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Call of the Chorus Frog: An Undergraduate Experience in Field Research in the Elwha River Basin

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By Nicole VandePutte

By the light of our headlamps, we hiked once more towards the ponds deep in the forest. Our group traveled in silence. The only sounds heard were those of our footsteps and the rushing of the Elwha River in the distance.

We had traversed these trails countless times in the past two weeks, but night had a way of making the forest unfamiliar. Luckily, my fellow researchers Sverre and Nora have an impeccable sense of direction, so I followed their lead.

Soon, from a distance, we heard the chorus of frogs. The group collectively paused. We turned off our headlamps, and continued in utter darkness as quietly as possible. Caution was paramount. Either too much movement, or the glare of our lights, would scare off the frogs, and our late-night excursion would be fruitless. We were there to listen for frogs and grade the site on a research scale of zero to three, with zero accounting for amphibian silence and three being a full-blown frog chorus.

We tiptoed forward. But upon reaching our destination, the chorus that could be heard from all the way back at our campsite had stopped. Perhaps we had made too much noise, or maybe the frogs were simply done for the night.

Still, we had come out there to collect data, so we began the aural survey. Nora looked at her stopwatch and silently nodded to us to start tracking every sound for three minutes. Those 180 seconds felt like an eternity. We stood there in darkened silence, with the only light coming from the moon and the only sounds from the river and the wind through the trees.

"Ribbit."

At some point during those three minutes, we heard it. I imagined that it was Freddy, the frog we had found earlier that day who didn't immediately jump for cover and even posed for a few research pictures. He must have felt sorry for us, and croaked in solidarity. Nora whispered that time was up. I scribbled down a "1" for this particular site in my notebook and our group headed back to camp, thoroughly bummed out we didn't catch the chorus.

Freddy the pacific chorus frog.

Back at camp, zipped snuggly into my sleeping bag and ready to drift off, I heard that cacophony of frogs in the distance. I opened my eyes and turned to my tent-mate and fellow group member Elyse. She just sighed: "We'll try again tomorrow."

Field Camp

Last spring, I found myself at the start of my first backpacking trip. Along with 14 classmates, a teacher's assistant and a professor, I loaded up a 50-pound backpack and set off on a 9-mile hike into Olympic National Park. This probably seems out of the ordinary for an undergraduate college course, but we were not ordinary students.

We were a hardy group from Western Washington University's Huxley College of the Environment, and all had strong interests in the outdoors, both recreationally and scientifically. Our professor and intrepid leader, Dr. John McLaughlin, is a wildlife ecologist who prefers to live his life in the outdoors, gathering data on everything from butterflies to carnivores.

McLaughlin regularly emphasized the importance of experiential learning during our preparations for the trip. "It's absurd that we would have you would spend your academic careers in a classroom, and then expect you to find field jobs," he would say.

McLaughlin's main goal as an educator is to give his students the experiences they need to be successful in their future professional careers. To remedy his students' lack of hands-on experience, he created a program called field camp. This is a block of classes that students take together in one quarter, where they assemble into research groups to design and execute a field study devoted to wildlife. Four weeks of the program are designated to backcountry trips for students to gain experience conducting scientific studies in the field.

History of the Elwha

So, what makes the Elwha River an ideal place for our fledgling research projects? Until recently, the river had two large dams restricting its flow. The Elwha Dam, 5 miles from the mouth of the river, began operating in 1914. 8 miles further up the river, the Glines Canyon Dam was built in 1927. It was not until 1938 that Olympic National Park was established, protecting wildlife habitat within its borders.

While these dams were an effective means of providing power, they dramatically altered the ecosystems connected to the river. Two large reservoirs formed behind the dams, flooding large areas of forest. They blocked salmon migration up the river, preventing access to their spawning habitat. The dams also interrupted transport of sediment to the river below the dams, causing erosion of the riverbed and the delta.

In the words of the National Park Service, "For over a century, the web of ecological and cultural connections in the Elwha Valley were broken." Push for removal of the dams began in the 1980s, led by the Elwha Klallam Tribe and environmental groups.

Decades later, removal finally began in September 2011. Due to the vast amounts of water and sediment held behind the dams, blowing them out all at once would have been catastrophic to the surrounding ecosystem, washing away existing vegetation and wildlife.

A more gradual approach was taken, removing a few feet at a time and allowing the reservoirs to slowly drain. After six months, the Elwha Dam was fully removed.

Site of former Glines Canyon Dam and Lake Mills Reservoir.

Cameron Macias, a member of the Lower Elwha Klallam Tribe and a WWU graduate, has described the river restoration as, "a major success for the Klallam people, and proves the effectiveness of methods for ecosystem restoration that will hopefully be used as a model in other restoration efforts worldwide."

Yet the National Park Service acknowledges that the work is not finished. According to NPS, "Though dam removal has been accomplished, restoration of the Elwha River ecosystem will remain an ongoing process."

It was our goal as aspiring researchers to monitor the progress of this ongoing restoration.

A Practice in the Scientific Method

To understand any one species in the Elwha is to understand its relationship with a wider ecosystem. Referring to beavers in the area, the Seattle Times environmental reporter Lynda Mapes notes that "While salmon have always been the marquee species of this recovery, as the river from the mountains to the sea returns to a more natural state, all sorts of other animals also are benefiting." Her assertion embodies what we hoped to observe through our research: the interconnectedness of a larger ecology to specific outcomes for wildlife species.

In class, the first two weeks of the academic quarter were spent preparing our research projects: asking questions, formulating hypotheses, and designing studies to test our predictions. We split into four groups based on our research interests: birds, fungi, ungulates (which include deer and elk), and, what emerged as my personal favorite, amphibians. My fellow frog enthusiasts included Nora and Sverre, as well as Morgan and Elyse.

Amphibian Group. From left to right: Sverre, Elyse, Morgan, Nicole, and Nora.

Our first task as a group was to formulate a question relating to amphibians in the Elwha that we could attempt to answer during our two weeks in the field. After much brainstorming and many iterations, we settled on the question, "Are wetlands in the former Lake Mills reservoir supporting amphibians to same extent as wetlands in Geyser Valley?" The goal of this question was to assess how habitat in the newly exposed land supported amphibians compared to areas unaffected by the dams. In other words, did dam removal reenergize and restore the frog population in Olympic National Park?

The class planned to camp in Geyser Valley, an area upriver of both dams and reservoirs and thus unimpacted by any disruption in water or sediment flow. This was to be our "control" site which indicated amphibian presence in an undisturbed Elwha ecosystem. The former Lake Mills reservoir, which was behind the Glines Canyon Dam, would be our disturbed site.

The next step was to decide what information was needed to answer our question. Ideally, we wanted to record concrete evidence of amphibians at each site, which would include adults, eggs, and tadpoles. However, adult frogs, toads, and salamanders are particularly good at hiding from larger animals and humans, and not all species were breeding at the time we were conducting our research. So, we considered other ways to predict amphibian presence.

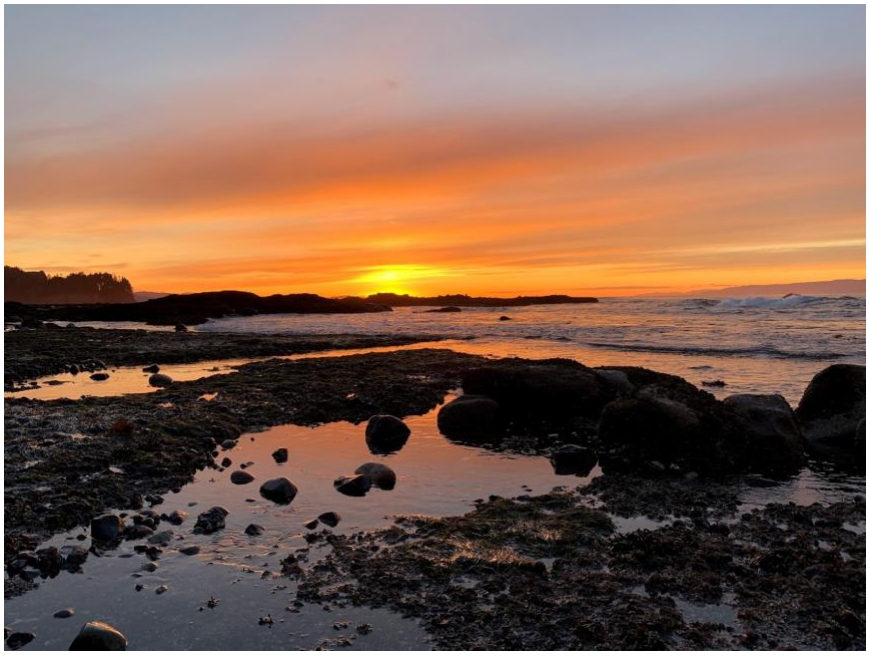
We decided to measure several habitat characteristics that we thought would be important to amphibian habitat. Our final list included wetland area, the flow of the water, the presence of algae, the amount of vegetation, tree cover, woody debris (fallen trees or branches), and the texture of the wetland bottom (soil or rocky). Our reasoning behind measuring all of this is that hopefully one or many of these

variables would indicate where amphibians are likely to be found, and we could use a statistical model to determine this based on the sites where we did find amphibian presence.

Getting Our Bearings

"One foot in front of the other," I told myself as I trudged uphill along the road into Olympic National Park. On either side of us towered a dense forest of large Douglas firs, Western red cedars, and Western hemlocks. It was a setting I would have marveled at if I didn't need all of my focus just to keep myself moving. My eyes were fixed on my feet as I willed myself forward and took care not to step on one of the many banana slugs that littered the ground.

This experience was is stark contrast to the night before. We had stayed at a campsite near the mouth of the river and watched the sunset over the ocean while playing in tide pools. Some classmates cooked dinner on a camp stove while Dr. McLaughlin baked a cherry cobbler on embers from our campfire. This was the first of many delicious desserts he would bake for us at camp. During this relaxed evening, it was easy to forget about the long day ahead of us.



Sunset over the Strait of Juan de Fuca.

It was my first backpacking trip, so I had expected a challenge. However, that didn't make the hike in any easier when the day came. We were going to be in the backcountry for four days, and the only supplies we would have we carried on our backs, resulting in packs weighing close to 50 pounds.

With the removal of the Glines Canyon Dam, the river was free to flow naturally. Unfortunately for us, its natural flow had washed out the road less than a mile into our hike, making the only way past a steep hiking trail alongside the river. This involved scrambling over fallen trees and sidling along a ledge over the river, all with heavy packs on our backs. As I looked at the river below, I was beginning to wonder if I would make it to the end of this hike.

Luckily, past that initial washout, the road was clear and I didn't have to worry about sliding into the river for the rest of the way.

Several hours and about 7 miles later, the road ended and became a narrow trail. Here we split into two groups to head to separate campsites. The maximum group size for camping in the park is 12, so as to minimize campers' impact. At this point we were descending into Geyser Valley, so the hike was no longer uphill, but there were many more obstacles in the form of fallen trees. I had hoped at this point we were almost there, but it still took us another hour to find a spot to set up camp.

The other group, led by our class teaching assistant, got to stay at an established campsite in the park. This came with amenities such as bear wires for hanging food, and, most enviably, an outhouse with a toilet. My group, led by Professor McLaughlin, was tasked with establishing our own camp. We settled on a site with fairly open ground covered in moss.

The weather that week was not ideal. The sound of the slow fall of raindrops through the trees brought a sense of tranquility, but conditions were otherwise dreary. The sky was gray and the valley was filled with pockets of mist, which resembled the geysers which gave the valley its name.

Amphibian Group walking through Geyser Valley.

Even when it wasn't actively raining, the ground, trees, and shrubs were all still wet, so we were living in our rain gear. When hiking we had to watch our step on slippery rocks and logs. The tarp we set up over our kitchen collected water and got progressively lower as time went on. By the end of the trip, all of our heads were touching the tarp as we ate and tried to stay out of the rain.

The purpose of this trip was to give us a chance to test out our study design and work out any problems that arose. In the two full days we were in the backcountry, we were mostly free to work on our projects. My group used this time to scout the area to get a lay of the land and identify any wetlands we would want to use in our study.

The hike out was a big improvement for me. I went from being at the back of the group on the way in to leading the charge on the way out. Either the hike in had really improved my stamina or I was just very ready to get home. We had the weekend to clean our clothes and gear, and on Monday we headed right back out to the Elwha.

Down to Business

I quietly walked along the edge of a small stream, eyes searching for any movement that would indicate the whereabouts of an amphibian. More often than not, we wouldn't find any, but in this case, I heard a small splash and looked just in time to see a red-legged frog swimming under a log. I smiled triumphantly and made a tally in my notebook.

Further up the stream, where we had already searched the perimeter, Sverre and Nora measured the area of the wetlands using a combination of a measuring tape and a rangefinder, which uses a laser to find distances. Morgan measured vegetation density using a quadrat, a 1x1 meter square made of PVC pipe that helps the user visualize a square meter. Elyse measured water velocity by dropping a rubber frog we named "Ducky" in the water and timing how long it took to travel one meter.

Left: Western toad in water with eggs. Right: Tadpoles in a pond.

This second trip out was better in all aspects. The weather was sunny and warm the whole time, and our group found a different campsite. Rather than the wet and mossy one, we chose a spot closer to the river and set up our tents on sand. Our kitchen area was under some big maple trees, and we were often surrounded by deer that seemed unperturbed by our presence.

Our first day collecting data was admittedly a little rocky, as we sorted out our individual roles and solidified our methods. We were slow going that day and collectively panicked about whether we would get all the data we needed during the trip. There were several disagreements, perhaps the most notable being about finding the area of a triangle. This was made all the more frustrating by its simplicity and our inability to Google the answer without cell service.

After a lunch break and some advising from Dr. McLaughlin, our spirits were raised and we found our groove. In the following days we developed a routine and worked as a well-oiled machine.

The most exciting method we used to detect amphibian presence was the aural surveys. These were our late-night hikes out to listen for frog choruses. During the breeding season, frogs gather in large groups and "ribbit" at night to attract potential mates. The only frog species breeding while we were there was the pacific tree frog (*Pseudacris regilla*), AKA the chorus frog, so this was our target during he surveys.

Elyse jumped, startled by something in the darkness. At this point, we had settled on using the red settings of our headlamps during aural surveys because it seemed less likely to scare off the frogs. However, for us it gave the night a much more sinister vibe and had us on edge. In the red glow, something large and low to the ground had scrambled across the cobbles, spooking Elyse. This turned out to be our first encounter with an adult Western toad. Compared to the amphibians we'd been seeing, this was a giant.

In the last few days of our trip, we headed down to the former Lake Mills reservoir. The environment here was noticeably different from Geyser Valley. Rather than the widely spaced, towering conifer trees we had become accustomed to, Lake Mills was mostly hills of exposed cobbles, with dense stands of young cottonwood trees surrounding any body of water. Many trees were planted as part of restoration efforts, but they had grown far beyond human efforts at this point.

Hiking here was a challenge, as the rocks tended to slide out from under our feet when we tried to go up or down the slopes. Perimeter searches were equally difficult with the dense vegetation along the water's edge.

Despite this, we were filled with excitement upon our arrival because all around us were quite literally thousands of tiny toads, all about the size of a quarter. Dr. McLaughlin told us they were likely Western toad metamorphs, meaning tadpoles that had just changed into toads and emerged from the water they were living in.

In Geyser Valley we had been searching high and low for a single frog, but now we had to watch our step just to avoid stepping on a toad. During one perimeter search, Sverre called out in excitement. When we regrouped he described his find to us as "a boiling pile of toads".

Western toad metamorph in Lake Mills area.

We worked hard there for two days, following the routine we had established in Geyser Valley. Our perimeter searches involved maneuvering through hundreds of thin-stemmed trees that were just inches apart from each other.

Crunching Numbers

I basked in the sun while sitting on a rock at the edge of the Elwha. As the river rushed by, several of my classmates were taking short swims in the chilly waters, but I was content to remain dry. It was our last full day in Olympic National Park, and three of four research groups had finished collecting data, so we were finally free to kick back and relax. I was proud of what my group had accomplished, and grateful that I had taken a step outside my comfort zone to take part in this adventure. Little did I know the stress we would face upon our return.

Our ultimate goal for the course was to create a poster of our research to present at WWU's Scholars Week. After returning, we had just about a week to analyze and synthesize the data we had collected. This was not without anxiety, since there was a very real possibility we would find no patterns in our data and would have nothing of interest to write about.

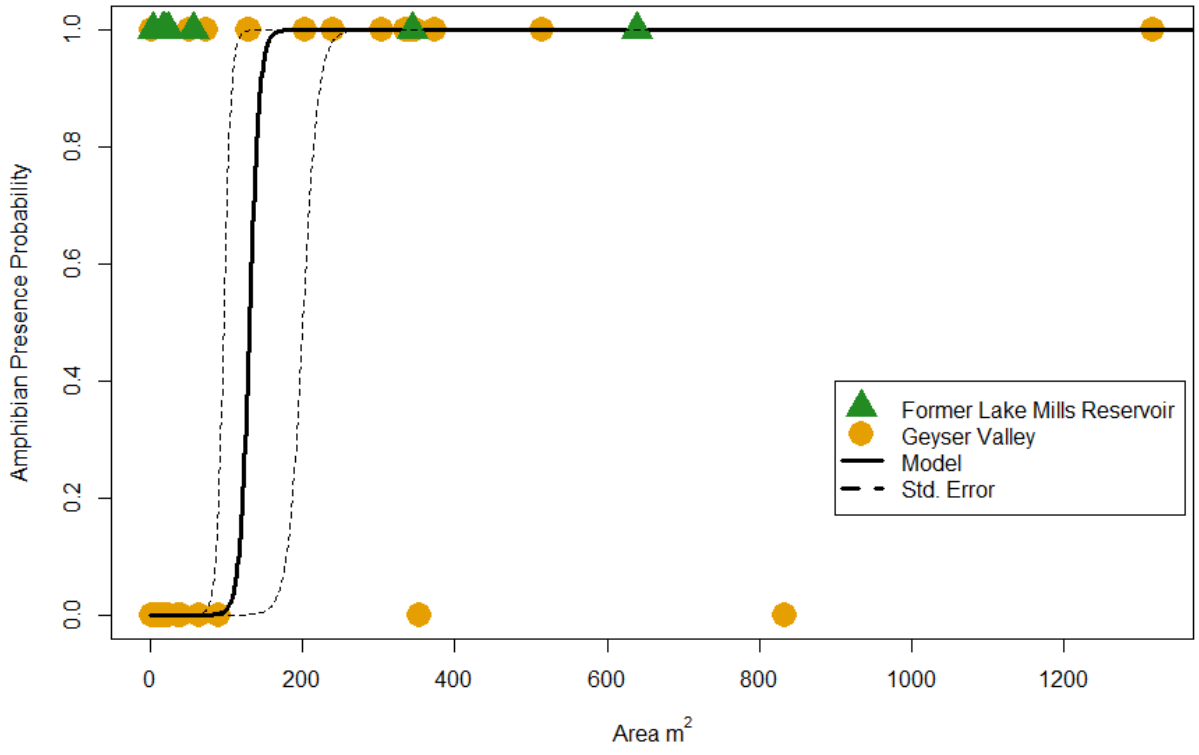
Several full days were spent in a computer lab analyzing our data with the statistical program R. We had all used this program before, but never for something quite so complicated. The tricky thing about R is it requires the user to basically write their own program. Dr. McLaughlin was kind enough to write a script for us, but we still had to understand it in order to use it properly.

Morgan, Elyse, and I tackled R while Nora wrote up the sections for our poster and Sverre created a map using our GPS coordinates. Once we finally got the R script

working, we tested all of the variables for patterns with amphibian presence. This involved generating graphs like the one below.

After several hours of tinkering with the program, we generated what we deemed to be a rather uninspired graph. That is, until Dr. McLaughlin walked by and exclaimed, "That's beautiful!" We looked incredulously at him, then at one another and broke out cheering. Our weeks of hard work collecting data had paid off.

Our graph showed that the bigger a wetland is, the greater chances there are of finding amphibians there, specifically for wetlands greater than 150 square meters. Not the most groundbreaking information, certainly, but for a first research attempt we were happy just to have results.

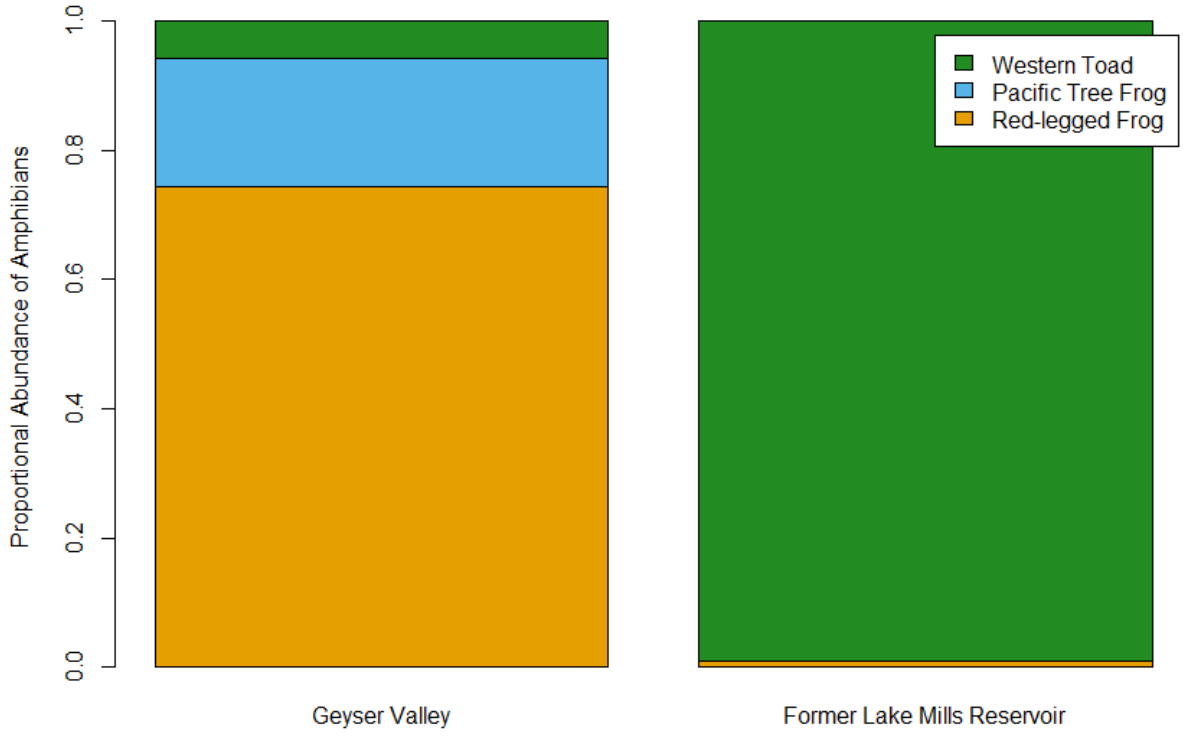


Probability of amphibians being present based on area of the wetland.

Lessons Learned

While exciting for us, our one strongest piece of doesn't actually help answer our original research question. We sought to compare the two sites, but all we ended up with was a trend for the river in general.

Originally, we were looking to compare raw numbers of amphibians in Geyser Valley and Lake Mills, but we realized that the different species found at each site might be more telling. There were more amphibians in Lake Mills, but 99% of those were Western toads, while there was a more even distribution of species in Geyser Valley (depicted in the bar graph below). It could be that Western toads are better at colonizing new wetlands than other species. Were we to continue our research, this would be our next line of investigation.



Species distributions at Geyser Valley and Lake Mills.

Sitting on a log, I listened to a chorus of frogs on the other side of the pond. I fixed my eyes on the stars while pondering this landscape. It was hard to believe that where I was sitting had been under a lake just five years earlier. Now the area was alive with plants and animals. The cacophony of frogs echoed throughout the valley, and somewhere out there the rabbits, the deer, and the black bear I had seen that day were listening to it as well.

This is what the area was like a century ago, before the dam went in and it became Lake Mills. Only the huge stumps preserved under the lake hint at what used to be. The site has a long way to go before it returns to its former glory, but it's still something beautiful.

One more time, I glanced at the stopwatch as it reached the three-minute mark.

"That's time."

Pacific tree frog chorusing.

On this occasion, I recorded a "3" in my notebook. The frog chorus had returned in full force. Sverre and I stood up, surveyed the scene one more time, and retraced our footsteps to regroup with the others.