2013 University of Washington Tacoma

Environmental Science/Studies Student Research Symposium

11th Annual UWaTERS

William W. Philip Hall
June 10, 2013

10:00 AM	**WELCOME**
10:05 AM	Salome Abaata – **Residual Polyfluorinated Compounds Present in Car Wash Products**
10:20 AM	Troy Albom – **Title TBA (Julie?)**
10:35 PM	Carolyn Green – **Interrupting Campus Culture to Change Behaviors with Recycling and Garbage**
10:50 AM	Brian Hite – **Improving Phosphorus Attenuation in Bio Retention Systems**
11:05 AM	Michelle McCartha – **Metallothionein as a Bio-indicator of Metal Toxicity in South Puget Sound**
11:20 AM	Robert Tournay – **The Phytochelatin Synthase Gene in Conifers**
11:35 AM -1:00 PM	**POSTER SESSION AND RECEPTION**

POSTER PRESENTATIONS:

Ordella Archer, Prim Ly (co-presenters): Algal Bloom of *Alexandrium* catenella at Dockton in Quartermaster Harbor
Caroline Ball: Restoring the Gary Oak: Washington's only native Oak
Michael J Barnett: Rail Renaissance- A GIS Analysis on the Impact of Re-Activation of Abandon Rail Lines in Washington State on Nearby Communities.
Serena Bell: Lowell Jr. Green Team
Jessica Berman, Simi Tumber (co-presenters): Does Water Movement Matter?
Alyssa Boettger: Perfluorinated Compounds in Household Laundry Rinse Water
William Hou Chan: The Clean Up Power of Mussels in Thea Foss Waterway
Janet Cook: The Effects of Anthropogenic Modifications on the Natural Beach Environment at Owen Beach in Tacoma, Washington
Tamika Greenwell: Restoration Ecology Capstone 2012-2013
Kelly Hatfield-Burmaz: Cost-Effective Recycling for Bethel School District
Megan Hintz: Oly Oly Oxen Free; The search for a self-sustaining Olympia oyster (*Ostrea lurida*) population
Bryan Huebner: A Geospatial Analysis of Anthropogenic Influences on River Basins in Pierce County, Washington
Caroline Jensen: GIS Certificate Capstone Project - Potential Park and Ride Locations
Cassandra Johnson: Controlled Burn Method Used for Restoration of South Puget Sound Prairies
Michelle Knowlen: Temperature effects on byssal thread production in the mussel, Mytilus trossulus
Jami Kovatch (presenter: Metal Pollution and Forest Decline in the Appalachian Mountains of New England
Danielle Litwin: Title? Abstract? (Erica?)
Tricia Lohr: It's all downhill from here: Analysis of the optimal routes for longboarders- An alternative transportation
Benjamin Lowery: Puget Creek Water Quality and Stream Flow
Vanessa Martin: The Impact of Biochar on Produce Yield
Cassandra McNeal: Taxonomic voucher sheets of the benthic invertebrates in Puget Sound
Maxwell Nagy: Gary Oak Woodland: An Ecosystem in Peril
Hannah Parker: OLYMPIA OYSTER LARVAL DISTRIBUTION IN A SMALL RESTORED BAY IN PUGET SOUND: A PILOT STUDY USING PASSIVE TUBE TRAPS AND QPCR
Jennifer Patterson: Comparison of Discrete Dissolved Oxygen Data to CTD Data and Phytoplankton vs. Dissolved Oxygen Levels
Jeremiah Payne: Alzheimer's amyloid beta oligomer characterization by Western Blot
Mico Pineda: Oak Woodland Restoration at Pierce College
Nicholas Schlafer: Water Properties in Quartermaster Harbor Puget Sound
Richard Schwartz: Effects of Topography on Erosional Capacity of Pyroclastic Density Currents: A Case Study from Mt. St. Helens
John Theiss: Columbia River Dams: Benefit for Consequence
Kevin Turner: Point Ruston; The ASARCO Superfund Clean-up Site
Jennifer Vittetoe: Foliar uptake of toxic metals and stress responses of pine seedlings from biosolids-treated sites at Pack Forest, WA
Ben Wells: Prioritizing New Tree Planting in the City of Tacoma
Jill Wetzel: UWT Rock Collection
Tyree Williams: The identification of fluorotelomer alcohols in laundry wash water samples from around the Puget Sound
Jolene Yaconetti: Sustainable Roots

ABSTRACTS:

Residual Polyfluorinated Compounds Present in Car Wash Products

Salome Abaata (presenter)
Mentored by: Dr. Joyce Dinglasan-Panlilio, IAS-Environmental Science and Studies, UW Tacoma

In 2006 Environmental Protection Agency (EPA) joined with eight major fluoropolymer and telomer manufacturers to launch the 2010/15 PFOA Stewardship Program. The goal of this program is to reach 95% reduction of Perfluorooctanoic acid (PFOA) and other chemicals that break down to form PFOA from emissions and products by 2010, and to work toward elimination of the emission of these chemicals by 2015. PFOA is a suspected carcinogen used in making polytetrafluoroethylene (PTFE) commonly known as Teflon, it is also a growing concern that PFOA does not breakdown and accumulates in the environment. Studies have shown that PFOA is found in blood samples; however the risk is still unknown. The purpose of this study is to determine the impact of this program on levels of these chemicals in car wash products produced after 2010, and to compare levels of precursor compounds present in products manufactured by companies that are not involved in the Stewardship program.

Albom Title

Troy Albom (presenter)
Mentored by: Julie Masura, IAS-Environmental Science and Studies, UW Tacoma

Plastic was meant to help preserve our natural resources, prior to its advent goods were made from metal, wood, bone, ivory or other such natural material. Today, a good number of consumer goods are made from plastic because it is inexpensive, and easy to manipulate into almost any shape. Plastic is the perfect material for our single use, disposable culture of today. It has been found to leave a significant impression on our environment, having a particular impact on marine ecosystems by way of simple pollution, and its inhabitants by way of ingestion, or entanglement. The purpose of our research is to determine the density of micro-plastic (plastics that range from 5 mm to .3 mm) in water bodies. To do this we collect samples by pulling a net behind a boat, then in lab extract the plastic from organic matter also collected with the sample by way of a wet peroxide oxidation process. Our data can then be used to establish the likelihood of marine organisms interacting with plastic debris, if organisms are found in the same water bodies as plastics, there is the possibility that ingestion may occur.

A Study of Solid Waste Produced for One, Two, and Three Person Households over a One Week Span

Brad Anderson (presenter), Patrick Tate, and Jared Mosier
Mentored by: Dr. Bonnie Becker, IAS-Environmental Science and Studies, UW Tacoma

Municipal solid waste (MSW) and the problems associated with its collection, processing, and disposal have become a major worldwide problem. The EPA estimates that about 243 million tons of MSW was produced in the United States in 2009 alone. These high numbers led to a research project that was designed to track individual output of household solid waste (both recyclable and non-recyclable materials) over a period of seven days, with a hypothesis that households with more individuals would produce more solid waste. We collected our data by separating our waste into recyclable and non-recyclable categories and then weighing each category with a standard 1 kg hanging spring scale over the seven day period. The results of our experiment showed that the amount of solid waste produced was not consistent with our theory that the amount was determined by the household size. There were unexpected variables (such as household pets) that were not initially considered, which led to a different overall outcome in the data. When the data is applied to a larger target area (such as county,

state or country), it shows that the amount of solid waste produced per person can have a dramatic effect on the overall amount of solid waste that is making its way into landfills.

Algal Bloom of *Alexandrium* catenella at Dockton in Quartermaster Harbor

Ordella Archer (co-presenter), Prim Ly (co-presenter)
Mentored by: Dr. Cheryl Greengrove, IAS-Environmental Science and Studies, UW Tacoma

The dinoflagellate, *Alexandrium catenella* (*Alex*), is a species of phytoplankton that spends most of its lifecycle as a cyst in surface sediments. As optimal environmental conditions are achieved growth dramatically increases into harmful algal blooms (HABs) within the water column. *Alex* generates saxitoxin, a neurotoxin that bio-accumulates in the tissues of shellfish; although the toxin is not usually harmful to the shellfish, mammals that ingest the shellfish can suffer from a condition known as Paralytic Shellfish Poisoning (PSP). Studies have shown that the frequency of HABs has increased in the Puget Sound and throughout the world over the last few decades, affecting fishery resources and causing increased economic damage. This on-going research at Dockton in Quartermaster Harbor, aims to catch the summer and fall blooms to better understand the environmental factors that lead to the excystment and HABs. Knowing the environmental factors associated with the occurrence of *Alex* will help us better predict, understand and manage the effects of HABs in the future.

Restoring the Gary Oak: Washington's only native Oak

Caroline Ball (presenter)
Mentored by: Dr. Matt Kelley, Urban Studies, University of Washington Tacoma; Dr. John Banks and Dr. Ursula Valdez, IAS-Environmental Science and Studies, UW Tacoma

This purpose of my Geographical Information Systems (GIS) project is to explore the most optimal potential sites in Western Washington that could be used for Garry oak restoration. Current restoration projects that work to restore the Garry oak to the Pacific Northwest are important because the tree is Washington's only native oak. Currently, ecosystems that are home to the Garry oak are rapidly vanishing because oak habitats are being heavily degraded due to human impact, placing them among the most endangered ecosystems in the United States. In this project, literature on previous oak rehabilitation projects was used in order to find the greatest factors that aid in the success of Garry oak restoration in Western Washington. These factors were then used in the mapping analysis phase of the project to select the most likely regions in Western Washington for Garry oak restoration success. The analysis also took into consideration the Garry oak's characteristic habitat features and key bird and butterfly species in the mapping portion. Ultimately, this project was completed by narrowing down the regions in which oak rehabilitation projects should take place in order to successfully restore the tree to Washington State. With optimal locations in Western Washington for oak tree restoration revealed, future oak restoration efforts can be concentrated in these locations.

Rail Renaissance- A GIS Analysis on the Impact of Re-Activation of Abandon Rail Lines in Washington State on Nearby Communities.

Michael J Barnett (presenter)
Mentored by: Dr. Matthew Kelley, Urban Studies, University of Washington Tacoma

The United States is faced with a growing population and decaying infrastructure, budget deficits and an unclear future in regards to commercial and personal transportation. Over the past decade many preeminent members of the scientific, political and economic communities have begun to consider the ageing but still functional national rail system to improve industrial, commercial and personnel transport. Abandoned rail lines throughout the country have been reactivated to varying degrees of success and the possibility of widespread reactivation of many abandon lines is a course discussed in Congress. The study area is Washington State and this project offers a spatial analysis, utilizing ESRI's

ArcGIS platform, of current and abandoned rail lines including a comparison of parcel and socio-economic variables and residential property values.

Lowell Jr. Green Team

Serena Bell (presenter)
Mentored by: Dr. Sian Davies-Vollum, IAS-Environmental Science and Studies, UW Tacoma

Throughout the 2012-2013 academic school year self-selected fourth and fifth grade students at Lowell Elementary School met twice a month during their lunch/recess hour to learn valuable lessons of environmental stewardship. Students involved gained valuable knowledge of the earth's natural systems, ways in which they can care for the earth in their everyday lives, as well as reduce their overall environmental impact. The number of students involved in the Jr. Green Team increased by the end of the year, showing an increased interest in the program. The success of lessons taught is evident in the increased knowledge of students who participated in learning activities. The Jr. Green Team has increased the students' environmental knowledge, enabling them to grow into environmentally responsible individuals who may someday change the world.

Does Water Movement Matter?

Jessica Berman (co-presenter), Simi Tumber (co-presenter)
Mentored by: Dr.Bonnie Becker , IAS-Environmental Science and Studies, UW Tacoma

The Olympia oyster (ostrea lurida) is a native species on the Pacific coast of North America. O. lurida are filter feeders meaning they filter their surrounding water and screen out the phytoplankton they feed on which helps keep the marine waters clean. In the late 1800s the O. lurida were being overexploited for commercial food consumption and by 1930s they were commercially extinct. Despite the lack of exploitation in the last decade O. lurida has failed to recover and active restoration efforts are needed. The primary problem is related to establishing new oyster beds. Therefore, we are determining if the restored populations are producing offspring that settle locally or the larvae emigrating to other oyster beds from different locations. From April to June 2013, the presence and dispersal of O. lurida larvae has been studied in Fidalgo Bay. The larvae were monitored using passive larval tube traps that contain a salted dimethylsulfoxide (DMSO) fixative. Then the larvae will be analyzed using qPCR to identify the larvae sub species. Once the larval distribution is measured the restoration efforts can be properly directed to establish a thriving population of O. lurida.

Perfluorinated Compounds in Household Laundry Rinse Water

Alyssa Boettger (presenter)
Mentored by: Dr. Joyce Dinglasan-Panlilio, IAS-Environmental Science and Studies, UW Tacoma

Perfluorinated compounds, or PFCs, are synthetic chemicals that are created to render products water and oil repellent. They are commonly used in stain-resistant clothing and upholstery as well as other consumer products including cosmetics, paints, and polishes. Strong C-F bonds greatly reduce the environmental degradation of PFCs which have consequently been measured in nearly all media ranging from soil, air, and water, to human and animal tissues. PFCs also escape degradation in waste water treatment plants where they are then discharged into surrounding waterways. These environmentally stable compounds are found globally and their bioaccumulation may result in toxic repercussions. This research will measure concentrations of perfluorinated carboxylic acids (PFCAs) of varying chain lengths (C2-C14) in laundry rinse water samples taken from random households within the Vancouver, WA area in order to determine a potential source of PFC input into the Columbia River. Concentrations present in the samples would indicate that widespread usage of consumer products containing PFCs is a contributing factor to PFC load in the environment. At this stage, method development is the primary focus. Challenges in measuring PFCs in a soapy water matrix prior to analysis on a liquid chromatograph

tandem mass spectrometer (LCMSMS) have led to testing several sample extraction methods including, solid phase extraction (SPE), liquid-liquid phase extraction, acidification, and precipitation.

The Clean Up Power of Mussels in Thea Foss Waterway

William Hou Chan (presenter)
Mentored by: Dr.Bonnie Becker , IAS-Environmental Science and Studies, UW Tacoma

The impact of mussel farm can lead to low dissolved oxygen, reduce light availability of eelgrass, the blooming of harmful algae, eutrophication, and increases the chances of paralytic shellfish poisoning in the Puyallup River Watershed. University of Washington-Tacoma Professor, Dr. Bonnie Becker and students from Marine Ecology class worked on the nutrients monitoring and mussel harvesting on the dock of Center for Urban Waters. Our hypothesis was to determine the mussels has an ability to fixate nitrogen content of the water. By occupying quadrats, the research team has harvested mussels along the mussel rafts. Total wet weight, dry weight and species distribution were determined in the UWT laboratory. It is important to acknowledge the percentage of nitrogen of mussels in order to explore the application of aquaculture technologies for nutrient mitigation in the marine environment of Tacoma, WA.

The Effects of Anthropogenic Modifications on the Natural Beach Environment at Owen Beach in Tacoma, Washington

Janet Cook (presenter)
Mentored by: Dr. Sian Davies-Vollum and Dr. Cheryl Greengrove, IAS-Environmental Science and Studies, UW Tacoma

Three distinctly different beach environments can be observed at Owen Beach in Tacoma, Washington; a natural beach environment, a partially modified beach environment and a fully engineered beach environment. Each part of the beach has a unique morphology and profile. This study was designed to analyze these differences and determine the effects, if any, that the anthropogenic modifications have on the slope, change in elevation and sediment characteristics along this beach over the course of a year. The beach slope and change in elevation were measured monthly starting May 2012 at three points along the beach face from each type of environment using a tape measure and Brunton compass. Sediment samples were taken from the same points and measured using a Particle Size Analyzer or grain size chart. Sketches were made of the beach profile that include tide line, landscape, data points, sediment deposition, high tide line, and modifications. Preliminary analyses of data shows that the anthropogenic modifications have a direct effect on the morphology and profile of the beach. The fully modified portion has been more static than the other two parts with larger particles and less change in slope. The modified portion has smaller particles along its shore and its slope has been more dynamic than the fully engineered portion of the beach. The natural portion of the beach is the most dynamic with much smaller particles along its shore and a larger change in slope throughout the year. It is important to study the effect that human engineering has on natural beach environments so that we can fully assess its impact on and applicability for managing coastlines for residential, commercial and recreational use in our communities.

Interrupting Campus Culture to Change Behaviors with Recycling and Garbage

Carolyn Green (presenter)
Mentored by: Dr. Lia Wetzstein, IAS-Environmental Science and Studies, UW Tacoma

Recycling is an important part of campus sustainability. A photographic collection was started in autumn 2012 to establish a baseline contamination rate for both recycling and garbage containers/bins at the University of Washington (UWT). It was found that recyclables such as plastic bottles, aluminum cans, and paper/cardboard were commonly found in garbage versus recycling containers, despite the

presence of labeled recycling containers on campus. Recycling bins were often contaminated with dirty disposable cups, glass, organic matter, food and candy wrappers prior to this project. The purpose of this study was to establish a foundational understanding of recycling efforts and help improve those efforts. This researcher used a mixed-method approach that encouraged college students to participant in recycling programs by investigating campus behavior, taking surveys, and adding new signage above recycling and garbage containers that focused on one specific building on campus, Russell T. Joy (JOY). A survey in spring 2013 (n= 151, RR1= 64%) suggest students know what to recycle on campus and 76% noted a short list of accepted recyclables by the containers would be helpful. Also misperceptions existed on what is recycled on campus with nearly 10% of participants who believed glass is recycled on campus, when it is not. Signs were added above garbage and recycling bins. Garbage and recycling containers in JOY building prior to new signage had a high contamination rate exceeding 75% for mixed recycling, garbage, and organic matter, whereas at the end of this study, the rate dropped to less than 10% with proper signage.

Restoration Ecology Capstone 2012-2013

Tamika Greenwell (presenter), Michael Carey, Helen Wilson, Lesley Hogue, Rosario Robles, Jessica Satterthwaite

Mentored by: Dr.Ursula Valdez , IAS-Environmental Science and Studies, UW Tacoma

I was involved with the restoration ecology capstone for the 2011-2012 academic school year at the University of Washington. During this time my project partners and I restored a degraded area of habitat located on the Pierce College campus. The total restoration area was approximately 9, 311 ft2 and consisted of manually removing invasive plant species and attempting to reestablish the project site back into a native oak prairie woodland by installing native plants for that particular ecosystem. Over the course of this three quarter capstone, the skills that were acquired included development of a site assessment, proposal for our project, a project work plan, and a stewardship plan. We also developed skills on how to engage the community in volunteering with the removal of invasive species, in addition to the solicitation of native plants and the implantation of the project.

Cost-Effective Recycling for Bethel School District

Kelly Hatfield-Burmaz (presenter)

Many public school districts nationwide contribute large percentages of municipal waste from recyclable materials. National statistics on school recycling indicate a high potential for waste reduction and overall savings if school districts were to implement low cost recycling plans. Waste audit research conducted throughout the Bethel School District revealed significant cost savings. By implementing simple recycling processes schools could redirect these resources to educational programs in need.

Oly Oly Oxen Free; The search for a self-sustaining Olympia oyster (*Ostrea lurida*) population

Megan Hintz (presenter), M. Stutz

Mentored by: Dr.Bonnie Becker , IAS-Environmental Science and Studies, UW Tacoma

Washington State was once home to a thriving shellfish industry and the demand by San Francisco and other western cities led to the commercial exploitation and eventual decline of the native oyster population. The Olympia oyster (*Ostrea lurida*) is native to most of the western coast of North America. Despite the lack of exploitation in the last decade *O. lurida* has failed to recover. It is a hermaphroditic and viviparous species whose spawning is temperature dependent and reproductive cycle is slow. Settlement by *O. lurida* larvae occurs on hard substrates consisting of shell or concrete for preferred attachment. Restoration efforts for this oyster are ongoing within many of the bays of Washington and one such location is Fidalgo Bay. In this study the effectiveness of restoration efforts in re-establishing a

self-sustaining *O. lurida* population are evaluated. Through the use of passive larval tube traps, chalk pucks, shell strings, and adult capture, the relative abundance and distribution of *O. lurida* can be evaluated and restoration efforts assessed. Very little attention has been given to Washington's native oyster population and little is known about its ecological importance in ecosystems. A restored site provides researchers the ability to study both and if successful, Fidalgo Bay can be used as a model system for possible restoration of other previously exploited species.

Improving Phosphorus Attenuation in Bio Retention Systems

Brian Hite (presenter), Andy James, and Kurt Marx
Mentored by: Dr. Joel Baker, *IAS-Environmental Science and Studies, UW Tacoma and the Center for Urban Waters*

Stormwater pollution is a growing problem in urban environments. When contaminants are released into our environment they collect in storm drains; and for the most part, flow untreated into streams, rivers, lakes, and oceans. Contaminants like copper from brake dust, nutrients from fertilizers, and detergents from washing cars, can adversely impact aquatic life. "Low Impact Development" designs such as rain gardens and bioretention systems are viable options to reduce harmful effects by filtering out many of the pollutants before they enter aquatic systems. However, bioretention systems do not adequately remove nutrients like phosphorus from stormwater; in fact bioretention systems may be adding phosphorus to the environment from the decomposition of organics within the soil mixes. The purpose of this study is to improve the performance of rain gardens in terms of phosphorus removal. In this research, we compared standard bioretention soil mixes (BSM) to bioretention systems with amendments, such as water treatment residual (WTR) or biochar to determine their ability to capture metals and nutrients like phosphorus through a multi-phase investigation. In the first phase, contaminant removal efficiency was determined for a set of soil amendments under standard conditions through a set of soil column experiments. In the second phase, the hydraulic conductivity and removal capacity of the best-performing amendment, WTR, was evaluated to determine an appropriate mixing-ratio. Finally, design parameters including the physical location of the amendment within the soil mix, and the effects of a saturated layer were investigated. Results suggested that effective phosphorus removal can be achieved from stormwater through the inclusion of amendments in LID designs with up to a 50-60% reduction in phosphorus.

A Geospatial Analysis of Anthropogenic Influences on River Basins in Pierce County, Washington

Bryan Huebner (presenter)
Mentored by: Dr. Matthew Kelley, Urban Studies, University of Washington Tacoma

This research project, through the use of Geographic Information Systems (GIS), is a geo-spatial analysis of the anthropogenic influences on all of the rivers that flow through Pierce County, Washington. Using topographical data, a predetermined set of influences, and GIS analyses, multiple basins were constructed along each of the rivers so that any evidence of the targeted influences could be calculated. The selected tributaries and the chosen influences were categorized using zonal statistics in order to deem the level of impact reflected in each of the basins along the rivers. As expected, the early calculations, showed some of the strongest negative influences on the rivers in the areas with the highest population densities, and greatest amounts of impervious surfaces. The concluding results of these analyses however suggest some of the higher levels of secondary pollutants that are being introduced into the rivers are occurring closer to moderately-developed areas. These areas have far less impervious surface coverage, and lower population densities than expected. This research was conducted in order to spatially display the impacts of human influences that are within the proximity of the rivers in our region, with hopes of raising awareness and promoting environmental stewardship.

GIS Certificate Capstone Project - Potential Park and Ride Locations

Caroline Jensen (presenter)
Mentored by: Dr. Matthew Kelley, Urban Studies, University of Washington Tacoma

TV commercials urging commuters to "ride the Soundtransit wave" may be a waste if potential transit users aren't able to access the system. For commuters who don't live within a walkable distance of a transit access point, using the system is a matter of parking. This shortage of parking to meet rider demand results in loss of ridership, overflow parking in residential areas, traffic congestion and negative environmental effects of air and noise pollution. At a time when routes are being reduced due to budget cuts, increasing transit use is an important topic to explore; public transit is an important community service which can increase urban sustainability. This capstone project explores identification of potential shared-use park-and-ride sites located on current transit routes near population clusters using ArcGIS 10. Shared use park-and-ride facilities are established within an existing parking lot where peak use is different to that of commuter use; often the transit authority agrees to maintain the lot in exchange for its use. The intended audience is Soundtransit and Metro. The spatial extent is low productivity transit areas in the South King Transit Planning Area east of the I-5 corridor whose commuters often travel long distances to reach their employment or educational destinations. Network Analyst was used to establish service areas of bus-stops and current park-and-rides to determine areas in need. Population as number of people over 18 old was used as a proxy for rider demand. Tax parcel use data was used to identify potential shared-use sites near rider demand within areas in need of service. The GIS analysis resulted in several potential shared-use parking sites.

Controlled Burn Method Used for Restoration of South Puget Sound Prairies

Cassandra Johnson (presenter)
Mentored by: Dr. Joyce Dinglasan-Panlilio, IAS-Environmental Science and Studies, UW Tacoma and Eric Delvin, School of Environmental Sciences and Forestry, UW Seattle

Prairie restoration in Western Washington is important because of the diverse and vital ecosystems that call it home. Mlot (1990) states that prairies provide a habitat for a rich diversity of fauna, including birds, mammals, butterflies, and other invertebrates; some of which are entirely dependent on the open habitat and type of plants that reside in prairies. The goal in prairie restoration is to reduce the abundance of non-native species like *Cytisus scoparius* (Scotch Broom). Another goal is to replenish native species, including the rare and threatened *Castilleja levisecta* (The Golden Paintbrush); critical as nectar sources for butterflies and other animals. Methods in eliminating invasive species include fire, solarization, herbicide spraying, and mowing. The restoration project should include both the removal of invasive plants and re-establishment of native plant communities to get maximum results. The results after two years concluded that fire, a controlled burn method, was the most successful in eradicating invasive species. The burn method resulted in the most growth of native species and solarization resulted in the least growth in experimental arrays in Puget Sound prairie habitat.

Temperature effects on byssal thread production in the mussel, Mytilus trossulus

Michelle Knowlen (presenter) and Angeline Blattenbauer
Mentored by: Dr. Laura Newcomb, Department of Biology, University of Washington, Seattle and Friday Harbor Laboratories

Mussels attach themselves to hard substrates by extruding thin, strong, and flexible hair-like attachments known as byssal threads, which are anchored in place with small adhesive plaques. While many studies have examined how multiple abiotic variables affect mussel attachment strength, few have performed extensive single variable tests within a controlled lab setting. In this study, we investigated the effects of temperature on byssus production in the native Northern Pacific intertidal

blue mussel, Mytilus trossulus, and expected to see a decline in production with increasing temperatures (specifically, between 18°C-25°C). We also hypothesized that threads produced in warmer temperatures would show a visual decline in quality, either through thinning, degradation, or tearing. Mussels were placed in a temperature controlled flume for 24 hours. Six different trials were run at 10°C, 14°C, 18°C, 20°C, 22°C, and 25°C. Byssal threads were counted for the duration of each trial to determine production and rate of attachment. Threads produced under these different temperature regimes were analyzed using scanning electron microscopy to visually compare differences in quality. Overall, there was a significantly negative correlation between thread production and increases in temperature, with the highest amount occurring at 18°C (11.25 threads +2.0 s.e.m.) and the lowest at 25°C (0 threads). Acclimatization and rate of thread production was also negatively affected by temperature increases. In addition, we saw a significant difference in percentage of mussel attachment between temperatures, with up to 93% attached in the 10°C and 18°C treatments and 50-0% in the 20°C-25°C treatments. However, visual analyses of thread quality differences were inconclusive. Our findings indicate that climatic temperature increases may negatively affect both the range of M. trossulus within Northern Pacific rocky intertidal zones as well as potentially setback the aquaculture of the species.

Metal Pollution and Forest Decline in the Appalachian Mountains of New England

Jami Kovatch (presenter) and Sharon Hunter
Mentored by: Dr. Erica Cline and Dr. James Gawel, IAS-Environmental Science and Studies, UW Tacoma

Spruce-fir forests in the Appalachian Mountains are experiencing decline; in particular, red spruce (*Picea rubens*) has largely been eliminated from the higher part of its elevational range. Appalachian forests are downwind from coal-fired power plants and other industrial sources of pollutants in the Midwest, forming a gradient of heavy metals in forest soils reflecting many decades of deposition. Soils tend to reflect historical deposition, while accumulation of metals on lichens reflect more recent deposition. Phytochelatins (metal-binding peptides) provide a more sensitive and direct indication of metals stress at the cellular level. We studied tree stress responses in six sites along this depositional gradient by measuring metals concentrations in soil and on the growing edges of two lichen species (*Hypogymnia physodes* and *Imshaugia aleurites*), and identified correlations with metals uptake into red spruce foliage and phytochelatin production in roots and foliage. Metals in soils and foliage were measured using inductively coupled plasma mass spectrometry (ICP-MS), while phytochelatins were detected using high-performance liquid chromatography (HPLC). Results showed that there were strong differences by site for metals from lichens, organic, and mineral soil. Despite high levels in the soil, Pb was not detected in foliage. Foliar uptake of Zn differed by site, and was significantly higher in Abraham than the other sites. Foliar uptake of Cu and Cd did not differ significantly by site. Recent metals deposition (measured on lichens) for Cd, Cu, and Zn were above what a US Forest Service survey determined as typical background levels in North American forests, implying that despite tighter industrial regulations, forests are continuing to be exposed to toxic metals. The correlation between Zn and Cd in organic soil and PCs in foliage suggests that these metals may be contributing to red spruce decline.

It's all downhill from here: Analysis of the optimal routes for longboarders- An alternative transportation

Tricia Lohr (presenter)
Mentored by: Dr. Matthew Kelley, Urban Studies, University of Washington Tacoma

Using GIS (Geographical Information Systems), the degree of slope, road conditions, types of roads, and distance have been taken into consideration to provide a "cost path" analysis for optimal routes through Tacoma, WA on a longboard. Transportation is an imperative part of life everywhere and alternative

forms are even more important to people today. Longboarding (long skateboards) is a form of leisure and transportation, going in out of popularity since the 1960's. Downhill longboarding has since become a competitive sport, with Washington being home to a downhill racetrack used annually for competitions and other purposes. The longboarding community grows each year in the forms of transportation, sport, and leisure. Tacoma has low quality street conditions and differing degrees of slope, which is why it has been chosen for optimal routes for a beginner, intermediate, and advanced ride. GIS is a way to show the audience a road map emphasizing safety, suggesting road repair, and taking multiple factors into consideration to do so.

Puget Creek Water Quality and Stream Flow

Benjamin Lowery (Presenter)
Mentored by: Dr. Cheryl Greengrove, IAS-Environmental Science and Studies, UW Tacoma

As part of a larger restoration effort for salmon habitat on Puget Creek my capstone research at Puget Creek Restoration Society involved a comparative analysis of water quality monitoring and flow discharge on Puget Creek. The objective of the water quality monitoring was to compare Puget Creek Restoration Society (PCRS) instruments to University Washington Tacoma (UWT) instruments for verification of accuracy. The comparative analysis revealed a faulty pH probe used by PCRS and also facilitated the implementation of a more frequent calibration of their DurOx 325 dissolved oxygen probe. The results of this study has verified the accuracy of their water quality instrument and provided them with an estimate of the cubic feet per second of discharge flowing out of Puget Creek.

The Impact of Biochar on Produce Yield

Vanessa Martin (presenter), Hugh McLaughlin, Art Donnelly
Mentored by: Dr. Bonnie Becker, IAS-Environmental Science and Studies, UW Tacoma

Sustainable farming practices are becoming increasingly more necessary in areas such as Latin America. This is due to it's over exploited natural resources which have maximized their short-term profits. By using biochar as a soil amendment along with organic fertilizers, it can significantly improve a soil's, productivity, tilth, nutrient, and water retention for crop growth. At South Seattle Community College a test site was broken down into sections with unaltered soil, another with a soil/compost mixture, another with a soil/biochar mixture, and finally a biochar/compost mixture. The objective was to determine which plot produces both the most harvestable crops and the most nutritious. The harvested biomass was weighed and concluded for further research. Currently the results are pending.

Metallothionein as a Bio-indicator of Metal Toxicity in South Puget Sound

Michelle McCartha (presenter) and Katie Best
Mentored by: Dr. Bonnie Becker and Dr. Jim Gawel, IAS-Environmental Science and Studies, UW Tacoma

Metallothionein (MT) is produced by benthic invertebrates in response to metal pollution, and as such provides a valuable tool for monitoring metal contamination impacts in Puget Sound. In this study, we explored the degree of correlation between MT in benthic invertebrates and metal contamination both in the field and in the lab. Seven stations were sampled, including five in Commencement Bay, an industrial harbor, and two control sites near the less impacted Nisqually delta. MT concentrations in collective samples of benthic worms were analyzed and compared with metal concentrations (Cd, Cu, Pb, and Zn) found in sediments to determine the benthic response to metal stress in situ. In addition, sediments were collected from all stations and used in a lab validation study exposing clean polychaete worms, Alitta virens (formerly Nereis virens), to metals in the sediments for 21 days in order to determine how the proteins develop in a controlled environment absent of normal adaptive responses. Both the collective sample of worms and Alitta virens were analyzed for MT concentrations using a published spectrophotometric method. Results indicated that average MT concentrations for in situ

worms and metals concentrations Cu, Pb, and Zn at the Point Defiance station were higher than other stations. This is suggestive of a relationship between metals in the sediment and MT in the worms, although in some cases, the pattern is complicated by the bioavailability of metals as reflected with grain size. Quantifying MT allows for measurement of the bioavailability of metals, which can be difficult to quantify in other ways, such as directly sampling sediments. The use of MT in marine worms as a bioindicator of metal stress may be beneficial in monitoring the health of Puget Sound.

Taxonomic voucher sheets of the benthic invertebrates in Puget Sound

Cassandra McNeal (presenter)
Mentored by: Dr. Bonnie Becker, IAS-Environmental Science and Studies, UW Tacoma

Creation of a taxonomic voucher sheets for benthic invertebrates of Puget Sound will help with future identification. As the number of registered taxonomists decreases we need a way to properly identify species in the future. With the Department of Ecology's specimen collection, we are working on creating a set of voucher sheets to hopefully one day be used as a public reference.

Gary Oak Woodland: An Ecosystem in Peril

Maxwell Nagy (presenter), Caroline Ball, Stacie Gary, Mico Pineda
Mentored by: Dr. Ursula Valdez, IAS-Environmental Science and Studies, UW Tacoma; Dr. Warren Gold, IAS, UW Bothell; Lindsey Hamilton, Dr. Kern Ewing, Dr. Jim Fridley, School of Environmental and Forest Sciences UW Seattle

This project small team that oversaw a restoration project on some of Pierce College land. This project involved working with both the UW and Pierce College faculty as advisors, and Pierce College students as volunteer workers. The restoration involved removal of invasive plant species, such as Himalayan Blackberry and Scotch Broom. This was done utilizing volunteer events to clear the area for planting. After this, Garry Oak trees and assorted flowers were added to the plot of land. The plants put in the ground will one day recreate the rare oak woodland ecosystem as the owners of the land continue stewardship.

OLYMPIA OYSTER LARVAL DISTRIBUTION IN A SMALL RESTORED BAY IN PUGET SOUND: A PILOT STUDY USING PASSIVE TUBE TRAPS AND QPCR

Hannah Parker (presenter), Vadopalas, B. (University of Washington School of Aquatic and Fishery Sciences); Allen, B. (Puget Sound Restoration Fund), Behrens, M.D. (Pacific Lutheran University)
Mentored by: Dr.Bonnie Becker , IAS-Environmental Science and Studies, UW Tacoma

The Olympia oyster (*Ostrea lurida*) is the subject of many restoration projects in the Pacific Northwest. In situ larval counts during breeding seasons can be used to assess the efficacy of such projects and the health of *O. lurida* populations, , but sorting and identifying larvae is time and resource intensive, limiting the practicality of this method. The purpose of this experiment was to combine the novel approaches of time-integrating larval tube traps and quantitative polymerase chain reactions (qPCR) to determine the applicability of using these methods for larval surveys. Fidalgo Bay, a site with a restored population of *O. lurida*, was chosen for the pilot. Six traps were deployed for one week with additional traps deployed the following week in the same locations. Standards and samples were filtered, prepared, and analyzed using the qPCR method. Inhibition of qPCR was detected in some standards and field-collected samples. Preliminary results derived from samples without inhibition indicate larvae in approximate quantities realistic to the scope of this study. With minor modifications, these methods have the potential to simplify and make feasible larval surveys that could otherwise be too impractical to undertake.

Comparison of Discrete Dissolved Oxygen Data to CTD Data and Phytoplankton vs. Dissolved Oxygen Levels

Jennifer Patterson (presenter)
Mentored by: Dr. Cheryl Greengrove, IAS-Environmental Science and Studies, UW Tacoma

Eutrophication is the term used to describe the process of a nutrient rich body of water becoming oxygen deficient. Excess nutrients, such as phosphates and nitrates, trigger algal blooms that are larger than normal. When the algal blooms die off, the decomposition process uses up the dissolved oxygen in the water and leaves behind a hypoxic environment. Quartermaster Harbor is Puget Sound is an area of concern. King County and University of Washington Tacoma began taking water samples in Quartermaster Harbor to analyze nutrient levels, dissolved oxygen levels, chlorophyll and phytoplankton abundance. Discrete samples as well as continuous data from a CTD were collected. The project also looked specifically for Alexandrium blooms. This particular phytoplankton is known to be responsible for causing Paralytic Shellfish Poisoning. The ability to track and possibly predict Alex blooms could allow local shellfish farms to harvest their crops before they become toxic.

Alzheimer's amyloid beta oligomer characterization by Western Blot

Jeremiah Payne (presenter)
Mentored by: Dr. John Finke, IAS-Environmental Science and Studies, UW Tacoma

Selective identification of unique "clumps" of the beta-amyloid peptide, known as oligomers, can enable an early detection test for Alzheimer's Disease. This project sought to determine to determine if binding of commercial monoclonal and polyclonal antibodies can distinguish between different oligomer preparations. In contrast to published studies, we find that the monoclonal antibody 6E10 generally recognizes all different oligomer preparations regardless of the prep recipe. Also surprisingly, polyclonal antibodies A11 and Officer, reported to be "oligomer-specific", do not appear to bind any of the oligomers and actually show a weak preference for the non-oligomer precursors. While the simple Western Blot technology used in the present study appears insufficient for use as an Alzheimer's diagnostic of oligomers, differences in the size of oligomers from the different preparations were noted. Therefore, it is concluded that more advanced biophysical methods in our lab, such as fluorescence and surface plasmon resonance, may prove to be more successful in distinguishing these subtle differences. Such advanced methods may be better suited than standard Western Blots or ELISAs as the basis of early-detection technology of Alzheimer's Disease from human sera.

Oak Woodland Restoration at Pierce College

Mico Pineda (presenter), Caroline Ball, Stacie Gary, Mico Pineda, Maxwell Nagy
Mentored by: Dr. Ursula Valdez, IAS-Environmental Science and Studies, UW Tacoma; Dr. Warren Gold, IAS, UW Bothell; Lindsey Hamilton, Dr. Kern Ewing, Dr. Jim Fridley, School of Environmental and Forest Sciences UW Seattle

Oak Woodland ecosystems, once a sprawling habitat in the Western United States have quickly diminished in size due to the recent population growth and introduction of rapidly growing invasive, non-native plant species (McCreary 2010, Devine and Harrington 2004). Due to extraneous pressures placed on these Oak Woodland habitats, many species populations, such as Taylor's Checkerspot (Euphydryas editha taylori) and Valley Silverspot (Speyeria zerene bremnerii) have slowly disappeared. Placing them on the brink of the endangered species list. In an attempt to restore these failing populations, we conducted a restorative study in accordance with Pierce College at Fort Steilacoom. With the help of their science department, we removed invasive species, replanted distinct species common to our targeted habitat and developed a stewardship plan that ensures the success of an Oak

woodland restoration. Ongoing evaluations and surveyance are needed to assess the development of our project.

Water Properties in Quartermaster Harbor Puget Sound

Nicholas Schlafer (presenter)
Mentored by: Dr. Cheryl Greengrove and Julie Masura, IAS-Environmental Science and Studies, UW Tacoma

Quartermaster Harbor (QMH) is a shallow, southward facing bay in central Puget Sound with high concentration of Alexandrium catenella cysts (a type of phytoplankton that can cause paralytic shellfish poisoning) and poor water quality. This study analyzed water properties and the phytoplankton community of QMH which were sampled monthly from 2007-2011 to determine why Quartermaster Harbor provides such favorable environmental conditions for Alexandrium catenella, and what parameters affects dissolved oxygen in the bay. Results suggest that oxygen in the inner harbor is a function of both physical and biological forcing conditions. Dissolved oxygen, phytoplankton, and nutrient levels are linked in a seasonal pattern which is then intensified by the geographical configuration of the bay to create conditions optimal for high concentrations of Alexandrium catenella and low oxygen levels in the later summer.

Effects of Topography on Erosional Capacity of Pyroclastic Density Currents: A Case Study from Mt. St. Helens

Richard Schwartz (presenter), Chad Sharp
Mentored by: Dr. Peter Selkin, IAS-Environmental Science and Studies, UW Tacoma and Dr. Brittany Brand, Boise State University

Our research uses the well-exposed pyroclastic density currents (PDC) deposits from the May 18, 1980 eruption of Mt St Helens (WA) to explore how PDCs are influenced by surface roughness. We mapped and sampled deposits from a single PDC proximal, medial, and distal distances from the source, focusing on changes with distance from source and a comparison between deposits in areas of low and high surface roughness. Grain size and componentry data of deposits downstream from preexisting debris avalanche hummock, which provided high surface roughness, contain a threefold-increase in hummock components relative to PDC deposits in areas of low surface roughness. This suggests that high surface roughness promotes the erosive capacity of PDCs. The main driving force for PDCs is their great density relative to the air, thus increasing the density at the base of the current through substrate erosion could potentially increase the run-out distance, thereby increasing the destructive radius. *This research was supported in part by the the Mary Cline Memorial Undergraduate Research Award*

Columbia River Dams: Benefit for Consequence

John Theiss (presenter)
Mentored by: Dr. Jane Compson, IAS, UW Tacoma

Before the arrival European settlement, the Columbia River Basin was home to many Native American tribes, such as the Nez Perce and Kootenai tribes. The Columbia River and its water flow contained the migration of 16 million salmon and steelhead annually during the late 1800s. By the 1990s, their numbers had dropped to 1 million annually after the development of hydro-electrical dams. The dams' ability to irrigate the 250,000 square miles of the Columbia Basin was a major factor that brought about this change. This study compares the positive and negative consequences from the Columbia River dams. Specifically, the study investigates the benefits to the Pacific Northwest region and its policies, economy, and society. These benefits are compared to the negative impacts to the environment and local Native American tribes. By examining these different factors, I hope to assess and determine the dams as being overall beneficial or detrimental structures.

The Phytochelatin Synthase Gene in Conifers

Robert Tournay (presenter)

Mentored by: Dr. Erica Cline and Dr. Jutta Heller, IAS-Environmental Science and Studies, UW Tacoma

Toxic heavy metals, like cadmium and arsenic, enter the environment through human activities, carrying long term implications to both human health and ecosystem integrity. As primary producers, plants occupy a critical entry point for heavy metals into the food web. Some plants possess molecular adaptations conferring a natural tolerance to accumulations of heavy metals in their tissues. One mechanism is the biosynthesis of phytochelatins by the enzyme phytochelatin synthase (PCS). The objective of this project was to amplify the PCS gene in conifers, which had not previously been studied. PCS gene segments from *Pinus Ponderosa* and *Pinus contorta*, successfully sequenced last year, were used to design conifer specific primers. Using the new primers, I have amplified and sequenced PCS gene segments in four additional conifer species; Douglas-fir (*Pseudotsuga menziesii*), Western white pine (*Pinus monticola*), Norway spruce (*Picea abies*) and Red spruce (*Picea rubens*).

Point Ruston; The ASARCO Superfund Clean-up Site

Kevin Turner (presenter)

Mentored by: Dr. Cheryl Greengrove, IAS-Environmental Science and Studies, UW Tacoma

I did my internship at Point Ruston which is a planned redevelopment project on the site of the former ASARCO Tacoma Smelter located on Ruston Way in the City of Tacoma and Town of Ruston. My capstone speech will cover the history of the ASARCO site, the redevelopment plans for Point Ruston, and the environmental testing which I was responsible for during my internship at Point Ruston. In addition, I will cover EPA requirements which needed to be fulfilled in order to transform the site into a public community housing area and a commercial business site.

Fo**liar uptake of toxic metals and stress responses of pine seedlings from biosolids-treated sites at Pack Forest, WA**

Jennifer Vittetoe (presenter)

Mentored by: Dr. Erica Cline and Dr. Jim Gawel, IAS-Environmental Science and Studies, UW Tacoma and Dr. Greg Ettl, School of Environmental and Forest Sciences, UW Seattle

Biosolids applications can increase heavy metals in soils, which may impact seedling survival in managed forests. Western white pine (*Pinus monticola*) seedlings, planted in a biosolids-treated site at Pack Forest in the lower foothills of the Washington Cascades, have experienced heavy mortality which has prevented reforestation of the site even after 30 years of replanting. The purpose of this study was to determine whether these seedlings are exhibiting metals stress. Soil and foliar metal content was measured using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Phytochelatins, glutathione, and cysteine, compounds that are induced by metals stress and serve as bioindicators of metals stress, were measured in freshly emerged needles using high performance liquid chromatography (HPLC). Soil metals, at 16 ppm for cadmium, 293.5 ppm for copper, 585 ppm for zinc, and 509.5 ppm for lead, were substantially elevated at this site compared to commeasurable untreated sites, and furthermore, these were significantly higher than at other biosolids-treated sites. Foliar cadmium was 2.6 ppm, copper was 10 ppm, zinc was 177 ppm, and lead was undetectable; of these, all but lead was significantly elevated in seedlings growing in the biosolids-treated site compared to control seedlings. Phytochelatins, glutathione, and cysteine were significantly elevated in the biosolids-treated site compared to the control. The elevated foliar metals, in particular the highly toxic cadmium, and elevated levels of Phytochelatins and their precursors suggest that these seedlings are experiencing metals stress.

Prioritizing New Tree Planting in the City of Tacoma

Ben Wells (presenter)
Mentored by: Dr. Matthew Kelley, Urban Studies, University of Washington Tacoma
My capstone project uses a Geographic Information System (GIS) to prioritize new tree planting areas within the City of Tacoma. I worked in conjunction with the City of Tacoma's urban forester to accomplish this task. In my analysis I used various datasets; tree canopy coverage in the city, demographic data, and parcel information. I standardized these data so that I could perform the analyses necessary to locate the priority regions for planting. GIS can be used for a variety of spatial and non-spatial analyses completing tasks from programming to complex multi-faceted data manipulation programs. The analyses conducted for this project were spatially focused as I was considering a specific geographic area of the city to be categorized as the highest priority for planting. The results of my study specified regions of the city considered to be highest priority for new tree planting according to the criteria specified.

UWT Rock Collection
Jill Wetzel (presenter)
Mentored by: Dr. Peter Selkin and Dr. Sian Davies-Vollum, IAS-Environmental Science and Studies, UW Tacoma
In the early to mid 90's, UWT sent out a call to bolster its collection for the new Geology classes. Samples came in from Dr. Eric Cheney and Dr. Catherine Summa, as well as smaller additions over the years from students and faculty members. But there wasn't the manpower to properly label, organize, and catalogue the donated samples, specifically those from Dr. Cheney. In 2006 or so, Susan Black made an attempt, starting the samples donated from UW Seattle (the majority of the Paleo Collection), but was unable to finish the samples from the Cheney Collection. In Winter Quarter, 2011, Mike Gala and I went to work. While Mike worked mostly with the Mineral Collection, I took on the task of the rest of the collections. I reformatted the database, labeled photographed and organized the samples, with a majority of the Cheney Collection going into long-term storage. But not all of the work is done. A new collection, the Anthropo Collection (rocks of man-made or man-altered origins such as furnace slag and died agate) was formed. This is an exciting time for the UWT collections!

The identification of fluorotelomer alcohols in laundry wash water samples from around the Puget Sound
Tyree Williams (presenter)
Mentored by: Dr. Joyce Dinglasan-Panlilio, IAS-Environmental Science and Studies, UW Tacoma
Polyfluorinated compounds are a class of compounds widely used by producers of textiles, paint, and lubricating oils because of their oil and water repellant properties. This class of compounds include fluorotelomer alcohols (FTOHs) and fluorinated sulfonamide alcohols. These compounds are precursors to more environmentally hazardous compounds such as perfluoroalkyl sulfonates (PFSAs) and perfluoroalkyl carboxylates (PFCAs). Polyfluorinated precursors are known to be highly volatile because of their increased vapor pressure and decreased boiling point, thus capable of long-range atmospheric transport. The purpose of this study is to test for the presence of various polyfluorinated precursors in laundry rinse water samples gathered from random homes in the Vancouver, WA area. Polyfluorinated precursors were extracted from samples via solid phase microextraction (SPME) and analyzed using gas chromatography-mass spectrometry analysis. Currently, it has been found that 1H-1H-Perfluoro N decyl Acrylate, 1H-1H-2H-2H-Perfluorodecyl methacrylate, 1-H, 1-H Perfluoro-1-decanol, N-ethyl perfluorooctane sulfonamidoethanol, and various other precursors to PFCAs and PFSAs are present in the tested laundry wash water samples. Preliminary samples contained a concentration range of 0.64 parts per trillion [ppt] to 162.2 parts per trillion [ppt] for various polyfluorinated precursors. This study shows that polyfluorinated precursors are detected in laundry rinse water, and polyfluorinated

compounds used in the production of clothing are contributing to the PFSA and PFCA load in to the environment.

Sustainable Roots

Jolene Yaconetti (presenter)
Mentored by: Julie Masura, IAS-Environmental Science and Studies, UW Tacoma

Sustainable Roots, an initiative of The Northwest Leadership Foundation, created a seven-week environmental program, called "Hilltop Garden Explorers". This summer program is held at McCarver Elementary School in Tacoma, Washington. Curriculum classes are enhanced with lessons through-out the year and Communities Actively Strengthening Tacoma in Neighborhood Gardens and Schools continue this program during the school year. Children are taught the importance of nutrition, challenged with opportunities to learn basic gardening techniques, and discover how to be good stewards of the earth. Youth become more aware of their own dietary habits and the simplicity of growing healthy food. Sharing easy environmental strategies with their families', aids in reducing food insecurities, heightens awareness of environmental impacts and enriches community relationships. Connecting impoverish communities with agricultural possibilities allows individuals and groups to contribute their knowledge, skills, and experience. In the future, youth will make healthier choices for nourishment and contribute to sustainability of their families and the earth.