iUTAH Undergraduate Research Fellows (iFellows)
Research Symposium – July 27, 2016

Abstracts

1. Fire Severity Increases Snow Accumulation in Mixed Conifer Forests

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Snowpack is an important resource for water supply but varies year to year depending on several different variables, including topographical variables. One variable that is largely unknown is how much fire alters snowpack. More and more frequently, forest systems are being modified by fire, resulting in a gradient of fire severity across landscapes. This study characterizes how peak snow accumulation is affected by varying degrees of fire severity in mixed conifer forests. Comparing the percent mortality with snow accumulation shows an increase in snow depth by 30% for 2015 and 2016. Overall, we found that as burn severity increases, snow depth increases. Fires causes low forest density that allows more snow to accumulate, but there is also more direct solar radiation that can cause ablation to happen at a faster rate. Further study is needed to gain a greater understanding of how snow ablation is affected by forest canopy.

2. Quantification of MeHg Fluctuations in the Provo River over a 24-hour Cycle

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Anthropogenic emissions increase the natural mercury (Hg) levels in the Earth's biogeochemical cycle. In aquatic ecosystems, like the Provo River, Hg converts to the neurotoxin methylmercury (MeHg), which bioaccumulates through the food chain. Typical human exposure to MeHg occurs from the consumption of contaminated fish. A mercury advisory for Jordanelle Reservoir, located along the Provo River, created a need for the river analysis. The purpose of this study was to quantify the fluctuations of MeHg in the Upper Provo River over a 24-hour period. Results of the unfiltered MeHg in comparison to gage height show the highest MeHg levels (> 0.1 ng/L) coincided with the lowest gage heights (<94cm) during the hours of 1900 to 2200. These levels were within the range found in ambient waters of 0.078 and 0.55 ng/L for MeHg. The results of this study will aid in determining future collection times of river samples.

3. Identifying and Comparing Fecal Contamination Sources in Three Utah watersheds

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As the population in Utah increases and more demands are placed on Utah's water sources, it is becoming even more essential to be able to identify and address water quality issues. Currently, tests can be run to determine if water is polluted or contaminated, but when it comes to determining the origin of the pollution, such as fecal contamination, there are not many fast and effective ways to find that source. This study looks at developing a basic microbial source tracking procedure, a technique that identifies fecal bacteria associated with specific host animals. This procedure will provide managers and residents of Utah with a way of identifying sources of fecal pollution so they can take steps to mitigate it and find a solution. We took samples from the Logan, Provo, and Red Butte Creek watersheds and analyzed them for human, dog, and ruminant fecal contamination using quantitative PCR. We also worked on creating qPCR standards by which we will be able to compare water samples and absolutely quantify the level of bacteria from humans, dogs, and ruminants.

4. The Effects of Elevation on Evapotranspiration

SHANAE TATE, *Brigham Young University, r.shanae.tate@gmail.com*
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Evapotranspiration (ET) remains one of the more difficult variables to account for in the hydrologic cycle. There are several methods with which one can estimate ET, including the use of eddy covariance and vegetative indices. One of the simpler methods is a water balance equation using soil water content data. These data have significant implications for both agricultural and forest systems and are collected with sensors employing Time Domain-Transmissometry (TDT). These TDT measurements involve the time of travel of electromagnetic waves through different media, including soil, air, and water. As the travel time through water is significantly slower than that for soil solids and air, this gives an indication of the water content in the soil. The iUTAH GAMUT network contains an array of TDT sensors that are continuously collecting data in the Provo, Logan, and Red Butte Creek Watersheds. An analysis of these data and precipitation data give an indication of ET. Through this analysis, we find that ET varies along an elevation gradient. The loss of soil moisture to ET begins in later months for sites at higher elevations and the rate of ET is also lower at those sites. The difference in timing is related to the timing of snowmelt and the rate of ET is related to plant community as well as climatic factors. The soil water measurements are useful for water-budget ET calculations during dry periods, however may not be used at sites with high water tables that continually replenish the soil pores with water. In these cases the change in soil water content does not give a representation of ET. Each site in the iUTAH GAMUT has unique qualities and the soil water content in each help to understand the hydrology of the system.

5. The Effect of Plot Size on Nitrogen Content and Water Sourcing of Urban Trees in Salt Lake City, UT

LILY WETTERLIN, *University of Utah, lily.wetterlin@live.com*

Urban trees face severe limitation of plantable space, which effects both rooting depth and the amount of available soil. The limitation of plantable space ultimately influences water and nutrient supply. Determining a correlation between plot size and water and nitrogen sources and availability, respectively, is important for the future sustainability of urban landscapes. To address this, we collected stem and leaf samples from 2 species of trees (Tilia cordata and Fraxinus pennsylvanica) from 3 locations in Salt Lake City: Sugarhouse Park area, Liberty Park area, and the Avenues Cemetery area. Twenty trees (10 of each species) were sampled from each of the locations, 10 from the interior of each park and 10 from the streets surrounding each park. The plot sizes varied for the trees surrounding each park. In total, 60 trees from variable plot sizes were sampled. Water was extracted from the stems to determine oxygen (Î´18O) and hydrogen (Î´2H) stable isotope ratios. Stable isotopes ratios of water were analyzed by mass spectrometry, and used to assess water sourcing. Mass spectrometry was also used to find the isotopic composition and content of nitrogen in the leaf samples collected. I hypothesize that trees with the larger amount of plantable space will have a higher abundance of leaf nitrogen and rely on groundwater, and that trees with a smaller amount of plantable space will have less leaf nitrogen and rely more on irrigation systems.

6. Microbes vs. Nutrients: Understanding Nutrient Pollution in Streams

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Microbial growth in stream systems can be limited by low nutrient concentrations. Nutrient loads to streams have increased with urbanization and agricultural land use. This has potential to cause stream eutrophication. This poster discusses the impact of specific nutrient loads that are of growing concern - nitrogen and phosphorus. I used two techniques to understand potential effects of elevated nutrients on microbial communities in the Provo River. Nutrient inputs did not significantly affect microbial biomass at the Provo River site. Continued research on which bacterial taxonomic units are using the nutrients is still in process. Examinations of bacterial preference for ammonium, nitrate, and organic nitrogen are being done using DNA stable isotope probing (DNA-SIP).This process uses a heavier stable isotope of a nutrient to analyze which bacterial taxonomic units are using the nutrient. The DNA-SIP technique has never been used to analyze stream bacterial taxonomic units in this context, and a basic method is also explained.

7. Measuring Flow Rates in Small Urban Stormwater Systems

MITCHELL STEELE, *Utah State University, mcsteele8@gmail.com*

Urban stormwater runoff from streets, parking lots, lawns and roofs is one of the largest impairments to our shared water systems. Untreated stormwater can contaminate surface water, making it unfit for use and/or habitat. In an effort to reduce stormwater runoff, the City of Logan installed street-side bio-retention bays along 300 E in town. This project will attempt to determine the hydraulic efficiency of the retention basins during storm events as well as the water quality as it drains through the basins. The results of this study can be used to decided whether or not to revise the designs or implement more.

8. Determining the Quantity and Quality of Rainwater Drainage from Various Rooftops

JOYDINO BEYALE, *Utah State University Eastern—Blanding, joydinobeyale@gmail.com*

Rainwater is an important natural resource for sustaining life; it is also essential to the environment. Due to high demand for water in urban areas and its contamination by human activities, implementing stormwater harvesting for groundwater recharge may be an option for increasing water supplies. This project is focused on collecting stromwater from commercial and industrial rooftops including: flat roofs layered with specific membranes, pitched metal roofs, roofs with solar panels, and a green roof. This roof runoff generated in the first flush and for the full rainfall events will be collected and analyzed for water quality indicators. Tipping Bucket Flow Gauges will be placed in roof drain manholes to measure the quantity of runoff draining from these roofs. An Isco Autosampler will be connected to the effluent of the Tipping Bucket Flow Gauge to collect samples for laboratory analyses. Standard lab procedures will be used to determine metals, nutrients, and organics in the runoff water as a function of the type of roof being sampled. These data will help determine if roof drainage is of sufficient quantity and high quality to be safe to use as a substitute water resource for humans and the environment to help manage the future water needs in the state of Utah. Harvesting and proper management of both rainwater and stormwater resources is urgently required to ensure a safe and adequate supply of water for future needs of the growing population in the Intermountain West.

9. Bioretention Effectiveness in a Semi-arid Climate

DARCIE CHRISTENSEN, *Utah State University, darc.c@aggiemail.usu.edu*
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With significant changes happening in watersheds due to rapid urbanization, bioretention is becoming a more common method to slow high velocity runoff and remove contaminants. Though a lot of research has been done on bioretention in wetland type systems, not much has been done in a semi-arid climate with native species that do not require additional irrigation. The focus for this study was on the analysis of nitrogen removal by vegetation and determining associated microbial roles in nitrogen cycling. Isotope ratio mass spectrometry was used to quantify total nitrogen (TN) in various wetland and upland plant species throughout various seasons. Real-Time Polymerase Chain Reaction (qPCR) was used to amplify and quantify bacterial DNA to determine diversity within the soils. The results will show the effectiveness of native plants in removing nitrogen from stormwater influent.

10. Utilizing Hydroponic Systems to Optimize Food Production in Salt Lake City, Utah

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Urban agriculture is increasingly popular and important in Salt Lake City, Utah. However, Salt Lake has limited water and land availability, a semi arid climate, and cold, snowy winters that make traditional agriculture difficult. Utilizing hydroponic systems may be a solution because they requires less area and water than traditional agricultural practices, and can produce food year round with the use of grow lights. However, additional energy and nutrient input is required to run hydroponic systems. We are comparing the water, nutrient, and energy input of plants grown in hydroponic systems versus traditional container gardening in three different environments; indoors with grow lights, in a greenhouse, and outdoors. The objective of this study is to sustainably optimize food production in Salt Lake. So far the data shows that the greenhouse environment requires the least amount of water, energy, and nutrient input, and produces the greatest amount of yield.

11. Cross Cutting Relationships Among Community Concerns and Green Urban Infrastructure in the Jordan River Corridor
LUIS VIDAL, *University of Utah, luisguillermo.vidal@gmail.com*

A public intercept model survey was conducted in the Jordan River corridor of Salt Lake City, Utah. The survey's questionnaire asked residents on their perceptions and opinions of the Jordan River, the surrounding parks and areas, and a proposed new green infrastructure. The results of the questionnaire will explore the relationships between residents and their green urban infrastructure in the river corridor. Analysis of the data was conducted after reaching 401 respondents and analyzed through SPSS. Specific terms related to parks and green spaces that are asked in scalar questions in the questionnaire show that supports for parks is always present regardless of which term is posed. A Frequency of visits to parks and how parks impact quality life also found no correlation between the two variables.

12. Spatial Impacts on Local Perceptions of the Jordan River
CYNTHIA ELLIOTT, *Weber State University, cynthiaelliott@mail.weber.edu*
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The Jordan River, which flows through the west side of Salt Lake City, is considered by some to be a natural amenity that can improve the quality of life in the community. Efforts have been made to turn the stream into a recreation area. It is not known the extent to which local residents benefit from those efforts. Our study explores how proximity to the Jordan River may affect local concerns and perceptions about certain aspects of the Jordan River. We distributed a questionnaire using iPads through public intercept methods. To be able to spatially analyze different questions on the survey, it asks respondents their proximity to the Jordan River. With this information, we were able to see whether or not proximity affects perceptions people have about the river. We found evidence that proximity to the Jordan River has a relationship with how people perceive that the river affects the quality of life in their neighborhood, as well as a relationship with how frequently people visit the Jordan River and surrounding parks. There was no statistically significant relationship between proximity to the river and concern about the area. Other variables also affect people's perceptions of the river, including the neighborhood lived in, frequency of visitation, and gender.

13. Utah Water Institutions and Policy Boundaries
STACY HENDERSON, *Salt Lake Community College, shendersonutah@gmail.com*
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This project aims to geographically display different Utah water institutions' policy boundaries in relation to counties. I utilized ArcMap and data from Utah AGRC and USGS to create a series that includes the following maps: watersheds and elevation; Utah Division of Water Rights policy areas; Utah Division of Water Quality assessment units; Utah Water Conservation Districts; and Utah water conservancy districts and metropolitan water districts. I found that different water institutions have varying geographic areas within which their decisions are implemented, and those boundaries generally do not coincide with other water institutions' boundaries or with county boundaries. The visual display of these varying alignments of institutional boundaries illustrates the need for these institutions to have boundary-spanning lines of communication and forums for interaction to ensure that Utah's water is being used effectively and in a way that conserves it for future generations.

14. A Comparative Analysis of Attitudes Toward Drinking Water Between Utah and the Nation
ADAM WHALEN, *University of Utah, adam.whalen@utah.edu*
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Issues surrounding water have become increasingly prevalent in the arid regions of the western United States. Existing public opinion research in Utah gauges attitudes toward water issues among the citizenry; however, there is little to no understanding about where these attitudes compare to the rest of the nation. This study reviews extensive secondary data and analyzes national and state level surveys with water related questions. This data was then compared to similar water surveys completed in Utah and comparable questions were identified. The study ultimately selected perceived drinking water quality as the dependent variable for analysis. Specific demographic factors such as age, sex, educational attainment, and region of residence represent the independent variables. Linear regression analyses were calculated, and demonstrate a very slight but significant correlation between several of the variables.

The resulting comparisons highlight the similarities and contrasts between Utah, the nation, and several demographic groups. The implications and nuances of these findings are discussed.

15. What Factors Affect the Way People Think About Xeriscaping

GABRIELA MARTINEZ, *Salt Lake Community College, martinez.gabriela@utah.edu*
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Xeriscaping is a widely accepted water saving alternative to the more traditional lawn style of landscaping typically seen in single-family homes. It requires the use of smart landscaping choices, such as: drought-tolerant plants, mulch, and rocks. We hypothesize that people's beliefs and their cultural background, water availability perception and the neighborhood they live in influence attitudes toward xeriscaping.

16. Mapping Curbside Delivery of Secondary Water in Urban Areas of Cache Valley, Utah

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When Cache Valley, Utah was initially settled, canals were constructed to convey irrigation water from local rivers to developing communities for irrigation. As urban neighborhoods grew, water was conveyed through the city from canals to individual properties using city street gutters. These are secondary water rights and are organized through a complex system of water rights and management districts. Today, many neighborhoods in the historic sections of these early settlements continue to flood their property and retain their secondary water rights. The purpose of this study is to map Cache Valley urban where city streets convey secondary water used for flood irrigation.

17. Mosaicking and Georeferencing Thermal Infrared Imagery of Swaner Preserve, Park City, Utah

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Remote sensing using airborne devices such as an infrared camera attached to a drone are instrumental in monitoring the spatial patterns of stream temperatures. As such, the imagery collected using forward looking infrared (FLIR) systems must be processed to visually represent the values of a stream'sradiant temperature patterns. This project processed thermal infrared imagery captured at Swaner Preserve, Park City, Utah to create a georeferenced mosaic that delineates the location of water on a section of Swaner Preserve and visually represents the variance in radiant temperature of the stream's water.

18. Channel Width Movement, Flow Error Analysis, and the Impact of Change on the lower Bear River, UT

TODD BROWN, *Utah State University, toddkay.94@gmail.com*
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How much water do we use and where do we use it to benefit both humans and the environment? Managing any river system requires an understanding of its ecology and hydrology. The Watershed Area of Suitable Habitat (WASH) system model is created to understand both. This WASH model functions to recommend environmental flows for riverine, floodplains, and wetland. It also recommends sites for restoration. This is going to help benefit the environment by allocating water for environmental users and also determining the quantity and the times of water needed for restoration purposes at different locations along the Bear River. In 2012, 2013, and 2015 the Bear River Fellows conducted multi-day river trips on the Bear River to collect data. During these trips we collected water surface level, stream flow, pressure data, river bank bed topology, and riparian zones using the Acoustic Doppler Current Profiler (ADCP), Garmin GPS, and HOBO pressure transducers. We collected these hydrologic and ecological data at 3 different sites; the Cub River site, the confluence of the Cub and Bear River, and the Morton site. Using the data collected from these river trips I was able to organize and compare the data for river width and comparing stage and flow from year to year taking into account the human and the data collection instrument errors. I was able to determine the change in the total river width comparing 2013 to 2015 and also determine the stage and flow relationship of the river at different times. The relationship is a linear relationship showing the higher the stage, the more flow. I also took into consideration the possible error; helping make the model more precise. This research is helping protect the environment by considering riverine suitability, floodplain suitability, and wetland suitability throughout the year.