Coastal Biocultural Restoration as a Nexus for Innovation
NSF Convergence Accelerator Workshop Report
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www.bcrworkshop.com

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Mahalo:
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I. Executive Summary

Indigenous cultures and languages hold immense ecological knowledge developed through long-standing observation of places. Indigenous ecological knowledge ensured the survival of Indigenous peoples over time, and it is increasingly relevant today to questions of societal sustainability. Biocultural restoration is the restoration of Indigenous social ecological systems with the intent to positively impact the environment and people**.** For this workshop we narrowed the scope to "coastal" biocultural restoration because coasts are transition zones of immense ecological and economic importance, and are increasingly threatened by intensifying effects of climate change.

Biocultural restoration presents both a challenge and opportunity to innovate technologies, methods, and models that apply Indigenous knowledges in the 21st century as a practice of continuity with earlier forms of Indigenous innovation, management, and excellence. However, any approach to these innovations requires protocols, standards of practice, and relationship building in order to achieve equitable, reciprocal, and transparent convergence across sectors, disciplines, practices, and peoples.

The *Coastal Biocultural Restoration as a Nexus for Innovation* Workshop was held virtually on Zoom over the course of four days in May 2021, engaging 314 participants from 6 countries and 10 U.S. states. Participants were diverse and represented different sectors of society including Indigenous Peoples / Native Hawaiians, scientists, businesses/corporations, government officials, tribal leaders, university leaders, cultural practitioners, and community-based nonprofit leaders.

Participants were asked to ideate and describe potential projects and project deliverables that:

1) Have been vetted within their own knowledge systems. Examples include, but are not limited to, peer-reviewed ecological research and publications, and place-based practices that have been implemented, adapted, and refined over generations.
2) Are cutting edge/emerging/innovative by nature.
3) Fill gaps in existing coastal biocultural restoration activities or amplify/scale/leverage the results of coastal biocultural restoration for greater social or environmental impact.
4) May come from applications in different industries/disciplines and/or require collaboration across sectors.

Participants developed a range of potential projects within the limited timeframe of the workshop (detailed in Appendix A).

Based on the ideas and information shared by participants, we can envision a highly productive large-scale, distributed Center for Traditional Ecological Knowledge that would exceed the scope of the NSF Convergence Accelerator Program. In the report below, we have highlighted specific topical areas that most well-align to the Convergence Accelerator Program, and that are well-poised to enable research leading to innovative solutions on 1-3 year time scales. Further discussion of each proposed track and sub-track can be found in Section V. Potential Deliverables.

Track A: Integrating Indigenous Ecological Knowledge and/or Traditional Ecological Knowledge (TEK) into Data-Driven Decision Making

Sub-tracks: TEK Data Collection; TEK Decision Support Tools; TEK Data Sovereignty Usage Guidelines and Standards

The overarching goal of this track is to develop data collection methods, environmental monitoring technologies, decision support tools, and data sovereignty standards and guidelines to support the integration of Indigenous ecological knowledge and traditional ecological knowledge (TEK) into coastal land use, planning, natural resource management, legal/policy decision making (especially in the contexts of climate change adaptation and mitigation), and regenerative and sustainable development. The cohort of projects supported through this track will catalyze innovative partnerships among coastal Indigenous and local communities, government, planners, environmental scientists, nonprofits and businesses, fisheries, data scientists, engineers, and other stakeholders. Collectively, this cohort will produce products, processes and resources to enhance coastal data-based resilience planning, environmental monitoring, and resource management at local scales while ensuring Indigenous community sovereignty over community data.

Track B: Indigenous Empowerment through Community Engagement & Education Pathways

Sub-tracks: Centering Indigenous Communities; Educational Pathways for Indigenous students

The overarching goal of this track is to center Indigenous communities and ensure equitable, transparent, and reciprocal participation of Indigenous communities in projects leveraging Indigenous knowledge. This track will create better programs, processes, and resources to support Indigenous community engagement and Indigenous success in STEM education and STEM and resource management fields. The cohort of projects supported through this track will converge Indigenous communities, universities, planners, STEM & resource management educators, businesses, nonprofits, community outreach and engagement professionals, and others. Collectively, this cohort will produce innovative educational programs, curricula, and community engagement resources, guidelines, standards, and networks. The cohort of synergistic projects focused on Indigenous community engagement and Indigenous education will contribute to achieving national goals around diversity, equity, and inclusion in STEM.

Track C: Localized Sustainable Infrastructure

The overarching goal of this track is to develop localized, sustainable infrastructure technologies that are based in or complement Indigenous watershed management systems. This track also aims to create plans for the integration of localized sustainable infrastructure to fill existing gaps and prioritizes restoration efforts that generate economic benefits for Indigenous and local communities. The cohort of projects supported through this track will involve a range of partnerships among engineers, planners, entrepreneurs, designers, geologists, Indigenous and/or local community organizations, soil scientists, private sector partners, workforce development programs, public agencies, and other stakeholders. Collectively, this cohort will produce products, technologies, methods, and plans to address challenges in green energy, waste management, urban and regional planning, and watershed and soil health.

II. Introduction

This workshop was grounded in the key idea that Indigenous cultures are "biocultural," meaning they developed historically as part of a resilient and life-supporting social-ecological system.[1] In addition to the lived and experienced histories of Indigenous and local community members, there is a growing body of scientific and academic literature establishing how Indigenous Peoples maintain distinct worldviews and ways of life, often in resistance to a dominant or colonial culture that seeks to disappear them. Indigenous cultures and languages hold immense ecological knowledge developed through long-standing observation of places. This knowledge is often considered sacred within Indigenous worldviews and is passed down intergenerationally, in some instances over tens of thousands of years. Indigenous ecological knowledge ensured the survival of Indigenous Peoples over time, and it is increasingly relevant today to questions of how to manage regional resources sustainably.

Biocultural restoration is the restoration of these social ecological systems that seek to positively impact the environment, as well as the Indigenous peoples of a particular place. Indeed, biocultural restoration has been defined as, "the mutually reinforcing restoration of land and culture such that repair of ecosystem services contributes to cultural revitalization, and renewal of culture promotes restoration of ecologic integrity."[2] For this workshop we narrowed the scope to "coastal" biocultural restoration, and we defined the term "coastal" as including coasts and waterways of all kinds. Coasts are boundary zones of immense ecological and economic importance.

A key inspiration for this workshop was the 2018 publication of a special issue of the journal *Sustainability*, edited by Dr. Kawika B. Winter, Kevin Chang, and Dr. Noa Kekuewa Lincoln. The special issue, entitled "Biocultural Restoration in Hawai‘i," sought to highlight projects in Hawai‘i aiming to restore ‘āina momona, or perpetual resource abundance.[3] It was notable as the largest collection to date of scientific papers authored by Native Hawaiian scholars, with more than 50% of authors being women. However, biocultural restoration is by no means limited to Hawai‘i. This workshop sought to include participants from across Turtle Island and internationally. 11 out of 94 special issue authors registered for the workshop, and 3 participated as speakers.

The workshop was hosted by Purple Mai‘a Foundation in collaboration with the Office of Indigenous Innovation, University of Hawai‘i, Dr. Brian Glazer, University of Hawai‘i at Mānoa, Kua‘āina Ulu ‘Auamo (KUA), and the Hawai‘i Alliance for Community-Based Economic Development (HACBED).

We sought to hold space for Kānaka Maoli (Native Hawaiians), Indigenous Peoples and local community members from Turtle Island and around the world to convene together with individuals and organizations that work with and for these groups, in meaningful discussions on the future of coastal biocultural

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[1] Chang, Kevin; Winter, Kawika B.; Lincoln, Noa K. 2019. "Hawai‘i in Focus: Navigating Pathways in Global Biocultural Leadership" *Sustainability* 11, no. 1: 283. https://doi.org/10.3390/su11010283

[2] Kimmerer, R. 2011. Restoration and reciprocity: The contributions of traditional ecological knowledge. Pages 257 – 276 in D. Egan, E. E. Hjerpe, and J. Abrams, eds. Human dimensions of ecological restoration: Integrating science, nature, and culture. Island Press, Washington, D.C.

[3] *Sustainability* 11, no. 1. Edited by Chang, Kevin; Winter, Kawika B.; Lincoln, Noa K. 2019. https://www.mdpi.com/journal/sustainability/special_issues/Biocultural_Restoration

restoration. Efforts at coastal biocultural restoration have developed, against the odds, within frameworks of conservation, nonprofit/philanthropy, and education. We were driven to organize the workshop by the belief that in many instances, coastal biocultural restoration projects are now poised to become regenerative and sustainable paths to abundance as well as scalable models that generate positive social-environmental impact.

The workshop goals were to:

1) Identify priorities for high-impact applications of biocultural restoration
2) Share successful models
3) Strengthen network connections

Additionally, participants were told that the workshop would result in a report to the NSF that would answer the questions:

- What deliverables could be achieved in 1-3 years to amplify or scale instances of coastal biocultural restoration and/or innovations emerging out of coastal biocultural restoration, via technology, use-inspired research, and application?
- What scientific disciplines and stakeholders need to be involved for projects to be a success?
- What are the relevant concerns that need to be addressed for projects to be pono and ethical?

Participants were asked to ideate and describe potential projects and project deliverables that:

1) Have been vetted within their own knowledge systems. Examples include, but are not limited to, peer-reviewed ecological research and publications, and place-based practices that have been implemented, adapted, and refined over generations.
2) Are cutting edge/emerging/innovative by nature
3) Fill gaps in existing coastal biocultural restoration activities or amplify/scale/leverage the results of coastal biocultural restoration for greater social or environmental impact
4) May come from applications in different industries/disciplines and/or require collaboration across sectors

The projects/deliverables participants developed during the limited time of the workshop are possible outcomes of our proposed tracks, which are discussed in section V. Potential Tracks. Participants' brainstormed solutions are also listed in Appendix A of this report.

Participants were asked to agree to abide by the workshop's Free, Prior and Informed Consent (FPIC) Guidelines. These Guidelines sought to ensure that all participants understood the context that should inform whatever they chose to share during the workshop. The FPIC guidelines were referred to throughout the workshop in an effort to not only transparently inform participants of the intention, ground rules, and hoped-for outcomes of the workshop, but to also socialize to all participants the practices of permission-seeking and consent they should put in place when seeking to share, cite, or attribute Indigenous knowledge. The workshop FPIC Guidelines are discussed further in the "IV. Challenges and Convergent Opportunities" section of the report, the full Guidelines document is included in Appendix E.

The workshop was divided into 4 subtopics (Aho) that looked at coastal biocultural restoration primarily from the perspectives of coastal resilience; sensing and observation technologies; sustainable

development; and diversity, equity, and inclusion of Indigenous Peoples in STEM and resource management. Please see Appendix D for paragraph descriptions of each Aho topic.

All total, 387 tickets were reserved and of those, 314 people signed in on their desktop or mobile device to attend the workshop. Participants accessed the workshop from 6 countries (also 6 continents) and 10 U.S. states. In total 201 hours of sessions were watched. Participants were diverse and represented different sectors of society including Indigenous Peoples / Native Hawaiians, scientists, businesses/corporations, government officials, tribal leaders, university leaders, and community-based nonprofit leaders. Please see Appendix C for a list of workshop participants who elected to include their names in this report.

III. Workshop Organization & Format

We employed a workshop facilitation process based on the Human Centered Design Thinking practice.[4] This process roughly goes through stages of: Identify challenge/opportunity → Reframe challenge statement into a How Might We (HMW) question→ Ideation → Categorization/refinement → Viability testing/vetting → Planning → Shareback. A Diverge/Converge methodology was used throughout.

Additionally the main three days of the workshop made use of two Native Hawaiian process frameworks.

The first was the Three Piko framework elucidated by Dr. Kekuni Blaisdell.[5] Piko O, the fontanelle, represents connection to ancestors. We reflected this by setting aside one day for sharing genealogies, innovative models, and challenges. Piko I, the navel, represented connection to mākua (parents) and the contemporary world. We reflected this by including a day of a‘o aku, a‘o mai--learning from each other to brainstorm and refine solutions. Finally, Piko A, the reproductive organs, represent connection to mamo (descendants). This was reflected in spending the final day of the workshop refining ideas to 1-year and 3-year deliverables that we can commit to for future generations.

The second important framework was the ‘Aha framework developed by Kawika Winter based on ancestral teachings. We posited that coastal biocultural restoration would be the *‘aha* (lit. cord) of this convergence workshop. The workshop was then composed of four interrelated *aho* (lit. string) tracks, which were themselves made up of *a‘a* (fiber) breakouts.

What this all meant was that the workshop came together as three days:

Day 1	Piko O	4 Aho meetings	Identify challenge/opportunity
Day 2	Piko I	20 A‘a meetings (5 per Aho)	Ideation, categorization, viability testing
Day 3	Piko A	~16 A‘a meetings (topics naturally consolidated or were eliminated) 1 ‘Aha meeting (plenary)	Planning Shareback

[4] “Design Kit.” n.d. www.designkit.org. https://www.designkit.org/.
[5] “16- Kekuni Blaisdell Explains the Hawaiian Concept of Piko.” n.d. www.youtube.com. Accessed June 3, 2021. https://www.youtube.com/watch?v=i2FmbdusZko&feature=youtu.be

IV. Challenges and Convergent Opportunities

Biocultural restoration efforts or, as it has been called, "the biocultural paradigm," holds significant transformative potential for addressing local and global sustainability. This has led Merçon et al. to argue the need for "discursive bridging and inter-sectorial collaboration."[6] In addition to these needs, we argue that coastal biocultural restoration presents both a challenge and opportunity to innovate technologies, methods, and models that apply Indigenous knowledge in the 21st century as a practice of continuity with earlier forms of Indigenous innovation, management, and excellence. It has become clear that contemporary societies would benefit greatly from applying the insights of Indigenous ecological knowledge to address the compounding crises of climate change, ecosystem loss, and resiliency--but such knowledge, to achieve efficacy, must inevitably be applied within today's technological and market-driven context.

Positioned in Hawai'i, we've seen how Kanaka Maoli-led community groups have worked to restore biocultural relationships with place, in the process creating zones of biocultural restoration. These zones are centers of innovation in areas such as natural resource management, resilience design, computational and network systems for data-driven decision-making, regenerative economic development, inclusive and equitable educational/workforce practices, and other areas.

However, any approach to these innovations requires protocols, standards of practice, and relationship building in order to achieve equitable convergence across sectors, disciplines, practices, and peoples.

Before the workshop even began, collaborators and invited participants expressed to us--the workshop organizers--their concerns around sharing Indigenous knowledge within the forum of the planned workshop. Concerns were based in the experiences of individuals and communities with researchers, scientists, governments, businesses/corporations, and superiors within the academy wherein Indigenous knowledge was not protected, respected, or properly attributed. Examples of the types of concerns expressed include but are not limited to questions such as:

- How will workshop participants understand the workshop report, the purpose and intentions of the Convergence Accelerator, and be able to choose what they share with the NSF / the U.S. federal government and the general public based on that understanding?
- Will the workshop include space for important discussions around data sovereignty for Indigenous communities? (According to the United States Indigenous Data Sovereignty Network, "Indigenous data sovereignty is the right of a nation to govern the collection, ownership, and application of its own data. It derives from tribes' inherent right to govern their peoples, lands, and resources."[7]
- How will workshop organizers ask permission of participants about what information can be included in notes, workshop recordings, and in the workshop report?

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[6] Merçon et al. 2019. "From local landscapes to international policy: contributions of the biocultural paradigm to global sustainability". https://doi.org/10.1017/sus.2019.4

[7] "United States Indigenous Data Sovereignty Network." n.d. United States Indigenous Data Sovereignty Network. Accessed June 3, 2021. https://usindigenousdata.org/

- How will we ensure proper attribution of any Indigenous knowledge shared and included in the workshop report?
- How will workshop organizers protect Indigenous participants from non-Indigenous participants, who may have greater institutional credentials and may take ideas shared for use in their own research without proper attribution or citation?
- How will Indigenous Intellectual Property Rights be protected in the context of this workshop?[8]

Concerns were also based on knowledge of relevant international guidelines such as the United Nations Declaration on the Rights of Indigenous Peoples, which includes the right to Free, Prior and Informed Consent (FPIC).[9]

In response, we worked with our collaborators to draft FPIC Guidelines for the workshop that we hoped would address these concerns. The Guidelines covered the intention, ground rules, and hoped-for outcomes of the workshop. All facilitators, notetakers, and workshop organizers were asked to review the Guidelines in their final draft form, and key points for implementing the guidelines were discussed as part of facilitator and staff preparation meetings for the workshop.

Part of our approach was to distribute the FPIC Guidelines to participants ahead of the workshop and refer to them during the opening plenary and at the start of all aho and a‘a breakout sessions. The repeated references helped to socialize to all participants the practices of permission-seeking and consent they should put in place when seeking to share, cite, or attribute Indigenous knowledge. Participants were asked to agree to abide by FPIC Guidelines and to reference the Guidelines in order to understand the context that should inform whatever they chose to share during the workshop. You can view the full Guidelines document in Appendix E.

Anecdotally, responses to the workshop FPIC Guidelines were positive. During aho and a‘a breakout sessions, participants identified needs and potential solutions for generating similar and extended types of guidelines that could be elevated to standard practice at national and international scales. For more on this see proposed sub-tracks “TEK Data Sovereignty Usage Guidelines and Standards” and “Centering Indigenous Communities” (pages 8-12).

A related set of concerns involved ensuring community representation and equity in funding and resources that support research projects and collaborations. Participants expressed concerns about the imbalance in research funding for direct and indirect costs that goes to institutions and universities compared to the relatively lesser funding that goes to Indigenous communities for their participation in project activities. Participants highlights how the nature of grant/project selection and awarding processes can put Indigenous communities at a disadvantage in keeping up with application and award timelines and meeting policy and reporting requirements. One a‘a group chose to focus on these issues, and their recommendations to convergence funders working with Indigenous communities is included in Appendix B of this report.

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[8] Anderson, Jane E. “Indigenous Knowledge and Intellectual Property Rights.” Elsevier Ltd. 2015. https://www.academia.edu/29649475/Intellectual_Property_and_Indigenous_Knowledge

[9] “Free, Prior and Informed Consent | Indigenous Peoples | Food and Agriculture Organization of the United Nations.” n.d. www.fao.org. http://www.fao.org/indigenous-peoples/our-pillars/fpic/en/

V. Potential Tracks

A. Integrating Indigenous Ecological Knowledge and/or Traditional Ecological Knowledge (TEK) into Data-Driven Decision Making

Participants in several a'a discussed the value of integrating Indigenous ecological knowledge and TEK into land use, planning, natural resource management plans, and legal/policy decision making especially in the contexts of climate change adaptation and mitigation. A similar vein of discussion focused on TEK and monitoring technologies for commercial use supporting regenerative and sustainable development. Participants that provided insights that led to this track included Environmental Scientists, Members of Coastal First Nations, Cultural Practitioners, Non-Profit Organization Leaders, Civic Tech Expert, GIS experts, Robotics, AI engineer, Planners, Educators, fishers, entrepreneurs, etc.

TEK refers to the evolving knowledge acquired by Indigenous and local peoples over hundreds or thousands of years through direct contact with the environment.[10] Community support is often cited as being among the most important factors contributing to the long-term success of management plans, and plans that incorporate [TEK] are likely to draw more support from user groups.[11] TEK, which includes Indigenous resource management practices and ancestral growing methods in stories or observations, may offer more locally appropriate, sustainable options when it comes to resource management. Uses of TEK were discussed during the workshop in the contexts of fishing/fisheries, agriculture, hydraulic infrastructure and irrigation, and waste management.

TEK is retained and transmitted through customary oral or artistic traditions and does not always interface coherently with western science and contemporary forms of data. Furthermore cultural differences in expectations about timelines, reciprocity, and responsibility, plus uneven power dynamics, can make engagement between Indigenous and local communities and researchers sometimes fraught. TEK may be considered Indigenous intellectual property or intangible cultural heritage and requires the development of frameworks that protect the rights of Indigenous communities engaged in collaboration on convergence projects. That being said, we propose three sub-tracks to address different, but critical parts of this challenge:

1. TEK Data Collection
2. TEK DSS, Data Visualization, and Artificial Intelligence-driven predictive analytics platforms
3. TEK Data Sovereignty Usage Guidelines and Standards

Each sub-track could result in unique deliverables and necessitate convergence.

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[10] U.S. Fish and Wildlife Service. "Traditional Ecological Knowledge" fws.gov/nativeamerican/pdf/tek-fact-sheet.pdf

[11] Nicholas A.O. Hill, Keith P. Michael, Allen Frazer, Stefan Leslie. "The utility and risk of local ecological knowledge in developing stakeholder driven fisheries management: The Foveaux Strait dredge oyster fishery, New Zealand," *Ocean & Coastal Management*, Volume 53, Issue 11, 2010, Pages 659-668, https://doi.org/10.1016/j.ocecoaman.2010.04.011

Possible Deliverables:

1. TEK Data Collection: IoT applications, Multi-tiered sensor networks (including but not exclusive or limited to camera traps, acoustic sensors, environmental DNA analysis, citizen science initiatives), TEK documentation initiatives and programs, New geospatial datasets.
2. TEK Decision Support Tools: Decision Support Software (DSS)[12], Data Visualization (Dashboards, AR, VR, XR), Algorithms for ethical predictive analytics, New applications of fledgling/other discipline machine learning, industry knowledge hub.
3. TEK Data Sovereignty Usage Guidelines: Standard frameworks for protecting communities' data sovereignty & other best management practices for TEK data, Digital K-12 or college curriculum, Standard frameworks for engagement with holders of TEK, IRB-like councils or committees to regulate the use of TEK.

Convergence/Partnerships:
Computer scientists/Developers/Programmers, Planners/Local Planning Departments, Government Officials, Community Leaders, Drone Operator, TE knowledge holders, Indigenous language specialists/Linguists, Geneticists, Electrical engineers, Citizen scientists, Designers, Project managers, Geologists, Archaeologists, Oceanographers, Data Scientists, Database Architects, Industry partners (i.e. ESRI, Google, IBM, etc.), Documentarians, Interviewers, Local community organizations/cultural organizations, Mediators, Teachers/Educators, Epistemologist, AR/VR/XR engineers, Mathematicians, Curriculum Developers, Systems Thinkers, Marketers.

Examples of Deliverables Generated During Workshop by Participants (See Appendix A for more details)		
Sub-track	#	Deliverable Examples
TEK Data Collection	8.3	Program to incorporate traditional and ecologically sound land management practices to mitigate impacts of climate change
	11.3	Develop accurate and inclusive orthography (diacriticals, keyboard support, fonts, etc.)
	14.3	Practices of Continuity: Indigenous peoples have always gathered and communicated environmental data through their own customary traditions. This solution empowers Indigenous communities to create new stories and renew/evolve their traditions in response to our environment changing and the challenges of the present moment. Rather than sending settler scholars to conduct informant interviews of Native peoples, this solution would involve putting technology into the hands of creators for community-driven storytelling to move people and affect research and policy.

[12] Decision Support Software or DSS are information systems that support organizational decision-making and business activities. DSS goals are (1) to reduce decision cycle time, provide relevant information for decision making, enhance workforce effectiveness with more in-depth and fast data analysis, improve communication and collaboration among decision makers, and performance monitoring and ad hoc querying. These systems are usually utilized by large corporations and organizations. Examples of DSS include SAP BusinessObjects Business Intelligence and Salesforce Analytics Cloud.

TEK DSS, Data Visualization, and Artificial Intelligence-driven predictive analytics platforms	8.2	Decision support tool to integrate traditional cultural knowledge and academic research to inform land use designations and ensure accountability by government and landowners
	11.1	Provide more usable data products (and training) that are widely and openly accessible to wide varieties of users, excluding sensitive information (proprietary software packages vs. 'open' kml files, etc.); Develop innovative ways to visualize and tell stories about geospatial datasets, highlight culturally sensitive areas.
	11.2	Develop methods to map TEK and how this info can be used in the context of coastal restoration and adaptation to sea level rise.
TEK Data Sovereignty Usage Guidelines and Standards	1.2	Clearly articulate how data will be used and communicated with consideration for how it benefits the community through co-production of problems, ideas, solutions; Engage and activate students and communities with monitoring, analysis opportunities to empower with tools to identify e.g., biological testing, etc.
	3.2	A program/process for developing local metrics of success that sync up researchers'/ governments'/NGOs' interests with Indigenous community interests. Metrics should not be limited to monetary & production metrics, but should reflect community interests, which might encompass things like biodiversity, peoples' connection to land, ceremony, where food ends up, networks, sociological measures, ecosystem services of protected land etc.
	10.3	Create a guide for a process by which local groups can define terms/practices specific to the context of their geography, culture, and project goals. The guide would create shared knowledge, language, terminology, and context for work that centers Indigenous knowledge in planning. It would be a way of sharing practices that is not exclusive to academia.
	14.1	Explicitly negotiate terms for data collection and knowledge sharing through universally accepted Indigenous NDA Plan
	17	A large network/center/hub to support the collaboration of Indigenous peoples and communities with researchers in and out of the academy. The center would create outputs such as reimagined requirements for funding and the review and reporting/evaluation process that include Indigenous communities; documentation of what respect looks like in engagement with Indigenous communities, with the goal of elevating these respect guidelines to the level of other required/standard safety and human research protocols; resources for professors engaged in teaching and/or research on their responsibilities; resources on areas where Western training and Western notions of what science is may create tension with Indigenous knowledge, Indigenous protocols and Indigenous relational accountability; resources on topics like Free, Prior & Informed Consent processes and Data Sovereignty, etc.

B. Indigenous Empowerment through Community Engagement & Education Pathways

Participants in several a‘a focused on solutions that would address the need for Indigenous empowerment in projects leveraging Indigenous knowledge. Many discussions focused on developing and scaling better processes and practices of community engagement that would not only ensure Indigenous inclusion but actually center Indigenous community needs, research questions, and concerns from the start. Discussions returned to the need for a foundation of equity, reciprocity, and transparency in relationships between researchers, government, or businesses and Indigenous communities.

Another subset of a‘a discussions focused on innovative educational pathways that would support equity and inclusion of Indigenous students in STEM and resource management education and fields. Participants considered the need to credentialize practitioners, link Indigenous students to emerging industries and careers related to biocultural restoration, and train educators and researchers in the academy on respect, Indigenous knowledge, and culture-based or place-based education methods.

We propose two sub-tracks to address the overlapping challenges of centering Indigenous community and educational pathways:

4. Centering Indigenous Communities
5. Educational Pathways for Indigenous students

Each sub-track could result in unique deliverables and necessitate convergence.

Possible Deliverables:

4. Centering Indigenous Communities: Guidelines, best practices, case studies, processes for Indigenous community engagement that are elevated to standard practice; creation of new types of professional community liaison worker; networks or hubs that develop guidelines and create oversight/accountability mechanisms
5. Educational Pathways: scalable bridge programs, innovative curriculum, educator training programs, school food programs, mentorship/apprenticeship models

Convergence/Partnerships:
Indigenous communities; universities; state, city, or county departments; STEM & resource management educators at secondary and postsecondary levels; experts on UN and other frameworks of Indigenous rights; IRB / human research experts; businesses, nonprofits, or corporations in emerging biocultural restoration fields; human resources professionals; community organizers or community outreach and engagement professionals; facilitators

Examples of Deliverables Generated During Workshop by Participants (See Appendix A for more details)		
Sub-track	#	Deliverable Examples

Centering Indigenous Community	3.1	Develop tools/processes, best practices, and new kinds of jobs/positions inside government for community engagement and stakeholder participation in decision making. A key facet of this is creating the jobs/positions for champions on the inside of government who speak multiple languages (professional jargons, local dialects, etc.) and can translate between community and researchers/government. This type of professional (or team of professionals) would spend time with communities on the ground and follow up, communicating community concerns by packaging information and pushing it up to relevant government staff & vice versa.
	5.1	Process for vetting and confirming that research projects are grounded in community needs (guiding principles, design, relationships and co-designing the outcome, with opportunities to share and validate as you go).
	10.1	Rethink how we do community engagement on green infrastructure. Create access points, effectively use technology to broaden meetings and knowledge sharing, ensure participation and contribution from an Indigenous perspective, ground guiding questions in Indigenous approaches, and achieve understanding so that partners collaborate for the long haul.
	14.1	Explicitly negotiate terms for data collection and knowledge sharing through universally accepted Indigenous NDA Plan
	17	A large network/center/hub to support the collaboration of Indigenous peoples and communities with researchers in and out of the academy. The center would create outputs such as reimagined requirements for funding and the review and reporting/evaluation process that include Indigenous communities; documentation of what respect looks like in engagement with Indigenous communities, with the goal of elevating these respect guidelines to the level of other required/standard safety and human research protocols; resources for professors engaged in teaching and/or research on their responsibilities; resources on areas where Western training and Western notions of what science is may create tension with Indigenous knowledge, Indigenous protocols and Indigenous relational accountability; resources on topics like Free, Prior & Informed Consent processes and Data Sovereignty, etc.
Education Pathways	14.2	Through dialogue with partners, communities, leaders, and industry, socialize the idea that connectivity and technology have the potential to bring both harm and benefit; they are not neutral. Focus the conversation on how technological innovations can be used as a force for good for Indigenous peoples & support this conversation with work to increase K-12 education and post-secondary education in respectful, reciprocal research partnerships.
	16.1	Develop regional bridge programs from high school to college with a focus on place-based learning and career development in biocultural restoration and coastal management fields. Work to be undertaken would include research/planning as well as implementation & scaling.
	16.2	Develop a program of internships with aligned emerging businesses doing the business of coastal management and restoration with Indigenous knowledge.

		Goal of the program would be to train and mentor young students into new/emerging fields and career paths.
	18.1	*Focus on the Educators* - Program for Teacher Training & Professional Development that focuses on culturally sustaining pedagogy, sustainable development, biocultural restoration to uplift students into STEM/Resource Management
	18.2	*Amplify Existing Pathways* - K to 12 programs that offer educational and enrichment activities that augment existing tracks, leading to early credentialing/certifications and college credit and pathway to career opportunities
	18.3	*Cohort-Based, Apprentice/Mentorship Program* - Support post-secondary Indigenous students with cohort structure with linkages to professional and cultural mentorships and paid internships; framework for flexible stipends to address family obligations, etc.
	19	A university food program for Indigenous undergraduate or graduate students in STEM and Resource Management fields, parallel with a biometrics study following student physical, mental, spiritual health & academic performance and retention while on a traditional, place-based diet linked to a specific regional biocultural restoration effort. For example, in Hawai‘i this might look like a study group of STEM or Resource Management students that eats traditional food crops and plant medicines produced in a restored or in-restoration ahupua‘a system (Hawaiian agricultural system from mountains to the sea) that they themselves are studying. In year 1 teams could develop a pilot program at a local university and in years 2-3 teams could work to develop partnerships and collaborations to scale the program model to other regions and/or to other demographics.

C. Localized Sustainable Infrastructure Technologies and Plans

During the workshop, participants frequently referred to the Native Hawaiian Ahupua‘a Land Management System as a framework for their discussion of localized infrastructure like renewable energy microgrids and localized waste and wastewater management systems. Ahupua‘a are defined as land divisions, usually extending from the uplands to the sea, which included governance structures and were sized based on an equilibrium between the supply of natural resources and the needs of the local population. Historically ahupua‘a contained complex technological systems that worked in synergy. For example, water from precipitation high in the watershed would flow towards the coasts via streams that were partially diverted via ‘auwai (ditches) that led to lo‘i kalo (wetland taro patches). Historically in areas like He‘eia on O‘ahu, there was enough water to support hundreds of acres of lo‘i in a single area. The cool and flowing water supported the growth of taro, which was a major food source, before ‘auwai returned water to the stream, where it would flow into the ocean and mix with saltwater. This nutrified brackish water mixture supported the growth of algae and fish in the loko i‘a or Hawaiian fishponds. Taro and fish were staples that fed the communities that stewarded these systems. The ahupua‘a system and its

accompanying technologies (loʻi kalo, etc.) provided food as well as healthy wetland and coastal ecosystems, aquifer recharge, and other ecosystem services. There are hundreds of ahupuaʻa throughout the state of Hawaiʻi.

As places pursue sustainable development as a means of mitigating or adapting to the effects of climate change, localization of infrastructure will be increasingly important. Climate change impacts are regional and even local, so infrastructure development should be implemented at hyper-local or watershed scales and exhibit synergy with existing systems. In the example cited above, pollution high in the watershed of an ahupuaʻa (for example, through cesspools discharging sewage into a stream) would impact all areas below it, necessitating watershed scale infrastructure development. Participants mostly focused on innovation in localized renewable energy like wave energy, hydrogen fuels, and microgrid-supporting technologies as well as localized waste management systems or methods (i.e. leveraging biomass pyrolysis) and/or waste conversion innovations like biochar production facilities. This proposed track would call for localized, sustainable infrastructure technologies and plans for their use based in Indigenous management systems like the aforementioned.

Restoration efforts and methods like biomass pyrolysis (making biochar) result in saleable/value-added products that may also generate economic benefits for the communities that host these localized infrastructure systems. Dual-impact (environmental, economic, etc.) innovations should be prioritized.

Possible Deliverables:

- Greener hydrogen fuel production methods
- Waste treatment and management system(s)
- Microgrid innovations
- Dual-impact localized sustainable infrastructure innovations
- Innovative, watershed-scale infrastructure development plans

Convergence/Partnerships: Civil Engineers, Mechanical Engineers, Chemists, Planners, Economist, Entrepreneurs, Lawyers, Designers, Geologists, Physicist, Local community organizations, Soil scientists, Marine Scientist, Computer Scientists, Private sector partners, workforce development program, Project managers, Public agencies (permitting and approval), biochemist.

Examples of Deliverables Generated During Workshop by Participants (See Appendix A for more details)		
Track	#	Deliverable Examples
Localized Sustainable Infrastructure	2	Pilot hatcheries. Develop small scale/pilot research projects that demonstrate integration of aspects of closed system agriculture approach. Hatchery was chosen as an example of this. Hatchery's goal is restoration, not profit.
	9.1	Circular economic development project around fish indicator species that also improve the health of “ridge to reef” (in Hawaiʻi, this is the ahupuaʻa model). Indigenous voices should set the context and drive solutions. Such a project might include creating a micro-economy around products made from

		invasives or wastes produced in the process of restoring ecologies (ex. In Hawai‘i: Kiawe pod flour, mangrove biochar, invasive fish/limu as fertilizer for farmers).
	9.2	Circular economic development project around waste management with parallel study on the effects of an ahupua‘a approach (ridge to reef) on water quality and fish enhancement. The project would identify upstream outputs and how to manage certain waste products in order to positively affect water quality and fish populations, using algae or fish species as indicators of upstream pollution. An example waste management technology might be pyrolysis technology (biochar).
	1.1	Investigate & test Indigenous resource management as solution/adaptation strategy to environmental change, including using nature-based features to adapt and manage risk to sea level rise (e.g., coastal restoration as ecosystem services plus beach runup, dune restoration, ecosystem health)
	1.3	Develop appreciation for multiple perspectives of value in coastal resources (reconcile and converge modern, economic, with traditional, ecosystem services?)
	8.1	Community as the Technology--Program to catalyze specific geographic community networks to drive collaboration throughout a watershed to drive adoption of traditional land management frameworks

Appendix A: Grid view of all solutions, convergence dream teams, and special considerations ideated by workshop participants

A‘a	Solution	Convergence	Considerations
1	**How can we build capacity in local communities for projects to be implemented, monitored, and maintained?**		
1.1	Investigate & test Indigenous resource management as solution/adaptation strategy to environmental change, including using nature-based features to adapt and manage risk to sea level rise (e.g., coastal restoration as ecosystem services plus beach runup, dune restoration, ecosystem health) Year 1: ● Consolidate data and best practices on: ○ Engaging community from the beginning, and providing them with equitable compensation ○ Protocol for sharing and respecting data ○ Collate & integrate existing biocultural indigenous restoration research into widely available and multidisciplinary case studies (incorporate historical ecology work) and inventory methods ● Different areas of expertise and community groups would submit proposals for funding on the above topic, then generate project ideas for years 2&3 ○ Ex: distribute lessons for aquaculture/fisheries Year 2: ● Proposals above would lead to case studies and pilots using historical data to design nature based projects ○ Compare these case studies highlighting aspects of Indigenous management approaches, pilot projects ● Establish process-based metrics, ex. measuring the sense of (kuleana) responsibility people feel toward the site	Various community groups	Require local participation and develop models for t(0) equitable compensation for practitioners (doesn’t have to be monetary) Cross-cutting best practice: community endorsement should be broadly applicable to community needs, not just one or two community representatives Establish rules of conduct/engagement, data sharing policies, with community groups
1.2	Clearly articulate how data will be used and communicated with consideration for how it benefits the community through co-production of problems, ideas, solutions; Engage and activate students and communities with monitoring, analysis opportunities to empower with tools to identify e.g., biological testing, etc. Year 1:	Place-based groups (social science, economics, ecology, community NGOs, Sea Grant, homeowners associations, recreationalists,	Require local participation and develop models for t(0) equitable compensation for practitioners (doesn’t have to be monetary)

	● Engage specific place-based groups; Dedicate resources for review, inventory, further engagement with practitioners & researchers ● Develop long-term local recruitment plan for education & public outreach, e.g. identify career pipelines (yr 1 student pathways to yr 3 solutions, etc.) Year 2: ● Community data ownership plan for long term storage, security, redundancy; usability of data for broad public/community access & use (better, friendly analysis & visualization tools) (develop data visualization & portals for immediate application in coastal monitoring & restoration). ● Comparison among specific scalable case studies highlighting aspects of Indigenous management approaches--how to use historical ecology to design nature-based solutions (derive metrics from this) ● Case study outputs should be a diverse suite of outputs beyond the traditional peer reviewed publications ex. art, educational materials, policy briefs	industry)	Cross-cutting best practice: community endorsement should be broadly applicable to community needs, not just one or two community representatives Establish rules of conduct/engagement, data sharing policies, with community groups
1.3	Develop appreciation for multiple perspectives of value in coastal resources (reconcile and converge modern, economic, with traditional, ecosystem services?) Year 1: ● Collate & consolidate existing/prior research at a site moving toward baselines of associated multi-perspective "values" ● Incorporate Indigenous and place-based values into models and research tools (e.g. Sea level rise model that shows sacred sites, not just residential and industrial)		Community endorsement should be broadly applicable to community needs, not just one or two community representatives
2	**How might we develop regenerative economies that counter land loss, support healthy coasts, and build resilience to flooding?**		
2	Pilot hatcheries. Develop small scale / pilot research projects that demonstrate integration of aspects of closed system agriculture approach. Hatchery was chosen as an example of this. Hatchery's goal is restoration, not profit. Year 1: ● Pilot hatchery, setup and build during year 1 (depending on the specific fish species) ● Develop small scale / pilot research projects Year 2: ● Include technology, automation, software, and data collection to track metrics from the	Projects showing collaboration between orgs (e.g. nonprofits) and/or industry tie-ins Aquaculturists, Practitioners, Mechanical engineers, Software engineers,	History/knowledge Groups that profit off of management of invasives

	hatchery. This allows effective data collection and reporting, and would help the projects scale. ● Using technology is what our kūpuna did, we should continue doing the same. ● Hire skilled technicians from local communities ● Projects could show collaboration between orgs (e.g. nonprofits) and/or industry tie-ins ● Include a workforce development component that creates living wage jobs	Environmental engineers, Civil engineer, Political science, politicians, Community colleges, State groups funded through WIOA (Dept of Labor), skilled technicians	
3	**Where are there opportunities in the development of policies for Indigenous or local knowledge to be not only incorporated, but to help guide design and decision making?**		
3.1	Develop tools/processes, best practices, and new kinds of jobs/positions inside government for community engagement and stakeholder participation in decision making. A key facet of this is creating the jobs/positions for champions on the inside of government who speak multiple languages (professional jargons, local dialects, etc.) and can translate between community and researchers/government. This type of professional (or team of professionals) would spend time with communities on the ground and follow up, communicating community concerns by packaging information and pushing it up to relevant government staff & vice versa. Year 1 - Funding for community representatives to participate in design/development discussions with planning agencies - Multiple positions for community reps who have expertise in different backgrounds - Capacity building in project management, design charette, etc. Years 2-3 - Cadre of skilled people who are trained/paid to do this work, e.g., 5 people on 3 islands trained in this kind of facilitation - Develop framework/standardized methodology that is shareable in other areas (Caveat: communities organize/change in different ways so framework needs to be adaptable)	Project management, social science, conservation background; Connector and outreach professional--provide transparency about peoples' participation; Team member(s) with Native language proficiency and cultural knowledge of the place; Facilitator/mediator; Someone versed in policy who is able to identify areas for positive change	Need to be able to pay people for their time spent on engagement; Need all aspects of the dream team for there to be balance, trust, representation from positions of power and on-the-ground work; Traditional job postings might not reach the target audience of people we are trying to reach...need appropriate recruiting, e.g., within university Hawaiian Studies programs, though people shouldn't have to hold degrees; Disparity of "weight" between different knowledge-holders, persistence of injustice
3.2	A program/process for developing local metrics of success that sync up researchers'/ governments'/NGOs' interests with Indigenous community interests. Metrics should not be limited to monetary & production metrics, but should reflect community interests, which might encompass things like biodiversity, peoples' connection to land, ceremony, where food ends up, networks,	Community liaisons & Indigenous communities; Ecologists / biocultural researchers to weave concepts of species	Need NDA to protect sensitivity of knowledge that community members may share. How to incorporate critically important cultural

	sociological measures, ecosystem services of protected land etc. Year 1 - Identify communities and establish trust - Identify metrics that matter to community and conservation organizations, identify disconnects and elevate Indigenous prioritizations; map relationships between metrics; highlight areas of agreement between Indigenous priorities and dominant science Years 2-3 - Demonstrate that indigenous prioritizations MATTER → build programs that support those metrics of success	diversity and ecosystem services; Soil experts, geologists, agronomist (esp. If working on food security direction); Network specialist to demonstrate food web and network of food distribution	services but knowing they might have to be redacted in certain ways of reporting (e.g., network visualization); Epistemic violence has created different weights of knowledge, this program would have to counter epistemic violence
5	**How can we foster relationships better between researchers and native communities, create spaces where we can all learn from each other?**		
5.1	Vetting and confirming that research projects are grounded in community needs (guiding principles, design, relationships and co-designing the outcome, with opportunities to share and validate as you go).		
5.2	A tiered approach to co-funding & co-communing, including funding community member support and compensation based on values that are important to the community, the needs of the project and fostering long lasting relationships		
5.3	Ethically build the relationship to people and place to facilitate the appropriate point of entry and collaboration		
8	**How might we apply traditional land management frameworks to holistically manage watersheds in a modern society (which includes so many different land owners and stakeholders)?**		
8.1	Community as the Technology--Program to catalyze specific geographic community networks to drive collaboration throughout a watershed to drive adoption of traditional land management frameworks - Existing relationships where community is the technology - Managers that have pre-existing relationship - Citizen-science opportunities; people are the sensors; multi-tiered community sensing Year 1 ● Lay the foundation for a decision support tool ● Deepen existing networks and members ● Work across network to find existing knowledge and gaps to hit the ground running in year 2 ● Gather requirements: What elements could go	Government and landowners	Scientists' distrust of Indigenous knowledge; sometimes they don't understand how to work with multiple sources of knowledge Names given to research sites become naturalized over time and erase Native presence/knowledge. Instead site names should reflect

	into decision support tool? ● Define geographic scale to draw in multiple knowledge systems (cultural norms and values) ● Identify various technologies to incorporate		heritage/history and respect the culture. Supporting long term relationships and supporting research within them

8.2	Decision support tool to integrate traditional cultural knowledge and academic research to inform land use designations and ensure accountability by government and landowners
	- Platform will have to collect diverse data sets from various watershed projects; paleo records
	- Hawaiian newspaper records/other indigenous sources; what plants were used for homes, etc
	- Integrating Hawaiian Studies / Indigenous studies
	- Conduct spatial, cultural and natural resources inventories
	- Multi-tiered sensing applications (humans and tech)
	  - Utilize cutting edge tech (IoT, satellites, relational databases, AI/ML)
	  - People
			Accountability by government and landowners
			
			To ensure adoption and usage, must be led by Indigenous/cultural practitioners

8.3	Program to incorporate traditional and ecologically sound land management practices to mitigate impacts of climate change and pollution - Redesigning concrete channels that run from uplands to oceans - Capturing stormwater discharge - Fencing - Conversion of cesspools - Update bill language to modern day biocultural needs, particularly community-driven tracks for broader and faster adoption of practices - Paleo records and mapping - Kupuna / elder interviews		Connectivity to current land use laws and regulations Pace of change at state levels is slow
9	**How might we catalyze a circular economy that is fed by biocultural restoration efforts, especially in urban/suburban areas?**		
9.1	Circular economic development project around fish indicator species that also improve the health of “ridge to reef” (in Hawai‘i, this is the ahupua‘a model). Indigenous voices should set the context and drive solutions. Such a project might include creating a micro-economy around products made from invasives or wastes produced in the process of restoring ecologies	Community / fishing families; ocean wayfaring industry; small business association; product manager; workforce development	Practitioners and fishing families would have to be the ones to move this project forward. Protection of

	(ex. In Hawai‘i: Kiawe pod flour, mangrove biochar, invasive fish/limu as fertilizer for farmers). Example: Opelu Ko‘a study. Study opelu as an indicator species, led by Indigenous practitioners or fishing families. Build small businesses around opelu and other byproducts of restoration from mountains to sea. Study the evolving management processes and highlight nearshore and pelagic connections. Build in components with education and the larger community. Year 1 - Identify the right communities - Market research - Could set up local corporation to manage the program, non profit or for profit; identify board of directors - Community interviews on what the problems are, and how the community wishes they were solved - Define key workforce positions that ‘ohana and community members would fill from the start and in the future - Draft business plan - Identify potential partners to take over the project after NSF funding	programs; fisheries experts; cultural practitioners ex. net makers; farmers; conservationists; ecologists	Indigenous and local/community knowledge. Strong data management agreements that prioritizes those protections. Community-driven research agenda development and implementation Community / fishing families should have the long-term, sustainable paid positions in this circular economy Make sure any potential project does not go against any regulations or protections in place at the local/state/federal level ESA/NEPA requirements
9.2	Circular economic development project around waste management with parallel study on the effects of an ahupua‘a approach (ridge to reef) on water quality and fish enhancement. The project would identify upstream outputs and how to manage certain waste products in order to positively affect water quality and fish populations, using algae or fish species as indicators of upstream pollution. An example waste management technology might be pyrolysis technology (biochar). Year 1 - Baseline measurements - Establish project collaborator relationships		
10	**What applications/innovations emerge when indigenous knowledge is applied to green infrastructure, planning, design, construction and maintenance?**		
10.1	Rethink how we do community engagement on green infrastructure. Create access points, effectively use technology (or not use it when it’s prohibitive to	Trained facilitators are key; Insight into government;	Goal of inclusion, have checks set up at every step of the way to

	participation) to broaden meetings and knowledge sharing, ensure participation and contribution from an Indigenous perspective, ground guiding questions in Indigenous approaches, and achieve understanding so that partners collaborate for the long haul.
	Year 1
	Look at infrastructure planning through a community equity lens.
	- Identify stakeholders, Community relationships, Planners
	- Work with stakeholders to identify the needed infrastructure and Indigenous knowledge
	- Bring this knowledge to developers
	- Notification system to bring community together
	  - Identify the system most effective to reach people that are not usually represented
	  - Get feedback on planning
	Years 2-3
	- Define actions to weave Indigenous knowledge into existing infrastructure plans
	- Shift to communities and counties driving development
	- 3rd year, come up with a plan to implement on a statewide level
		Representative from each community group; Systems thinker; Developers	ensure there is no exclusion (and their voices are being heard)
			
			Developers have different priorities, how can we find common ground
			
			Respectful dialogue between differing parties/perspectives
			
			Funding. Developers oftentimes lead design because they hold the money.
			
			Shift to counties & communities driving development.

10.2	Better funding: Involve communities in prioritizing capital improvement projects and allocating funds. Incentivize developer investment - show how green infrastructure and incorporating Indigenous knowledge and perspective has long-term economic benefits for all stakeholders as well as social, cultural, and environmental.		
10.3	Create a guide for a process by which local groups can define terms/practices specific to the context of their geography, culture, and project goals. The guide would create shared knowledge, language, terminology, and context for work that centers Indigenous knowledge in planning. It would be a way of sharing practices that is not exclusive to academia. Year 1 - Research: Have conversations with community members, get their input on what challenges they experience when working with development projects, as well as their ideal solutions Years 2-3 - Generalize for best practices and scaling - Regional testing and refinement	Project leaders need to be trusted by communities; Community leaders; Researchers; Cultural practitioners; Planning department representative; Policy representative	Concerns around use of traditional knowledge Land ownership can be a contentions or unfamiliar concept to some Indigenous peoples Respect for the sacredness of shared Indigenous knowledge. Ensure to give credit where credit is due. This expectation needs

			to be set from the beginning.
11	**How might open geospatial data, aerial imagery, and machine learning be utilized or redesigned so as to protect cultural resources & Indigenous knowledge?**		
11.1	Provide more usable data products (and training) that are widely and openly accessible to wide varieties of users, excluding sensitive information (proprietary software packages vs. 'open' kml files, etc.); Develop innovative ways to visualize and tell stories about geospatial datasets, highlight culturally sensitive areas. Year 1: - Identify usable vs. "unusable" data products and/or interfaces/platforms/packages for multiple end-users; gaps between known data & diverse applications - Prioritize data needs and innovative dataviz solutions that don't require high tech experience - Identify emerging Augmented Reality / Virtual Reality technologies that would accelerate data product access & awareness - Identify tools for integrating sketch mapping and more quantitative data gathering & analyses - Target a shovel-ready pilot, e.g. PNW traditional tsunami mapping with pollen records, to link to contemporary vulnerability & risk management - Inventory hardware & software tool needs, identify Technology Readiness Level for developing/emerging tools to scale for Phase 2 Years 2-3: - New geospatial datasets - BMPs for culturally sensitive areas - Performance metrics for evidence of protection of resources, cultural practices, restoration, {# users, db access, etc} - New applications of fledgling/other discipline ML - DataViz tools, user guides, K-12, community college curricula, case studies for data stories - Empowered/trained communities that weren't previously armed with emergent tech data	Community groups, local planning depts, computer scientists, data collectors, drone groups, archaeologists, subject matter experts, science communicators to bridge to → expert storytellers (press, media, art), historians, documentarians, interface designers, backend/frontend developers,	Julie: "The how is more important than the what" t(0) conversation & credentialed relationship building/trust again; WHY, WHO, WHO benefits, from pre-project planning phase through implementation through challenges with story-telling knowledge, widely available maps vs access to tech-enabled data Approach & angle of engagement for kupuna, community consultations, M.L., A.I., unintended consequences & downstream impacts
11.2	Develop methods to map TEK and how this info can be used in the context of coastal restoration and adaptation to sea level rise. Year 1: - Identify relevant existing case studies to use as examples - Identify groups and ways for trust-building with	Should be run from a TEK table, with other expertise, backgrounds, etc. pulling up chairs Educators,	Specific to SLR, flooding, new potential unscrupulous characters? Insurance, reinsurance, real estate, etc.

	TEK sources; targeted place-people-practice engagements - Broaden from acute response within TEK to identify needs to longer-term inclusion & accomplishments - Identify limitations of existing methods (environmental measurements/observations, ML tasks at millions iterations, etc), develop capacity & pipelines for student education and dual fluency perspectives & career trajectories Years 2-3: - Scalable & adaptable case studies success stories - Growing databases, empowered communities - New hyperlocal scale quantification of Sea Level Rise, episodic flooding events, frequency/duration/impact - New outputs beyond scientific publications - Shared understanding & appreciation for contemporary sciences and Indigenous knowledge - Diversify power structure for coastal flooding data and decision-making, "pulling up more chairs to the table" - Updated resources in GIS curriculum, training materials, industry internships, etc.	presenters, etc.	
11.3	Develop accurate and inclusive orthography (diacriticals, keyboard support, fonts, etc.) Year 1: - Develop a metadata standard that would properly articulate the nuance of language prior to full development of tools - Identify current language challenges & prioritize "shovel-ready" projects to PoC for later deliverables - Identify existing software projects in the space, (engage industry, ESRI, Apple, Windows, Google, for product integration?) - Targeted workshops, community surveys, interviews with case study locations Years 2-3: - Improved web search engine optimization & outputs - Established pipeline, documented standards - Commercial product adoption	Indigenous language specialists, linguists, for verification of data entry & handling complicated translation variations Backend/frontend programmers for translation of tools, storage, viz Industry partners (ESRI, Google, etc.) and also open-source projects Operating systems mfrs (Apple, Microsoft)	Need Indigenous inclusion from t(0); complexity of dialects, etc. Unknown unknowns? Why hasn't this been solved yet? Is there a tech block or has it been 'market size' http://www.kipukadatabase.com/ uses web fonts, but comes with limitations for porting to other applications Long-term maintenance and support for funding
14	**How might we enhance the interface and coherence between traditional ways of knowing (e.g., kilo, customary oral traditions) and emerging technologies and contemporary forms of "data"?**		

14.1	Explicitly negotiate terms for data collection and knowledge sharing through universally accepted Indigenous NDA Plan Year 1 ● Review existing instruments for Indigenous IP--What gaps need to be filled? ● Identify data sensitivity concerns (understanding levels of knowledge that are appropriate/inappropriate to share) ● Review existing data privacy documents other Indigenous communities have successfully implemented Years 2-3 ● Develop Indigenous knowledge best practices: A trusted review process through pairing of Indigenous communities and scientists ● Develop more nuanced and culturally engaged form of the NSF's required Data Management Plan ● Develop Framework for how to use agreement and protocols in conducting workshops	Intellectual property lawyer, Indigenous knowledge keepers, Individuals from communities who have created agreements like this, Legal consultation, Media publications teams on how to update their policies around how the work is shared down the line, Data stewardship/managers, Data analytics experts, Expertise in digital security	Should include terms of post-publication, accountability by media. Some way the community is supported from what happens from these discussions, and that being a part of the plan. Accountability for researchers. Ensure reciprocity from the start by pairing the researcher (e.g., student) with the needs from the community side. Also reciprocity can be exchange. Potentially lack of Indigenous representation in research/funding/decision-making spaces, e.g., NSF board
14.2	Through dialogue with partners, communities, leaders, and industry, socialize the idea that connectivity and technology have the potential to bring both harm and benefit; they are not neutral. Focus the conversation on how technological innovations can be used as a force for good for Indigenous peoples & support this conversation with work to increase K-12 education and post-secondary education in respectful, reciprocal research partnerships. Year 1 - Come to agreement on methodology - Early engagement of community (provide advance notice) - Develop theory of change - What methods/actions get us to outcomes of changes to education as well as other streams of actions Years 2-3 - Guide, led by Indigenous knowledge keepers and educators, for communicating the concepts of Indigenous knowledge and ways of knowing about the ocean to scientists, educators, and the	Includes Indigenous and non-Indigenous expertise in and out of education, science, and policy (the people who can see across these knowledge systems)	

	public - Create document with explicit protocols that industry and others use to protect Indigenous communities in their effort to get reciprocity, ensure equity - Pathways to share globally to mobilize broader societal actions towards ocean sustainability and outcomes envisaged for the UN decade of ocean science of sustainable development - Mission aligned partnerships with industry - Trained post-secondary students in conducting community-engaged projects in partnership with communities		
14.3	Practices of Continuity: Indigenous peoples have always gathered and communicated environmental data through their own customary traditions. This solution empowers Indigenous communities to create new stories and renew/evolve their traditions in response to our environment changing and the challenges of the present moment. Rather than sending settler scholars to conduct informant interviews of Native peoples, this solution would involve putting technology into the hands of creators for community-driven storytelling to move people and affect research and policy. Year 1 - Review existing models - Develop methodology - Develop plan for program where Indigenous graduate researchers conduct research with their own communities	Digital Scholars, Community Members, Indigenous Language Programs, Traditional Knowledge Keepers, co-PI/co-Supervisor team, K-12 teachers, People who talk about indigenous, University advisors/mentors that are open to bringing into multiple disciplines, Filmmakers, Artists and music, Technical Expertise (engagement/indigenous expertise), Fellows in a cohort, Podcast makers, People who talk about Indigenous Futures	Following FPIC and IRB; Trust; Touch and go when it comes to research (that's why invest in students in the community even if their professors are not from the community); Lack of continuity; Risk of too narrow in scope, geographically while trying to put reigns around it, managing scope creep; Understanding of the restrictions around sharing different types of knowledge - e.g. sacred knowledge, chants/stories held by one family or group etc.
16	**How might we develop career pathways connected to indigenous practice while creating livable wages in STEM and Resource Management (Kuleana into Careers)?**		
16.1	Develop regional bridge programs from high school to college with a focus on place-based learning and career development in biocultural restoration and coastal management fields. Work to be undertaken would include research/planning as well as implementation & scaling.	Trans disciplinary faculty team that have a passion for and wants to teach early college pathway courses;	

	Year 1 - Develop partnerships with target community colleges that serve Indigenous communities, including tribal colleges - Survey other bridge programs from high school to college, collect the data on existing programs, find best practices, ways of replicating what these programs are doing - Identify faculty that have a passion for and want to teach early college pathway courses - Engage with current and former leaders from university land and sea grant extension programs to understand what opportunities for partnerships exist - Develop a fundable program for Indigenous practice extension agents	Education policy makers, placed based practitioners, STEM squared teachers; Consortium of CC's; Existing networks of indigenous groups, community development corp, Indigenous business leaders; Former leaders of land and sea grant extension programs	
16.2	Develop a program of internships with aligned emerging businesses doing the business of coastal management and restoration with Indigenous knowledge. Goal of the program would be to train and mentor young students into new/emerging fields and career paths.		
17	**How might we center Indigenous wisdom as a foundational piece of STEM and Resources Management as to amplify and prevent erasure of indigenous brilliance?**		
17	A large network/center/hub to support the collaboration of Indigenous peoples and communities with researchers in and out of the academy. In year 1 teams could identify existing Indigenous hubs/centers and vision and prototype what the center would look like. In years 2-3 the the center could begin the work of creating outputs such as reimagined requirements for funding and the review and reporting/evaluation process that include Indigenous communities; documentation of what respect looks like in engagement with Indigenous communities, with the goal of elevating these respect guidelines to the level of other required/standard safety and human research protocols; resources for professors engaged in teaching and/or research on their responsibilities; resources on areas where Western training and Western notions of what science is may create tension with Indigenous knowledge, Indigenous protocols and Indigenous relational accountability; resources on topics like Free, Prior & Informed Consent processes and Data Sovereignty, etc.	Indigenous scientists/researchers, Indigenous communities, Indigenous practitioners, Universities, UN specialists on Rights of Indigenous Peoples, Anthropologists, Native Language speakers/experts, NSF and other public and private funders, Education researchers	While the network/center/hub would serve researchers, teams should also consider community center models that are beyond universities. Work in this area should keep a place-based emphasis since Indigenous Peoples are not homogenous and there isn't a one-size-fits-all approach.
18	**How might we build safe supported educational environments for Indigenous people to thrive in STEM and Resource Management?**		

18.1	*Focus on the Educators* - Program for Teacher Training & Professional Development that focuses on culturally sustaining pedagogy, sustainable development, biocultural restoration to uplift students into STEM/Resource Management Year 1 ● identifying and organizing educators across academics and workforce ● plan for institutionalizing with decision makers ● identify community partners ● start to develop curriculum for educators ● incentives for recruitment of teachers Years 2-3 ● new curriculum for educators/professionals ● established network of educators ● established network of community partners ● dissemination of results ● systemic change in educational system		
18.2	*Amplify Existing Pathways* - K to 12 programs that offer educational and enrichment activities that augment existing tracks, leading to early credentialing/certifications and college credit and pathway to career opportunities Year 1 - Inventory existing, long-standing internship programs (e.g., PIPES) - Identifying benchmarks and/or certificates for K12 students to achieve - Developing materials/curriculum - Alignment with current tracks in high school Years 2-3 - Increased capacity		
18.3	*Cohort-Based, Apprentice/Mentorship Program* - Support post-secondary Indigenous students with cohort structure with linkages to professional and cultural mentorships and paid internships; framework for flexible stipends to address family obligations, etc. Year 1 ● Learning, listening and sharing sessions with other nascent/developing programs ● Identify series of certificates to level up students to ultimate degree ● Tied to community partners who have earned certificates ● Develop framework for flexible stipends ● Inventory of relevant paid internships with cultural practitioners/community partners Years 2-3		Family obligations, Dedicated space on campus for support, Information to post-academic career opportunities, not just academic careers, Help to attain useful certifications, Make all relevant resources easily available

	● Launch of several pilots, learning and evaluation ● Launch version 2.0, learning and evaluation ● Determining increased capacity and employability of cohorts ● Targeted dissemination of results ● Increased retention of students		
19	**How might we influence policy at all levels to ensure that decision making is aligned to Indigenous practices?**		
19	A university food program for Indigenous undergraduate or graduate students in STEM and Resource Management fields, parallel with a biometrics study following student physical, mental, spiritual health & academic performance and retention while on a traditional, place-based diet linked to a specific regional biocultural restoration effort. For example, in Hawai‘i this might look like a study group of STEM or Resource Management students that eats traditional food crops and plant medicines produced in a restored or in-restoration ahupua‘a system (Hawaiian agricultural system from mountains to the sea) that they themselves are studying. In year 1 teams could develop a pilot program at a local university and in years 2-3 teams could work to develop partnerships and collaborations to scale the program model to other regions and/or to other demographics.	University food programs, Human Health / Nutrition researchers, Agroecologists, Native healthcare practitioners, Farmers/fisherpeople, Post-secondary educators in STEM & Resource Management, Chefs and/or food service businesses	Human Research considerations; Free, Prior & Informed Consent; safety of biometric data from big pharma and agribusiness; reciprocity for research subjects & communities such as access to free health care, food, education/training regarding health and nutrition, stipends/honoraria

Appendix B: Recommendations to Funders

How might we co-design the grants application process to be more accessible to Indigenous communities that may be disenfranchised by the stringent timelines and exacting deliverables required by institutional sources of financing – to seed upfront support (capacity and capability) for beginning and continuing projects (including access to observational instrumentation)?

- Funnel via an organization that is independent of institutions and government
    - Way for many smaller projects to come together, build efficiencies, and bring more community members together under a larger concept
    - One proposal that can be used across different funding opportunities
    - Provide education and training
    - Review proposals and provide feedback
        - Feedback on applications from funders as well
- Build Capacity
    - One-on-one technical assistance
    - Provide templates for organizations to use
    - Synchronous and asynchronous support
    - Budget examples that can be accessed independently
    - Provide business support
    - Provide additional funds for training
- Adapt the granting system
    - Incorporate additional metrics into grant evaluation and reporting, beyond traditional Western metrics including:
        - Social service indicators
        - Spiritual aspects
        - Holistic community resource
        - Kilo observation platform
    - Pilot programs
    - Relationships before transactions; Build relationships with national funders
- Crowdsourcing
    - Identify and build communities' capacities to fund themselves

Appendix C: List of Participants

The workshop was attended by over 300 viewers, and of those 211 unique participants contributed to substantive aho and aʻa discussions that informed this report and its recommendations. Following our FPIC protocol, participants were surveyed for permission to include their names. The list below is those who gave their permission to be listed, and is not an exhaustive list of all workshop participants.

Aaron Stein

Adina Paytan, Researcher, UCSC

Alissa R. Takesy, Grad Student, University of California Santa Cruz

Amanda Millin, Food Sustainability Program Manager, HOH808 / Mālama Puʻuloa

Amber Pairis, Director, Climate Science Alliance

Amberlene Thompson, Scribe, Purple Maiʻa

Andrea Akall'eq Burgess, Global Director Indigenous Peoples and Local Communities Program, The Nature Conservancy

Ardis Eschenberg, Chancellor, Windward Community College

Barry Antonio Costa-Pierce, Professor of Ocean Food Systems, University of New England and President/CEO of the Ecological Aquaculture Foundation LLC

Becca R. Lensing, Graduate Student, University of Hawaiʻi at Mānoa

Benjamin Trevino, President & CEO, Hawaii Institute for Public Affairs

Brenda Asuncion, Hui Mālama Loko Iʻa Coordinator, Kuaʻāina Ulu ʻAuamo

Brent Kakesako, Hawai'i Alliance for Community-Based Economic Development

Brian "Ioane" Jahn, Sustainable Agriculture Program Coordinator, Kāpili Like Hawaiʻi

Brian Glazer, Associate Professor, University of Hawai'i

Bruce Hamilton, Program Director, NSF

Carlo Caruso, Graduate Student, Hawaii Institute of Marine Biology

Chaitanya Baru, Senior Science Advisor, NSF

Charles Abimbola Faseyi, Mr, Africa Centre of Excellence in Coastal Resilience, University of Cape Coast, Ghana

Chenae Bullock, Shinnecock Tribal Member, Owner of Moskehtu Consulting LLC

Christina Comfort, Program Manager, WAI: Wastewater Alternatives & Innovations

Colleen McCormick, Coastal First Nations-Great Bear Initiative

Corine Sinsin PhD, Laboratory of Biomathematics and Forest Estimations, Faculty of Agronomic Sciences, University of Abomey-Calavi

Cynthia Chan, Education Grant Manager, Billion Oyster Project

Daniel (Bubba) Lipe

Dawn Lippert, CEO, Elemental Excelerator

Deborah Bidwell

Diamond Tachera, Graduate Research Assistant, University of Hawaiʻi at Mānoa

Don Gerhart, President and CEO, Challenger Biosciences LLC

Eleanor Sterling, Jaffe Chief Conservation Scientist, Center for Biodiversity and Conservation, American Museum of Natural History

Elizabeth A. Lenz, PhD, Assistant Director for Diversity and Community Engagement, University of Hawai‘i Sea Grant College Program

Emilia Kandagawa, Community Process Designer, Hawai‘i Institute for Public Affairs

Emuobonuvie Grace Ayeta, Ms, University of Cape Coast, Ghana

Esther Widiasih, Associate Professor, UHWO

Frederick Reppun, Education Coordinator, He‘eia National Estuarine Research Reserve, University of Hawai‘i

George I Matsumoto; Senior Education and Research Specialist. Monterey Bay Aquarium Research Institute

Guilliana E. Hernández-Casanova, Graduate Student, University of Puerto Rico at Mayagüez

‘Ainoa Manuia, Computer Science Coordinator, Ke Kula ‘O Nāwahīokalani‘ōpu‘u

Ilima Ho-Lastimosa, Waimanalo Learning Center

Jarrett Keohokalole, Senator, Hawaii State Legislature

Jason Edward Lewis, University Research Chair, Concordia University

Jason Mehlinger - Education Specialist - Hawai‘i's Division of Aquatic Resources

Jason Younker, Assistant Vice President and Advisor to the President for Sovereignty and Government-to-government Relations, University of Oregon

Jay Castro, Guampedia

Jeanie Yukitomo HawaiiUSA FCU Senior Business Development Officer

Jennifer VanderVeur, Sr Program Manager for Maui Nui, The Coral Reef Alliance

Jenny Yagodich, Director of Educational Programs, Mālama Pūpūkea-Waimea

Joachim Schneider, Project Coordinator, WAI: Wastewater Alternatives & Innovations

Joanna Philippoff, Assistant Specialist, University of Hawaii at Manoa

Joe Warmington (Mountains to Sea Wellington)

Judith Lemus, Interim Director, Hawai‘i Institute of Marine Biology

Julie Maldonado, Associate Director, Livelihoods Knowledge Exchange Network (LiKEN)

Julie-Ann Cachola, Planner, Department of Hawaiian Home Lands

Kainalu Steward, M.S Candidate Tropical Conservation Biology & Environmental Science, UH Hilo

Kalisi Mausio, Crop modeler, University of Hawaii

Kammie Tavares, Geospatial Analyst, UH Mānoa SOEST

Kamuela (Samuel) Plunkett

Kawika B. Winter, Reserve Manager, Heeia National Estuarine Research Reserve

Kealoha Fox PhD, Senior Advisor, Institute for Climate & Peace

Kēhaunani Springer, coastal community capacity development advisor, Conservation International Hawai’i

Kelly Asato, Teacher, Public School

Kelly Williams, Lecturer, University of Hawaii West Oahu

KEVIN CHANG

Kevin Mukai, COO, Hohonu

Kimeona Kane, Director of Community Outreach- 808 Cleanups

Kimi Makaiau

Kirk Deitschman, Ke Kula Nui O Waimanalo

Lala Nuss

Laura Stein, Aquaculture Industry Analyst, Minnowtech

Leon Wang (王立中), Ocean Solutions Accelerator Associate, Sustainable Ocean Alliance

Lesley Iaukea, Specialist, University of Hawaii Mānoa

Lisa McManus, Assistant Research Professor, Hawaii Institute of Marine Biology

Lydia Ladah, CICESE

Lyle Tabata

Madeleine Sherman, Communications and Educational Associate, Hawaii Institute of Marine Biology

Malia Ana J Rivera, Specialist/Professor, University of Hawaii at Manoa

Malia Waits - Limu hui member

Manuel WMD Kuloloia, Makuakane, I Ke Kai o Kuloloi'a Lineage - Ke Kai o Kuloloi'a

Manulani Aluli Meyer

Marco Hatch, Associate Professor, Western Washington University

Matt Ito, Ph.D Student, University of Hawai‘i at Mānoa

Matthew Neel, Cultural Heritage Management MA, Sonoma State University

Meagan Wengrove

Melanie Lander, Community Planning and Design Extension Agent, Hawaii Sea Grant College Program

Melissa Poe, Social Scientist, University of Washington Sea Grant

Melissa Rietfors, Program Specialist VI, ALU LIKE, Inc.

Melodie Grubbs, Science, Research & Policy Specialist, University of Southern California Sea Grant Program

Merri Keliikuli, HACBED

Mikhail Davis, Director of Technical Sustainability, Interface, Inc.

Mindy Mizobe, Project Manager, Hawaii Institute of Marine Biology

Moana P.K. "Ulu" Ching

Nakoa Goo, Graduate Assistant, University of Hawai'i

Nicholas Hill, CEO, Coast 4C

Nicole L. Crane

Onyeweenu C. Ogene, Teacher Resident, Alder Graduate School of Education, Class of 2021

Paula Moehlenkamp

Pauline Sato, Executive and Program Director, Malama Learning Center

Pohai Kirkland

Pua‘ala Pascua, Coordinator, Ahupua‘a Accelerator Initiative

R. Eugene Turner; Boyd Professor, Louisiana State University

Robert Richmond, Research Professor, Kewalo Marine Laboratory, University of Hawaii at Manoa

Ronnie Huddy Hau'ula Restoration and Historian

Rosalyn KRD Concepcion, Loko I`a Po`o, PAF/Waikalua Loko I`a

Rosanna Alegado, Associate Professor of Oceanography, Director of the Sea Grant Center of Excellence for Integrated Knowledge Systems

Sabina Jehan Khan

Sam Aruch, Founder, Natural Resource Data Solutions Inc

Sandy Ward, Executive Director, Hui o Ho`ohonua

Scott Laursen, Climate Adaptation Extension Specialist, Pacific Islands Climate Adaptation Science Center

Shalen Prado, PhD Candidate, McMaster University

Stanley Gaudion

Sutej Hugu, Regional Coordinator for East Asia, ICCA Consortium

Yoshimi M. Rii, Research Coordinator, He‘eia National Estuarine Research Reserve, Hawai‘i Institute of Marine Biology

Yvonne Chan, PhD John Kay Teaching Chair in Research Science, ‘Iolani School

Appendix D: Aho Descriptions

Aho 1: Coastal Biocultural Restoration for Resilience: Food & Flooding
Under climate change and ecological crisis, coastal areas are at risk of flooding and other disasters. At the same time coasts encompass boundary zones that contain biodiversity and can be highly productive of ecosystem services and food for humans. This track explores the twin challenge and potential of coastal biocultural restoration for resilience, highlighting the potential of Indigenous knowledge contributions to hydrology, geomorphology, as well as stewardship of freshwater, brackish, and saltwater ecosystems.

Aho 2: Integrating Indigenous Knowledge of Place with Computational & Network Systems
Indigenous ecological knowledge is the result of living in long-standing relationships with place--relationships characterized by close observation, communication protocols, and reciprocity that have produced well-tested practices. This track explores how Indigenous, observation-based stewardship can inform innovations in areas like sensor system networks, computer vision, and emerging computational innovations such as machine learning, data integration, information management, quantitative analytics, data visualization, and IoT technologies.

Aho 3: Sustainable Development and Coastal Biocultural Restoration
Breaking out of limited frameworks of "preservation," Indigenous biocultural restoration seeks to achieve positive social and environmental impact through sustainable development and social entrepreneurship. This track considers the economic and social potentials for biocultural interactions between humans and environments that (re)generate circular and/or sustainable economic value for local and regional communities.

Aho 4: Indigenous People in STEM & Resource Management
STEM and resource management fields face severe challenges in diversity, equity, and inclusion of Indigenous peoples. This track considers effective models and opportunities for engaging, retaining, and accelerating Indigenous peoples in STEM and resource management education, training, and innovation through place-based, culturally responsive, and other relevant pedagogies.

Appendix E: Free, Prior, and Informed Consent Guidelines

Recognizing the egregious history of thefts and appropriations of knowledge from Indigenous Peoples by institutions, scientists, governments, corporations, and others, and recognizing that the UN Declaration of the Rights of Indigenous Peoples states that Free, Prior, and Informed Consent (FPIC) is a right of Indigenous Peoples, this document sets up guidelines for:

- The process that will be used for writing the workshop report
- An ʻaelike, or acknowledgement and agreement, outlining best practices and standards all workshop organizers, speakers, and participants will be asked to follow in this workshop

ʻAelike: Standards in Collaborative Participation

The following code of conduct was developed to facilitate meaningful collaboration and exchange. By participating in this **virtual** workshop, you agree to follow these best practices and will be held to the following standards:

- Be respectful of other participants' manaʻo, please do not interrupt
- Please be aware of the air you take up in the room
- Respect the viewpoint of others: non-agreement can be a respectful process
- Do your best to be an active listener and a thoughtful participant
- Please remember to mute yourself when not speaking to help minimize background noise
- Be understanding of those who are juggling multiple responsibilities (childcare, schooling, kupuna care, etc.)

ʻAelike: Standards on Sharing and Caring for Indigenous and Local Knowledge

Within the context of this workshop, there may be information that knowledge holders, their organizations, or respective communities consider sensitive, private, or are otherwise unwilling to share in the public domain without express consent. To ensure that knowledge is shared in appropriate ways and that information and materials produced based on the workshop are used in ways that respect FPIC, we propose the following:

- No one, including guardians of traditional knowledge, is required to share any information they don't want to share with workshop organizers or participants, and should not be pressured to do so.
- No one, including guardians of traditional knowledge, is required to answer questions they do not want to answer from workshop organizers or other participants, and should not be pressured to do so.
- Participants can and should make requests of workshop organizers and other participants about how knowledge may or may not be shared, and who information should be attributed to. These requests will be honored.
- While exchange is highly valued, we remind our participants that Indigenous and local knowledge shared by workshop participants and speakers should not be reshared beyond the workshop without first:
    - Asking permission from the sharer, and
    - Asking who the knowledge should be attributed to.

- Consistent with the World Intellectual Property Organization's practical guide on the Intellectual Property (IP) rights of Indigenous Peoples and Local Communities, participants maintain IP rights over anything they share in the workshop.

The Workshop Report

Participants should understand that one outcome of this workshop will be a summary report that will be submitted to the U.S. National Science Foundation (NSF) to inform the creation of a potential track in the NSF's Convergence Accelerator. The report will also be shared publicly via the workshop website (bcrworkshop.com).

Please read the Workshop Overview for more information on the overarching goals, format, and desired outcomes from the workshop.

→ Portions of this workshop will be recorded to inform the Workshop Report

- Workshop facilitators will advise all participants regarding which sessions will be recorded and will also verbally indicate when recording is being turned on. Our virtual workshop platform, Zoom, will also present a pop-up box notification that recording has started.
- At any time, participants can ask organizers and facilitators to temporarily disable video recording when sharing sensitive information that they do not want recorded. These requests will be honored.
- Plenary and panelist presentations in the Workshop will be video recorded and posted online.
- Aho meetings may be recorded for reference when writing the Workshop Report, but will not be posted online. All session recordings will be accessible by the facilitators and core planning team only.

→ Detailed notes will be taken during Aho meetings.

- In some instances, a volunteer scribe will take notes during group discussions in the workshop; this scribe will be identified if they are taking notes. Notes will solely be used to inform the Workshop Report.
- In some instances, workshop participants will be asked to contribute to a Google Doc or other online document (Google Slides, Google Jamboard, a survey/questionnaire, etc.). Information written by participants in shared documents may also be used to inform the Workshop Report.
- Participants can, and should, make requests of workshop organizers, facilitators, and scribes to record information in a specific way when note taking. These requests will be honored. For example:
    - Asking that information shared not be recorded in the notes
    - Asking that information shared be marked as not for use in the report
    - Asking that information shared be attributed to a specific person or group
    - Asking that information shared be presented in the report in a way that does not identify the source of the information, or identifies the information with a region (rather than a specific community) or general stakeholder group

- Information recorded in the notes or contributed via online documents will not be used by the workshop organizers or their collaborators for purposes other than composing the workshop report without prior approval and consent of workshop participants.
- After the completion of the workshop, notes will be accessible by the facilitators and core planning team only.
- Participants can withdraw what they've shared at any time and request that information be deleted, including after workshop meetings, and these requests will be honored. Please bear in mind that requests to delete information from the workshop report *after* it has been submitted to the NSF cannot be accommodated.

→ Information used in the report will be attributed to the correct sources based on permission.

- Workshop participants will be asked in a post-survey if they give permission that their full name be listed in the workshop report in a list of workshop participants.
- In some instances workshop participants will co-create or otherwise collaboratively produce position statements or recommendations, and these will be presented in the workshop report as contributions by the general group of workshop participants.
- Direct quotations or summaries of specific information from one individual or organization may be included in the workshop report. These individuals or organizations will be contacted during the writing of the report to ask permission to include the information and attribution to them, and before the draft report is circulated to all workshop participants.

→ Participants will be given the opportunity to review the workshop report before submission to the NSF and before posting the report to the workshop website.

- A draft of the workshop report will be distributed to all registered participants using the email address provided upon registration. A deadline for feedback will be identified upon distribution, however please note that the review and comment period will be no less than one week and no more than two weeks to allocate time for subsequent editing.
- Contact Kelsey Amos, kelsey@purplemaia.org with questions or comments about the report draft.
- Responsibility for the final draft of the report rests exclusively with the authors.