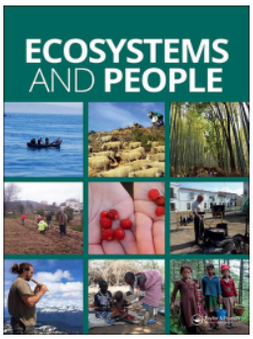

Ecosystems and People

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/tbsm22

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**To cite this article:** Rebecca J. Ingram, Kirsten M. Leong, Alohi Nakachi & Jamison M. Gove (2024) Dimensions of cultural ecosystem service contributions to human well-being in marine environments, Ecosystems and People, 20:1, 2378155, DOI: 10.1080/26395916.2024.2378155

**To link to this article:** https://doi.org/10.1080/26395916.2024.2378155

ECOSYSTEMS AND PEOPLE
2024, VOL. 20, NO. 1, 2378155
https://doi.org/10.1080/26395916.2024.2378155

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# Dimensions of cultural ecosystem service contributions to human well-being in marine environments

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**ABSTRACT**

Human well-being is critically linked to the condition of marine ecosystems. Intangible services, benefits, and values derived from ecosystems play a vital role in human well-being and promote conservation efforts that ultimately support ecosystem sustainability. Similar to many regions, communities along the west coast of Hawai'i Island are intertwined with their diverse and productive ecosystem. Though multiple resource management programs focus on operationalizing ecosystem-based management in this region, they lack adequate inclusion of connections between people and their environment. To address this, we used the Cultural Ecosystem Services (CES) framework to investigate intangible connections and opportunities to include them in resource management. Through unstructured interviews with community members on Hawai'i Island, we explored relationships between CES and human well-being. We found that certain CES seem to be strongly related and/or connected to a large number of other CES. We also describe emergent interview themes, which include the ecosystem's influence on well-being, types of access to CES, and the values that people ascribe to their ecosystem-derived connections. Importantly, these themes represent necessary modifications to ecosystem assessment frameworks. Additionally, we suggest stepping away from discussing CES as if they exist in segregated categories that contribute to individual facets of human well-being. Taken collectively, our findings support deepening the scope of ecosystem assessments and improving sociocultural indicators for the benefit of marine ecosystems and human well-being alike.

**ARTICLE HISTORY**
Received 25 July 2023
Accepted 4 July 2024

**EDITED BY**
Maraja Riechers

**KEYWORDS**
Human well-being; cultural ecosystem services; integrated ecosystem assessment; indicators; Hawai'i

## Introduction

Human well-being encompasses the psychological, physical, spiritual, social, and economic aspects of an individual's life and is a concept fundamentally intertwined with ecosystem sustainability (i.e. the ability for an ecosystem to sustain natural functions, processes, and productivity) (Leemans and de Groot 2003; Breslow et al. 2016; Hicks et al. 2016). Ecosystems contribute substantially to human well-being in material and non-material ways, forging connections between humans and their environment (Chan et al. 2012; Amberson et al. 2016). These connections influence perceptions and behaviors that can enhance both ecosystem sustainability and human well-being by encouraging conservation, fostering resilience, and promoting support for sustainable policies (Millennium Ecosystem Assessment 2005; Folke et al. 2016; Rodrigues et al. 2017). Conservation and management efforts have yet to adequately account for this, undermining management and sustainability goals (Millennium Ecosystem Assessment 2005; Ash et al. 2012; Chan et al. 2012; Dillard et al. 2013; Hernández-Morcillo et al. 2013; Fish et al. 2016; Ives et al. 2018; Donkersloot et al. 2020).

Cultural Ecosystem Services (CES) are part of a framework developed by the Millennium Ecosystem Assessment (2005), one of the most common frameworks used to examine ecosystem services. CES are distinctly different from the other provisioning, supporting, and regulating ecosystem services in the framework, which generally refer to tangible or quantifiable services and benefits (Millennium Ecosystem Assessment 2005). Instead, CES describe intangible services, benefits, and values that people derive through their relationships with ecosystems, such as spiritual values and sense of place, which all contribute to human well-being (Millennium Ecosystem Assessment 2005; Chan et al. 2011). Studies have shown a positive link between ecosystem services and human well-being (King et al. 2014), but exploration into how changing CES may result in corresponding changes to human well-being are

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/26395916.2024.2378155.

largely unknown (Rodrigues et al. 2017; Willis et al. 2018). There is a growing understanding that the relationship between CES and human well-being is not a linear, 1–1 relationship (Huynh et al. 2022). Investigating how communities identify, appreciate, and interact with CES will help unravel the links between CES and human well-being, which is necessary to achieve marine environmental sustainability goals (Milcu et al. 2013; Pascua et al. 2017; Rodrigues et al. 2017; Kosanic and Petzold 2020) and support marine management under increased threats from human impacts and global climate change (Qiang and Silliman 2019).

The linkages between ecosystem services and human well-being are a critical component of ecosystem-based management (EBM), which is a management strategy rooted in social-ecological systems thinking for achieving sustainability (O'Higgins et al. 2020; Piet et al. 2020). EBM commonly relies on ecosystem assessments and indicators to evaluate the state of ecosystem conditions (Rice and Rochet 2005; Piet et al. 2020). Indicators typically focus on conventional and quantifiable metrics (e.g. biophysical and ecological data) rather than non-monetary social dynamics, such as human well-being and CES (Breslow et al. 2017; Dacks et al. 2019; Hornborg et al. 2019). While indicators of biological and ecological conditions are critical, it is a large leap to assume they wholly represent what society values and finds meaningful in a given ecosystem. Importantly, the selection of indicators inherently defines what is considered 'relevant' in a given region, thereby carrying a huge influence on what is managed (Hicks et al. 2016). The challenge lies in understanding how the marine environment is contributing to human well-being, learning the social meanings and values attributed to CES, and embedding this information within EBM strategies.

The west coast of Hawai'i Island, an area commonly known as West Hawai'i, is home to many communities defined by geography, ethnicity, identity, and interest who live within a diverse and productive ecosystem (Figure 1). The region's population includes Indigenous Kanaka Maoli (Native Hawaiians), locals with multi-generational ties or more recent settlers, and large populations of transient communities (e.g. tourists, short-term residents, traveling professionals). The diverse marine environment is a backbone in providing ecosystem services such as food, recreation, and cultural identity. Global and local stressors including climate change, rapid population increase, coastal development, pollutants, and fishing pressures compromise the condition of the marine environment and connected human well-being (Friedlander et al. 2008; Gove et al. 2019).

Multiple management regimes focused on operationalizing EBM exist in this region, including the National Oceanic and Atmospheric Administration's Integrated Ecosystem Assessment (IEA). The IEA seeks to achieve local management goals by identifying and monitoring components of social-ecological systems. This research purposefully works to help fill the social indicator gap within the IEA and beyond by using research results to guide social indicator development. We conducted in-depth, unstructured interviews to investigate the relationship between CES and human well-being among community members in West Hawai'i. Discussions about CES can

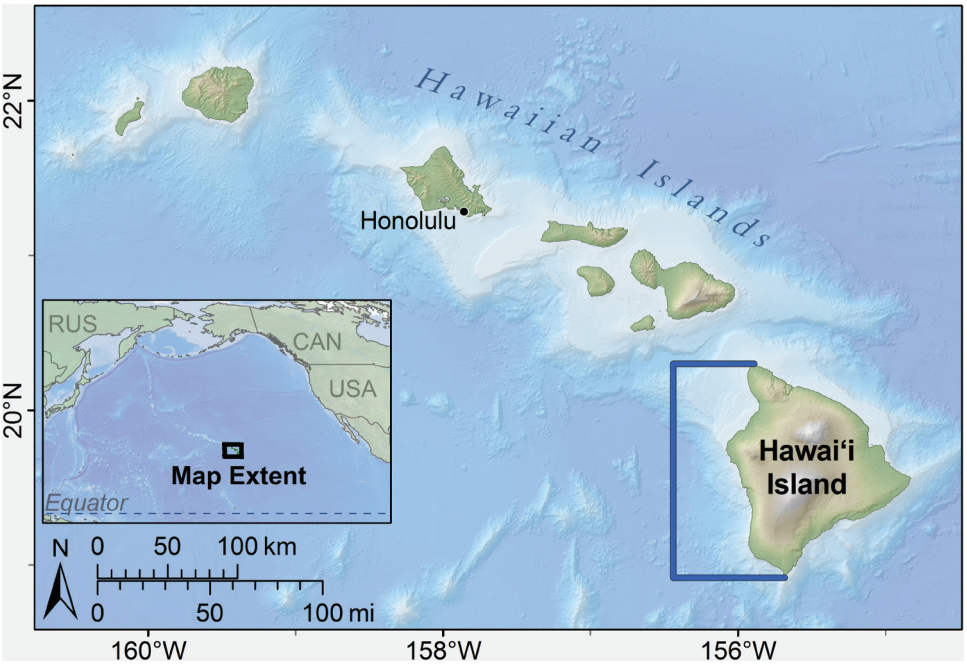


Figure 1. Map of the general location of West Hawai'i within the hawaiian archipelago.

reveal the importance of different aspects of relationships and interactions between people and their environment (Leemans and de Groot 2003). Our research objectives were 1) to investigate how the marine environment contributes to human well-being through CES specifically, and 2) determine how this information could be operationalized within management approaches. In our results, we describe patterns from the data and emergent interview themes which help illuminate the multifaceted nature of understanding and monitoring intangible elements of human well-being in resource management.

## Methods

### Research approach and data collection

We began by completing extensive preliminary research to frame our research scope (Ingram et al. 2018; Leong et al. 2019). Preliminary research included a detailed literature review, discussions with and input from field experts, and pilot interviews; all of which guided development of background materials used in this research, including human well-being domains and interview guides (see Leong et al. (2019) for detailed review). We applied a qualitative, case study approach to address our research objectives and contribute to human well-being and CES literature rather than attempting to generalize our results to a population level (Yin 2009). We then conducted in-depth, unstructured interviews with community members who live along the west coast of Hawai'i Island. Our previous work identified key considerations that guided our selection of interviewees, including cultural, community, research, and governance/management conditions (Leong et al. 2019). We chose 24 interviewees using purposive sampling of key informants involved in West Hawai'i ocean-based conservation (Patton 1990; Palinkas et al. 2015). Additionally, we used snowball sampling methods which identified seven additional interviewees (Patton 1990).

Interviewees' ages ranged from 25 to 86 years old. Out of 31 interviewees, 21 were born in Hawai'i (nine born in West Hawai'i specifically). All interviewees had lived in West Hawai'i for at least 10 cumulative years. They were involved in marine conservation via one or more routes (e.g. one interviewee was a marine resource manager and a volunteer for another marine conservation organization). A total of 10 interviewees were currently in or retired from a state or federal resource management position, seven interviewees worked for non-governmental resource management organizations, and nine interviewees worked for a private sector company focused on ocean conservation. Interview materials included a consent form, interview guide, and our list of human well-being domains with attributes and prompts from previous work (prompts were only used if an interviewee had not already voluntarily discussed a CES or human well-being domain) (Leong et al. 2019). We had two interview guides designed with both direct and indirect questions; one guide was oriented towards community leaders and one was oriented towards individuals in paid resource management roles (Appendix A). No two interviews were identical or followed the guide exactly. The depth and scope of any given topic varied depending on the interviewee's expertise and interests.

The lead author conducted 24 unstructured interviews with 31 interviewees between April 2018 and March 2019. Three were group interviews (group sizes: two, four, and five). Interviews lasted between 45 min and 2.5 h, took place in a mutually agreed upon location, and were audio-recorded. Detailed notes on interviews were written up within 48 h of interview completion. Audio recordings of interviews were transcribed, and interviewees received a copy to review and inform the interviewer of any corrections or redactions.

### Data analysis and qualitative coding

Our analysis invoked a mixed inductive and deductive approach. We created an initial codebook prior to coding interviews using a deductive process (Saldaña 2021). This initial codebook consisted of a list of human well-being domains, CES, and other topics related to human well-being. We used multiple sources to create this codebook including key references (Millennium Ecosystem Assessment 2005; Millennium Ecosystem Assessment Board 2005; Smith and Clay 2010; Michalos et al. 2011; Dillard et al. 2013; Smith et al. 2013; Gould et al. 2014; Wongbusarakum et al. 2014; Biedenweg et al. 2016; Breslow et al. 2016; Pascua et al. 2017), preliminary research (Ingram et al. 2018; Leong et al. 2019), and collaboration with related research being conducted separately from this work but simultaneously with similar communities (Gould et al. 2022). Our codebook went through multiple iterations during this process.

After importing transcripts into NVivo qualitative data analysis software (version 12 Pro, QSR International, Inc.), we completed two phases of coding. The lead author conducted all coding, and reviewed progress with co-authors regularly (approximately biweekly) until finished. We deductively coded relevant segments of text from each interview that illustrated pre-identified codes in our codebook. During this process, new codes were inductively added to our codebook as new concepts arose (Saldaña 2021). This resulted in a final multi-

level codebook with 222 codes (Appendix B). Level one codes were main categories/topics and may have had nested sub-codes, referred to as level two codes. Similarly, level two codes may have also had nested sub-codes. The final codebook had 30 level one codes, 47 level two codes, 100 level three codes, 44 level four codes, and one level five code. One important level one code included 'well-being', under which domains of human well-being were listed (Leong et al. 2019). 'Well-being' also included the sub-code 'CES', which comprised 14 CES and their 13 associated sub-codes. Concurrent with the first phase of coding all interviews, we compiled our final list of CES and associated definitions and examples to explore during analysis (Table 1). This list of CES did not include any novel CES that we had not previously read in literature (largely due to the exploration of West Hawai'i CES in Pascua et al. (2017)). Using the final codebook, we then completed a comprehensive coding phase. This involved reading through each interview to verify the accuracy of existing coded sections, discovering sections of text that were missing codes, or re-code sections based on the updated codebook.

Our coding process allowed for any single segment of an interview transcript (e.g. several words, one sentence, or one answer) to have multiple codes assigned to it, an event known as a co-occurrence (Saldaña 2021). For example, when asked about a spiritual relationship to the ocean, one interviewee replied,

> For me, personally, I feel spiritually connected to the ocean because it is what brings me joy. Looking at it is what calms me down. There's a sense of purpose when I look at the ocean. There's a sense of connection when I look at the ocean. Things make sense when I'm in the water. (28)

Despite the interview question targeting spirituality specifically, this segment wove multiple topics together and we gave it multiple codes, including mental and emotional health, aesthetics, sense of place, and identity. Identifying co-occurrences allowed us to perform a co-occurrence analysis in which we identified, counted, and examined how often codes appeared together in the data. We examined co-occurrences between each CES and each individual code (e.g. other CES, well-being domains, and all sub-codes).

Additionally, we conducted a thematic analysis by familiarizing ourselves with the data, reviewing existing codes, organizing our codes based on patterns, and condensing patterns into broader themes (Braun and Clarke 2006; Seidman 2006; Saldaña 2021). Through this iterative process, we discerned three predominant themes that emerged, all illustrating how the coastal and marine environment relates to intangible aspects of human well-being.

After completing our analysis, we presented our findings to available interviewees via virtual meetings to ensure that our interpretation captured all interviewee's meaning and correctly portrayed their perspectives and beliefs, a process called member-checking (Glesne 2016). We also sent a detailed report describing our research and findings to interviewees (Ingram et al. 2020). In addition to ensuring accurate representation, this process helped to ensure that we, as researchers, did not reveal more information than interviewees intended to be made public (Seidman 2006; Glesne 2016). All interviewees were encouraged to communicate any feedback, including discrepancies; only positive feedback was received.

## Results

### *Strong and diverse relationships among cultural ecosystem services*

Our interview analysis resulted in 2668 individual coded segments. In alignment with our research objectives, we examined the coded segments that related to CES specifically. Our analysis revealed relationships among multiple concepts via code co-occurrences. We first examined co-occurrences between each individual CES and all other relevant codes (codes considered irrelevant for analysis included generic codes, such as 'memorable quote'). We discovered 832 total co-occurrences, with a range of 1–23 co-occurrence pairs (Ingram et al. 2020; Appendix C). The CES with the highest number of co-occurrences with all other codes were *Heritage, Tradition, Culture* (236 co-occurrences, meaning we coded *Heritage, Tradition, Culture* with another code 236 times); *Sense of Place* (172); and *Social Relations* (121) (Table 2). A total of 70% (579 out of 832) of all co-occurrences in the dataset existed between a CES and non-CES code (e.g. *Heritage, Tradition, Culture* and *Reciprocity* co-occurred 8 times). However, all of these co-occurrences happened relatively fewer times than co-occurrences between a CES and another CES (e.g. *Heritage, Tradition, Culture* and *Sense of Place* co-occurred 23 times), leading us to examine these co-occurrence relationships explicitly.

There were 253 co-occurrences between a CES and another CES. We calculated these connections in two different ways: diverse and strong connections. We calculated diverse connections by tallying the number of different CES that co-occurred with one specific CES (e.g. aesthetics co-occurred one or more times with eight other CES). We calculated strong connections by adding together the number of co-occurrences between two particular CES (e.g. aesthetics co-occurred with spirituality six times). Figure 2 illustrates the diversity

**Table 1.** List of Cultural Ecosystem Services, associated definitions, and an interview quote that illustrate each Cultural Ecosystem Services. Definitions are summarized from key references (see methods section for details).

| Cultural Ecosystem Service | Definition of Code | Illustrative Quote |
|---|---|---|
| Aesthetics  | Satisfaction or meaning from visual characteristics or beauty from the coast and/or ocean, in general; also includes satisfaction from other sensory experiences | "It is one of the most beautiful places for me on earth. And it can be gentle breezes like this or it can be a savage wind that rips everything, but it's speaking to you. It has a mood, you know". |
| Bequest  | Importance of coast and/or ocean for future generations; includes sharing experiences with children and grandchildren | "The benefit to me is that it's a food source [long pause]. And I want it to be a food source for my children and their children, too". |
| Ceremony  | Importance of coast and/or ocean for ceremonies | "Being able to go on the heiau[1] and acknowledge ceremony, practices, and honoring the place and honoring the elemental forms around us". |
| Education and Knowledge  | Learning or teaching opportunities related to coast and/or ocean; knowledge transmission from one person/entity to another (including place-based, observational, formal, informal, etc.); Local and Traditional Ecological Knowledge; ability to recognize the presence of environmental signs or indicators (e.g. bioindicators) | "Being in a place or going to that specific place so much because it was my favorite beach or it is my favorite beach that I would notice the subtle changes or drastic changes from interacting with that same location over and over again". |
| Existence  | Implication that the coast and/or ocean matters simply because they exist, because they are a part of Earth, and/or because they have a right to exist | "Whether or not we're physically accessing the mauna[2] or the kai,[3] that knowing that they are there, enhances our balance in the world". |
| Fulfilling Stewardship  | Caring for coasts and/or ocean because it provides a multitude of benefits and/or satisfaction to a person; ability to care for resources and environment | "I still believe that if you take care of the land, take care of the ocean, it's going to take care of you, and that's my upbringing from my parents, my kupunas[4] (sic) before me". |
| Heritage, Tradition, Culture  | Multi-generational interactions/connections with natural resources; connection to cultural traditions, stories, and/or past events; archaeological and historic sites; cultural resources; acceptable historical change; includes differentiation between Native Hawaiian and different/unspecified heritage | "Looking at our old chants as data, because a chant is actually just a documentation of what's happening during this time". |
| Identity  | Personal or communal identity in relation to the coast and/or ocean; included the code 'identity of West Hawai'i' | "In some ways, [my children have] been more shaped by the coastline than I was because they were immersed in it from when they were little. And when they were little, we spent a lot of time down there". |
| Inspiration  | Instances when the coast and/or ocean specifically inspired art or other form of creative expression; local artistic or creative practices | "The ocean is inspiration in one way or another for the work we do, for the play that we do, for our tie to this place". |
| Recreation  | Playing, leisure, and activities related to coast and/or ocean; includes extractive and non-extractive activities | "I always tell them, you know, when you go fishing, it's okay that you don't catch fish. You don't have to come home with anything. The whole part about going fishing is being able to go outdoors with your family and make memories… of being outdoors and enjoying the outdoors. It's not just going out and having to catch something". |
| Sacred  | Expressions of coast and/or ocean having sacred or religious significance | "You have that sense of reverence when you're there and you have that sense of respect and reverence for everything and everyone that you encounter". |
| Sense of Place  | The coast and/or ocean contribute to a person's sense of belonging or 'feeling at home;' sense of self, community, and/or home in direct relation to the coasts and/or ocean | "If you can see the ocean, if you're in the ocean, if your toes are touching it or like you can – you're even far enough away you can't see it, but you feel it, it's like home, you know". |

(*Continued*)

**Table 1.** (Continued).

| Cultural Ecosystem Service | Definition of Code | Illustrative Quote |
|---|---|---|
| Social Relations  | Coast and/or ocean responsible for strengthening ties in family or community; presence of strong social ties or networks; sense of community; trust in neighbors | "From a family's perspective [the ocean] really brings us close together because everybody has a duty when [we] go camping, you know? My son and I catch all the fish, the girls clean them, and then my son and I do the cooking. The girls [also] take care of the campsite". |
| Spirituality  | Coast and/or ocean responsible for metaphysical forces larger than oneself or beyond one's comprehension; interacting with the coast/ocean to perpetuate spiritual beliefs and practices (e.g. divine power); can be a reference to a specific religion | "I think just walking the trails for me is a spiritual connection. And swimming, always, being in the water". |

[1]Heiau: Pre-Christian place of worship, shrine; some heiau were elaborately constructed stone platforms, others simple earth terraces. Many are preserved today.
[2]Mauna: Mountain.
[3]Kai: Sea.
[4]Kupuna: grandparent, ancestor, relative or close friend of the grandparents' generation; also starting point, source: growing (plural: kūpuna).

**Table 2.** Results from our interview analysis included counting the number of times each Cultural Ecosystem Services was coded within the data. This table reports totals for each Cultural Ecosystem Services individually/alone, each Cultural Ecosystem Services when coded with any other code, and each Cultural Ecosystem Services when coded with another Cultural Ecosystem Services.

| CES | CES Alone | CES/All Codes Co-Occurrences | CES/CES Co-Occurrences |
|---|---|---|---|
| aesthetics | 15 | 32 | 18 |
| bequest | 24 | 53 | 33 |
| ceremony | 4 | 14 | 11 |
| education and knowledge | 26 | 33 | 18 |
| existence | 12 | 17 | 4 |
| fulfilling stewardship | 67 | 92 | 47 |
| heritage, tradition, culture | 98 | 236 | 107 |
| identity | 49 | 96 | 53 |
| inspiration | 2 | 3 | 2 |
| recreation | 56 | 114 | 32 |
| sacred | 5 | 13 | 6 |
| sense of place | 69 | 172 | 72 |
| social relations | 55 | 121 | 57 |
| spirituality | 47 | 89 | 46 |

of connections (represented by the number of individual lines) and strength of connections (represented by thickness of lines). The diversity of CES/CES connections ranged from 2 to 11. Four CES (*Heritage, Tradition, Culture*; *Sense of Place*; *Social Relations*; *Fulfilling Stewardship*) each had at least one co-occurrence with 11 different CES. The strength of connections ranged from 1 to 23. The strongest connections were between *Heritage, Tradition, Culture* and *Sense of Place* (23 co-occurrences); *Heritage, Tradition, Culture* and *Fulfilling Stewardship* (17); *Heritage, Tradition, Culture* and *Social Relations* (15); *Heritage, Tradition, Culture* and *Identity* (13); and finally, *Sense of Place* and *Identity* (12).

During our member-checking process, interviewees discussed the concept of strong and diverse CES connections. They pointed out the usefulness of grouping certain CES to study them from a broader perspective, akin to viewing them through a wide-angle or 'macro' lens. This approach contrasts with examining each CES in isolation, which is more like looking through a narrow-focus or 'micro' lens. They also recognized the advantage of focusing on a CES that serves as a diverse link to other CES. This strategy was viewed as effectively highlighting the CES that might be unintentionally overlooked when each service is examined separately.

## Emergent interview themes: three facets of contributions of CES to human well-being

Three dominant themes emerged from our thematic analysis: Ecological Influence, Dimensions of Coastal and Marine Access, and Values and Meanings. Ecological Influence is an expansion of what typical monitoring indicators (e.g. biological and ecological data) represent in ecosystem assessments and how ecological components impact human well-being. Dimensions of Coastal and Ocean Access refers to how people can both physically and/or mentally connect with a place. Values and Meanings illuminates the social values and meanings that people develop related to the coastal and marine environment. Our three emergent interview themes illustrate that there are multiple facets of CES (e.g. creating, obtaining, valuing) that together encompass contributions of CES to well-being; evaluating each facet individually


**Figure 2.** Co-occurrences between Cultural Ecosystem Services. Diversity of connections (represented by the number of individual lines) and strength of connections (represented by thickness of lines). Interactive version: https://public.flourish.studio/visualisation/10866413/.

cannot provide an accurate representation of the whole story.

### *Ecological influence*

The Ecological Influence theme describes the impact of ecological components on human well-being. Data describing these components (e.g. fish abundance, coral cover, sea temperature) are typically included in marine ecosystem assessments. These data are necessary for monitoring the condition of an ecosystem; however, interviews provided insight into how these data reveal information not only about ecosystem condition but specifically to human well-being.

Both prompted and unprompted, interviewees gave examples of how ecological conditions influence their personal and community well-being. Interviewees discussed positive emotions that they derive from the coast or ocean, including stress relief, calmness, joy, excitement, and happiness. In contrast, multiple interviewees also brought up negative emotions, such as sadness, anger, and frustration. This was particularly true when discussing coral bleaching events (an unprompted topic). Words that interviewees used to describe coral decline included fear, sadness, anger, heartbreak, depression, and frustration. One interview describes, *'I think on the emotional level, there has to be some kind of an impact that reflects what's happening ecologically' (19).*

Other than influencing overall human well-being, this theme also describes how ecological conditions can influence specific CES. Here, we provide three examples from interviews. First, interviewees discussed that when fish populations are large enough to sustain local food supply, CES like *Aesthetics*, *Identity*, and *Heritage, Tradition, Culture* are also supported. We heard during interviews that, '*culture and people's identity is strongly tied to food,' (17)* as well as, *'the way that those things of the sea contribute not only nutritionally, but aesthetically. And the flavor aspect to our lives. Our lives are just richer when we eat like that' (10)*. In our second example, interviewees spoke of how water quality conditions support the existence of *Recreation* and *Spirituality*. This is highlighted in the following quote,

> I used to be drawn to more ocean activities, like personally and spiritually. And now—I mean, yeah, I'll go surfing, but I also just go to the pool because I don't want to see [the changes]. Or, because there's

> [too many] people or because I know there's like brown water and there's chemicals [in the ocean]. (24)

And finally, interviewees discussed how biodiversity supports *Aesthetics* and *Recreation*,

> You know, just the color therapy when you go for a snorkel or even if you're not snorkeling, you're just sitting at the beach. Those changes in color and textures that you get to see, I think, are good for your head and your heart. (18)

Interviewees consistently described a correlation between the range of ecological conditions and the corresponding availability and/or quality of CES. This pattern underscores the integral link between the health of the ecosystems and the potential for realizing the full spectrum of benefits provided by CES.

### Dimensions of coastal and ocean access

The Dimensions of Coastal and Ocean Access theme explores the multidimensional concept of access to the coastal and marine environment, which encapsulates physical, emotional, and experiential connections. Our analysis illuminated how people are creating connections not only by literal access, but also by building and maintaining connections that may or may not require physical proximity to generate the CES that contribute to their well-being. The dimensions of access in this theme were consumptive (e.g. catching fish to eat), non-consumptive (e.g. a family gathering at a beach), and felt at both individual and collective levels. Several interviewees discussed the importance of connections created through indirect access. For example, one interviewee said that their role as a fisher person included sharing catch with those who are unable to fish as a way to, *'allow some of those people who can no longer fish, a connection. Can't [fish], right? So, they still have that connection' (29)*. These interviewees emphasized that the significance of sharing fish goes beyond sharing calories or nutrients.

This perspective of access underscores the interconnectivity among CES interviewees described. Most interviewees shared that *Recreation* and *Fulfilling Stewardship* were conduits for creating or maintaining a deeper connection with the coastal and marine environment. Interviewees frequently mentioned *Recreation*, but rarely as a standalone. For example, one interviewee said, *'paddling … It's recreational, it can be sporting, [NAMES] often invite me to pray on their canoe races before the race begins. So it's a great medium for both physical and spiritual connection' (10)*. Similarly, interviewees often discussed *Fulfilling Stewardship* as a means to create and maintain connections through stewardship actions. One interviewee said, *'Engaging with this place and space, whether it's in the ocean or the land, I think it's a kuleana*[1] *in itself and [a] reconnecting' (24)*. These CES are providing the conduit for people to create and maintain connections with their surroundings, leading to many associated values. A critical insight was that, as one interviewee described, '*pure recreation*' with '*no taking care*' (i.e. no stewardship mentality or motive) was destructive to both the environment and human well-being. Another interviewee explained that having a connection to place is a critical link to caring for place, and that, *'a negative feedback loop [is] created if the ability for people to feel empowered and participate [in taking care of place] goes away'* (19).

Importantly, interviewees disagreed about whether physical access is a necessity in order to sustain a personal connection to the coast or ocean. While some explained that their well-being would be enhanced by memories, emotional attachment, or mo'olelo[2] regardless of circumstance, some interviewees expressed that they need continued, physical access to experience a positive impact to their well-being. A few went on to explain that their access had been altered or severed due to environmental or social changes (e.g. development, land ownership changes); thus, they prefer their memories over any attempts to create a replacement connection.

This theme argues for an expanded understanding of how people access CES that redefines the traditionally narrow view to encompass the myriad ways that connections to/with CES exist, beyond physical and spatial boundaries.

### Values and meanings

The Values and Meanings theme emerged from the diverse ways interviewees derive meaning from the coastal and marine environment and the values they discussed in relation to ecological conditions. Another way to interpret this theme borrows from the field of psychology and is referred to as 'meaning-making', defined as, 'the process of how individuals make sense of knowledge, experience, relationships, and the self' (Ignelzi 2000). The values and meanings that interviewees discussed cultivated respect and connection between people and place.

Interviewees cited examples of values which commonly included eating locally sourced food, sharing mo'olelo, and using traditional names. Seven interviewees spoke explicitly about eating locally sourced food (i.e. caught or gathered on island). One interviewee said, *'We have to 'ai*[3] *of this place in order to understand its value to us. Without that, why take*

*care of a place, yeah? If you cannot eat from it' (23)*. Another interviewee said, *'the diversity of flavors, and just restoring the 'ono, restoring the taste that we have for the things of the sea' (10)*. Eight interviewees said that sharing mo'olelo and using traditional place names is a meaningful aspect of their lives. Interviewees explained that mo'olelo and traditional place names speak of the relationship that kūpuna had with the place, resources, and habitat. In reference to using the traditional name for a beach, one person said, '*[it] not only honors and maintains the integrity of the place, but also informs those that come there, really look at the name, [Place Name], what does it mean?' (9)* This interviewee suggested that the traditional place name teaches both history and proper care for the place. Another interviewee echoed this sentiment, *'the mo'olelo associated with [the place] and like, how the place names really are clues into the resource management' (21)*. During the member-checking process, one interviewee explained,

> I think that is just one example of maintaining the integrity of place, by using the traditional names that our kūpuna gifted this place because this is what the place meant to them. I think that's very important for us in the maintenance of our relationships with 'āina[4] and connection with kupuna. (23)

We use the above quotes to point out how CES are embedded within the values and meanings that people create and experience from their relationships with the coastal and marine environment. For example, these quotes point specifically to CES such as *Bequest*; *Education and Knowledge*; *Heritage, Tradition, Culture*; *Fulfilling Stewardship*; *Identity*; and *Sense of Place*. During interviews, we discussed, unprompted, how understanding social values can be useful or beneficial in informing and guiding resource management. One interviewee directly involved in resource management stated that it would be helpful to have this data collected and shared, and the lack of access to this type of information hinders success. According to this interviewee, this is a weak point in the management process.

## Discussion

Our analysis sought to deepen our understanding of how CES contribute to human well-being in multifaceted ways and use this knowledge to bolster marine resource management. We used this understanding to first, improve how social data can be included within ecosystem assessments by recognizing connections between CES; and second, we suggest a strategy for broadening the inclusion of intangible elements of human well-being.

We recognize that this style of research, by nature, does include limitations. Our qualitative, case study approach is contextually bound and less generalizable, with a potential for inherent subjectivity that can lead to bias during analysis and interpretation. Additionally, quality interview data relies on the honesty and transparency of interviewees. Our preliminary research was conducted specifically to mitigate these limitations, identifying key cultural, community, academic, and governance factors to guide this research (Leong et al. 2019). Key informants were selected for their extensive knowledge in subjects relevant to our research goals, following the guidance of Palinkas et al. (2015). And, notably, despite our study being funded by NOAA (well known in the study area as a Federal marine management agency), participants provided candid reflections, including criticisms, suggesting a level of comfort with the interview process that supports the authenticity of our findings.

Conducted before the onset of the COVID-19 pandemic, our research does not capture any potential subsequent shifts in environmental perceptions. Nevertheless, it provides a vital pre-pandemic benchmark for future comparative studies. Our study aligns with earlier research (Shackeroff 2008; Vaughan 2018) and offers a snapshot of pre-pandemic attitudes, providing a point of departure for longitudinal investigations into the pandemic's influence on public perceptions and values in relation to the marine environment. Although timeline and changing societal values present inherent risks to the current applicability of any study, the contributions of our work lie in these baseline insights, crucial for understanding the evolution of environmental perceptions in the face of global changes.

### Strong and diverse connections improve scope of social indicators

The inclusion of CES in the Ecosystem Services framework was important for incorporating elements of human-nature relationships which had largely been missing from resource management frameworks (Millennium Ecosystem Assessment 2005). Yet, the CES framework requires a researcher or manager to tease apart people's experiences and values and place them into distinct categories, even though this is fundamentally contradictory to how CES exist in reality (Fish et al. 2016, Gould et al. 2019). Our results support the growing understanding that CES are not individual, separate categories, but instead exist as simultaneous and overlapping elements interwoven with each other and other ecosystem services

(Klain et al. 2014; Amberson et al. 2016; Pascua et al. 2017; Gould et al. 2020). Additionally, and similar to most social concepts, CES arise from interactions and relationships between people and place; therefore, every person's values and perceptions of CES will differ (Martín-López et al. 2012).

Investigating CES individually (i.e. looking at CES through a 'micro' lens) does serve an important purpose including understanding details about a specific CES and the mechanisms through which it enhances human well-being (i.e. how it is created, experienced, and/or valued). However, it can be unrealistic to gather this micro-level data for CES across larger scales due to cost and time constraints, and difficulties arise if incorporating into quantitative models or management tools (Leong et al. 2019; Freitag et al. 2022). Fish et al. (2016) support what we heard during member-checking: that it would be more beneficial to view CES as supporting and reinforcing one another rather than existing separately. In response, we propose focusing monitoring efforts on the CES that have strong and diverse connections with other CES. Our results suggest that indicators of these particular CES (which would likely vary regionally) would also tangentially monitor other CES. For example, *Sense of Place* was both a strong and diverse connector in our research. This suggests that *Sense of Place* is very related to the presence, and possibly condition, of CES connected with *Sense of Place*, such as *Aesthetics*, *Ceremony*, and *Identity*. Using this as guidance can assist with identifying which ecosystem monitoring indicators may be a priority based on their ability to monitor multiple CES and their closely related human well-being domains, such as mental and physical health (Donkersloot et al. 2020). This concept is closely related to the topic of ecosystem service 'bundling' in which ecosystem services that frequently exist together are examined or monitored in tandem (Martín-López et al. 2012; Klain et al. 2014; Ament et al. 2017; Clements and Cumming 2017; Meacham et al. 2022). This can be a strong tool for management in guiding the critical selection of indicators, which would benefit from aligning with the preferences of the community (Ament et al. 2017; Clements and Cumming 2017).

### Integrating community insights and values to enhance coastal and marine resource management

Our study presents three interwoven themes that support a comprehensive strategy for including intangible elements of human well-being in ecosystem assessments. The first, Ecosystem Influence, underscores that biological and ecological conditions create opportunities for ecosystems to positively influence human well-being. Our second theme, Dimensions of Coastal and Ocean Access, challenges traditional notions of access and details the multifaceted avenues in which people connect with the marine environment. Our third theme, Values and Meanings, highlights that access to desirable ecosystem conditions is necessary but not sufficient to fully understand if and how the marine environment supports human well-being. By synthesizing these themes, we offer a more comprehensive lens for examining CES and their impacts to human well-being.

Traditionally, ecosystem assessment indicators have monitored ecosystem components and high-level, secondary social data and assumed that these indicators will serve as a proxy for CES (Breslow et al. 2017; Dacks et al. 2019; Hornborg et al. 2019). This link between measurable, biophysical indicator metrics and how much those metrics actually matter to or affect people is widely understudied (Olander et al. 2018) and misses the multifaceted nature in which people interact with the environment. Our findings suggest that while the existence of CES fundamentally depends on ecological condition, this does not necessarily reveal how people obtain or value CES (Meacham et al. 2022). The derived values and meanings of CES are formed through a complex matrix of experiences, emotions, and memories which influence how people make choices, behave, and address trade-offs. Our research highlights a need to broaden social indicator data to address these gaps.

Successful resource management must include an understanding of how communities feel, prioritize, and make decisions regarding ecosystem services (Hicks et al. 2016; Lau et al. 2018). Resource management strategies would be bolstered by community input that guides and shapes the process of indicator development. The indicators in ecosystem assessments can more accurately reflect reality if they include data that explains how people access, experience, and value the coastal and marine environment. As our thematic analysis illustrates, these data describe how human well-being is intertwined with the environment. A representative collection of indicators would monitor CES across multiple levels: where they are generated, accessed, and valued.

An essential step in effectively monitoring CES will be to recognize them as an interrelated web, and step away from attempts to measure CES only as segregated categories. This would acknowledge the values that CES provide are often greater as a whole than as individual parts. Including CES in ecosystem assessments in this way would introduce new challenges, such as implementing or designing methodologies for capturing and interpreting

complex, intersecting data. Despite challenges, it is a worthwhile effort that is likely to benefit from community involvement. Indicators developed through local, participatory processes are more likely to accurately represent the lived experiences and values of a community, which in turn can bolster support for the ecosystem assessment and subsequent policies (King et al. 2014; Hernández-Morcillo et al. 2013; Biedenweg et al. 2016; Breslow et al. 2017; Sterling et al. 2017). Future research should aim to address how the complexities of CES that we have described here can positively influence policy-making and conservation strategies.

Managing for favorable ecosystem conditions is a critical step for ensuring the availability of CES, yet this step alone is not sufficient. Understanding and monitoring the dimensions of access and the myriad values associated with the marine environment are necessary additions to ecosystem assessment frameworks. Together, these three layers are critical to the existence and understanding of CES as a whole (Figure 3). To help achieve this goal, we suggest adopting a gestalt perspective that recognizes that biological or ecological indicators alone will not add up to the entire social-ecological system. Such indicators are imperative in understanding ecosystem conditions, but this data alone cannot accurately provide insight on how the relationships between people and their environment contribute to well-being. To support both ecological and social sustainability, indicators must expand to include data on how communities create meaning and assign value to the marine environment. This expanded data would empower communities and bolster management by capturing how people connect with the coastal and marine environment and fostering policy supported by the communities they serve.

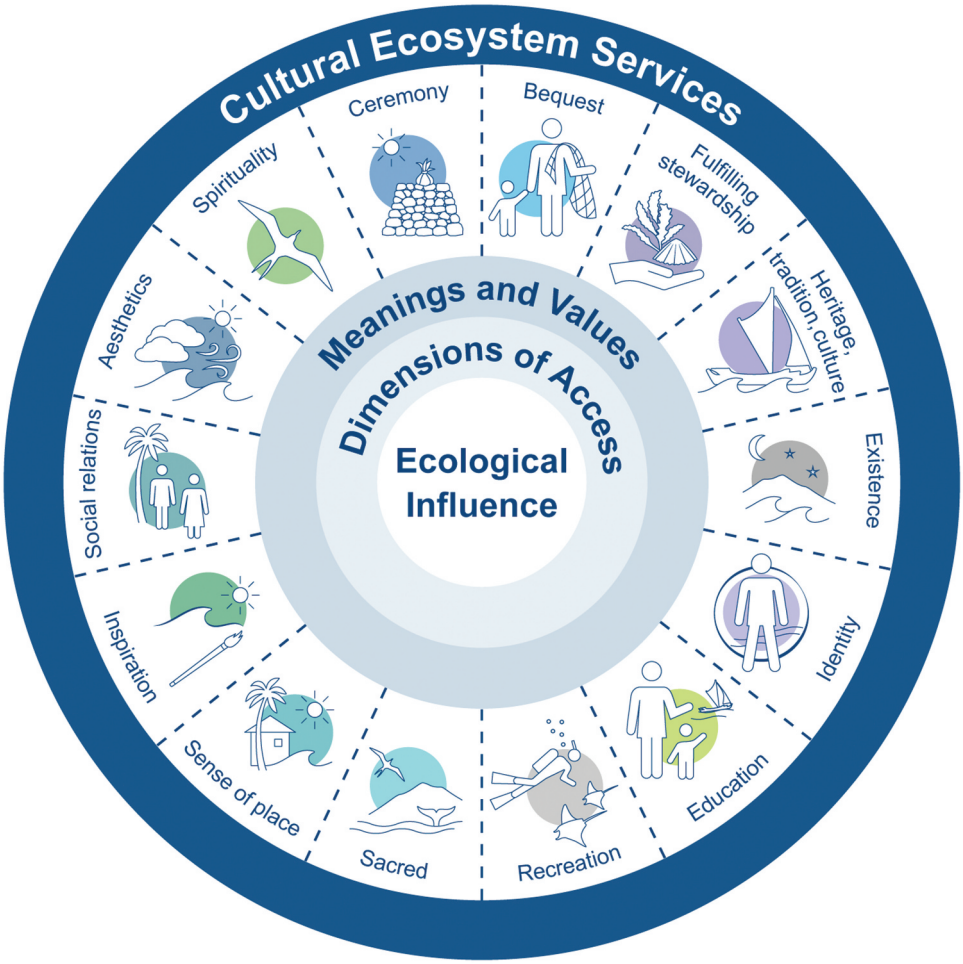


Figure 3. A conceptual framework illustrating our thematic analysis. The innermost circle, ecosystem influence, represents the foundation upon which Cultural Ecosystem Services are built. The next circle, dimensions of coastal and ocean access, expands the access to a multidimensional perspective. The next circle, values and meanings, encompasses the diverse social values and meanings associated with the marine environment. These circles build upon one another to create the core of an interrelated web of Cultural Ecosystem Services. This framework underpins the need for a suite of indicators that can represent a gestalt perspective of the social-ecological system they monitor.

## Notes

1. Kuleana: Right, privilege, concern, responsibility, title, jurisdiction, authority, ownership; reason, cause, function, justification; small piece of property.
2. Moʻolelo: Story, tale, myth, history, tradition, literature, legend, chronical, record.
3. ʻAi: Food, food plant; to eat, destroy, consume; to taste, bite, grasp; edible.
4. ʻĀina: Land, earth; Lit. that which feeds.

## Acknowledgements

This research exists solely because of the generosity of interviewees, to whom we extend our gratitude. Their dedication to protecting their place is admirable and inspiring. We acknowledge and thank project mentors for their input. We give credit to Amanda Merritt for designing and creating all graphics. We thank two anonymous reviewers. This research was supported by NOAA's Integrated Ecosystem Assessment Program (contribution no. 2023_3).

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Data availability statement

The data that support the findings of this study are openly available in NOAA's Institutional Repository at https://www.fisheries.noaa.gov/inport/item/62739.

## Ethics statement

This study was carried out in accordance with the recommendations of the University of Hawaiʻi Institutional Review Board with written informed consent from all subjects. The project has exempt status for Human Subjects Research from the University of Hawaiʻi Committee on Human Studies under the exempt project 19,449, Socioeconomics of Western Pacific Fisheries.

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