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Holomua Marine Initiative: community-generated socio-cultural principles and indicators for marine conservation and management in Hawai'i

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ABSTRACT. Marine managers commonly use ecological indicators in planning and evaluations; however, few programs monitor social and cultural impacts of management. Practical approaches to identifying and monitoring social and cultural aspects of communities' relationships with their environment could assist many agencies in understanding the impacts of their efforts to achieve conservation goals. The Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources (DAR) launched the Holomua Marine Initiative to collaborate and engage with communities to strengthen co-management efforts, which included integrating socio-cultural aspects into the planning and assessment of marine management. Our team, which included resource managers, Western and indigenous scientists, community leaders, students, agency, and university staff engaged in collaborative management efforts in Hawai'i, developed an approach to monitor the social and cultural impacts of DAR's management actions. Through online collaborative workshops with community members and non-profit leaders engaged in marine conservation in Hawai'i, we co-developed socio-cultural principles and indicators based on their reciprocal relationships with the nearshore environment. During the workshops, we used small group activities, snow cards, sorting, and categorization to generate nine fundamental principles, with associated indicators, to guide marine management in Hawai'i. Many of the principles and indicators are comparable to those developed in other parts of the Pacific, revolving around themes including the perpetuation of local and indigenous knowledge across generations, and access to land and natural resources. Participants also suggested themes less prevalent in other research, such as the need to evaluate impacts of tourism on community relationships with coastal areas. We offer recommendations for the development of socio-cultural principles and indicators in other place-based contexts, and emphasize the importance of on-going community collaboration. Developing a socio-cultural monitoring framework with community members impacted by marine management decisions could enable others engaged in collaborative efforts, including government agencies, to holistically understand and address impacts of their policies and actions. Monitoring layered socio-cultural impacts of marine management on local and indigenous communities has the potential to shift management goals, and enhance long-term effectiveness and support for initiatives to protect coastal resources worldwide.

Key Words: *collaborative management; co-management; community-based; cultural; holistic health; marine conservation; marine management; marine monitoring; participatory research; social and cultural indicators; socio-cultural indicators*

INTRODUCTION

The global "30x30" initiative aims to protect 30% of the world's lands and oceans by the year 2030. These targets have intensified political drive and mobilized funding to establish marine management areas (MMAs) globally in order to achieve conservation goals (IUCN 2016). Although widespread global adoption of MMAs into marine management efforts offers an approach to preserve biodiversity, conservation-based restrictions can disproportionately impact communities that have long cared for and subsisted from the coastal resources where MMAs are established (Govan and Arju 2020). Furthermore, the success of MMAs can hinge upon the assistance and support of these same communities, creating a dichotomy in which particular communities are both potential victims and partners (Berkes 2007, Bennett and Dearden 2014). To make sound decisions that incorporate the importance of coastal resources to place-based communities, marine managers require approaches to understand and monitor how communities value, care for, and relate to the environment, as well as how these relationships are impacted by management actions. However, approaches to understanding socio-cultural impacts of management actions remain underdeveloped and are yet to be widely adopted in marine management (Kittinger et al. 2014, Scholte et al. 2015, Davies et al. 2018). Consequently, agency and collaborative marine management efforts often focus on purely ecological measures of success.

In Hawai'i, the Department of Land and Natural Resources, Division of Aquatic Resources (DAR) utilizes a range of ecological indicators to measure the efficacy of marine management strategies. Indicators such as coral cover, fish abundance and biomass, or macroalgae cover, are commonly used to measure the success of management projects (Juanes et al. 2008, Arias-González et al. 2010, Schmitter-Soto et al. 2018, Sangaji 2022). The objectives of these management projects are often guided by principles or underlying values that serve as a foundation for a system or policy, such as protecting native species or preserving biodiversity (Dale et al. 2000, DAR 2022). Indicators allow managers to measure their progress toward management principles or goals (Rice and Rochet 2005, Dacks et al. 2019, Bennett et al. 2021). Although ecological principles and indicators are crucial for achieving ecosystem objectives, they ignore the human dimensions of the communities tied to those ecosystems along with their underlying socio-cultural values (Cinner et al. 2014, Breslow et al. 2016, Ingram et al. 2020).

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In an ecosystem services framework, the tangible and intangible benefits an ecosystem provides to stakeholders, and the importance that stakeholder groups place on those benefits, are defined as socio-cultural values (Scholte et al. 2015). We adapted this ecosystem services framework to the context of marine management and the communities tied to the spaces where management occurs. We define socio-cultural "principles" as the fundamental values or goals communities wish to perpetuate or enhance through management. Socio-cultural "indicators" are measurable factors used to describe the state of a principle.

The development and implementation of similarly framed socio-cultural principles and indicators have emerged in countries such as British Columbia, Canada (Burt et al. 2014), Indonesia (Green et al. 2020), and the Bahamas (Knowles et al. 2017). Table 1 outlines socio-cultural principles and indicators developed for other marine management initiatives around the world. Some locations also include economic and governance considerations. Each area used different approaches to develop and describe its goals (principles) and the metrics (indicators) used to reach each goal. As marine managers' project purpose, scope, scale, and objectives vary, along with communities' relationships and connections to place, a universal one-size-fits-all menu of principles and indicators is unlikely to be effective (Burt et al. 2014, Bennett et al. 2021). Community values and relationships with the environment are place-based and contextual, suggesting the need for socio-cultural monitoring programs to be developed collaboratively with local groups (Leong et al. 2019). Because marine managers differ in the extent to which they consider principles and indicators related to human dimensions, examples that center on social and cultural aspects of the marine environment can empower managers and communities to collaborate effectively.

Following the International Union for Conservation of Nature (IUCN) resolution establishing the global "30x30" goals, DAR began leading efforts to effectively manage Hawai'i's nearshore waters through the Holomua Marine Initiative, which emphasizes community engagement and collaboration in the planning, implementation, and monitoring of island-based management strategies (DAR 2023). From the outset of the Holomua Marine Initiative, DAR identified their need to understand how communities value and relate to their nearshore environments. DAR decided to utilize a collaborative approach to develop socio-cultural principles and indicators, which will enable effective evaluation of management measures and their impacts on place-based communities over time. Collaborative arrangements in which government agencies and community groups share power and responsibility for both management and monitoring can enhance the effectiveness of marine management around the world (Pomeroy et al. 2001, Vaughan and Caldwell 2015, Winter et al. 2021). Communities benefit from more equitable distribution of rights, information, and decision-making power, while agency management incorporates in-depth knowledge of local ecosystems and benefits from higher compliance, reduced enforcement costs, and enhanced capacity for adaptive management (Jentoft 2005, Gelcich et al. 2010, DeRoy et al. 2019). Although collaborative management and monitoring may bring benefits to coastal communities and resources, it is understandable that community members may be wary of engaging in collaborative arrangements because of injustices and displacement of coastal communities stemming from conservation-focused policy.

The restrictive regulations often accompanying the implementation of MMAs have resulted in inequitable situations with negative impacts on indigenous communities that rely on small-scale fishing and subsistence harvesting, both of which are common *Kanaka* ʻŌiwi (Native Hawaiian) cultural practices (Grafeld et al. 2017, Govan and Arju 2020). In Hawai'i, marine ecosystems hold deep cultural significance. For instance, the *Kanaka* ʻŌiwi creation chant, the *Kumulipo*, describes the coral polyp (*koʻa*) as the source of all life, including the Hawaiian people (Liliuokalani et al. 1978). *Kanaka* ʻŌiwi are not the only demographic in Hawai'i with profound ties to the ocean; similar relationships permeate through Hawai'i's multicultural communities, which are often intrinsically connected to marine environments through livelihoods, food, subsistence, and a diverse assemblage of cultural practices (Grafeld et al. 2017, Vaughan 2018). Furthermore, these relationships with the environment continue to support the perpetuation of family history, community relationships, and culture (Vaughan and Vitousek 2013). Many in Hawai'i conceptualize how important their ties to the environment are by viewing their connection with marine ecosystems as reciprocal relationships, in which those supported by the environment are ethically responsible for caring for, restoring, and protecting it; Hawaiian culture reflects this through *kuleana,* or responsibility, to the environment and community (Vaughan 2018, Diver et al. 2019, Gould et al. 2019).

To maintain and strengthen reciprocal relations, individuals and communities must be able to benefit from, care for, and give back to the places and ecosystems to which they relate (Diver et al. 2019). Policies that impinge on the necessary components of reciprocal relationships can sever those relationships and, in doing so, disturb the framework that provides the social and cultural benefits mentioned previously. Collaboration allows communities to incorporate the perpetuation of their relationships with the environment directly into the decision-making processes that might otherwise threaten those relationships; it also mitigates the potential for marine management policies to harm communities' relationships to place (Berkes 2007, Bennett et al. 2017, Davies et al. 2018). Through collaborative efforts, DAR hopes to enhance the communities' relationships with the nearshore environment. DAR intends to incorporate socio-cultural indicators into its monitoring programs to understand how their policies affect community-place relationships and assess how those relationships might change over time.

In this project, we aimed to develop socio-cultural principles and indicators for DAR and the Holomua Marine Initiative to use in the planning and monitoring of existing and new MMAs throughout Hawai'i. We worked with Hawai'i community leaders and non-governmental organization (NGO) partners to articulate community-centric socio-cultural principles and indicators. Our team approached the development process through the lens of communities' place-based reciprocal relationships with the environment. By acknowledging those reciprocal relationships and developing a socio-cultural monitoring framework, we aimed to help DAR understand how communities care for their

Table 1. Examples of socio-cultural principles and indicators created for marine management initiatives around the world.

Location	Principles/goals	Indicator/strategy examples
British Columbia, Canada (Burt et al. 2014)	Marine livelihoods and food security: enhance capabilities and assets for income and subsistence activities	Consider the economic importance of fishing in Marine Protected Area (MPA) design and placement
		Identify areas that are key sites/routes for current and prospective marine tourism and include them in the MPA network
		Support employment opportunities related to cultural information and sharing
	Non-monetary and intangible benefits: Understand and incorporate non-monetary benefits of MPAs	Consider poverty reduction strategies as a potential indirect benefit or long-term goal of MPAs
		Create "buffer" zones within which recreational activities can be pursued with reduced impacts on sensitive ecological areas
		Protect natural areas that provide important supporting services
	Culture and history: protect cultural and historic features and support traditional practices and connections to natural/sacred areas	Support local efforts to protect and preserve local culture and history
		Identify and encompass spiritually significant areas or sacred natural sites within MPAs or networks
	Education and knowledge sharing: foster education, research, and knowledge sharing opportunities within the MPA network	Facilitate dialogue and empower stakeholders to participate in decision making
		Provide information and education to visitors on low-impact recreational practices
		Establish community-based participatory research programs
Indonesia (Greene et al. 2020)	Facilitate minimal or no conflicting use of marine resources and fisheries	Three years after the MPA has been established, the number of conflicting use between resources users has decreased by 50%
	Support sustainable community livelihoods based on marine resources	Three years after the MPA has been established, 20 home industries processing fish products in the MPA have been certified as sustainable
	Promote active community participation and support in MPA management	Three years after the MPA has been established, 50% of local wisdom is acknowledged and institutionalized in the MPA through formal recognition
The Bahamas (Knowles et al. 2017)	Promoting equity in risk sharing	Ensure effective management of natural resources that local communities identify as important to their livelihoods and cultural heritage
		Protect economic multiplicity due to seasonal livelihood patterns whenever possible
	Minimize conflict	Allow for current and future multiple uses
		Minimize conflicts by considering existing and future patterns of population trends and resource use to reduce conflicts among resource users
	Considering costs and benefits	Ensure the costs and benefits of protected areas are shared equitably within and among communities
		Consider costs and benefits of placing protected areas near major towns and cities
	Ensuring social, ecological, and economic sustainability	Prioritize areas for management where appropriate protection is important for providing ecosystem goods and services
		Work closely with local community members to improve enforcement of existing regulations
	Facilitating effective governance and management	Foster political will and leadership at the highest level
		Document existing management arrangements
	Considering social and cultural values	Recognize and respect land ownership, traditional resource use and access, and cultural claims
		Share knowledge and communicate the benefits of protected areas through education and capacity building programs among stakeholders
	Facilitating effective governance and management	Integrate opportunities for co-management with local communities, other stakeholders, and across relevant government agencies
	Prioritizing adaptability	Prioritize areas for protection where human communities are likely to be more resilient to climate change impacts
		Support capacity and flexibility to adapt to changing social, ecological, and economic conditions for the life, culture, and livelihoods of Bahamians
	Improving compliance and enforcement	Augment existing enforcement with co-management strategies
		Actively strengthen deficits in capacity to ensure sufficient resources, skills, and capacities

nearshore marine areas and how management strategies can affect communities' social and cultural connections with the nearshore environment.

METHODS

Our core research team includes three graduate students and two staff from the University of Hawai'i (UH) at Mānoa, three DAR employees, and one conservation NGO staff member. Multiple team members are also cultural practitioners, ocean users, and community members. Three are Native Hawaiian. Our team designed a series of workshops to develop socio-cultural principles and indicators in collaboration with community leaders. Workshops are a common method for developing principles and indicators in natural resource management because they allow in-depth discussions about stakeholders' and participants' values, needs, and priorities (Pascua et al. 2017, Sterling et al. 2017a, Dacks et al. 2019). Because of the COVID-19 pandemic, the workshops, which included many elders, were held online for participants' safety. Before the formal workshops, we conducted a practice workshop with UH undergraduate and graduate students serving as participants to test the effectiveness of the planned activities and prompts. Based on feedback from students and facilitators, we revised the agenda and activities to improve the subsequent community workshops.

We conducted four online workshops between 22 April 2021, and 18 May 2021, three to develop draft principles and indicators, then a fourth to get feedback from all participants. The initial three development workshops focused on understanding communities' reciprocal relationships with marine ecosystems in

Hawai'i. These relationships were the basis of the developed socio-cultural principles and indicators. We organized the initial three development workshops by islands based on population to balance the number of participants and optimize engagement. These three workshops focused on (1) O'ahu Island, (2) Kaua'i and Hawai'i Islands, and (3) Maui Nui, which include the islands of Maui, Lāna'i, and Moloka'i. The fourth feedback workshop, conducted on 18 May 2021, presented the proposed socio-cultural principles and indicators developed from the initial workshops for feedback from all original participants. All workshops were held over Zoom and lasted approximately 2.5 hours. Facilitators, including both DAR and UH staff and graduate students, each had some training in meeting facilitation. To help ensure accurate tracking of each participant's contributions, we recorded each workshop and transcribed the recordings verbatim using Otter.ai software.

Approximately 7–12 participants joined each workshop, with 30 combined overall (O'ahu = 12, Kaua'i = 3, Hawai'i Island = 8, Maui Nui=7). Workshop participants were selected based on their longstanding connections and existing collaborative efforts with DAR, or their high level of demonstrated involvement in community-based management, stewardship, or education in nearshore ecosystems. We emphasized recruiting members who were Native Hawaiian or born and raised in the Hawaiian Islands. We used purposive sampling to identify potential participants from each island (Creswell et al. 2007); utilizing DAR contact lists and multiple nonprofit and community networks to invite workshop participation via email or text message for those not active on email. Our outreach materials included background information on the study and an informed consent document following the Institutional Review Board (IRB) protocol. The University of Hawai'i IRB approved this research under protocol 2021-00088.

Approximately 74% of the development workshop participants were members of community-based stewardship or educational organizations, 13% were from local conservation NGOs, 10% were affiliated with the University of Hawai'i at Mānoa, and the remainder were prominent community members representing other important stakeholder groups such as fishers and cultural practitioners. Many participants represented more than one stakeholder group. For example, several attendees involved with a stewardship organization also identified themselves as fishers or cultural practitioners, and multiple student participants were also community members or NGO employees. Participants were approximately 55% female and 45% male, ranging from 20 to 80 years of age. Ethnicities represented in workshops included Native Hawaiian, Caucasian, and Asian, with a majority identifying as multi-racial.

We opened all the workshops with a Hawaiian *oli,* or chant, a common way to start a gathering in Hawai'i by asking for guidance and permission from *akua* (Gods) and ancestors. To allow participants to get to know each other personally and create a more comfortable space, we started the meeting dialog with the question, "What is your favorite food from the ocean and why?" When asking for answers to our discussion questions, we used Zoom breakout rooms to place participants in smaller groups of two to four participants. For a full agenda of the development workshops, see Appendix 1.

We began the discussion breakout rooms with introductions and a visioning exercise to get participants to envision the nearshore place they are connected to or find personally meaningful. This question began with the prompt, "Think about a coastal, nearshore place on (island name) that is important to you. Close your eyes or look out a nearby window and envision this place," which was followed by a series of questions including "What does it look like? What can you hear? Smell? What do you feel?" After the visioning exercise, we asked a series of prompts and questions to facilitate deeper discussions on the reciprocal relationships participants held with the nearshore environment, such as "How does that coastal nearshore place enrich the lives of your '*ohana* (family) and community?"

Participants shared their answers using methods from previous studies that facilitate workshop discussions, which include "snow cards," a technique involving the listing and grouping of ideas (Pascua et al. 2017), and free listing (Dacks et al. 2019). We adapted these approaches to an online setting by having participants respond using Mural, an online interactive application. Mural allowed for anonymous responses, participation by multiple individuals at one time, and flexibility in how and when participants presented and organized their answers. Our team used workshop transcripts to analyze participant responses through an iterative coding process in Atlas.ti (Creswell et al. 2007, Miles et al. 2019). This technique utilizes an inductive data analysis process that builds codes, categories, and themes by organizing data from multiple sources into abstract information units. We inputted the transcript data and wrote memos (short phrases, ideas, or key concepts) to start the initial process of exploring the data. Team members then used the software to describe, classify, and interpret the transcript data by forming codes (labels attached to data units that assign symbolic meaning). We formed codes based on categories identified by participants during the workshops. After coding, we translated the data into socio-cultural principles with associated indicators for each (Figs. 1 and 2).

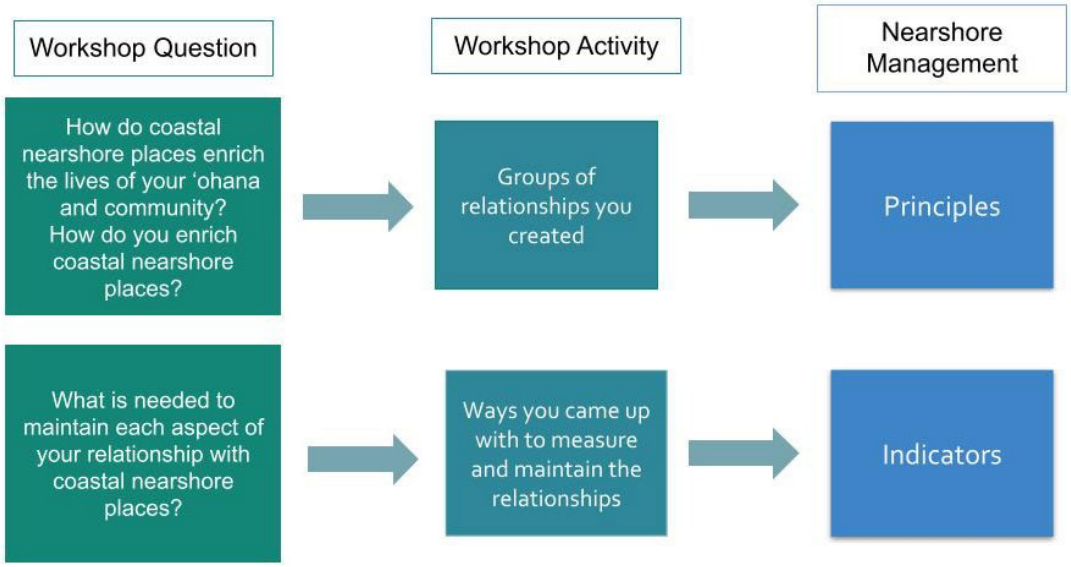
The fourth feedback workshop had 16 participants from the original development workshops. After beginning the workshop with cultural protocol (*oli*) and an opening question, we introduced and explained each proposed principle, two at a time, along with their associated indicators. Participants offered feedback in smaller breakout groups using Mural, and then we presented each group's input to the collective. Our team repeated this process until all principles and indicators were presented and discussed. For a full agenda of the feedback workshop, see Appendix 2.

RESULTS

Community participants collaboratively created nine socio-cultural principles through the four workshops, with 6 to 15 corresponding indicators each, totaling 61 indicators. The nine socio-cultural principles developed are shown in Table 2, along with a few examples of corresponding indicators, which we reduced to avoid duplication. Indicators are not listed in any particular order. For a full list of indicators developed from the workshops, see Appendix 3.

Participants in each of the three development workshops independently generated similar principles, though they came from different islands, each with its own unique cultural practices,

Fig. 1. Steps depicting the creation of socio-cultural principles and indicators for nearshore management based on discussion questions and activities during the workshops.



coastal issues and environments. In the fourth feedback workshop, participants also largely agreed with the proposed principles and indicators. Feedback from participants was similar regardless of which island they were from or which development workshop they participated in. Based on participant feedback in workshop four, we adjusted the phrasing of one socio-cultural principle to articulate community objectives more clearly and enhance applicability across places. The original principle to "maintain and enhance local access and quality of experience in the nearshore area" was reworded to "ensure appropriate access and sustain the quality of experience in the nearshore area." Several community members shared that "enhancing" access is not always beneficial to the resources of a place or the people who depend upon them. In addition, participants also added a supplementary principle urging government agencies to "utilize transparent and collaborative processes to address impacts to the nearshore area," along with a few indicators to measure the new principle. This principle provides a way to evaluate government agencies, along with the socio-cultural impacts of their management.

Participants also emphasized the overlapping nature of the different aspects of their relationships with nearshore areas. Principles are thus interdependent and connected, which is also reflected in the repetition of some indicators across principles. Participants often found it difficult to distinguish boundaries between principles because many depend upon one another. For example, appropriate access is a necessary condition for most of the other principles such as education across generations, strengthening well-being, support for family and community relationships, along with maintaining resources and habitat that provide food; all of which depend upon the ability to be in a place. Empowering community caretaking efforts in turn depends upon education and perpetuation of place-based *pono* (balanced, correct, mutually beneficial, e.g., taking only what you need) knowledge and practices. Principles are interconnected and positive improvements in certain principles are likely to be associated with positive changes in others, meaning that measuring progress in a few of the principles might suggest progress in others, which are more difficult to measure.

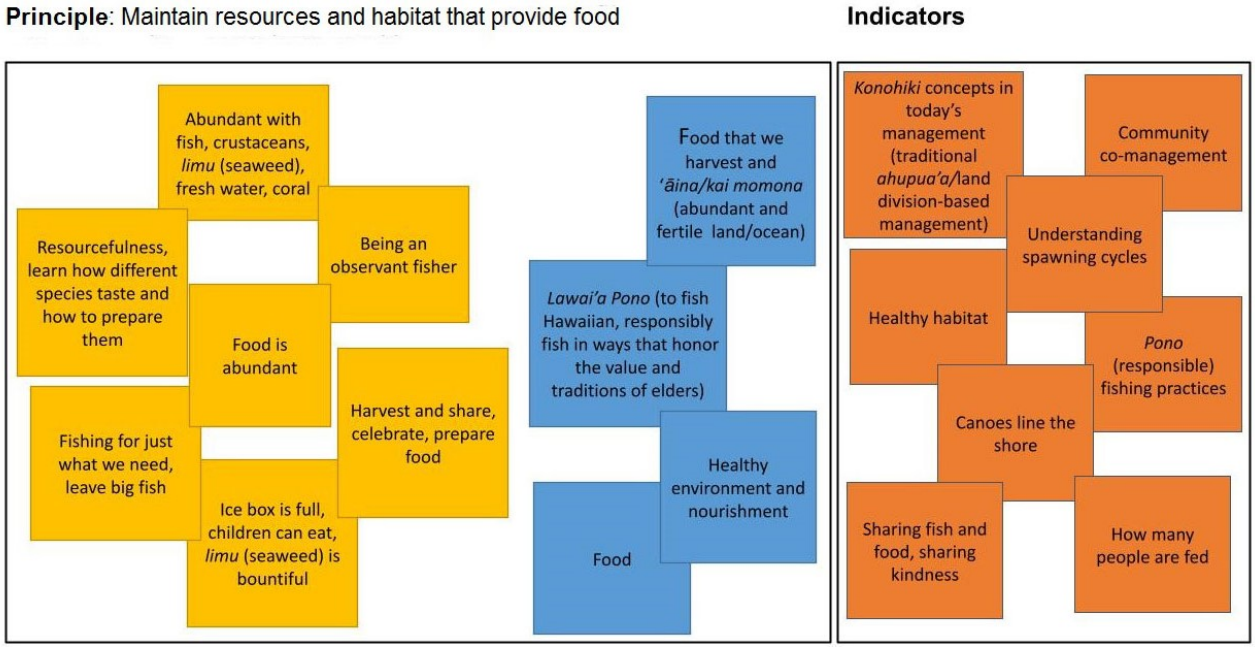
DISCUSSION

In this research, we engaged community leaders, fishers, cultural practitioners, conservationists, and managers together to articulate principles and indicators to guide and measure the effectiveness of marine management. Where management goals and indicators of success are often solely ecological, we focused on articulating the social and cultural impacts of management. This process resulted in nine principles articulating potential outcomes of effective marine management for communities and their relationships with nearshore areas. Community members also identified over 60 indicators that could be used to measure these principles. Here we reflect on three findings from this process. First, we identify multiple process lessons that could be useful in other places seeking to develop and measure the social and cultural impacts of management. Second, principles articulated by participants in this study, are similar to those developed in other studies, suggesting that some principles might be useful across places with similar histories and colonial legacies. Third, despite similarities across locales, place-based processes to develop socio-cultural monitoring are still vital in order to reflect values and perspectives of local communities. Place-based knowledge is essential to interpret and measure progress toward these principles, and there is a need to adapt and simplify indicators to keep monitoring and measurement from becoming overly burdensome on communities.

Implications for processes to develop socio-cultural indicators

For our workshops, we utilized purposive sampling to identify individuals who hold strong reciprocal relationships with nearshore areas. We intentionally sought out participants who identified as Native Hawaiian or who were born and raised in the

Fig. 2. Example of one socio-cultural principle and the corresponding set of indicators that were identified from participants' responses in Mural.



Hawaiian Islands, along with individuals engaged in caring for coastal areas. Programs or agencies seeking to create socio-cultural principles and indicators could also identify key participants based on longstanding and in-depth relationships with their environment, and involvement in caretaking efforts, including engagement in collaborative management.

Beginning workshops with cultural protocols appropriate to place was necessary to engage participants. We started our workshops with an *oli* (chant), followed by an opening question that all participants could answer as equals, before identifying their work affiliations that set social hierarchies (Carey and Markus 2017). Our approach, grounded in indigenous research methods and traditions of "talk-story," allowed participants to share their relationships with their coastal home area, finding commonalities, instead of focusing on who were government employees, researchers, or fisherpeople, avoiding manager-community conflicts that can prevent successful collaboration (Au and Kawakami 1985, Sletto 2008, Powell et al. 2018, Harangody et al. 2022). In a place like Hawai'i, where people can perceive state government institutions as an extension of illegal occupation by a foreign force (Sai 2004, 2008), meetings focused narrowly on agency management proposals often engender distrust (Bennett and Dearden 2014, Delgado-Serrano 2017). Following indigenous protocol, offering time for talk story and dialogue (Harangody et al. 2022), then crafting principles and indicators based on responses to open-ended questions, has potential to create space for inclusive and productive participation.

Comparison of socio-cultural principles to previous studies

The principles and indicators identified through our workshops reflect previously developed socio-cultural principles and indicators from similar research conducted within Hawai'i and the central Pacific (Pascua et al. 2017, Sterling et al. 2017b, Leong et al. 2019, Dacks et al. 2019; Table 3). Terminology varied across studies, for example, with "attributes" or "factors" being used in place of "principles." However, the actual content of principles supports key themes from other research, such as the importance of perpetuating local and indigenous knowledge across generations, and access to land and natural resources (Table 3). These topics also appear in studies from other parts of the world, such as British Columbia and the Bahamas (Burt et al. 2014, Knowles et al. 2017; Table 1).

The theme of protecting and maintaining local access to land, water, and other natural resources emerges in other communities where legacy impacts of colonialism challenge continued reciprocal relationships with coastal ecosystems. In Hawai'i for example, ongoing occupation by the United States of America enables foreign acquisition of coastal lands for private use, cutting off access for subsistence fishing and other cultural practice (Panarella 1998, Akutagawa and Baldauf 2013, Vaughan 2018). Capitalism and neocolonialism continue to displace indigenous coastal communities around the world, for example, in Northern Australia, Brazil, and Chile (Barreau et al. 2016, Constantino 2016, Annandale et al. 2021, Duarte et al. 2023). Foreign land ownership, corporate ventures such as commercial aquaculture farms, and the establishment of marine protected areas funded largely by Western governments and NGOs, can all prevent local communities from accessing and caring for their traditional lands and seascapes (Barreau et al. 2016, Constantino 2016, Annandale et al. 2021, Duarte et al. 2023). Principles emphasizing increased community access along with more decentralized governance, may be powerful wherever community organizations are working to correct legacies of injustice. At the same time, collaboratively developed management areas, with rules allowing traditional and

Table 2. The nine socio-cultural principles and examples of corresponding indicators developed from the community-based workshops.

Principles	Indicators
Perpetuate place-based *pono* (balanced, correct, mutually beneficial) knowledge, traditions, and practices	Presence and number of families participating in activities that the community determines as important for their place
	Presence of *kilo* training (observations)
	Place names and *moʻolelo* (stories) are used, shared, and represented in management plans, maps, and signs
	Presence of management/protection plans for sacred places and community input in plan
Provide education between generations in the nearshore area that reflect the ecosystem, traditions, and history of the place	Presence, number, and regularity of place-based education programs in the nearshore area for children
	Presence and number of outreach programs for all ages in the nearshore area
	Education and outreach includes traditional and local knowledge
	Community members from the area create and/or deliver the education and outreach programs
	Presence and sharing of *kūpuna* (ancestor or elder) knowledge (informal/outside of formal education and outreach programs)
Maintain resources and habitat that provide food	Abundance and diversity of food resources including fish, algae, and invertebrates
	Quality of habitat
	Number of commercial harvesting operations
	Number of people participating in non-commercial harvesting
	Presence of sharing what is harvested with outside networks
	Knowledge and use of *pono* (balanced, correct, mutually beneficial) harvesting practices
	Number of harvesting violations or enforcement actions
	Presence of boats and other gear used for harvesting
	Perceived ability to access harvesting locations
	Presence and number of people involved in Makai Watch (a collaborative, statewide program in which citizens work with the state to promote compliance to rules, education, and monitoring)
Provide a place to practice and strengthen mental, physical, and spiritual well-being	Nearshore area positively contributes to mental and spiritual health
	Perception of safety of the nearshore area
	Type of activities present in the nearshore area, number of people doing those activities, and how often they return to do those activities
Provide a place where relationships within family and community are supported and maintained	Number of local families utilizing the nearshore area
	Presence, number, and use of community gathering places
	Number of community stewardship efforts in the nearshore area
	Communities' perception on support from managing agencies
Ensure appropriate access and sustain the quality of experience in nearshore area	Number of illegal activities in the nearshore area
	Number of repeat visits and length of time locals have been visiting nearshore area
	Perception of safety of the nearshore area
	Number of commercial activities in nearshore area
	Presence of facilities to support access (e.g., restrooms and parking lots)
	Amount of shoreline access blocked by private property
Empower and grow community efforts to *mālama ʻāina* and *kai* (care for the land and ocean)	Number of community-based stewardship organizations
	Number of volunteer hours and percentage of returning volunteers
	Number of collaborative, co-management efforts or areas
	Amount of shoreline area being stewarded by the community
Manage the number and impact of visitors on the nearshore area	Presence of visitor education about importance of nearshore area
	Presence of visitor education about *pono* (balanced, correct, mutually beneficial) practices
	Presence of mechanisms to manage visitor impacts
	Percentage of visitor fees that are allocated to local stewardship of the nearshore area (if fees are present)
Utilize transparent and collaborative processes to address impacts to the nearshore area	Presence of collaboration between community, city, county, and state to address nearshore impacts (where appropriate)
	Management directly addresses impacts to nearshore area
	Presence of collaborative monitoring between community and state
	Percentage of money gained from enforcement that is allocated to local stewardship efforts

customary uses, can enhance community access, care and governance, alongside ecosystem abundance (Cinner et al. 2014, Vaughan 2018, Winter et al. 2023).

Many coastal communities worldwide also face precipitous loss of their indigenous knowledge, language, and culture (Townsend 2014, Barreau et al. 2016, Stocker et al. 2016, Edgar et al. 2022). Similarly, the importance of perpetuating traditional ecological knowledge across generations is applicable across the Pacific (Pascua et al. 2017, Sterling et al. 2017b, Leong et al. 2019, Dacks et al. 2019) and beyond. This research suggests that locally based educational programs that connect elders and youth, and engage entire families in traditional harvest and practices, could be a measurable indicator of the success of MMAs and other management efforts. Although in this case principles and indicators were developed through a place-based approach, their similarity to those developed through similar processes in other contexts may suggest widespread importance of certain fundamental socio-cultural principles. Although these more universal socio-cultural principles may be applicable in diverse locations across the world, it is still vital for local communities and managers to adapt principles to their own setting and environment.

The importance of place-based principles and participation

This project demonstrated the importance of place-specific ecological knowledge and experiences, which are constantly changing with local conditions. Participants brought in-depth, cross-generational knowledge of coastal environments, along with comprehensive assessments of their current conditions, based upon spending time in the areas they harvest and care for. For example, the importance of managing tourism emerged as a

Table 3. Summary of socio-cultural principles and indicators from previous studies throughout the Pacific compared to principles developed in this study.

Category	Principles from previous studies	Example corresponding indicators from previous studies	Principles identified in this study
Knowledge and education (Pascua et al. 2017, Sterling et al. 2017a, Leong et al. 2019)	Sharing knowledge between generations	Presence of experiential, land-based education; learning from elders; culture-based education	Perpetuate place-based *pono* (balanced, correct, mutually beneficial) knowledge, traditions, and practices
	Local knowledge about the marine and coastal environment	Knowledge of seasonal patterns or plant/animal behavior and reproductive cycles	Provide education between generations in the nearshore area that reflect the ecosystem, traditions, and history of the place
	Gaining knowledge through observation or practice	How often an individual observes seasonal patterns, harvests, or goes fishing	
Access to land and natural resources (Pascua et al. 2017, Sterling et al. 2017a, Dacks et al. 2019)	Physical access	How far an individual travels to a marine area	Ensure appropriate access and sustain the quality of experience in nearshore area
	Access to resources	Presence of food species; perception of water/habitat quality	Maintain resources and habitat that provide food
Social networks (Vaughan and Vitousek 2013, Pascua et al. 2017, Dacks et al. 2019, Leong et al. 2019)	Perpetuation of practices/skills that allow individuals to provide for and share with their families and communities	Goods for household, sharing, and income; jobs that require knowledge of traditional practices; community fishing endeavors	Provide a place where relationships within family and community are supported and maintained
	Presence of strong social ties or networks; sense of community	Networks of people to share with and receive from; the practice of gifting/exchanging goods; presence of community spaces	
Governance (Sterling et al. 2017a, Dacks et al. 2019, Leong et al. 2019)	Representation of Hawaiian values in management	Perception of presence of Hawaiian values in management process	Perpetuate place-based *pono* (balanced, correct, mutually beneficial) knowledge, traditions, and practices
	Community involvement in decision making	Perception of level of community involvement	Utilize transparent and collaborative processes to address impacts to the nearshore area
Connectedness to place (Dacks et al. 2019, Leong et al. 2019)	Security	Perceptions of ecological and environmental risks	Ensure appropriate access and sustain the quality of experience in nearshore area
	Intergenerational interactions/connections with the marine area	Number of practices related to connection; presence of traditional names for place, wind, rain, etc.	Empower and grow community efforts to *mālama ʻāina* and *kai* (care for the land and ocean)
Health and diet (Pascua et al. 2017, Sterling et al. 2017a, Dacks et al. 2019)	Opportunities for an active lifestyle	Participation in activities that strengthen mind and body	Provide a place to practice and strengthen mental, physical, and spiritual well-being
	Individuals' ability to provide food for their family	Number of seafood items that are caught/harvested each week; number of seafood items bought each week	Maintain resources and habitat that provide food

key current threat to reciprocal relationships with coastal areas in Hawai'i, though less articulated in other efforts to develop socio-cultural principles for coastal management in the Pacific. From 2009 to 2019, annual visitor counts to Hawai'i rose from approximately 6.5 to 10.4 million, a record 59% increase over a decade (Hawai'i Tourism Authority 2009, 2019). Although increasing tourism has contributed substantially to Hawai'i's economy, the number of visitors has significant ecological and socio-cultural impacts (Liu and Var 1986, Needham et al. 2008, Spencer et al. 2020). A case study conducted on the east side of O'ahu revealed that over 65% of resident survey respondents agreed that tourism had increased traffic, increased the cost of living, and additionally expressed that they felt "worried," "irritated," or "outraged" by the presence of tourists in their community (Spencer et al. 2020). As tourism grows to drive coastal economies worldwide, conflicts will increase between recreational and subsistence users, eroding long-standing community relationships with inshore areas (Needham et al. 2008). Taking time to collaboratively identify current conditions for a given area can reveal critical threats and management needs that drive place-based principles and indicators.

Collaboratively developed socio-cultural monitoring programs offer pathways to assess historically neglected aspects of coastal management impacts (Jentoft 2005, DeRoy et al. 2019, Ingram et al. 2020). However, socio-cultural monitoring requires continual community involvement, not just in the initial development of principles and indicators, but in the refinement and monitoring (Lincoln et al. 2018, Bennett et al. 2021). Our workshops resulted in a total of 61 proposed indicators, too many for managers or community partners to measure in multiple locations (Rosenström et al. 2006). Different indicators, applicable to a given context and place, could be used to measure the same universal principle in diverse ways across geographies. Each indicator's applicability, relevance, and interpretation may vary depending on the context and values of the place-specific communities where monitoring will occur (Dacks et al. 2019, Leong et al. 2019).

Measuring changes in indicators needed to evaluate progress on most of these principles relies upon in-depth knowledge of a particular place (Vaughan 2018, Leong et al. 2019, Winter et al. 2023). For example, not all community members, and certainly not visitors, would be able to provide useful insight on whether a

place is providing the surrounding community with food, or whether traditional fishing and gathering practices are being perpetuated. Therefore, collaboration between resource managers and the appropriate community members must continue well beyond identifying socio-cultural principles and indicators, and include opportunities for reflection and discussion on the socio-cultural monitoring program (Bennett et al. 2021). Collaboration takes time and effort, and community members should be compensated for their needed contributions. In addition, processes to develop holistic indicators for monitoring should not be overly burdensome for communities, and should build upon other collaborative management efforts rather than replacing or detracting from past work (Cadiz 2017).

CONCLUSION

Globalized approaches to conservation position many indigenous communities to carry the burdens of environmental initiatives planned from industrialized nations. Resource management should not solely focus on conservation or biodiversity targets, but also integrate human well-being objectives grounded in social and cultural dimensions. With 30x30 campaigns accelerating and much debated worldwide, collaborative creation of socio-cultural principles and indicators may offer means to not only formally consider, but also shift how management acknowledges and views their impacts on community relationships with the environment. Socio-cultural principles articulate community visions for social and ecological health of natural resources, or desired collective goals for resource management. Adopting target objectives such as perpetuating place-based knowledge and practices, maintaining family relationships, or empowering community caretaking efforts, alongside biodiversity targets, fundamentally changes management approaches. Comprehensive, interdisciplinary frameworks that include indicators linked to socio-cultural outcomes alongside ecological measures may help to inform more effective resource management that is inclusive of diverse identities, cultures, and value systems throughout the world. By engaging communities in assessing progress toward collective principles, socio-cultural monitoring has potential to further strengthen perpetual, reciprocal, and caretaking relationships between people and place.

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Data Availability:

We used no code, and are willing to make all data fully available.

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Appendix 1. Meeting agenda for the community-based development workshops hosted to identify and create socio-cultural principles.

Intro and Roadmap: ***20 minutes***

Welcome and *Oli*
Opening Question: What is your favorite food from the ocean? Why?
Workshop Expectations and Objectives
Workshop agenda
How will the information collected today be used?
Mural Demonstration

Peoples' relationships with coastal places: ***45 minutes***

Small group activity (Breakout rooms)

a. Introductions
b. Envisioning Exercise: Think about a coastal nearshore place that is important to you.
c. Brainstorm in Mural and discuss: How does that coastal nearshore place enrich the lives of your *'ohana* (family) and community? How do you enrich that coastal nearshore place?

Large group discussion (Main Zoom room)

10 minute Break

Grouping your answers in Mural: ***25 minutes***

Small group activity (Same breakout rooms)
Review the resulting categories from all groups (Main zoom room)

10 minute Break

Measure and maintain these relationships: ***30 minutes***

Small group activity (New breakout rooms)

d. Introductions
e. Brainstorm in Mural and discuss: What is needed to maintain each aspect of your relationship with coastal nearshore places?

Large group discussion (Main Zoom room)

Wrap-Up: ***10 minutes***

Final Questions or Comments
Next steps
Application to Marine Management
Mahalo

Appendix 2. Meeting agenda for the community-based workshops hosted to collect feedback and input following the drafting of socio-cultural principles.

Intro and Roadmap: ***20 minutes***

Welcome and *Oli*
Opening Question: What is your favorite thing to do at your nearshore place?
Why are we here
Workshop Objectives and Agenda
Application of results to nearshore management
Mural Demo
Principle Overview

Principle and Indicator 1-2 Review and Feedback: ***25 minutes***

Present in large group
Small group review and discussion in Mural (Breakout rooms)
Share with larger group (in main Zoom room)

Principle and Indicator 3-4 Review and Feedback: ***25 minutes***

Present in large group
Small group review and discussion in Mural (Same breakout rooms)
Share with large group (in main Zoom room)

10 minute Break

Principle and Indicator 5-7 Review and Feedback: ***30 minutes***

Present in large group
Small group review and discussion in Mural (Same breakout rooms)
Share with large group (in main Zoom room)

Principle Overview and Additional Recommendations: ***10 minutes***

Large group discussion

a. Principle Overview- Gaps or additional comments?
b. Additional Recommendations

Wrap-Up: ***10 minutes***

Next Steps
Oli Mahalo

Appendix 3. Comprehensive list of proposed socio-cultural indicators that can be used to measure corresponding principles identified in community-based workshops. Asterisks denote repeated indicators that appear at least twice and measure more than one principle.

Principle	Indicators
Perpetuate place-based pono knowledge, traditions, and practices	Types of activities that families are doing in nearshore place (based on what community determines as important activities for their place)*
	Number of *moʻolelo* (stories), *oli* (chant), and hula about the nearshore place and number created over time
	Presence of *kilo* (observation) training
	Protect and respect sacred places in a way that follows community wishes (e.g., burials, shrines, altars)
	Place names and *moʻolelo* (stories) are used, shared, and represented in management, maps, and signs
	Number of people doing practices important to place (e.g. ceremonies, rituals)*
	Presence of public art or oral history projects that represent stories of the place
Provide education between generations in the nearshore area that reflect the ecosystem, traditions, and history of the place	Presence and number of place-based education programs for children (e.g., school field trips and camps); Regularity that children participate in these programs (number of times per year)
	Presence and regularity that lessons about local nearshore areas are taught in school curriculum
	Presence and number of outreach programs for all ages related to the nearshore area
	Presence and sharing of *kūpuna* (elders) knowledge
	Number of children staying in Hawaiʻi for higher education
	Community members create and/or deliver education programs

Principle	Indicators
Provide education between generations in the nearshore area that reflect the ecosystem, traditions, and history of the place (continued)	Education and outreach includes traditional and local knowledge (e.g., spawning cycles, proper ways to harvest, place names, stories) Number of children graduating from high school with experience/knowledge in Hawaiian culture, stewardship, and traditional or customary practices
Maintain resources and habitat that provide food	Perceived ability to access harvesting locations* Amount of catch shared within community (presence of sharing harvest, especially with kūpuna or elders who can‘t harvest themselves)* Presence of community harvesting methods* Number of people participating in non-commercial harvesting Number of people that are fed from subsistence harvesting Presence and use of traditional practices in harvesting Quality of the habitat (Number of naturally flowing streams in the watershed, percent coral cover, nearshore urban development, water quality) Number of commercial harvesting operations* Types of fish people are harvesting for subsistence (trophy fish vs more sustainable species) Presence and number of people involved in Makai Watch program (a community-based collaborative statewide program to promote compliance to rules, education, and monitoring)* Number of fishing and gathering violations or number of enforcement actions*

Principle	Indicators
Maintain resources and habitat that provide food (continued)	Site-specific rules and management (e.g., gear types, closures during spawning, slot limits)
	Presence and access to boats or other gear to practice harvesting based on the place
	Knowledge and use of pono practices (e.g., leave the bigger fish, only take as much as you need)
	Abundance and diversity of food resources
Utilize transparent and collaborative processes to address impacts to the nearshore area	Presence of collaboration between community, city, county, and state to address nearshore impacts, where appropriate
	Money gained from enforcement (fines, etc.) in an area goes back to that area through outreach/education or nonprofits
	Management directly addresses impacts to the nearshore area (e.g., visitors, sedimentation, climate change, etc.)
	Presence of collaborative monitoring of nearshore area between community and state
	Presence of community input on management of nearshore area*
Manage the number and impact of visitors on the nearshore area	Presence of visitor activities that are appropriate for the nearshore area (as determined by the community)
	Carrying capacity is determined and not exceeded*
	Presence of visitor education about proper and respectful practices
	Presence of visitor education about importance of the nearshore area (culturally and/or ecologically)
	Presence of mechanisms to manage visitor impact (e.g. barriers around sensitive areas, closed days, etc.)

Principle	Indicators
Manage the number and impact of visitors on the nearshore area (continued)	Survey question- Do visitors feel responsibility to care for the nearshore place? If visitor fees are present, they are used for protection, restoration, and/or education in the nearshore area
Provide a place to practice and strengthen mental, physical, and spiritual wellbeing	Types of activities and number of people doing those Survey question- nearshore area providing opportunities to challenge oneself and/or skills Survey question- perception of safety* Survey question- nearshore area contributing to mental and spiritual health Frequency of use/visitation of the area by local residents* Presence of spiritual or ceremonial practices*
Ensure appropriate access and sustain the quality of experience in nearshore area	Amount of access blocked by private property* Number of local people vs visitors in a place (ensure percentage of local use is maintained or increased)* Survey question- perception of safety* Length of time over which locals have been visiting a place Frequency of use/visitation of the area by local residents* Survey question- perception of quality of the experience Number of commercial operations* Presence of facilities that support access (e.g., restrooms, parking lots)

Principle	Indicators
Ensure appropriate access and sustain the quality of experience in nearshore area (continued)	Adherence to community-determined boundaries and access (e.g., areas for kids or the elderly, areas for surfing or fishing) Number of illegal activities or violations*
Empower and grow community efforts to *mālama ʻāina and kai* (to care for the land and ocean)	Number of community-based organizations or community stewardship efforts* Number of volunteers or hours contributed towards stewardship efforts Number of young people engaged in stewardship or related advocacy work Number of collaboratively/co-managed marine areas Presence of community input in rule-making* Survey question- perception of community support from governing agencies* Number of traditional Hawaiian fish ponds (*loko iʻa*) Area of shoreline being stewarded Number of career pathways available for stewardship/conservation focus areas Presence and number of community members involved in Makai Watch program (a community-based collaborative statewide program to promote compliance to rules, education, and monitoring)*
Provide a place where relationships within family and community are supported and maintained	Number of community or family efforts to care for the nearshore area (e.g., pick up trash, etc.)* Resources gathered or harvested are shared between community members* Presence of community harvesting methods*

Principle	Indicators
Provide a place where relationships within family and community are supported and maintained (continued)	Presence, number, and use of community gathering places (e.g., pavilions)
	Number of local families at the nearshore place*
	Survey question- perception of community support from governing agencies*