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Nā Kilo 'Āina: Visions of Biocultural Restoration through Indigenous Relationships between People and Place

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Abstract: Within the realm of multifaceted biocultural approaches to restoring resource abundance, it is increasingly clear that resource-management strategies must account for equitable outcomes rooted in an understanding that biological and social-ecological systems are one. Here, we present a case study of the Nā Kilo 'Āina Program (NKA)—one approach to confront today's complex social, cultural, and biological management challenges through the lens of biocultural monitoring, community engagement, and capacity building. Through a series of initiatives, including Huli 'Ia, Pilinakai, Annual Nohona Camps, and Kūka'i Laulaha International Exchange Program, NKA aims to empower communities to strengthen reciprocal pilina (relationships) between people and place, and to better understand the realistic social, cultural, and ecological needs to support 'āina momona, a state of thriving, abundant and productive people and places. After 10 years of implementation, NKA has established partnerships with communities, state/federal agencies, and local schools across the Hawaiian Islands to address broader social and cultural behavior changes needed to improve resource management. Ultimately, NKA creates a platform to innovate local management strategies and provides key contributions to guiding broader indigenous-driven approaches to conservation that restore and support resilient social-ecological systems.

Keywords: biocultural monitoring; community engagement; community-based management; indigenous knowledge; indigenous science; Hawai'i

1. Introduction

The term biocultural continues to gain momentum in research and conservation circles around the world, but the underlying concept of linked biological and cultural systems is something place-based and indigenous communities have known for generations. Broadly described in the literature as work at the intersection of biological, cultural, and linguistic diversity [1], research that examines the relationship between diverse cultures and their varied ecological contexts [2], and approaches that start with and are based upon cultural, place-based perspectives [3], a number of interdisciplinary and multifaceted efforts have attempted to characterize biocultural-oriented research. These studies, supported by social-ecological research exploring the feedbacks between humans and

natural systems [4], highlight a broad-sweeping need to develop biocultural approaches to understand the linkages and feedback between human well-being and ecological systems [5,6]. Yet there remains a need for case studies and programmatic examples sharing cultural approaches to building biocultural frameworks that are applicable at multiple scales.

A growing body of literature across academic disciplines asserts the importance of using a biocultural approach that recognizes the connections between people and place in order to inform adaptive management strategies [6,7], community-based management initiatives [7], and environmental literacy projects [8]. For example, Kimmerer (2011) uses the term “reciprocal restoration” to describe “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 ecological integrity” [9]. Winthrop (2014) uses the terminology “culturally reflexive stewardship” to describe stewardship practices grounded in cultural foundations, affirming social identity, and sharing cultural knowledge and motivations [10]. Pascua et al. (2017) use the concept of cultural ecosystem services as a mechanism to characterize “the ways place-based and indigenous groups interact with their surroundings to derive all forms of sustenance and maintain connection to place [11]”.

Understanding sociocultural and ecological systems requires a holistic understanding of the relationships and feedbacks that encompass intangible cultural-ecosystem services [11–13]. Recognizing that humans and the environment are one system is integral to improving adaptive management and governance [5]. Indigenous approaches have been an important means to enhance this understanding and recognition by highlighting the importance of relationships, values, and principles in guiding equitable and effective long-term outcomes [14]. The health of the environment is inextricably and reciprocally linked to the spiritual, emotional, physical, and overall cultural health and well-being of indigenous people [6,15]. In Alaska’s Inuit communities, climate change is threatening sea-ice ecosystems, a culturally and spiritually significant landscape, and subsequently contributing to the physical and emotional displacement of these groups to the landscapes that support their elements of social and cultural well-being [16]. In Hawai’i, these indigenous approaches have been applied on a larger scale managing biocultural seascapes, such as Papahānaumokuākea Marine National Monument and other large-scale marine protected areas [17].

Research that explores the restoration of social–ecological systems, and complementary efforts to better understand coupled human and environmental systems, require interdisciplinary tools and techniques as well as holistic perspectives that acknowledge reciprocal feedback between people and place [18,19]. In particular, social-ecological systems that encompass place-based and communities provide time-tested and context-specific insight into biocultural restoration in present day [15].

Putting aside preconceived notions of how science is defined in the modern-day context, in this paper we use the words “indigenous knowledge” and “indigenous science” interchangeably as a purposeful and meaningful way to respect the value of traditional knowledge. Traditional knowledge is a knowledge–practice–belief system that forms unmatched repositories of lived and experienced knowledge of natural resource management, acquired over generations, and often millennia, of interactions between people and place [20,21]. These repositories of long-term observations are born from indigenous inquiry and life experiences that shaped adaptive practices and allowed that culture to survive. It is crucial to be aware of how integration of traditional ecological knowledge into resource management can force indigenous people to fit into non-indigenous interpretations of what traditional and customary practices are and try to conform their knowledge systems into existing management systems [21]. Avoiding predetermined roles within collaborative research partnerships, it is critical to consider a mental shift from declaring the modern scientist as the principal investigator to declaring both indigenous peoples and academic scientists as co-researchers [22]. Indigenous science is a form of indigenous knowledge that “relates to both the science knowledge of long-resident, usually oral-culture peoples, as well as the science knowledge of all peoples who as participants in the culture are affected by the worldview and relativist interests of their home communities” [23]. We use “indigenous science”

to honor the biocultural knowledge encompassed in indigenous knowledge–practice–belief systems perpetuated through cultural values and practices.

Indigenous knowledge has been widely recognized for its value in providing alternative approaches to create adaptive ecosystem-based management, providing mechanisms for cultural institutions, leadership capacity, and perpetuating values and practice through intergenerational knowledge transmission [5]. Biocultural approaches present an opportunity for indigenous communities to build adaptive collaborative resource management built on indigenous values, worldview, and knowledge while accounting for social, cultural, and ecological factors [24]. There is substantial potential to support the development of equitable two-way research partnerships to bridge knowledge systems and create solutions based on a local-level understanding of the cultural and social factors that support resilient communities. Co-management approaches should be considered a ‘knowledge partnership’ that has far-reaching impact into supporting resilience through social learning networks, trust building, knowledge exchange, and collaborative problem solving [6,25]. Some inherent challenges in merging two knowledge systems surround the nature of the process ensuring that both systems are valued and equally respected, and indigenous people are not further marginalized from the partnership process and subsequent management decisions [26,27]. Adaptive governance of social-ecological systems will only be successful through first recognizing that humans and the environment are interconnected in one coevolving system [6].

Bridging the gap between the local and global scale, indigenous communities are integral to the development of biocultural approaches that are relevant to the local social, economic, and political environments that communities live in [28–30]. At a local-level, place-based approach is essential to assess aspects of resilience in social-ecological systems and to identify how specific environments and geographies affect holistic health of people and place [31]. Socio-ecological frameworks should also expand to integrate measures of community health and development helping communities find their strengths, strengthening their social systems and sense of place, among other important aspects of resilience [32]. However, transparent communication about the trade-offs between biodiversity conservation and human well-being is necessary to develop realistic solutions [33].

1.1. Weaving Indigenous Research, Community Engagement, and Capacity Building into our Biocultural Approach to Restoration

In building biocultural frameworks from the community level with applications for broader social-ecological systems, this paper presents a novel approach to weaving indigenous research, community engagement, and capacity building into biocultural restoration stemming from an indigenous worldview. As definitions of biocultural conservation continue to expand, and scholars and practitioners alike continue to weave ancestral and contemporary knowledge, technology, and philosophy, there is a critical need to demonstrate what these tools and approaches might look like in action, and from the perspective of indigenous communities. The Nā Kilo ‘Āina (NKA) Program represents one initiative to provide guidance for building measures and frameworks based on indigenous worldviews, perspectives, and values.

In this paper, we present a case study of the NKA Program, a programmatic approach to biocultural restoration of social–ecological systems that aims to address today’s complex social, cultural, and biological management challenges through weaving biocultural research, community engagement, and capacity building to impact local resource management and influence national and global management and policies. First, we focus on how NKA addresses biocultural restoration through an indigenous-based framework that creates a platform to collectively address cultural and social behavior changes needed to improve the holistic health and well-being of ‘āina, Hawai‘i’s biocultural landscapes and seascapes. Second, we provide an overview of the biocultural monitoring tools and community engagement strategies of the NKA Program. The NKA biocultural approach is explained through a programmatic framework that operates through Native Hawaiian community networks and partnerships from local to statewide resource management. NKA community networks

provide guidance for developing holistic measures of culture-based, social-ecological resilience based on local-community needs. NKA's work contributes to a recent movement to develop and implement culturally grounded indicators of social–ecological resilience [34]. This highlights a novel contribution towards developing biocultural indicators of linked cultural and ecological health to develop effective place-based management and contribute to the creation of culturally grounded frameworks for social-ecological resilience on a broader scale. Lastly, we highlight the role of NKA in building capacity within Native Hawaiian communities to respond to the challenges of research and management partnerships. This approach and the tools addressing social, cultural, and ecological health are applicable to other programs that aim to utilize a place-based or culture-based approach to biocultural restoration of social–ecological systems.

1.2. Strengthening Indigenous-Driven Initiatives to Support Resilient Social-ecological Systems

Globally, there are many examples of how indigenous people can guide and improve adaptive ecosystem-based approaches, supporting social-ecological resilience [16]. Yet, in many instances, conservation has marginalized indigenous people through management strategies that displace and subsequently negatively impact the well-being of indigenous communities [28,35]. As a result of colonization, numerous indigenous peoples have been disconnected from their ancestral lands and stripped of the power to control decisions that affect the well-being of their indigenous culture and the environment to which they are connected [36]. This paper provides an additional case study of an indigenous group engaging in collaborations to confront the systemic disconnect between people and nature.

A growing body of recent work aims to develop culturally grounded sustainability well-being indicators to better understand how ecological and sociocultural factors and feedbacks operate on multiple scales [3,34]. Indigenous-driven biocultural frameworks from Australia [37] and Aotearoa (New Zealand) [24,38,39] provide important contributions to resource management that include cultural well-being. Māori from the Ngāi Tahu Iwi in South Island, Aotearoa (New Zealand) are at the forefront of working in partnership with the University of Waikato developing a Māori-based framework for management of freshwater systems [24,38,39]. These frameworks are based on understanding cultural well-being through intimate knowledge of the relationships between people and the environment [31].

Several case studies aim to provide guidance for empirical research that can address paired human and environmental health in the context of social-ecological resilience, yet more are needed [32,40]. Ens et al. (2016) showed that indigenous biocultural knowledge plays a key role in joint efforts in protecting cultural and biological-diversity hotspots in Australia's terrestrial systems [41]. Additionally, partnerships with small-island communities in Indonesia, the Philippines, and Timor-Leste demonstrated the potential for indigenous knowledge to inform biodiversity conservation, disaster risk reduction, and climate change adaptation strategies [42]. Local communities can increase the relevance of scientific information to a broader group of stakeholders, produce communication materials that depend on the sociocultural environment, while also revitalizing traditional knowledge systems and strengthening intergenerational knowledge transmission [42].

In the midst of innovating biocultural approaches to collaborative co-management of social-ecological systems on multiple scales, it is essential to share the perspective of indigenous-driven efforts highlighting the importance of relationships, values and principles in guiding equitable and effective long-term outcomes in mainstream conservation [14]. These types of partnerships also serve as a mechanism for social justice and require engagement around issues of community capacity building, differential power dynamics, and the lessons from research and management partnerships [13,16,22,26,40,41,43]. It is important to acknowledge the need to decolonize Western discourse in research and create space for indigenous people to represent themselves [36]. In Aotearoa (New Zealand), Māori are at the forefront of building and implementing culturally grounded frameworks of holistic freshwater stream system health through Māori worldview and practice [38,39].

These efforts, supporting a collective voice advocating for indigenous communities to gain more control over their management decision making, fill a larger role than just consultation in cooperative, community-based, and collaborative management [21,27,36,40,44].

2. Nā Kilo 'Āina: A Biocultural Programmatic Approach

Established by Nā Maka o Papahānaumokuākea (NMP) ten years ago, the NKA Program utilizes a multifaceted, culturally grounded approach to address the complex resource management issues of today through biocultural monitoring tools and programs for community engagement that support positive cultural and social behavior shifts (Table 1). The systemic disconnect between people and nature underscores the need to develop measures of holistic health through a cultural understanding of social–ecological systems. The NKA Program works towards healing disconnects between people and the environment through honoring the importance of pilina. Pilina (defined as relationships) are threads that bind people to the places to which they connect, and to each other, to encourage a return to indigenous knowledge systems. Ultimately, NKA emphasizes the need to develop, build, and nurture pilina within the community to become more aware of dominant patterns of both the environment and people.

In the face of environmental, social, and political change, NKA operates on the shared understanding that, in order to improve place-based resource management, it is vital to strengthen pilina to 'āina through building communities of kilo, defined as both the practice and role of keen observer. Native Hawaiian knowledge systems of kilo support multigenerational communities to build a collective and intimate understanding of biocultural landscapes and seascapes. NKA initiatives are designed to empower communities through biocultural monitoring and community engagement to gather and build relationships between people who are committed to deepening place-based knowledge and expanding culturally grounded research. The program also builds the capacity of Native Hawaiians and local students, conservation professionals, and educators to serve communities and increase their voice and participation in management. This initiative weaves ecological and sociocultural information together to explore the holistic interconnectedness of the paired human and natural environment and assesses intertidal ecology (marine invertebrates and algae), algal diversity, population densities, and reproductive seasons and size of resource invertebrates such as 'opihi (*Cellana* spp.) and hā'uke'uke (*Colobocentrotus atratus*).

Building networks through a biocultural approach to community-based resource management increases knowledge sharing and empowers communities to navigate through highly complex social and cultural systems. NKA creates a safe space for critical discussion within community-based resource management for communities to co-develop management solutions that ensure the continuation of a productive and resilient 'āina. Ultimately, it is important to consider the sociocultural impacts of management decisions [45].

2.1. Overarching Vision: Restoring 'Āina Momona, the Holistic Health of People and Place

NKA is made up of several initiatives that strive to strengthen indigenous visions of healthy and productive social-ecological systems, or 'āina, a community of people and place. Feeding from the places that feed you continues a lifelong pilina that binds your commitment to care for these places and share this deep pilina and understanding into the next generations. In this special issue, 'āina momona (lit. fat, sweet, or fertile lands) is described as a state of perpetual resource abundance. Based on the foundation of NKA, we expand that definition to include abundant and productive communities that are inclusive of people and places. Our approach views supporting social-ecological resilience as a mechanism to return to 'āina momona, thriving and productive communities of people and places. 'Āina momona is the ultimate long-term goal for biocultural restoration in Hawai'i that speaks to the productive, healthy, and resilient lands and oceans, including the intimate reciprocal relationships our ancestors had with 'āina, which we are re-remembering today. Though 'āina is commonly used to reference land and resources, it is important to clarify that a deeper meaning of the term centers around

the reciprocal relationships between the lands, oceans, and people which feed and sustain well-being. Beyond the physical and/or material aspect of provisioning sustenance, this concept also includes feeding and sustaining the emotional, mental, and spiritual dimensions of well-being. Through this expanded definition of *‘āina* and its broader implications of the meaning of *‘āina momona*, we identify a greater collective movement to adjust our behaviors to support health and productivity together with lands, watersheds, and oceans with which we all share space. Seeing conservation as healing our people and for collective conversation about shifting behavior based on the holistic needs of a place and the practices those landscapes and seascapes can sustain [46]. Many Native Hawaiian scholars share related insights through their research on the value of intimate relationships to places and how inseparable, continual connections to places allow place-based and indigenous peoples to thrive [47–49]. These relationships are at the core of well-being as Native peoples acknowledge cultural relationships through genealogies and traditional cultural expressions and archival documents that connect Native Hawaiians to the lands and oceans across the Hawaiian Archipelago, including the Northwestern Hawaiian Islands [50]. These connections broaden the perspective of participants to honor and respect themselves/their individual self, family, community, surroundings, and places [51].

2.2. Creating a Foundation Based on Native Hawaiian Place-Based Values and Perspectives

NKA is a biocultural monitoring and community capacity-building program, established by the nonprofit group, Nā Maka o Papahānaumokuākea (NMP), and implemented in partnership with the University of Hawai‘i Sea Grant Program and a network of community partner organizations, and state and federal agencies. In 2009, a small group of Native Hawaiian undergraduates and graduate students at the University of Hawai‘i at Hilo recognized the importance of indigenous science in developing meaningful guidance to support community-based biocultural approaches in research and resource management. To address this gap, these scholars drew from their strong cultural backgrounds and formal training in ecology to develop the NKA program.

Established by NMP ten years ago, NKA initiatives are centered around biocultural monitoring tools, community engagement, and capacity building. Community-engagement strategies focus on the understanding of *pilina* as an important component to *‘āina momona*, the holistic vision of Native Hawaiian communities. The focal point of NKA is indigenous inquiry and multidisciplinary research applied in locally-relevant, experientially-driven programs, activities, and tools designed for multigenerational communities. Through focusing on intertidal ecosystems, NKA builds capacity within communities to collect quantitative and qualitative data from intertidal ecosystems and extending across terrestrial and marine ecosystems.

2.3. Addressing Complex Resource Management in Hawai‘i

Consistent with other approaches in community-based conservation that use a systematic approach, recognize coupled systems inclusive of humans, and utilize participatory methods in resource management [7], customary marine-resource management in Hawai‘i is characterized by traditional and local practices grounded in a sophisticated understanding of and familiarity with an area, resulting from generations of interaction with the natural resources of that place [52,53]. Developed by necessity as a means for the native tenants to not only survive on one of the world’s most remote island chains, but to thrive, these place-based interactions have come to represent the deep-seated connections between people and the places they descend from, relate to, and identify with [11]. Traditional knowledge is based on a traditional system of knowing, founded on fundamental observations, relationships, and practice. This knowledge lives on through Hawaiian communities that function as both physical places and social groups that are regarded as “cultural *kīpuka*”, where knowledge is passed on through active transmission of generational and ancestral knowledge through cultural practices [54].

Traditionally, Native Hawaiians possessed a sophisticated land- and ocean-resource management system built on a strict religious and social norms [52,53,55,56]. Traditional management systems

were self-sufficient for more than 1500 years, providing for estimated populations of 400,000 to 800,000 people [57]. Yet, the current health of Hawai'i's coastal fisheries is extremely threatened by major anthropogenic stressors [58–60]. As of 2013, Hawai'i's estimated population is approximately 1.4 million people. The effects of this growing population are reverberating through the political, social, cultural, and environmental communities as Hawai'i, and the world, prepares for a future dealing with overpopulation, urban development, and the deteriorating health of fisheries [60].

Drawing from traditional knowledge to support community-based marine resource management provides a promising path to respond to these issues and can facilitate the creation of collaborative, innovative approaches to conserve marine resources [46]. Recently, managers and practitioners in communities across Hawai'i have begun to explore formal co-management agreements, in particular those grounded in place-based cultural norms, values, and practices, between community groups and resource managers, like the State of Hawai'i [61–63]. These efforts are oriented around uplifting both people and place towards a vision of *‘āina momona*. However, it is important to note that compromises on both sides are necessary across both parties if co-management is truly the desired goal [33].

Though communities are involved in participatory co-management approaches, there remains additional room to empower communities through building a community's ability to trust in their knowledge systems and advocate for their priorities and vision of health and balance to ultimately restore biocultural landscapes/seascapes on their own terms. Pacific Island scholar, 'Epeli Hau'ofa (2000), explains, "We cannot do away with the global system, but we can control aspects of its encroachment and take opportunities when we see them in order to create space for ourselves [64]". This underscores the self-determination of Pacific Islanders to create equitable engagement in management to develop solutions that will guide the future health and well-being of their biocultural environment and future generations.

3. Programmatic Initiatives

Community-based resource monitoring depends on the trust, reciprocity, and inclusivity of indigenous peoples in decision-making and management [65,66]. Examining the patterns of indigenous knowledge and relationships to freshwater systems across Aotearoa (New Zealand), Australia, and North America, scholars use the term "cultural keystone species" as a focal point to better understand holistic freshwater-ecosystem processes through the interconnectedness of people to these ecosystems [67]. Māori developed a cultural health index focused on indicators of human–environment relationships through indigenous worldviews for a variety of river types that can grow national datasets of holistic health of people and ecosystems [38].

While there is indeed ecological research conducted under the NKA Program, our program acknowledges community data-sharing protocols regarding the research component of this work. This is part of a long-term partnership with local communities in Hawai'i to build local capacity of culturally grounded research and community engagement and to ultimately improve community-based resource management. The research is protected for the community to approve its use. The quantitative data NKA has collected is community-owned and part of collective discussions and co-management efforts to improve local, place-based resource management in Hawai'i. Due to the sensitive nature of the information, in particular target species populations and locations, the findings are protected as a principle of respect to the communities with which we partner and can only be shared in a more generalized format, pending community approval.

Table 1. Summary overview of Nā Kilo 'Āina Program (NKA) initiatives.

Initiative	Outputs/Deliverables	Scope/Scale of Engagement (<i>n</i> = No. of Communities Engaged)	Key Outcomes
Huli 'Ia Qualitative Biocultural Monitoring	Over 20 Huli 'Ia posters distributed for educational use	Since 2008, NKA has facilitated over 84 monthly Huli 'Ia discussions engaging ~138 participants ranging from 9–83 years old (<i>n</i> = 7)	Using this information, place-based Mauka-Makai (landscape and seascape) seasonal calendars were developed in three communities
Pilinakai Integrated Approach to Community-Based Monitoring including Quantitative Biocultural Monitoring	A Master's thesis developed in 2011 through the Hawai'i inuiākea program at UHM	Over 72 monitoring and data-collection weekends (2010–present) (<i>n</i> = 5) 20 University of Hawai'i at Hilo and University of Hawai'i at Mānoa undergraduate interns Three Graduate in Hawaiian Studies, Natural Resources and Environmental Management degrees built upon the Pilinakai and Nā Kilo 'Āina Program	Participants engaging in nature (both lands and ocean) to encourage personal connection, re-connecting to nature to discover responsibilities as native peoples
NKA Annual Nohona Community Engagement Camps and Programs	Over the past six years, NKA has hosted 12 camps, including annual camps in Kawaihae, Hawai'i (since 2011) and Hā'ena, Kaua'i (since 2016), and contributed to more than 10 other leadership and Lawai'a 'Ohana camps throughout Hawai'i	To date, NKA has worked with communities on Hawai'i Island, Maui, Moloka'i, Lāna'i, O'ahu, and Kaua'i (<i>n</i> = 9) Cumulative total of 550 participants ranging from 2–85 years of age. Over 33 interns trained in NKA monitoring tools	Developed biological inventory and monitoring methodology together with communities
Kūka'i Laulaha Leadership Building through Growing Indigenous Networks	50 photo books gifted to international partners	Annual cultural exchange in Mangaia, Cook Islands, and Aotearoa (New Zealand) established in 2014 (<i>n</i> = 5) Over 50 participants ranging from 16–70 years of age	Participants share cultural values, social issues, and resource-management strategies

4. Biocultural Community-Based Research and Monitoring Tools

4.1. Huli 'Ia

The concept of adaptation is embodied by indigenous peoples whose ancestors survived through adapting to a multitude of environmental changes. Traditional knowledge is part of a knowledge–practice–belief system [20] and in the Pacific Islands, indigenous communities are entering into community-based approaches rooted in contemporary extensions of traditional knowledge systems that provide valuable high-resolution insight into merging monitoring, customary management, and social mechanisms to support resilient holistic systems [68]. To perpetuate oral transmission of this contemporary knowledge base, we engage in training our memories to identify the changes in the environment and what how that can inform human behavior. This encourages local communities to engage in the knowledge system of kilo, keen place-based observations, that enabled our indigenous ancestors to understand their surroundings well enough to know when and where to gather food in order to sustain themselves for generations.

Huli 'Ia is an NMP tool that supports the NKA Program and engages participants in a process of conducting recurring biocultural monitoring activities to quantitatively assess coastal ecosystems while also qualitatively documenting observations—for example, storm systems, cloud patterns, flowering/fruited plants, reproductive events of land and ocean organisms, fish schooling/aggregating, and size classes (see [34] for additional details). In a facilitated process, participants document seasonal changes and shifts across entire landscapes over time in an effort to identify correlations between and across species and zones including the ocean, land, and sky. In a facilitated discussion with community biocultural-monitoring participants, the group discusses observations of dominant patterns at a particular time-bound scale (usually one month).

Through a discussion of individual observations and group comparisons, participants collectively learn how to reawaken their senses to pay attention to detailed occurrences from the changing of wind direction, wind speed, dominant cloud formations, and rain patterns, and begin to recognize connections between those observations across time and space. This internalization is ultimately intended to inform how people interact with the environment through Native Hawaiian knowledge systems. For example, this might include avoiding harvesting species in a particular location when it is known to be spawning. Huli 'Ia illuminates a dominant seasonal shift in shoreline communities that can inform future monitoring in these highly variable ecosystems. Built through long-term observation tested by environmental challenges throughout time [52], traditional knowledge can guide ecological monitoring and climate-change resilience frameworks [68,69]. For example, it was important to be down at the shoreline throughout both the rough surf in Ho'oilō (wet season) and the calm conditions of Kauwela (dry season) to record collective observations. Over time, the number of recorded observations grew as people enhanced their ability to observe the environment at the shoreline and in the respective areas where they reside. Driven by patterns of rain, storms, and high surf, the lands and ocean became a teacher. We learned how to empower our knowledge systems to increase the capacity of communities to adapt to conditions under climate change and increasing anthropogenic pressures.

Huli 'Ia is a platform to record place-based cycles of productivity in relation to seasons and lunar cycles to guide and inform management practices. Huli 'Ia aims to awaken the ancestral mindset of paying attention to our environment and our impact on it, and encourages participants to ingrain observations into memory. Community participation in this type of research generates greater social awareness and systemic change [70]. After engaging in participatory methods (as described in [46]) and discussing observations through Huli 'Ia for two years in one of our study sites, our NKA team reviewed the data in an attempt to identify cultural and ecological indicators of ecosystem health. We looked for dominant patterns of occurrences and the relationships between space and time of each traditional Hawaiian month and season. Native Hawaiian knowledge systems are intimately attentive to environmental changes related to the seasons—Kauwela (dry

season) and Ho'oilō (wet season)—moon phases, and periods of growth that guide Native Hawaiian approaches to co-management [53]. Native Hawaiian knowledge systems are extremely holistic in nature. Through the use of poetic imagery embedded in traditional knowledge systems and physical pictures, we developed a seasonal calendar showcasing these dominant natural cycles and their correlations. These cycles provide a place-based timeline of social–ecological cycles to guide discussions and implementation of best practices in support of these cycles and, ultimately, their productivity. The seasonal calendar also includes 'ōlelo no'eau, or traditional Hawaiian proverbs. 'Ōlelo no'eau is a traditional process of composing easily remembered wise sayings in order to document and transmit information through poetry [71]. Based on monitoring activities, participants compose contemporary 'ōlelo no'eau to document new knowledge, perpetuating a traditional-knowledge transmission mechanism passing on information to the next generation. To look at patterns from terrestrial and marine systems, we worked in collaboration with the team who manages one of the last remaining remnants of Hawaiian dryland-forest ecosystems. We collaborated to develop a mauka to makai (lit., the mountains to the ocean) seasonal calendar identifying patterns informed through combining their place-based knowledge of the dominant drivers of ecosystem and landscape level changes. The NKA team continues to share the Huli 'Ia methodology through partnerships ranging from local community organizations to state and federal agencies in Papahānaumokuākea Marine National Monument (PMNM). Monthly observations were distilled and compiled into seasonal calendars for North Kona, Hawai'i Island and Hōlanikū (Kure Atoll) in the PMNM.

4.2. Pilinakai

Pilinakai led to building integrating tools to understand intertidal-ecosystem health and build collective place-based knowledge of how to guide behaviors that support the holistic health and productivity of these ecosystems. Biocultural approaches rooted in intertidal ecosystems lead to understanding how resource management needs to reflect the social, cultural, and biological needs of the place. Developed through major partners, the Pilinakai team pulled the strands of integration of knowledge systems as biocultural approaches to empower communities in creating management decisions that support productive and resilient ecosystems inclusive of people. Additional contributions of this research approach include increasing opportunities for two-way mentorship between local undergraduate and graduate students including UHH faculty.

NKA's Pilinakai initiative is coordinated and implemented by indigenous and place-based professionals who are committed to helping communities identify management tools that support productive ecosystems in a biocultural framework. The genealogy of Pilinakai is extensive with important foundational stepping stones that provided safe places and support systems for Native Hawaiians to integrate knowledge systems into practice from the community, state, and federal levels. Focused on intertidal ecosystems, Pilinakai was initially developed from a master's thesis in Hawaiian Studies at the Kamakākūkalani Center for Hawaiian Studies at the University of Hawai'i at Mānoa [72] utilizing standard biological survey protocols introduced by Dr. Chris Bird and implemented and evolved by project mentors as tools for community-based monitoring throughout the Hawaiian Islands. Our study examines temporal patterns in spawning behavior, invertebrate population densities and size structure, and community composition. Huli 'Ia, a monitoring tool, was developed and refined through the Pilinakai project in Ka'ūpūlehu and extended into other communities in West Hawai'i, Kaua'i, and into PMNM. Pilinakai blended both Huli 'Ia and the biological intertidal surveys into a biocultural approach applying these tools in different capacities with different communities. Through growing the vision of integrated intertidal monitoring during the Holo-I-Moana Cruise, the Pilinakai leadership advocated to establish the Annual PMNM Intertidal Research Cruise and the Pilinakai team helped develop and implement the cruise with major partners, the National Oceanic and Atmospheric Administration (NOAA) PMNM office, Office of Hawaiian Affairs, The Nature Conservancy, Nā Maka o Papahānaumokuākea, University of Hawai'i, Conservation International, and Dr. Chris Bird at Texas A&M University Corpus Christi. Members of Pilinakai joined this

multidisciplinary group of community members from the 'Opihi Monitoring Partnership, managers, and academic researchers, to better understand the ecology of 'opihi populations and intertidal communities through a biocultural lens.

The Keaholoa STEM Scholars Program (KSSP) and the Kū'ula Traditional Marine-Resource Management course at UHH inspired and provided a platform to grow the application of these approaches into practice. It was through the KSSP framework that Pilinakai was able to establish itself into the programs implemented within community-based marine resource management today. The KSSP Pilinakai initiative innovated a way for culturally-grounded research and monitoring pillars to develop Huli 'Ia and quantitative biological tools to assess local populations and intertidal-ecosystem health. The central question driving Pilinakai intertidal monitoring is, "How do we know our environment in such a way that, when we interact with it, it's in a healthy, sustainable way?" This foundational question drove the subsequent implementation of the Huli 'Ia initiative along with evolving quantitative biological surveys with a focus on understanding intertidal ecosystems and overharvested limpets known as 'opihi (*Cellana* spp.).

In response to concerns about overharvesting of 'opihi, the Ka'ūpūlehu community was interested in monitoring intertidal resources at Kalaemanō. From 2010 to 2012, a group of Native Hawaiian undergraduate student scholars from the UHH KSSP started an intensive research effort with a community in West Hawai'i. Starting from the central questions of Pilinakai, this project used Huli 'Ia and conducted quantitative survey methods adapted from the standardized intertidal monitoring tools. The Pilinakai team entered into this community partnership on a shared commitment of dedicating at least five years of monitoring in Ka'ūpūlehu. As Native Hawaiian and local students and mentors with backgrounds in Hawaiian Studies and Marine Science, the Pilinakai team conducted monthly monitoring using transects to assess intertidal invertebrate diversity, population densities and size structures. Findings included information on peak 'opihi recruitment and population-size structure and abundance. Understanding the most abundant size classes of 'opihi and sizes of highest reproductive potential are essential to creating rules that protect present and future 'opihi abundance.

One important output of the Pilinakai initiative has been the development and refinement of intertidal monitoring methods resulting in a suite of ecological data. In order to examine spawning seasons and the effect of 'opihi size on reproductive output, we collected ten individuals of the three 'opihi species, measured body size, dissected out the gonads, and calculated the gonad index (gonad weight/total weight \times 100). The gonad indices revealed two spawning seasons within a year, and larger sizes were more fecund than smaller sizes during their peak spawning season. Currently, the State of Hawai'i Division of Aquatic Resources enacts minimum-size limits for 'opihi in one blanket rule for all three species and there are no mandated rules that protect spawning season. This is the first study in Hawai'i to investigate spawning timing for the three endemic 'opihi species and provides more detailed place-based and species-specific information needed for effectively managing local populations.

The third survey method integrated into the Pilinakai biocultural monitoring is the 'opihi and hā'uke'uke rapid assessments being implemented in multiple communities on Hawai'i Island, O'ahu, and Kaua'i, and into PMNM. NMP is a partner organization in the statewide 'Opihi Monitoring Partnership that also conducts intertidal chain transects and rapid assessments on Maui and PMNM. The objective of this assessment was to collect information of the distribution of 'opihi by size and location on shoreline. The dataset provides critical information of 'opihi abundance by species, size, and location to ultimately develop an additional monitoring protocol. The long-term objective is to use this information to implement biannual monitoring of 'opihi populations. Another application has been to create maps of hotspots where 'opihi are most abundant. Examining the spatial and temporal distribution of these populations can help to develop management strategies that account for points of human access, harvesting, and further insight into how to investigate environmental factors linked to productive areas.

From 2010, this research effort established a baseline of intertidal communities including natural seasonal fluctuations in population sizes and size structure of culturally prized intertidal limpet, including the most abundant sizes. This is critical information to understand what level of harvesting these intertidal ecosystems can sustain. Coupled with knowledge of spawning seasons and productive larger sizes of 'opihī, this information has become a platform for creating place-based sustainable harvesting practices. In West Hawai'i, the Ka'ūpūlehu community supported the official designation of the Ka'ūpūlehu 10 year Try Wait Rest Area designed to replenish historical abundance to coastal fish populations and also included the protection of intertidal resources. Relationship building is integral to our long-term commitment to Ka'ūpūlehu and we continue to monitor these areas with students and community members participating in NKA programs throughout the year. Creating this framework and implementing it into practice in Ka'ūpūlehu has helped our team understand seasonal changes in intertidal communities through quantitative and qualitative methodologies. In Ka'ūpūlehu, this is critical information to inform the long-term sustainable fisheries management plan developed through the Ka'ūpūlehu Marine Life Advisory Committee. This is part of a growing dataset of intertidal community diversity, 'opihī densities, and algal composition across Hawai'i. Through a dedicated long-term commitment to local communities on Hawai'i, Kaua'i, and extended partnerships with communities throughout the Main Hawaiian Islands, Pilinakai has extended these tools from undergraduate- and graduate-level research, and then extends these tools into community engagement strategies implemented under NKA.

5. Community Engagement to Support Positive Cultural- and Social-Behavior Shifts

5.1. NKA Annual Nohona (Community Engagement Camps and Programs)

To date, NKA programs have hosted approximately 12 Annual Nohona community engagement camps and contributed to more than 10 other cultural and community-based camps throughout Hawai'i over the past six years. Culture-based education is one that stems from the foundation of a culture and is a framework of teaching and learning that is grounded in "the values, norms, knowledge, beliefs, practices, experiences, places, and language" of a culture [36]. NKA Annual Nohona are rooted in a culture-based and place-based educational framework to honor community resources of people and place and build capacity for youth to become future leaders in their community. Participants of these nohona build reciprocal relationships with place to understand its capability to feed the community, and the community's capability to feed and intimately tend to that place. NKA has worked with nine communities on Hawai'i Island, one community on Maui, one community on Moloka'i, one community on Lāna'i, four communities on O'ahu, and six communities on Kaua'i. NKA has hosted thousands of school-aged children from one-day-only field trips to recurring workshops throughout the years of implementing NKA programs. Through the implementation of trainings and programs, we have trained over 20 UHH undergraduate interns in biocultural monitoring tools and supported the successful completion of Master's of Science thesis drawing heavily from these methods (described in detail in [46]). NKA creates more opportunities for graduate and undergraduate research to expand on applying research towards indigenous-based approaches to research and resource management in intertidal, freshwater, and terrestrial ecosystems.

The students, educators, academic researchers, and conservation professionals involved in the administration of NKA initiatives collaborate across projects and disciplines to continually advance NKA's initiatives towards indigenous approaches to community engagement based on indigenous values honoring relationships. Family and community are key components of culture-based education, and involving families and members of the community supports the growth and success of learners [73]. NKA programs encourage parents and elders of the community to become educators through sharing their stories and knowledge of place to contribute to the cultural identity and sense of belonging of the next generation.

Reflective processes are important and necessary to build confidence, be accountable, and responsive to learning and to ultimately internally strengthen participants, as an individual and a collective [74]. NKA implements strategies focused on reflection in the program curriculum where NKA leadership facilitates safe spaces for participants to critically reflect on their learning and how the NKA activities are supporting their growth as a leader in the community. The NKA workshops serve as an opportunity to engage the next generation in this ancestral mindset to challenge behaviors in our community that hinder our relationships to people and place.

5.2. Kūka'i Laulaha: Broadening Vision of Biocultural Restoration and Building Leadership through Larger Indigenous Networks

Kūka'i Laulaha (KL) is an international cultural exchange built on the framework of pilina that extend between indigenous communities across the Pacific. KL has established and maintained connections with indigenous communities that face similar challenges of addressing biocultural resource abundance in their communities. It is an initiative to grow perspectives on the social, cultural, and biological management challenges that disrupt indigenous relationships to place, and it addresses this issue through strengthening foundations in indigenous language, history, and genealogy. This exchange creates opportunities to grow local leadership in Hawai'i and enables participants to critically think and evoke discussion about the impacts of management strategies and conservation models that are inclusive of human dimensions. It is an exchange for aspiring leaders, active community members, conservation managers and professionals as it is vital that our leadership and work ethic is grounded in honoring our places, our many cultures, and the reciprocal relationships that have become a shared responsibility.

Over the duration of this initiative, over 50 students and community members have participated in this exchange to Aotearoa and the Cook Islands and in turn, these participants have hosted numerous groups comprised of approximately 150 individuals from these communities. Participants are invited to the exchange program after contributing to our local NKA initiatives through discussions, research, monitoring, and/or community service. Past participants include high school students, UH Hilo and UH Mānoa undergraduate and graduate students, community members of Waimea, Kailapa, Molokai, and Hā'ena, and organizations including the Queen Lili'uokalani Children's Center, Hui Maka'āinana o Makana, and Kailapa Community Association. KL immerses participants in indigenous communities to gain understanding of cultural traditions, beliefs, and practices and how cultural values influence the way they manage their natural resources. Then, upon returning home, participants are encouraged to think about their role in the communities they serve, and create effective, multifaceted strategies guided by indigenous relationships to place.

More importantly, KL introduces participants to the realities and sometimes overwhelming sociocultural conflicts experienced by Pacific indigenous peoples, and ways to begin to heal to shift normalized behaviors. For example, for the past five years in Aotearoa, KL has been working with Te Taitimu Trust (TTT), a nonprofit organization whose goal is to motivate youth to become leaders in their communities. Each year, participants have been involved with TTT's annual camp that focuses on whanaungatanga, building familial relationships through shared experiences. It brings together rangatahi (youth) from various backgrounds who each deal with different realities at home. Some of these realities include suicide, gang involvement, and drug and alcohol abuse. It is through connections and conversations from communities such as TTT that KL participants have realized a different source of disconnect that affects the families of indigenous communities. In an effort to empower communities in natural-resource management, it important to consider these social environments and the potential consequences of resource-management decisions on long-term social and cultural health. KL provides an important opportunity to experience first-hand the struggles and strategies of environmental and community issues across the Pacific.

Within community engagement, NKA work on strategies to provide cultural foundations for cultivating a generation of young leadership within communities. Having older youth learn through

NKA and start to teach these lessons to younger children is part of a cord of succession to support the healing of 'āina, our community of people and place. Through long-term relationship building with young leaders, we support their role and contributions to community decision-making that benefit the overall health and wellness of 'āina.

6. Capacity Building within Indigenous Communities

Capacity building is a major challenge in creating long-term partnerships with indigenous communities [24]. Other major challenges in management partnerships include the short-term nature of grant-funded research projects and the potential for mismatch in research project and community-valued timelines [65]. In order to confront the recurring issue of inconsistent funding and subsequent high turnover of short-term partnerships with communities, the NKA team dedicates at least five years to communities with whom we work and operates through supporting community partnerships from a local, state, and federal level. As an extension of the value of pilina in managing for 'āina momona, healthy, productive, and resilient systems of people and place, NKA focuses on leadership and succession building that holds individuals and partnerships accountable to honoring pilina and reciprocity.

The NKA leadership team confronts the problem through a developing local leadership based on indigenous values of pilina and commitment to contributing to healthy communities. The team actively participates in NKA Annual Nohona and other activities throughout the year on the shared commitment to the collective work. This work is important for NKA leadership, which is a group of Native Hawaiian and local women from undergraduate and graduate levels spanning marine science, Hawaiian Studies, natural-resource management, and culture-based education who work across the Hawai'i to empower indigenous science and community engagement. Throughout the year, many of the same middle-school and high-school youth continue to participate in NKA activities and NKA leadership grow into the commitment to mentorship of the next generation of community members. Seeing examples of Native Hawaiian and local leadership provides a source of support for their individual paths. This addresses the need for succession building where youth can recognize their value to their community and positively contribute to foster critical thinking of the social, cultural, and ecological needs for their community to be healthy and thriving.

In the long-term, these youth will contribute positively to their community and stay actively involved in contributing to their community in some capacity. NKA creates opportunities to grow local and Native Hawaiian mentors and role models for the next generation of community leaders who understand the realities of their communities and how to support a path to heal these relationships that support a resilient social-ecological system. Through a shared long-term commitment to the communities we serve, NKA leadership facilitates discussions of social and cultural shifts needed to improve resource management and the holistic well-being of our communities. Collectively, these solutions enable the adaptive governance of social-ecological systems in the face of today's global environmental pressures and changes by prioritizing knowledge coproduction, collaboration, and social and institutional learning [6].

This case study highlights views and practices on cultivating reciprocal pilina with communities and within broader conservation partnerships and indigenous networks, provided through examples such as KL. The deeper the relationships grow within Hawai'i's communities and indigenous communities in Aotearoa and Mangaia in the Cook Islands, the more future generations can gain the experience and insight to lead NKA back home and how to apply it to their communities.

7. Discussion: Healing Communities to Support Healthy and Resilient Communities of People and Place

This paper offers a case study that defines biocultural restoration through indigenous relationships to people and place, sharing biocultural monitoring tools and community engagement and capacity building strategies that address holistic social-ecological systems. NKA is an example of how a

biocultural approach can inform community-based marine resource management ranging from a local to Archipelago-wide scale. It is part of a biocultural approach to developing culturally grounded indicators of well-being from a local to regional scale [3,30,34].

Huli 'Ia and Pilinakai are integral to the growth of NKA that contributed to how we as Native Hawaiians perpetuate indigenous-knowledge systems, biocultural monitoring, and community engagement to identify social and cultural factors to support resource management and holistic restoration of indigenous relationships to place. Huli 'Ia provides a culturally based methodology for understanding cultural and ecological connections based on a Native Hawaiian worldview. Learning from the 'āina and community through Huli 'Ia and Pilinakai and sharing NKA in other communities throughout Hawai'i provides one example of how the value of reciprocal pilina builds trust allowing for NKA to grow a community network and a larger indigenous network through KL.

As biocultural restoration of social–ecological systems and the sustainable use of natural resources continues to be a priority in discussions at regional, national, and global scales, many have realized that a first step is to acknowledge and aim to better understand the intrinsic connection between people and place [6]. The relationship between humans and the environment are widely acknowledged in indigenous epistemology, passed down through creation stories and other traditional forms of information dissemination for generations. 'Āina momona is the ultimate long-term goal that speaks to the productive, healthy, and resilient lands and oceans including the intimate reciprocal relationships our ancestors had with 'āina which we are re-remembering today. This reciprocal relationship is ingrained in the cultural memory of place-based and indigenous communities around the world. A growing number of disciplines including sustainability science and ecological restoration, as evidenced by this special issue, provides critical pathways to explore the multifaceted biocultural approaches to addressing resource abundance through strengthening the intimate connections between people and place.

Pilina and Reciprocity within Conservation and Research Partnerships

Conservation goals do not always align between the indigenous people and partner organizations, and new approaches are needed to respect and value indigenous knowledge and worldviews [35]. One area attempting to bridge this gap on multiple scales lies in developing culturally grounded indicators of natural, cultural, and socioeconomic well-being with application and relevance on a local scale [3,34]. For example, in Melanesia, agreeing on a shared vision and clear expectations is essential to create transparent communication and equitable outcomes [13,75].

NKA offers another dimension to community-driven research specifically focused on indigenous self-empowerment through capacity building in restoring 'āina momona, thriving, productive, and healthy biocultural communities. Empowering cultural perspectives and values provides invaluable insight into the feedbacks in a social-ecological system [3,13]. Indigenous approaches have woven cultural, social, and ecological into many cords of knowledge that have the power to address social justice and equity of costs and benefits, and the impact of conservation actions on cultural identity [13]. This is part of a rise in broadening the definition and advocating for self-determination of indigenous communities within conservation where communities define well-being [43]. However, because conservation goals do not always align with a collective solution developed from indigenous communities, it takes long-term commitment and personal investment to building relationships, trust, and reciprocal partnerships with indigenous communities in conservation. As previously noted, the potential mismatch in time frames between communities and partners is a challenge for grant-based work [65].

In the long-term, the goal of NKA is to empower community voices and decision-making as an 'ohana (family), gathering around building pilina to place and perpetuating ancestral-knowledge systems. Only the community itself can identify the best ways to reach out to their peers and to initiate the hard conversations about behavior changes. Through community self-empowerment, we support perpetuating traditional knowledge systems and building collective contemporary

knowledge of biocultural systems. In the long-term, we are supporting a movement to create place-based management and behavior shifts based on the collective and equitable needs of people and place. Ultimately, this approach provides thought-provoking insight into resource management and decision-making process and empowers community members to move collectively and to critically assess how management decisions may affect the environment and community into future generations.

8. Closing

Community-based resource management in the Pacific Islands is well-positioned to move forward within partnerships where indigenous people are at the core and not just the periphery. Pacific Islanders descend from ancestors who survived through harsh conditions and high degrees of environmental variability from which they possessed intimate traditional knowledge and values of reciprocity and respect for the environment [68]. Thus, those who possess intimate knowledge of place should be considered the most capable of making decisions about that place. As the tide continues to turn towards empowering indigenous communities in natural resource management, it is essential to share indigenous-driven initiatives that can guide future direction in addressing social, cultural, and ecological factors to address within resource management and in the broader restoration of social-ecological systems. This case study lays a foundation for empowering indigenous initiatives built on a collective vision of healthy thriving social-ecological systems and is part of a growing effort to clear a path forward for indigenous communities to bring their priorities to the forefront.

In closing, NKA is one approach honoring the importance of pilina as the important threads that bind our communities closer to each other and the places that feed our well-being. NKA gathers communities around pilina, in particular how maintaining healthy pilina to place and one another is an essential element of 'āina momona, thriving and productive communities of people and place. Ultimately, restoring biocultural health means healing indigenous relationships to place and each other.

As Native Hawaiians return to our core values of honoring reciprocity in pilina to the 'āina and to one another, we can improve the way we can rely on each other for research, community engagement, education, resource management, and policy. By coming together and trusting in ancestral knowledge systems, we are able to take steps forward together to build resilient and adaptive communities. As the community-based marine-resource-management movement grows in Hawai'i and the Pacific Islands, NKA strives to be present on all fronts of the social, biological, and cultural needs to create culturally grounded resource management designed to restore abundance and productivity to our biocultural lands and oceans.

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