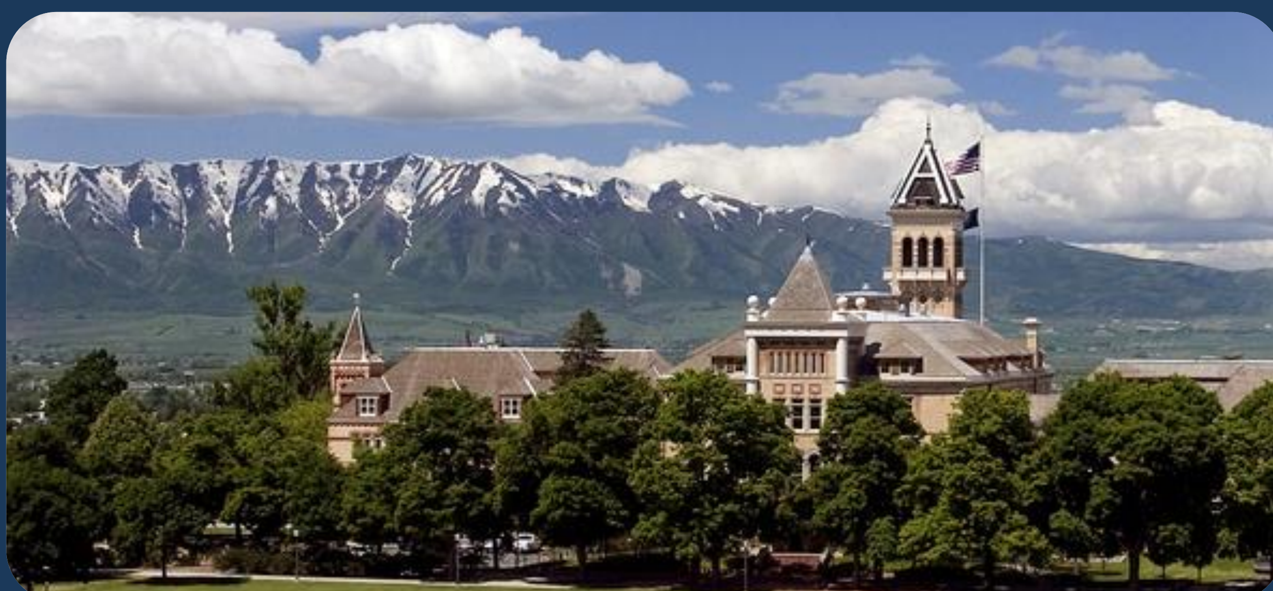
Utah State University
DEPARTMENT OF WATERSHED SCIENCES

Department of Watershed Sciences

Spring 2018
Graduate Student
Research Symposium



Friday, April 13, 2018
ECC 205/207
8:00 am – 2:30 pm

Utah State University
Quinney College of Natural Resources
Department of Watershed Sciences
Graduate Student
Research Symposium

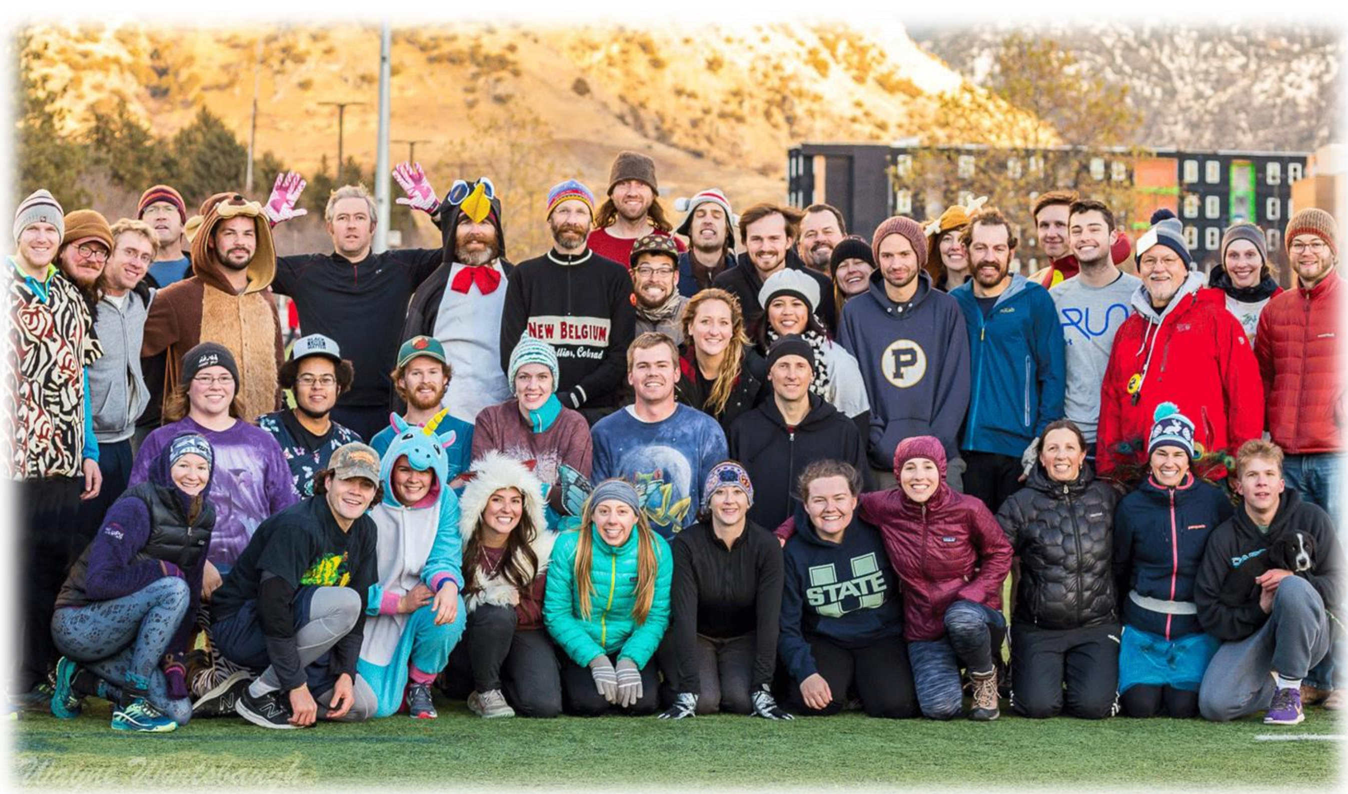
April 13, 2018

Welcome to the Department of Watershed Sciences Graduate Research Symposium. This symposium provides an opportunity for our graduate students to present ideas about their thesis/dissertation research and to receive feedback regarding their plans. Your comments and insights are welcome and expected.

Today, we will hear from nine M.S. and five Ph.D. students. Their presentations are a sample of the diversity of water resource, conservation, and ecosystem science issues that faculty, students, and research associates in the Department of Watershed Sciences explore.

3:00pm: Spring Softball Game (Graduate Students vs. Faculty/Staff)
on the Aggie Legacy West & Center Fields.

6:30pm: Social at Peter Wilcock's house (1624 Sunset Dr., Logan)



WATS Graduate Student Research Symposium Schedule

8:20	**Welcome: Dr. Peter Wilcock**
8:40	**Nicholas Barrett, Ph.D. in Ecology** *Major Advisor: Dr. Phaedra Budy*
9:00	**Niall Clancy, MS in Ecology** *Major Advisor: Dr. Janice Brahney*
9:20	**Ph.D. Research Update** **Rachel Hager, Ph.D. in Ecology** *Major Advisor: Dr. Karin Kettenring*
9:40	**Ph.D. Research Update** **Mitchell Donovan, Ph.D. in Watershed Science** *Major Advisor: Dr. Patrick Belmont*
10:00	**Adam Fisher, MS in Watershed Science** *Major Advisor: Dr. Patrick Belmont*
10:20	**Break**
10:40	**Jessica Scholz, MS in Watershed Science** *Major Advisor: Dr. Janice Brahney*
11:00	**Christina Leonard, Ph.D. in Watershed Science** *Major Advisor: Dr. Jack Schmidt*
11:20	**Madeline Friend, MS in Watershed Science** *Major Advisor: Dr. Jack Schmidt*
11:40	**Natalie Gillard, MS in Watershed Science** *Major Advisor: Dr. Patrick Belmont*
12:00	**Lunch**
12:40	**Deni Murray, MS in Ecology** *Major Advisor: Dr. Janice Brahney*
1:00	**Emily Leonard, MS in Ecology** *Major Advisor: Dr. Karin Kettenring*
1:20	**Ph.D. Research Update** **Suzan Tahir, Ph.D. in Ecology** *Major Advisor: Dr. Karin Kettenring*
1:40	**Maya Pendleton, MS in Ecology** *Major Advisor: Dr. Trisha Atwood*
2:00	**Jenna Keeton, MS in Ecology** *Major Advisor: Dr. Jereme Gaeta*

Abstracts

Nicholas Barrett, Ph.D. in Ecology

Major Advisor: Dr. Phaedra Budy

From individuals to ecosystems: Understanding how arctic lakes will respond to a rapidly warming climate

The Arctic region is experiencing the highest rates of warming around the globe, a trend that is likely to continue. However, the ecological consequences associated with this change are poorly understood. Ultimately, the effects of warming will depend on both the direct and indirect effects, as well as the ability of organisms to adapt to changing conditions. Direct effects of warming will likely include changes in lake ice-cover, thermal dynamics, nutrient cycling, and physiological functioning of organisms (e.g., metabolism). Indirect effects will include alterations in the availability of crucial resources such as suitable habitat, food, and dissolved oxygen as well as changes in the way organisms interact. Thus, warming may have substantial impacts on the physical, chemical, and biotic properties within a lake, with consequences likely spanning all levels of biological organization, from individuals to ecosystems. Therefore, given the ecological and subsistence importance of arctic lakes, we must improve our understanding regarding their response to climatic warming, which is the broad objective of my dissertation research. To accomplish this goal, I will address the following questions: (Chapter 1) How will warming and inter-annual variability in temperatures affect lake ecosystem metabolism? (Chapter 2) What are the direct and indirect effects of warming on an important consumer within arctic lakes and what are the implications for the entire food web? (Chapter 3) From a food web perspective, how will warming affect an entire lake ecosystem? Finally, (Chapter 4) how will populations of arctic fishes respond to warming at a landscape-level? To answer these questions, I plan to use a multi-faceted approach that incorporates both newly collected and historic field data, small and large-scale experiments, and bioenergetic and ecosystem models. Furthermore, this research will involve multiple scales of reference that encompass individual, population, community, ecosystem, and landscape-level responses to climatic warming. Through this research, we will gain valuable knowledge and predictive power essential in understanding the effects of climate change on arctic lakes. This will allow for effective management and conservation of freshwater resources within the Arctic.

Niall Clancy, MS in Ecology

Major Advisor: Dr. Janice Brahney

An investigation of *Didymosphenia geminate* bloom impacts and mitigation efforts on the stream fish community of the Kootenay River basin

While the negative impacts of invasive species are well documented, those of overabundant native species are more poorly understood. *Didymosphenia geminata* (a.k.a. 'Didymo' or 'Rock Snot') is a freshwater diatomaceous algae that can exhibit nuisance, bloom-forming behaviour when stream phosphorus concentrations are low, forming thick algal mats that can cover large areas of stream substrates. These mats have been shown to alter stream macroinvertebrate communities and hamper sub-surface angling activities. In southeastern British Columbia, fisheries biologists have observed a marked increase in Didymo blooms throughout the last decade. There is concern that these blooms contributed to a recent doubling of Kootenay Lake Rainbow Trout (*Oncorhynchus mykiss*) numbers, by increasing prey availability for juvenile Rainbow Trout in the Lardeau River, a Kootenay Lake tributary. This unexpected increase caused a large decline in adfluvial Kokanee (*Oncorhynchus nerka*), the adult Rainbow Trout's primary prey species. Didymo blooms have also damaged a fish screen meant to prevent hybridization of Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) in the White River basin of British Columbia, where Rainbow Trout are invasive. Here, I propose to study the effects of Didymo blooms on the diet, growth, condition, and distribution of stream fishes in the Lardeau River and Outlet Creek, a White River tributary. I will also examine the effectiveness of phosphorus addition as a mitigation tool. To do this, I will measure Didymo coverage, macroinvertebrate abundance & community metrics, and fish diets, isotopic composition, condition, growth, and community structure across a gradient of Didymo densities in the Lardeau River and Outlet Creek. I will compare the trophic niche of fish in high versus low Didymo concentrations and also use a bioenergetics approach to predict fish growth at different levels of Didymo abundance based on our data. Results will help elucidate the impacts of Didymo blooms on multiple trophic levels and potentially provide managers with a tool to mitigate such impacts.

Rachel Hager, Ph.D. in Ecology

Major Advisor: Dr. Karin Kettenring

Restoring ecosystem multifunctionality in Great Salt Lake wetlands using native bulrush genotypes

Wetlands provide critical ecosystem functions such as carbon storage, invasion resistance, habitat provisioning, and drought resilience. However, human activities over the past century more than half of the world's wetlands have been degraded due to invasive species, eutrophication, and climate change. Frequently restoration efforts do not restore ecosystem structure and functions to pre-degradation levels**.** The restoration of functioning wetlands may be facilitated through the introduction of diverse genotype assemblages, and informed by research on mechanisms driving diversity-function relationships. I will investigate how different individual genotypes may vary in functional traits and how assemblages of genotypes with varying functional traits support the restoration of multifunctionality through plantings of genotype assemblages. The objectives of this project are to: 1) Identify and quantify the variation of functional traits between and within populations of three native bulrush species (*Schoenoplectus acutus*, *S. americanus,* and *Bolboschoenus maritimus*) 2) Quantify the trait space of each genotype and calculate the dispersion of genotypes of a specific species in trait space 3) Select genotypes for wetland restoration based on their complementarity and occupied trait space for the desired ecosystem functions. Moving forward, I will apply these findings in a field experiment at Farmington Bay WMA this summer to restore wetland function through diverse genetic assemblages. Using population assemblages and ecosystem functions through a trait-based framework provides a strong potential for more targeted and potentially better performing wetland restorations in the future. Restoring the productivity and function of wetlands in an era of climate change will not reverse human caused impacts, but could aid in the recovery of these critical and valuable ecosystem functions.

Mitchell Donovan, Ph.D. in Watershed Science

Major Advisor: Dr. Patrick Belmont

Understanding the cause and impact of timescale bias in river migration rate measurements

Accurately measuring river meander migration over time is critical for understanding how rivers function and respond to changes in hydrology or sediment supply. Current approaches often compare river position in aerial imagery to estimate river migration rates at different times and over dissimilar intervals. Results from empirical data and a river migration model both confirm that comparing measurements over dissimilar timescales favor the conclusion that contemporary migration rates have increased. This bias results from systematic underestimations of migration rates measured over longer timescales, combined with a preponderance of short measurement intervals for contemporary images relative to historical. We find that increased probability of the channel reversals are the primary reason for reduced rates measured for longer time intervals. Model results show systematic changes in migration rates (0.1x – 10x) exhibit a secondary influence on timescale dependence, and only influence results in extreme cases. We evaluate the role of timescale dependence for the Root River, a single threaded meandering sand- and gravel-bedded river in southeastern Minnesota, USA, with 76 years of aerial photographs spanning an era of landscape changes that have drastically altered flows. Despite such changes, migration rates do not exhibit any significant changes over the period of study.

Adam Fisher, MS in Watershed Science

Major Advisor: Dr. Patrick Belmont

Evaluating sediment rating curves in rivers draining redwood forests to investigate trends in sediment production and transport

Suspended sediment strongly influences water quality, aquatic ecosystem health, and resource policy and management. Determining the sources of excess sediment loading has proven exceptionally challenging due to immense variability in erosional processes over space and time, heterogeneity in sediment transport and deposition, and a paucity of spatially explicit sediment monitoring data. Previous researchers have analyzed the relationship between flow and suspended sediment concentration, known as a sediment rating curve (SRC), and related the shape and characteristics of that curve to watershed characteristics, changes in base level, land use, and climate factors. I propose to investigate trends in SRCs in watersheds draining redwood forests along the north coast of California. The watersheds span a wide range of geologic and tectonic environments and land use histories. Preliminary results from 65 gages indicate that SRCs are extremely variable and may reflect different tectonic environments as well as land-use practices. I will extract near-channel and basin-wide morphometrics from lidar data to characterize the geomorphic setting of the watershed that drains to each gage. I propose to use the Random Forest statistical classification and regression model to investigate relationships between SRC attributes (i.e. shape, steepness, and vertical offset) and a variety of geologic, topographic and land use metrics. Some of these metrics include rock type, presence and extent of recent landslides and debris flows, long-term erosion rates quantified by in situ cosmogenic nuclide Beryllium-10, basin relief, normalized steepness index, timber harvest rates, and road density. My analysis will further the understanding of suspended sediment relations within the dynamic watersheds of northern California and hopefully inform policy makers and land managers regarding processes controlling sediment production.

Jessica Scholz, MS in Watershed Science

Major Advisor: Dr. Janice Brahney

Mechanisms for phosphorus increases in alpine lakes

Phosphorus is typically the most limiting nutrient in terrestrial aquatic ecosystems, and thus represents an important factor controlling water quality and ecosystem health. A recent nationwide survey conducted by the Environment Protection Agency (EPA) revealed that phosphorus has increased in lakes and rivers across the US from 2000-2014. Notably, these increases occurred in even the most isolated areas, minimally impacted by human activity. This study aims to identify potential mechanisms causing these nationwide increases in phosphorus to isolated aquatic systems. The aquatic systems I will be studying are located in the Uinta Mountains. Alpine aquatic ecosystems represent important sources of high-quality water and contain ecosystems sensitive to fluctuations in nutrient levels. I propose to test two hypotheses mechanisms for increased phosphorus to alpine lakes and streams: 1) Increases in dust-derived phosphorus deposited in remote lake catchments, and 2) changes in soil chemistry, associated with the recovery of acidified lakes that drive increased phosphorus and DOC leaching to alpine lakes. I will test these hypotheses with contemporary dust sampling and experimental analysis of alpine soils in varying pH conditions. For the first hypothesis, I will sample dust in locations spanning northern Utah as well as directly in the Uinta Mountains. From the dust samples, I will quantify the bioavailable forms of phosphorus using sequential extraction methods and identify spatial differences in dust-P concentrations across northern Utah. By doing this, I will determine whether dust is can potentially cause the observed increases in phosphorus and identify potential dust sources. For the second hypothesis, I will test the effects of soil water pH on the leaching of phosphorus and dissolved organic carbon in alpine soils. This hypothesis relates to the soil chemistry changes associated with recovery from acid deposition. For each soil sample from 5 different alpine catchments, I will adjust the soil pH and measure the concentration of phosphate and DOC in the leachate. This experiment will allow me to calculate the amount of P leached at various catchment soil pH values.

Christina Leonard, Ph.D. in Watershed Science

Major Advisor: Dr. Jack Schmidt

Linking high temporal resolution flux-based sediment budgets with channel change: What constitutes a big number?

There are relatively few field settings where data are sufficient to compare flux-based budgets with morphologic budgets based on analysis of change in channel and floodplain form. Nevertheless, understanding how flux-based measurements relate to channel change is critical in many places. Flux measurements directly link flow-regime changes caused by reservoir re-operation, climate change, or land use to channel change that may affect valued aquatic and riparian habitat or valley bottom land use. The Green River in Dinosaur National Monument and in the Uinta Basin is one such area where there is interest in linking decisions about upstream reservoir operations at Flaming Gorge with downstream changes of in-channel and floodplain habitat. River resources are managed by the National Park Service and the U.S. Fish and Wildlife Service whose objectives are to maintain and protect the native river landscape and endangered fish habitat. In contrast, operations of Flaming Gorge Reservoir are determined by the Bureau of Reclamation whose primary concern is water supply. The complementary and competing concerns of these federal agencies inspired funding of a fine sediment flux measurement program conducted by the U.S. Geological Survey Grand Canyon Monitoring and Research Center using a novel approach of acoustic current profilers to measure suspended fine-sediment load and measurements of dune migration to estimate bed load transport of sand. Five sediment gages have been operating since 2013 in the eastern Uinta Mountains and form a sediment budget for the Green and Yampa River in Dinosaur National Monument. For each year between 2013-2017, the efflux of sand exceeded the influx on the Yampa River, resulting in a net deficit of ~640,000 tons. On the Green River, upstream of Jensen, sand accumulated during low flow years and the budget was indeterminant during the remaining modest flow years. Both the Yampa and Green reaches accumulated or evacuated silt-and-clay during individual years, but there was no discernable change in the silt-and-clay budget over the entire period. Downstream of the Jensen gage the Green River leaves the Uinta Mountains and enters the Uinta Basin, where a sediment gage at Ouray has been operating in the since 2017. In 2017, transport of silt-and-clay and of sand at Ouray exceeded transport of fine sediment at Jensen, indicating that ~170,000 tons of silt-and-clay and ~230,000 tons of sand were evacuated from the Uinta Basin. The aim of this study is to separately link fine sediment flux differences of silt-and-clay and of sand to specific morphologic attributes of the channel and floodplain. Using the above transport data as an example, we ask the question, "Are the differences between influx and efflux of fine sediment large numbers or small numbers?" "Are the flux-based estimates of mass imbalance morphologically significant?" We seek to compare partitioned fine sediment mass balances, determined by measurements of sediment transport and based on mapping and measurement of channel and floodplain sediments, in order to determine if some parts of the alluvial valley are more sensitive to flux imbalances than other areas. Topping et al. (in revision) showed bed fining occurs relatively quickly following upstream perturbations in fine sediment supply but subsequent coarsening takes many decades. We hypothesize that such changes in bed grain size are a plausible, yet relatively unexplored, mechanism of channel adjustment which have the potential to dampen or exacerbate larger scale changes in channel form, cross-section geometry, or slope. Such dampening or exacerbation may cause channel form adjustment to be less or more than anticipated. In addition, where and how specific grain size classes of sediment are stored within the system may exert a dominate control on how sediment is routed downstream. Results of this study aim to establish morphological meaning to flux-based sediment budgets by identifying mechanisms, whether large (e.g., changes in cross-section geometry or slope) or small (e.g., changes in bed material grain size), which underlie channel response to upstream changes in sediment influx.

Madeline Friend, MS in Watershed Science

Major Advisor: Dr. Jack Schmidt

Influences of changing base level and episodic flash floods on tributary sediment remobilization in Lake Powell

Lake Powell is the second-largest reservoir in the United States and traps all incoming fine sediment the Colorado River used to transport through Glen Canyon and into Marble Canyon and Grand Canyon. A warming climate is projected to yield less streamflow in the Colorado River and its major headwater tributaries, inevitably leading to persistently less water stored in mainstem reservoirs. Sediment transported into the reservoir by the Colorado River, San Juan River, regional rivers such as the Escalante and Dirty Devil, and small ephemeral streams now forms deltas that partially fill upstream sections of many reservoir arms, including the side canyons for which Glen Canyon was once acclaimed. During periods of low reservoir levels, this fine sediment has potential to be eroded, remobilized, and transported further into Lake Powell. Although bathymetric measurements of sediment accumulation have been made in the largest reservoir arms, little is understood about fine sediment accumulation and evacuation in scenic, smaller side canyons. We seek to understand 1) how much fine sediment is in each tributary, 2) dominant factors controlling accumulation of fine sediment in reservoir arms, and 3) mechanisms controlling fine sediment remobilization during low reservoir elevations.

We distinguish four potential zones of Lake Powell whose tributary canyons potentially respond differently to fluctuating reservoir levels: 1) upstream from bedrock ledges that perch reservoir arms at artificially high levels, even when reservoir storage is low, 2) immediately downstream from these ledges, 3) in the central region where side canyons are significantly inundated, and 4) very near Glen Canyon Dam. We characterize tributaries by watershed area, bedrock type, and susceptibility to monsoon flash floods. We hypothesize the magnitude of sediment accumulation and evacuation differs through these four zones. We are using aerial imagery to quantify the amount of sediment accumulation in each tributary. In the future, we will measure how much sediment has accumulated in tributary mouths using aerial LiDAR and bathymetric data. We will couple this with attributes of monsoon season circulation. Ultimately, we hope to quantify the magnitude of side canyon inundation with water and fine sediment and understand potential recovery of these side canyons in the event of protracted reservoir drawdown

---

Natalie Gillard, MS in Watershed Science

Major Advisor: Dr. Patrick Belmont

Effects of post-wildfire changes in hydrology and sediment transport on Cutthroat trout habitat

In recent decades, wildfires have increased in size, frequency, and burn severity across the Intermountain West due to climate change and increased fuel loads. Streamflows typically increase considerably following a wildfire, especially in areas affected by high severity burn, due to loss of vegetation and decreased infiltration capacity. This increased runoff can increase hillslope erosion considerably and cause catastrophic erosional events called debris flows. Factors controlling debris flow initiation include topography, lithology, abundance of water-repellant soils and rainfall intensity and duration. Post-wildfire increases in sediment supply can dramatically alter channel morphology and fish habitat conditions both within the fire perimeter and in downstream reaches. There are still many open questions regarding hillslopes, channel networks, and fish habitat will be affected by post-wildfire flooding and sediment dynamics in the Intermountain West. This proposed research will identify and quantify the heterogeneous landscape response to wildfire through analysis of rainfall-runoff ratios, debris flows, and fish habitat. The questions this study will address include:

1. How well can we predict the magnitude of changes in rainfall-runoff ratios in wildfire affected areas using readily available metric such as watershed area, burn area, and burn severity?

2. How does grain size distribution differ among the various processes contributing sediment (e.g., sheetwash, gullying, debris flows) post-wildfire?

3. Are there 'hotspots' of change within stream networks where post-wildfire sediment inputs are especially beneficial or detrimental to fish habitat?

Deni Murray, MS in Ecology

Major Advisor: Dr. Janice Brahney

Beaver-Induced Biogeochemical Alterations in Mountain Streams

Beavers (*Castor canadensis*) are integral components of many alluvial stream ecosystems. Beavers cut wood and build dams, which impound stream flow and flood valley bottoms. This engineering feat reduces stream velocity and increases sedimentation rates upstream of dams, allowing nutrients and bacteria to bind with fine sediments deposited and trapped behind the dams. While it is evident beaver dams influence stream water quality, the specific drivers of biogeochemical change remain unclear. Beaver dams create patchiness in the streamscape, with stream reaches alternating between lotic and semi-lentic. Similarly, a beaver-pond itself exhibits highly heterogeneous habitats. Sections of a beaver pond may act similarly to the main channel, whereas other areas may experience dramatic differences in depth, temperature, hyporheic exchange and flow, creating strong heterogeneity in physical and chemical habitat.

I aim to understand how beaver dams can act as natural water-filters by altering the flux of nutrients and bacteria in stream ecosystems. However, research on beaver-dams as natural water filters is limited. Preliminary research suggests that sampling above and below an individual beaver pond does not capture the true biogeochemical effects of beaver dams because simplistic sampling locations ignore pond heterogeneity. At a reach scale, small differences in water quality above and below dams emerge, but, the overall effects of beaver dams on stream biogeochemistry is likely underestimated. To understand how beaver dams truly alter water quality in aquatic habitats, I will compare the biogeochemistry of two ponded and unponded stream reaches, immediately downstream of the selected ponds. I will thoroughly examine concentrations of dissolved and particulate nutrients (nitrogen, phosphorous, carbon), benthic and water column primary productivity, and physical stream parameters (i.e. temperature, pH, dissolved oxygen). I will also collect sediment cores from multiple, representative locations in the beaver ponds. I will use sediment and water column data to identify biogeochemical 'hotspots' within beaver ponds. I will also compare a stream with beaver dams to a stream with no beaver dams to understand the overall effect of dams on beaver-altered streams. My research will provide a foundation for future research concerning the ecology and hydrology of beaver-altered streams.

Emily Leonard, MS in Ecology

Major Advisor: Dr. Karin Kettenring

Response of invertebrate assemblages to *Phragmites australis* invasion and native plant revegetation in Great Salt Lake wetlands

The Great Salt Lake in Utah is continentally significant for millions of migratory shorebirds, waterfowl, and songbirds. However, an invasive grass, *Phragmites australis* (common reed), is rapidly invading these wetlands, outcompeting native vegetation, and substantially altering critical bird habitat. For these reasons, many current restoration efforts within GSL wetlands focus on the removal of *Phragmites* and the reestablishment of native plant communities to promote bird habitat. Although the removal of *Phragmites* can help restore native vegetation, additional factors, such as food resource availability, contribute to habitat quality. Specifically, invertebrates provide an important food source for many bird species, yet how *Phragmites* may be altering invertebrate assemblages is unclear. My proposed research addresses three primary objectives to help fill these knowledge gaps: 1) Examine how invertebrate assemblages respond to *Phragmites* invasion in Great Salt Lake wetlands 2) Identify if *Phragmites* removal and the reestablishment of native vegetation can restore invertebrate species composition, richness, biomass, and diversity within previously invaded wetlands and 3) Estimate the role of different restoration techniques in determining invertebrate recovery success. To accomplish these objectives, I will examine the emergence and movement of flying insects within four dominant GSL native wetland vegetation types, invaded *Phragmites* areas, and in two active restoration sites using a combination of emergence and windowpane traps. A focus on flying insects—that spend both their larval and adult stages within the wetlands—will highlight differences in invertebrate assemblages among vegetation types and suggest habitats that are potentially important for aquatic insect larvae. Recognizing how invertebrates interact with *Phragmites* as well as with native vegetation is a critical component of understanding how to best restore these wetland habitats. By gaining a better understanding of these relationships, invertebrate assemblage composition could serve as a potential assessment metric for determining restoration success in Great Salt Lake wetlands.

Suzan Tahir, Ph.D. in Ecology

Major Advisor: Dr. Karin Kettenring

What is the algal growth potential and assimilative capacity of Willard Spur: An experimental approach

Wetland ecological structure and function can become impaired by anthropogenic inputs of nutrients and/or changes to water availability. These two stressors converge in the Willard Spur (WS) wetlands of the Great Salt Lake. The first two chapters of my dissertation will address the spatial and temporal variability in water quality, sediment chemistry, and submerged aquatic vegetation (SAV). Preliminary data suggest that the WS is not a homogeneous aquatic system and shows spatial and temporal variability in water quality, sediment chemistry, and submerged aquatic vegetation. While my analyses thus far have shown that water quality and availability change over space and time in the WS, I am continuing to investigate the contribution of the inflows to this spatial and temporal variability.

We know that wetlands can become impaired by anthropogenic inputs of nitrogen (N) and phosphorus (P), thus the main goal of the last chapter of my dissertation is to investigate how increased nutrients (N and P) will affect the assimilative capacity of the WS wetlands. First, I hypothesize that both algae that live on SAV (epiphytes) and phytoplankton in the water column of WS are limited by water column nutrients, and that when added, will increase in biomass. Therefore, I will test this hypothesis by conducting a nutrient bioassay experiment in the lab by adding nitrate (KNO_3), ammonium ($(NH_4)_2SO_4$) and phosphate (Na_2HPO_4) at different concentrations (low, medium and high) as well as secondarily treated sewage effluent to surface water obtained from WS. Second, I hypothesize that nutrients will impair the assimilative capacity of the WS wetlands. I will test this hypothesis using mesocosm experiments (in-situ). Nutrients (either N, P, or both, as determined from the first bioassay) will be added biweekly to mesocosms for 4 weeks. Water samples will be tested for NO_3-N, NH_4-N, Total Nitrogen (TN), and Total Phosphorus (TP) to analyze the nutrient assimilation (measure the decline in nutrients over the course of 6-8 hours after the nutrients addition).

Since Utah undergoes one of the nation's fastest population growth rates, knowing the assimilative capacity of this ecosystem may help the Division of Water Quality (DWQ) with their future nutrient allocation decision making process or with their future wetland numeric standard developing policy. Moreover, the potential impact of these experiments can result in a more strategic allocation of available resources (by DWQ) towards addressing problems created by specific nutrients to protect valuable wetland ecosystems.

Keywords: Willard Spur, wetlands, anthropogenic inputs of nutrients, assimilative capacity, algal growth potential

---

Maya Pendleton, MS in Ecology

Major Advisor: Dr. Trisha Atwood

Ecosystem functioning of Great Salt Lake wetlands

Recent research has suggested that increased species diversity also increases ecosystem functioning, including multifunctionality (the ability of a habitat or community to support multiple functions simultaneously). However, nearly all of these studies have focused on species diversity at small spatial scales (i.e. plot scale). For my study, I will investigate how plant diversity at the habitat scale influences ecosystem functioning within Great Salt Lake (GSL) wetlands. The GSL wetlands account for approximately 80% of all

Utah wetlands. With relatively high species diversity at the landscape scale, GSL wetlands support an abundance of ecosystem functions and services including critical wildlife habitat, flood prevention, recreational opportunities, and carbon sequestration. However, over the last 30 years, the aggressive European plant *Phragmites australis* has invaded the GSL wetlands. This tenacious plant has spread rapidly, homogenizing the landscape. It is critical that we understand how different vegetation types within the GSL wetlands support ecosystem functioning, as this is the only way to predict the overall effects of *P. australis* on GSL wetlands.

My study aims to quantify individual ecosystem function and multifunctionality supported by the different wetland plant communities. To do this, I will address two objectives. Objective 1: Determine how independent ecosystem functions vary across different emergent wetland vegetation types within the GSL. Objective 2: Determine how multifunctionality, as measured by a multifunctionality index (MI), varies across different emergent wetland vegetation types. To accomplish these two objectives, I have chosen 10 plots of 7 dominant habitat types (70 total plots) and will evaluate the following functions: sedimentation rates, above and below ground carbon and nitrogen stores, biomass, avian habitat, and seed production. This data will allow me to determine how diversity at the habitat scale supports overall functioning of an ecosystem. With this information, we will also map ecosystem functioning across the GSL landscape. This data will serve as a baseline by which managers can assess changes to GSL wetlands and the functions and services they provide.

Jenna Keeton, MS in Ecology

Major Advisor: Dr. Jereme Gaeta

The efficacy and ecological consequences of using triploidy for aquatic invasive species management

The introduction of sterile triploid fish populations to water bodies is a management technique state agencies commonly use for stocking desirable sport fishes while avoiding harmful genetic introgression with native species. In the future, managers intend to use sterile triploid fish as a novel approach to eradicate invasive populations of the same species. Triploidy is accomplished by manipulating the number of chromosomes relative to diploid conspecifics, which results in altered physiology and fish sterility. However, the observed ecological consequences of triploidy manifest differently across fish species and may result in varied growth and behavior when compared to diploids. Evaluating and understanding the potential ecological consequences of triploidy in specific fish species is critical if triploids are to be used for future eradication efforts.

Recently, walleye (*Sander vitreus)* were illegally introduced to several reservoirs across northern Utah. Non-native walleye degrade established sport fisheries in addition to competing with and preying upon native and endangered fishes. Our research focuses on understanding the feasibilty of using triploidy as an invasive eradication technique for walleye. The objectives of this research are to: 1) determine if male triploid walleye exhibit spawning behavior; 2) compare whether triploid walleye disproportionately allocate energy towards somatic growth relative to diploid walleye; and 3) quantify the foraging success of triploid walleye compared to diploid conspecifics. We plan to address these objectives through a combination of multi-year, multi-site field sampling, laboratory trials, and the monitoring of fish behavior in experimental ponds. The results of this research will inform state fisheries managers in Utah of the ecological consequences and eradication efficacy of using triploid walleye to manage invasive conspecifics.

UtahStateUniversity
DEPARTMENT OF WATERSHED SCIENCES