SUMMER ECOLOGY PROGRAM

STUDENT RESEARCH REPORTS

July 2019

TABLE OF CONTENTS

Summer Field Ecology: An Introduction

By: Gina Roberti and Abi Groskopf, Mount St. Helens Institute staff

Mount St. Helens is a landscape of change, dynamism and resiliency. As a science educator, I see Mount St. Helens as a place to understand the processes of geological and ecological systems. It is equally a place to allow young minds to explore personal, social and intellectual adventures far from the routines of classroom walls and home towns. In July 2019, high school students from across the United States met in minivans at the Mount St. Helens Institute's rustic field camp as strangers to each other and to this dynamic place.

Summer Field Ecology is an intensive, weeklong field camp for high school students interested in natural resource and biology. The goals of the program are 1) to expose students to field practices and techniques, 2) to connect students to researchers from graduate students to professors, and 3) to actively contribute to real-world scientific research at Mount St. Helens.

Every day of camp, students joined professional researchers on various projects. This involved hiking several miles in rugged terrain through the blast zone created by the 1980 eruption of Mount St. Helens. Teams of students accompanied different research teams to assist with data collection.

Watching students chat with each other while wading in streams and share questions and observations from the day during our evening discussions, I realized that our week at Mount St. Helens was not just about learning science but about becoming friends, observers and story-tellers.

Throughout camp, students wrote reflections and took detailed notes from each of their experiences in the field. We asked them to compile their field notes into material that could teach a broader audience about the importance of scientific research at Mount St. Helens.

Here are their stories.

Summer Ecology Program Overview

Summer Ecology Program is a multi-day field-based camp for high school-aged youth to participate in contemporary research projects within the landscape affected by the 1980 eruption of Mount St. Helens. The entire camp takes place within the 1980 blast zone. Throughout the week-long camp, participants join professional researchers working at Mount St. Helens to assist in research projects. This involves hiking, collecting data and team building. Participants build relationships and learn alongside experts from universities and federal agencies who conduct research in the area affected by the 1980 eruption.

Field Research

All research took place on the Pumice Plain of Mount St. Helens. Located in the heart of the 1980 eruption zone, this part of Mount St. Helens National Volcanic Monument is restricted to public use. Researchers require permits to conduct research on the Pumice Plain and the Mount St. Helens Institute has a special use permit with the US Forest Service to collaborate with researchers on educational projects.

Throughout Summer Ecology Program, participants stay at the Mount St. Helens Institute Windy Ridge Field Camp. This remote field location does not have running water. It is located on the eastern side of Mount St. Helens approximately four hours from Portland.

During Summer Ecology Program, students acquired the following skills:

- Hiking off trail: learning techniques of how to carefully move across the sparsely vegetated landscape with minimal impact
- Carrying field equipment, collecting and labeling samples in the field
- Practicing field protocols for surveying streams including noting physical biological characteristics of the stream: length of section, algal index, composition of macroinvertebrates and abundance of amphibians, etc.
- Field science journaling techniques: daily debrief, daily journaling, journal prompts
- Becoming acquainted with field camp practices: maintaining remote field camp
- Installing Bushnell cameras on T posts viewing streams for determining seasonal stream flow (remote photography monitoring)
- Collecting leaf litter samples
- Soil Core sampling

Project Description

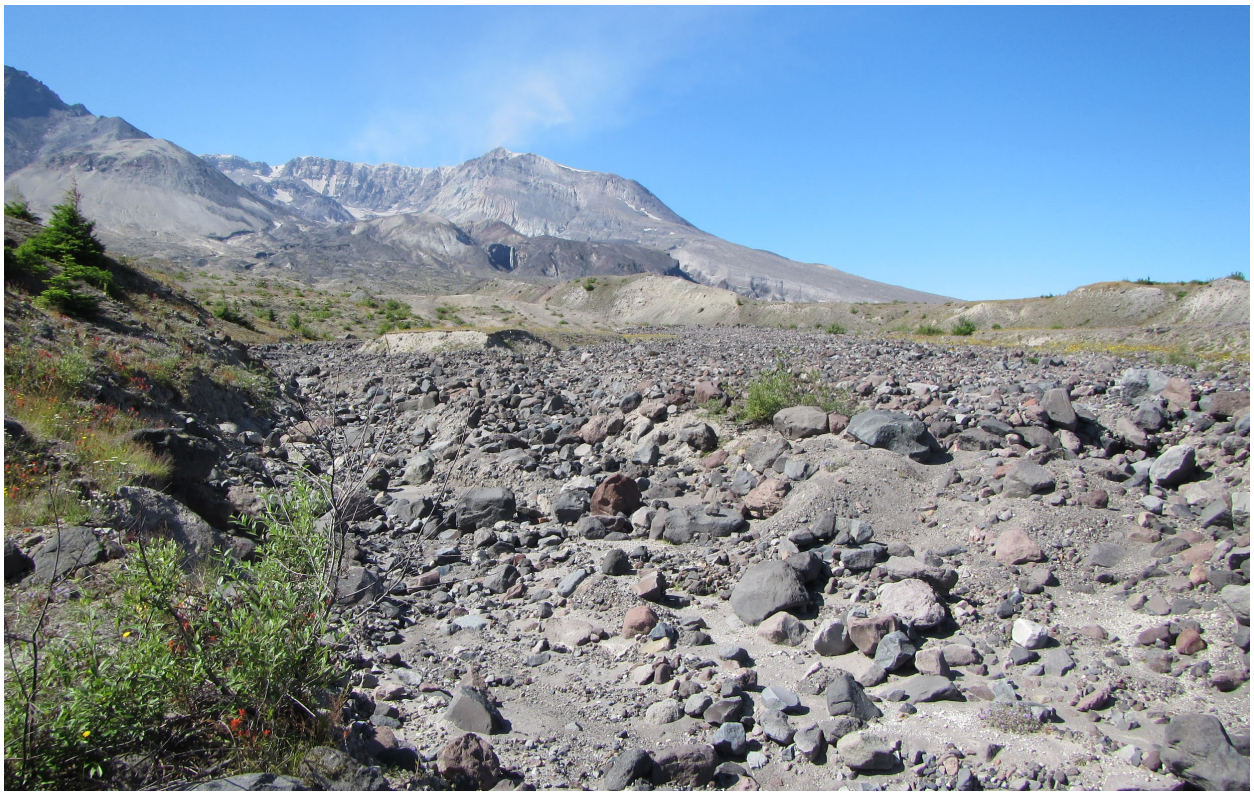
During Summer Ecology Program, participants assist professional scientists with field-based projects. Research topics include nutrient cycling in Spirit Lake, huckleberry restoration, plant ecology, species interactions on the Pumice Plain, stream ecology, pollinators and more. Professional researchers who have worked with Summer Field Ecology program include scientists from the University of Washington Tacoma, Washington State University Vancouver, The Evergreen State College, and the U.S. Forest Service.

The following articles summarize the experiences and research of participants in the 2019 Summer Ecology Program with the Mount St. Helens Institute. These articles speak to the diversity of research actively occurring in the landscape affected by the 1980 eruption of Mount St. Helens. Students were asked to write about their experiences for a public audience. Articles were compiled by staff at the Mount St. Helens Institute and shared with permission from students and researchers.

Research with Dr. Carri LeRoy

A detailed summary of Dr. LeRoy's research on Mount St. Helens in the summer of 2019

By Jessica Marlowe



Background on Research

In 1980, Mount St. Helens erupted which inevitably developed the Pumice Plain. Pumice is a porous volcanic rock, and scientists have been studying this plain for nearly 20 years due to the special qualities it possesses. The eruption gave scientists a special opportunity to observe how life can regenerate after its entire ecosystem is lost. Dr. Carri LeRoy is using her skills as a freshwater ecologist on the Pumice Plain of Mt. Saint Helens. She is studying the interaction between the willow plants and the weevils, an invasive type of beetle, as well as the evolution of stream patterns since the eruption in 1980.

The willow/ weevil interaction is particularly interesting. The weevils lay their eggs near the willows (typically in a female willow), and when they hatch, the larvae burrow into the plant. As the weevil larvae grow, they eat their way out of the willow, killing branches on the plant. Dr. LeRoy is studying this interaction due to its role in the regional nitrogen and carbon cycle. Typically, the quantity of carbon dioxide (CO_2) in the atmosphere is at its highest point in the fall since that is

when the majority of plants die and decompose. Due to all the willows dying, carbon is cycled into the atmosphere earlier in the summer. Dr. Carri LeRoy is attempting to understand why the weevils prefer the female willow over the male willow so she can fully understand the changes in the carbon cycle at Mount St. Helens.

Another study Dr. Carri LeRoy is conducting is the evolution of the streams since the eruption in 1980. During this study, she is monitoring three creeks on the Pumice Plain very closely: First Creek, Willow Creek, and Clear Creek, Geothermal Creek, and Camp Creek. First Creek often goes dry in the summer. Willow Creek has water downstream of a major spring, but upstream it is completely dry. Clear Creek is flowing strongly this year. Dr. LeRoy would like to determine where the water is coming from in each stream and the timing of each flow (if there is one).

Conducting the Research

Willow/Weevil Interaction

In order to fully understand the willow/weevil interaction, the differences between the male willow and the female willow need to be established. Dr. Carri LeRoy began this task by marking numerous shrubs on the Pumice Plain with a blue ribbon for male and a pink ribbon for female while the plants were in full bloom. With the plants properly marked by gender, she could then begin her tests. By pressing multiple leaf samples from both the male and the female willows she began determining the slight differences in their shape. Dr. LeRoy also began studying their genetic makeup by drying and then extracting DNA from both the male and female willow leaves. Other than genetic makeup and physical shape, Dr. LeRoy is studying the differences in their decomposition rates. She is doing this by collecting dead leaves from both the male and female willows, placing them in separate bags in the stream, then monitoring the rate in which the leaves decompose. During this study, has found that the male willow leaves decompose at a faster rate than the female willow leaves. So, why do the weevils prefer female willows over male willows? No one knows, but with time Dr. Carri LeRoy will crack the case.

Evolution of Streams

Unfortunately, stream researchers did not make it out to the Pumice Plain right after the eruption in 1980, but Dr. Carri LeRoy is attempting to make up for lost time now. She has placed 16 high tech wildlife Bushnell cameras aimed at the five creeks on the Pumice Plain. One at First Creek, Willow Creek, and Clear Creek. Reinforced with tape, metal posts, and straps, the cameras will be able to withstand all storms and curious elk. Each camera will take two pictures daily at 10 a.m. and 2 p.m. until the upcoming spring. Dr. LeRoy is also taking birds-eye pictures of the streams using a drone. In addition to the pictures, Dr. LeRoy is collecting water samples from each stream in order to determine where the water is coming from.

Take Away from Research

When Dr. Carri LeRoy is finished with her research, we will have a better understanding of stream patterns and how they evolve over time. This could help people predict future stream locations in order to prepare for them. We will also better understand the relationship between weevils and willows. With this knowledge, people will be better equipped to determine the next course of action. Should people get involved with the weevil infestation or should people let nature take its course on the pumice plain? All in all, people will be more educated with Dr. LeRoy's research.

About the Author, Jessica Marlowe

Jessica Marlowe is a high school senior who took part in the Ecology Program at the Mount St. Helens Institute in the summer of 2019. She assisted with Dr. Carri LeRoy's Field research on June 29, 2019. After the course on one day, Jessica became extremely educated in what Dr. Carri LeRoy had accomplished on the Pumice Plain.

A Day with the Tadpole

Surveying streams with ecologist Charlie Crisafulli

By Esther Moseley

Hello, my name is Esther Moseley, and I met Charlie Crisafulli through Mount. St. Helens Institute in the summer of 2019 on the pumice plain on Mt. St. Helens. The pumice plain is the most affected area from the 1980 eruption and has been studied by scientists from around the world for years. The reason I came to Summer Ecology Program is because I wanted a chance to study with different scientists and to learn more about ecology. Astoundingly, Charlie Crisafulli has been researching Mt St. Helens for nearly 40 years. Varying from baseline to broader ideas, the resident ecologist is all knowledgeable. During this camp we surveyed the number of amphibians in Mt. St. Helen's creeks in their habitat. Surveying the growth of their numbers is important so people know in what ways the environment and the human impact is affecting life there.

We started early in the day, wading through the creek to find contrasting spots in different perimeters. The categories we were studying were how fast the water went, the algal con, the amount of shade from plants, and the size of the rocks. We would feel the rocks for algae/slime content and use our arms to estimate the amount of shade in the specified area. In each area, the group would vote on the strength class of the water. The rock size would range from sand to large boulder. All of these factors contribute to life in the streams. Without rocks, there would be nothing for organisms to hide under or attach so they do not get swept downstream. Larger amphibians prefer the water where there are more macroinvertebrates. Each factor affects one another, and the amount and type in one place versus another.

When we would find a spot to lay out our nets and collect our specimen we had very specific steps. First, we would put up the net, and weigh it down with rocks. Next, we would disrupt the stream bed to loosen and scare creatures towards the net and we danced the twist just to make sure all of the creatures went downstream. After combing through the rocks we would check the net. Carefully, we would get the net out of the stream and find all of the tadpoles and macroinvertebrates. We'd measure and identify them (only the amphibians) and then set them free. Lastly, we put all the rocks back so life could continue in the stream.

The benefits of Charlie Crisafulli's research on the environment are very important. Without the studying of the streams, we would not know what lives in them or how to protect them. Preserving our environment is our duty, and the littlest actions from us can affect it. Besides this year (2019) the last time Charlie did this particular study was in 2016. This year we found bunches of tadpoles, a female Coastal Tailed Frog, and a Giant Coastal Salamander on our search. Compared to previous studies the amphibian life has been increasing. Since the eruption, more and more life has been developing and the streams are a great place to look for it. In the future, the public should look forward to new baseline research about the increasing of life on Mt. St. Helens. The environment there is like none ever recorded before and as people, we should be paying more attention to it.

About the Author, Esther Moseley

Esther Moseley is a high school student who took part in the Ecology Program at the Mount St. Helens Institute in the summer of 2019. She assisted with Charlie Crisafulli's field research on July 31, 2019.

Spirit Lake with Dr. Jim Gawel

Researching nutrient cycling on Spirit Lake at Mount St. Helens

By Judith Solomon

Dr. Gawel is an Associate Professor of Environmental Chemistry and Engineering at the University of Washington - Tacoma. He has had a teaching and research position at UW Tacoma for 14 years. Dr. Gawel obtained a Bachelor of Science in Civil Engineering from Brown University and a Ph.D. in Civil and Environmental Engineering from MIT. Dr. Gawel's focus is limnology: the study of inland aquatic ecosystems such as lakes. As a postdoctoral student at MIT, he studied arsenic contamination in urban lakes. More recently Dr. Gawel has studied eutrophication in Spy Pond, Wapato Lake and Spirit Lake. He is also the President of the Washington Lake Protection Association, a non-profit organization that protects lakes.

On July 31, 2019, I, as a participant in Mt. St. Helens Institute's Summer Ecology Program, had the distinct privilege of assisting Dr. Gawel with his data collection on Spirit Lake. This lake is very unique, because it was drastically changed by the 1980 eruption, and the ecosystem is still coming back. Spirit Lake is highly protected. There is only one hiking trail at Mt. St. Helens that provides access to the general public and swimming, boating and fishing are expressly prohibited to the public. However, the lake is open to a select group of researchers, and it seems lucky High School Ecology Program participants.

Dr. Gawel is part of a team of researchers studying the nitrogen load of Spirit Lake. Scientists were interested in what was allowing the fish in the lake to become so large. It was observed that more nitrogen was coming out of the lake then appeared to be coming into the lake. Dr. Gawel scored the lake looking for this mystery nitrogen source, until the only place left to look

was the log mats. Through satellite imaging, researchers were able to determine that about 20% of the surface Spirit Lake is filled with logs from the 1980 eruption, prior to the eruption 40% of the lake was covered in logs. This presents an interesting situation, because most lakes do not have logs on their surface because logs are removed relatively quickly. Logs are removed by people for timber and access for recreation. Logs on lakes are grossly understudied. In Spirit Lake however, the logs have had time to create whole tiny worlds on their undersides. Researchers noticed that algae is growing on the bottom of logs. Every time the logs rubbed together, the algae would come off and feed the fish, this in turn would make room for more algae to grow. Dr. Gawel believes that this algae is the mystery nitrogen source.

Dr. Gawel's ongoing project is to collect samples of the algae and determine the types of nitrogen being produced based on the molecules isotopic signatures. If the nitrogen in the fish has the same isotopic signatures as the algae, then he will be able to prove that the algae is the missing nitrogen. Dr. Gawel is collecting samples in multiple ways. Dr. Gawel uses log mats that he makes to avoid the equipment being destroyed. The log mats are made of logs on the lake, but they are roped together. So far none of the human-made log mats have survived the winter winds. One collection method is using microscope slides to collect algae without scraping and harming the plant. Another is by collecting the sediment that falls underneath the logs.

Currently, Dr. Gawel and his team are getting ready to publish some promising results. Dr. Gawel hopes to continue the research with more funding, mainly to charter a helicopter to collect samples. This research could have a large impact in the way lakes are maintained. I will take this experience with me for the rest of my life.

About the Author, Judith Solomon

Judith Solomon is a high school student who took part in the Ecology Program at the Mount St. Helens institute in the summer of 2019. She was one of two students who assisted Dr. Jim Gawel in surveying Spirit Lake by boat on July 31, 2019. Spirit Lake is the most famous lake of Mount St. Helens. The opportunity to participate in research on the lake is a unique opportunity.

Research on Mount St. Helens

Weevils and willows on the pumice plain

By Adalberto "Beto" Valdez

The short week I spent with my group up at Mount Saint Helens was a week I would never seem to forget. I went to the Summer Ecology Program that Mount St. Helens Institute holds annually every year. We learned so much about ecology. All of us were assigned a certain ecologist my ecologist was Becca Evans. Becca is a first year PhD student at Washington State University Vancouver in Dr. John Bishop's lab. She studies the effects of nitrogen deposition in conjunction with an invasive inveterate herbivore on soil development, carbon and nitrogen cycling, and microbial diversity and function.

To assist her in her research we went on a hike about four miles onto the pumice plain of Mount Saint Helens. This area is very close to the crater of the volcano and is an area heavily affected by the 1980 eruption. When arrived at a spot that Becca had marked off in a bunch of willow trees. Some of them were sprayed with a type of chemical that would make the weavers not able to bury their eggs in the roots of the willow bush. We went to the willow bush that was on the top of the hill, and when we reached the top of the hill where the willow bush stood the took a mallet and some type of tool that they used to get dirt out from under the tree. They told us that they had to take dirt samples. Becca told us the process that the dirt has to go through to get analyzed in the lab. First they store the dirt at room temperature they keep it in that room for a month before they get to analyze it.

Becca also have showed us that the bushes that they sprayed with chemicals seemed to thrive better than the ones that had never been sprayed. The plots that had been sprayed seemed to

have more life and color in them and the ones that didn't get sprayed seemed to only have one bush that was on the verge of death. We spent about an hour and a half on this task.

While working, we got to learn fascinating stuff from Becca about the beetles that like to bury their eggs in the willow tree. The females are the ones that laid the eggs in the root of a thriving willow tree the trees that they liked to invade the most were the females seemed to take in a lot more of carbon dioxide and other gasses that the earth produced naturally. Becca also showed us another project that they were working on about the decomposition of the leaves and how fast they would decompose due to the different amounts of carbon they had. I am sure that the male leaves decomposed a lot faster than the female trees this is still unknown due to the lack of research because it was one of their newer projects that they had started last winter.

It was an amazing getting to work with such brilliant people in the field of Mount Saint Helens. I was very thankful that I got to experience the wonders of the mountain.

About the Author, Beto Valdez

Beto Valdez is a high school student who took part in the Ecology Program at the Mount St. Helens Institute in the summer of 2019.

2019 Research Project Summary

Monday July 29, 2019 | Dr. Carri LeRoy | The Evergreen State College

Dr. Carri LeRoy is a freshwater ecologist and her research focuses on how riparian forests interact with streams and provide energy through leaf litterfall. Her research has shown that both the species diversity and genetic diversity of these litter inputs can affect in-stream leaf litter decomposition rates, aquatic fungi and aquatic macroinvertebrates. Her current research focuses on how leaf litter and salmon carcass inputs interact, what drives global patterns of leaf litter decomposition, how streams have developed in the 35 years since the eruption of Mt St Helens, and how endophyte infections can alter phytochemistry and leaf litter dynamics. Other topics she is interested include ecological genetics, sustainable practices, sci-art linkages, and issues of women and underrepresented groups in the sciences.

The Summer Ecology Program joined Carri and her undergraduate students to study streams on the Pumice Plain. Carri's crew joined for a fireside chat to talk about "life as a scientist" on Monday evening.

Tuesday July 30, 2019 | Becca Evans | Washington State University

Becca Evans is a first year PhD student at Washington State University-Vancouver in Dr. John Bishop's lab. Becca is studying the effects of nitrogen deposition in conjunction with an invasive inveterate herbivore on soil development, carbon and nitrogen cycling, and microbial diversity and function. She is also passionate about connecting science, policy, and education to address global change drivers.

The Summer Ecology Program joined Becca and two undergraduate students in surveying willows at Willow Springs. There are experimental plots where the group took soil core samples for genetic analysis.

Wednesday July 31, 2019 | Dr. Jim Gawel | University of Washington

Dr. Jim Gawel is Associate Professor of Environmental Chemistry and Engineering at the University of Washington Tacoma. Jim got his B.S. in Civil Engineering from Brown University with an emphasis in Environmental Problems and Planning, and his Ph.D. in Civil and Environmental Engineering from MIT. Jim has been teaching and doing research with undergraduates at UW Tacoma for 14 years and headed the Environmental Science and Studies program here for 6 years. He has also been working actively to understand lake eutrophication, developing nutrient mass balance budgets for Spy Pond, Wapato Lake in Tacoma and Spirit Lake near Mount St. Helens. Jim's other research interests include studying cellular bioindicators of metal stress in aquatic and terrestrial systems, making documentaries as public education and outreach tools to address water management issues and improving undergraduate environmental science education.

Two students from the Summer Ecology Program joined Jim for research on Spirit Lake by boat.

Wednesday July 31, 2019 | Charlie Crisafulli | Pacific Northwest Research Station

Charlie is a research ecologist who's been conducting work at Mount St. Helens since July 1980, just weeks after the catastrophic May 18, 1980, eruption. He leads studies that are providing insights into the initial and long-term responses of ecosystems to large, infrequent disturbance. His work explores the ecology of the volcano's small mammals, birds, amphibians, insects, and plants. Other research interests include the role of exotic species in montane lakes and the ecology of rare endemic salamanders.

Summer Ecology students joined Charlie at a stream called Bean Creek to survey streams.

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