Creating Spaces for Indigenous Voices within Planetary Science - Part 2

Input for the Planetary Science and Astrobiology Decadal Survey 2023-2032

Topic: State of the Profession

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Introduction

In August 2020, I was invited by Dr. Heather Kaluna to connect with Pwo Navigator Kālepa Baybayan around the topic of interplanetary exploration. This was a profound and deep opportunity to bring together something incredibly special. Pwo navigators have the highest level of oceanic navigation expertise. It surpasses the equivalent of a Ph.D. and Pwo navigators could be likened to members of the National Academy of Sciences. To speak with Kālepa is an enormous honor and opportunity to learn from an extraordinary leader. Another unique aspect of this collaboration is that Dr. Heather Kaluna is the first Native Hawaiian to earn a Ph.D. in astronomy and myself as the third Native Hawaiian to earn a Ph.D. in physics (behind the late-Dr. Paul Coleman in 1985 and Dr. Carena Church in 2014). In our conversations, Pwo Navigator Kālepa Baybayan, Dr. Heather Kaluna, and myself connected as Native Hawaiians representing different types of explorers.

Dr. Kaluna recognized that in creating this space, we could highlight the value of our Indigenous wayfinders within planetary science. She understood the expertise required to navigate across vast oceans is the exact expertise needed to evaluate what it means to travel beyond our Earth. Our conversation explored who the individuals were that became navigators, how they were able to travel these journeys that were upwards of 3,500 miles and what motivated them to do so. We then drew connections to modern human space exploration and what this new version of exploration means to our global community.

We had multiple conversations through video calls and through writing. During our conversations, key lessons stood out that can be implemented into our process of astronomy, physics, and planetary science. Throughout this document, I will refer to Dr. Kaluna by her first name, Heather, and Pwo Navigator Kālepa Baybayan by his first name, Kālepa. I am able to do this based on the trust we have built with one another. I would like to request that any reader of this article, honor each individual's earned titles until you have established your relationship with each of them.

I would like to direct the reader to the first paper in this series titled "Creating Spaces for Indigenous Voices within Planetary Science - Part 1" by Kaluna, Baybayan and Kamai. This document is a continuation of the conversation to highlight the value of our Indigenous voices and Polyneisan Navigator expertise within the context of planetary science.

Recommendation 1: Transform astronomy, physics and planetary science into a new way of practicing science that is grounded in who we are as a whole person. Create strategic access points that further engage our broader community with astronomy, physics, and planetary science.

I grew up 15 minutes from the largest research university in our state, University of Hawai'i, Mānoa, which is the same institution that operates and manages the telescopes on Maunakea. Yet it wasn't until I was accepted into the university that astronomy even crossed my mind. I made my way through the public school systems, though unfortunately it was not an environment setup

for me to imagine that intellectual pursuits were possible. If you don't score high on standardized tests, then you do not get selected as the "brilliant ones" who will achieve. For many of us in the public school system, the idea of college was something for the private school kids, super smart ones or the rich kids. At the time, there was not a lot of pride in being Native Hawaiian and I didn't have role models to look up to. There are negative stereotypes of who we are and what we can achieve. I didn't have a rich understanding about my history or culture. The only reason I applied to the University of Hawai'i, Mānoa was because of athletics. I grew up swimming and playing water polo, which meant that the only relationship that I had with the university was the pool.

As an undergraduate, I was introduced to astronomy in my freshman year and learned that we only truly understand 4% of the universe, the rest is in the forms of Dark Energy and Dark Matter. I am driven to understand this darkness in the universe and decided to major in physics, continue onto a masters, Ph.D. and now work as a Postdoctoral Scholar.

When I decided as an undergrad to major in physics, I didn't realize the rarity of my own decision. In my major, I met another Native Hawaiian pursuing physics, Carena Church. As we navigated through courses, we always wondered if we there were other Native Hawaiians in this field or if we were the only ones. As a sophomore, I joined a program known as *Kahuewai Ola*, where we connected with Native Hawaiians who were weaving their identities into their STEM practices. As a junior, we went on a trip to visit the telescopes on Maunakea, which was the first time I had ever seen them. I met Dr. Paul H.I. Coleman, who was the first Native Hawaiian to earn a Ph.D. in physics. Through his mentorship, I learned what research was, the need to participate and how to pursue opportunities. On a deeper level, this connected with the *kulena*, honorable responsibility, of Native Hawaiians in astrophysics, which helped me imagine a path to my Ph.D.

On my journey away from home to pursue graduate studies, I was asked many questions about my Hawaiian culture and the experience of growing up in the islands. What hurt the most for me is that I had a gaping hole in my own understanding of where I came from. I was unable to speak our language, I didn't know the stories of our people, I didn't have many role models to point to. In many cases, my educators in high school and college told me there was no value in learning my cultural perspectives and practices if I wanted to go anywhere in my life.

As a graduate student, I spent my days in an old tunnel at Fermilab. I was on a team building an instrument to see if space-time had holographic signatures. My path into instrumentation also did not follow the mainstream experimental path. I did not take apart a car as a kid, nor learn electronics in the garage with my grandpa or disassemble computers. My awareness that instrument science was a viable path did not happen until I was in a Ph.D. program, which meant I did not know that I needed to prepare in that specific way. Yet, I was prepared in many other aspects such as through athletics, student leadership projects and an ability to remain curious and ask questions, which came from how I was raised by the community in Hawai'i.

On the rides out to Fermilab, I would sit with our theorist and ask deep questions about quantum mechanics, the universe, and everything in between. I'd hop out at our site and learn everything

needed to build, which included assembling an ultra-high vacuum system, electronics, optics, lasers, digitizers, and computing. Additionally, I tried to figure out ways to build up my knowledge about my culture. Each Christmas when I'd travel back to Hawai'i to see my family and warm up, I would spend hours in a store called Nā Mea Hawai'i, where I bought as many books as I could and drag back to the mainland. One particular book became my grounding post throughout graduate school, which was *Hawaiki Rising*.

Hawaiki Rising is a book that talks about the journey of the revival of Polynesian Navigation. It chronicles the quest to understand how Native Hawaiians got to Hawai'i in the first place. It started as a scientific question to prove whether it was possible to circumnavigate vast oceans without modern navigation tools but rather guided by the traditional knowledge system based on observations of the stars, ocean waves, wind and birds. This book chronicles the story to save this body of knowledge from extinction while reviving a deep cultural understanding.

As I read this book during the freezing winters of Chicago, I thought deeply about how this story connected with what I was doing. The instrumentation that I was building is analogous to building a canoe. When we analyze the data, we are working to understand detailed information about waves that is at the core of how we, as astrophysicists, explore the universe. Light from distant stars travel as waves that are converted into an electrical signal by traveling as waves through the materials of our detectors. From there it is digitized and analyzed through Fourier-transforms, all of which is an end-to-end wave description. Given the foundational parallels between ocean and space, I found a deep connection to who I was, where I came from and why I was doing what I was doing. I started to wonder if I am a type of modern day navigator. How similar is the framework of what is developed to take voyages across vast oceans in connection with what we do in astrophysics? When Heather approached me to connect with Kālepa, I was excited about the opportunity to build upon these questions.

How to implement Recommendation 1: Reflecting on my story, there are key access points that were not created and we have an opportunity to be intentional to increase participation in astronomy, physics and planetary science. Starting with educators and researchers, we need to drive a new kind of narrative about science that is grounded in who we are as a whole person. We need to encourage students to include their cultural identities into learning about the fields of astronomy, physics, and planetary science. We need researchers to share what aspects of their identities are influencing their thoughts about scientific problems. We can ensure that we do not discourage the expression of each individual's unique paths because it ultimately ties into whether they can bring their creative thinking to solve the biggest mysteries in the universe.

Universities and research institutions have a responsibility to evaluate the rhetoric that is perpetuated within their host institutions. For example, departments need to actively address the erasure of Indigenous voices and wisdom. Universities prioritize their global reach and they need to increase their attention to their local reach. This can be done with strategic hiring of faculty that emphasize the knowledge that local people hold, ensuring every faculty has place-based cultural awareness training with their local indigenous population, and partner with existing programming that connects with the broader community. Universities need to set new kinds of priorities of engagement with their local communities. For example, nearly everyone in Hawai'i

has a relationship with UH athletics. We should set that as a standard for the level of recognition about what intellectual pursuits happen at the universities.

Funding agencies need to increase access to build up participation in physics and astronomy. NASA, NSF and DOE need to tap into new kinds of networks that reach a broader demographic of participants. Funding agencies need to host more seminars to share the ‘how to’ application process for funding and research opportunities. This will enable more people to understand what is possible to engage with at any stage of their learning process.

Given what we learned through 2020, it is possible to hold effective virtual seminars, colloquia and conferences. This enables broader participation across geography and institutions. This needs to become our standard practice and funding is needed to support grassroots efforts like researchseminars.org, which aim to enable access to all current seminar series. This opens up access to the latest research developments regardless of geography.

We need to think of creative ways to increase access to developing meaningful scientific experiences. This means supporting physical spaces such as museums and makers spaces that can run programming that can engage a broad demographic i.e. from *keiki* (children) to *kupuna* (elders) with hands-on experiences. It is important to create opportunities for the entire community. We need to move beyond a model that supports only the development of the youth. We need to provide ways for their family members to have a sense of the excitement about what science opportunities are available. For example, my favorite type of community engagement projects were with senior centers. We shared the most recent developments in astronomy with adults over 50. What they shared with me is they felt valued from us sharing the latest discoveries and brought all the new things they learned to their children and grandchildren. This infectious excitement about science is what will drive meaningful change and engagement. Funding agencies need to support the staffing needs to develop long-lasting programs. Additionally, partnerships between NASA centers need to extend into regions that would not otherwise have access to seeing the type of science that happens there.

Recommendation 2: Funding agencies must develop, evaluate and ensure that scientists and engineers are held to the highest ethical standards as seen with Pwo Navigators

Kālepa Baybayan was one of the original Native Hawaiians who trained in traditional wayfinding and was a key player in the cultural reawakening across the Pacific Oceans. Kālepa trained alongside Pwo Navigators Nainoa Thompson and learned from Master Navigator Mau Piailug, who was the last living knowledge holder of oceanic navigation in Satawal. In the conversation between Kālepa, Heather and myself, Kālepa shared wisdom from master Navigator Mau Piailug

“the Pwo challenged you to be a light to your community, to provide leadership and command on the canoe, to be a good steward of people and your culture, to provide nourishment to the islanders, and to protect and serve the island by being a resource that they can rely on.”

With this Indigenous wisdom, we can envision how to set this into the context of space exploration. If we are to explore beyond Earth, then our society and community becomes the global community. That would mean that as scientists and engineers, we need to be the light in the global community. We need to be good stewards of all of humanity and nourish the residence of our earth. We need to protect and serve the planet by being a resource they can rely on.

When we think about this in practice for instrumentalists, our typical path does not train us in this way. As instrumentalists, our focus tends to solely be on answering questions about technology and software development. We train in a Ph.D. program, further our knowledge in postdoctoral scholar appointments, staff scientist or engineer positions, and as faculty in universities. We, as instrument scientists, become the core of the fields of physics, astronomy and planetary science by proposing experiments, building them, and providing these observations to the astrophysics community. We, as instrumentalists, become the leaders of NASA missions, NSF funded observatories, and DOE laboratories and our practices become encoded into each collaboration and the science itself.

A key element missing for instrumentalists is training on our standards of leadership, excellence, and societal responsibility. Yet this larger ethical responsibility is left out and needs to be changed immediately. As Kālepa said during our conversations, if we are to pursue space exploration, we need to export the best of humanity.

How to implement Recommendation 2: When we go through ethics training at universities, they rarely focus on the ethics of physical sciences. What we need to develop in detail a field-specific ethics training for astronomy, physics and planetary science. This needs to become a critical component in our development at the undergraduate, graduate, faculty, staff scientist and funding agency-levels. We need to have important conversations about what are the larger societal implications pursuing space exploration through astronomical instrumentation, human space flight and robotics. These conversations must include Indigenous communities and engage a broad global reach to engage. In practice, scientific collaborations, seminar series, and teaching can invite leaders trained in humanitarian thinking to participate in these conversations.

Furthermore, scientists and engineers need to continuously engage in leadership training to truly understand our role model in the global community. It is not just about writing a line of code, soldering a wire or creating a plot, these collective actions have a profound impact on the global community. We need to develop in STEM that serves both the technical interest and our role in the local and global community. Funding agencies need to develop criteria to support this transformation into both top-level science and our humanitarian responsibilities. What we briefly learned from Kālepa is how this is done and there is so much more wisdom from Indigenous voices on how in practice to be a leader in this way.

Recommendations 3: Dialogue and discussions about Interplanetary space travel needs to engage the global community

Starting in 2013, the Polynesian Voyaging Society embarked on an ambitious voyage known as *Mālama Honua*. This voyage utilized traditional wayfinding techniques to circumnavigate the

global ocean. Lead navigators like Kālepa, Nainoa Thompson, and many others developed the plans and crews to help navigate from Hawai‘i to Tahiti to Australia to South Africa up through the Americas, through the Panama Canal to Rapa Nui to Tahiti and back home to Hawai‘i. This voyage spanned 6 years that brought together seasoned navigators and trained a new generation of navigators.

In Hawaiian, *Mālama* means ‘to care for’ and *Honua* means ‘our Earth’, which represented why that voyage took place. The intention was to connect with leaders across the globe who are participating in healing our planet from the effects of climate change. The crew met with children, grassroots organizers, and political leaders to share in mutual respect for each other’s contributions. Importantly, they learned ways to support each other towards this central mission to care for our earth.

When we think about explorations that take us beyond our planet, we need to recognize that these decisions have an impact on our entire global community.

In our conversations, Kālepa shared what motivated island nations in the past to leave their homes and explore the oceans. For traditional voyaging societies, there were two main components for exploring vast oceans - the health of society and the curiosity itself.

Guided by these principles, how we imagine incorporating that into the current practice of astronomy, physics and planetary science. **We can not be driven solely by curiosity to explore.** In traditional wayfinding societies, a healthy society is an essential aspect of when we explore. The same needs to be true when we talk about traveling to other celestial bodies. We need to engage and develop a way to meaningfully evaluate the health of our global community.

With the modern day voyage of Mālama Honua, a driving force was to protect our Earth and a deep understanding that we, as a global community, need to come together. This voyage took Indigenous knowledge systems and enabled a way to connect our humanity. In our conversations, Kālepa shared how they connected with communities and leaders who were bringing about change for the environment and the need for us to work together. The intentionally connected at events and summits where other leaders were engaging in this conversation.

How to implement Recommendation 3: As scientists and engineers, when we envision a voyage beyond our Earth, we should incorporate lessons from the leaders of Mālama Honua, like Kālepa, on all the aspects that made this a successful journey for humanity.

We need to participate and facilitate connections with the broad global community. As leaders in the field of space exploration, attendance at conferences and summits with grassroots organizers and political leaders across the globe need to become standard practice. Funding agencies should develop funding opportunities that will enable travel to existing conferences or enable the creation of new kinds of ways to engage. Within our own scientific conferences, we should invite members of the broad global to the community with access to participate through giving presentations.

Recommendation 4: Intentional and meaningful dialogue need to happen between Ph.D. scientists and Indigenous knowledge holders

In concluding this paper, one of the strongest recommendations we can make is this one.

We need to consistently provide intentional and meaningful opportunities to engage with Indigenous wisdom holders and scientists at the forefront of space exploration.

In our conversations, Kālepa, Heather and I brought forward important frameworks of thinking about what it means to explore beyond our planet. Clear examples are laid out in our stories and recommendations in both this paper and “Creating Spaces for Indigenous Voices within Planetary Science - Part 1”. These examples are merely scratching the surface on what value Indigenous wisdom brings into our space exploration activities.

Dr. Kaluna created space for us to engage with Pwo Navigator Kālepa Baybayan in a way that was authentic and meaningful. Through our conversations, we modeled what it looks like to engage in a way that truly honors the breadth and depth of value that Kālepa, as a Polynesian navigator, has to offer in thinking about what interplanetary space exploration means to humanity. Heather and I approached these interactions with reverence because the considerable honor it is to learn from Kālepa's expertise. His knowledge is equally valuable to the insights that Heather and I bring given our training in the academy.

We were honored that Master Navigator Baybayan took part in our process to envision a path forward for space exploration. Traditional wayfinding navigators are the original explorers who traveled beyond their horizons and cared for their societies. The depth of their technical knowledge is unprecedented given the capability to navigate vast oceans, the careful attention to the dynamics of creating crew and what the societal implications are for voyaging. That wisdom can drive a profound shift in the broader astronomy, physics, and planetary science communities.

How to implement Recommendation #4: The astronomy, physics and planetary science communities need to host conversations of this kind, which respect the intellectual expertise and honor Indigenous contributions. It is critical to understand that the engagement needs to be genuine rather than appropriating cultures and tokenizing individuals. We demonstrated our value of Kālepa's expertise by listening to his wisdom and sharing his stories alongside ours. We acknowledged his contributions through authorship on these papers. It is important to ask and understand what practices match those of the Indigenous wisdom holders.

We need to create a standard practice to invite indigenous leaders into the scientific process at all stages. This engagement will strengthen the direction of our scientific endeavors and the perceived value within these indigenous communities. This includes invitations involvement in scientific dialogues at scientific collaborations, scientific advisory councils, conference session panels with top scientific experts. When we create spaces for Indigenous voices within Planetary Science we will be led to new horizons.