Beyond services: A process and framework to incorporate cultural, genealogical, place-based, and indigenous relationships in ecosystem service assessments

Pua'ala Pascua [a,*], Heather McMillen [a,b], Tamara Ticktin [c], Mehana Vaughan [a,e], Kawika B. Winter [a,d]

[a] University of Hawai'i at Mānoa, Department of Natural Resource and Environmental Management, 1910 East-West Road Sherman 101, Honolulu, HI 96822, USA
[b] USDA Forest Service Northern Research Station, New York City Urban Field Station, 431 Walter Reed Road, Bayside, NY 11539, USA
[c] University of Hawai'i at Mānoa, Department of Botany, 3190 Maile Way, Room 101, Honolulu, HI 96822, USA
[d] National Tropical and Botanical Garden, Limahuli Garden and Preserve, P.O. Box 808, Hanalei, HI 96714, USA
[e] University of Hawai'i Sea Grant College Program, 2525 Correa Road, HIG 238, Honolulu, HI 96822, USA

ABSTRACT

Cultural ecosystem services (CES) – the non-material benefits realized through human-environmental interactions – contribute to ecosystem service assessments by revealing key social dimensions in natural resource management. Yet there is limited understanding of how CES are experienced by individuals with strong generational and genealogical ties to land. Consequently place-based CES are frequently absent from management policies. We use a case study from Hawai'i to: 1) outline a process of eliciting place-based and indigenous CES; 2) develop a Hawai'i-based CES framework that is adaptable to other place-based communities; 3) demonstrate how place-based CES compare/contrast with standard CES; and 4) discuss how this process can enhance resource management and land-use planning. Through interdisciplinary methods drawing on multiple years of research and workshops in two rural Hawai'i communities, we highlight concepts not well captured in the existing CES literature including reciprocal relationships between people and place, sense of security, traditional values, and cultural subsistence. Our framework presents CES from a Hawaiian place-based/indigenous point of view by highlighting four main categories: 'Ike (Knowledge), Mana (Spiritual Landscapes), Pilina Kanaka (Social Interactions), and Ola Mau (Physical and Mental Wellbeing). Ultimately, this research provides a methodology to engage place-based communities when identifying CES in ecosystem service assessments.

© 2017 Elsevier B.V. All rights reserved.

1. Introduction

Understanding the relationships between people, place, and resources is an essential aspect of successful, long-term natural resource management (Lyver et al., 2016, Winter and McClatchey, 2008). In recent years, scholars, resource managers, and decision-makers have turned their attention toward ecosystem service assessments as a tool to better understand the ways that people use, perceive benefits from, and interact with natural resources. Ecosystem service assessments make valuable contributions to natural resource management as they characterize the full suite of environmental benefits provided to people (Daily and Matson, 2008). As a result, decision-makers and decision-influencing bodies have called for integration of these assessments at global (i.e. IPBES, 2016), national (i.e. National Ecosystem Services Partnership, 2016), and regional scales (i.e. Goldstein et al., 2012). This mounting interest has resulted in a growing body of literature that documents the theoretical assumptions and methodological requirements behind the assessments (Costanza et al., 1997; De Groot et al., 2002). Yet there remains a need for applied ecosystem service research that can illustrate how services are perceived and experienced by individuals with strong cultural, generational, and genealogical ties to land. These strong connections are salient in place-based and indigenous communities across the globe, which further amplifies the need to understand how place-based perspectives can inform sustainable natural resource management.

Ecosystem service assessments address four main classes of services: provisioning services (i.e. food and water), regulating services (i.e. regulation of flood and droughts), supporting services (i.e. nutrient cycling), and cultural services (i.e. recreation and spirituality) (Millennium Ecosystem Assessment, 2005). Provisioning, regulating, and even supporting services can be quantified through

* Corresponding author.
  E-mail address: puaalap@hawaii.edu (P. Pascua).

well-established methods (Millennium Ecosystem Assessment, 2005), thus they are readily incorporated into assessments and management recommendations (Bunse et al., 2015). However, beyond recreation and scenic values, cultural ecosystem services (CES) have been both under-studied and under-represented in natural resource management (Chan et al., 2012; Daily and Matson, 2008; Daily et al., 2009; Milcu et al., 2013).

CES are important as they provide valuable insight into the human-environmental interface, ultimately revealing critical pathways for sustainable interactions with natural resources (Asah et al., 2014; Liu et al., 2007; Plieninger et al., 2015). CES are broadly defined as the non-material benefits that result from paired human and environmental interactions (Millennium Ecosystem Assessment, 2005). Subsequent studies have refined that definition to acknowledge CES as they relate to individuals with an attachment to a given area (Chan et al., 2011), to groups that share an adopted belief, worldview or ideology (Andersen et al., 2012), to those who derive indigenous identities from landscapes (Winthrop, 2014), and to groups that define well-being through a particular interpretive lens or cultural background (Baulcomb et al., 2015). Drawing from those definitions, in this study we define CES as the ways place-based and indigenous groups interact with their surroundings to derive all forms of sustenance and maintain connection to place.

Most CES assessments focus on recreation and scenic beauty, with less documentation of spiritual values, cultural identity, social cohesion, and heritage values (Chan et al., 2012; Gould et al., 2015). This is likely because many CES assessments identify the services easiest to value with the established methods rather than identifying services truly valued by a given community (Milcu et al., 2013). Yet, in places where groups share strong cultural ties to land based on place-based, multigenerational connections, recreation and scenic valuations do not adequately capture the total value of those landscapes in a way that can inform natural resource management and sustainable land-use planning (Liu and Opdam, 2014). CES assessments must incorporate methods to verify that the CES being discussed are indeed important and relevant to the given community (Baulcomb et al., 2015). Accurate identification of CES and their related benefits and values is a critical first step as it will facilitate subsequent analyses including valuation and assessments of trade-offs (Chan et al., 2012). While we recognize there remain a number of challenges to overcome in measuring and integrating CES into broader assessments, in this study we specifically focus on the identification stage to highlight foundational cultural aspects often overlooked in resource management.

Neglecting to acknowledge CES in resource management and decision-making can lead to dire and unintended consequences including ineffective regulations, low adoption of regulations, and public dissatisfaction with both regulations and regulators (Adamowicz et al., 1998; Asah et al., 2014; Chan et al., 2012). Some suggest that place-based and indigenous values are not accurately captured in existing ecosystem service methods; thus they have been unrepresented in resource management, particularly in policies on land-reform and wildlife management (Adamowicz et al., 1998; Kusel, 2001; Liu and Opdam, 2014; Venn and Quiggin, 2007). Others note fundamental challenges in aligning indigenous aspirations with external goals from land managers or other interest groups (Robinson et al., 2016). In this regard, identifying CES in an accurate and culturally appropriate way is vital in resource management efforts, particularly if they can make place-based values visible before important decisions are made (Turner et al., 2008). This provides a unique opportunity to highlight and empower place-based and indigenous values and practices through the avenue of ecosystem services (Jackson and Palmer, 2014).

The literature on CES in place-based communities is limited (the few examples include Adamowicz et al., 1998; Andersen et al., 2012; Gould et al., 2015; Jackson and Palmer, 2014; Kenter et al., 2011; Venn and Quiggin, 2007; Winthrop, 2014). As a result, interdisciplinary studies are critical to advance place-based CES research. One such study involving Native Coast Salish communities in Washington State (Donatuto et al., 2016), presents community-defined indigenous health indicators and attributes to enhance awareness and understanding of the human, environmental, and spiritual aspects often overlooked in standard health assessments. In examining biocultural relationships, Winthrop (2014) uses the term "culturally reflexive stewardship" to describe the ways that multigenerational residents demonstrate a strong commitment to culturally valued landscapes. In their research on community resilience, Berkes and Ross (2013) discuss the ways that socio-ecological factors (like CES) continually change and adapt while remaining within critical thresholds. A study on the emotional impact of natural disasters on native well-being (Palinkas et al., 1993) uses methods in psychology to show that cultural services like traditional relationships, subsistence production, and goods distribution are linked to environmental health. Additionally, two resource management tools from Aotearoa (New Zealand) are key in enhancing CES research: the Cultural Health Index and the Mauri Model. Tipa and Tierney's Cultural Health Index (2006) highlights cultural factors that impact Maori well-being including links between lands and genealogy, exercise of customary custodianship, ancestral teachings, life giving forces, and kinship. The Mauri Model (Morgan, 2010), a decision-support tool that continues to grow in popularity and application across the Pacific, quantifies impacts to *mauri* (the life force of all living things) across social, cultural, and environmental dimensions.

While there is growing interest to ensure CES are both represented and considered equally alongside the other classes of ecosystem services, there are few documented instances where a CES framework highlighted important values and was used to inform decision-making (Chan et al., 2012). There is also a need for participatory and interdisciplinary methods in CES assessments that can capture place-based sociocultural perspectives and expand researcher perspectives beyond the standard CES in the literature (Chan et al., 2012; de Oliveira and Berkes, 2014; García-Nieto et al., 2015).

Here, we present a case study from Hawai'i to outline a process of eliciting place-based and indigenous CES. Informed by community workshops and a small working group, we created and present a Hawai'i-based CES framework that can be adapted for other place-based communities. We use the framework and emerging themes from the process to demonstrate how CES from place-based communities compare/contrast with standard CES documented in the literature. We conclude by demonstrating how this process can be applied to aid natural resource management and sustainable land-use planning by making important considerations visible in decision-making.

1.1. Background

1.1.1. Existing CES categories

The most frequently cited CES framework comes from the Millennium Ecosystem Assessment (2003). CES is one of four functional classes acknowledged in the MA. The 2003 framework highlights CES obtained through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences (Table 1). While the MA framework is intended to be widely applicable, the early stages of our research aimed to elicit and identify CES in a place-based context, uninfluenced by the MA. This provided an important opportunity first to elicit place-based perspec-

Table 1
Categories of CES outlined in the 2003 Millennium Ecosystem Assessment *Ecosystems and Human Well-being: Framework for Assessment.*

MA CES Categories and Descriptions
Cultural diversity- The diversity of ecosystems is one factor influencing the diversity of cultures.
Spiritual and religious values- Many religions attach spiritual and religious values to ecosystems or their components.
Knowledge systems (traditional and formal)- Ecosystems influence the types of knowledge systems developed by different cultures.
Educational values- Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.
Inspiration- Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising.
Aesthetic values- Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, "scenic drives," and the selection of housing locations.
Social relations- Ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies.
Sense of place- Many people value the "sense of place" that is associated with recognized features of their environment, including aspects of the ecosystem.
Cultural heritage values- Many societies place high value on the maintenance of either historically important landscapes ("cultural landscapes") or culturally significant species.
Recreation and ecotourism- People often choose where to spend their leisure time based in part on the character of the natural or cultivated landscapes in a particular area.

tives, then to compare those place-based CES against a standard framework.

1.1.2. Local communities, place-based perspectives, and management implications in Hawai'i

Understanding the ways that CES are perceived is essential in setting policies, promoting sustainable livelihoods, and enhancing well-being (Asah et al., 2014). This is best achieved at smaller spatial scales like local communities where the importance of CES are more pronounced and ethnographic information can provide additional context (Adamowicz et al., 1998; Darvill and Lindo, 2015). Engaging local experts and resource users is an important way to gain insight into social processes that influence CES, to verify the relevance of CES, and to demonstrate respect for diverse knowledge systems (Baulcomb et al., 2015; Raymond et al., 2013). Further, collaboration and consultation with community-based indigenous partners fosters long-term relationships and encourages research agendas that are respectful and ethnical from an indigenous perspective (Louis, 2007).

Hawai'i is an ideal location to explore place-based CES because of the important role place-based perspectives play in natural resource management (Gould et al., 2015). Yet there are several important considerations to acknowledge in investigating place-based and indigenous values and practices. In addition to the indigenous Native Hawaiian population, a number of ethnic groups have settled in the islands resulting in diverse yet distinct socio-cultural beliefs that can be challenging to incorporate in natural resource planning and management if not approached with care (Umemoto, 2001). Indigenous resource management is predicated upon the ability to distinguish between the rights and responsibilities of the general public and the rights and responsibilities of specific communities (Tipa and Welch, 2006; Vaughan, 2016). As the primary economy of Hawai'i shifted from a traditional subsistence economy to a commercial agricultural economy, then to a tourism-based economy, the altered social structure, resident demographics, and resulting socio-cultural practices have modified the lens through which place-based CES are both realized and understood by the general public –affecting both indigenous and non-indigenous alike. To complicate matters further, indigenous knowledge systems are spatially and temporally specific (Louis, 2007; Robinson et al., 2016). Yet there remain pockets of rural communities where descendants of the original native tenants still practice and perpetuate cultural fishing, farming, gathering, and hunting practices in a way that is specific to their lands (see *cultural kīpuka*, McGregor, 2007). In this study we focus on rural communities like these which often include both individuals of indigenous descent (*'ōiwi, lit. native son*) and descendants of the plantation-era workers, such as Japanese, Chinese, Filipino, Portuguese, and others, who have lived upon the land for multiple generations (*kama'āina, lit. child of the land*). These communities are recognized for demonstrating strong and resilient aspects of Native Hawaiian culture (McGregor, 2007) and act as repositories for place-based practices and traditional ecological knowledge, making them ideal locations to explore CES that often remain unseen. These are contemporary indigenous Hawaiian communities at the forefront of revitalizing traditional/customary practices and teaching others to re-learn their place-specific practices and guiding values. Thus, understanding CES in these place-based and indigenous communities is especially rich and informative of not just what was but what may be to come.

Traditional Native Hawaiian place-based practices (also called traditional and customary practices) were originally codified and protected under the Hawaiian Kingdom in 1850 and carry legal protections that persist into the present day State of Hawai'i (Hawai'i State Constitution, 1978; MacKenzie, 1991). In traditional Native Hawaiian social systems, native tenants (*hoa 'āina*) were afforded specific rights to access and use natural resources based upon their traditional responsibilities (*kuleana*) to both the social hierarchy and to the natural resources themselves (McGregor, 1996). These historic protections have facilitated an important role for place-based practices (and their related place-based CES) in present day natural resource management. For example, the current State of Hawai'i Community-based Subsistence Fishing Area designation was created to protect and reaffirm fishing practices customarily and traditionally exercised for purposes of Native Hawaiian subsistence, culture, and religion (HRS §188–22.6). This nearshore marine management designation requires that the state work with community members to create management strategies based on traditional and customary Hawaiian practices and values specific to that area (Higuchi, 2008). This is just one way lineal descendants and multigenerational families are highly regarded as subject matter experts in natural resource decision-making. Their valuable perspectives on place-based practices and traditional ecological knowledge provide unique and important contributions, which Hawai'i law mandates be considered in land-use planning and natural resource management. In addition, the Hawai'i environmental assessment process includes a unique step called a cultural impact assessment. This process is intended to identify important cultural sites (i.e. archeological) that may be adversely impacted by a proposed land-use or management action. The final report includes archaeological inventories, ethnohistoric information, and transcribed interviews with community members. While cultural impact assessments can provide detailed characterizations of a cultural site, it sometimes fails to capture the specific reasons why a site is highly valued from a cultural perspective. Our CES approach offers a promising alternative because it is a more holistic assessment built upon foundational relationships between people and place. Our methodological contribution offers

a way to assess community level benefits in a way that can be adapted to other communities in Hawai'i.

1.1.3. Study sites

Ka'ūpūlehu is an *ahupua'a* (traditional socio-political divisions of land that informed tenure systems) in North Kona, Hawai'i Island. This traditional land division runs from the shoreline of Kahuwai and Kalaemanō upland to Hainoa at 8,271ft elevation on the summit of Hualālai Mountain (Fig. 1). Due to its leeward orientation and predominantly volcanic landscape, Ka'ūpūlehu has a distinctly arid climate. It belongs to the *kalana* (larger traditional region specific to Hawai'i Island) called Kekaha Wai 'Ole or Waterless Kekaha (Maly and Maly, 1998). Customary socio-ecological interactions in Ka'ūpūlehu included extensive fishing and limited upland agriculture. Because subsistence resources were limited, the customary exchange of goods was important in Ka'ūpūlehu and throughout the Kekaha region. Upland goods like sweet potato and *pa'i 'ai* (firm *poi*) were traded for shoreline goods like *pa'akai* (salt) throughout the districts of the Kona Coast, and even as far as Maui. Due to a variety of circumstances, many of the lineal descendants and longtime residents of Ka'ūpūlehu are no longer able to live in the region. Independent of this consideration, present-day socio-ecological interactions with the environment are maintained through pastoral practices, dryland forest restoration, outreach education, and marine resource monitoring.

Halele'a is a *moku* (larger districts that span multiple *ahupua'a*) that extends from the *ahupua'a* of Kalihiwai in the East to that of Hā'ena in the West (Fig. 2). Unlike the Kekaha on Hawai'i Island, the *moku* of Halele'a has deep alluvial soils and abundant freshwater resources – including springs, perennial streams, and a river – which supported extensive *lo'i kalo* (irrigated taro pond systems) and *kuauna* (non-irrigated agricultural terracing systems). These freshwater resources make important contributions to nearshore productivity and supported traditional socio-ecological marine interactions including *mahi i'a* (fish aquaculture), *'ohi* (intertidal gathering of seaweed and invertebrates), and *lawai'a* (fishing). The highly productive upland and coastal regions supported the customary practice of *māhele*, the exchange and collective sharing of goods across the district and with other distant regions of Kaua'i. Since the mid-1800s changes in the primary economy (subsistence to agricultural to tourism) have led to shifts in land-use and resident demographics (Maly and Maly, 2003; Andrade, 2008; Vaughan and Ardoin, 2014). While some of the traditional socio-ecological interactions such as agriculture, fishing, and customary gifting/exchange networks have persisted into present day (Vaughan and Vitousek, 2013), as in Ka'ūpūlehu many of the lineal descendants and longtime residents have relocated to live and work in other *ahupua'a* within the *moku* or to other parts of the island.

2. Methods

2.1. Working group

As a first step towards understanding place-based CES in Hawai'i, we convened a four person working group to develop a preliminary conceptual framework. The purpose of the working group was to identify an initial set of place-based and indigenous CES to be triangulated and refined with community workshop results. The working group consisted of academic researchers from Hawaiian studies and natural resource management backgrounds who collectively possessed years of experience working with local communities in Hawai'i. The working group included indigenous scholars with ties to the communities we were working in and all working group members were considered knowledgeable about traditional/customary practices. As oral histories, spiritual prac-
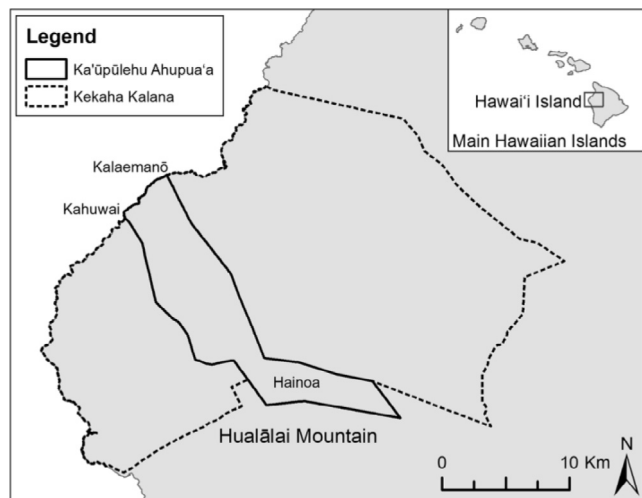

Fig. 1. Map of Ka'ūpūlehu Ahupua'a situated in the larger *kalana* (traditional region) of Kekaha, Hawai'i Island.
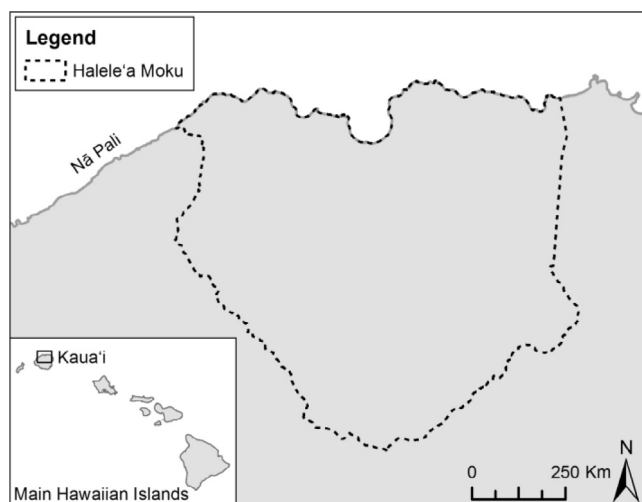

Fig. 2. Map of Halele'a *moku* (larger traditional district) on the North coast of the island of Kaua'i.

tices, and personal narratives are important for knowledge transmission in indigenous communities (Louis, 2007), working group participants were not constrained to drawing from academic literature. Instead, they were asked to identify key components of environmental kinship in Hawai'i by drawing from firsthand knowledge (gained through personal upbringing and experiences in addition to previous community work) and published materials on relevant values, proverbs, and traditional practices (including ethnohistoric reports and Hawaiian language literature). From these responses, we organized higher order groupings of benefits, which later became the four main categories of the resulting framework. The iterative framework was circulated among the working group participants for content edits and additions. The working group draft was refined multiple times prior to the subsequent community workshops. Following the community workshops the working group version was used to triangulate and build upon workshop results.

2.2. Community workshops

Our second step involved eliciting place-based perspectives through community workshops in Ka'ūpūlehu, Hawai'i Island

(Fig. 1) and Haleleʻa, Kauaʻi (Fig. 2). Community workshops provided a unique opportunity to learn about CES through a place-based, participatory approach. This approach stems from deliberative methods in natural resource management, recognized for their value in engaging local experts, integrating diverse values, improving public participation, facilitating critical dialogue, and increasing legitimacy of results (Bunse et al., 2015; Lo and Spash, 2013; Raymond et al., 2014). We chose to engage the rural communities of Kaʻūpūlehu and Haleleʻa for their important role in perpetuating traditional and customary practices in addition to being active in projects on community resilience and sustainable land management. Participants were knowledgeable about place-based perspectives, which they developed through long-standing relationships as ancestral descendants and/or multigenerational residents. They were equally knowledgeable about sustainable land management practices, which they practiced traditionally and continue to pursue through collaborative partnerships. Further, the researchers engaged in this work were unique in that cumulatively, they possessed years of experience working with both communities. Researcher relationships provided broader socio-cultural context and further informed culturally appropriate interactions and indigenous research methodology including, but not limited to, sensitive and proprietary information, consent, and community review processes. The information presented in this paper is one component of a larger project examining the impacts of land-use and climate change on socio-ecological resilience in both locations.

The purpose of the workshops was to gather first hand perspectives on place-based and indigenous CES in Hawaiʻi by creating an appropriate setting for local communities to talk about important human and environmental interactions in their place. Participant recruitment was purposive (Tongco, 2007) with participants invited based upon their connection to each location as ʻōiwi and kamaʻāina and their role as local experts, conservation practitioners, and cultural practitioners. Several were descendants of long-time farming, fishing, hunting, gathering, and/or ranching families in the area. Many worked for environmental conservation programs as educators, conservation workers, cultural practitioners and/or community consultants. Workshops were held at nearby community centers in each location. A total of 13 participants were in attendance at the Kaʻūpūlehu workshop and 19 participants attended the Haleleʻa workshop. As these are small, rural communities respondents were few, but a strong representation knowledgeable about the places and practices discussed. Our methods are unique in that the community participants are recognized as subject matter experts, which is not often the case in ecosystem service research.

Each workshop opened with Hawaiian cultural protocol: an *oli* (chant) greeting participants and showing appreciation towards the ancestral lands from which they descend. Introductions were followed by a thorough discussion of the "ground rules" or expectations of participants, then by a thoughtful discussion of information sharing and intellectual property rights. The format for both workshops used facilitation tools including a free listing/pile sorting activity called "snowcards" (Ching, 2014), and drew from methods in group based deliberation during small group breakout sessions and group presentations (Kenter et al., 2011; Raymond et al., 2014). The first workshop activity, snowcards, began with a brief guided visualization portion that asked workshop participants to think about the ways they interact with the environment including the atmosphere, the land, and the marine environment. Participants were provided with a prompt such as "What are the ways you are sustained by ʻāina (literally land, but figuratively all that provides sustenance)?" (see Supplemental Table 1). Then they were asked to write each response that came to mind on a blank response card. Responses were then posted on to the wall where everyone could see them, with workshop

facilitators helping to group like items, and some authors choosing to place their card into a group themselves. Back in the large group setting, participants were asked to discuss, agree upon groupings, and to assign a title to each group (see Supplemental Table 2). Framing our conversation and activities around relationship to place, rather than cultural ecosystem services, allowed us to highlight invisible losses- important concepts that can be overlooked in natural resource management if the appropriate questions are not asked (Turner et al., 2008).

In the second workshop activity, a break-out group activity, each group discussed a different land-use selected based on present day and historic area land-uses, either fishing, farming, ranching, or forestry. Participants self-selected their group based upon their level of comfort/familiarity with each land-use. Participants were provided with a second set of prompts (for example "How does this environment sustain you?") then presented their answers back to the larger group (Supplemental Table 2). The workshops closed with a discussion of next steps, including the scheduling of follow-up discussions as necessary. After a preliminary review of the Kaʻūpūlehu workshop results, we determined that break-out group responses were too broad with limited explanation (likely a result of time limitations) and additional clarification was necessary. Open-ended, in-depth interviews were carried out with 10 of the Kaʻūpūlehu workshop participants. Interview responses were used to supplement workshop results and informed the re-wording of prompts (for clarity) in the Haleleʻa community workshop.

Acknowledging that no community is homogenous, perspectives can differ drastically both within and across communities. The two communities we engaged were similar, but also distinct, requiring that we adapt our methods to accommodate each group. Our process was unique in that the methods and approach were designed to be flexible so that it could be adapted as necessary in each location. For example, during the participant recruitment stage we were informed that one of our locations favored face-to-face or phone contact over email correspondence. We were fortunate to have individuals from that particular area on our research team and we relied heavily on their academic, professional, and personal networks in identifying and inviting participants. Another example of adaptation was demonstrated during the breakout group activity. Participants in one of the workshop locations were knowledgeable about a variety of the land-use considerations and did not feel comfortable limiting input to one specific group. We were able to accommodate this request by allowing the larger group to contribute responses during the group reporting stage. We recommend that any CES research incorporate similar flexibility into their methods in order to best accommodate participants.

Participants provided both oral and written consent and all resulting materials including a plain language workshop summary, technical reports/manuscripts, and the last iteration of the framework, were sent via digital or hard copy for their review. Further, results were presented in-person to community participants as an additional measure to ensure accuracy and confirm the ability to share with external academic audiences. There were no requests to correct or withhold information. Participant interaction was consistent with and approved under the human subjects procedures established by the University of Hawaiʻi Institutional Review Board, but equally as important, interactions followed culturally appropriate protocols and were attentive to the communication methods preferred by participants.

2.3. Data analysis

Data collected in the community workshops were compiled then analyzed with qualitative methods including deductive coding of the snow-card activity results (where resulting responses

were compared against the MA CES Categories) and inductive or open coding of overall workshop and breakout group results/ discussions (where responses were combed for emergent services and themes) (Maxwell, 2005).

The working group conceptual framework was then modified to include community workshop results. Emergent CES revealed through open coding were incorporated into the framework as new services or were used to refine existing categories when there was overlap. Snow-card activity and follow-up interview results were integrated into the framework as location specific examples of each service and in some instances provided the location specific language used to re-title an existing service or category.

3. Results and discussion

3.1. Hawai'i-based CES framework

Working group and community workshop results were combined to create a Hawai'i-based framework of CES. The framework presented in Table 2 was one product of a more holistic process to capture and communicate place-based CES. A total of 10 framework iterations were created in the small working group and several revised iterations were created as a result of the community workshops. These iterations were shared with community members following the workshops to check for accuracy and consent to share with academic audiences (see acceptable sharable version in Supplemental Materials).

Use of native language was a major consideration in building the framework. Native Hawaiian terms are used extensively throughout this framework. This use is consistent with other scholars emphasis on using terms that are well suited to place and local language (McMillen et al., 2014) that are aligned with indigenous ontology and epistemology (Louis, 2007). Further, place-based cultural practices are best described with their respective place-based cultural terms, which can embody deep cultural narratives that only some will fully understand (Louis, 2007; Pukui et al., 1972). The majority of the framework uses well-established terms in Hawaiian epistemology, however in select instances we use place-specific terms suggested by community participants and contemporary Hawaiian lexicon as needed. While we provide translations and descriptions to encourage broader use and applicability of the framework, it is important to recognize that literal translations offer just a glimpse into meaning-laden cultural concepts. Researchers suggest that in engaging diverse groups, the language used must be adequate for decision-makers but must also remain relevant in their respective social settings to promote continued community engagement (Raymond et al., 2013; Umemoto, 2001).

The framework is divided into four categories: *'Ike*: Knowledge, *Mana*: Spirituality, *Pilina Kanaka*: Social Interactions, and *Ola Mau*: Physical and Mental Wellness. The *'Ike* category touches upon CES connected to knowledge acquisition and the recognition of multiple sources of knowledge. The *Mana* category acknowledges spiritual connections to the natural world. The *Pilina Kanaka* category acknowledges the CES tied to social interactions. The last category, *Ola Mau*, speaks to physical and mental wellbeing.[1]

---

[1] It is important to note that because this is indeed an iterative process, the version presented here should not be considered an exhaustive list of all CES for all places in Hawai'i. Instead the framework is a communication tool to help communities articulate their thoughts to resource managers and more importantly, to one another. Shareable versions of the framework, like the one displayed here, are also intended to provide researchers with a basic introduction to some of the meaningful CES in Hawai'i with the hope that they will engage in similar processes to identify meaningful CES in their respective study sites.

3.2. MA CES category comparison

One important result is that contrary to the MA nomenclature, which differentiates between services and constituents of well-being, participants did not distinguish between ecosystem services and derived values. Therefore, our framework uses the term 'CES' as an all-encompassing term describing both cultural services and associated values. This study defines cultural ecosystem services as the ways place-based and indigenous groups interact with their surroundings to derive all forms of sustenance and maintain connection to place. Working group and community workshop responses to prompts using this definition revealed co-produced and interconnected services and linked values. Thus attempting to separate between services and derived values would have been in contradiction to participants' perspectives and descriptions. Instead, we felt it more effective, and less confusing for participants, not to distinguish between the two. In this section we compare and contrast our Hawai'i-based framework and the MA CES Categories (Table 3), by emphasizing comparable categories, reinterpreted categories, and emergent categories.

3.2.1. Comparable MA categories

Our results resonate well with several of the MA CES categories including Spiritual and religious values, Sense of place, and Cultural heritage. Spiritual and religious values were frequently mentioned, particularly with regard to Native Hawaiian ceremonial rituals and cultural protocol. This is captured throughout the *Mana*: Spirituality category of the Hawai'i-based framework but is specifically addressed through the use of cultural protocol such as *oli* (chants) and *pule* (prayer) to interact with the *mana*, or spiritual force of a landscape. Throughout the workshop participants described concepts that resonate with Sense of place and Cultural heritage, but did not distinguish between the two. These concepts are collectively captured in the *Ola Mau*: Physical and mental wellness category of the Hawai'i-based framework as both sense of place and cultural heritage were discussed as determinants of physical and mental well-being in place-based communities. The *Ola Mau* category acknowledges the factors that contribute to sense of place and cultural heritage (ultimately informing wellness) by identifying benefits such as the availability and quality of subsistence resources.

Our results also resonate with and build upon the MA categories including Education and Social relations. Educational values were frequently mentioned and are captured through the *'Ike*: Knowledge category in the framework. While participants did speak to the value of both informal and formal educational opportunities, our responses expanded the MA educational values category to include experimental/action-based learning and learning through observation. Both communities engaged through this research have strong experiential and culture-based education programs, thus the emphasis on education was strong. Social relations were mentioned often and these are captured in the *Pilina Kanaka*: Social Interactions category of the Hawai'i-based framework. The MA definition contrasts social relations across societies such as fishing, nomadic herding, and agricultural communities, however as our work involved small, rural communities there was little to no distinction between community members who were well-versed in fishing, ranching, and agricultural practices. Instead, our Social Interactions framework category captures factors that facilitate social cohesion including the ability to provide for your family and strong social networks to share both knowledge and resources.

3.2.2. Reinterpreted MA categories

Our place-based responses touch upon several of the MA Categories including Inspiration, Aesthetic value, and Recreation and ecotourism but we interpret them in ways that are not currently

Table 2

A Hawai'i-based Cultural Ecosystem Service Framework. This place-based framework captures key concepts in reciprocal environmental kinship in Hawai'i (*aloha 'āina*, literally translated as love for the land) and provides important perspectives on cultural, cosmological, and genealogical connections to place.

Category	Benefit	Examples/indicators
'Ike: Knowledge	*Ma ka hana ka 'ike*: Opportunities to learn place-based practices by actually doing them	Gathering salt from natural pools and making salt in raised ponds, gathering and preparing seasonally abundant seaweed varieties
	Nānā i ke kumu: Opportunities to observe familiar natural processes and seasonal occurrences	Seasonal weather patterns, timing and intensity of rain, plant/animal behavior and reproductive cycles
	Hālau 'Ike: Opportunities for diverse (formal and informal) learning	Scientific research, experiential, *'āina*-based (land-based) education, learning from elders
Mana: Spirituality	*Ho'omana/Mauli Ola*: Spiritual beliefs and practices that allow people to interact with the mana of a landscape	Formal ceremonial practices, informal interactions, perpetuation of songs, chants, dances, and prayers of/for place
	Wahi pana: Existence of, appropriate access to, and understanding of place-specific practices associated with storied landscapes (*wahi pana*).	Important cultural sites like birth place (*one hānau*) and family burial sites (*kulaiwi*), places where place specific gathering/harvesting practices occur
	Kinolau: Presence and recognition of plants, animals, and elements that represent/symbolize Hawaiian deities	Creation and use of ceremonial garlands(lei), ceremonial offerings such as fresh water and rain
	'Aumakua: Presence and recognition of familial guardians/ancestors; resources themselves recognized as kin	Individual turtle (*honu*), owl (*pueo*), or shark (*manō*) that are cared for by and take care of specific families.
	Hō'ailona: Presence of environmental signs/indicators and the ability to recognize them	Types of rainbows to signal events, species that signal the cycles of another plant/animal species (bioindicators)
	I ka 'ōlelo nō ke ola, i ka 'ōlelo nō ka make: Presence of place-based Hawaiian terms/names describing environment	Place names, species names, environmental process names, rain names, creating new cultural proverbs to describe these observations
Pilina Kanaka: Social Interactions	*Ho'olako*: Perpetuation of practices/skills that allow individuals to provide for their families	Goods for household, sharing, and income, jobs that require knowledge of traditional practices or the discipline required to do them well
	'Ike aku, 'ike mai: Opportunities to share traditional/local knowledge and values	Formal and informal apprenticeships, place-based fishing/gathering practices, acknowledgement of young leaders
	Kōkua aku, kōkua mai: Presence of strong social ties/ social networks	Network of people to share with and receive from, gifting/exchange of upland and coastal goods, the many hands that help when a task needs to be done
Ola Mau: Physical and Mental Wellbeing	*Lako/Momona*: Availability and access to subsistence resources rich enough for people to thrive	Quantity and quality of water, presence and abundance of species of cultural value, fertile soil
	Ho'oikaika kino: Opportunities for an active lifestyle to support the physical demands of specialized practices	Outdoor activities that promote health & strength
	'Oihana: Opportunities for engaging in family roles and occupations	Existence and availability of occupations such as *lawai'a* (fishing), *mahi'ai* (farming), and *paniolo pipi* (cattle ranching)
	Mo'okū'auhau/Noho Papa: Opportunities for multigenerational presence on and interaction with lands that foster security and sense of place	Presence by lease, physical access, ownership, and/or occupation

Table 3

A comparison of the MA CES Categories and our studies' place-based responses.

MA CES Categories	Place-based Responses		
	Comparable	Reinterpreted	Omitted[a]
Cultural diversity			X
Spiritual and religious values	X		
Knowledge systems (traditional and formal)			X
Educational values	X		
Inspiration		X	
Aesthetic values		X	
Social relations	X		
Sense of place	X		
Cultural heritage values	X		
Recreation and ecotourism		X	

[a] Cultural Diversity and Knowledge systems were not explicitly mentioned during the community workshops. This is likely attributed to the framing of the discussion (to specifically acknowledge place-based perspectives as opposed to culturally diverse perspectives) in addition to the purposive recruitment of participants. While participants were undoubtedly cognizant of multiple knowledge systems including traditional and formal knowledge, it is possible that general agreement across the group did not warrant a discussion of the topic.

captured in the MA framework. Inspiration was discussed to a lesser degree and was described as the basis for perpetuating cultural practices such as storytelling, writing songs, or creating new cultural proverbs/sayings. For our purposes it was a cross cutting category/benefit and imbedded in several places of the Hawai'i-based framework. Aesthetic values did not clearly emerge as a stand-alone category, rather this concept was associated with the ability to observe familiar natural processes and seasonal occurrences, for example, observing seasonally consistent rain patterns and flowering/fruiting of plants. Recreation was mentioned at both community workshops but was described slightly differently than what is commonly considered recreational value. Rather than speaking to leisure time activities as described in the MA, workshop participants spoke to the benefits associated with recreation (such as spending time with family, doing a physical activity to promote wellness) and linked those benefits to their day-to-day tasks. Participants who had labor-intensive jobs benefited by earning a living as well as from the health and well-being benefits from physical activity. Others who enjoy surfing, specifically spoke to the mental benefits it provided them including time to reflect and time to be surrounded by the environment. Thus in our framework, recreation is embedded in the *Ola Mau*: Physical and mental wellness, rather than being considered as a separate category.

3.2.3. Going beyond the MA categories

Our research revealed two overarching CES not yet documented in CES research and a third that is not yet commonly accepted as a CES. The first novel CES is the value of security. Our participants

described security as the feeling of safety from being in a familiar place and the feeling of knowing that you will always have someplace to return. It was difficult to pinpoint where this CES would fit in the Hawai'i-based framework as it was such a cross-cutting concept. It is currently captured as a benefit under the Physical and Mental Wellness category, though it can be applied elsewhere. The second novel CES is the perpetuation of traditional values associated with a practice. While previously inconsistent with what one would consider an ecosystem service, participants explained that environmental conditions play an important role in enhancing or impeding the perpetuation of traditional values and norms that guide human-environmental interactions. Customary norms such as aloha 'āina (lit. love for the land, also used to describe environmental kinship in Hawai'i) inform how people interact with both natural settings and one another and underpin long-term perpetuation of traditional practices (Vaughan et al., 2016). The concept of traditional values was mentioned often at both community workshops and included examples such as respect for resources (i.e. catching only enough fish to eat rather than catching as many as you can) and respect for people and their belongings (i.e. not touching what doesn't belong to you). Perpetuation of these values was linked to multiple categories and benefits within the framework including the perpetuation of traditional practices and opportunities to share knowledge. Ultimately we used this CES to expand our existing Knowledge Sharing benefit to acknowledge the sharing of knowledge of place-based practices along with the values tied to those practices.

The last service that emerged in our study that is not yet commonly accepted as a CES is a concept that we've titled cultural subsistence. Cultural subsistence was described by participants as a holistic approach to cultivating or harvesting subsistence resources (i.e. crops, fish, cattle) resulting in cross-cutting spiritual, physical, mental, educational, and environmental benefits. Examples include traditional fishing practices, which perpetuate knowledge of fish ecology (i.e. limiting harvest during spawning aggregations to support abundant resources), support intergenerational transfer of knowledge and strong social networks (i.e. when families and communities fish together and share their catch), provide physical sustenance (i.e. protein, omega 3 fatty acids), and mental wellness (i.e. knowing your food was sustainably caught). Subsistence is often considered a provisioning service as it is linked to the material provision of goods, yet these examples show far more importance than just food. The linked and overlapping benefits associated with cultural subsistence practices (further described in Section 3.3.2) suggest that it should be considered a CES, particularly if there are important cultural impacts to consider should that subsistence practice become threatened. Ultimately the identification of these three new services – security, perpetuation of traditional values, and cultural subsistence – reinforce the need for new methods to appropriately identify CES meaningful to those who will be impacted by a natural resource or land management decision. Other entirely different categories may emerge in other settings.

3.3. Emerging themes and considerations

3.3.1. Understanding reciprocal relationships

Community participants provided rich responses and personal examples which revealed key themes and considerations in place-based and indigenous CES. The concept of reciprocal environmental kinship was central in both the small working group and in the community workshops. Similar concepts in relational values are relevant and important in communities worldwide (Chan et al., 2016; Lyver et al., 2016). Workshop participants expressed some discomfort with the terms "services" and "benefits" as this language did not adequately capture the relational values between indigenous people and place. Instead, participants

identified as descendants of their ancestral lands (kama'āina, which literally translates as child of the land). One participant from Ka'ūpūlehu described Hualālai (the Kona Mountain Range on which they reside) as the nurturing mother who protects the region from harsh weather systems. Workshop participants described place-based practices as a means for caring for both people and place. Participants spoke of shaping and being shaped by healthy "ancestral landscapes" and "storied landscapes" as the basis for sustenance of body, mind, spirit and cultural identity. Several participants from Halele'a described the act of taro farming (an important cultural and agricultural practice in their region) as caring for their older sibling Hāloa (taro is a culturally important plant and carries cosmological genealogical connections to the first Hawaiian). This practice of caring for Hāloa, in return, enhanced their own physical and mental wellness.

3.3.2. Interwoven connections

Both the working group and the workshop participants struggled with the seemingly artificial distinction between CES categories and between CES and other ES. CES are interconnected and highly dependent upon one another, thus they create multiple overlapping and linked benefits (Baulcomb et al., 2015). With regards to distinguishing between CES categories, during the free-listing/pile-sorting activity at one community workshop, participants expressed strong preference towards overlapping values and did not at all agree with creating distinct groupings. After additional discussion, workshop participants eventually proceeded once they were allowed to create sub-categories instead of separate categories. This preference towards holistic interpretation is an important contribution to CES research as it reveals linkages not currently captured in the MA CES framework.

With regard to distinguishing between CES and other ES, both workshops discussions highlighted the strong connections between CES, provisioning services, and supporting services. One example from Halele'a centered around Hawaiian agriculture. Participants could quickly identify, in detail, the myriad ways in which Hawaiian agriculture sustains them. Hawaiian agriculture provides subsistence crops, a provisioning service; The cultivation of traditional crops like taro contributes to cultural identity, a cultural service; Traditional agricultural practices supported healthy waterways, a supporting service; The consumption of traditional crops supports physical wellness, a cultural service; Last, sharing the final product promotes social cohesion, another cultural service. The multiple overlapping and linked benefits highlight the importance of considering cascading and multi-tiered impacts of resource management decisions on place-based communities. For example conversion of agricultural lands to luxury housing (as is happening throughout Halele'a) could impact all of the ES tied to Hawaiian agriculture. These interwoven connections between CES categories and between CES and other ES emerged in community responses elicited through participatory methods and might have been missed had we used standard CES assessment methods such as individual preference surveys. Understanding these linkages provides decision-makers with an important opportunity to circumvent cascading negative impacts and, conversely, to leverage opportunities for impactful, favorable outcomes.

3.3.3. Access

Workshop participants in both locations spoke to the importance of access to land as a means to support relationships to place. Access was broadly defined and included concepts such as physical access (i.e. visiting, living, and/or working in a place) and socioeconomic access (i.e. ability to afford living in that place and availability of leases). In both workshop locations, access was primarily supported through employment opportunities at culture-based environmental education programs. The primary threat to access

in both locations was real estate development. In Ka'ūpūlehu, housing development continues to encroach on historic ranching lands. In Halele'a, increasing development of luxury resorts and vacation homes challenge the ability of multigenerational families to keep up with rapidly increasing property taxes. Many have been dislocated from lands their families have lived upon and relied upon for generations within the past two decades. Loss of access threatens CES, which we've defined as the ways place-based and indigenous groups interact with their surroundings to derive all forms of sustenance and maintain connection to place. While it is important to identify meaningful CES, it is also important to account for the factors that impact an individual's access to that CES. Effective resource management must consider the social impacts that result from loss of physical and/or socio-economic access. Potential solutions include protecting indigenous and tribal lands, developing community land trusts, and providing opportunities for formal resource guardianship (Vaughan, 2016).

3.4. Putting ecosystem services into practice

Our original research presents an approach to developing a place-based cultural ecosystem service framework as a decision-support tool for sustainable land management. Our study puts CES into practice by developing a participatory approach engaging academic scholars and two rural communities to document CES that are important in place-based and indigenous communities in Hawai'i. In this paper we compare theory-based CES (as outlined in the MA Categories) with the CES revealed by working group and community workshop participants. Results demonstrate that the MA CES nomenclature is an important point of reference, but should not be considered exhaustive, particularly in places where groups share strong cultural connections to land. The approach we present here responds to the need to incorporate place-based and indigenous perspectives in the course of developing ecosystem service assessment tools and indicators. We acknowledge that there remain theoretical and epistemological obstacles in the subsequent processes of measuring CES and integrating them alongside other services in broad ecosystem service assessments (Chan et al., 2012; Robinson et al., 2016). However, we've learned from other fields that partial improvements to assessments are still useful in decision-making as they provide additional information typically omitted from the assessments or relegated as anecdotal (Donatuto et al., 2016).

In building the iterative framework, we used a tabular format to distinguish between individual services and categories of services and share this information with largely linear-oriented audiences. In reality, each service and category of service actually connect seamlessly. They are interwoven and interdependent. In our final feedback presentations, community members and research colleagues briefly discussed other diagrammatic representations that better depict the interrelationships between individual services and categories of services including a circular diagram. Due to time constraints, we were not able to address this feedback during the scope of this project. However we recommend this as an area for additional development in future community or academic-driven iterations of the framework.

The methods presented here are intended to encourage researchers to engage communities in a way that is attentive to and respectful of indigenous perspectives while capturing their holistic perspectives (Louis, 2007). One key finding is that the linear approach of much ecosystem service assessment, including this one, is a barrier to identifying and fully understanding CES. In our project we struggled to capture the interwoven nature of CES and participants struggled when asked to distinguish or differentiate once CES from another. Many resource management valuation approaches are built upon the ability to trade one distinct unit for another. In contrast, indigenous communities and practitioners view the many elements of relationships with natural resources as one (Jackson and Palmer, 2014; McMillen et al., 2014; Robinson et al., 2016). These connections are captured at times in larger concepts such as environmental kinship or biocultural relationships. These elements depend upon and strengthen one another, so the idea of comparing their worth in order to choose which to give up is both unsuitable and inappropriate. We recommend that future research on CES consider culturally appropriate methods to capture integration, vs. to categorize, as well as to understand which services tend to be more linked than others and why. Though quantification could never adequately or respectfully address much of the subject matter covered in this framework, much remains to be learned from the ways other disciplines approach environmental assessments in indigenous communities, including the use of descriptive scales which combine narratives and descriptive information allowing participants to address the determinants of indigenous health in their own terms (Donatuto et al., 2016; Morgan, 2010).

This discussion raises two concerns beyond the scope of this project: 1) whether CES need to be separated and/or categorized at all in ecosystem service assessments; and 2) whether assessing and measuring CES is appropriate from an indigenous perspective. To the first concern, we recommend additional research on integrated assessments, namely whether they can be used to emphasize complex linkages and reciprocal connections between CES and across CES and other ecosystem services. To the second concern, we stress that CES should be determined and subsequently assessed in place-based and indigenous communities by place-based and indigenous groups. We are hopeful that with increasing indigenous representation in CES research (both indigenous participants and indigenous researchers), culturally-appropriate methods will continue to improve. We recommend that researchers work closely with place-based and indigenous participants to first determine whether developing a place-based framework highlighting CES and other important socio-cultural factors is a tool they find useful and second to tackle adapting and applying it in sustainable natural resource management for their place.

4. Implications for management

Decisions aimed at natural resource management will affect place-based communities whether or not community members are involved in the decision making process. The cultural, generational, and genealogical connections described throughout this paper demonstrate the ways place-based communities can be deeply affected by land-use and natural resource management decisions. For example, as real estate development continues to threaten place-based practices in both of the communities we worked with, community members have collaborated with researchers and conservation groups to make decision-makers aware of the multi-tiered impacts related to loss of access and agricultural land-use conversion. CES resulting from place attachment are far more multifaceted than surface level understandings prominent in the literature which focus solely on recreational and scenic values (Adamowicz et al., 1998; Darvill and Lindo, 2015; Liu and Opdam, 2014; Raymond et al., 2013). Place-based frameworks for assessing CES, such as the one described in this paper, may be useful in policy by making important socio-cultural concepts such as reciprocal relationships, interwoven connections, and access considerations, visible before decisions are made. Further, the identification and acknowledgement of place-based CES can facilitate community buy-in and support for

management decisions, thus enhancing management success (Adamowicz et al., 1998; Asah et al., 2012; Chan et al., 2012).

As ecosystem service assessments continue to grow in popularity, this locally based assessment represents a critical first step towards integrating multiple knowledge systems and values into the assessments and subsequent decision-making. Framing land-use planning and resource management discussions around these benefits can reveal pathways to design and deliver strategies that can meet the needs of place-based communities and managers alike (Robinson et al., 2016). While some of the examples presented in this paper are site-specific, the framework is organized in a way that allows for broader relevance in other place-based and indigenous communities. The services and benefits presented in our framework – concepts like security, traditional values, cultural subsistence, and reciprocal relationships – are prominent in place-based and indigenous communities throughout the globe. Examples include the traditional relationships and subsistence production of the Native Alaskan Aleut (Palinkas et al., 1993), the customary custodianship, ancestral teachings, life giving forces, and environmental kinship of the Aotearoa Maori (Panelli and Tipa, 2007; Tipa and Teirney, 2006), and the culturally reflexive stewardship of the Colombia Plateau American Indians (Winthrop, 2014). While future research should be cognizant of the differences among place-based and indigenous groups, this framework may be able to serve as a starting point for future CES assessments.

Through this research, we present a process that allows communities the opportunity to articulate their values and concerns, which are not often captured through common approaches to CES research. We see the resulting framework as an important communication tool to facilitate resource management dialogue within communities and between communities, researchers, and decision-makers. We also see the framework as a tool that can help to inform resource managers about the socio-cultural impacts of their decisions, which should be taken into account before any decision is made. By sharing this process, we hope to encourage both emerging and established researchers to engage local experts in accurately and appropriately identifying place-based CES. Ultimately we hope that this process and the resulting framework can make otherwise illusive sociocultural considerations visible and considered equally with other types of ecosystem services in natural resource management and land-use decision-making.

Acknowledgements

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ecoser.2017.03.012.

References

Adamowicz, W., Beckley, T., MacDonald, D.H., Just, L., Luckert, M., Murray, E., Phillips, W., 1998. In search of forest resource values of indigenous peoples: are nonmarket valuation techniques applicable? Soc. Nat. Resour. 11 (1), 51–66.

Andersen, M.D., Kerr, G.N., Lambert, S.J., 2012. Cultural differences in environmental valuation. In New Zealand Agricultural and Resource Economics Society Conference, pp. 30–31.

Andrade, C., 2008. Hā'ena: Through the Eyes of the Ancestors. University of Hawai'i Press.

Asah, S.T., Blahna, D.J., Ryan, C.M., 2012. Involving forest communities in identifying and constructing ecosystem services: millennium assessment and place specificity. J. Forest. 110 (3), 149–156.

Asah, S.T., Guerry, A.D., Blahna, D.J., Lawler, J.J., 2014. Perception, acquisition and use of ecosystem services: Human behavior, and ecosystem management and policy implications. Ecosyst. Serv. 10, 180–186.

Baulcomb, C., Fletcher, R., Lewis, A., Akoglu, E., Robinson, L., von Almen, A., Hussain, S., Glenk, K., 2015. A pathway to identifying and valuing cultural ecosystem services: an application to marine food webs. Ecosyst. Serv. 11, 128–139.

Berkes, F., Ross, H., 2013. Community resilience: toward an integrated approach. Soc. Nat. Resour. 26 (1), 5–20.

Bunse, L., Rendon, O., Luque, S., 2015. What can deliberative approaches bring to the monetary valuation of ecosystem services? A literature review. Ecosyst. Serv. 14, 88–97.

Chan, K.M., Goldstein, J., Satterfield, T., Hannahs, N., Kikiloi, K., Naidoo, R., Vadeboncoeur, N., Woodside, U., 2011. Cultural Services and Non-Use Values. In: Karieva, Peter M. et al. (Eds.), Natural Capital: Theory & Practice of Mapping Ecosystem Services. Oxford University Press, Oxford (England), New York, pp. 206–228.

Chan, K.M., Guerry, A.D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., Bostrom, A., Chuenpagdee, R., Gould, R., Halpern, B.S., Hannahs, N., Levine, J., Norton, B., Ruckelshaus, M., Russell, R., Tam, J., Woodside, U., 2012. Where are cultural and social in ecosystem services? A framework for constructive engagement. BioScience 62 (8), 744–756.

Chan, K.M., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., Gould, R., Hannahs, N., Jax, K., Klain, S., Luck, G.W., 2016. Opinion: Why protect nature? Rethinking values and the environment. Proc. Natl. Acad. Sci. 113 (6), 1462–1465.

Ching, D., 2014. Facilitating Strategic Thinking and Planning. Pacific Center for Collaboration.

Costanza, R., d'Arge, R., Limburg, K., Grasso, M., de Groot, R., Faber, S., O'Neill, R.V., Van den Belt, M., Paruelo, J., Raskin, R.G., Hannon, B., 1997. The value of the world's ecosystem services and natural capital. Ecol. Econ. 25 (1), 3–15.

Daily, G.C., Matson, P.A., 2008. Ecosystem services: From theory to implementation. Proc. Natl. Acad. Sci. 105 (28), 9455–9456.

Daily, G.C., Polasky, S., Goldstein, J., Kareiva, P., Mooney, H.A., Pejchar, L., Ricketts, T. H., Salzman, J., Shallenberger, R., 2009. Ecosystem services in decision making: time to deliver. Front. Ecol. Environ. 7 (1), 21–28.

Darvill, R., Lindo, Z., 2015. Quantifying and mapping ecosystem service use across stakeholder groups: Implications for conservation with priorities for cultural values. Ecosyst. Serv. 13 (2015), 153–161.

De Groot, R.S., Wilson, M.A., Boumans, R.M., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecol. Econ. 41 (3), 393–408.

de Oliveira, L.E.C., Berkes, F., 2014. What value São Pedro's procession? Ecosystem services from local people's perceptions. Ecol. Econ. 107, 114–121.

Donatuto, J., Campbell, L., Gregory, R., 2016. Developing responsive indicators of indigenous community health. Int. J. Environ. Res. Public Health 13 (9), 899.

García-Nieto, A.P., Quintas-Soriano, C., García-Llorente, M., Palomo, I., Montes, C., Martín-López, B., 2015. Collaborative mapping of ecosystem services: the role of stakeholders' profiles. Ecosyst. Serv. 13 (2015), 141–152.

Goldstein, J.H., Caldarone, G., Duarte, T.K., Ennaanay, D., Hannahs, N., Mendoza, G., Polasky, S., Wolny, S., Daily, G.C., 2012. Integrating ecosystem-service tradeoffs into land-use decisions. Proc. Natl. Acad. Sci. 109 (19), 7565–7570.

Gould, R.K., Klain, S.C., Ardoin, N.M., Satterfield, T., Woodside, U., Hannahs, N., Daily, G.C., Chan, K.M., 2015. A protocol for eliciting nonmaterial values through a cultural ecosystem services frame. Conserv. Biol. 29 (2), 575–586.

Hawai'i State Constitution, 1978. Article 12. Section 7.

Higuchi, J., 2008. Propagating cultural Kipuka: the obstacles and opportunities of establishing a community-based subsistence finishing area. Univ. Haw. Law Rev. 31, 193.

IPBES, 2016. Summary for policymakers of the methodological assessment of scenarios and models of biodiversity and ecosystem services by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. In: Ferrier, S., Ninan, K.N., Leadley, P., Alkemade, R., AcostaMichlik, L., Akcakaya, H.R., Brotons, L., Cheung, W., Christensen, V., Harhash, K.H., Kabubo-Mariara, J., Lundquist, C., Obersteiner, M., Pereira, H., Peterson, G., Pichs, R., Ravindranath, N., Rondinini, C., Wintle, B. (Eds.). (in preparation).

Jackson, S., Palmer, L.R., 2014. Reconceptualizing ecosystem services Possibilities for cultivating and valuing the ethics and practices of care. Progress in Human Geography, p. 0309132514540016.

Kenter, J.O., Hyde, T., Christie, M., Fazey, I., 2011. The importance of deliberation in valuing ecosystem services in developing countries—Evidence from the Solomon Islands. Glob. Environ. Change 21 (2), 505–521.

Kusel, J., 2001. Assessing well-being in forest dependent communities. J. Sustain. For. 13 (1–2), 359–384.

Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., Moran, E., Pell, A.N., Deadman, P., Kratz, T., Lubchenco, J., Ostrom, E., 2007. Complexity of coupled human and natural systems. Science 317 (5844), 1513–1516.

Liu, J., Opdam, P., 2014. Valuing ecosystem services in community-based landscape planning: introducing a wellbeing-based approach. Landscape Ecol. 29 (8), 1347–1360.

Lo, A.Y., Spash, C., 2013. Deliberative monetary valuation: in search of a democratic and value plural approach to environmental policy. J. Econ. Surv. 27 (4), 768–789.

Louis, R.P., 2007. Can you hear us now? Voices from the margin: using indigenous methodologies in geographic research. Geograph. Res. 45 (2), 130–139.

Lyver, P.O'B., Akins, A., Phipps, H., Kahui, V., Towns, D.R., Moller, H., 2016. Key biocultural values to guide restoration action and planning in New Zealand. Restor. Ecol. 24, 314–323.

Mackenzie, M.A., 1991. Native Hawaiian rights handbook. Native Hawaiian Legal Corporation and the Office of Hawaiian Affairs, Honolulu, HI.

Maly, K., Maly, O., 1998. Kaʻūpūlehu ma ka ʻĀina Kaha. A report on the Archival and Historical Documentary Research and Oral History Interviews. HiKaupu-16 (052098). Hilo, Hawaiʻi: Kumu Pono Associates LLC.

Maly, K., Maly, O., 2003. Hana ka lima, ʻai ka waha: A collection of historical accounts and oral history interviews with kamaʻaina residents and fisherpeople of lands in the Haleleʻa-Napali region on the island of Kauaʻi. HiPae-74(11103). Hilo, Hawaiʻi: Kumu Pono Associates LLC.

Maxwell, J., 2005. Qualitative research design: an interactive approach. Sage Publications, Thousand Oaks, California.

McGregor, D., 2007. Nā Kuaʻāina: Living Hawaiian Culture. University of Hawaii Press, p. 8.

McGregor, D.P., 1996. An introduction to the Hoaʻaina and their rights. Hawaiian J. Hist. 30, 1–27.

McMillen, H., Ticktin, T., Friedlander, A., Jupiter, S.D., Thaman, R.R., Campbell, J., Veitayaki, J., Giambelluca, T., Nihmei, S., Rupeni, E., Apis-Overhoff, L., 2014. Small islands, valuable insights: systems of customary resource use and resilience to climate change in the Pacific. Ecol. Soc. 19 (4), 44.

Millennium Ecosystem Assessment (MEA), 2003. Ecosystems and Human Well-Being: A Framework for Assessment. Island Press, Washington, DC, USA.

Millennium Ecosystem Assessment (MEA), 2005. Ecosystems and human well-being, vol. 5. Island Press, Washington, DC, USA.

Milcu, A.I., Hanspach, J., Abson, D., Fischer, J., 2013. Cultural ecosystem services: a literature review and prospects for future research. Ecol. Soc. 18 (3), 44.

Morgan, T.K.K.B., 2010. The Mauri Model Decision-Making Framework: Robust Decision-Making for Community Cultural Mosaics. In: Te Rito, J.S., Healy, S. (Eds.), 4th International Traditional Knowledge Conference. Nga Pae o te Maramatanga, Auckland, pp. 245–250.

National Ecosystem Services Partnership, 2016. Federal Resource Management and Ecosystem Services Guidebook. National Ecosystem Services Partnership, Duke University, Durham. https://nespguidebook.com.

Palinkas, L.A., Petterson, J.S., Russell, J., Downs, M.A., 1993. Community patterns of psychiatric disorders after the Exxon Valdez oil spill. Am. J. Psychiatry 150 (10), 1517–1523.

Panelli, R., Tipa, G., 2007. Placing well-being: A Maori case study of cultural and environmental specificity. EcoHealth 4 (4), 445–460.

Plieninger, T., Bieling, C., Fagerholm, N., Byg, A., Hartel, T., Hurley, P., Lopez-Santiago, C., Nagabhatla, N., Oteros-Rozas, E., Raymond, C., van der Hosrst, C., Huntsinger, L., 2015. The role of cultural ecosystem services in landscape management and planning. Curr. Opin. Environ. Sustain. 14, 28–33.

Pukui, M.K., Haertig, E.W., Lee, C.A., 1972. Nana i ke Kumu. Honolulu: Hui Hanai 1:35–40.

Raymond, C.M., Kenter, J.O., Plieninger, T., Turner, N.J., Alexander, K.A., 2014. Comparing instrumental and deliberative paradigms underpinning the assessment of social values for cultural ecosystem services. Ecol. Econ. 107, 145–156.

Raymond, C.M., Singh, G.G., Benessaiah, K., Bernhardt, J.R., Levine, J., Nelson, H., Turner, N., Norton, B., Tam, J., Chan, K.M., 2013. Ecosystem services and beyond: Using multiple metaphors to understand human–environment relationships. Bioscience 63 (7), 536–546.

Robinson, C.J., James, G., Whitehead, P.J., 2016. Negotiating Indigenous benefits from payment for ecosystem service (PES) schemes. Global Environ. Change 38, 21–29.

Tipa, G., Teirney, L.D., 2006. A Cultural Health Index for Streams and Waterways: A tool for nationwide use. Ministry for the Environment, Wellington, pp. 1–58.

Tipa, G., Welch, R., 2006. Comanagement of natural resources issues of definition from an indigenous community perspective. J. Appl. Behav. Sci. 42 (3), 373–391.

Tongco, M.D.C., 2007. Purposive sampling as a tool for informant selection. Ethnobot. Res. Appl. 5, 147–158.

Turner, N.J., Gregory, R., Brooks, C., Failing, L., Satterfield, T., 2008. From invisibility to transparency: identifying the implications. Ecol. Soc. 13 (2), 7.

Umemoto, K., 2001. Walking in another's shoes. J. Plann. Edu. Res. 21 (1), 17–31.

Vaughan, M.B., Thompson, B., Ayers, A.L., 2016. Pāwehe Ke Kai a ʻo Hā ʻena: Creating State Law based on Customary Indigenous Norms of Coastal Management. Soc. Nat. Resources. 30 (1), 31–46.

Vaughan, M.B., 2016. Kaiaulu: The Surrounding Sea. Oregon State University Press. In review.

Vaughan, M.B., Ardoin, N.M., 2014. The implications of differing tourist/resident perceptions for community-based resource management: a Hawaiian coastal resource area study. J. Sustain. Tourism 22 (1), 50–68.

Vaughan, M.B., Vitousek, P.M., 2013. Mahele: sustaining communities through small-scale inshore fishery catch and sharing networks 1. Pac. Sci. 67 (3), 329–344.

Venn, T.J., Quiggin, J., 2007. Accommodating indigenous cultural heritage values in resource assessment: Cape York Peninsula and the Murray-Darling Basin, Australia. Ecol. Econ. 61 (2), 334–344.

Winter, K.B., McClatchey, W., 2008. Quantifying Evolution of Cultural Interactions with Plants: Implications for Managing Diversity for Resilience in Social-Ecological System. In: Albuquerque, U.P. (Ed.) Ethnobotany: A Focus on Brazil. Functional Ecosystems and Communities 2 (Special Issue 1) 1–10.

Winthrop, R.H., 2014. The strange case of cultural services: Limits of the ecosystem services paradigm. Ecol. Econ. 108, 208–214.