2016 UWaTERS

University Y Student Center

3:00-3:30 Welcome

Mary Cline Award Announcements

Chancellor Pagano Opening Remarks

3:30-4:00 Keynote Speaker: Terrie Klinger – Using Resilience Approaches to Address Marine Environmental Change

4:00-5:00 Poster Session 1

5:00-6:00 Poster Session 2

Participants of Poster Session 1

Itzchel Aguilar-Bazan, Keith Bergeron, Rickly Clousing Maleia Smith & Enrique Ugas (2)
Catrina Bean (3)
Madison Benson (3)
Rachael Nastasia Brown (4)
Axton Bullock (5)
Kenneth Burkart (5)
Lyndsey Claassen (8)
William Collier, Phoenix Cornwell & Kelly Pettibone (8)
Anthony Endresen (9)
Morgan Frost (10)
Jennifer Gonzaga (11)
Erin Hull (12)
Jean Jensen (13)
Amina Kedir (14)
Tara Knutsen (14)
Chase McLaughlin (15)
Brenda Smithhisler (19)
Nicolas Thompson (20)
Emily Thomsen (20)
Hanna Yang (21)

Participants of Poster Session 2

Morgan Anderson (2)
Jasmine Bowman (4)
Sem Chan (6)
Jesse Chase (7)
Ren-Chieh Chang & Ashley Fowler (6)
Erica Christie (7)
Jessica Dennis (9)
Nichole Engel (10)
Alaina Guthrie, Brody Howe, Hayley Mathews & Rebecca Rigg (11)
Olivia Jasper (12)
Alison-Marie Johnson (13)
Hayley Mathews (15)
Mehakpreet Multani (16)
April O'Donnell (16)
Dez Overman (17)
Calum Ramsay (17)
Gurjot Samra (18)
Rachel Sangsland (18)
Nicole Smith (19)
Jacob Tomashek (21)
Ryan Hanley, Kristal Hedrick, Nicole Taini (22)
Daniel Pak Chau, Michael Madison & Katie Zentner (22)

A framework for sustainable community garden development

Itzchel Aguilar-Bazan, Keith Bergeron, Ricky Clousing, Maleia Smith and Enrique J. Ugas

Mentor: Cynthia Updegrave

Our individual research projects held in common a shared vision to establish a framework for sustainable student involvement in community food sovereignty. This endeavor was realized through assisting to set up the garden as a social center for education and involvement in food production and giving. This research encompassed many facets of community gardening, including: Food Systems: Our intention being to provide sustainable, pesticide, and chemically free nutrition. A planting plan that included many variations of fruits and vegetables was implemented. Social Systems: Creating a peaceful surrounding that draws students into participation in the garden; the art of place making was very much a focal point in designing a sustainable framework for community involvement. Native Systems: Focusing on native ecological systems in the Northwest we can see a clear picture of the relationship between the biotic and abiotic systems. Native plants are an important sustenance for Northwest tribes. Natural Systems: Soil amendment and simple weeding/garden maintenance were a major issue in the cleanup effort. The relationship between decomposing matter, mycorrhizae, and root systems are an important factor when considering food production. Educational Systems: Teaching the public about soil amending techniques, implementing proper planting methods, extending the harvest through preservation, and learning about human's inter-relationship with nature. In conclusion we found that there is a keenness and intense enthusiasm by the student population to participate in gardening activities. Earth day was a focal event in the transitioning of the garden and the turnout was encouraging.

Occurrence of perfluorinated compounds in mussels from Commencement Bay, Tacoma WA

Morgan Anderson

Mentor: Joyce Dinglasan-Panlilio

With advances in technology, often comes pollutants as byproducts of their production. Perfluorinated compounds (PFCs) are manufactured compounds used for making everyday items water resistant. As useful as PFCs can be, they are incredibly stable contaminants whose side effects are still being investigated. Although human studies have been inconclusive to the effects of PFCs, animal studies show that they can be incredibly toxic. Bioindicators are often used to track the effect of pollution within an ecosystem. They are very sensitive to their environment and may change their morphology, physiology or behavior when exposed to pollutants. In this experiment mussels were chosen as the bioindicator for the level of PFC contamination in Commencement Bay, Tacoma WA. Using a spike and recovery of 25 ppb and 1 ppb on store bought samples the method for PFC extraction is currently being developed to achieve 75-150% recovery of compounds. Analyses of samples are performed by liquid chromatography- tandem mass spectrometry (LC-MSMS). Using the retention time, peak area and molecular weight from each compound, the PFCs can be identified and their concentration quantified. Once the method is developed it will be applied to the mussel samples from Commencement Bay to measure the levels of PFC contamination.

Wind Energy: placement of future wind farms throughout Idaho

Catrina Bean

Mentor: Matthew Kelley

For over a century mankind has relied upon burning fossil fuels, such as coal, in order to provide the majority of their energy needs. While beneficial in meeting man's energy needs, the impact that it has had on the Earth, known as the greenhouse effect, is far from beneficial. The greenhouse effect has raised worldwide concern for the Earth's future health, leading to the research and development for alternative energy sources. One of the alternatives to burning coal is using wind to generate energy. Wind power is commonly implemented by using many large wind turbines in one particular area known as a wind farm. The placement of windfarms can be a bit tricky due to the data that is required in order to perform spatial analysis for any particular building site. For the last decade or so Idaho state has begun implementing a new energy plan, which includes the addition of wind power. In order to spatially analyze where wind farms can be placed throughout Idaho, Geographical Information Systems (GIS) will be used to analyze and model data. The data sets that have been obtained for this analysis include: land cover, land use, wind patterns and elevation. By using various ArcGIS tools the layers of data will be added together in order to determine if there are areas suitable for the placement of future wind farms in 3 of Idaho's counties which are topographically different from one another.

Ecological impacts of supplementation on wild steelhead

Madison Benson

Mentor: Erik McDonald

The Hood Canal Steelhead Project is a 16-year study (2007-2022) will attempt to assess the impact of supplementation on the Hood Canal endangered steelhead populations. Declining populations resulted in hatchery practices that have negatively influenced genetic variation, ecological interactions, and decreased natural selection. This study examines a unique supplementation strategy that allows male and female steelhead to mate in their natural environment. The supplementation process includes collecting eyed eggs from redds in natal streams to be then raised in hatcheries. After the steelhead reached the age of two-year old smolt or an adult, they are released back into their natal stream. To analyze if this new processes of supplementation is effective, habitat and wild smolt data were collected during the supplementation phase in the controlled streams, Tahuya and Little Quilcene, and in one supplemented Dewatto stream. When wild smolt were gathered from screw traps, they were measured for fork length (mm), weight (g), scales for age analysis, fin clip for mark-recapture (trap efficiency) and genetic analyses. It was found that in 2014, 5% of adults returned in the Dewatto from the 2012 the smolt abundance. Therefore, results suggest that supplementation may currently not be negatively affecting wild smolt environmental interactions with food resources, their age of maturity and migration rates out of natal streams.

Elwha River Valley Restoration: effects of soil inoculation on Ectomycorrhizal diversity on Douglas-Fir (*Pseudotsuga menziesii*)

Jasmine Bowman

Mentor: Erica Cline

Elwha river valley dam removal began in September of 2011 and ended in summer of 2014 (NPS-ERRR). It is the largest dam removal in U.S. history, and now serves as a "living laboratory" for long term monitoring of ecosystem restoration recovery (NPS-ERRR). Dams disrupt the ecosystem of rivers and riparian areas causing loss of habitat, and trap sediments which can build up in reservoirs over time. These sediments are nutrient poor making restoration efforts difficult. The removal of the Elwha dam left behind over 800 acres of nutrient deprived sediments (Chenoweth et al. 2013). Ectomycorrhizal fungus are known to form healthy symbiotic relationships and aid in nutrient and water uptake, along with helping seedling establishment, productivity, and species diversity (Cline, et al. 2005). Our goal is to restore the natural riparian area, by promoting diversity of ectomycorrhizal fungus on Douglas fir root tips. Douglas fir seedling were inoculated with fungi in order to promote ectomycorrhizal fungi colonization. Seedling were then planted in a greenhouse, or on site in order to determine the best method for successful inoculation. Using DNA extraction and PCR techniques, Douglas fir root tips from the field were examined for the presence of fungal DNA. Species identification will be completed using DNA sequencing. There were 14 morphotypes encountered for control inoculated with river and field soil. Finding the best method to establish successful fungal colonization will be an important contribution for other reforestation projects.

Mapping the future value of ecosystem services in the Puyallup Watershed

Rachael Nastasia Brown

Mentor: Matthew Kelley

The past century of urbanization has severely diminished the Puyallup watershed's ability to provide ecosystem services to populations that reside within it. The increase of impervious surface cover (concrete), ecosystem degradation, and deforestation have combined to diminish the health and vitality of the ecosystems in this watershed and the future impacts of climate change and population growth promise to inhibit them still further. In an effort to quantify the impacts of these changes the estimated economic value of these services were mapped to reflect both current value and predicted value in the event of four different IPCC SREC scenarios. The analysis is still ongoing but it shows real promise for visualizing where and how much value will be lost as result of population increase, economic growth, and other factors.

Olympia oyster (*Ostrea lurida*) larval abundance from two bays in Puget Sound

Axton Bullock

Mentor: Bonnie Becker

The Olympia oyster (*Ostrea Lurida*) is a native oyster found on the west coast of the U.S. that has been commercially extinct in Puget Sound since the 1940s. Recently they have been the subject of restoration efforts in Washington State. It has been documented that bivalves can travel vast distances of coastline as larvae in their planktonic life stage. This is a valuable stage in the *O. luridia* lifecycle as it is the only time that the oyster is mobile and can contribute to other populations. It is therefore important to track the oyster in its larval planktonic stage to help aid in restoration of the species. Plankton samples were collected from two bays in western Washington. Fidalgo Bay to the north, and Dyes inlet in central Puget Sound. Samples were collected at the ebb tide and the flood tide from both locations, as well as from two different depths in the water column. The plankton samples were hand counted visually using microscopy, and quantified with quantitative, real time PCR for comparison. The results will indicate what the larval oysters are doing at different tides. If higher densities of oysters are found in an ebb tide versus the flood tide, it is predicted that larval oysters are being exported. If the flood tide contains significantly higher densities then at ebb tide, then it is possible that larval oysters are being imported from other estuaries, or are being retained in their natal bay.

Nutrient contributions from floating logs in Spirit Lake, Mount Saint Helens National Volcanic Monument

Kenneth Burkart

Mentor: Jim Gawel

When Mount St. Helens erupted in May 1980, the landslide and subsequent tsunami deposited about 350,000 acre-ft of pyrolized trees into what was left of Spirit Lake. Today this log mat covers approximately 20% of the lake's surface. While the ecological importance of large woody debris (LWD) has been well established in streams, there has been little research on the nutrient contributions from LWD to lakes. LWD is often removed from lakes for timber and recreational management. It can contribute nutrients to lakes in several ways: (1) through macroinvertebrate processing of the LWD; (2) through physical abrasion caused by wind; and (3) through the production and shedding of biofilm that establishes on the LWD. The resulting inputs may be a significant source of nutrients for oligotrophic (low nutrient) alpine lakes, leading to greater primary productivity. To measure nutrient inputs to Spirit Lake from the floating log mat, three collection sites, representing areas frequently under the log mat or with no log mat coverage, were instrumented with triplicate sediment traps. Sediment traps were also placed under two approximately 400 ft^2 artificial log mats anchored in place in protected bays in the lake. Total inputs of C, N, and P were measured by CHN analysis or ICP-OES. Results were very location specific. The fixed log mat in Donnybrook Cove produced lower C, N and P than was collected nearby by the traps influenced heavily by the mobile natural log mat. In Duck Bay, a warm, organic-rich area of the lake protected from the natural log mat, C and N were greater under the log mat, while P was greater in open water. By understanding the influence of LWD on nutrient cycling in lakes, this study may influence future management decisions concerning the removal or addition of LWD in aquatic environments.

Changes in class schedule that may result in more carbon emissions

Sem Chan

Mentor: Kimberly Davenport

The phrase “global warming” has been frequency used in the last few decades to describe the temperature changes in the Earth’s atmosphere. These changes are the result of carbon emissions and greenhouse gases that humans have created. One big factor that contributes to carbon emissions is the carbon dioxide gases that are release into the atmosphere from transportation. According to the Bureau of Transportation, 253 billion vehicles were registered in 2012 which does not account for the number of trips per day. An individual’s work or school schedule can impact the number of trips each person makes. A preliminary survey was conducted in July 2014 of students on campus at the University of Washington Tacoma (UWT) shows that 81% of students use their personal vehicle as means of transportation to and from school and about 60% of students are commuting from outside the Tacoma area. This number does not reflect the class schedule change that UWT had implemented effective September 2014 changing class schedules from 2 days per week to 3 days per week. This change may result in more frequent trips by students to and from school which can result in more carbon emissions.

Monitoring plastic debris in marine sediments in Puget Sound: preliminary study

Ren-Chieh Chang and Ashley Fowler

Mentors: Cheryl Greengrove and Julie Masura

Plastic debris in the marine environment has been a growing concern due to its durability in the ocean environment and potential impacts on marine organisms. Characterization of plastic debris is approached via size as macroplastics (> 5mm), microplastics (5-0.330mm), and nanoplastics (<0.330mm), all of which are located in surface waters, within the water column, on beaches and within seafloor sediments. This is a preliminary study on monitoring plastics debris in marine sediments in Puget Sound with the goal of establishing a baseline to determine the concentrations of plastics in marine benthic communities and work to deepen our understanding of the impacts of plastic debris on marine ecosystems throughout the Pacific Northwest. In collaboration with the Washington State Department of Ecology’s, Marine Sediment Monitoring Team and the Puget Sound Ecosystem Monitoring Program, ten samples weighing 200 grams each were processed and analyzed from different stations. A majority of plastics found were fibers of various colors and sizes. Bellingham had the highest concentration of microplastics at $2.x10^{-3}$ milligram (mg) of microplastics per gram (g) of sediment. The lowest concentration was found at Sinclair Inlet with $4x10^{-5}$ (mg/g) of microplastics. Further analysis was performed to determine whether there was a correlation between concentration of microplastics and particle size of sand, silt and clay. When comparing percent of sand, silt and clay it was determined that there was no correlation.

Egg Aggregation: behavior of *Drosophila suzukii*

Jesse Chase

Mentor: Jeremy Davis

Drosophila suzukii is an invasive species of fruit fly, which can cause significant economic loss for fruit and berry agriculture. *D. suzukii* have a serrated ovipsositor allowing them to lays eggs on ripening fruit before it has fallen to the ground. With this species' ability to oviposit on fruit pre harvest, it is important to study *D. suzukii* egg-laying behavior. While previous published research indicates that *D. suzukii* randomly distribute their eggs across fruit, our own anecdotal observations lead us to expect that *D. suzukii* aggregate their eggs both within and across fruit. In this study, we positioned host berries in a "bug dorm" to determine if egg aggregation is occurring. We have found *D. suzukii* does aggregate eggs. This research will offer insight into this invasive species' behavior, inform how potential management practices are designed and implemented.

Environmental factors influencing larval behavior in *Drosphila suzukii*

Erica Christie

Mentor: Jeremy Davis

Drosophila suzukii are an invasive species of fly that can potentially have large negative impacts on berry agriculture in the United States. *D. suzukii* fill a unique niche relative to other members of its genus in that it lays eggs and develops in ripening fruit before it has fallen to the ground. Thus, in this species, the decision to pupate on or in their host fruit, or leave to settle in uncertain soil environments may have larger fitness effects than is the case for other species of *Drosophila.* We expect that *D. suzukii* larvae will be particularly sensitive to environmental cues when deciding where to pupate. In this study, we manipulated the position of host fruits (suspended or on the ground) and presence of vibrational predator cues to determine whether these factors influence larval behavior. We have found effects of the position of fruit and the presence of vibrational cues associated with predation on larval behavior and pupation site selection. This research will offer insight into this invasive species behavior in the field from which possible management practices can be derived.

Developing the curriculum of the Marine Science Program at YMCA Camp Seymour

Lyndsey Claassen

Mentor: Erik McDonald

Knowledge gaps and misconceptions exist within the scope of the environment and problems facing it, especially in young minds. Because some environmental processes can be especially challenging for younger students to imagine, interactions within the natural world itself are notably helpful. Expansion of the curriculum at YMCA Camp Seymour will benefit society by teaching younger generations how to interact with their ecosystem and also understand how human impacts affect various waterways. This is important because it shows the students what pollution is, how it is demonstrated in current environmental issues, and how they might impact their surroundings. In order to help campers more completely understand marine environments and their role on the ecosystem, changes were made to the curriculum to help present the related information and concepts. A framework was created so that new materials were consistently introduced to a camper that attends all four years of the program. These courses included more hands-on activities where campers would conduct field samples, run experiments, and explore their environment to develop a deeper understanding of marine life and ecological changes that affect its survival. With the additions to the program, students will more readily understand the pressing needs for habitat conservation, problem solving, and decision making towards prevailing environmental concerns. The materials presented in the class create a reliable basis of understanding to help students with their conceptions of the marine world.

Ecological and social rehabilitation in Titlow Park: our experience and prospects for the future

William Collier, Phoenix Cornwell and Kelly Pettibone

Mentor: Cynthia Updegrave (REN)

For the 2015-16 University of Washington Restoration Ecology Capstone, we undertook an ecological restoration project in Tacoma's Titlow Park. We faced two closely related problems: How to do an ecological restoration on a permanent, abrupt, and unnatural roadside edge, and how to encourage positive social interactions, while discouraging the undesirable social impacts. We designed our site to be a gradual edge-habitat transitional zone between the road, along with urban development beyond, and the covered forest behind. Plants and their arrangements were chosen to provide habitat and foraging resources for native pollinators and song birds, inviting their presence and positive benefits. The same design and elements were used to create a visually appealing and cared-for look for park visitors, with open lines of sight to enhance public safety, inviting a positive social presence. Looking to the future, we know that the site will never be a self-sustaining ecological unit, and that human intervention would always be necessary. One of our goals for this urban edge habitat is a positive and restorative interaction between people and nature, and we cannot, nor should we, envision a time when people will back off and leave nature on its own. We have, therefore, presented a set of recommendations, both to Metro Parks and UW Tacoma, among which is to establish a long-term, working relationship between the Park and the University in a collaborative effort to maintain and expand our initial work, as a site for recreational and educational benefit to the Tacoma public and to the UWT science program and its students.

Using DNA sequencing to identify the dinoflagellate species present in Puget Sound water bodies

Jessica Dennis

Mentor: Jack Vincent

Paralytic Shellfish Poisoning (PSP) cases have been associated with Washington water bodies in the Puget Sound region. PSP is caused by a naturally occurring biotoxin that accumulates in shellfish, consumed by larger organisms, and in turn, affects the nervous system. Muscles are paralyzed and in some severe cases, illness or death may occur. Human consumption of shellfish in the Puget Sound region and the possibility of PSP occurring is cause for concern. The biotoxin that produces PSP is suspected to be produced by a dinoflagellate species called *Alexandrium cantenella* in the Puget Sound. Harmful algal blooms have been a type of indicator for PSP. The intention here is for scientists to identify the exact species responsible for PSP in order to warn the public about whether shellfish consumption is safe. Upon completion of isolating the dinoflagellates from Puget Sound core smaples and the DNA successfully extracted, definitively identifying the species using DNA sequencing will be the next step. The data collected during this project will allow scientists to understand when the dinoflagellate species is most abundant. This information is valuable for Washington's shellfish industry, recreational clam diggers, and Native American Tribes. The research conducted will aid in minimizing health risks and economic loss by means of early detection of the harmful algal blooms and increased presence of dinoflagellate species.

Phytoremediation of arsenic by aquatic plants in contaminated urban lakes in South Central Puget Sound Region

Anthony Endresen

Mentor: Jim Gawel

Phytoremediation, a plant-based green technology for cleaning hazardous waste sites, has received increasing attention in recent decades. In the 1980s, early research was successful in identifying hyperaccumulators, plants that are able to take up large quantities of available metal contaminants. Subsequent research has identified plant species as likely candidates for arsenic phytoremediation specifically. The ability of vastly different plant species to successfully take up arsenic suggests that multiple modes for entry into the plant exist. Using a broad approach, this experiment focuses on the possibility for different aquatic plants to take up arsenic from their environments, namely contaminated urban lakes. Identification of plant species with the ability to accumulate higher concentrations of arsenic will lead to possible remediation recommendations. This study focuses on the "zone of deposition" for the former ASARCO smelter, located in Ruston, Washington. We collected emergent, floating, and submergent aquatic plant species from eleven lakes contaminated by aerial emissions from the smelter, which specialized in arsenic extraction from copper ores. After washing, drying and microwave-assisted acid digestion, plant samples were analyzed for total arsenic by ICP-MS. Results revealed floating plant species showed low to moderate arsenic removal with no detection of arsenic removal for nearly all emergent species. On the other hand, our results revealed that the highest concentrations of arsenic were consistently found in the submergent plant species, with concentrations exceeding 300 mg As/kg dry weight in milfoil in one lake. Experimental results indicate that submergent species should be studied further for potential use in phytoremediation of arsenic under field conditions.

Dungeness River monitoring for Phytophthora ramorum

Nichole Engel

Mentor: Marianne Elliot – WSU

Phytophthora ramorum is the plant pathogen responsible for sudden oak death within tree populations, and ramorum blight in a variety of woody ornamental plants including rhododendrons. This pathogen has made its way through California, killing an excess of one million oak trees (APS 2008), Oregon, and now Washington. An increasing number of tree deaths means habitat loss for a variety of organism. It is through its presence in water that the pathogen has the ability to spread long distances. Within this study our main objective was to determine if *P. ramorum* was present in the Dungeness River system, from which a positive result was obtained in the past. Eleven different sampling locations in the water system were chosen and sampled in two week intervals. During each interval mesh bags with rhododendron leaves were suspended in the water at each location, at the end of the two weeks they were taken out and analyzed for the presence of *P. ramorum* and new leaves were placed in the bags, this was repeated for six intervals. To perform analysis, leaves were incubated and suspicious samples isolated and allowed to grow. Afterwards PCR was performed on isolations that had morphological similarities to *P. ramorum*. Samples were then sent to GeneWiz for sequencing. The final results showed no *P. ramorum* although four other types of Phytophthora were found. Halophytophthora which was only found in a Virginia fresh water sample was also present at one of the sampling locations.

Genetic connectivity of Heteronemerteans in Antarctica

Morgan Frost

Mentor: Megan Schwartz

The open-ocean environment offers few obvious vicariants to gene flow between related populations, and they are generally understudied. The Southern Ocean is contiguous with the Atlantic, Indian and Pacific Oceans but delimited by the Antarctic Circumpolar Current (ACC), the fastest flowing current in the world, moving around the pole from east to west. The Antarctic Polar Front (APF), a stretch of water approximately 20-40 km wide with a distinctive horizontal stratification of temperature, salinity and oxygen saturation, may present a vicariant barrier to gene flow. We tested the hypothesis that the combined effect of the ACC and APF act as vicariant barriers to dispersal and essentially block gene flow between the populations they separate using a phylum of ribbon worms (Nemertea) which are common benthic predators in the Southern Ocean. Additionally, we tested the hypotheses that putative nemertean species present with geographic distributions around Antarctica maintain gene flow through a planktonic dispersal stage. We sampled DNA from nemertean species obtained from the Amundsen, Bellingshausen, Eastern Weddell, and Ross Seas, as well as from the Scotia Arc which spans the ACC and the Antarctic Peninsula. Our data demonstrates that there are 10, as of yet, species to be described found in the Southern Ocean with circumpolar distributions. Additionally, we demonstrated through haplotype network analysis that gene flow is maintained for many of these species. This new information gives us insights into the biodiversity of the Antarctic and can be useful to make future conservations decisions as the Antarctic ice caps melt and the dynamics of sea ice and shelf fauna change.

Olympia oysters, connectivity, and LASERS

Jennifer Gonzaga

Mentor: Bonnie Becker and Megan Hintz

Olympia oysters (*Ostrea lurida*) were historically overharvested to near extinction. Populations have failed to recover naturally leading to a need for active restoration. *O. lurida* provide ecosystem services including filtering water, providing habitat, food, and increasing the overall diversity of the ecosystem. The intent of this research is to determine spatial patterns and connectivity of *O. lurida* planktonic larvae in Puget Sound, WA. We sampled larvae at two depths in the water column and at both ebb and flow tides. Larvae in the water can be sourced back to the natal populations using trace elemental fingerprinting. Trace metals embedded into shell during early life history is representative of the water body where the individual formed its shell. Analysis by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) will yield results that indicate trace elemental ratios in respect to calcium. This data will be used to analyze the distribution patterns of local and traveler *O. lurida* planktonic larvae in the bay. These results will give insightful information on veliger larvae behavior that could be used to help aid restoration efforts as well as shed light on *Ostrea lurida* dispersal and connectivity.

A proposal for recycling nitrile gloves at University of Washington Tacoma

Alaina Guthrie, Brody Howe, Hayley Mathews and Rebecca Rigg

Mentor: Kim Davenport

The University of Washington Tacoma campus sits in the heart of the downtown Tacoma area, in a location that not only influences the students to interact with downtown directly and also the community that surrounds it. Disposal of solid waste is a growing issue, as we are creating more waste and landfills are reaching their capacity. By utilizing the RightCycle program, UW Tacoma can recycle used nitrile gloves from laboratory classes and transform them into raw material. This material can then be used to manufacture park benches, watering cans, chairs or even Frisbees. With this program, the UW Tacoma campus would serve as an example in sustainable waste reduction. All students surveyed (n=41) were receptive to participating in such a program and 80% expressed willingness to pay higher student lab fees toward implementing glove recycling. This proposal outlines the costs and benefits to using the RightCycle program at UW Tacoma.

Arsenic in urban lakes: mobility, bioaccumulation and ecological toxicity

Erin Hull

Mentor: Jim Gawel

Elevated levels of arsenic have been reported in surface waters of urban lakes around the Puget Sound as a result of heavy metal contamination from the late ASARCO smelter in Ruston, Washington. Arsenic is a neurotoxin, carcinogen and a priority Superfund contaminant. Processes that lead to elevated arsenic concentrations in the water column have been well-studied in thermally stratified lakes, but not in periodically mixed (polymictic), oxygenated lakes. Typically, arsenic is only mobilized from sediments when lakes become anoxic during stratification. This project examines the mobility, bioaccumulation and toxicity of arsenic in four urban lakes in the Puget Sound lowlands that range from seasonally stratified and anoxic to polymictic and oxygenated. Specifically, we aim to discover why one lake has elevated levels of arsenic in surface waters, yet regularly mixes and remains oxygenated. Monthly, water quality parameters were measured and water samples were collected at multiple depths throughout the water column. Plankton samples were also collected using vertical net tows. Samples were digested and analyzed for total arsenic by ICP-MS. Phytoplankton and zooplankton in polymictic, oxygenated lakes accumulated more arsenic than plankton in thermally stratified lakes, even though arsenic concentrations were similar between the lakes. This data suggests arsenic in polymictic urban lakes is not only bioavailable, but has the potential to travel up the food chain. This project has important implications for lake management by aiming to create a model for predicting arsenic bioavailability based on physical lake characteristics to better protect humans and the ecosystem from possible toxicity.

Old growth forest habitat loss effects alleviation for locally threatened wood ducks

Olivia Jasper

Mentor: Jeremy Davis

Fort Lewis's 86,000 of land have undergone serious changes since its inception in 1917 which have caused habitat loss for many locally threatened species. The wood duck population and its ability to grow have been stifled by loss of old growth forests via fire, logging and development of the joint base. In order to alleviate this, he Fort Lewis Forestry Department monitors the population of wood ducks and builds and places new habitats for them. Habitat loss for wood ducks will be constant struggle to amend as old growth forest takes 450-600 years to recover. Additionally, wood ducks tend to seek a new nest- or tree cavity- each year in which to lay their eggs and raise their young. And so, they don't maintain, line, build or clean their nests to each nest must be hand cleaned and re-lined each season. This process, while in-depth and measurably successful in the past several years, has no end in sight and will continue until we no longer feel the need to preserve this species.

The effect of supplementation on Puget Sound Steelhead

Jean Jensen

Mentor: Erik McDonald

Puget Sound Steelhead (*Oncorhynchus mykiss*) is one of the most valued endangered species on the list, especially to those living in the Pacific Northwest. In an attempt to increase the population size of steelhead, we are supplementing the population with hatchery raised fish in four streams of the Hood Canal river basin while keep three streams constant as the control streams. Tradition hatchery practices have had a negative impact on the genetic diversity of Steelhead, as well as increase rates of residualism. To avoid this, we are incorporating hydraulic redd pumping to allow for female sexual selection. If there is a significant increase in the proportional population size in a supplemented steam, then supplementation has a positive effect on population size. If we see an increase in proportional population size over many years, then we can assume that steelhead are becoming more genetically fit. If we see a decrease in population size, this could mean that hatchery raised steelhead are outcompeting wild steelhead and hindering their eventually journey to the ocean. If these new hatchery practices prove to be successful in increasing genetic fitness of steelhead, this could open the window for new policy that would require hatcheries and fisheries to adopted new methods that more closely alight with their life history cycle.

Historical abundance of the harmful dinoflagellate *Alexandrium* in a sediment core from Quartermaster Harbor, Puget Sound, Washington

Alison-Marie Johnson

Mentors: Cheryl Greengrove and Julie Masura

Alexandrium is a dinoflagellate that produces saxitoxin; this toxin is known to cause paralytic shellfish poisoning when shellfish contaminated with high concentrations of *Alexandrium* are consumed. Due to the possibility of toxicity and the potential for negative economic impacts, the presence of *Alexandrium* is regularly monitored throughout the Puget Sound. *Alexandrium* spends part of its life cycle as a cyst in the sediment before excysting as a free-swimming dinoflagellate. Cyst concentrations in sediment cores can be used to evaluate historical presence and temporal variability. A 2005 project, funded by NOAA's ECOHAB program, has shown surface sediments in Quartermaster Harbor (QMH) having some of the highest *Alexandrium* cysts concentrations in Puget Sound. In July 2010, sediment cores were collected from five locations in Puget Sound to determine the historical distribution of *Alexandrium*. The purpose of this study is to quantify *Alexandrium* cyst abundances in a 202 cm Kasten core collected from QMH's inner harbor. Sediments were prepared by sieving material between 20 and 90 µm in diameter and staining with Primulin before being analyzed for *Alexandrium* presence under epifluorescence using an FITS filter on a compound microscope. Results show maximum cyst sediment concentrations near the surface, exponentially decreasing to 0 cysts/ml sediment below 58 cm. The core was characterized by analyzing the grain-size distribution and percent organic content of each sub-sample of the core in order to determine if there is a relationship between cyst abundance and these properties. ^{210}Pb dating was completed in order to correlate core depth and time.

Metal uptake in midge larvae in contaminated urban lakes in the Puget Sound region

Amina Kedir

Mentor: Jim Gawel

Arsenic is a neurotoxin and carcinogen and an important environmental pollutant in the South-Central Puget Sound region. Arsenic emitted by the former ASARCO smelter located in Ruston, Washington, has impacted a large number of lakes in the region via aerial deposition downwind. Previous research has shown that arsenic in some of these lakes is bioavailable, and high concentrations were measured in plankton. In this study we investigate the effect of arsenic uptake in Chironomidae larvae, freshwater benthic macro-invertebrates known as "blood worms." These organisms are commonly found in the low oxygen bottom waters of urban lakes where arsenic concentrations are highest, and they are an important prey species for fish. We collected the midge larvae from two lakes in the region – Lake Killarney (a shallow, eutrophic, high-arsenic lake) and North Lake (a deeper, eutrophic, medium-arsenic lake) – to examine the uptake of arsenic in lake biota. Sediments containing larvae were sampled using a ponar dredge and then larvae were separated with a sieve. Larvae were rinsed with DI water and frozen to euthanize. Samples were dried, digested (microwave-assisted in nitric acid) and analyzed for total metals by ICP-MS. Our results show increased metal uptake (As, Cu and Zn) in Lake Killarney compared to North Lake, correlated to metal levels in sediments. This study provides evidence that arsenic and other ASARCO metal contaminants are bioavailable in urban lakes in the Puget Sound region. The potential impact of this contamination on these organisms and higher trophic levels remains to be studied.

Improving usability of the Puyallup River Outreach Project website to decrease bounce rate

Tara Knutsen

Mentor: Jim Gawel

The Puyallup River Outreach Project's (PROP) website functions as a reservoir of information pertaining to the Puyallup River Watershed. Overall, we wanted to improve user friendliness so that we could decrease the bounce rate (rate at which users leave the site after visiting one page). We conducted two usability tests. The first usability test gave target users a stack of cards to sort. Each card represents a page of content for the PROP's website. The goal of this test was to find out how users would categorize our site's content in order to find a way to improve the efficiency of our site's hierarchy and organization. Overall, we found two primary issues identified by users from this usability test. First, most users were unsure of how to group the "Film Festival" with the other content. Having a direct link on the homepage would alleviate this confusion for users as identified by our A/B testing (comparing two versions of the site to see which performs better). Second, users grouped content differently than what was initially used. Most users made an "Organizations" heading or an "Events/Social" heading for site content. Based on these results, we conducted A/B testing comparing our previous headings (Watershed Library, Organization Library, Be a PROPER, and About Us) with new headings based on our card sorting results (Find Resources, Find Organizations, Get Involved, and About PROP). We found that the new headings had a higher success rate for completing tasks among users. The original bounce rate for the PROP website before implementing changes was 90.54%. After changes, the bounce rate decreased to 71.94%. We expect that these changes will increase public use of and traffic on the website and increase the initiative's impact on regional environmental education in the future.

Industrial stormwater management in the Tacoma Tideflats: engaging with the community to determine effective ways to improve stormwater quality

Hayley Mathews

Mentor: Jutta Heller

Stormwater runoff is a significant environmental problem, especially in urban areas with large areas of land covered with buildings, roads, parking lots, and pavement. In areas with industrial activity, there are unique factors such as use of chemicals and metals that can be harmful to humans and the environment when in natural waters, which aren't used in other businesses or residential areas. This project is focused on the industrial properties in and around the Port of Tacoma. In my internship I compiled data from the past two years on which industrial stormwater general permit holders frequently violated their permitted effluent limits, and worked on developing a survey to go out to industrial stormwater general permit holders. Violation data will help determine what issues are currently keeping permittees from improving their stormwater quality, and we can use the results to determine helpful best management practices (BMPs) to recommend, and survey results will help determine how to best reach out the permittees to provide recommendations. In the future the project group will continue reviewing BMPs to recommend, and explore incentives to help encourage the implementation of BMPs throughout the Tacoma tideflats.

Hood Canal Steelhead (*Oncorhynchus mykiss*) Project: reviving population counts while evolving smolt-rearing techniques of conservation hatcheries

Chase McLaughlin

Mentor: Erik McDonald

Steelhead (*Oncorhynchus mykiss*), Washington's State Fish, have been on the decline for over a century. As our region has witnessed this steelhead population plunge, the 16-year Hood Canal Steelhead Project was birthed in 2007 as an effort to remedy the low population numbers. Hatchery-influenced selection can cause both: captively bred fish-populations to survive at low rates and behave unnaturally in the wild. Through the Hood Canal Steelhead Project, contributors are actively trying to refine and implement new approaches to fish rearing in conservation hatcheries. These efforts come with the following goals: restore three steelhead populations in the Hood Canal while simultaneously evaluating the effectiveness of hatchery supplementation as a conservation strategy for steelhead. Our UWT team answered the following analysis questions: Do hatchery growth rates match wild smolt growth rates? How do egg-to-smolt survival estimates and smolt-to-adult survival rates differ between supplemented and control streams? And lastly, do different capture efficiencies for hatchery and wild fish serve as an indicator of domestication? With these focused goals in mind, our UWT undergraduate research team led by Erik McDonald, used screw traps to count and identify fish and collect scale and tissue samples for further study. Our data collection process is not yet over, results will be analyzed by June 8th, 2016 for the UWaTERS conference.

The effect of carbohydrates on proteins on blood-brain barrier

Mehakpreet Multani

Mentor: John Finke

This project looked at how carbohydrates can have effect on the ability of proteins to cross the blood-brain barrier (BBB). The blood brain barrier are formed by endothelial cells of the brain capillaries, restricts access to brain cells of blood-borne compounds and facilitates nutrients essential for normal metabolism to reach brain cells. Carbohydrates and amino acids are able to cross the BBB. We specifically looked at the literature research behind the experiment to further identify the potential candidates in the experimental investigation of the simple modification for proteins to cross the blood-brain barrier with a focus on the P-Glycoprotein. A search engine from the University of Washington's Library database was acquired, and specific keywords were typed into the search such as "blood brain barrier" "carbohydrates" and "proteins". Literature was read to determine that some compounds are effectively transported by P-GP and others are not. Results of our conducted research were successful. Carbohydrates that are attached to proteins, such as those attached to P-Glycoproteins in this case, are effective.

UV-visible light spectra as a climate proxy in Himalayan sediments

April O'Donnell

Mentor: Peter Selkin

The mineral composition of marine sediments is an indicator of climate history. Sediment core samples collected from International Ocean Discovery Program Expedition 354 to the Bay of Bengal were analyzed using visible and UV diffuse reflectance spectroscopy to determine changes in mineralogy deposited over approximately the last 100,000 years. Analysis of a set of ship-board data using non-negative matrix factorization showed three endmembers corresponding to different mineral assemblages: one with a blue spectrum (peak wavelength of 400 nm), a second with a reflectance in the 400-500 nm wavelength range, and the third with a red spectrum. The mineral content of these endmembers will be evaluated by comparing their reflectance to the USGS Digital Spectral Library. Changes in composition through time were be compared to known climate proxy records over the same time period to determine new mineral climate proxies.

The amount of science used in local integrating organizations to help improve watersheds

Dez Overman

Mentor: Tom Koontz

Restoring large watersheds like the Puget Sound basin is expected to require both community-based collaboration and scientific knowledge. Throughout this project a group of students and one professor researched 6 different community-based "local integrating organizations" (LIOs) that were funded by the Puget Sound Partnership to develop strategic plans. We looked at the project proposals that each LIO had and all of their meeting minutes to see if they were using the money from Puget Sound Partnership to implement science into their efforts to improve their local watersheds. Over our three-month research, we found that little science was being discussed or used in LIO general meetings to improve watersheds.

Determining the role of science in watershed planning and decision-making: a case study on Puget Sounds NGO's

Calum Ramsay

Mentor: Tom Koontz

State and local level environmental projects have become increasingly significant tools for ecosystem research, management and policy implementation. These studies provide scientists, policy-makers and managers with the knowledge to create useful policies to address issues affecting their local environments. In the Puget Sound, NGO's (non-governmental organizations) and watershed groups are responsible for developing effective and feasible projects and policies to address environmental issues. By studying the integration of science by these organizations, we can understand how scientific principles and processes are incorporated into projects, plans, policies, etc. Information regarding project goals, designs, partners and other elements are gathered through a process called 'coding', in which we reviewed minutes from past meetings for NGO's and watershed organizations. Through coding, we searched for important traits such as how issues were selected to be researched, how funding was allocated to projects and what kind of research/study was conducted before implementation. Our findings didn't result in a conclusive answer as to whether or not science was being regularly incorporated by NGO's or watershed organizations. However, we gained a better understanding of how projects were selected and policies were created in response to local needs or pressures. Partners for different projects also represented outside sources of knowledge that could have helped to develop projects or policies into more appropriate forms. In the future, we can research into sub-committees beyond executive committee for more detailed analysis of individual projects or plans. Also, direct contact with these organizations for statements or interviews could provide useful insight into how these groups use science.

Using morphology of foraminifera as an indicator for environmental conditions

Gurjot Samra

Mentor: Julie Masura

Foraminifera are amoeboid protists that are sensitive to environmental change; the complexity of their morphology make them prime indicators of change. These organisms can be used as indicators of the environment of the past and present through the morphology and chemical composition of their shells. The purpose of this study was to examine the morphology of foraminifera found in the Puget Sound and compare their structure to samples studied by the Puget Sound Foraminifera Research Project at the Burke Museum at the University of Washington. Foraminifera were extracted from two sediment samples collected from the inner harbor of Quartermaster Harbor and the Dockton dock. Using a dissecting and compound microscope, the foraminifera were mounted and high resolution images of their shells were taken to compare their morphology to high resolution image archives available through the Burke Museum. All specimens were identified as agglutinated, which inhibited the ability to classify as to what genus or species were present using light microscopes. Foraminifera become agglutinated when they cement surrounding sedimentary particles to their shells. The purpose of this study was to look at the baseline of foraminifera found in Quartermaster Harbor and the agglutinated conditions of the foraminifera samples found show Quartermaster Harbor is a shallow brackish environment for foraminifera to live. In the future, deeper sediment cores dating back 100+ years need to be analyzed to see if the environmental conditions were the same.

Determining the role of science in watershed planning: a case study of the Puget Sound Partnership

Rachel Sangsland

Mentor: Tom Koontz

Science is an important tool for watershed groups to properly identify key drivers of environmental degradation and impaired water quality. Though science within watershed management seems intuitive, members of the scientific community and management groups often find it hard to collaborate on what a watershed needs. The Puget Sound Partnership is a state agency using collaborative efforts between scientists and community partners to improve ecosystem recovery. The purpose of this project was to observe this organization's method of incorporating science into watershed planning, and how the agency influences actions plans to the local integrated watershed organizations. We measured science in a top-down approach, coding meeting minutes from executive meetings and technical groups. Scientific references and collaboration with state science-based agencies were recorded in both meeting minutes and major documents the Puget Sound Partnership used to guide the local watershed organizations. Our results indicate that science is a guiding policy tool for watershed groups participating with the Puget Sound Partnership. Our results also show that use of science isn't emerging from the local groups but rather they are following the lead of the Puget Sound Partnership in the use of science. The watershed action plans that the local groups create, scarcely reference peer reviewed science.

Fish acute toxicity syndromes: the effect of storm water pollutants on Coho Salmon

Nicole Smith

Mentor: Edward Kolodziej

In the urbanized region of the Pacific Northwest, research shows that storm water runoff is found to be contaminated with unknown pollutants and is causing pre-spawn mortality in adult Coho Salmon in a matter of hours after a rainfall event. With as much rainwater as the Pacific Northwest receives, chemicals including pesticides, herbicides, fungicides, oils, gasoline, heavy metals, etc., are continually being discharged into streams and rivers, eventually reaching the Puget Sound. Recent evidence suggests that the mortality mechanism seems to be histotoxic hypoxia, a disorder in which metabolic poisons disrupt cellular oxygen uptake and utilization. This study is primary based on a literature review and compiles a list of all compounds implicated in histotoxic hypoxia or other instances of acute toxicity in fish. Subsequently, the compilation will be compared with data regarding the masses of known pollutants that cause acute toxicity in fish to the masses of unidentified compounds collected from waters in the Pacific Northwest. Collected data may determine the compound or mixture of compounds causing acute mortality in Coho Salmon. These results may lead to better watershed management planning to protect aquatic environments from these toxic pollutants.

Tracking shellfish larvae using molecular biology

Brenda Smithhisler

Mentor: Bonnie Becker

Shellfish are a valuable cultural, recreational, and commercial resource for Washington state. The success of both wild and cultured shellfish populations is dependent upon recruitment of planktonic larvae. Due to issues of cost, time, expertise and inaccuracy associated with bivalve identification using microscopy, real-time polymerase chain reaction is being employed to identify and quantify larvae using DNA technology. We are quantifying species-specific abundance and distribution of three commercially important species using novel approaches. Environmental plankton samples were collected via two rounds of in-situ pumping at four locations in intertidal waters in Washington State. Pumping was performed at two depths: near the water surface and above the sea floor and at two times: before sunrise and sunset, in order to determine the spatial and temporal distribution of bivalve larvae. Genetic assays for Pacific geoduck clam (*Panopea generosa*) Olympia oyster (*Ostrea lurida*), and Pacific oyster (*Crassostrea gigas*) have been designed. The collected field samples underwent qPCR quantification using these assays. Preliminary results show species variability in response to environmental cues as well as variability in abundance between sites. Results will be further analyzed to provide a comprehensive snapshot of the larvae of multiple shellfish species in Washington. This information may be used to determine dispersal trajectories and larval response to ocean acidification and environmental stress. Additionally, results may provide information regarding population connectivity and gene flow to aid in restoration efforts across the Salish Sea.

Analysis of outgoing steelhead smolts in the Hood Canal Steelhead Project

Nicholas Thompson

Mentor: Erik McDonald

Due to the continual decline of wild steelhead (*Oncorhynchus mykiss*) populations in the northwest, this study was conducted in order to determine the effectiveness of the application of new Steelhead hatchery techniques. Current hatchery techniques increase residualism and precociousness in males. Loss of genetic diversity has plagued the current populations due to artificial insemination in current practices, which results in unfit hatchery fish. Steelhead smolt were collected from two control streams (Little Quilcene and Tahuya) and one supplemented stream (Dewatto). Smolt abundance, length and mass data from 2013, 2014, 2015 and 2016, were compared between control and supplemented streams. Results not present, awaiting 2016 data conclusion.

The Olympia Oyster Obstacle: a comparison of size and reproductive rates of our native oyster in Puget Sound

Emily Thomsen

Mentor: Bonnie Becker and Megan Hintz

The Olympia Oyster (*Ostrea Lurida)* population of the Puget Sound has been historically exploited to near extinction and has failed to recover. Restoration has been difficult and complicated therefore, much is left to be understood about the dynamics of the population that can inform restoration. This study looked at the effect of population location on shell heights and brooding rates. In particular, we evaluated trends in shell heights and brooding levels by population and by basin. Between June and August 2015, we haphazardly selected over 14000 Olympia Oysters from eleven different bays throughout the Puget Sound. We non-destructively sampled each open oyster for their reproductive status and recorded shell heights over 15mm. The results of this study show that North sound had the highest percent brooding rate and average shell height by basin. The lowest percent brooding rate was South sound and the lowest average shell height by basin was Central sound. This is important to know because understanding diversity among different subpopulations in Puget Sound will help better understand the dynamics of Olympia oyster populations and their variability, all to better inform restoration efforts.

Shrinking UWT's ecological footprint through sustainable and health oriented food options

Jacob Tomashek

Mentor: Kim Davenport

With the student population of University of Washington Tacoma (UWT) expected to grow in coming years, food and drink options must be provided to the student body while maintaining a concern of eco-efficiency and sustainability (social, economic, and environmental) as a priority. According to a survey taken during Winter quarter 2016, students are dissatisfied with the availability and quality and costs of food available on campus. By providing healthier, locally sourced, and environmentally friendly options, the ecological footprint of the campus should be reduced considerably, and in the process make UWT's status on par with other UW locations (Seattle and Bothell). Proposed ideas include establishing a food court type environment, have stores serve more items that cater to students' desires while having more products that are more eco-friendly and nutritious, and as a result increase hours of the surrounding stores for the satisfaction of early morning and late night students that have only a few minutes in between classes. By measuring the satisfaction of students, via surveys and statistics on what is purchased, there is a focus to better prepare UWT for the future. Other factors that will contribute to footprint deduction include conventional and clearly detailed recycling bins on campus, along with a reduction in the amount of foods served in non-compostable containers. Further research will be done to examine which methods can be put forward to meet these goals.

Measuring restoration efforts of *Ostrea lurida* using demographic analysis

Hannah Yang

Mentor: Bonnie Becker

Ostrea lurida (Olympia oyster) provides an essential service to Puget Sound's diverse ecosystem. They provide food, water filtration, denitrification, removal of heavy metals, and habitat for other organisms. Since the 1840's, the Olympia oyster's population has dramatically declined due to overharvesting and poor water quality. They are now being reintroduced around the Puget Sound. We will be comparing data between a restoration site (Fidalgo Bay) and a remnant site (Mud Bay which is part of Dyes Inlet). The shell height frequency and population density were measured at these two locations. The data was recorded from randomly placed quadrats within 2 sections (each section measuring 25m x 30m) at both sites. The results show there is a higher population density and distributed height frequency at Mud Bay compared to Fidalgo Bay. We are observing whether the restoration site will be able to repopulate and be sustainable on their own. This snapshot of data and results can help predict the responsiveness of the Olympia oyster's populations after years of restoration efforts.

An analysis of diet, non-recyclable waste, and natural resource use

Ryan Hanley, Kristal Hedrick and Nicole Taini

Mentor: John Finke

With over 7.4 billion people that live on earth, it is necessary to examine sustainable diet options. Nutrition is important, but there are many conflicting opinions regarding the optimal diet. The objective of the study was to investigate if people who consume less animal products can better meet daily recommended nutritional values, produce less non-recyclable waste, and consequently use less natural resources. Three participants recorded food and beverage intake for ten consecutive days. Throughout the data collection period, one participant maintained a diet without any consumption of animal-derived food (vegan). The second participant maintained a diet with low animal product consumption, and the third practiced a fully omnivorous diet with moderate animal product intake. Using an online nutritional tracker, Supertracker, a nutrient report graph was generated for each participant over the ten days of data collection for five aspects of diet: protein, calcium, saturated! fat, cholesterol, and iron. The main aspect of the experiment required the amount of animal-derived food products to be recorded by each participant. In addition, all non-recyclable packaging materials from food consumption were collected for later analysis. Analysis of waste and nutrient data over the ten-day period does not fully support that people who consume less animal products better meet daily recommended nutritional values, produce less non-recyclable waste, and therefore use less resources. This multifaceted experiment provided copious data that puts resource use in perspective, and sets a foundation that allows for continued experimentation.

The influence of recycling programs

Pak Chau, Michael Madison and Katie Zentner

Mentor: John Finke

Our experiment set out to test whether the extensiveness of recycling program dependent on location influenced the amount of waste recycled as opposed to trashed. In this experiment, the weight of both the recycling and trash was recorded in three different households to test how location and the resulting recycling program affects the amount recycled. If the experiment, on a small scale, can show that recycling programs increase the efficiency of recycling in each household, there would be alegitimate reason to test this theory on a large scale, potentially resulting in a conclusion that shows how the world, in the grand scheme, can increase the amount of waste recycled to decrease the amount of trash in landfills.