

Advancing Research & Conservation in Alpine Environments Using Citizen Science

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Abstract

How can science and the arts collaborate to expand the breadth of research and promote the conservation of our natural world? This was one of the many questions at the heart of my Capstone because I personally thought art and science ran parallel to one another and could not be used in conjunction. In Summer 2022, I traveled to three locations: The Nelchina Valley located near the Chugach region of Alaska, the Northern Wind River Range between Elkhart Park and Titcomb Basin, and the Southern Wind River Range around the Cirque of the Towers, Shadow Lake, and Big Sandy Lake in Northwest Wyoming. The goal of my Capstone was to capture images of vegetation then submit them to the Global Vegetation Project, a worldwide repository of georeferenced vegetation data. I entered 59 photos in previously undocumented areas from each of these three regions then developed a public-facing website to document my journey and artistic process. My hope is to share photographic data points of vegetation (including Crowberry, Labrador tea, White Spruce, various species of Sage, White Pine, and more) in alpine environments that will provide a record of the three regions I documented over time. Beyond contributing to future research and conservation efforts with my own data, I hope my work inspires others to participate in citizen science by promoting the visual arts in conservation and research.

Keywords: alpine, vegetation, citizen science, photography, visual arts, conservation

Project Background

Prior to beginning this project, I developed an affinity for the outdoors, especially the mountains throughout Wyoming and Colorado. In the Spring of 2022, I enrolled in a course with the National Outdoor Leadership School (NOLS) to learn technical mountaineering and climbing skills in glaciated Alaska. In the Spring, I was enrolled in the Honors Pandemic & Outbreaks course with Dr. Cassidy and there was a student, Harrison Edwards, who briefly explained his work with Dr. Laughlin, the Global Vegetation Project, and his Capstone. Before hearing about his Capstone work, I imagined my Capstone being another checkbox to tick, but that changed when I learned that I could intertwine many of my passions and interests including mountaineering, the outdoors, photography, and conservation into the Capstone project.

Thus, I decided to continue the work Harrison started with GVeg but do it in my own way. Rather than focus on Wyoming like he did, I decided to conduct my Capstone in alpine environments across the United States starting in Alaska while enrolled on my NOLS course. Much of my experience in the outdoors comes from being in the alpine, specifically backpacking and climbing in the Bighorn Mountains of Wyoming. I wanted my Capstone to be a contribution to conservation efforts in the places I love, but more than anything I wanted this project to extend to an audience broader than academia.

Conservation and research are niche activities generally reserved for specific people, but the realm of citizen science can be utilized by myself and others to make an impact. This is one of the primary reasons I chose photography and the Global Vegetation Project to be part of my capstone; they are both accessible to the public and with a little practice can be used for conservation efforts. Also, quantitative research that is supplemented with qualitative research

(such as photographs) tends to be better understood by those not directly involved in specific research (Kaplan, 2018).

The Global Vegetation Project itself is a global, open-source repository of vegetation which is made available by the University of Wyoming Biodiversity Institute (<https://gveg.wyobiodiversity.org/>). Anyone can submit photos to GVeg accompanied by species represented in the photo, the latitude and longitude of the place the photo was captured, and the biome of that area. Furthermore, anyone can access photos submitted by other users. In terms of this project, photos of a similar geographic area or ecoregion can be accessed by researchers and conservationists to conduct longitudinal studies of locations with photos submitted across multiple years. Specifically, GVeg uses a combination of photography and climate data to create a visual medium to explore ecological patterns (Wessel et al., 2021). One shortfall of GVeg is areas must have photos submitted from different years for patterns to be observed. This is a reason I choose to document the Nelchina Valley in Alaska, the Northern Wind River Range around Titcomb Basin, and the Southern Wind River Range near the Cirque of the Towers; the photos I submitted to GVeg represent the first photos from each of these three regions.

The Global Vegetation project represented my medium to contribute to research and conservation using citizen science. The term "citizen science" gained traction in the UK and United States independent of each other but has come to a complementary meaning: According to Dr. Rick Bonney, 'In most parts of the world today, citizen science refers primarily to projects involving public collection of data, although some researchers, particularly in the field of science and technology studies, have not picked up on this fact, which can be confusing and which sometimes leads to odd manuscript reviews', (Bonney, 2021). This researcher also found that 37% of the 186 indicators described in 12 international environmental agreements would require

monitoring by professional scientists while the other 63% could be completely monitored by a range of citizen science activities. Citizen science is and will continue to be instrumental to global research and conservation efforts.

Methods

While in these regions I used a Canon EOS R and an EF 24-70mm F/2.8 lens to take photos of landscapes and vegetation at various apertures. For each “landscape” photo I took (which included at least three species of vegetation) I also captured individual photos of the species represented in the photo at a closer proximity. I submitted these close-up photos to graduate students under Dr. Laughlin’s direction for species identification. We used knowledge from the online alpine ecology education course *Alpandino* and the *Alaska Vegetation Plots Database* to identify species (Körner & Stöcklin, 2011). In general, photos from the same region generally harbored similar species, but there were a few photographs with species not identified elsewhere.

Along each expedition I carried a GPS device (Garmin eTrex®) that was connected via Bluetooth to my camera. The GPS’ purpose was twofold: 1) it embedded longitudinal and latitudinal coordinates into every picture I took and 2) tracked the routes of each expedition. I initially stored the photos on SD cards within the camera then transferred them to an SSD after each expedition. Once at a computer, I sorted through the photos and subjectively selected the “best” photos from each region. The word “best” included many factors since the scope of this project is both focused on science and digital art. The general criteria I used to select were those that were fundamentally appealing (proper exposure, framing, focus, etc.), include at least three species of vegetation, and aesthetically pleasing (composition, background, foreground, etc.)

Finally, I passed these photos through editing software including Adobe Photoshop and Lightroom to enhance the creative process and ensure a similar theme (similar exposure, color profile, framing, sharpness, etc.) across all the photos submitted.

After the photos were edited, I assigned each a specific file name that I entered into an Excel spreadsheet. The spreadsheet included the image file name and the corresponding observation date, my first and last name, the place name (which I assigned based on USGS quad maps), latitude and longitude, vegetation type, species represented in the photo, naturalness of the area, and the vegetation classification system I used. Using this spreadsheet, I bulk submitted the photos instead of individually entering each with its corresponding data.

Creative Challenges & Rewards

Much of this project was not out of the ordinary for me since I spent significant time prior to this summer in the outdoors and practicing photography. However, this experience did not necessarily prepare me for this summer. Much of the time I spent in the outdoors prior to this summer was backpacking, hiking, and some rock climbing in Wyoming whereas much of this summer was spent on long, expedition-style trips that included glacier travel, snow field navigation, general mountaineering, and an ungroomed trail. Similarly, most of the photos I took before this summer were portrait sessions and urban photography; this summer was primarily made up of landscape and wildlife photography. In both situations, my previous experience was helpful to quickly adapt and learn new skills, but not without challenges along the way.

In terms of photography, the most difficult challenge I faced was adapting to lighting. In photoshoots before going to Alaska, I was able to select prime times to take photos, mainly around golden hour which is an hour after sunrise and an hour before sunset. I also made use of

objects and filters to manipulate light on subjects, whether it was a building or person. Over this summer, light was completely out of my control. On top of not being able to bring special equipment to manipulate light because of size and weights restrictions from being in the backcountry, when I was in a location to take pictures the lighting did not produce an aesthetic image because of harsh shadows or not enough light.

In the moment it was difficult to cope with not capturing “good” images because I knew that I would not see that location again, especially in Alaska. I combated this by manipulating my camera settings including ISO, shutter speed, and aperture and focal length over multiple images. Even adjusting all my settings rendered unpleasing images. However, after processing in Lightroom and Photoshop I was able to save many of the photos. Using techniques like masking, color grading, and light manipulation I was able to make the photos I took look like how I saw them in person while also highlighting the natural environment like specific species and geographic features. This was one of the most rewarding aspects of this Capstone because in portrait and urban photography, I never dealt with adverse photography conditions and only had to do minor edits to my photos. Over many hours I developed my own editing style and self-learned techniques I was unaware of before this summer.

Beyond developing my own editing style and capturing images in adverse conditions, I also grew my skillset as a photographer by expanding into landscape and nature photography. As previously stated, most of the pictures I took before conducting this Capstone were of specific subjects in planned areas. In Alaska and the Winds of Wyoming, I had no plan or idea of what I would photograph nor any experience photographing landscapes. Over the duration of the summer, I learned how to properly frame and capture images of the environment. Reflecting on my images, I saw a clear progression in my competency to capture images that were both

aesthetically pleasing and included specific subjects, such as vegetation. Most of my photos of landscapes now follow a similar format and can be recognized as my own by friends who follow my work as the result of trial and error throughout the summer.

Becoming a better photographer and outdoorsperson while conducting this Capstone was an extremely rewarding experience but submitting the photos and being a part of a greater conservation effort was the greatest reward of this project. I considered participating in conservation efforts and research difficult, boring, and inaccessible before beginning my Capstone. Through the lens of citizen science, conservation and research can be a highly creative, individual process that can make use of personal hobbies and strengths to contribute to the bigger picture.

Creating a Website

One of the primary goals of this Capstone was not only to document alpine vegetation in undocumented areas, but also share my work to a broader audience than those in the Honors College and involved with the Global Vegetation Project. Part of me originally wanted to print a few of my images and display them at coffee shops local to Southeast Wyoming. However, I wanted to display my work in a more permanent way. Thus, I decided to present this project and engage in public research by designing a website.

Of all the creative processes I engaged with during my Capstone, creating a website was the most difficult because it was completely foreign to me. I went back and forth initially deciding which website software to use; this was a challenge itself because there are endless options each with their own pros and cons. I settled on using Adobe Portfolio because it seamlessly integrated with Lightroom and Photoshop, and because I continually pay for an

Adobe creative suite subscription the website will be published and accessible to anyone with the link.

Beyond choosing which software to use, I also had to decide the entire format and design of the website from scratch. I wanted my website to be twofold; a way to present my Capstone and encourage others to participate in their own conservation efforts while also acting as a personal portfolio of the incredible summer I had. After many iterations of the website including changes to the amount of pages, content of the pages, specificity, aesthetics, and overall goal I finally arrived at what I thought captured the original goals of my Capstone: To document alpine vegetation, highlight using citizen science, and share my love for the outdoors.

The website is split into two primary sections. The first is a contact and about page that provides a few methods to contact me if one is interested in my work or has questions. This page also includes a quick personal blurb about my experience in the outdoors and my education so those that view my site can understand the scope of the project and reasons I chose it. The second section is the main homepage of the website which houses four separate subsections: Photos, Expeditions, Critical Reflection, and Additional Resources.

Deciding how many subsections and what each would cover was the most difficult part of creating the website because I wanted to cover a lot of material and present my work, but not be overbearing with the amount of content on each page. I created four subsections because it struck the best balance between covering enough material to a specific part of the project, but not including too much content at once. The Photos subsection includes 24 of my favorite photos I submitted to GVeg. I choose photos that I both liked aesthetically and showed the wide array of compositions ranging from wide landscape shots to macro shots of specific species. In this section I hope to inspire those who have already taken photos of places to submit what they have

and show future photographers and citizen scientists the content they can expect to submit to GVeg.

The second subsection I created was called Expeditions and included images from the three expeditions I was a part of over the summer. This part of the website acted mainly as a means to display my personal portfolio and highlight memories I created over the summer. My original thought for this part of the website was to create a map of each expedition then mark points along the map where certain pictures were taken and include small blurbs of stories from that place. After starting this for the expedition in Alaska, I decided against it because it was far too personal and took away from the broadness I wanted to convey in this Capstone. My next iteration of this section was a header for each expedition followed by a one to two paragraph summary of the expedition and my favorite photos. Again, even with much less text on this page, it felt too personal, and I finally decided to only include the header, dates, and photos of each expedition. Doing this will allow viewers to engage more with the photos and even give them a reason to contact me if they wish to hear the personal aspect of each expedition.

The third subsection was simply a copy of this critical reflection. To break up a long piece of text, I added photos and designs to the page. However, the focus of this page is the critical reflection and is more geared towards viewers who are interested the academic side of my work. The final subsection I created was a page for extra information called Additional Information. This section acted as a catch-all for things I wanted to include on the website but did not fit into the other pages or subsections. I included maps from each expedition, links to scholarly articles about citizen science and the National Outdoor Leadership School, and GVeg resources for those interested in contributing.

Designing a website was the most rewarding part of this Capstone experience because it forced me to learn a completely foreign skill and allowed me to address the original goals of this project. This website will act as a permanent display for the Global Vegetation Project and inspire others to use their creative outlets and hobbies to contribute to conservation around the world.

Project Impact

This project did not relate explicitly to my major in civil engineering, but rather to the many passions that I have including conservation, photography, the beauty of the alpine, and the outdoors in general. However, I hope it will inform both those in the realm of science and academia as well as the outdoors about conservation using citizen science.

The photos I submitted to the repository of the Global Vegetation Project will be invaluable to future generations of educators and scientists studying ecology. During times like the Covid-19 pandemic or for people restricted by other factors, it can sometimes be difficult to conduct field projects. The Global Vegetation Project bridges this gap by providing a plethora of data related to ecology that educators from the kindergarten to the graduate level can utilize in a multitude of ways. The photos I submitted will allow those educators to introduce students to ecology in alpine regions of Wyoming and Alaska. Those just beginning to learn about biomes and different vegetation types will benefit from photos captured in every biome across the world, not just the alpine. My project aimed to further the knowledge of those interested in alpine ecology by providing some of the first photos in prevalent mountain ranges above treeline — it is extremely difficult to travel to some of the places I conducted expeditions, and my photos will enable learners to see alpine ecology digitally. Moreover, these photos will enable researchers to

conduct longitudinal studies of regions that continue to be documented. Researchers can reference photos many years later and compare those photos to subsequent photos to collect data at specific locations. The photos I submitted act as the first of hopefully many more submitted from the Chugach Region of Alaska and the Wind River Range in Wyoming.

These photos will also be useful for outdoor organizations and conservation efforts through documenting the beauty of alpine environments. It is my hope the website I designed will raise awareness for the Global Vegetation Project and encourage citizen science across all alpine environments. Much of the time, photographs of breathtaking alpine environments capture only the portions that are beautiful. Take Everest for example. Many of the photos submitted from expeditions are of mountaineers on the summit, incredible views of the Himalayas, and lines of alpinists traversing to the summit. However, beyond those photos is a mountain littered with bodies mummified by the cold, thousands of empty oxygen tanks, abandoned tents and shelters, and garbage from every person who embarked on an Everest expedition. Only those who have been up Everest multiple times know of the accumulation of mankind's impact — this project not only encourages people to document the changing ecology in alpine environments, but also document the change accrued in response to human impact.

Results

After selecting and editing photos, this Honors Capstone submitted 59 total photographs to the Global Vegetation Project. Of those 59, there were a mix of landscape, macro, and semi-wide-angle photos that documented three geographic regions: the Nelchina Valley and East Matanuska Fork River in the Chugach region of Alaska, the northern Wind River Range between Elkhart Park and Titcomb Basin, and the southern Wind River Range around a loop including

Shadow Lake, the Cirque of the Towers, and Big Sandy Lake. Prior to beginning this Capstone, I talked with my advisor and Dr. Laughlin about other areas I could document over the summer; two areas I would have liked to submit photos from are the Cloud Peak Wilderness in the Bighorn Mountains and mountains around Rocky Mountain National Park. I plan to submit photos from these regions outside the limits of this Capstone in the coming years to continue documenting underrepresented areas of alpine photo submissions.

Beyond successfully completing the Capstone requirements and fulfilling the parameters set by Drs. Cassady and Laughlin, I accomplished my primary goal to undermine the precedent that research is strictly academic. By utilizing citizen science in this project, I have shown that those not necessarily associated with a field of research can contribute a significant amount; in my case I contributed to ecology research without any prior experience in ecology whatsoever. While some fields may be fundamentally more difficult to contribute to, those that are based on conservation efforts and physical phenomena are much easier to contribute to because hobbies like photography, hiking, birdwatching, and others already make it more accessible.

Over the course of this Capstone, I developed significantly as an artist by being exposed to foreign concepts and new challenges. Initially I needed to quickly adapt to a new style of photography which included landscapes with changing and never-perfect light. After selecting photos, I learned a variety of photo editing techniques to enhance the aesthetic and detail quality of the photo while still maintaining the “realness” of the photo and making it look like it was not edited. Finally, to present this Capstone to both the Honors College and a public audience, I designed my first website and portfolio to capture the multi-faceted nature of my project.

It was designing this website that proved to be the most rewarding part of this project overall. While I made artistic decisions like how many pages to include, the content of those

pages, and how “personal” I was, I reflected on the experience itself and conveyed it in the website design. This website will continue to be rewarding as I hope that it will reach an audience that will be inspired to contribute research and conservation efforts using their skills and passions.

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