

Biodiversity Restoration: Giving Sage Hill a Physical, Educational, and Digital Presence

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Our Focus:

How can we improve the condition of Sage Hill in a way in which we could monitor noticeable changes over the course of two quarters?

1. Draft and implement a native plant restoration plan
2. Give Sage Hill a physical, digital, and educational presence

What is Sage Hill?

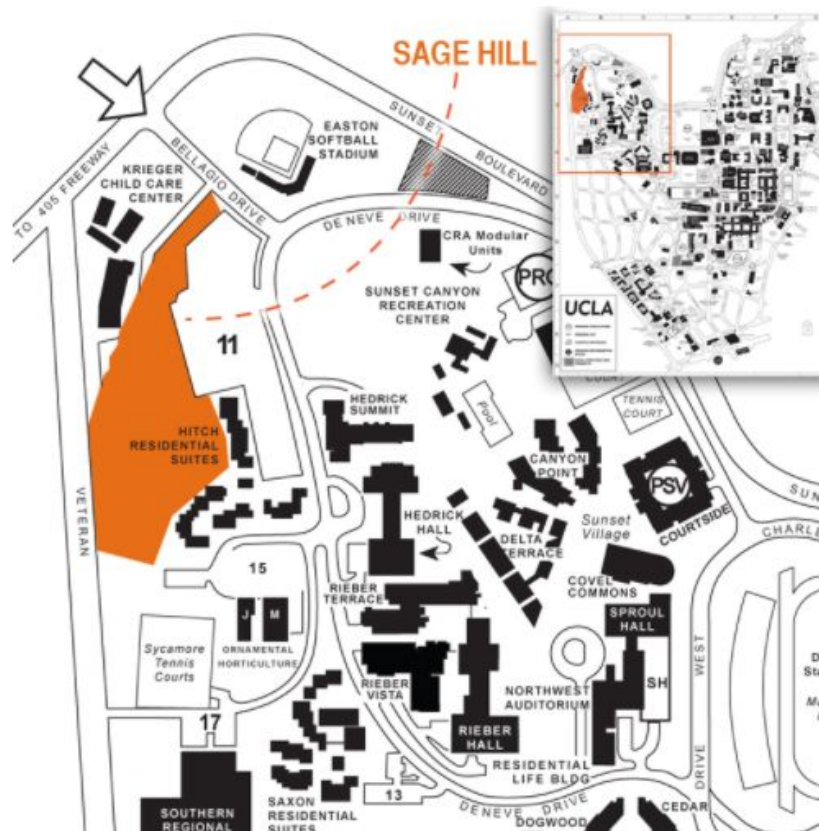


Photo: A map showing Sage Hill's location, pulled from the Sage Hill website:
<http://www.sscnet.ucla.edu/geog/sagehill/about.html>

Sage Hill is a 4-acre plot of undeveloped, naturally thriving land on the UCLA campus. It hosts the highest diversity of native California species on campus and remains the only natural area on campus. Pound for pound, Sage Hill contains more native plant and animal species than anywhere on campus- even compared to the Mildred Mathias Botanical Gardens. Although only a small portion of UCLA students and faculty are aware of Sage Hill, it is a vital part of the campus and crucial to the history and identity of Los Angeles. Thousands of years ago, the site was home to megafauna and in more recent times it resembled native California vegetation: grasslands with oak woodlands. The site was also used by Los Angeles' predecessors, the native Tongva tribe who utilized the native oak trees, laurel sumac, and elderberry present at the site. As development took place in the surrounding areas, many of the native species were affected and some were lost at the site. Nevertheless, fast forward several decades and Sage Hill has persisted- and our team's project took place at a crucial developmental stage for Sage Hill, one that has made great strides in returning the site to its once pristine vegetative cover.

Why is protecting biodiversity at Sage Hill important?

Biological diversity is important within an ecosystem because the higher the biodiversity is in an area, the less likely it is that the area will suffer from extinction events due to natural disasters and anthropogenic disturbances. Applying this to the context of Sage Hill, it was critical for our team to address this question because it paved the way for our implementation of a native plant species restoration program which sought to increase numbers of native *Encelia californica* (California brittlebush) which in turn would increase biodiversity at the site. Our planting of over seventy *Encelia californica* increases biodiversity because native insect and animal species

thrive on native plant species. This meant our brittlebush plants would attract native pollinators, a combination of native insects and native birds which would become food sources for other native species, such as native lizard and bird species - and so on and so forth, ultimately increasing the entire biodiversity of the site!



Photo: Sage Hill's nursery, filled with Team Biodiversity members and dozens of native California plants.

We could see the increase in biodiversity during spring quarter after our plants had matured a bit; there were more lizard, insect, and bird species which had more resources all due to the food-web effect initiated by the availability of more native plant species. In addition to maintaining the biological aspect of Sage Hill, it is important to protect native species because of the sense of identity that it gives us as being inhabitants of Los Angeles. As Californians, and

even more specifically as Angelenos, our native species is what makes us unique. These species aren't found anywhere else as readily as they are here and we should take great pride in boasting and preserving such species because they are what makes us unique and provide an aesthetic value that is priceless. The same pride we take in representing the California grizzly bear is the same pride we should have in bragging about the California brittlebush!

What did we do this quarter?

We successfully transplanted over 70 *Encelia californica* plants to seven different experimental plots that were chosen based on a number of conditions, such as amount of sunlight availability and different degrees of slope, during winter quarter. This quarter we worked on quantifying our success of this transplantation by measuring the heights of our plants and noting which plots did best based on variable conditions. We continued to weed around our plants just as we did winter quarter to ensure they weren't outcompeted and we had to switch to artificial method of watering our plants since we could not depend on natural rainfall. The maintenance of our plants by engaging in field work at the site fulfilled our goal of giving Sage Hill a physical presence.

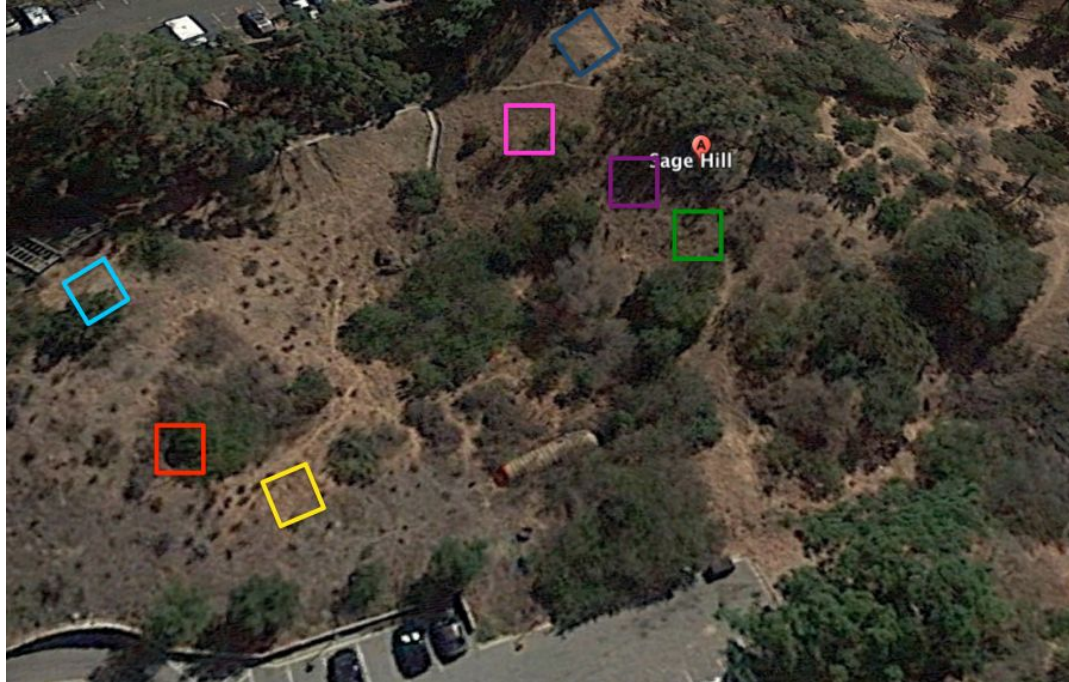


Asides from monitoring and tending to our plants, we catalogued the native species through the citizen science mobile app, iNaturalist, through a few Bioblitz events we held in collaboration with other organizations such as Environmental Student Network and Professor Gillespie's Geography 111 students. We also presented our findings at the Earth Day fair, Undergraduate Research Week, and Green Gala awards in hopes of bringing attention to Sage Hill and raising awareness of why it is so important to preserve and restore the site. We gained a lot of exposure this year due to our efforts and we were fortunate enough to have the Daily Bruin do a feature on our team's research at Sage Hill. All of these efforts combined fulfilled our goal of giving Sage Hill a digital presence. Finally, our goal of giving Sage Hill an educational presence has probably been the toughest component of our project, but we think will prove to be the most rewarding. Asides from facilitating an understanding of what Sage Hill constitutes at events such as the Earth Day fair and Undergraduate Research Week, we wanted to give Sage

Hill a sense of identity by placing a sign that lists all the necessary information regarding the site such as: cultural history of the native Tongva tribe which utilized the site, native flora and fauna found at the site, and the do's/dont's for the site. We secured funding through a The Green Initiative Fund grant and though we've had many setbacks due to legislative reasons, we aim to have this done before the fall. This sign is intended to teach and educate UCLA faculty, students, and staff, and we hope that this will motivate such individuals to also become champions for the cause.

So how did we accomplish this?

To work towards a restoration plan, we focused on identifying good location and strategy for native plant growth. We chose to use the species *Encelia californica* because they were available and are a beautiful addition to any landscape! The next step was to choose seven plots at Sage Hill that were in varied locations but that we could still both monitor and maintain. With about seventy young *Encelia californica* in the Sage Hill nursery, planting seven plots of ten seemed to be an even way to distribute the plants. We tried to pick areas with diverse amounts of shade, proximity to other shrubs, and height up the hill. This turned out to be more difficult once we actually went to those plots because Sage Hill is full of weeds, sharp grasses, and the dry soil made it a challenge many days not to slide down the hill while working at a plot. Despite those hurdles, we established seven diverse plots and got to work.



Working on the plots immediately turned our team into dedicated gardeners when we weeded out the invasive grasses from the plots. They were stubborn and strong, which just emphasized to us the importance of removing those from the area. Once areas were weed-free, it was time to take the baby plants out of the nursery. We transplanted the *Encilia californica* juvenile plants into their new homes by digging spacious holes, loosening the roots, and providing plenty of soil to the new plant.



Photo: Team Biodiversity beginning our seventy-plant experiment. As you can see, we show our plants lots of love!

After all seventy plants were safely in the ground, we began the next phase of restoration: managing and monitoring. Each week, our team watered the plots equally and removed weeds from the area. We also monitored the success of each plant through its growth. We quantified plant growth by measuring from the base of the stem to the top of the highest leaf. We then took the averages for each plot to account for any differences that might have been caused by plants being at the edge of the plot or from our own mistakes in measuring the plants in an inconsistent order.

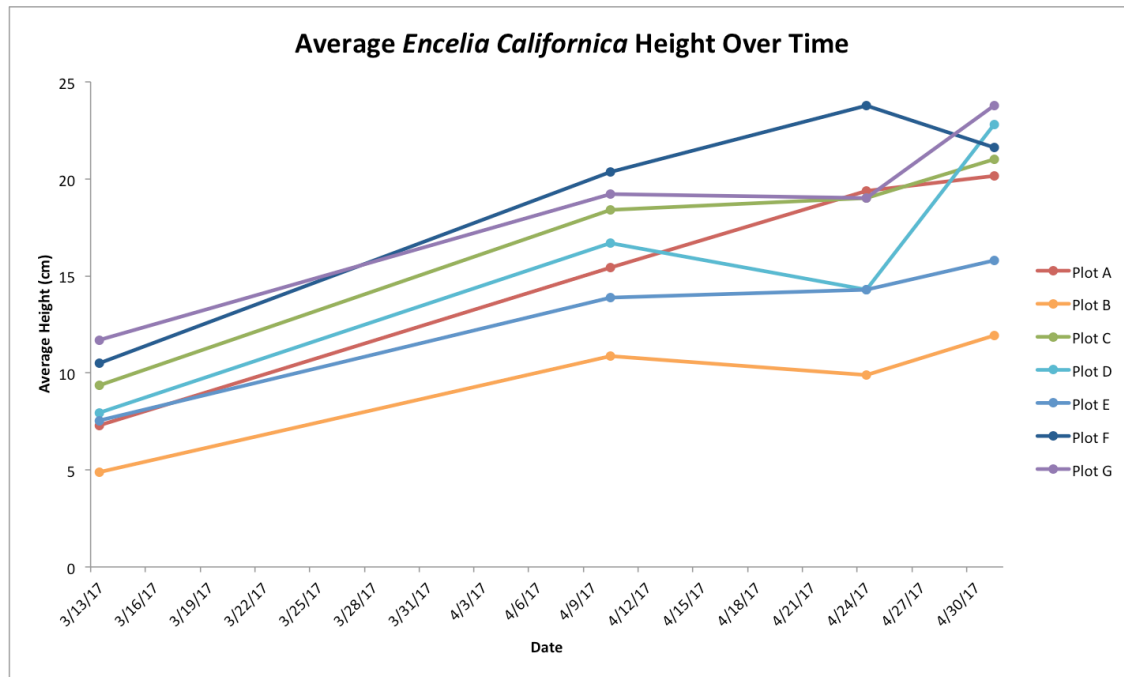
What did we find?

During our field visits, we collected data on our transplanted *E. californica* individuals and tracked their survival and growth over time. The data table represents the average plant height in each of the seven plots at four time intervals. As seen in the table, the general trend across the plots was an increase in plant height from 8.5 cm to 19.6 cm. Although five of our plants died over the course of the program (we speculate due to desiccation), we were impressed and satisfied with the general survivorship and growth of the transplants. Each week when we would monitor the plots we would be overjoyed to see the plants' growth and we were emotionally distressed each time one would die.

Plant Height (cm)				
Plots	March 13, 2017	April 10, 2017	April 24, 2017	May 1, 2017
Plot A	7.3	15.5	19.4	20.2
Plot B	4.9	10.9	9.9	11.9
Plot C	9.4	18.4	19	21
Plot D	8	16.7	19.6	22.8
Plot E	7.6	13.9	14.3	15.8
Plot F	10.5	20.4	23.8	21.6
Plot G	11.7	19.2	19	23.8
Plot average	8.5	16.4	17.9	19.6

The figure is a visual representation of the plant height data over time. Each of the color coded lines corresponds to a plot. As previously mentioned (and somewhat not so surprisingly), the general trend was an increase in plant height over time. Some plots experienced more growth than others, likely due to the microclimate and specific conditions of each plot. For example, plot B was on a steep, sunny, exposed hillside with incredibly rocky and dry soil. Our team member,

Abir had a difficult time shoveling and digging the holes to transplant the *E. californicas* because of the dry and hard soil at plot B. There is a high likelihood that these abiotic conditions had an effect on the success of the transplants. Plot B had the lowest plant height at the end of the program and also had the highest number of dead plants (three of the five dead plants were in plot B).



What do our results show?

With a 92.8% survival rate (if we were grading our plots, that's still an A!), our restoration plan turned out to be a success. Our devoted routine (weeding + watering twice a week), the small bouts of rainwater Los Angeles received, and the plants' resilience helped contribute to the 11.1 cm average growth amongst all the plots. We also got some experimental research out of all of this, as we observed that the plots in open areas not blocked by other plants

fared much better than their neighbors in shadier areas. While Plot B struggled a bit in life (it only had an average growth of 7 cm, and as mentioned it above, it had to go through a few mortalities), Plot D was our prized child, experiencing an average growth of 14.9 cm. The pictures below capture a Plot D plant's journey through the seven weeks we took care of it.



There were relatively few tragedies amongst our plants. Plot B saw three plant deaths, Plot G had one, and Plot E had a broken plant. We suspect that most of these deaths occurred to external enemies, such as passerbys who don't notice the beautiful native flora they're squashing. Furthermore, three of the plots (B, F, and G) experienced dips in average plant height measurement throughout the seven weeks. This may have been due to factors like broken stems and changes in plant conditions, or due to the parents (our human error and inconsistencies in our measuring).

The despite the challenges we faced, our plants grew up to be healthy and strong, and we hope to keep visiting them in the future to check on their progress. This first cohort of sixty-five *Encelia californica* will help set the stage for continued restoration on Sage Hill.

How did we spread the word?

Outreach and spreading awareness of Sage Hill was a big component of our project. One of the first things we did was to increase our digital presence. The Daily Bruin came out to Sage Hill and did two articles on what our team has been doing and the importance of Sage Hill on our campus. We also wanted to show how many native species can be found at our site. We used iNaturalist, a citizen science app that lets anyone input data about flora or fauna that gets fact checked by a scientist, to show just how many native species inhabit Sage Hill. There were two BioBlitzes over the two quarters that brought researchers and students together to put data into iNaturalist.

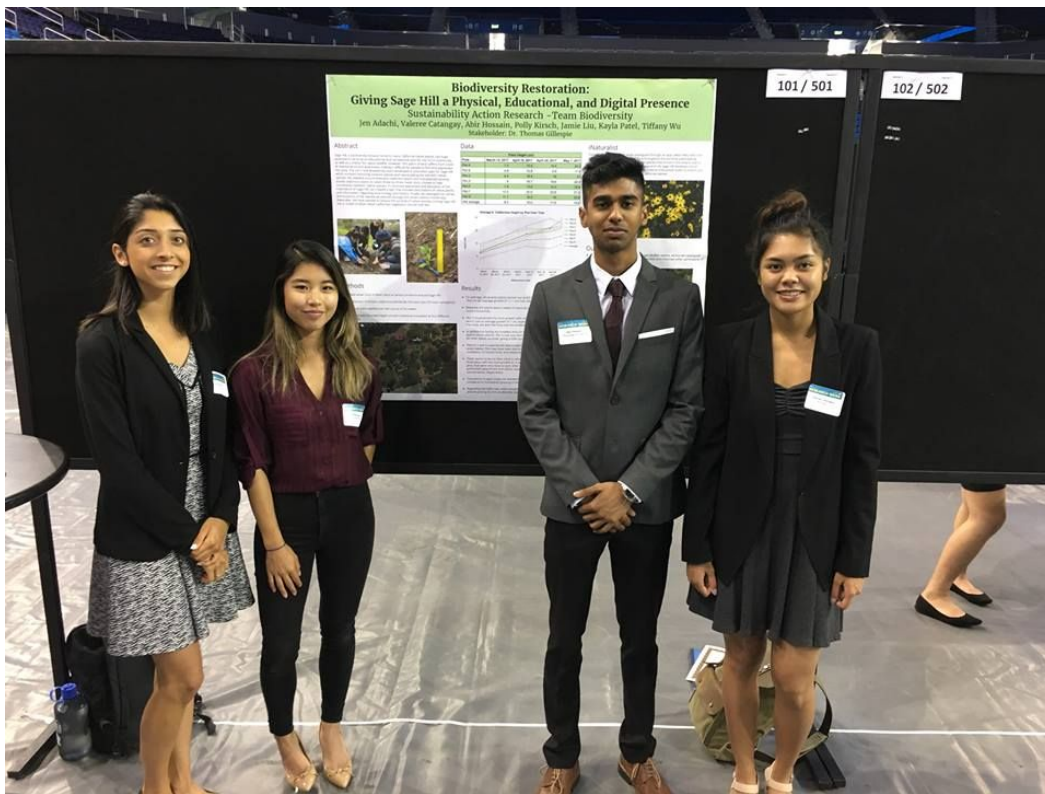


Photo: Some of our team members presenting our research at Undergraduate Poster Day.

Beyond increasing our digital presence, we also wanted to increase Sage Hill's physical presence. One way that this happened was through the sign to help make the area a more permanent, recognized area on campus. We also did a site visit with Cody Chappel, the Wildlife Restoration Manager at TreePeople, and he advised us on some tips and strategies to tackle restoring Sage Hill. We also presented our poster at the Green Gala, a celebration of the green initiatives that have been going on around campus, and the Undergraduate Poster Research Day, a chance for undergraduates who have been working on research all year to present their findings. We also participated in Earth Day and created a small game for people to guess which plants are natives and which are invasive. In addition to spreading awareness around campus, we also worked hard to restore Sage Hill to a fraction of what it used to be so that students, teachers, and visitors will one day be able to visit the area and appreciate the amount of biodiversity and native plants and animals that can be found there.

Educational Sign

We received funding from The Green Initiative Fund (TGIF) to put a sign in at Sage Hill made by the UCLA Sign shop. The sign should contain a variety of information about Sage Hill and the native species of the area. The content includes names and photos of native vegetation, mammals, birds, and herpetofauna. This information explains what is unique about Sage Hill and why it is important to protect biodiversity. The sign information also includes Native American content as well as the rules of Sage Hill. The sign should designate Sage Hill a distinct area on campus and hopefully increase awareness and interest in the site.

What sort of challenges did we face?

Team Biodiversity learned and accomplished a lot in these two quarters with SAR, but it was certainly no easy feat. Right off the bat, one of the challenges we faced was: what exactly will our project be? Sage Hill was ripe with possibilities and already had a dedicated task force. We wanted to find a project that could help improve this natural site, as well as a project we could call our own. When we finally came up with the idea to design and implement a restoration plan, we were determined to execute it.

As the quarters went on, we faced another problem. Our team is the largest SAR group by far, and coordinating schedules with seven people can be tricky. There weren't many meetings when all seven of us were able to make it, especially once spring quarter rolled around. Still, all of our group members contributed and put in the effort to do what we could for our favorite hill. Whether it was in large clumps or small scatterings, Sage Hill felt our presence as we weeded, watered, and measured our plants.

Finally, our biggest challenge had to do with creating a sign for Sage Hill. We easily obtained funding from TGIF, but the other parts of the process - designing the sign and communicating with the sign shop - were a tad slower. However, we are back on the path to making and ordering the sign again, and will continue to carry out this process into the summer. We're determined to finish implementing the sign by the time fall quarter comes around, since it will be an important part of establishing Sage Hill's identity on the UCLA campus.

Conclusion

Throughout the course of these two quarters, Biodiversity team strived to give identity to Sage Hill. It has amazing potential to become an established site for education, recreation, and research with its various naturally thriving species. Visitors can take nature walks while enjoying a delightful view of grassy and flowery pasture, as well as observe and conduct experimental research related to the multitude of flora and fauna.

Our primary goal was to implement a habitat restoration plan to introduce native plant species to the site as well as eradicate invasive species. We also emphasized outreach within the UCLA community, spreading awareness of Sage Hill as a visitation site among students, faculty, and staff. We hoped as a team to lay out a good foundation for restoration for the next SAR teams to come, and, through signage of Sage Hill, take a big leap forward for increasing awareness of the site. While we faced several challenges accomplishing these goals, we learned the value of constant perseverance and determination in our work. As Sage Hill continues to develop, promoting the site and allowing it to thrive will increase both biodiversity at UCLA and knowledge of its importance.

