I. Project Title
Assessing alpine plant response to 30 years of climate shifts in the Sierra Nevada

II. Project Completion Date
Winter 2020

III. Students, Departments, and Majors
(1) Charles Gibbons, Natural Resources and Environmental Science Department, Environmental Protection and Management

(2) Karen Bach, Biology Department, Biological Science

(3) Kieran Althaus, Political Science Department, Political Science

(4) Dena Paolilli, Biology Department, Graduate Student in Biology

IV. Faculty Advisor and Department
Dena Grossenbacher, Biology Department

V. Cooperating Industry, Agency, Non-Profit, or University Organization(s)
National Park Service, Sequoia and Kings Canyon National Parks

VI. Executive Summary

Objective 1: Assess whether Sierran alpine plant communities have shifted in diversity and abundance over the last 30 years by resampling historic Natural Resource Inventory plots in Kings Canyon National Park (lead by Paolilli and Gibbons).

Summary Objective 1: With funding provided by Baker-Koob, we completed our second of three field seasons in Sequoia and Kings National Parks. Overall, this season was very successful and quite busy – we were in the field from mid-July to September. In 2019, we sampled 7 regions within the parks and 61 plots total, expanding our dataset and gaining a wider understanding of plant community changes throughout the alpine. One important aspect of this season was the resurvey of the Dusy Basin region, sampled both historically and in
2018. Having three time points for comparison will allow us to assess for year to year vs decadal community shifts as well as test for observer bias and error.

**Objective 2:** Determine whether species are shifting elevationally based on traits including plant height, plant width, and specific leaf area (*lead by Abelli-Amen*).

**Summary Objective 2:** Ella Abelli-Amen was unfortunately unable to work this season, however Karen Bach did an excellent job of continuing the Surface Leaf Area Project. She collected vouchers from many different individuals throughout the season. She was subsequently able to perform analyses on the dataset collected and wrote a manuscript based on her work as part of her senior thesis at CalPoly.

**Objective 3:** Create an outreach video and teaching module for local middle and high school biology students (*lead by Gibbons*).

**Summary Objective 3:** In 2019, additional footage was recorded on the Dusy Basin trip, including interviews with the researchers. To date, several short videos have been produced and work has begun to identify concepts for a teaching module. The teaching module will be completed in 2020 with additional support from Baker-Koob.

**VII. Major Accomplishments**

(1) Dena Paolilli has presented talks on the project at the International Botanical Society of America conference in July of 2019 and the California Botanical Society conference in April of 2019.

(2) 250+ specimens have been collected for herbarium mounting including both vascular and bryophyte specimens.

(3) In 2019, the crew conducted 7 trips to unique regions of the parks, sampling 61 plots in total. To date the project has completed 11 trips and sampled 101 plots. Throughout our work on these trips a total of 171 plant species have been learned by students.

**VIII. Expenditure of Funds**

<table>
<thead>
<tr>
<th>Student</th>
<th>Lodging Costs</th>
<th>Travel Costs</th>
<th>Food Costs</th>
<th>Gear Costs</th>
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<td>Dena Paolilli</td>
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<td>Karen Bach</td>
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<td>Kieran Althaus</td>
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<tr>
<td>Charlie Gibbons</td>
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<td>400</td>
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<td>60</td>
</tr>
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</table>

**IX. Impact on Student Learning**

This project has been very formative in the lives of every student who has worked on the crew. To date five students have worked as field researchers on the project hiking throughout Sequoia and Kings Canyon National Parks, locating plots needing to be resampled, and conducting plant surveys.
What this project entails is an intense and immersive learn by doing experience. Students gain experience firsthand in a wide array of useful practices ranging from coordinating trip logistics and weighing in on decisions made for the crew to the great swaths of ecological knowledge learned and plant species observed. One great experience that students were able to have through this project is the exposure to professional conduct as a field researcher working in parks and with the National Park Service. Students actively observe the responsibilities of Park Service Rangers and Staff as well as the reverence they have for these parks. Further, while working with Dr. Dena Grossenbacher, a veteran botanist knowledgeable in the alpine flora of the Sierras, the crew was able to hone their botany skills in a challenging environment. Skills such as understanding plant morphology, developing accurate field ID skills with very difficult plant groups such as Graminoids, learning the work habits of honestly conducted science, and the management of plant and soil samples were practiced quite frequently throughout the season making the students proficient.

For the students that have partaken in this project, each of them have experienced extremely valuable milestones in their professional careers and lives. Through the 2019 season, Karen Bach was able to complete her senior thesis and move on towards graduating in the quarter that followed. The experience for her was exceptional getting to explore new parts of the sierras and learn so many amazing and hardy plants. For Kieran Althaus, this season was something pretty special, graduating in 2019 with a degree in Political Science, he knew he wanted to pursue botany and decided to do so by applying to grad school for research in urban forestry and botany. So, this season was a great step for him graduating college and working as a field botanist pursuing his passion. Charlie Gibbons has worked on the project for both seasons thus far and will continue to assist in research and see through all the necessary plots sampled. This project has been a profound experience for him exposing him to an area of research and lifestyle that has prompted a significant change in the direction he wants to take with his life. Overall, this project has been very beneficial and constructive to all the students who have worked on it and it certainly has an immense impact upon student learning, an impact made possible through support from Baker-Koob and many dedicated individuals passionate for science.