

Undergraduate Botany Portfolio Proposal for Upper-Division Honors

E Pa‘a Ke Kahua:

Building foundational skills for engaging
in community-driven research

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Introduction

The work I showcase in this portfolio demonstrates my identity as a botany-focused researcher, as a *kānaka maoli*, and as an engaged community member concerned with the *ola* of my lāhui-- human and non-human. This portfolio demonstrates the work I have undertaken, in and outside of research settings, to develop an array of skills that I can leverage to contribute to my community through research.

Noho ‘o Paki Kalanihelemai’iluna Keali’ihe’enalukalani me Kuhooheihēipahu Kawao hānau ‘ia ‘o Abner Kuho’oheihēipahu Pākī, he kane. Noho ‘o Abner Kuho’oheihēipahu Pākī me Kaiwekualani, hānau ‘ia o Kapahupainakaleikoa Pākī he wahine. Noho ‘o Kapahupainakaleikoa Pākī me Palile Lanihuli Naliko Lau’okalani Ke’ōpuhiwa, hānau ‘ia ‘o Kapahupainakaleikoa Keopuhiwa, he wahine. Noho ‘o Kapahupainakaleikoa Keopuhiwa me Fong Shea, hānau ‘ia o Elizabeth Alina Keopuhiwa Shea, he wahine. Noho ‘o Elizabeth Alina Keopuhiwa Shea me Fong Hing, Hānau ‘ia o Mildred Chan Yet Fong, he wahine. Noho ‘o Mildred Chan Yet Fong me Thomas Tam Mee Wong, hānau ‘ia ‘o Darren Jun Wah Wong, he kāne. Noho ‘o Darren Jun Wah Wong me Brandi Jennifer Francis, a hānau ‘ia ‘o Maile Ku‘uleilani Wong, he wahine. I recite a part of my mo‘okū‘auhau here to remember my *kūpuna* who shape, lead, and guide my hana, and to illustrate my pilina to the community I hope to serve. As a *kānaka maoli*, my most immediate communities are *kānaka maoli* and the ‘āina from whom we descend. In Hawai‘i, *Kānaka Maoli* have been dispossessed from land and systematically disempowered, excluded, and marginalized. Western science can act as an extension of settler

colonialism in that it excludes and extracts; we see this in Hawai‘i and across the pacific (Slammer and Lynch 2021).

Science at its core is curiosity--curiosity that stems from respect and wonder for things unknown. Research is how we organize that curiosity in western pedagogy, but curiosity is not unique to the west, neither is science. As a kānaka Maoli, I am rooted in the teachings of our kūpuna; I look to their observations and am eager to approach my surroundings with their worldview. This knowledge system forms the foundation for my work. However, I am also seeking knowledge within the western university system, where I see an opportunity to build the capacity I need to contribute to my community, in modernity.

More recently, professors, researchers, and students at UH have been intentionally prioritizing research that serves community goals and engages with ‘ike kūpuna. Historical ecology approaches implemented in Kohala and Hāmākua are changing how we engage in ecological restoration (Kurashima et al., 2017, Peralto 2018). Meanwhile, spatial models reinforce our understanding of the capacity and diversity of Indigenous agroecosystems in Hawai‘i (Kurashima et al., 2019). Researchers are capturing the stories of their communities and highlighting the strength of the traditional systems of stewarding (Vaughn 2018).

Simultaneously, other researchers are thinking critically about restoring systems to the future in our rapidly changing environment. (Burnett et al. 2019). Some researchers are shifting to co-producing knowledge with community organizations (Hastings et. al 2020), and even establishing entities that seek to build bridges between conventional science and indigenous knowledge with a focus on whole Ahupua‘a restoration (Winter et al. 2020). Others have focused on reframing our communication of this knowledge, like microbiologist Dr. Kiana Frank

who has utilized a “mo‘olelo” framework for communicating to improve accessibility to scientific knowledge. (Frank 2016) Scientists engaged in serving Kānaka ‘Ōiwi communities have inspired me immensely. I hope to contribute to changing the way science contributes to Hawai‘i’s communities. I hope to leverage the resources, technology, and perspectives in Hawai‘i’s science community to restore ‘āina-- the land that comprises it and the people and culture who sustain it.

Through this portfolio, I synthesize my diverse experience in botanical research through the lens of community. The time I’ve spent cultivating my knowledge of ‘Ōlelo Hawai‘i grounds this work and connects me in another thread to my community. In this portfolio, I ask “how can I contribute to my community through engaging in research?” And, “how do I cultivate the skills necessary to contribute well?”

This portfolio prepares me for a career in community-driven research and resource management. It demonstrates proficiency in experimental design, data collection, data analysis, social science methods, community engagement, adaptive land management, and ‘Ōlelo Hawai‘i. It also reflects the capacity I am developing to problem-solve in the face of social and environmental instability. The components range from an academic research paper to education materials for a community-based non-profit. These components reflect the rigorous and interdisciplinary approach I hope to carry throughout my education and into my eventual career.

Component 1

‘Imi ā ho‘ākoakoa: Investigating the salinity tolerance of coastal dune species.

In this component, I will Leverage UROP funding to design and run a greenhouse experiment under the supervision of Dr. Kasey Barton. I will produce and disseminate an academic paper that synthesizes this experiment and a field experiment I conducted on Kauaʻi.

My proposed research investigates the effects of seawater inundation on coastal dune plants in a controlled greenhouse environment. This project will build off a previous field experiment, which I conducted during summer 2021 at the National Tropical Botanical Gardens on Kauaʻi to test how seawater flooding affected the survival of seedlings out-planted into the dunes. Seedlings are more sensitive than juvenile and adult plants to salinity (Lum and Barton 2020), highlighting the importance of considering early life stages for plant resilience to sea-level rise. The proposed experiments include additional untested species and physiological trait analyses for insights into the mechanisms underlying species variation in tolerance to seawater inundation.

Specifically, I propose a greenhouse experiment in which a suite of key native coastal dune seedlings are inundated with seawater, and metrics of tolerance (survival, growth, and reproduction) as well as photosynthetic performance (chlorophyll content, stomatal conductance) are monitored. Tolerance traits will inform whether or not these plants are able to cope with salinity stress, while photosynthetic performance traits will indicate the mechanisms that these plants use to cope with salinity stress. I propose investigating the same species as the field experiment, with a few additions, and analyzing these data in relation to one another. Given the recent research demonstrating that two key coastal dune species are vulnerable to salinity stress in the seedling and seed stages, (Lum and Barton 2020) I anticipate a degree of vulnerability in

these species as well. This experiment will help us understand which of these coastal dune species are most vulnerable to saltwater inundation stress and will provide insight into which species should be prioritized in coastal dune conservation.

Hawai'i's coastal dune ecosystems are threatened by global sea-level rise, leading to increased salinization of coastal habitats due to belowground intrusion into the freshwater lens as well as increased coastal flooding from high tides and more frequent storms (Anderson et al. 2018, Anderson et al. 2015). Sea level rise is thus leading to greater salinity stress for coastal dune plants. Characterizing salinity tolerance across species may aid in conservation, identifying tolerant species useful for the restoration and vulnerable species needing intensive management to conserve.

This project also presents a unique opportunity to simulate a real coastal inundation event. Many experiments investigating salt stress use saline solutions, which don't reliably simulate seawater (Hanley et al. 2020). Moreover, most salt stress experiments apply saltwater treatments to plants, which doesn't properly mimic coastal flooding events during which coastal plants are entirely submerged in seawater. My project will fill this gap, providing new insights into coastal dune plant responses to simulated coastal flooding and inundation. Additionally, this experiment is a continuation of an already established project (Barton lab), and we will be able to leverage existing data for a more comprehensive understanding of sea-level rise effects on coastal dune plants in Hawaii.

The end product of this component is an academic paper ready to be submitted for publication. This paper, and the project that it synthesizes, will help to cultivate my expertise in this field and help me understand the knowledge gaps that remain. This will also develop

expertise in plant physiology, and my proficiency in experimental design, data analysis, team leadership, and science communication. This component demonstrates the technical skills I am developing and familiarity with botanical research methods, which can both be applied to community-driven research.

Component 2

Hō‘ulu‘ulu: Centralizing the Kuana‘ike of Practitioners of Indigenous Agroforestry

In the Fall and Winter of 2021, I collaborated with Ph.D. candidate Zoe Hastings on a component of her dissertation research. We interviewed 36 agroforestry practitioners, asking specifically about the motivators and barriers to their practice. We found a clear dichotomy between practitioners of indigenous agroforestry and practitioners. One barrier that emerged is that indigenous knowledge is not valued. Another barrier is that practitioners are unable to access suitable information. (Hastings et al. 2021). Many of the practitioners we interviewed expressed the desire to communicate with other folks practicing a similar form of agroforestry. Sharing information is incredibly valuable when engaging in place-based and indigenous work, but it is important that these spaces are safe for marginalized indigenous practitioners. Furthermore, it is important that the knowledge be appropriate for their practice.

In response to this need, I propose making a static map of Agroforestry practitioners. This map will include layers that group practitioners with similar foci (those focused on education, those focused on commercial production, those focused on preserving cultural

practices and placed-based knowledge, etc). This will ideally streamline knowledge sharing among agroforestry practitioners with similar values. We will ask permission to include practitioners from our research and include a forum that allows practitioners to easily join the map. The map will be open access and be preliminarily housed on the website we created for our research --Ho‘ulu‘ulu.com, but I will also reach out to community partners Kanu Ka ‘Ike, KUA, and Kāko‘o ‘Ōiwi and ask if they would be interested in housing the map on their website as well. This will be completed under the mentorship and guidance of Zoe Hastings and Tamara Ticktin.

I want to emphasize that this map will be specific to folks who identify their practice as Indigenous. While outcrossing information can be valuable, there is an apparent need for this type of knowledge share.

This component of my portfolio not only demonstrates the capacity I have built-in social science methods but also allows me to take action on the things we have learned in this research. It demonstrates how I hope to ‘auamo kuleana as a researcher and a desire to innovate and be responsive to needs in the communities I hope to serve.

Component 3

‘A‘ohe u‘i hele wale o Kohala: Community Engagement & Education Materials for Pu‘ulani in He‘eia

I have worked in He‘eia for two and a half years stewarding a *pu‘u* called pu‘ulani. The project, conceived in a partnership between Kāko‘o ‘Ōiwi and UH, utilizes agroforestry (an indigenous agricultural system integrating multi-story crops) in biocultural restoration. The

comprehensive research looks at the capacity of agroforestry to increase carbon sequestration, decrease erosion, combat invasive weeds, and build community. With extensive community involvement, we repopulated Pu‘ulani with a beautifully diverse system of culturally significant medicine, lei, and food plants.

I have been involved in every aspect of the project from plant and soil monitoring, to ethnobotanical research and carbon analysis. My capability and confidence have grown alongside my responsibility in the management and monitoring of Pu‘ulani. I am now the main steward of Pu‘ulani from the UH side.

Part of my responsibility outside of research and maintenance is to host groups and talk to community members about the site. I have hosted some of these workdays in ‘Ōlelo Hawai‘i and will continue to do so. For this component, I propose producing an online scrapbook of community workdays and survey responses as a record of this engagement. I will design a survey to disseminate to community members who have visited Pu‘ulani multiple times, to understand the different pilina that have been built with that wahi as it has been restored.

I propose, additionally, developing outreach material for Pu‘ulani. I propose creating printed lā‘au cards that highlight pertinent cultural and ecological information for each of the species planted on the pu‘u. These can be shared with visitors and volunteers to encourage

This will demonstrate my ability to create education and outreach materials, and organizational and communication skills across disciplines. I will continue to organize and host community and ‘Ōlelo Hawai‘i workdays as COVID. This will allow me to engage with ‘Ōlelo Hawai‘i, improve my communication skills, and serve the community directly. This component

of my portfolio will demonstrate how I hope to continue to engage with the community in restoration and research.

Component 4

Noho au a kupa: Using kilo to inform management at Pu‘ulani.

The final component of my portfolio will engage again with the work I do at Pu‘ulani. As a lead steward of that space, I am charged with daily management and rationalizing larger management decisions. In a changing climate, it is important that management strategies are adaptive. In this component of my portfolio, I will assemble a Kilo-based management plan using the kilo (observations) I have made over the two years I have stewarded that ‘āina. This plan will help myself and other stewards to make cohesive management decisions, and also imbibe ‘ike kūpuna into the decisions as well. I will compose a personal reflection that demonstrates the way the kilo contributed to the document’s form. This will be completed in collaboration with and under the mentorship of Tamara Ticktin, Leah Bremer, Māhealani Bohtelo, and Zoe Hastings. This component will demonstrate the skills and knowledge I am building in resource management.

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Timetable

Semester	Component 1	Component 2	Component 3	Component 4
Fall 2021	•Reach out to collaborators to gauge interest in hosting the map on their website.	•Write UROP Proposal •Start Inundation Experiment •Organize and Analyze Data from Field Experiment	•Finish species cards •Host 1 'Ōlelo Hawai'i Workday	•Finish Kilo Management Plan. (December 2021)
Spring 2022	•Work on the agroforestry map throughout the	•Continue Inundation experiment	•Host 1 'Ōlelo Hawai'i Work Day.	

	semester until completion.			
Summer 2022	•Publish Map to Houluulu.com and other organization's websites.	•Write and Disseminate Paper	•Host Work Day	
Fall 2022	•Compile and present portfolio		•Host 1 Work Day	

Resources

UROP, SEAgant, WRRRC, NSHEMP, UH Presidential Scholarship, Undergraduate Honors Program