

Ho'okele ka Wa'a

RECALIBRATING THE SAIL PLAN FOR NATIVE HAWAIIANS AND PACIFIC ISLANDERS IN THE OCEAN SCIENCES

By Haunani H. Kane, C. Anela Choy, Barbara C. Bruno, Diamond K. Tachera,
Keku'iapōiula Kelliipuleole, Jennifer A.T.K. Wong-Ala, John H.R. Burns, Clifford A. Kaponu,
Kailey H. Pascoe, Kainalu Steward, and Rosanna 'Anolani Alegado

ABSTRACT. In Hawai'i and across much of Oceania, Pacific Islanders celebrate the connections between our islands and the ocean that surrounds us. Since the beginning of time, we have relied upon precise observations of marine and celestial realms to intentionally navigate thousands of miles across vast expanses of open ocean. Through our migrations, we have created—and continue to create—purposeful relationships by observing the movements of swells, weather patterns, celestial bodies, and marine life. In direct opposition to colonial Western thought, we view Oceania as a metaphorical road that connects rather than separates island people (Hau'ofa, 1994). As descendants of the ocean, the dearth of Native Hawaiians and Pacific Islanders (NHPs) in ocean science seems inconsonant. We wonder, where are all our island people in the ocean sciences? In better defining the persistent, systemic, and collective barriers that NHPs face within Western society and the academy, we identify gaps that conventional professional development programs aimed at minoritized groups in the geosciences have been unsuccessful in filling. We share lessons learned from building two wa'a (canoes) in programs that center oceanic ways of knowing.

OUR SEA OF ISLANDS¹

Kupe, Kaha'i, Hawai'iloa, Pele mā.

We celebrate the names of our first ancestors who purposely navigated thousands of miles to find the most isolated islands in the world.

Ta'aroa, Maui, Nafanua.

We come from a sea of islands, home to some of the greatest ocean scientists, individuals who were elevated to higher spiritual status because of their abilities to intimately read the movement of swells, weather patterns, celestial bodies, and marine life.

"We sweat and cry salt water, so we know that the ocean is really in our blood." (Teiwa, 2017)

We come from a sea of islands and as island people believe the ocean not only surrounds us but is also within us. The ocean defines our identity, our culture, and everyday life.

As contemporary scientists, students, teachers, and descendants of the ocean, we are often the only Native Hawaiians and Pacific Islanders² (NHPs) in our respective fields, barely ripples. Yet the wake of the trails left by our ancestral

oceanic knowledge as expressed in our oral traditions, myths, and legends is massive. On the career path of ocean science, we constantly ask ourselves, where are all our island people? Why is the course so difficult to navigate? Here, we articulate the systemic and structural barriers NHP students face in higher education and provide examples of programs that aim to improve NHP outcomes but have had varied success. Like the voyages of our ancestors, we share lessons learned from building two wa'a (canoes)—programs specifically designed by NHPs to carry our students toward futures that center oceanic ways of knowing.

NATIVE HAWAIIAN AND PACIFIC ISLANDERS IN THE ACADEMY

Currently, ~1.7 million NHPs reside in the United States, including 680,353 Native Hawaiians (US Census Bureau, 2023). About 25% of NHPs aged 25+ hold post-secondary degrees, including 17% with bachelor's and 8% with graduate or professional degrees. These statistics are markedly lower than the overall US population: 35% of US residents aged 25+ have post-secondary degrees,

¹ Inspired by the essay "Our Sea of Islands" by Epele Hau'ofa.

² Pacific Islanders encompasses peoples from the Independent State of Samoa, American Samoa, Hawai'i, Tokelau, Tahiti, Tonga, the Cook Islands, French Polynesia, Niue, Pitcairn, Rapa Nui, Tuvalu, Wallis and Futuna, Aotearoa, Guam, Mariana Islands, Saipan, Palau, Yap, Chuuk, Pohnpei, Kosrae, Marshall Island, Kiribati, Nauru, Tinian, Peleliu, Kwajalein, Enewetak, Bikini, Fiji, New Caledonia, Papua New Guinea, the Solomon Islands, and Vanuatu (US Department of the Interior, 2021).

including 21% with bachelor's and 14% with graduate or professional degrees (US Census Bureau, 2021a).

Tracking NHPI representation in the geosciences (Earth scientists, geologists, and oceanographers) is challenging because of confidentiality concerns due to extremely small sample size, which leads to suppression of those data. Nationally, NHPI earn 0.3% of all science and engineering degrees and an even lower (suppressed) percentage of geoscience degrees (US Census Bureau, 2021a). Approximately 21% of all bachelor's degrees earned are in STEM fields; however, for NHPIs, the comparison figure is 15% (NCES, 2022). NHPIs make up 0.3% of all occupations, 0.2% of all science and engineering occupations, and an even lower (suppressed) percentage of geoscientist occupations (US Census Bureau, 2021b). NHPI principal investigators have the lowest National Science Foundation (NSF) proposal submission rates of all races and ethnicities tracked, with numbers too small to be reported for the NSF Directorate for Geosciences (Chen et al., 2022).

Arguably, the higher education system in Hawai'i has the greatest potential for creating training opportunities for NHPIs in ocean sciences. At the University of Hawai'i at Mānoa (UHM), Hawai'i's only research-intensive institution, nearly one-third of students identify as belonging to ethnic minority groups (UHM, 2021). NHPIs are generally underrepresented (16% of students vs. 27% in the general population) in all three UHM STEM colleges: College of Engineering (14%), College of Natural Sciences (10%), and particularly, the School of Ocean and Earth Science and Technology (SOEST; 6%) (UHM, 2021).

Why are NHPIs severely minoritized within the ocean sciences? The customs and practices of Indigenous Pacific Islanders nurture deep cultural and scientific connections that are central to holistically managing and understanding their lands and oceans. At first glance, Indigenous lifeways align with numerous

facets of ocean (and Earth) science. For example, the *ahupua'a*, a traditional land division extending from the uplands to the sea, is used to sustainably manage resources by envisioning land-watershed-ocean connections (Kamakau, 1991). This traditional framework can be inherent to tracing the flows of organisms or contaminants across diverse ecosystem components and landscapes. However, NHPIs face a number of intersectional barriers stemming from legacies of colonization and the resultant/specific ecosystem(s) of impacts that persist today. To address barriers in the ocean sciences, the historical and ongoing traumas impacting NHPIs must be directly addressed, not minimized, with active engagement in reclamation of cultural identities and knowledge.

SYSTEMIC BARRIERS: ENDURING LEGACIES OF COLONIALISM AND IMPERIALISM

The lens through which the rest of the world sees NHPIs is extremely narrow. We have been romanticized as exotic (O'Brien, 2006) or are portrayed as too small and poor to attain economic or political independence from wealthy nations (Hau'ofa, 1994). Historically, these paternalistic notions provided the justification to claim lands and resources beginning in the 1500s with the Manila galleon trade, then the Dutch in the 1600s, and expanding in the 1700s with British explorers such as James Cook. In asserting an external view of origin and ancestry onto Indigenous Pacific Islanders through racialized divisions (Melanesia, Micronesia, and Polynesia), Western explorers reshaped our identities and relations to one another (Arvin, 2019).

These wounds of colonialism were further deepened by imposition of Christianity, which cast Oceania cultures as savage and barbaric, engendering damaging and negative views of our own epistemologies that persist today (Teaiwa, 1994; Fuller, 2016).

In Hawai'i, the arrival of the missionaries, coincident with the collapse of the *kapu* (political and social) system, heralded the introduction of written language forms and supplanting of customary Native Hawaiian spiritual beliefs. Together with the decimation of the Native Hawaiian populace due to introduced infectious diseases (Trask, 1999), the overthrow of the Hawaiian kingdom in 1893 marked the spiritual, physical, and political dismantling of Native Hawaiians. These historical traumas have left indelible marks on the psyche of Native Hawaiians (Kana'iaupuni and Malone, 2006). The legacies of cultural suppression, Western land tenure, and governance policies have created pervasive and significant economic and health inequities that have not been ameliorated under statehood (Archer, 2018; Riley et al., 2022).

In the twentieth century, massive displacement and disenfranchisement of the people of Oceania accelerated as a fallout of the Spanish-American War and subsequent World Wars (Hilton and Ickringill, 1999). During World War II, Indigenous Pacific Islanders were subjected to Japanese occupation, family separation, forced labor, and prostitution (Lindstrom and White, 1990). In addition to these brutalities, allied campaigns wrought dramatic environmental damage as resource extraction was carried out to benefit military forces, forests were razed, and invasive species were introduced and spread, irrevocably altering the continuity of customary practices (Bennett, 2009). But perhaps most harmful to the identity of Oceania has been the physical destruction of our homelands by the US military around Bikini Atoll and across the Marshall Islands, in Tahiti, and Kaho'olawe, Hawai'i (Kajihiro, 2009; Davis, 2015). In tearing us from our sacred relationships with the birthlands of our ancestors under the pretense of scientific and military research, the US government unknowingly created a false dichotomy between science and culture.

STRUCTURAL BARRIERS: CONTESTED SPACES IN THE ACADEMY

Research is a defining characteristic of universities as part of an institutional commitment to knowledge creation. Western epistemologies around science and knowledge place higher value on quantifiable approaches (Guba and Lincoln, 1994; Cech et al., 2017), thereby perceiving Indigenous Pacific knowledges about ocean sciences as less valid. In reality, “what is generally understood as knowledge in the universities of our world represents a very small proportion of the global treasury of knowledge” (Hall and Tandon, 2017). Unfortunately, when the litany of historical wrongs committed against Native communities (e.g., nuclear testing, medical experiments) are also taken into account, it is no surprise that scientific research is perceived as “a dirty word” to many Indigenous peoples (Smith, 2021), making STEM a difficult major and career to pursue.

The barriers NHPIs face in higher education are multi-layered and intersectional with the struggles shared by many other minoritized and Indigenous scholars experience. Academia is an elite space that serves colonial interests explicitly and implicitly (Justice, 2004), continuing to reproduce these systems of privilege and excluding other ways of knowing (Miheuah and Wilson, 2004). Western education systems actively participated in the suppression of Native language, oppression of cultural practices, and occupation of Indigenous lands. Institutions of higher education are not safe spaces for NHPI students but instead can be sites of contention and conflict. One of the biggest barriers to entry and retention identified by students and staff from NHPI programs is that Native Hawaiian students are a minority despite learning in their home university (Takabayashi et al., 2022). Feelings of inferiority, tokenism, loneliness, and isolation are common. Lacking a proper support system, many NHPIs eventually leave science entirely (Allaire, 2019). Efforts to diversify the

discipline need to address the role of hostile and exclusionary work and learning environments (Marin-Spiotta et al., 2023).

Western educational metrics of success can also conflict with Oceania life ways. Whereas Cartesian frameworks locate knowledge and therefore productivity as being personal and individual, NHPIs are invested in collective academic self-enhancement (Tassell et al., 2010). These disagreements likely arise from epistemological differences—our knowledge is grounded in the natural environment and in the ancestral line of the family (Meyer, 2001), and the recognition of kinship with our environment leads to knowledge that has kinship with community.

Though poor preparation is cited as a stumbling block to a career in STEM/ocean sciences for NHPI students, specialized attention to geographic challenges of island peoples should be emphasized instead. Centralization of resources often requires students to relocate to a different island, incurring significant financial costs and separation from family (Kerr et al., 2018). For example, in Micronesia, the University of Guam is the only four-year college, with remaining island groups having only two-year colleges. Technological infrastructure and use of distance learning can be employed to meet the educational needs of students from island nations. In addition, implementation of place-based ocean curricula that incorporates cultural knowledge and practices is a way to circumvent a shortage in STEM teachers and facilities. This requires thinking beyond Western science pedagogies.

Finally, academic programs that are implemented to address systemic and academic challenges for NHPI students are often not institutionalized. Pedagogical approaches that expand beyond Western frameworks are viewed as exploratory and usually rely on temporary grants. Underinvestment in NHPI-focused resources puts potentially successful programs at risk and engenders job security issues for program staff who are more likely to be NHPIs. Nevertheless, a number of

innovative programs have been implemented to support NHPI students in the ocean sciences.

RECRUITING VOYAGERS: SUMMER BRIDGES AND RESEARCH EXPERIENCES

Here we review past and present programs created to increase the presence and capacity of NHPIs in the geosciences. Each program is described below, and the main lessons learned are summarized in [Table 1](#).

Three summer bridge programs for high school and community college students are offered at SOEST, the college that offers oceanography and marine science degrees at UHM. Hawai‘i Institute of Marine Biology (HIMB) Research Experiences in Marine Science is an inquiry-driven experiential marine biology course that builds science and environmental literacy skills for Hawai‘i high school students and recent graduates (Rivera et al., 2022). Earth-Planets-Ike-Kuleana is a two-week program for Hawai‘i high school students and teachers to experience the Earth sciences. The SOEST summer bridge (2013–2021) was a week-long, field-based program designed to allow University of Hawai‘i (UH) community college students to draw connections between Hawaiian and Western science (Bruno et al., 2016). The success of these programs is that they expose students to geoscience majors and careers and create opportunities for NHPIs to envision their role in tackling Hawai‘i’s growing environmental challenges.

The C-MORE Scholars program (2006–2016) provided UH undergraduates and recent graduates closely mentored, academic-year research experiences at three levels: trainee (undergraduate research assistant, learning basic skills), intern (undergraduate researcher, conducting research with a fair degree of independence), and fellow (team lead on research projects, often mentoring trainees). Students could participate for multiple years and advance through the levels. The program provided a pathway toward

TABLE 1. Geosciences programs serving Native Hawaiians and Pacific Islanders (NHPIs).

FOCUS	PROGRAM NAME(S)	LESSONS LEARNED
Summer bridge programs	• HIMB Research Experiences in Marine Science (2013–present) • Earth-Planets-‘Ike-Kuleana (2019–present) • SOEST Summer Bridge (2013–2021)	Experiential courses that connect Native Hawaiian culture and Western science empower students to envision themselves in geoscience majors and careers.
Multi-year undergraduate research and professional development programs	• C-MORE Scholars (2006–2021) • ‘Ike Wai Scholars (2006–2021)	A hui (alliance) of students is critically important. The peer-to-peer relationships students developed proved to be most instrumental and continue to sustain them today as they move into graduate, postdoctoral, and professional positions. Moving beyond the ivory tower, there is value in engaging students in community-based research projects that involve teams of students, address community issues, are co-developed and co-managed with community members, and are developed in accordance with the Kūlana Noi‘i.
Introducing students to marine science outside of the university system	• Nā Wa‘a Mauo (2015–present)	Wa‘a, Hawaiian outrigger canoes, can be used to blend Indigenous and institutional sciences to create community driven marine stewardship. Wa‘a create emotional successes for students and self-confidence.
Culturally based curriculum	• Kū‘ula (2008–present)	Students want courses that examine Indigenous and Western knowledge systems as well as immersive experiences with community-based natural resource management. Relationships developed in this course were critical in moving on to ocean and natural resource careers.
Undergraduate mentorship and community/cohort building	• Maile Mentoring Bridge (2013–present)	An intentional network of dedicated mentors and community members provides a range of critical support for entraining early career NHPI students in the geosciences. Regular, sustained mentoring-centered activities serving NHPI students can result in a range of unexpected benefits such as problem-solving and creating a powerful sense of belonging in an otherwise lonely academic journey.
Indigenous-led research programs	• The MEGA Lab (2019–present)	Hawaiian research methods are valued through global partnerships. Indigenous- and community-led research builds student leadership and confidence in research. Brand marketing and storytelling are important tools for increasing inclusivity and personalization of ocean sciences beyond academia.

graduate school and diverse geoscience careers. Other aspects of the program included monthly workshops (to learn professional skills, interact with peers, and build a sense of community), public presentation of research, and community outreach (Bruno et al., 2011, 2013).

‘Ike Wai Scholars (2017–2021) was built on the C-MORE Scholars model. Its main innovation was authentic research projects based on local community needs, following the Kūlana Noi‘i guidelines for conducting research in Hawai‘i (Kūlana Noi‘i Working Group, 2021). For example, some scholars conducted research at Sumida Farm, a fourth-generation, family-run farm growing the majority of the state’s watercress. Undergraduates, UH scientists, and farm owners collaborated to develop research projects addressing threats due to climate change (Engels et al., 2020). C-MORE and ‘Ike Wai Scholars together served a total of 132 students, including ~48% NHPIs. This provided a

critical mass that enabled NHPI students to develop a sense of belonging and power within geoscience fields.

Kū‘ula integrated science was developed as an undergraduate-graduate dual-level course at UH Hilo. This course creates a space for students to explore the ways Western and Hawaiian sciences can be integrated into current conservation efforts in Hawai‘i. The course is successful in attracting Native Hawaiian students (70%–90% of students across five cohorts), and the majority of students (90%) are now working in the natural resource sector or pursuing graduate degrees (Takabayashi et al., 2022). Students celebrate this course because it creates a student support system that reduces feelings of isolation and instills confidence to explore their identities as Indigenous scientists. Many students, teachers, and community mentors continue to work closely in their professional capacities.

The Nā Wa‘a Mauō Marine Stewardship

Program uses wa‘a as a vehicle for high school students and the community of Hilo, Hawai‘i, to care for the ocean (Pihana et al., 2022). The program blends Indigenous and institutional sciences to create community-driven marine stewardship efforts through community work days and includes a voyaging program for Hawaiian high school students. A critical lesson learned is that programmatic success is not defined solely by achievements in academics and cultural empowerment but includes emotional successes as well. Cultural practices such as the wa‘a create leadership roles that ultimately increase students’ confidence and strengthen their relationships with the community.

Though these programs provided exposure to geosciences through educational and research experiences, NHPIs continued to be most severely absent from the ocean sciences at UH. What was missing? We realized a need for wrap-around experiences aimed at preventing

NHPI students from “slipping through the cracks.” This need inspired two Native Hawaiian programs that were designed and led by Native Hawaiian ocean scientists. We share lessons learned from building two wa’a—programs specifically designed to carry our students forward toward futures that center oceanic ways of knowing.

BUILDING THE WA’A: NHPI PROGRAMS DESIGNED BY NHPIs

SOEST Maile Mentoring Bridge

With the goal of attracting and retaining more NHPIs into geoscience degree programs and careers, the SOEST Maile Mentoring Bridge program was founded in 2013 (hereafter referred to as Maile; [Figure 1](#)). The foundation of Maile was to build and foster robust partnerships with neighboring community colleges within the UH system. We targeted both community-building social events ([Figure 2](#)) and summer bridge programs (e.g., Bruno et al., 2016) to foster intentional and successful student transfer pathways from community colleges. Prior to, or upon, arrival at UHM, Maile mentees are carefully paired with experienced mentors—SOEST graduate students, postdocs, or recent graduates—all of whom receive professional development and mentoring training. At monthly mentee-mentor lunch meetings, mentees receive individualized mentoring and near-peer support. For example, mentors provide advice and encouragement to apply for research opportunities and scholarships. Lunch costs and mentoring stipends are supported by the program, and all participants attend larger Maile group activities

to share their experiences, build community, collaborate, discuss future career pathways, and strategize solutions to unique challenges or any problems.

Since its inception, Maile has grown from an initial mentee cohort of 10 students from Kapiolani Community College and UHM to a pre-pandemic peak in 2019 of 28 mentees from all UH community colleges statewide. Funding support has expanded from an initial Sea Grant program development grant to include federal (NSF) and private (Kamehameha Schools) awards, as well as some institutional intramural support. Since 2013, numerous mentees have transitioned to serving as mentors and program managers, and several mentors are now faculty or working as professional geoscientists. However, significant administrative, programmatic, and financial barriers remain to sustainably grow and support Maile well into the future. We review the primary barriers and key successes below, reflecting discussion among past participants, program managers, founders, and faculty directors (all coauthors of this manuscript).

A longstanding key success of Maile is fostering a thriving community of interconnected peer and near-peer Native Hawaiian and other underrepresented geoscience scholars ([Figure 2](#)). Being a

part of this community greatly reduces feelings of isolation and loneliness for minority groups and provides direct exposure to potential geoscience career pathways and increased representation (role models) across career stages from those in the affinity group. Some Maile participants cited the program as a key source of belonging, sharing that the relationships built through Maile solely sustained their past and current retention in STEM (higher education, geoscience careers).

The connections I made through Maile were integral in keeping me in SOEST. My close circle of friends were in Maile. My research, academic, and life mentors are in Maile... When I had to take a leave of absence as an undergraduate, those same relationships are what brought me back.

– Former Maile mentee, current mentor, and PhD candidate at UHM

For many, the idea of success transformed through their participation in Maile. Many shared that they were not able to envision degrees or careers beyond a bachelor’s degree in SOEST. However, through direct exposure to different types of place-based research, meaningful interactions with scientific role models (e.g., women, Native Hawaiians), and a safe space to air and discuss a range of

FIGURE 1. The inaugural 2013 Maile Mentoring Bridge cohort included undergraduate mentees from Kapi’olani Community College and University of Hawai’i at Mānoa (UHM) and mentors from UHM who were graduate students, postdocs, or recent graduates. Since 2013, numerous mentees have transitioned to mentors and program managers, and several mentors are now faculty.





FIGURE 2. In addition to providing mentorship and financial support, Maile also builds community by organizing culturally grounded activities. In Hawaiian culture, the lunar calendar is referenced for fishing, farming, productivity, and deep-sea voyages. Here, Maile mentors and mentees observe the intertidal zone during the full moon in March 2021.

conflicts (societal, community, and individual), participants were encouraged by the possibility of pursuing graduate degrees and stable jobs in STEM and contributing to bettering both the community and the environment.

When joining Maile, I defined success as earning my bachelor's and getting a good paying job. As I continued with my BS and created goals with my mentors, I learned more about research in Hawai'i and how it impacted my island home. Observing how my mentors did their science while working with the community and working to increase the representation of under-represented students in STEM (e.g., creating Maile) helped me envision the type of scientist I wanted to be. As a PhD student living in Oregon, I am equally proud of the science I have done and the work I have done to increase diversity, equity, and inclusion at the predominately white institution and geoscience college I am a part of.

—Former mentee, current PhD candidate at Oregon State University

Looking forward, to continue the many unique successes stemming from mentoring programs like Maile requires institutionalized administrative, personnel, and

financial support. The general leadership model of Maile has included a formal faculty director and/or co-director and a single program manager, who is usually a degree-seeking graduate student or post-doc, which brings many challenges.

A dedicated, full-time position would greatly benefit the Maile program. Since the creation of the program, faculty have given some of their time to guide graduate students to run the program; however, this is not a sustainable way to host the program long-term. To allow for continued and growing success, I believe 50% of a faculty member's time, or 100% of a program manager's time, is required to keep up with the increasing enrollment within SOEST.

— Former mentee, current co-director of Maile and project scientist at the National Center for Atmospheric Research

THE MEGA LAB RESEARCH PROGRAM

To overcome traditional barriers related to retention of NHPs in the ocean sciences, the multiscale environmental graphical analysis (MEGA) Lab, a predominantly Native Hawaiian-led lab and non-profit physically located in Hilo, Hawai'i, has developed a research program that

prioritizes inclusive research experiences. Foundational to the success of our research has been (1) incorporating community members and cultural values into research projects, and (2) creating global partnerships that value Native Hawaiian research.

Research Experience 1: Modeling a Research Expedition After Hawaiian Voyaging Values

A common barrier for NHP students in ocean sciences is a feeling of disconnect between cultural values and self-identity as a scientist. We developed a research expedition to creatively explore what Native science and “kuleana” (responsibility) could look like if research and cultural priorities were equally weighted in all aspects of the research design. To accomplish this, we assembled a Native Hawaiian research team composed of early career scientists, graduate students, community members, a resource manager, and a documenter (Figure 3). Our diverse team embarked on a 15-day voyage to Papahānaumokuākea Marine National Monument, a 1,350 mile (2,170 km) chain of smaller islands, atolls, and seamounts that exist in the realm of Pō. Pō is revered by Hawaiian people as a space of creation that produces life and is also known as a realm of the gods. The collective group agreed that the purpose of the research expedition was to (1) create space for Indigenous researchers and community members to reconnect and build relationships with their ancestral islands, and (2) assess the recovery of low-lying atolls and rocky intertidal habitat following a catastrophic hurricane.

The research expedition was unique in that we chose to use a sailing vessel and modeled our transit after Hawaiian voyaging values. All researchers had shared responsibilities (e.g., fishing, cooking, vessel maintenance) and learned basic sailing and navigation. Cultural protocols were prioritized as research methods and each workday began and ended by collectively setting intentions and offering oli (chant). Students took on leadership roles

while sailing and conducting research and cultural protocols. Students cited this experience as being pivotal in their completing or embarking on a degree in the ocean sciences: three students earned MS degrees, two were accepted into PhD programs, and one began an undergraduate degree.

It's safe to say that no one's life went untouched after finishing this incredible journey. This trip went beyond research and reminded us that we are products of resilient kūpuna (ancestors) who continue to guide and inspire this collective work. Representation and how we are represented as Native people is sacred.

– Native Hawaiian PhD student, UHM

Research Experience 2: Mapping Cloudbreak

The second research experience, Mapping Cloudbreak, allowed researchers to grow global partnerships and showed that the value of Native Hawaiian research extends beyond academia. This project was inspired by the desire to increase inclusivity and personalization in the ocean sciences by utilizing a key storytelling element that involves surfers participating in ocean protection and awareness. Through consultation with the Fiji surfing association, Fiji fisheries and

forest, and the Tavarua island resort, the Mapping Cloudbreak project couples cultural practice with research to better understand how the structure and health of coral reefs influences Nakurukurumailani, Fiji, one of the best waves in the world (Figure 4). While traditional scientific funding sources require efforts to broaden impact, they are often hesitant to invest funds in strategies such as storytelling and brand marketing, which have been shown to be effective in other industries (Kaponi et al., 2023). Recognizing this as a barrier to inclusivity and science communication, our team sought a corporate collaboration with Reef footwear. In addition to supporting travel and data collection, Reef footwear also invested in a marketing campaign and media partnerships that introduced the broader surf community to the concept of Indigenous research and marine photogrammetry. A 20-minute documentary was created and accepted into several film festivals, eventually finding a distribution home on both Surflife and Outside TV's Dispatches program, and garnering over 340,000 views to date.

The Mapping Cloudbreak project also supported the mentorship of two Native Hawaiian female graduate students in marine science. These graduate students are now leading a team of students who

are analyzing three-dimensional models of the reef and GPS data collected by surfers' watches to explore how the structural characteristics of reefs influence human interactions with and relationships to the reefs.

People are more likely to remember and understand information presented in the form of a story compared to dry facts and data. Storytelling was a fundamental tool for this research project, which really helped drive my research questions and methods. Surfers have knowledge about a surf break and reef that scientists may overlook. The combination of perspectives and skill sets allows us to achieve a deeper understanding about the coral reef structures beneath a surf break.

– Native Hawaiian PhD student,
Arizona State University

WAYPOINTS FOR THE FUTURE: LESSONS LEARNED

We identified several systemic barriers for NHPs pursuing ocean science. These barriers stem from legacies of colonization and continue to persist due to structural barriers in modern academia. As we chart a sail plan for the future, we must first directly address the historical and ongoing traumas NHPs face through active engagement in reclamation of

FIGURE 3. (a) A research expedition was modeled after voyaging values by a team of Native Hawaiian scientists and community members. (b) The expedition's research methods prioritized cultural protocols. Here, students offer their leo (voices) as they thank the island and their ancestors after a day of productive research.





FIGURE 4. (a) A Native Hawaiian graduate student and (b) the student's mentor collected data to be used for understanding modern relationships between reef structure and wave riders. Photo credits: Todd Glaser

cultural identities and knowledge. We provide the following recommendations with examples for creating long-term support systems and structures for NHPIs in the ocean sciences.

Build a Community Support System Where NHPI Students Can Safely Explore Their Whole Identity as Indigenous Scientists

Efforts to diversify the ocean sciences must include greater acceptance of Indigenous knowledge in research and epistemological differences within the classroom. At UH Hilo, the Kū'ula: Integrated Science course showed that NHPI students want courses that examine both Native Hawaiian and Western knowledge systems and their applications to resource management. By integrating cultural values and research methods, students in NHPI programs like The MEGA Lab have increased their confidence in their self-identities, worth, and ability to lead. One of the main takeaways of all past and existing programs is that the peer-to-peer relationships students develop prove to be most instrumental and continue to sustain them

beyond graduation. The Maile mentorship has been successful in creating an intentional network of dedicated mentors who provide a range of critical support for entraining early career NHPI students in the geosciences.

Build Community Beyond the University System

We must also creatively address the geographic challenges of island peoples through distance learning and implementing place-based culturally driven curricula. The Nā Wa'a Mauō Marine Stewardship Program uses wa'a as a vehicle for high school students and the community of Hilo to care for the ocean, and to build emotional and academic successes (Pihana et al., 2022). Furthermore, The MEGA Lab has found that Indigenous- and community-led research increases student leadership and inclusion of people from diverse backgrounds. Finally, brand marketing and storytelling are important tools for increasing personalization in the ocean sciences and broadening impact to include audiences beyond academia.

Provide Long-Term, Institutionalized Support Toward Efforts That Support NHPIs

Not surprisingly, but often overlooked, is the inclusion of NHPIs in the development and leadership of NHPI programs. NHPI leadership ensures that these programs are culturally centered safe spaces for students to grow their identities as both NHPIs and scientists. Maile and The MEGA Lab are two examples of wa'a that have been specifically designed for—and by—NHPIs to carry our students to futures in the ocean sciences that center oceanic ways of knowing. These programs prove that we can continue to actively serve and protect our communities through higher education in the ocean sciences while simultaneously celebrating NHPI culture. In order to be successful, long-term, institutionalized support in NHPI programs, including full-time faculty member or program manager support, is necessary.

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AUTHORS

Hauani H. Kane (hkane@hawaii.edu) is Assistant Professor, Department of Earth Sciences, School of Ocean and Earth Science and Technology (SOEST), University of Hawai'i at Mānoa (UHM), Honolulu, HI, and The MEGA Lab, Hilo, HI, USA. **C. Anela Choy** is Associate Professor, Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, USA. **Barbara C. Bruno** is Specialist, Hawai'i Institute of Geophysics and Planetology, SOEST, UHM, Honolulu, HI, USA. **Diamond K. Tachera** was a PhD student, Hawai'i Institute of Geophysics and Planetology, SOEST, UHM, Honolulu, HI, USA, and is currently a postdoctoral fellow, Mesoscale & Microscale Meteorology Laboratory, National Center for Atmospheric Research (NCAR). **Keku'iapōiula Keliipuleole** is a graduate student in the Marine Biology Graduate Program, SOEST/School of Life Sciences, UHM, Honolulu, HI, USA. **Jennifer A.T.K. Wong-Ala** is a PhD student in the College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, Corvallis, OR, USA. **John H.R. Burns** is Associate Professor, The MEGA Lab, and Department of Marine Science and Data Science, University of Hawai'i at Hilo, Hilo, HI, USA. **Clifford A. Kapono** is Assistant Professor, and **Kailey H. Pascoe** is a PhD student, both at The MEGA Lab, Hilo, HI, and Center for Global Discovery and Conservation Science, Arizona State University, Tempe, AZ, USA. **Kainalu Steward** is a graduate student in the Department of Earth Sciences, SOEST, UHM, Honolulu, HI, and The MEGA Lab, Hilo, HI, USA. **Rosanna 'Anolani Alegado** (r alegado@hawaii.edu) is Associate Professor, Center for Global Discovery and Conservation Science, Arizona State University, Tempe, AZ; Department of Oceanography and Hawai'i Sea Grant College Program, SOEST, UHM, Honolulu, HI, USA.

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