Undergraduate Research and Creative Work

11 December 2020 – 9:15am to 12:45pm
Virtual Showcase
Honolulu, Hawai‘i
## SCHEDULE & MEETING INFORMATION

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<td>9:15-9:30a</td>
<td>Opening Ceremony</td>
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<td>9:30-10:30a</td>
<td>Oral Session 1</td>
<td>'Ilima Room</td>
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<td>• <em>Arts &amp; Humanities - Creative</em></td>
<td>Kukui Room</td>
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<td>10:30-10:40a</td>
<td>Break</td>
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<td>10:40-11:40a</td>
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<td>• <em>Arts &amp; Humanities – Research and Social Sciences</em></td>
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Please join us for the release reception of volume V of the Horizons undergraduate journal

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<td>12:30-12:45p</td>
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<td>'Ilima</td>
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**FOR ALL SESSIONS:**

*Dial in by phone: +1 408 638 0968*

**Password for all rooms: 12112020**
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<td>Emily Holmberg</td>
<td>Daddy Issues: A Feminist Analysis of Gender and Race in the Era of Indian Removal</td>
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<td>Maximillian Soares Miehlstein</td>
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<td>Leah Keller</td>
<td>Identifying Multiple Values of Coastlines and Beaches Threatened by Sea Level Rise to Inform Environmentally and Socially Just Policy</td>
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<td>Edmond Chong, Sydney Dempsey, Eliesse Hihara, Isabella Kotsol, Creselle Morales</td>
<td>Unmanned Aerial System with Search-and-Rescue Package-Delivery Capabilities</td>
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<td>Christopher Aguilar</td>
<td>Development of a Solar Water Heater for Hawaiian Climate</td>
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<td>Bradly Boucher, Van Le</td>
<td>Angular Distribution of Gamma-Ray Emission from Velocity-Dependent Dark Matter Annihilation in Subhalos</td>
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<td>Andrew Kecskes</td>
<td>Trophic interactions of Megafauna in Tokuda the Mariana and Kermadec Trenches Inferred from Stable Isotope Analysis</td>
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<td>Kristina Theam</td>
<td>Identifying Opsin Gene Expression in the Visual System of the Copepod Labidocera madurae</td>
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<td>Lauren Block</td>
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<td>Emily-Rose Gootgeld</td>
<td>Examining Ontogenetic Change of Fin Size Ratio in the Scalloped Hammerhead Shark</td>
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<td>Mary Winnicki</td>
<td>The Genetic History of Cannabis</td>
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<td>Chelsea Tanaka</td>
<td>Mapping and Characterization of Hairy Sheath Frayed2 (Hsf2) – a New Leaf Patterning Mutation in Maize</td>
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<td>Anya Wu</td>
<td>Die in Place or Die Trying: Modelling Climate Induced Migration Flows and Receiving Country Response</td>
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<td>Kaela Iwai</td>
<td>A Genetic Complementation Analysis of the Pollen Heat Sensitivity Phenotype Conferred by the Mutant PDI9 Gene in Arabidopsis thaliana Plants</td>
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<td>Limu Kala Room</td>
<td>Assessing Balance and Posture in Cancer Treatment Patients After a 12-Week Exercise Intervention Program</td>
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<td>Katherine Aliki</td>
<td>Synthesis of L-Alanine 3,3-D2 and L Alanine-3-D</td>
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<td>Nathaniel Hogsten</td>
<td>Ultrasound Mediated Gene Therapy for Hemophilia B</td>
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<td>Giorgio Tran</td>
<td>Development of a Novel Immuno-PET Probe to Detect Osteomyelitis Infection</td>
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Abstracts of oral and poster presentations are listed in alphabetical order of presenter’s last name. Information below the name includes the student’s major, the category of their presentation, and time/location of presentation. If appropriate, the faculty mentor’s name, as given by the student, is listed below the abstract.

Group abstracts are listed alphabetically by the Last Name of the group member whose name occurs below:

**Malia Adams,** Mahina Smith  
**Bradly Boucher,** Van Le  
**Edmond Chong,** Syndney Dempsey, Eliesse Hihara, Isabella Kotsol, Creselle Morales  
**Sunny Kim,** Markus Rohlfing
Directing a Film from a Native Cultural Perspective

After canceling our original project of an indigenous story in Moloka‘i, we took it upon ourselves to come up with another proposal based on the director’s own journey. The story portrays the struggle of the director connecting with her culture as a Native Hawaiian woman raised away from Hawai‘i.

The short film is an indigenous-experimental film about a young Hawaiian woman, Kamahina, exploring her place as a product of the survival of her culture and the hardships endured by her great-grandmother. We show Kamahina’s journey by depicting the forest taking over her house. And at the same time, we see her great-grandmother in the forest mastering western culture forced upon her as a means of survival. In order to accomplish the look of this film, we had to cover the whole house with plants, native and alien. It was important for us to be able to show Native Hawaiian pre-western contact meaning we used traditional Hawaiian clothing made out of Kapa and leis.

The film was inspired by recently found tapes from the 90’s, where the daughters of Etelka Mahoe (the inspiration of the story) talk about their Hawaiian mother and American father. Most of the conversation in the tapes focus on the fact that Etelka’s husband, John Quincy Adams, who was related to the former US President. With this project we hoped to give back the recognition Etelka deserves as the protagonist of her own history.

Mentor: Associate Professor Lisette Marie Flanary

Co-Authors: Ciana Bird, Kylee Jervis, Lily Engh, Wesly Kealoha, Alessandra Agallian
Development of a Solar Water Heater System for Hawaiian Climate

Solar Hot Water Heaters (SWH) are an innovative, renewable energy resource installed in many places in Hawai‘i. They utilize sunlight heating of a collector to transfer heat to water for use in establishments and inside homes. The unique climate a SWH is situated in can greatly affect its ability to transfer heat, as well as the properties of the fluid used within its systems. Our focus is to develop a solar hot water heater system that allows for testing of environmental factors, fluid changes and integration, and overall system performance testing. To complete this, we developed a custom solar hot water system, that includes a flat plate solar collector, heat exchanger, and water tank, to perform tests on several potential effects. To properly evaluate system performance, we utilized thermocouples within each loop, and resistance temperature detectors to determine characteristic temperature fluctuations. Using systematic analysis of key components, which included trapezoidal integration of our solar irradiance and utilization of differential temperatures within custom designed system performance evaluation software, we performed testing of the SWH in real conditions, and isolated potential effects. Our results yielded several indications. The heat loss of flat plate solar collectors during periods of low solar irradiance proved significant for heat retention, and the effects of convective wind losses over the flat plate collector also impacted the system. The potential use of a solar irradiance detector in SWH controllers, and development of a system to reduce wind losses can provide improvements for SWH in Hawaii.

Mentor: Dr. Woochul Lee
Assessing Balance and Posture in Cancer Treatment Patients After a 12-Week Exercise Intervention Program

*Background:* Cancer treatments such as chemotherapy, radiation, and surgery lead to impediments in physical well-being. The purpose of this study was to determine if posture and balance is improved in cancer patients after a 12-week exercise program.

*Methods:* Thirty-eight cancer patients were enrolled and participated in exercise programs targeting balance, posture, strength and cardiovascular fitness. Twelve participants were new to the program and 4 returned for a second, 12-week session. Due to the COVID-19 pandemic, sessions transitioned to virtual delivery after 6-weeks of in-person meetings. The frequency of exercise sessions remained the same, i.e., 36 and 24, 90-minute sessions for new and returning patients, respectively. Prior to and after the intervention, posture was measured with the plumbline method and overhead squat test; balance was measured using the unipedal single leg stance and the Bertec balance screener. Paired t-tests, 2-way ANOVA’s and Bonferroni’s posthoc tests were used to determine significant differences.

*Results:* Sixteen female patients completed the program (breast, n=14, endometrial, n=1, non-hodgkin’s lymphoma, n=1). Significant improvements in balance on the left leg (eyes closed) and limits of stability (LOS) during leftward excursion was significantly improved in returning patients, but not new patients (p=0.0029 and p=0.0013, respectively). Qualitative postural data was ambiguous and did not show clear trends toward improvement.

*Conclusion:* Returning participants had significant improvements in balance, new participants alone did not. A limitation to this study was the interruption caused by the pandemic, thus additional research is required to validate these findings.

Mentors: Dr. Paulette Yamada, Dr. Cheri Teranishi
Water Leaching Pretreatment of *Millettia pinnata* (Pongamia) Pods to Improve Fuel Properties

Pongamia is recognized as a potential feedstock for sustainable aviation fuel production due to its relatively high oil yields and robust nature. However, studies on the use of the pongamia pod, which is typically disposed of after seed separation, are currently limited. Chemical analysis of pod material determined that fuel use may be limited due to high chlorine and potassium content. In this study, a hard water wash was performed to improve the fuel qualities of pods for thermochemical conversion. A factorial, $2^3$ experimental design determined the effects of process operating parameters: particle size (whole pod and <2 mm diameter), rinse water temperature (25 and 75°C), and rinse duration (10 min and 2 hours) at a 1:20 w/w biomass:water ratio. The elemental content, ash content, and higher heating value (HHV) of solid samples were determined after treatment. Environmental impacts of the process were also evaluated by measuring the ion content, chemical oxygen demand (COD), non-purgeable organic carbon (NPOC), and total nitrogen (TN) of leachates. After treatment, HHV increases 11-15.6% (relative), reaching up to 18.7 MJ/kg, and ash content is reduced by 14.6-59.5% (relative), to a low of 2.79% w/w, with significant removal of sodium (Na), phosphorus (P), sulfur (S), chlorine (Cl), and potassium (K). Moreover, the nitrogen content of pods decreases 8.5-12%wt. The COD of leachate ranges from 173-4833 mg/L, indicating that the treatment of leachate is required. Based on the results, treatment at 75°C for 10 minutes with pods <2mm is recommended as it yielded the most cost-effective results.

Mentor: Dr. Jinxia Fu
Optimizing Larval Fish Rearing with Copepods

In recent years, improvement of technology has made the saltwater aquarium hobby more accessible to the average person, resulting in an increased demand for marine ornamental fish. Unlike freshwater fish, most saltwater fish have not been reared in captivity and must be collected from the wild. Efforts are being made to increase the availability of captive-bred fish to the consumer, therefore reducing harvesting pressures on reefs. However, bottlenecks like larval nutrition have slowed this progress. In the wild, larval fish feed mainly on copepods, but these microplankton are difficult to culture on a large scale. Thus, marine ornamental breeding has been limited by feeding plankton that are easier to rear, but less nutritional. The aim of this study was to optimize the rearing of larval clownfish, *Amphiprion ocellaris*, using copepods to increase fish survival and health, while reducing the total number of copepods invested and labor costs.

Using a coculture system, a self-sustaining population of *Parvocalanus crassirostris* copepods were introduced into the larval fish rearing tanks. Adult copepods reproduced, supplying larval copepods to feed the fish. Surplus copepods developed in the tank together with the larval fish, which met the increasing feeding needs of the fish as they gained competency. While fish survival was low, likely due to external factors, the coculture system effectively reduced the total copepod investment, as well as labor costs compared to feeding copepods daily. While the coculture method appears promising, further refinement is needed before applying it at a greater scale.

Mentor: Dr. Daniel K. Hartline

Co-Author: Dr. Petra H. Lenz
The road to wellbeing is complex, multifaceted, and continuously requires mindfulness and consistent attention to one’s habits, environment, and lifestyle. One pathway that supports the pursuit of optimal wellbeing and health is Health & Wellness, a field of study with ancient roots and significant modern application in restoring and maintaining balance in the human psyche, body, and emotional experience. In this approach, the focus is on preventatively addressing root causes of a lack of wellbeing and even illness rather than the delivery of what could be viewed as more modern pharmaceutical symptom-based treatments (Lad, 2006; Raghupathi & Raghupathi, 2018). The field of Health & Wellness applies holistic, natural remedies to heal ailments and aims to prevent future illness through the creation and maintenance of health-supportive lifestyle habits and choices including movement of the physical body, the establishment of balanced sleep and diet habits, and the utilization of meditation, positive thinking, as well as herbs and supplements which can be sourced organically from the Earth. In this project, Health & Wellness is used as a lens to propose approaches such as a regular yoga practice that may be used as an antidote for many psychological, emotional, and physical health crises that face millions of Americans today, such as the staggering rate of suicide among female adolescents which has shown an alarming increase of 7.9% between 2007 and 2016 (Ruch, 2019), and can serve as an alternative approach to solve many of the nation’s unaddressed healthcare issues.

Mentors: Dr. Siobhán Ní Dhonacha, Dr. Amy Schiffner
Angular Distribution of Gamma-Ray Emission from Velocity-Dependent Dark Matter Annihilation in Subhalos

Computing J-factors for a given dark matter distribution is the bulk of this project. Dark matter is a weakly-interacting particle. It doesn't interact with light. The only way we can see it currently is through its gravitational interaction with luminous matter. So when we see stars moving faster than we would expect, based on Newtonian gravitational dynamics, we conclude that there is more matter 'pulling' on the stars. In dwarf spheroidal galaxies (old, faint galaxies with very few stars), we see stars moving much faster than expected so we assume there is a lot of dark matter. These dwarf spheroidal galaxies have some of the most dark matter-dominated objects in our local universe. We don't know how the dark matter is distributed within these galaxies, but we know that it is there. We can make some assumptions about the dark matter which yields a functional form of the dark matter distribution. Using this dark matter distribution, we can calculate how it is contributing to an annihilation signal. This contribution is called the J-factor. We have assumed here that dark matter self-annihilates, hits itself, and turns into gamma rays, within the dark matter halo. You would imagine that somewhere with a high concentration of dark matter would have more gamma rays coming from it since the dark matter can annihilate more frequently. This effect is encoded in the J-factor, which is computed through Python codes.

Mentors: Jason Kumar, Jack Runburg
Unmanned Aerial System with Search-and-Rescue Package-Delivery Capabilities

The University of Hawai‘i Drone Technologies (UHDT) is a Vertically Integrated Project (VIP) consisting of undergraduate students of various engineering disciplines and class standings. The goal of UHDT is to increase the efficiency and success of search-and-rescue (SAR) missions through the development of autonomous waypoint navigation, target localization, image capture and classification, and package delivery for unmanned aerial systems (UAS). UHDT uses a systems engineering approach to design, manufacture, and test subsystem components, where functional requirements, constraints, and decision-making matrices drive the design process for the commercial off-the-shelf (COTS) My Twin Dream fixed-wing airframe.

UHDT has three subsystems with distinct roles and functions to meet these objectives. The Unmanned Aerial Vehicle (UAV) subsystem 3D-printed components designed in Solidworks for the package-delivery system. They also soldered electronics onto a printed circuit board designed in Eagle software to distribute power to all electrical components in the UAV. The Unmanned Ground Vehicle (UGV) subsystem modified a COTS LaTrax RC car with handpicked electronics and a 3D-printed housing to attach to the package-delivery system. Lastly, the Image Processing (IP) subsystem wrote code to localize and classify images taken from a camera in the UAV.

Testing moved in stages from individual components to subsystem tests. The integration of a drop mechanism and IP software into the autonomous system was accomplished through system-level flight tests. Overall, UHDT created an Unmanned Aerial System capable of autonomously navigating through set GPS locations, delivering a payload, and classifying captured images using IP software.
Mentor: Dr. Wayne Shiroma
Emily-Rose Gootgeld
Biology, Psychology (minor), Marine Biology (certificate)
Natural Sciences
UROP
Oral Presentation: Session 1 (9:30-10:30) in Limu Kala Room

Examining Ontogenetic Change of Fin Size Ratio in the Scalloped Hammerhead Shark

Adult scalloped hammerhead sharks (*Sphyrna lewini*) mostly swim rolled at an angle, utilizing the dorsal fin as an effective lift-generating surface. Large hammerheads are unique in having proportionally larger dorsal fins than pectoral fins. It was demonstrated that this rolling behavior is linked to greater swimming efficiency in adult great hammerhead sharks (*Sphyrna mokarran*). It is presumed this improved swimming efficiency also applies to adult *S. lewini* but rolling behavior has not been observed in juveniles. It is possible that morphological changes in the size ratios between the dorsal fin, pectoral fins, body size, and weight might account for the ontogenetic onset of rolling behavior in *S. lewini*. Changes in the ratios of *S. lewini* fins to their body were examined throughout maturity. Fin size and body length measurements were gathered from *S. lewini* of all ages caught inside Kāneʻohe Bay, Hawaiʻi. Measurements were taken from two sub-adult hammerheads in the enclosure at the Hawaiʻi Institute of Marine Biology (HIMB) using laser photogrammetry. Comparison of the precaudal length to the dorsal to pectoral fin size ratio found that there is no significant change in the fin size ratios of individuals of various ages. No significant difference was found between individuals of the same age class. The study was limited by the small sample size due to the resources and funding provided. Even though a significant ontogenetic change was not seen in this study, the data provides insight into shifts in hydrodynamic characteristics that might explain the onset of rolling behavior.

Mentor: Dr. Kim Holland

Co-Author: Mark Royer
Synthesis of L-Alanine 3,3-D2 and L-Alanine-3-D

This project aims to synthesize two isotopically-labeled compounds known as dideuterated alanine (L-Alanine 3,3-D2) and monodeuterated alanine (L-Alanine-3-D). These particular compounds are essential to a larger research project currently being conducted by Prof. Joseph T. Jarrett at the University of Hawaii at Mānoa that aims to understand biotin biosynthesis and use this knowledge to find treatment for tuberculosis. The objective of this experiment is to start with the amino acid serine and to process it through a series of chemical reactions until the deuterated alanine products are produced. This project is set within a biochemistry lab on the campus of University of Hawaii at Mānoa and incorporates modern organic chemistry methods to achieve this goal. Thus far I have reached the final steps of producing monodeuterated alanine (L-Alanine-3-D). It has been proven that the step to deuterate alanine is possible, so now I will refine the process and increase the yield of the reaction. All that is left after this is to deprotect the groups attached to serine in the initial steps to obtain the final product. Therefore it can be concluded that this project thus far has been a success. After the completion of the monodeuterated alanine the process for dideuterated alanine, which has the same preliminary reaction steps as monodeuterated alanine, will begin.

Mentor: Joseph Jarrett

Co-Author: Matt Lam
Introduction: This project aims to analyze different conceptions of race, gender, and nation in the early 19th century era of Removal in regard to United States relations with Native Americans, especially the “Five Civilized Tribes.” As the newly developing United States was struggling to create its identity in politics and foreign relations, Anglo-American ideas of race, gender, and nation highly influenced the ways in which both the United States and state governments handled interactions with the original inhabitants of the North American continent. This research will analyze the language and content of primary source documents in order to discern how notions of race, gender, and nation were interpreted and implemented.

Methods: This study follows a chronological trajectory all the way from the early 1800s through the middle of the 19th century. This trajectory demonstrates key cultural, social, and political shifts with regard to race and gender in the indigenous nations that were subject to removal in the early to mid-nineteenth century.

Results and Conclusion: What this analysis showed is that there was a marked shift from the matriarchal and matrilineal power of women in the Native American nations of the Southeast (and elsewhere) to a political structure largely dominated by elite college-educated men. This shift corresponds to rhetoric from indigenous peoples protesting against impeding removal to Indian Territory, west of the Mississippi. Furthermore, much of the rhetoric used by both Euro-Americans and indigenous peoples involve feminist theory such as paternalism, infantilization, and conceptions of race.

Mentors: Dr. Suzanna Reiss, Dr. Shirley Buchanan
A Genetic Complementation Analysis of the Pollen Heat Sensitivity Phenotype Conferred by the Mutant PDI9 Gene in *Arabidopsis thaliana* Plants

Protein disulfide isomerase (PDI) is an enzyme that catalyzes the formation, breakage, and isomerization of disulfide bonds in order to fold proteins into their proper tertiary conformation in eukaryotes. The experimental model plant, *Arabidopsis thaliana*, has 14 PDI-like proteins that range in domain organization and subcellular localization. One specific PDI protein, PDI9, has a domain arrangement of a-a’-b (a and a’, thioredoxin catalytic domains; b, fold domain) and is primarily located in the endoplasmic reticulum (ER). Recently, PDI9 has been found to be highly expressed and plays a role in the heat tolerance of pollen.

A complementation analysis is done to verify that the PDI9 gene is involved in the pollen heat sensitivity phenotype. A hybrid cross is made between two different PDI9 mutant parents, each parent differs only in the sub-region where the PDI9 gene is disrupted by a T-DNA insert. If the pollen of the progeny of this cross is heat sensitive, then the PDI9 gene is concluded to be involved in the pollen phenotype. In the future, the mechanism through which PDI9 acts in response to heat stress as a part of unfolded protein response (UPR) can eventually be obtained to gain a better understanding of a plant’s response to environmental stresses, such as global warming.

Mentor: Dr. David Christopher
Piʻimoku Keahi-Wood  
Hawaiian studies (Mālama ʻāina), Education (minor)  
Arts & Humanities - Creative  
Honors, UROP  
Oral Presentation: Session 2 (10:40-11:40) in ʻIlīma Room

He Lālā Au No Kuʻu Kumu

Where are they now? Where are the alumni of Hālau Kū Māna (HKM)? As Hawaiʻi’s educational history and students' needs continue to be understood, the number of alumni fostered in Hawaiian-Focused public charter schools continues to grow as well. HKM’s foundations are drawn from kuleana (responsibilities) grounded in Hawaiian perspectives and a curriculum rooted in Hawaiian culture. Thus, one may wonder about the educational impacts of this school on its graduates, as little information is available on the outcome of HKM through alumni follow-up. Therefore, He lālā au no kuʻu kumu, is a project that aims to provide a glimpse into the educational impacts of HKM and provide a source for students to gain insight into possibilities post-high school from individuals with first-hand experiences. Through an oral history approach, this project highlights alumni experiences documented through a research thesis and supplementary website. This website is a space where video clips of interviews conducted are displayed, and a brief timeline of Hawaiʻi’s education history is available. As an alumnus of HKM, I have experienced both the opportunities and challenges of graduating from a Hawaiian-focused Charter School (HFCS). To support findings and gain more insight into the impacts of HKM, a literature review was also conducted on the commencement of HFCSs, alumni data collected by Hoʻolako Like, and a vision for graduates crafted by 17 HFCSs. This project presents a mere glimpse into the impacts of HKM on its alumni, both the opportunities and challenges.

Mentors: Nalani Balutski, Dr. Kahunawai Wright, Keola Ryan
Identifying Multiple Values of Coastlines and Beaches Threatened by Sea Level Rise to Inform Environmentally and Socially Just Policy

By the end of the century, 89 percent of Oahu's sandy beaches will be chronically eroded due to intense sea level rise (SLR) and subsequent hardening adaptation methods. This is expected to cause a loss of livelihoods, property, and access to beaches and marine resources. As management decisions made today will impact the continued existence of these coastal environments, it is imperative to gather the voices of all stakeholders, especially the public through community participation. Thus, this project seeks to ask, in what ways can the multiple values of coastlines and beaches inform environmentally and socially just policymaking surrounding SLR?

I draw on data from ten interviews with local community members, residents, cultural practitioners, NGOs, and users of the beach from three vulnerable locations: Sunset Beach, Kāhala Beach, and the Kaʻaʻawa coastline. Respondents were selected through snowball sampling and provided intensive qualitative data from interviews averaging 1 hour. Interviews were then coded to draw out prominent themes. I found that respondents express spiritual and cultural significance, nearshore recreation, and aesthetic or scenic beauty, to be the most valuable aspects of beaches. Additionally, respondents call for future management to include the removal of current sea walls and the banning of future ones. Respondents were also accepting of managed retreat as an imminent future management action but required governmental support through needs-based compensation or a land swap. Lastly, focus groups with the affected communities, government representatives, and scientific experts that centered on education and genuine listening are needed.

Mentor: Dr. Laurel Mei-Singh
Game Design for Art Students Using Unreal Engine

Game development is the creative and technical process of making a video game from a concept to a polished product that is ready for release. The process involves three key stages, pre-production, production, and post-production. Resources online provide information on the different components of each stage, but lack a cohesive, in-depth, beginning-to-end timeline of the development of video games.

We followed the stages of game development and created our own game in a widely-used game engine called, Unreal Engine. For the art portion, the design program, Adobe Photoshop, was utilized. The project focused on the documentation of our process from artwork to game production in Unreal Engine. It served as a source to construct a detailed guide that aspiring students interested in game development can use to obtain the information they need to create their first game.

From evaluating the results, planning during pre-production had a substantial impact on the overall game. Despite the production stage being the most elaborate and time-consuming step, if pre-production lacks careful organization, the foundation of the game becomes precarious.

The guide was created to help students in the game industry path find their first steps into the beauty of game creation. Uncovering all the stages involved in one concise resource will offer students a way to acquire a thorough understanding of game development all in one place. It will also encourage them to seek more extensive information about the specific components of each stage to broaden their education.

Mentor: Dr. George Wang

Co-Author: Laura Margulies
Nina Krupa  
Biology  
Natural Sciences  
Honors, UROP  
Oral Presentation: Session 2 (10:40-11:40) in Limu Kala Room

Development of a Novel Immuno-PET Probe to Detect Osteomyelitis Infection

Osteomyelitis is a rare infection of the bone or bone marrow, usually caused by *Staphylococcus aureus* bacterium, that affects less than one percent of the global population. However, diabetic patients are at greater risk for osteomyelitis due to the prevalence of peripheral neuropathy and associated foot ulcerations in this group of individuals. Diagnosing osteomyelitis proves to be challenging and undiagnosed infections often lead to necrosis and surgical amputation. Therefore, a technique for early, effective and unambiguous diagnosis is necessary to assist both providers and patients.

Given the current limitations with diagnosing osteomyelitis our novel approach is to combine positron emission tomography (PET) imaging with monoclonal antibody targeting of the *S. aureus* bacterium with techniques known as Immuno-PET imaging to directly “see” the bacteria rather than the more traditional approach of examining a patient’s response. In our preliminary research we used a fully characterized Zika virus (ZIK-E) antibody fragment as a prototype before proceeding with *S. aureus*. We were able to modify the ZIK-E antibody fragment with the proposed chemistry involving attaching a radioactive glucose tag for imaging to the antibody, validating the chemistry and we checked to see if the specificity and/or affinity the of the antibody was altered after this modification. We are in the process of developing an antibody fragment specific for *S. aureus* antigen and conjugating it with a radioactive glucose tag for PET imaging.

Mentors: Dr. Aaron Cullen, Dr. Clay Wakano
Robust Non-destructive Damage Evaluation Method
Based on Multi-sensor Data Fusion

Deflection is an important structural damage factor. Yet, modern deflection-measuring methods are constrained by various physical and economic factors. This research proposes an indirect deflection method utilizing multi-sensor data fusion techniques, and it aims to find accurate non-zero dynamic deflection of a structure from acceleration and strain measurements. The two measurements were chosen as displacement is related to acceleration by integral calculus and strain is directly proportional to deflection.

A programming software, MATLAB, was used to extract both data to reconstruct displacement. In addition to analytical studies, two reinforced concrete beam specimens were tested to validate the proposed method. The estimated deflection obtained utilizing acceleration and strain data are compared with the actual deflection measured by Linear Variable Differential Transformer (LVDT). The acceleration and strain data were measured using wireless accelerometers and strain gauges. LVDT measurement is essential as it measures deflection directly and serves as a theoretical value to compare with estimated deflection values. An analytical and simulation tool, Zeus-NL, was used to estimate the behavior of tested beams.

The beam tests revealed a zero-mean dynamic displacement when utilizing acceleration measurements collected during dynamic loading. The strain measurements revealed similar static deflections with the deflection measured by LVDT till the yielding point of the beam at 70 kips. When replicating the same loading conditions in Zeus-NL, the acceleration measurements also revealed a zero-mean dynamic displacement in MATLAB. From both acceleration and strain measurements, it was proven that indirect deflection methods could be utilized to find structural deflections.

Mentor: Dr. DoSoo Moo
Envisioning Futures of Fishing for the Placencia Peninsula

In 1962, Creole fishermen from the Placencia Village of Belize established the Placencia Producers Cooperative Society Limited (PPCSL), in which ten fishermen organized to provide reef species for Placencia Village, Monkey River, Seine Bight, and Mango Creek communities (Spang, 2019, p. 21). The PPCSL is no longer able to purchase fishermen’s catch, or employ women for processing the catch. Additionally, issues stemming from illegal fishing and climate change challenge the co-management interactions between the non-profit based in Placencia and the Fisheries Department. Fisherfolk and other community leaders from key fishing families of Placencia Village were contacted for a virtual interview using either Skype or WhatsApp, to make a total of eight interviews. Each interview was transcribed and analyzed for common themes and meaningful quotes. To learn about each interviewee’s accumulated knowledge of Placencia’s fisheries, questions like “who taught you to fish?” and “what solutions do you think would lessen the occurrence of illegal fishing practices?” were asked. Throughout the interviews, themes of adaptive capacity to changing fishing conditions, and long-standing commitment to protect Placencia’s fisheries, emerged. One interviewee described the commitment of Placencia villagers throughout the six year process of protecting Laughing Bird Caye as a national park, and another described their plan to purchase a boat with fellow fishermen from Placencia in order to augment existing enforcement for illegal fishing. While the PPCSL is no longer a fully operating cooperative, it remains an extremely foundational part of Placencia Village, and is vital to its fishing families’ history.

Mentor: Dr. Mehana Vaughan
Identities of Autistic Adults

Autism Spectrum Disorder is a complex disability with social and cognitive sequelae. This study examines the prevalence of various diagnosis-related identities and the factors that influence the development of a positive disability identity. This study used Qualtrics to survey anonymous autistic participants (N=252, X_{age}=20.85). Results were congruent with disability identity development theories. Increased community involvement, disability acceptance/pride, and acceptance of autism as a natural variation of human neurotypes all correlated with increased pride in a diagnosis-related identity (p<.001). Acceptance of autism was positively correlated with a general acceptance of disability (p<.001) and both positively correlated with increased community involvement (p<.001) Most autistic people prefer identity-first language, with 82.2% accepting “autistic” only and 66.8% accepting “disabled” only as appropriate. Additionally, similarly to past studies of autism and gender identity, participants showed greater gender incongruence and higher tendencies toward androgyny. Over half (50.6%) identified as transgender, and 43% reported they identified as neither male nor female. Results suggest that autistic people have a definitive preference in how they would like to be addressed and develop an authentic identity associated with their diagnosis. The higher rate of gender variance in the autistic population indicates that mindful consideration of gender diversity is even more pertinent when interacting with autistic individuals.

Mentor: Dr. Loriena Yancura
Mapping and Characterization of *Hairy Sheath Frayed2 (Hsf2)* – a New Leaf Patterning Mutation in Maize

Organ formation is mediated by molecular signals that regulate the spatial organization of cells and tissues. To understand how organ formation is regulated, the maize leaf is used as a model system. The maize leaf is divided into four segments - the sheath, auricle, ligule, and blade - organized along a proximal-distal (P-D) axis. Mutations that alter patterning signals perturb this P-D organization. Two mutations that affect P-D leaf patterning are *Hairy Sheath Frayed1 (Hsf1)* and *Hairy Sheath Frayed2 (Hsf2)*. Both mutations are semi-dominant and produce “prongs,” which are outgrowths of proximal tissues from the distal blade. The *Hsf1* mutation is caused by altered cytokinin (CK) signaling which leads to the misexpression of several genes involved in organ formation. The gene underlying the *Hsf2* mutation has not been identified but *Hsf2* has been mapped to chromosome 5. To determine if *Hsf2* affects the same pathways as *Hsf1*, double mutant analyses were done with *Hsf1* and with *Liguleless3-O (Lg3-O)*, a gene misexpressed in developing *Hsf1* prongs. Results showed that when *Hsf2* is combined with either mutation, prong size and frequency increased suggesting that *Hsf2* affects CK signaling and similar genes misexpressed in *Hsf1*. Additionally, a PCR-based genotyping assay was developed for a marker gene linked to the *Hsf2* mutant. Mapping results showed a discordance between the *Hsf2* phenotype and the marker genotype and identified an expressivity issue with the heterozygous *Hsf2* phenotype. Future studies developing more closely linked PCR markers will help identify the gene underlying *Hsf2*.

Mentor: Dr. Michael Muszynski
Copepods are small crustaceans that form the basis of marine food webs by serving as the essential link between photosynthetic phytoplankton and larger, heterotrophic marine sea creatures. However, despite their ecological importance, not much is known about how copepod visual systems function.

Visual gene expression was studied in *Labidocera madurae*, a copepod species with unique eyes found locally in Hawaiʻi. While most copepods have a singular, three-partite eye, the Pontellid copepods have modified this eye type, forming three separate eyes: two dorsal and one ventral. The dorsal eyes are especially distinct due to the presence of an enlarged lens, scanning abilities, and an unusual photoreceptor setup. Additionally, the genus *Labidocera* is sexually dimorphic—males tend to have much larger dorsal eyes than females. Because of the unique traits found in *Labidocera* eyes, it is valuable to analyze their opsin gene expression, as opsins are the proteins responsible for mediating light detection in animal visual systems.

Three opsin genes were isolated from *Labidocera madurae* in previous laboratory work. These genes were used to create mRNA riboprobes, which molecularly label sites of gene expression through the process of *in situ* hybridization. *In situ* hybridization, when combined with confocal microscopy, generates a 3-dimensional image of gene expression in the eye. Preliminary confocal microscopy work showed that opsin gene expression patterns differed between the three opsin genes, between the ventral and the dorsal eyes, and between male and female eyes. Further confocal work should be done to make more direct comparisons between groups.

Mentor: Dr. Megan Porter
Co-Author: Mireille Steck
Trophic Interactions of Megafauna in the Mariana and Kermadec Trenches
Inferred from Stable Isotope Analysis

Hadal trenches house distinct ecosystems but we know little about their sources of nutrition or trophic structures. We evaluated megafaunal food web structure and nutritional sources in the Kermadec and Mariana trenches using carbon and nitrogen stable isotope analysis ($\delta^{15}$N and $\delta^{13}$C values) of bulk tissues and proteinaceous individual amino acids (AAs). In the Kermadec Trench, bulk $\delta^{15}$N values ranged from 5.8‰ in trench sediment to 17.5‰ in tissues of the supergiant amphipod, Allicela gigantea. $\delta^{15}$N values of detritivores were much higher than those of sediments. The $\delta^{13}$C values ranged from -21.4‰ in sediments to -17.3‰ in the brittle star, Ophiolimna sp. Mariana Trench fishes, amphipods, and sediments had slightly lower $\delta^{15}$N values than those from the Kermadec Trench, possibly because the Mariana Trench lies under more oligotrophic surface waters. We also found evidence for multiple food inputs in each trench. Trophic levels determined from isotopic analysis of individual AAs in the Kermadec Trench ranged from three for detritivores to five for fishes. Source-AA $\delta^{15}$N values were variable, with much of this variation occurring in small amphipods. For the other fauna sampled, there was a significant increase in $\delta^{15}$N source-AA values with increasing collection depth. This increase could reflect larger amounts of highly microbially reworked organic matter with increasing depth or sporadic input from turbidity flows. Although further sampling across a broader faunal diversity will be required to understand these food webs, our results provide new insights into hadal trophic interactions and suggest that trench food webs are very dynamic.

Mentor: Dr. Jeffrey C. Drazen
Co-Authors: Mackenzie E. Gerringer, Brian N. Popp, Eleanna Grammatopoulou, Daniel J. Mayor
Hemophilia B is an X-linked inherited bleeding disorder caused by mutations in the blood clotting factor IX (FIX). People with this disease do not clot appropriately and suffer from many complications related to prolonged bleeding times. Current therapy involves replenishing FIX with recombinant protein, which is inconvenient, expensive, and sometimes not successful. Hemophilia B is attractive for gene therapy because restoring as little as 3% of FIX activity can ameliorate the bleeding. Present gene therapy efforts use viral vectors to deliver FIX to patients. However, viral methods have limitations such as nonspecific localization and unwanted immune responses. In our lab we are developing a non-viral, minimally invasive, and anatomically precise approach for treating hemophilia B. This method utilizes lipid microbubbles, plasmids, and Focused Ultrasound (FUS) for delivery. The plasmid, which expresses a more active form of human FIX (hFIX), known as hFIX Padua, is attached to microbubbles. These microbubbles, injected intravenously, are subjected to FUS as they pass through the liver, leading to destruction of the bubbles and deposition of the expression construct in hepatic cells. Seven days after transfection in mice that lack FIX, FUS treated mice (n=5) show recovery of approximately 10% of FIX activity, with one mouse showing almost complete restoration of FIX activity (~80%). We are presently studying the reliability and range of results from this technique.

Mentors: Dr. Ralph Shohet, MD; Dr. Cynthia Anderson, PhD; Abigail Avelar
The Genetic History of Cannabis

Cannabis (*Cannabis sativa*) has traveled throughout the world. It originated from Central Asia and diverted in two directions. A broad leaf strain developed towards the east and the narrow leaf strain developed in the west. The two paths crossed again, and a great deal of hybridization occurred. However, the genetic relationship between the different species remains relatively unknown. This study serves to identify the various existing strains. To do this we obtained data from the 1000 Genome Project and inputted these files into Geneious, a bioinformatics software. We then aligned these samples to a reference guide, and from these analyses, we extracted the consensus sequence of each alignment. We downloaded these as Fastq files and used Geneious again to create a phylogenetic tree with the previous results. Using the phylogenetic tree, we were able to determine three distinctive groups and two outlier groupings. With the information gathered from this experiment, the created tree will provide a preliminary guide for the relationship between species and different populations, as well as population history. As more alignments are made, the tree will grow larger and we will get a better understanding of the genetic evolutionary history of cannabis.

Mentor: Dr. Michael Kantar

Co-Author: Dr. Anna Halpin
Anya Wu
Molecular Cell Biology, Mathematics (minor)
Natural Sciences
Experience
Oral Presentation: Session 1 (9:30-10:30) in Hāpu'u Room

Die in Place or Die Trying: Modelling Climate Induced Migration Flows and Receiving Country Response

Climate change is now widely seen as a problem not only for the natural environment but to many people across the world as well. In recent years the issue of climate change-induced migration has drawn the attention of scholars, and now media accounts of migrant flows across the Mediterranean Sea and through Central America and Mexico have brought this issue into the political arena in the European Union and the United States, with public policy consequences currently unfolding. It has become clear that the story of climate change-induced migration is as much about the response in receiving countries as it is about conditions in sending countries. This paper presents a mathematical model to aid in conceptualizing flows of climate refugees as well as responses in intermediary and receiving countries. Our model simulates current conditions and outcomes and provides insights about potential future conditions.

Mentors: Dr. Michael Kantar, Dr. Daisuke Takagi, Dr. Keith Bettinger
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Dr. George Wang
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PROGRAM SCHEDULE
Welcome & Introduction...........................Dr. Vernadette Gonzalez, Honors Director
Panel Discussion.................................................................Volume V Student Authors
                                        Moderator: Dr. Jayme Scally, Editor
Closing.................................................................Dr. Jayme Scally, Editor

ABOUT THE JOURNAL
*Horizons* is a peer-reviewed academic journal dedicated to high-quality creativity, innovation, and research created, conducted, and synthesized by undergraduate students at the University of Hawai‘i at Mānoa (UHM) in all academic fields represented by the UHM campus community.

Each annual issue, released in the fall, is published with simultaneous print and online versions. See the full version on our website at: [https://kahualike.manoa.hawaii.edu/horizons/](https://kahualike.manoa.hawaii.edu/horizons/)

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We invite students enrolled at UHM during the Spring 2020 through Spring 2021 semesters to submit work produced within this time frame to be considered for the Fall 2021 issue (Volume VI). We encourage submissions from any undergraduate academic discipline.

For specific deadlines and detailed instructions on how to submit works for consideration, please visit our website listed above.

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