft (especially those from outside our area) that are launching in Little Bitterroot Lake to assess risk and to solicit their help in the defense process. The second stage is to *inquire* about their level of knowledge related to the identification, transportation of vectors, and effects of AIS. The third stage is to *warn* boaters about Montana laws related to transporting AIS. The fourth stage is to *report* and document any watercraft with suspected AIS or suspicious activity. The program ensures that locals understand they must take action so the process of mitigating and eliminating the introduction of AIS into Little Bitterroot Lake is immediate. Thus far local boaters are enthusiastic and supportive of these efforts. They recognize that if they want to keep fishing/boating and enjoying our lake, they must be active boaters. The Local Boaters Active Defense Program has created a stronger force against AIS in Little Bitterroot Lake.

Cynthia Ingelfinger, Science & Education Coordinator, NWMTLVMN Coordinator, Whitefish Lake Institute

Cynthia is the Science and Education coordinator for the Whitefish Lake Institute where she conducts educational programs and baseline research and fieldwork. She also coordinates the Northwest Montana Lakes Volunteer Monitoring Network (NWMTLVMN)—the long-standing citizen science program managed by WLI and funded by Montana Fish, Wildlife & Parks. She has a degree in Environmental Studies from Brown University and a Master of Science from the Field Naturalist Program at the University of Vermont.

Northwest Montana Volunteer Lakes Monitoring Network (NWMTLVMN)

The NWMTLVMN is a partnership between Montana Fish, Wildlife & Parks and the Whitefish Lake Institute. Fifty volunteers monitoring a total of fifty locations on forty-one lakes in Flathead, Lake, Lincoln and Missoula counties. The lakes represent diversity in public use, accessibility and morphology. Our mission is to recruit and train volunteers to monitor water quality, identify and report aquatic invasive species (AIS) and promote watershed stewardship in northwest Montana. Through this program, we train citizen scientists to collect basic limnological measurements that will establish lake trend data over time and monitor for the presence of AIS. Many of these lakes previously had no scientific data. Volunteers monitor Secchi disk depth and temperature; and also serve as reporters for AIS or any major or sudden changes that may be observed in or around a lake. Each summer, a WLI scientist visits each site to collect chemistry samples and physical parameters using a Hydrolab. Plankton samples are collected each year for detection of larval zebra/quagga mussels. An annual report is prepared by WLI detailing water chemistry results and dissolved oxygen and temperature profiles and provides interpretation and discussion for management purposes. The partnership enables WLI to extend its monitoring reach through volunteer efforts, while involving community members in understanding and protecting their natural resources. Volunteers can access information, report their data, and stay abreast of AIS issues on the NWMTLVMN website (www.nwmtlvmn.org).

Franz Ingelfinger, Restoration Ecologist, MT Fish, Wildlife and Parks (Moderator)

Since 2016, Franz has worked as a Restoration Ecologist with Montana Fish, Wildlife & Parks, charged with property stewardship, habitat management, and wetland and riparian restoration in the Flathead Valley. Franz received his M.S. in Wildlife from the University of Wyoming, and prior to arriving in Montana, spent 15 years in working as a Coastal Ecologist for a Massachusetts-based land conservation organization and as a Restoration Ecologist focusing on tidal marshes and dam removal for the Massachusetts Department of Fish and Game.

Rich Janssen
Rich Janssen Jr. is an enrolled Qlispe (Pend O'reille) Tribal Member of the Confederated Salish and Kootenai Tribes. He has spent his entire career with the Tribes, the last nine as the Department Head of Natural Resources, which includes over 202 employees within the Divisions of Environmental Protection, Fish, Wildlife, Recreation and Conservation, and Engineering and Water Resources. Mr. Janssen has an undergraduate degree from the University of Montana (Missoula) 1993, and a Masters of Business Administration from Gonzaga University (2007). Mr. Janssen is married with two grown children, and his Bulldog Dennis, and is a strong advocate for all people with Autism. More information at www.cskt.org.

What is the legacy? A discussion of the past, present and future impacts of coal mining in the transboundary Elk/Koocanusa/Kootenai watershed
Erin Sexton and Rich Janssen
The transboundary Kootenai Basin is entirely within the traditional territory of the Salish, Kootenai (Ktunaxa) and Pend d' Oreille (Qlispe) tribes, which covers parts of western Montana, western Idaho and southeastern British Columbia (B.C.). Canada's Elk River is a headwaters tributary of the Elk/Koocanusa/Kootenai watershed, which supports fish species that are of cultural significance as well as species listed under provincial or federal designations; including westslope cutthroat and bull trout and Kootenai River white sturgeon. The Elk Valley is B.C.'s largest coal-producing region, generating over 800 million tons of waste rock per year. Mining contamination is currently degrading water quality and aquatic life in the Elk River and impacting water quality and fish in the international waters of Koocanusa Reservoir/Kootenai River. An analysis of water chemistry and aquatic life downstream of the Elk Valley mines showed significantly elevated concentrations of nitrate and total nitrogen (>1000x), sulfates (>100x) and selenium (>20x), as compared to the non-mine impacted condition observed above the mines and in the adjacent transboundary Flathead River. Aquatic life showed significant effects of mining contamination with decreases in benthos and periphyton diversity and increases in species tolerant to disturbance. The Councils of the three governments of the transboundary Ktunaxa Nation propose a unique solution to address mining contamination in the transboundary Kootenai system; one that relies upon indigenous leadership, watershed-scale monitoring, transparent, objective assessment and mitigation for damages, evaluation of cumulative impacts, and consideration of legacy current and future impacts to species that are of cultural and subsistence importance.

Mike Koopal, Executive Director, Whitefish Lake Institute
Mike is the founder and executive director of the Whitefish Lake Institute. He serves as chair of the Aquatic Invasive Species (AIS) Early Detection and Monitoring Committee for the Upper Columbia Conservation Commission (UC^3), on the Executive Committee of the Flathead Basin Commission, and on the board of directors of the Montana Watershed Coordination Council. He served on the Whitefish Climate Action Plan Committee, provided technical assistance to the Bigfork Stormwater Advisory Committee and was a co-coordinator of the second and third editions of the Montana Lake Book. Mike is a past recipient of the Individual Achievement Award by the Montana Chapter of the American Fisheries Society for his outstanding contribution to the protection and enhancement of fisheries resources in Montana.

Collaborative lake management at the local level
Whitefish Lake in northwest Montana displays characteristic development pressure and ecological issues of a popular lake used by the local community for many resource and recreational amenities. Founded in 2005, the Whitefish Lake Institute (WLI) is a non-advocacy NGO that has successfully utilized scientific research and collaborative partnerships to support water quality policy and improvements. WLI assembled a long-term water quality monitoring program on Whitefish Lake and local streams. In 2015, WLI compiled data from that program along with historical partner data in the *Whitefish Area Water Resources Report: A Status of the Whitefish Lake Watershed and Surrounding Area*. The report provides 64 actionable items for project partners to improve water quality. Examples of projects undertaken by collaborative partnerships to include; the secondary remediation of the 1989 train derailment where 25,000 gallons of diesel spilled into Whitefish Lake; installation of a boat ramp interceptor trench to divert gasoline constituents to protect public health; coordination of a volunteer lake monitoring program on 40+ lakes in northwest Montana; investigation of septic leachate along the shoreline area of the Whitefish Lake and on-going investigation of mitigation options; and preparation of an annual AIS Management Plan for the City of Whitefish. WLI also helped broker a development project whereby WLI was gifted 30 acres of sensitive wetland habitat near Whitefish Lake. WLI subsequently constructed an interpretive nature trail that annually hosts school and adult groups.

An Aquatic Invasive Species success story: Early detection, rapid response, and aggressive mitigation of Eurasian Watermilfoil in Beaver Lake, Montana (Poster)
In 2011, the Montana DNRC discovered Eurasian Watermilfoil (EWM) in Beaver Lake near Whitefish, Montana. Beaver Lake is hydrologically connected to Whitefish Lake through Beaver Creek. A multi-agency AIS response team which included the Whitefish Lake Institute (WLI), responded to the discovery. Initial management included a diver survey took and the placement of bottom barriers over the EWM patch near the boat ramp. Since 2012, WLI has drafted a Whitefish Aquatic Invasive Species Management Plan that is financially supported by the City of Whitefish. An important plan task is the annual suction dredging of EWM—carefully done to remove the whole plant including the rhizomes —in Beaver Lake. Suction dredged EWM has been reduced from 23.5 pounds of fresh weight in 2012 to 0 plants found in 2018. Because of the real threat to Whitefish Lake and the Columbia River Basin, WLI and the City of Whitefish are committed to a long-term investment in the project, and suction dredging will continue indefinitely until EWM has been eradicated. WLI also collects eDNA samples analyzed by the University of Montana Conservation Genomics Laboratory as a tool to assess project success. This atypical AIS success story is the result of very early detection coupled with rapid response and aggressive mitigation techniques employed by the power of partnerships.

Valerie Kurth, Ph.D., Resource Conservationist, Flathead Conservation District (Moderator)
Valerie spent more than 10 years in academic teaching and research before coming to the FCD in 2014. She studied forest ecology (soils, ecosystem ecology, and mycology) while earning her Ph.D. from Northern Arizona University, and has taught college-level courses in ecology and environmental science. Prior to graduate school, she spent many field seasons doing botanical surveys around the western U.S., including Theodore Roosevelt National Park, Yellowstone National Park, Grand Teton National Park, and Dinosaur National Monument. She loves traveling, gardening, and many outdoor activities.

Ian Lacey, High School Student, Whitefish High School
Ian is a junior at Whitefish High School. He plays soccer and runs track, and has been part of FREEFLOW for the past three years. He is very interested in the outdoors and its preservation and although his specific plans for the future aren't set yet, he intends to study geoscience with a focus on hydrology.
(see Anna Cook for abstract)

Ed Lieser, Retired forester, Flathead National Forest, Past MT House Representative (Panelist)
Ed served in the US Navy subsequently earning a BS degree in Natural Resources Management from the University of Minnesota in 1979. He began a career in the US Forest Service in Potlach, Idaho, eventually moving to Whitefish in 1990 to work for the Flathead National Forest. He retired from the Forest Service in 2008 after 30 years of service, and started a forestry consulting business. Ed since gravitated toward volunteer service and has, over the years contributed to a number of local organizations including Whitefish Lake Institute (WLI) and the Whitefish Water District board for 10 years. Ed brings an understanding of terrestrial ecosystems and 35 years of experience in the application of forest management in the Rocky Mountains. He is concerned about the threat to Whitefish Lake from aging septic systems. Ed was elected to the Montana House of Representatives for District 4, Whitefish in 2012 and served two terms.

Mark Lorang, Ph.D., Chief Science Officer, Freshwater Map
Dr. Lorang did his graduate work at Oregon State University and was a research professor for 17 years at the University of Montana's Flathead Lake Biological Station before retiring and forming the company Freshwater Map. His role as a research professor was to quantify the physical template for ecological work on rivers and lakes. During this time, Dr. Lorang pioneered the use of acoustic doppler profilers and remote sensing as applied to mapping aquatic habitat in rivers and lakes, he continues that endeavor as Chief Science Officer for Freshwater Map.

The not so flat Flathead Lake

Wind and the waves generated on Flathead lake cause the lake to rock back and forth within its basin. These long period lake oscillations are referred to as seiches and can have periods ranging from 15 minutes to nearly two hours while amplitudes range from a few centimeters to nearly 0.5 m. Wind stress and waves transfer both momentum and water shoreward which forces the seiche motions that in turn drive a complex system of surface and deep-water currents. Acoustic Doppler profilers and long temperature chains were deployed in Flathead Lake for a period of 6 months to measure seiches and the associated currents. A deep current situated between 50 m and 70 m in depth, several hundred meters thick and several km wide reaching velocities of 0.3 m/s were discovered in Flathead Lake. These currents are larger in size and magnitude than the Flathead River during base flow conditions. Results from empirical data and modeling will be presented and linked to strategies for early detection of Aquatic Invasive Species, specifically detecting and finding invasive mussels.

Paul McKenzie, Land & Resource Manager, F.H. Stoltze Land & Lumber Co. (Moderator)
Paul began his career with F.H. Stoltze Land & Lumber Co. in 2003 as a Management Forester, becoming Lands & Resource Manager in 2008. Paul is tasked with oversight of three professional foresters responsible for all aspects of land management on the company's 39,000-acre tree farm; for overseeing the procurement of sawlog material for the sawmill; biomass for the 2.5 MW cogeneration facility and management of company and contract logging crews. Raised in the suburbs of Boston, with parents in engineering and paralegal careers, Forestry helped Paul get back to the agricultural roots of the previous generation. A 1992 graduate of the University of New Hampshire with a BS in Forest Management, Paul has practiced forestry for a variety of private, industry and agency organizations from New England to Alaska. He is active in a variety of collaborative efforts, including board member of the Kootenai Forest Stakeholders, member of the Whitefish Range Partnership and Whitefish Face Working Group. He is active in many industry and community organizations on a local and national scale. He is Past President of the Montana Wood Products Association, active in the Federal Timber Purchaser's committee, member of the Flathead County Resource Advisory Committee, has been active in the Columbia Falls Chamber of Commerce, Society of American Foresters, and Tree Farm systems. Paul is a "Certified Forester" accredited by the Society of American Foresters. Paul resides in Columbia Falls where he owns and manages a small tree farm with his wife Holly and two children.

Caitlin Mitchell, Program Assistant, Blackfoot Challenge
Caitlin started working for the Blackfoot Challenge in March 2017 as the Water and Forestry Technician and Assistant. Her work includes monitoring water quality and quantity in streams, sampling for aquatic invasive species in lakes, administering fuels reduction projects on private lands, and engaging students in water education with local school and summer programs. Caitlin first came to Montana through a field course in the Swan Valley where she fell in love with the landscape and ecosystem diversity. Once she received her degree from Virginia Tech in Environmental Sciences she moved back west to pursue a career in natural resource conservation. En route to Montana Caitlin worked as a Hydrology Technician for the Casper, WY BLM field office and as a cheese-making intern at Tucker Family Farms in Victor, MT. Caitlin harbors a deep love and passion for sustainability and the environment. She also loves to hike, swim, ski, and skate, always with her dog Kodi by her side.

The Blackfoot-Clearwater-Swan AIS partnership: Collaboration across watershed boundaries strengthens regional resilience

Caitlin Mitchell & Rob Rich

Three local watershed organizations in the southwestern Crown of the Continent ecosystem – Blackfoot Challenge, Clearwater Resource Council, and Swan Valley Connections – have forged a partnership using outreach, proactive lake monitoring, and the help of citizen scientists to prevent aquatic invasive species (AIS). Situated at the headwaters for the Columbia River Basin, with rising concerns for negative impacts on a recreation-based economy, damage to irrigation infrastructure, and impairment to critical habitat for threatened bull and westslope cutthroat trout, this collaborative models a streamlined use of grant funding managed by the Missoula County Weed District and the ability to share resources while remaining in touch with community priorities as individual watershed groups. Representatives from all three organizations are eager to share the methods that make their partnership effective at a regional scale, and why citizen science and collaboration is crucial as AIS concerns continue to change and grow.

Jeff Mow, Superintendent, Glacier National Park
Jeff has been the Glacier National Park Superintendent since August of 2013. He first came to Montana in 1979 and worked five summers doing geologic mapping for the US Geological Survey in the Flint Creek, Sapphire, and Anaconda-Pintlar ranges. His first visit to Glacier NP was in 1988 where he spent two weeks on the Red Bench Fire in the North Fork of the Flathead. Jeff is a graduate of Carleton College and attended the University of Michigan for graduate school. Much of Jeff's 30 years with the National Park Service has been in Alaska where he began as a seasonal ranger at Glacier Bay National Park and later in his career he served as the superintendent of Kenai Fjords National Park and acting superintendent at Denali National Park and Preserve. He lives in Whitefish Montana with his wife and son and they are all passionate about winter sports including all types of skiing and skating. In the "off-season" they enjoy biking, hiking, camping, and paddling.

Glacier National Park – Challenges and opportunities during uncertain times (Luncheon Keynote)

In the last four years, wildfire and extreme levels of visitation have proven challenging for Glacier National Park. At the height of the visitor season visitation at Glacier NP has edged closer to the levels seen at Yellowstone NP. These levels of visitation have proven challenging within the park but also provide opportunities beyond the park in the area known as the Crown of the Continent. Wildfires in the park and smoke from across the west impact a significant tourism economy in northwest Montana. Thinking about how we manage "national parks for the next 100 years" will require developing resilience and strategies to contend with the uncertainties of exploding demand for outdoor recreation , technological innovation, changing visitor expectations and climate.

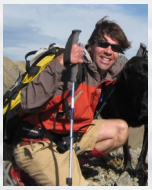
Clint Muhlfeld, Ph.D., Acting National Fisheries Program Manager, USGS
Dr. Muhlfeld is a Research Aquatic Ecologist at the USGS Northern Rocky Mountain Science Center stationed in Glacier National Park, Montana, and Associate Research Professor at the University of Montana, Flathead Lake Biological Station. Clint's applied research focuses on understanding the effects of invasive species, climate change, and habitat disturbance on the ecology and conservation of freshwater fishes and ecosystems. His research goal is to understand how aquatic species interact with physical and biological templates over space and time to advance science and to inform conservation and management, with particular focus on aquatic ecosystems of the northern Rocky Mountains, USA and Canada. He currently serves as the National Fisheries Program Manager for the USGS.

Trout in hot water? Understanding climate change effects on native salmonids for conservation in the Northern Rockies

Clint C. Muhlfeld*, Ryan Kovach, and Vin D'Angelo

Climate change is expected to dramatically impact aquatic ecosystems worldwide, yet empirical understanding of how climate change influences ecological and evolutionary processes and resulting patterns of biodiversity is limited. Here, we combine long-term biological monitoring data with high-resolution climate predictions to evaluate how climate change and other human stressors influence the vulnerability of native salmonids in the northern Rocky Mountains, USA and Canada. We found that climate warming is (cont.)

exacerbating interactions between native westslope cutthroat trout and non-native rainbow trout through invasive hybridization, which could spell genomic extinction for many populations. Bull trout populations are generally depressed, more variable, and declining where spawning and rearing habitat is limited, invasive species and land use are prevalent, and stream temperatures are highest. Although invasive fishes and climate change have strong negative effects on native populations, proactive control programs appear to be effectively tempering their negative impact. Finally, both bull trout and westslope cutthroat trout were found to be highly vulnerable to climate change at low elevations and in their southernmost habitats. However, vulnerability rankings varied widely and were dependent on multiple factors (climate, habitat, demographic, and genetic) and spatial context. Our results emphasize that climate warming will exacerbate imperilment of cold-water specialists, yet other stressors – especially invasive species and habitat loss – are immediate threats that can be addressed by proactive conservation and climate adaptation strategies.



John Muhlfeld, Mayor, City of Whitefish

John Muhlfeld is serving his second term as Mayor of Whitefish. He has participated in City government for the past 20 years, serving on multiple boards including the Whitefish Lake and Lakeshore Protection Committee, Whitefish Legacy Partners, and Whitefish Lake Institute. John is a restoration hydrologist and founding principal of River Design Group based in Whitefish, a private consulting firm offering specialized water resources engineering services to government agencies, non-profit organizations, and tribal organizations throughout the Pacific Northwest.

The Haskill Basin Conservation Easement – Permanent protection of the City of Whitefish's municipal water supply

The City of Whitefish derives 90% of its municipal water supply from surface water sources in Haskill Basin, a tributary to the Whitefish River two miles northeast of town. For over 100-years, the City operated the supply on little more than a friendly handshake with the landowner, F.H. Stoltze Land & Lumber Company, the oldest continuously operated integrated wood products company in Montana. Despite having rights to the water, the City had limited legal property access rights or rights to operate and maintain the diversion structures and infrastructure. Situated in one of the fastest growing communities in the Intermountain West, Haskill Basin was highly threatened by residential and commercial development. To prohibit future subdivision and development, in 2016, the City partnered with The Trust for Public Land, Montana Fish, Wildlife & Parks, and F.H. Stoltze Land and Lumber Company to purchase a permanent conservation easement on 3,020 acres in the Haskill basin watershed. The project was highlighted in the City's adopted Climate Action Plan. By deferring development, the project sequestered approximately 10,000 metric tons of above-ground forest carbon, equivalent to 36,677 tons of carbon dioxide, or nearly ten years of emissions from City municipal operations. With a predicted 2.5-degree Fahrenheit increase in annual average temperatures in Northwest Montana , impacts will include longer fire seasons, extended growing seasons, lower summer stream flows, and earlier snowmelt. This new prompted City officials to begin exploring alternative water conservation measures and water sources to ensure our community is resilient and prepared for the effects of climate change.

David Naftz, Research hydrologist, USGS Wyoming-Montana Water Science Center

David has been a research hydrologist with the U.S. Geological Survey for the past 34 years, currently located in Helena, MT, with the Wyoming-Montana Water Science Center. Ongoing and recent research projects include: (1) biogeochemical cycling of selenium and nutrients in Great Salt Lake; (2) diurnal mercury cycling in wetlands; (3) using thermocline manipulation to remediate mercury-contaminated reservoirs; (4) biogeochemical assessment of contaminant migration from an active uranium mill; (5) using geophysical and geochemical tools to identify submarine groundwater discharge; (6) environmental hazard assessment of abandoned mine lands; (7) mapping and hydrodynamic modeling of selenium plumes along near shore areas of Great Salt Lake; (8) mercury cycling in Lake Powell; (9) ecosystem modeling of transboundary selenium inputs to Lake Koocanusa; (10) biogeochemical cycling and selenium/mercury interactions in the Bighorn Canyon National Recreation Area; (11) assessing impacts from current and legacy uranium mining in areas surrounding Grand Canyon National Park; and (12) using fiber optic DTS, environmental tracers, and tube seepage meters to investigate the mixing of a legacy uranium plume with the Little Wind River.

Non-resident Selenium imports to Lake Koocanusa and Bighorn Lake, MT: Sources, biogeochemical cycling, and tailwater implications

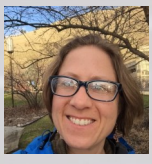
Lake Koocanusa straddles the boundary between Canada (British Columbia (BC)) and the United States (Montana, (MT)), while Bighorn Lake straddles the Wyoming (WY)-MT border. Both reservoirs receive most of their selenium (Se) inputs from non-MT sources associated with mining induced disturbance of Se-rich landscapes. The MT Department of Environmental Quality has identified Lake Koocanusa as threatened by Se and both reservoirs are subject to newly established criteria for Se (USEPA, 2016). Annual Se loadings to Lake Koocanusa from areas in BC increased from 2,600 kg in 1992 to over 13,000 kg in 2012. The first active treatment plant to remove Se from waters upstream of the reservoir was installed in 2015; however, the plant has only operated intermittently and is currently (July 2018) offline for repairs. A downward trend in annual Se load entering Lake Koocanusa from areas in BC during 2014-16 has been observed. Bighorn Lake receives most of its water from the Shoshone and Bighorn River watersheds, located in WY. The majority of the annual Se load entering Bighorn Lake is sourced from the Bighorn River watershed which contains mining operations that disturb large areas of Cretaceous-age marine shales that are enriched in Se. Biogeochemical samples were collected from multiple sites in Lake Koocanusa during 2015-17. Results from these sampling programs are being used to populate an ecosystem-scale Se modeling methodology (Presser and Luoma, 2010) to support development of site-specific Se guidelines for the protection of aquatic life. Those results, their effects, and recommendations for future studies will be discussed in detail.

Nanette M. Nelson, Research Scientist, Flathead Lake Biological Station

Nanette is an environmental economist with interests in non-market valuation of environmental goods and services relying on both stated and revealed preference techniques. She has used the contingent valuation method to estimate the public's willingness to pay for improved water and air quality. Using hedonic methods, she's estimated the value of open space as observed from real estate transactions. Since arriving at the Flathead Lake Biological Station she has expanded her research to include assessing the economic impacts of zebra and quagga mussel invasion. A corollary of her AIS research is an interest in evaluating the efficacy of various AIS prevention efforts including understanding why people behave the way they do and how we can design interventions that result in changing people's behavior.

Predicting Costs of Dreissenid Mussel Invasion in Montana (Poster)

Management decisions about invasive species must account for both ecosystem and economic impacts. National estimates of economic damages from invasive species, while attention grabbing, are of little use to managers at the regional, state or local level. Increasingly reliant on estimates of economic impacts to justify funding of invasive species management programs, managers require timely and place-specific assessments of damages. This study developed an approach to estimating potential costs associated with dreissenid mussels that are scalable, general, and predictive. I used this approach in Montana, one of a few western states that remain mussel-free, to predict potential costs for a range of stakeholders statewide and for the Columbia and Missouri river basins. Predictions of economic costs were based on the extrapolation of mussel mitigation and damage costs borne by others elsewhere. Potential damages for consumptive uses were estimated on a per volume basis. Economic costs for nonconsumptive uses were based on per unit costs or percent reductions in usage or value. The predicted annual cost of dreissenid mussels invading Montana ranged from $96.3 to $234 million assuming all surface water users would incur mitigation costs. Predictions of annual costs for the Columbia and Missouri River Basin portions of the state were $29.3 to $80.9 million and $66.9 to $153.5 million, respectively. This analysis of the distribution of potential economic impacts both spatially and among user groups provides managers a financial accounting of *no action* and essential evidence to continue funding the state's Aquatic Invasive Species program.



Terri Nichols, Watershed Programs Coordinator, Montana Watershed Coordination Council

Terri serves communities statewide in her role with the Montana Watershed Coordination Council. She holds a master's degree in Environmental Studies and Natural Resources Conflict Resolution from the University of Montana and a bachelor's degree in journalism from Wayne State University in her hometown of Detroit. Terri has explored streams and wetlands across Montana as a technician for both the Montana Natural Heritage Program and the U.S. Forest Service, but she holds a special place in her heart for the lakes of the Flathead valley, where she lived for eight years. In addition to her field experience, Terri worked for years as a writer and editor and served two years as a forestry and agriculture volunteer in the Peace Corps in rural northern Zambia. (cont.)

Watershed Stories: Highlighting the personal impacts of the watershed approach

Montana's watershed organizations bring landowners and communities together to find innovative, practical solutions to better steward natural resources amidst a changing landscape and increasing pressures on our families and communities. The Montana Watershed Coordination Council's Watershed Stories campaign highlights the personal stories behind these solutions. Watershed Stories share the commitment and impact of the people who make the Watershed Approach to conservation possible. Through print, electronic, and social media, this campaign elevates the community-driven work of watershed organizations and their role in protecting Montana's heritage of clean water, family farms and ranches, rich wildlife habitat, and people who work together with mutual respect. This presentation will focus on how Watershed Stories came about, the work we've done so far on this campaign, and opportunities to highlight stories in your own community.

Nicky Ouellet, Flathead Valley Reporter, Montana Public Radio (MTPR)

Nicky is the Flathead Valley reporter for Montana Public Radio. Prior to journalism, Nicky taught high school English on the Pine Ridge Indian Reservation in South Dakota, served as an English Teaching Assistant as a Fulbright Fellow in Russia, and coaxed toddlers down the bunny hill at Whitefish Mountain Resort. She holds an MA in Environmental and Natural Resource Journalism from the University of Montana and a BA in English and Russian from Oberlin College.

Subsurface: How to speak the science of AIS in a way your neighbor will remember

When zebra mussels were first found in Montana in 2016, managers and scientists recognized their potential to wreak havoc on infrastructure, recreation and lake-adjacent economies. Conveying that risk to the general public proved a trickier task. Montana Public Radio decided to beef up its AIS reporting with a five-part podcast focusing on the mussels' impacts elsewhere, assessing management actions and considering what it means to live in altered ecosystems. SubSurface uses sound-rich storytelling to break down the science of how mussels spread and explore potential remedies if they arrive here. The series has been used as an education tool in classrooms and shared among public stakeholders. We'll hear clips from the series and peel back the curtain of how it was made.

Erich Peitzsch, Physical Scientist, USGS Northern Rocky Mountain Science Center

Erich is a Physical Scientist at the U.S. Geological Survey Northern Rocky Mountain Science Center. He has worked for the USGS since 2007 studying avalanches, snow, and glaciers, and as the Director of the Flathead Avalanche Center in northwest Montana. He earned his M.S. in Earth Sciences from Montana State University (MSU) in 2009, and is currently also working on his Ph.D. at MSU. His current research focuses on avalanche frequency and magnitude and how they relate to various weather and climate processes. He is also using remote and close-range sensing to examine snow depth changes in avalanche path starting zones and relating such changes to weather patterns. When not studying the cryosphere, he spends time climbing, skiing, and running in the mountains usually chasing his two young sons. (See Jim Elser for abstract)

Matthew Peschel

Matthew is a fourth generation Whitefish resident and an eighth grader at Whitefish Middle School. He has spent every summer at his grandparents' house on Whitefish Lake recreating and enjoying the lake with his family.

Perspective from a fourth generation Whitefish resident (Poster)

Whitefish Lake is important to our community because this wonderful lake provides many resources for people in town, like fishing, water to maintain our luscious gardens, and most importantly, fresh clean water to drink. Whitefish Lake should be protected in order to keep a clean lake for people to enjoy. We can do it by not littering, and we also need to protect it from development. Whitefish community members gain a lot from Whitefish Lake.

Mark Reller, Principal/Owner, Constellation Services

Mark is one of Montana's native sons. He was born in Bozeman, raised in Thompson Falls then returned to Bozeman and MSU for his BS and MS in Agricultural Engineering. His Masters work focused on water management, a craft he has practiced for over 30 years. His work has included a surface accounting model of the Musselshell River which he created while working as a surface water hydrologist at the Montana Department of Natural Resources and Conservation. Also at DNRC he worked on the State's Surface Water Supply Report. He has worked on large reservoir management for both the State of Montana as staff for the Northwest Power and Conservation Council and as the Liaison to Montana for the Bonneville Power Administration. Mark owns and operates Constellation Services also known as MarksLakeMaps.com. In this capacity he has collected and processed bathymetric data for over 100 lakes and reservoirs in Montana and around the Pacific Northwest.

What are you managing?

The purpose of this talk is to expose attendees to the basic principles, concepts and tools for creating lake or reservoir bathymetrics. Volume, surface area, mean average depth, and maximum depth are common metrics in lake management decisions. Gathering current bathymetric data utilizes global positioning systems (GPS) and sonar depth soundings. This talk will present insights from over 25 years of bathymetric data collection in Montana and the Northwest. Attendees will see real data sets and the story behind their acquisition, analysis, presentation options, and final use. Data collection techniques and mission planning inform the bathymetric data collection process. Data processing approaches convert raw position and corresponding depth measurements into products needed by lake managers such as traditional depth contour maps and shaded image maps. Further analysis also provides lake or reservoir volume in aggregate or in volume slices. Informed approaches to future depth monitoring can help water managers understand sediment loading and, or redistribution. Accurate and up to date bathymetric data sets contribute to better water management, improved fisheries management and safer recreational management. Depth & data collection and bathymetric analysis by Constellation Services, MarksLakeMaps.com.

Rob Rich, Aquatics Program Coordinator, Swan Valley Connections

Rob is Swan Valley Connection's Aquatic Programs Coordinator. He has an MFA in Creative Writing from Western Washington University, a MS in Natural Resources from University of Vermont, and a BA in Environmental Studies - with a minor in Wilderness Studies - from the University of Montana. Rob has over ten years of experience advancing partnerships with land trusts and conservation nonprofits, and he is a freelance writer and consulting naturalist who has worked across the Pacific Northwest and New England. Rob is particularly fond of beavers, whose keystone role in our watersheds inspire his devotion to conserve biodiversity and ecosystem health.
(See Caitlin Mitchell for abstract)

Ryan Richardson, Fluvial Geomorphologist, River Design Group

Ryan is a geologist that has spent his career dedicated to studying the processes that shape rivers and floodplains. Ryan joined River Design Group (RDG) in 2016 as the fluvial geomorphologist in Whitefish Montana, where he conducts all the geomorphic work for our Montana, Idaho, and Wyoming projects. He earned his MS at the University of Wyoming where he and his collaborators developed and applied new techniques in remote sensing to map rivers in high resolution over the watershed scale. Before joining the RDG team, he worked for the US Forest Service Rocky Mountain Research Station on projects focusing on stream responses to forest fires and their impacts on downstream communities. Ryan's experience conducting geomorphic assessments with the USFS coupled with his unique skill set utilizing remote sensing in the fluvial environment makes him a strong member of RDG. Since joining RDG, Ryan has developed the new unmanned aerial systems program to survey restoration projects using photogrammetry and collect high resolution aerial imagery for design and (cont.)

monitoring. He is a licensed FAA commercial remote pilot and is in charge of all UAS operations out of the Montana office. Ryan serves as RDGs remote sensing specialist and is a technical writer on reports. When he isn't on the job, Ryan can be found in his kayak or drift boat depending the time of year all across the West.

Tie channel restoration: Reconnecting floodplain lakes to the Kootenai River

Floodplains are an integral component of healthy, functioning rivers. Anthropogenic modification through the construction of levees, dams, and irrigation has disconnected floodplain-river interaction in the majority of the large rivers in the United States, including the Kootenai River in Montana and Idaho. To address impaired floodplain function, many restoration initiatives have identified opportunities to breach levees, remove dams and modify infrastructure to allow water and sediment to flow onto the floodplain, promote nutrient exchange and provide off-channel aquatic and terrestrial habitats for fish and wildlife. The Kootenai Tribe of Idaho's Kootenai River Habitat Restoration Program is an example of how these techniques are being used to restore former floodplain lakes and wetlands in a highly altered northern Idaho ecosystem in. One such technique to improve floodplain connection is tie channel restoration. Tie channels are naturally occurring surface water connections between floodplain lakes and rivers. These geomorphically unique landforms are not created through the same morphodynamic processes that form river channels, but are laterally stable for thousands of years. Despite having differing morphology when compared to river channels, tie channels have distinct characteristics that are common throughout the many ecoregions in which they are present. This presentation provides a general overview of tie channels and describes how the Tribe's design team developed process-based floodplain designs using geomorphic criteria based on observed tie-channel characteristics.

Hannah Riedl, Watershed Protection Section, DEQ

Hannah responds to citizen reports and coordinates outreach for Montana's state HAB team at the Department of Environmental Quality's (DEQ) Nonpoint Source Program, whose goal is to provide financial and technical resources to local stakeholder groups working to protect and restore water quality from pollution through voluntary practices. Additionally, she facilitates the Water Pollution Control Advisory Council, a council composed of representatives that advise DEQ on rulemaking during public meetings. Hannah grew up near the shores of Lake Tahoe but is grateful to call Montana home. She can be found outside business hours roaming the trails of Helena with her husband and two well-behaved rampageous dogs.

Montana's Harmful Algal Bloom (HAB) program: A lesson in communication

Standing bodies of water exposed to sun (e.g., lakes, reservoirs, stock ponds, and roadside ditches) have the potential to develop HABs in Montana. Due to changing climatic conditions, HABs are increasingly likely throughout much of the state as well as the country. Montana created a state HAB team and implemented a HAB program in the summer of 2017. The public can now report the occurrence of HABs to the HAB team through an online reporting system. Once the HABs are reported, the HAB team investigates the threat and implements any measures necessary to protect public health and the environment. The Montana HAB Team includes members from the Department of Environmental Quality (DEQ), Department of Public Health and Human Services (DPHHS), and Fish, Wildlife and Parks (FWP). The HAB team has also developed a guidance for local, state, federal, and private landowners to protect people, pets, and livestock from the effects of HABs in Montana. The guidance discusses the general process, factors to consider, and suggestions and recommendations to consider when a waterbody is experiencing a potential HAB. The success of the Montana HABs program is dependent on communication; the ability of the public to report the occurrence of HABs to state agencies and the effectiveness of state agencies to communicate the location and potential risks of the HABs to the general public.

Eric Sawtelle, High School teacher, Whitefish High School

Eric has been teaching high school science in Montana for the past 16 years. He teaches GIS, Field Ecology, and Earth Science, and facilitates the Flathead River Educational Effort for Focused Learning in Our Watershed program (Project FREEFLOW) at Whitefish High School. Project FREEFLOW provides students with an opportunity to acquire and analyze water quality data, develop an understanding of natural resource management, and study current land use issues. Students involved conduct field studies, perform technical writing, and present research to the public. Prior to teaching, Eric worked as a Lake Monitoring Coordinator for Montana Fish, Wildlife & Parks, as a Soil and Chemistry Lab Technician for the University of Montana, a Naturalist for Yosemite Valley School, and a Field Biologist for the Institute for Bird Populations. Eric has a MS in Secondary Science Education from MSU, Bozeman, and a BS in Ecology and Systematic Biology from Cal Poly.

North Fork of the Flathead River dispersed campsite and water quality Study (Poster)

The Whitefish High School Project FREEFLOW recently began a long term project to study water quality and dispersed campsite changes along the North Fork of the Flathead River. Students developed a study plan with the following goals: 1) Monitor and assess dispersed river-use campsites, 2) Examine chemical, physical and biological water quality parameters, 3) Increase student opportunities to work with scientists and natural resource managements professionals, 4) Integrate with Forest Service and Park Service Wild & Scenic River managers and their long-term monitoring goals, 5) Make data publicly accessible through a student created online ESRI Story Map. Students participated in two 4 day outings along the upper North Fork between Ford River Access and Big Creek River Access. Potential campsites and water quality data have been added into a GIS map and database. Next steps will include adapting data collection parameters to integrate with US Forest Service and National Park Service river management protocols and to continue the study in partnership with these management agencies.

Geoffrey Schladow, Ph.D.; Director, UC Davis, Tahoe Environmental Research Center

Geoffrey Schladow holds B. Eng. and Ph.D. degrees in civil engineering from the University of Western Australia, and an M. Eng. in hydraulic engineering from the University of California at Berkeley. For over thirty years his research has focused on the interactions between the complex fluid motions found in nature and their impacts on water quality, ecosystem health and watershed processes. He has published over 170 research papers and technical reports, and has guided over 70 graduate students. Dr Schladow is an expert on both field data collection and numerical modeling, and frequently brings together teams of researchers to work on large, interdisciplinary projects. He holds the position of Professor of water resources and environmental engineering at UC Davis, and is the founding director of the UC Davis Tahoe Environmental Research Center.

The Meaning of lake restoration in the face of climate change: The case of Lake Tahoe (Plenary)

Lake restoration has typically involved the removal or reduction of stressors that have reduced the ecological function of a lake, damaged its scenic or aesthetic values, or degraded it in a way that the community will no longer accept. The stressor varied from excess nutrient input due to poor land management, the incursion of non-native species, or a change to watershed hydrology due to upstream dams, just to name a few. Often there are multiple stressors acting. The guiding vision has invariably been that if the stressor is removed, then the system could return to its prior pristine state, or something acceptably close. When the lake in question is large, the timescales for such efforts are often multi-decadal. So how do we factor climate change into lake restoration? When the idyllic pre-disturbance lake may not have existed for decades, and the future restored lake is a similar distance in the future, are we even talking about the same system? Lake Tahoe provides a well-studied example. Its most publicized stressor is poor urban land use management over a sixty-year period. Its target for full restoration of clarity (a useful metric) is 2070. Beyond the simple rise of air temperature expected in that time interval, the effect of climate change has been and will be astounding. Longer stratification, loss of deep mixing, loss of a snow-dominated hydrology, and record-breaking water temperatures year after year. At what point do we accept that we are restoring a different lake?

Erin Sexton, Sr. Scientist, Flathead Lake Biological Station

Erin is a Senior Research Scientist with the University of Montana, Flathead Lake Biological Station. Erin's research focus encompasses the international landscape known as the Crown of the Continent Ecosystem. She is involved in several collaborations within and across the Crown of the Continent, and more recently the Alaska/British Columbia transboundary rivers. Her emphasis is on ensuring that sound science informs policy. Erin lives just a few miles from Glacier National Park in NW Montana with her family. They enjoy skiing, hiking, biking, playing on the rivers and gardening.

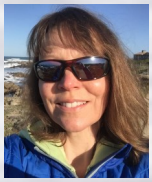
(See Rich Janssen for abstract)

Craig Stafford, Ph.D., Biology Professor, University of Montana
Dr. Stafford works as an adjunct professor and researcher at the University of Montana. His research focuses on water quality, fisheries, and their intersection. Dr. Stafford received his Ph.D. in the Division of Biological Sciences at the University of Montana

Paradox of the Pondweed: Oligotrophication and Decreasing Winter Oxygen Concentrations in a Shallow Reservoir
Long-term trends in environmental conditions were quantified for Georgetown Lake, a relatively shallow montane reservoir. Trends in nutrients, phytoplankton, macrophytes, and zooplankton indicate that the reservoir has become more oligotrophic. Paradoxically, dissolved oxygen concentrations have diminished towards the end of ice cover. A proposed explanation is that the expanded macrophyte coverage has increased the yearly proportion and amount of organic decay that occurs during ice cover, aided by the reservoir's physical setting.

Michael Suplee, Ph.D. Water Quality Planning Group Leader, Department of Environmental Quality (DEQ)—Standards
Michael Suplee has worked in the fields of water-quality, water pollution control, and fisheries since the mid-1980s, including two years in the U.S. Peace Corps in West Africa assisting with aquaculture development. He received his doctoral degree in 2000 from Texas A&M University, where he conducted research on phosphorus cycling in lake sediments. He has worked for the Montana DEQ since 1998 and has been in the water quality standards unit since 2000. Dr. Suplee has carried out various research projects in Montana streams & rivers, including a public perception survey of what constitutes nuisance algal growth, large-scale studies on the Yellowstone and Missouri rivers, and a whole-stream nutrient enrichment study. Dr. Suplee developed numeric nutrient criteria for Montana's streams and rivers and the state adopted these criteria as water quality standards in 2014.

Canyon Ferry Lake Numeric Nutrient Criteria Development using a Computer Water Quality Model
Michael Suplee, Rosie Sada – DEQ; and Kyle Flynn – CDM Smith
Canyon Ferry is a dimictic eutrophic to hyper-eutrophic lake formed by an impoundment on the Missouri River, and is 40.2 km long, 7.2 km wide (max), and 50 m deep (max). The Missouri River contributes almost all water and nitrogen and phosphorus (nutrient) inputs. The lake is used for flood control, irrigation, municipal and industrial water supply, power, and recreation. Algae blooms have been common since 1957, and livestock deaths caused by toxic cyanobacterial blooms occurred in the mid-1980s. Blooms usually occur in late July to early August, and dominant bloom species include *Aphanizomenon*, *Anabaena*, and *Microcystis*. Complaints from the public are common. The lake has been studied, but no study has specifically addressed controlling the cyanobacteria blooms. Controls on nutrient inputs might be able to limit the intensity and frequency of the blooms. We propose developing numeric nutrient criteria for Canyon Ferry Lake via a dynamic model (CE-QUAL-W2). This is a two-dimensional, longitudinal/vertical, hydro-dynamic, and water quality model applicable to relatively long and narrow waterbodies exhibiting longitudinal and vertical water quality gradients. Key model endpoints are phytoplankton concentrations, frequency/severity of booms, and phytoplankton successional patterns. Intensive sampling (in cooperation with the USGS) was undertaken 2015-2016, with follow-up work in 2017 and 2018. Key methods and findings will be presented. Development of numeric nutrient criteria is not a guarantee that such criteria can readily be achieved. The lake's watershed is huge and most control measures would have to be achieved via nonpoint-source best management practices. Implications will be discussed.



Kris Tempel, Habitat Conservation Biologist, Fish, Wildlife and Parks
Kris is a Habitat Conservation Biologist for Montana Fish, Wildlife and Parks. She has a Bachelor's Degree in Fisheries Science from Oregon State University and a Master's Degree in Conservation Biology from Green Mountain College. Kris has experience researching and protecting aquatic resources and has spent the last decade conserving fish and wildlife habitat and connectivity corridors at a landscape level in northwestern Montana.

Protecting watersheds and water quality through conservation easements
The Montana Department of Fish, Wildlife and Parks and The Trust for Public Land worked with multiple partners to conserve 13,398 acres of important fish and wildlife habitat including a rare fen, a migratory corridor for bull trout, westslope cutthroat trout habitat, nesting habitat for trumpeter swans, important spring grizzly bear habitat and a portion of the headwaters of Whitefish Lake. All the forks of Lazy Creek originate on the property and Swift Creek flows through the property's eastern portion. Both creeks drain directly into Whitefish Lake which provides 20% of the water supply for the City of Whitefish. The upstream resources included in this project provide important water filtration, erosion control, and soil stability functions, and directly impact the water quality of Whitefish Lake. In 2018, conservation easements were placed on the property that will prevent development, protect its incredible fish, wildlife, and water resources, and secure public recreational opportunities in perpetuity. The story of how this was accomplished is the focus of this presentation.

Sophia Valenzuela
Sophia is a Montana Energy Corps member serving as the Sustainability Coordinator for the City of Whitefish. She grew up in California and her background is in chemical engineering with a focus on renewable energy technologies, particularly solar. Her current work is focused on implementing the City's Climate Action Plan, emphasizing the intersection of science and policy.

Watershed Management and the Whitefish Climate Action Plan (Poster)
In April 2018, the City of Whitefish approved a Climate Action Plan intended to improve the City's climate change resiliency. Hotter, drier summers and shorter, warmer winters will have huge impacts on the watershed that supplies city residents with water for drinking, irrigation, and recreation. In response, the City is working on numerous initiatives related to forest and watershed management that tie in local companies, private citizens, and nonprofits to find solutions to threats posed by drought, forest fire, and invasive species. Since Whitefish relies entirely on surface water for domestic supply, it is highly sensitive to contamination by soil erosion and wildfire pollution. And with more and more of the City's water being pumped out of Whitefish Lake in the hot summer months when demand is high and the Haskill Basin is parched, the threat of aquatic invasive species looms large. Watershed contamination can be minimized by lessening wildfire risk through proper forest management, and conserving land in Haskill Basin to prevent development in vulnerable areas. The City is also making water conservation a priority, with a focus on reducing the use of drinking water for irrigation. Maintaining monitoring checkpoints at Whitefish Lake boat ramps and preparing a rapid response plan in the event of invasive species introduction will also be imperative to protect the watershed. This poster will display successful City initiatives and ongoing projects, with an emphasis on local partnerships and community involvement to achieve Climate Action Plan goals.

Constanza van der Pahlen, Critical Lands Specialist and Program Director Flathead Lakers
Constanza has been working for the Flathead Lakers since 2000 coordinating two partnerships that work together to protect and restore critical lands. Constanza has a Masters in Environmental Studies from Yale School of Forestry and Environmental Studies. She worked in Brazil on community development and resource protection and for The Nature Conservancy in western Massachusetts helping identify critical areas. As the Critical Lands Project Director, Constanza brought people together to identify critical lands in the Flathead Watershed and to collaborate on planning and implementing conservation and restoration projects. The Critical Lands Project received the 2007 Montana Watershed Stewardship Award for organizing and protecting Flathead Basin resources. The Flathead River to Lake Initiative, a partnership that developed from this project, received the 2017 Montana Wetland Stewardship Award. (See Hilary Devlin for abstract)

Trista Vick-Majors, Ph.D., Postdoctoral Research Associate, Flathead Lake Biological Station
Trista is a Postdoctoral Research Associate at Flathead Lake Biological Station. She has a M.S. and Ph.D. from Montana State University, where she studied microbial ecology and biogeochemistry in Antarctic lakes. Her research now focuses on microorganisms and biogeochemical processes in low-nutrient or energy-limited aquatic environments. (cont.)

Aerobic methane production resulting from phosphorus cycling in Flathead Lake (Poster)

Trista J. Vick-Majors, Matthew J. Church, Adam Baumann, Shawn Devlin, John E. Dore, James Elser, Hannah Fay, Madeline Glad, John Ranieri

Well-oxygenated surface waters of freshwater lakes, paradoxically, are often oversaturated with methane. Historically, anaerobic microbial metabolisms were thought to be the only biogenic sources of methane; however, anaerobic methanogenesis cannot always account for the methane oversaturation observed in large lakes. Newly appreciated aerobic pathways for microbial methane production in oligotrophic aquatic environments involve recycling of growth-limiting nutrients such as phosphorus (P) from methylated organic compounds. We determined methane concentrations and examined the potential for microbial production of methane from methylphosphonate in the oxygenated, phosphate-poor epilimnetic waters of Flathead Lake, Montana. Water column methane concentrations were measured monthly, and were consistently oversaturated with respect to air. Experiments in which whole lake water was amended with glucose as a carbon source, nitrate as a nitrogen source and methylphosphonate as the sole P source resulted in methane production proportional to P uptake. Experiments with phosphate as the sole P source did not stimulate methane production, and methane production was suppressed in experiments containing equimolar concentrations of phosphate and methylphosphonate. Our results indicate that microbial phosphorus scavenging may underlie aerobic methane production in Flathead Lake and highlight the potential importance of this pathway in sustaining methane supersaturation in P-deficient freshwater lakes.

John Wachsmuth, Retired Fisheries Conservation Specialist; Montana Fish, Wildlife & Parks (Moderator)

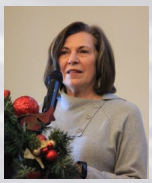
John retired from MFWP Region 1 where he held a number of positions since he first assisted on a Tongue, Powder, and Yellowstone Rivers sauger and shovelnose fisheries study. He worked on a bull trout study in the Swan Valley, baseline water quality and fisheries data collection on Hungry Horse Reservoir, and spearheaded the development of early citizen monitoring programs, and later the Northwest Montana Lakes Volunteer Monitoring Network, adding an AIS early detection component to the program. He was instrumental in guiding development of the first and second editions of the Montana Lake Book. John has a BS in Natural Resource Management from the University of Montana and an MS in Aquatic Natural Resource Management with an emphasis on AIS from the University of Denver.

Vicki Watson, Ph.D., Professor (retired), University of Montana, Clark Fork Kootenai Basin Council

Vicki grew up on a Texas blackland prairie farm near Cummings Creek, headwaters of the Texas Trinity River. She went to college in the San Jacinto River basin near Houston, and attended graduate school by the Yahara River chain of lakes in Madison, WI. She spent the last 35 years studying, enjoying, and working to restore western Montana's Clark Fork River, headwaters to the Columbia River. She just retired from the University of Montana but not from watershed keeping. She thanks all these rivers for helping satisfy her thirst for life.

Clark Fork Kootenai River Basins Council -- history, mission, makeup, projects

In 2001 the Montana legislature created the Clark Fork Task Force (CFTF) to develop a water management plan for the entire Clark Fork Basin. In 2013, the legislature directed the DNRC to work with citizen groups to create a new Montana State Water Plan. The CFTF was selected to update that basin's water plan, and additional members and add the Kootenai River basin to the state water plan. With the addition of the Kootenai River members, this expanded Task Force worked with the DNRC (and three other river basin groups) to update the state water plan. After the plan was adopted in 2015, members of the Clark Fork Task Force, along with many additional stakeholders, representing various parts of the basin, came together in 2016 to re-envision the CFTF as a Basin Council with expanded role and membership. A major focus of this council is promoting and monitoring the implementation of the basin water plan. The council also plans to identify and address common basin-wide concerns, challenges, and solutions that are best addressed at the basin-level. Currently, the council is assisting in developing a watershed restoration plan for the central Clark Fork basin, developing education and outreach materials, assessing available and needed data for management, and seeking funding.

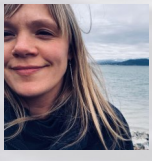


Germaine White, Retired Information & Education Specialist & AIS Program Manager, Confederated/Salish & Kootenai Tribes

Germaine retired from her position as the Information and Education Specialist & AIS Program Manager for the Confederated Salish & Kootenai Tribes (CSKT) working in the Division of Fish, Wildlife, Recreation and Conservation, Natural Resources Department. She is an educator, focused on environmental education and implementing outreach programs for diverse audiences. Germaine coordinated public involvement activities associated with the management of fish, wildlife and recreation; she developed, produced and disseminated educational materials, represented the CSKT in numerous forms of media, and conducted the annual River and Lake Honoring events. She also developed and supervised to CSKT Aquatic Invasive Species program including inspection stations and education and outreach. Germaine has a Masters of Education in Multicultural-Bilingual Education from Montana State University and a Bachelors of Arts in Liberal Arts from the University of Montana.

Living landscapes: Culture, climate science, and education in tribal communities

For thousands of years, the Salish, Pend d'Oreille, and Kootenai people have inhabited a vast territory that includes much of the Northern Rockies. To have flourished for millennia, the tribes had to develop a profound understanding of their homeland and the population dynamics of its plants and animals across seasons and the longer cycles of decades and centuries. The Climate Science Education Project develops two climate change related college courses—a Remote Sensing class using NASA data sets and imagery, and an undergraduate introductory-level climate change course. This course will cover climate change science and examine how climate change has affected traditional and contemporary tribal land uses on the reservation. The course, developed at Salish Kootenai College, will be offered there and made available and adapted to other tribal colleges and students across the nation. The project also develops an extensive web-based, interactive Learning Unit for reservation high school teachers drawing upon NASA developed curriculum and learning tools placed within the context of the tribal perspective by integrating oral histories, stories, and elder interviews as well as contemporary observations on how climate change has affected traditional and contemporary tribal land uses on the reservation. It also develops a companion "Social Media" Site for high school science classes to allow students to network with schools on other reservations and tribal groups from Alaska to Arizona. The platform would also include a robust forum for teachers so they can exchange climate change information and curriculum ideas.



Kate Wilson, Commission Administrator, Upper Columbia Conservation Committee & Flathead Basin Commission, MT DNRC

Kate has been working in the water world for over 12 years. Her initial focus was on water quality and quantity issues in the Pend Oreille Basin for the Lakes Commission, an advisory board to the Governor of Idaho. Stemming from the Lakes Commission work , Kate became engrossed in the aquatic invasive species issue, pursuing a Master of Science at the University of Florida where she worked for the Center for Aquatic Invasive Plants. From there she moved to Canada to develop a comprehensive AIS Program for Alberta, where she spent five years. She served as Chair of the National Aquatic Invasive Species Committee (NAISC), the Alberta AIS Standing Committee, the Co-Chair of the Pacific Northwest Economic Region (PNWER) Invasive Species Working Group, and participates in the Western Regional Panel on Aquatic Nuisance Species, the Columbia River Basin/100th Meridian, and the Aquatic Plant Management Society. Kate recently returned to her roots taking a position with the Montana Department of Natural Resources and Conservation, serving a dual role as Commission Administrator for legislatively created the Upper Columbia Conservation Commission, focused on prevention and management of aquatic invasive species west of the Continental Divide, and the Flathead Basin Commission, focused on water quality and natural resource protection. She is dedicated to protecting the freshwater resources of the west and all the native critters that live here.

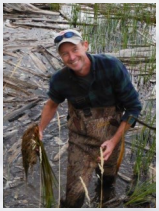
Protecting the water & natural resources west of the divide: The value of legislatively created commissions

The Flathead Basin Commission (FBC) is a diverse, uniquely structured non-regulatory organization that was created by the Montana Legislature in 1983. The FBC works to accomplish its mission in a consensus-building manner, emphasizing education, coordination, broad-based community involvement, partnerships with agencies and nonprofit groups, and the voluntary participation of basin residents. Created in the 2017 legislative session by House Bill 622, the Upper Columbia Conservation Commission (UC^3) was established to foster close cooperation and coordination between international, federal, regional, state, tribal, and local water resource managers for the development and implementation of comprehensive Upper Columbia River Basin prevention and management measures to prevent the introduction and/or further establishment of aquatic invasive species (AIS). Having federal, state and Tribal agencies at the table alongside partner groups and concerned citizens is a real benefit to the basin and positions the both Commissions well to undertake (cont.)

meaningful work with a lasting impact. As Commission Administrator for two legislatively-created natural resource focused Commissions in Montana, the presentation will focus on the intention, duties and values associated with each Commission. Themes to include; structural changes in the FBC, as well as emerging priorities and direction moving forward; factors leading to the creation of the UC^3 - the detection of invasive mussel veligers in two Montana reservoirs in 2016, and the 'destination' that Montana has become for recreational pursuits; and organizational structure, funding, accomplishments and challenges associated with both Commissions.

Northern Rockies mandatory aquatic invasive species protocols for wildfire equipment (Poster)

Aquatic invasive species (AIS) are one of the greatest threats facing freshwater resources in the West, and while trailered watercraft are known to be the most likely pathway of introduction, equipment used in water is also a concern. This includes equipment used for firefighting in addition to other uses such as in-water construction. The Northern Rockies Coordinating Group, comprised of North Idaho, Montana and North Dakota) developed a mandatory protocol in 2018 to address the potential spread of AIS by wildfire equipment. This protocol is supported by the national Guide to Preventing AIS Transport by Wildfire Operations, which provides science-based recommendations for a whole host of AIS. (cont.) The Northern Rockies protocol is focused on invasive mussels and takes an approach that is both functional and manageable by field staff. In wildland fire management, AIS can be transported via firefighting equipment that contacts or transports untreated water, such as portable pumps (including floatable pumps), portable tanks, helicopter buckets, and internal tanks of fire engines, water tenders, helicopters, and fixed wing aircraft. By being conscious of drafting techniques (priming the pump from the source water ***not*** the tank water) and following Clean Drain Dry principles, the risk of many types of equipment can be mitigated. The components that have the highest risk of introducing or spreading AIS include foot valves, drafting hoses and helicopter buckets. The Northern Rockies Coordinating Group Directive focuses on these items for mandatory decontamination between uses. The poster focuses on the development and implementation of these protocols.



Thomas Woolf, **AIS Bureau Chief, Montana Fish, Wildlife & Parks**

Tom has worked on aquatic invasive species issues for nearly twenty years, most recently with the Idaho State Department of Agriculture developing and implementing Idaho's AIS program. In 2017 he started as the AIS Bureau Chief for Montana Fish Wildlife and Parks and currently manages the state's AIS program.

The expansion of Montana's AIS program

The detection of dreissenid mussel larvae in Montana led to a rapid expansion of the AIS program state-wide. FWP has implemented expanded watercraft inspection, early detection monitoring and education to address the AIS issue. Working closely with partners, Montana is building the most comprehensive and successful AIS program in the nation to protect our waters from invasive species.

Cody Youngbull, Ph.D., Physicist - Optical Materials, Devices, and Sensors. Research Professor, University of Montana, Division of Biological Sciences, Flathead Lake Biological Station

Dr. Youngbull earned a Ph.D. in Condensed Matter Physics from the University of Washington in 2001 for his work on ultrafast laser manufacturing of polymer photonic sensors. Prior to this, Dr. Youngbull received his degree in Biophysics and was employed at Los Alamos National Laboratory in the Nonproliferation and International Security Division. Dr. Youngbull has been a Research Professor for 8 years, developing free-space optical communications systems and biosensors based on emulsion droplet microfluidics and novel optical materials. Dr. Youngbull currently directs SensorSpace, a cutting-edge facility for environmental sensor design, prototyping, production, and deployment at the Flathead Lake Biological Station.

Automatic detection of aquatic invasive and pathogenic species through their DNA signature

Dr. Youngbull will present the DNA-Tracker, a novel field instrument for detecting the presence and activity of life from environmental water samples. The instrument is based on emulsion droplet microfluidic technology which allows for digital quantification of target nucleic acids. The instrument was developed at Flathead Lake Biological Station (FLBS) and is currently being deployed in the fight against the invasion of non-native freshwater mussels in Montana and the spread of aquatic viruses in the Puget Sound. Dr. Youngbull will also be presenting SensorSpace: A Cutting-Edge NSF Facility for Environmental Sensor Education, Design, Prototyping, Production, and Deployment.