I OLA KA ʻĀINA, I OLA NŌ KĀKOU: PLACE-BASED AND INDIGENOUS PERSPECTIVES ON CULTURAL ECOSYSTEM SERVICES IN HAWAIʻI

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Dedication and Acknowledgements:

‘O kākou nā mamo aloha o nā kūpuna.
We are the beloved descendants of those who have come before.

This research would not have been possible without the love, support, wisdom, and upbringing provided by my family. This thesis is dedicated to all those who had a hand in guiding me to where I am today –Mom, Dad, Puna, Papa P, Papa Gil, Aunty Shirlene, Uncle Brian, Uncle Clyde, Igarashi, Pascua, and Wong aunties and cousins. And to those who are looking down from above – Nana, Papa, Grandpa Tommy, Bachan and Grandpa, Gramps and Grannie, Aunty Ma, Aunty Pua, Aunty Janie, and all those who have come before me, mahalo for your guidance and protection. As the first in all four branches of our ‘ohana to complete a Master’s degree, I dedicate this accomplishment to all of you. For all that I am and for all that you’ve set me up to achieve, thank you.

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Abstract:
Cultural ecosystem services (CES) – the non-material benefits realized through human-environmental interactions – make important contributions to ecosystem service assessments as they reveal key social considerations in natural resource management. Yet there exists a critical gap in understanding how CES are perceived by individuals with strong generational and genealogical ties to land. Existing ecosystem service assessments do not accurately capture these place-based values, thus they have been underrepresented in resource management, particularly in policies surrounding land reform and wildlife management. This research presents a case study from Hawai‘i to outline a process of eliciting place-based and indigenous CES and to document the challenges and opportunities encountered with this approach. The objective of this project is to highlight important CES in Hawai‘i as perceived by those with strong cultural connections to place, namely multi-generational residents (kama‘āina) and indigenous descendants (kama‘āina), then to demonstrate how those CES compare/contrast with commonly recognized CES. To accomplish this objective, our research team created a novel interdisciplinary, mixed methods approach involving two rural community workshops and the development of a Hawai‘i-based CES framework. Our results highlight CES from a Hawaiian place-based/indigenous point of view and include services related to cultural practices, ancestral landscapes, and environmental kinship. Although some of the results are site-specific, it is anticipated that the process we created can be applied in natural resource management and land-use planning in place-based communities throughout Hawai‘i and across the Pacific. The ultimate goal of this project is to provide other researchers with a methodology to engage community/cultural groups when identifying CES in their respective ecosystem service assessments.

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1. Introduction

Ecosystem service assessments are important natural resource management tools that have grown in popularity among decision-makers like government agencies, and decision-influencing bodies like non-governmental conservation organizations (Daily et al. 2009). These assessments describe the full suite of environmental services provided to people and are used to inform natural resource management (Daily and Matson 2008). Ecosystem service assessments are typically divided into four main categories: provisioning (e.g. food and water), regulating (e.g. regulation of flood and droughts), supporting (e.g. nutrient cycling), and cultural (e.g. recreation and spiritual) (Millennium Ecosystem Assessment 2003).

Cultural ecosystem services (CES) make important contributions to ecosystem service assessments as they specifically address the human dimensions of natural resource management (Chan et al. 2011, Darvill and Lindo 2015, Liu and Opdam 2014). CES integrate both social and environmental considerations, thus they are a tool to bridge diverse academic disciplines and address real-world issues (Milcu et al. 2013). Furthermore, by examining the human-environmental interface, they reveal critical pathways for sustainable interaction with natural resources (Liu et al. 2007, Plieninger et al. 2015). Although ecosystem service assessments continue to grow in popularity amongst approaches to resource management, CES remain one of the most challenging categories of ecosystem services to identify, quantify, and incorporate into natural resource decision-making (Chan et al. 2012, Daily and Matson 2008, Daily et al. 2009).

Popular definitions of CES broadly describe the non-material benefits that result from paired human and environmental interactions (Costanza et al. 1997, Millennium Ecosystem Assessment 2003). However others argue that this general definition and the standard non-market valuation techniques used to quantify them, systematically underrepresent place-based value systems (Adamowicz et al. 1998). In response, recent scholarship has defined 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). Building 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.

While CES are distinct from other ecosystem services because of their unique human dimensions and non-material contributions, including well-being and quality of life, CES should be recognized as complementary and vitally important to wider ecosystem service research (Chan et al. 2011, Milcu et al. 2013). Yet there are no instances where a commonly accepted CES framework highlighted important values, characterized their changes with respect to a given scenario, and was included alongside other ES in decision-making (Chan et al. 2012). This is likely because CES are place-based, intangible, and highly interconnected – three qualities that make them particularly enigmatic to characterize and integrate into decision-making (Daily and Matson 2008). First, CES are co-produced through interactions between environmental characteristics and human practices associated with a specific location (Chan et al. 2011). These place-based services are highly influenced by spatial variation in the physical environment (i.e. geographic features, land cover, and climate) and are perceived through specific cultural lenses (Baulcomb et al. 2015, Darvill and Lindo 2015, Liu and Opdam 2014). Thus it is highly unlikely that a standardized framework of CES can be applied in diverse socio-ecological environments. Second, CES are intangible and involve non-use values that are difficult to classify and measure (Chan et al. 2011). As non-market goods and services, the subjective social values associated

with CES are much broader and far more difficult to contextualize than goods that can be exchanged in the marketplace (Bunse et al. 2015). Lastly, CES are interconnected and highly dependent upon one another, thus they create multiple overlapping and linked benefits (Baulcomb et al. 2015, Vaughan and Vitousek 2013). For example, Chan et al. (2011) explain that the loss of fishing impacts the provision of fish, but might also affect a larger suite of linked cultural impacts, including the perpetuation of practices and the transmission of knowledge.

As a result of these challenges, most scholarship on CES is limited to studies of tourism, recreation, and scenic beauty (Chan et al. 2012, Milcu et al. 2013). While the popular monetary valuation approach used in these studies can provide decision-makers with an explicit dollar value suggesting societal worth or cost of degradation (Constanza et al. 1997), these assessments do little to capture the diverse and context-specific sociocultural values associated with natural resources (Liu and Opdam 2014). Researchers have rarely identified ecosystem services according to place-based perceptions (Andersen et al. 2012, de Olivera and Berkes 2014, Winthrop 2014), yet neglecting to acknowledge these services in decision-making and resource management can lead to dire and unintended consequences (Adamowicz et al. 1998, Chan et al. 2012). This is especially true in the case of biocultural landscapes – places where groups share strong cultural ties defined by reciprocal connections to the natural environment (Posey 1999). When resource management strategies involve sacred sites and ancestral landscapes – places inhabited by and considered kin to generations of descendants – it is critical to account for the diverse sociocultural values and perspectives specifically linked to these places. However, because these values are not accurately captured in existing ecosystem service approaches, they have been underrepresented in resource management, particularly in policies on land-reform and wildlife management (Adamowicz et al. 1998, Kusel 2001, Venn and Quiggin 2007). In this regard, CES assessments are vital for resource management efforts, particularly if they can make place-based values visible when important decisions are being made (Turner et al. 2008). These limitations reveal two critical gaps in CES research: first, the increased need to incorporate participatory and transdisciplinary methods that can capture place-based sociocultural perspectives into CES assessments; and second, to expand researcher perspectives beyond the common orstandard CES listed in the literature (Chan et al. 2012, de Olivera and Berkes 2014, Garcia-Nieto et al. 2015).

Here we use an example from Hawai‘i to demonstrate:
1. How can we create a process to capture place-based cultural ecosystem services?
2. What CES are revealed using this approach and how might those services compare to common CES categories and associated benefits?
3. What challenges and opportunities are encountered using this integrated approach?
4. How can this process improve resource management in other place-based communities?

The objective of this project is to highlight important CES in Hawai‘i as perceived by those with strong cultural connections to place, namely multi-generational residents (*kama‘āina*) and indigenous Native Hawaiians and their descendants (*‘ōiwi*). To accomplish this objective, our research team implemented a novel interdisciplinary, mixed methods approach, involving two rural community workshops and the development of a Hawai‘i-based CES framework. Although some of the examples in the framework are site-specific, it is anticipated that the process we created can be applied in natural resource management and land-use planning in place-based and indigenous resource management throughout the world. Ultimately this project is intended to

provide other researchers with a methodology to engage community and cultural groups when identifying CES in their respective ecosystem service assessments.

2. Background

2.1 A review of CES categories in the literature

The 2003 Millennium Ecosystem Assessment (MEA) provides the closest thing to a commonly accepted CES framework. Yet a broader review of CES literature reveals subtle differences from the CES described in the MEA. Some of these differences can be attributed to diction (as many are synonyms), while others represent new contributions to a growing list of distinct CES. Costanza et al. (1998) were some of the first to introduce different types of CES as they described aesthetic, artistic, educational, spiritual, and/or scenic values. A few years later, the Millennium Ecosystem Assessment (2003) expanded that list to include CES such as spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience. More recently, Chan et al. (2011) describe the benefits associated with CES (including place/heritage values, existence/bequest values, and option values) while also including subsistence as a novel CES category (shown with an asterisk below as Chan et al. (2011) were one of the few to mention this CES). Drawing from this literature, we compiled a list of 12 of the most common CES and their associated benefits (Table 1). While this list should not be considered exhaustive, it does represent many of the most popular/common CES that appears in ecosystem service assessment literature.

Table 1. 12 common CES categories and associated benefits derived from popular CES literature (Costanza et al. 1998, Millennium Ecosystem Assessment 2003, Chan et al. 2011). The "*" indicates a novel category with limited recognition in the CES literature.

Material/Subsistence*	**Existence/bequest**
Place/heritage	**Option**
Activity	**Social cohesion**
Spiritual	**Aesthetic**
Inspiration	**Employment**
Knowledge	**Identity**

2.2 Transforming the current approach to CES research

Our study aims to address two main gaps in the common approach to CES research. First, we question the suitability of non-market valuation techniques like choice experiments, contingent valuation, travel cost models, and hedonic pricing in determining place-based values. As is the case with most economic approaches, a set of assumptions regarding profit maximization, production flow, and purchasing power is required in order to use these methods. However a number of studies are critical of these theoretical assumptions, as they diverge from the epistemological value systems tied to CES (Adamowicz et al. 1998, Andersen et. al 2012, Bunse et al. 2015, Chan et al. 2011, de Olivera and Berkes 2014, Gould et. al 2015, Raymond et al. 2013, Venn and Quiggin 2007, Winthrop 2014). These studies demonstrate the need for methods that capture important cultural considerations such as the intrinsic value of ecosystems, the non-substitutable nature of sacred values, consideration of future generations, recognition of collective sharing, wealth, and satiation, and the reciprocal relationship between people and the places they care about.

The second gap emerged as studies began to identify services easiest to value with the established methods, rather than identifying services truly valued by a given audience (Milcu et al. 2013). 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). However, as mentioned earlier, in places where groups share strong cultural ties to land based on multi-generational connections or genealogical recognition of environmental kinship, recreation and scenic valuations do not adequately capture the total value of those landscapes in natural resource management and land-use decision-making. CES assessments must incorporate methods to verify that the CES being discussed are indeed relevant to the respondents sampled (Baulcomb et al. 2015). Chan et al. (2012) write that only after we accurately determine prominent CES and their associated benefits, values, and relationships, can we begin to facilitate subsequent valuation.

The method described here aims to address these concerns 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 2012, Raymond et al. 2014).

2.2 Other place-based approaches

Few studies specifically examine CES in places where groups share strong cultural ties to a landscape (including Adamowicz et al. 1998, Andersen et al. 2012, Gould et al. 2015, Kenter et al. 2011, Venn and Quiggin 2007, Winthrop 2014). This growing area of interest makes substantial contributions to the ways in which CES can be contextualized and understood. Supporting studies on socio-ecological factors similar to CES in biocultural landscapes are equally valuable in enhancing our understanding. A review of this interdisciplinary research highlights important concepts that should be captured, or at a minimum, considered in any place-based and indigenous CES research. One biocultural CES study, Winthrop (2014) uses the term "culturally reflexive stewardship" to describe the ways that multi-generational residents demonstrate a strong commitment to culturally valued landscapes. Berkes and Ross (2013) advance the understanding of CES in biocultural landscapes through their discussion of community resilience, where socio-ecological factors (like CES) continually change and adapt while remaining within critical thresholds. In a study on the impact of natural disasters on native well-being, Palinkas et al. (1993) use methods in psychology to show that cultural services like traditional relationships, subsistence production, and goods distribution are linked to environmental health.

With regard to place-based CES, we encountered two valuable resource management tools from Aotearoa (New Zealand). 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 second tool from Aotearoa, which has grown in popularity across the Pacific, is the Mauri Model, a decision-support tool that quantifies impacts to *mauri* (the life force of all living things) across social, cultural, and environmental dimensions (Morgan et al. 2010). These studies use interdisciplinary methods to demonstrate the importance of considering CES in resource planning and help to frame place-based approaches by highlighting some of the services a CES framework could include. These examples further supported our desire to move away from non-

market valuation methods and towards participatory, deliberative and facilitation techniques to conduct this research.

3. Methods

3.1 Study Area

This study examines place-based and indigenous CES in the Hawaiian Islands by drawing from case studies conducted in two rural communities. Though Hawai‘i is one of the most geographically remote island chains in the world, a number of ethnic groups have settled in the islands, resulting in diverse yet distinct sociocultural beliefs that can be challenging to incorporate in natural resource planning and management (Umemoto 2001). Adamowicz et al. (1998) note that popular methods in CES valuation may be appropriate if special attention is paid to local ethnographic contexts; and Darvill and Lindo (2015) note that CES are more important at smaller spatial scales like local communities. In Hawai‘i, local communities are defined and understood in a variety of ways. Vaughan and Caldwell (2015) provide a conceptual example of nested communities- the all encompassing being communities of interest (interested parties), then geographic communities, then communities of shared sociocultural beliefs based upon long-term interaction with resources. Our research specifically focuses on place-based and indigenous perspectives in Hawai‘i, therefore we chose to focus on a more narrow definition of community so that we could capture perspectives held by kama‘āina (indigenous Native Hawaiians) and kama‘āina (multi-generational residents, often descendants of early sugar plantation workers)[1]. While kama‘āina and kama‘āina acknowledge distinct values that may differ spatially and intergenerationally (Adamowicz et al. 1998), the collective local ecological knowledge held between both groups makes Hawai‘i an ideal context to develop and improve the cultural components of standard practices in ecosystem services research.

3.1.1 Case Study Site 1: Ka‘ūpūlehu, Hawai‘i Island

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 8,271 ft elevation on the summit of Hualālai Mountain (Figure 1) (Forest Solutions Inc. 2006, Kumu Pono Associates 1998). The nearly 23,600 acres (approximately 105 km^2) that make up this ahupua‘a were passed down through the chiefly lineage of Princess Bernice Pauahi Bishop, and upon her passing the land was endowed to the Kamehameha Schools, a Native Hawaiian educational organization and the largest private landowner in the state. The Kamehameha Schools continues to own the majority of the ahupua‘a, and manages the land through lease and management agreements (KS NRMP 2011).

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 (Kumu Pono Associates 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. *Ma uka* (upland) goods like *‘uala* (sweet potato) and *pa‘i ‘ai* (firm *poi*, or pounded taro) were traded for *ma kai* (shoreline) goods

[1] It is worthwhile to note that ‘ōiwi are not always solely of Native Hawaiian descent. Most also carry numerous other ethnicities including the plantation ethnicities noted in the description of kama‘āina.

like *pa‘akai* (salt) throughout the districts of the Kona Coast, and even as far as Maui (Kumu Pono Associates 1998). 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 ahupua‘a. 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.

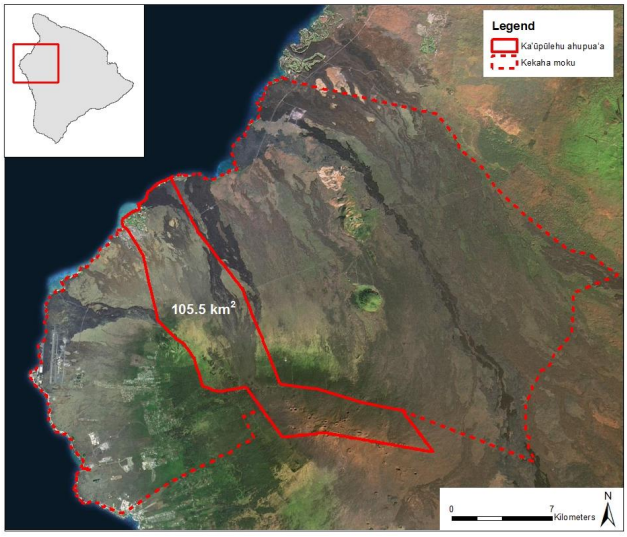

Figure 1. Map of Ka‘ūpūlehu Ahupua‘a situated in the larger kalana (traditional region) of Kekaha, Hawai‘i Island. A larger version of this map can be found in the appendicies.

3.1.2. Case Study Site 2: Hā‘ena, Kaua‘i

Hā‘ena is an ahupua‘a on Kaua‘i's northern coast, situated in the *moku* (larger districts that span multiple ahupua‘a) of Halele‘a (Figure 2). The ahupua‘a of Hā‘ena is the westernmost boundary of the Halele‘a Moku, which extends eastward to Kalihiwai. Unlike the Kekaha region of Kona, the moku of Halele‘a has abundant freshwater resources, including streams and springs which support 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 *loko i‘a* (aquaculture), *‘ohi* (intertidal gleaning of seaweed and mollusks), and *lawai‘a* (fishing). The highly productive upland and coastal regions supported extensive customary exchange and collective sharing of goods across Halele‘a and to other distant regions of Kaua‘i. Since the mid-1800s, changes in the primary economy (subsistence to pastoral to tourism) gave way to dramatic land-use and resident socio-demographic changes (Kumu Pono Associates 2003). While some of the traditional socio-ecological interactions such as agriculture, fishing, and customary gifting/exchange networks have persisted into the present day, much like in Ka‘ūpūlehu many of the lineal descendants and long-time residents no longer live within the ahupua‘a and have relocated to live and work in other ahupua‘a within the moku including Kilauea and Waipā. For this reason, the larger Halele‘a moku is the appropriate scale for examining socio-ecological interactions in this case study.

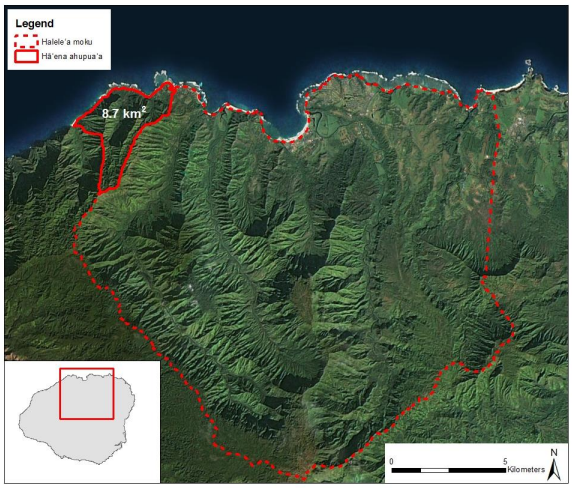

Figure 2. Map of Hāʻena Ahupuaʻa in the larger moku of Haleleʻa, Kauaʻi. A larger map can be found in the appendicies.

3.2 Small Working Group

Prior to engaging community participants in this research, a preliminary conceptual framework of Hawaiʻi-based CES was developed in a small working group of four subject matter experts. The small working group served as the first step towards conceptualizing cultural services in Hawaiʻi. Working group participants were affiliated with the University of Hawaiʻi at Mānoa Natural Resource and Environmental Management Department. They were asked to participate based upon: 1) their in-depth knowledge of Hawaiian culture and natural resource management and 2) their years of experience working with local communities. Participants were asked to identify key components of environmental kinship in Hawaiʻi by drawing from firsthand knowledge, published secondary materials on relevant values, proverbs, and traditional practices in Hawaiʻi, and, when necessary, literature on environmental kinship in other biocultural landscapes. When possible, relevant Native Hawaiian terms, values, or sayings were used to describe each component of environmental kinship. Once these components (which were synonymous with the term "benefits") were identified, they were organized into relevant categories of services. Examples were provided for each benefit when possible. Framework iterations were circulated and refined multiple times among the small working group participants before the community workshop.

3.3 Community Workshops

Engaging local practitioners and resource users is an important way to gain insight into social contexts behind CES, to verify the relevance of CES to respondents, and to demonstrate respect for diverse knowledge (Baulcomb et al. 2015, Raymond et al. 2013). With this in mind, community workshops provided an appropriate avenue to refine and deepen our initial understanding of CES in Hawaiʻi by presenting first-hand perspectives and lived or experienced knowledge on meaningful CES as they relate to various land-uses and environments. The two rural communities involved in our case studies were selected based upon their engagement and their ongoing participation in an overarching research project examining socio-ecological resilience to climate change in island communities. The people of both communities have strong connections to their respective ahupuaʻa as kamaʻāina and kamaʻāina of those landscapes.

The Kaʻūpūlehu workshop entitled "I ola ka ʻāina, I ola nō kākou: A workshop on ʻōiwi and kamaʻāina perspectives on cultural ecosystem services" was conducted on April 6, 2015 at a community center in the region. A total of 13 participants were in attendance (Table 2). Participant recruitment was purposive (Tongco 2007) based on two factors: 1) in-depth and long-term relationships to Kekaha through membership in agricultural education programs, ranching families, native forest restoration programs, marine conservation groups, and traditional voyaging groups; and 2) existing relationships with researchers established previously through UH collaborative research projects.

The Hāʻena workshop, which shared a similar title, was conducted on October 2, 2015, also at a popular community center in the region. Recruitment in this location relied upon similar purposive sampling (Tongco 2007) and participants were invited based upon their role as local experts, conservation practitioners, and cultural practitioners in fishing, ranching, agriculture, native forest restoration and/or outreach education programs. A total of 19 participants attended.

Participants engaged at both workshops provided both oral and written consent and all resulting materials were sent via digital or hard copy for their review. Participant interaction was consistent with the human subjects procedures established by the University of Hawaiʻi Institutional Review Board.

Table 2. Workshop Participation. Both locations were small, rural communities, thus respondents were few, but extremely knowledgeable about the place and practices discussed in the workshop. As place-based and genealogical perspectives are a focus of this research, here we present the participant relationship to the case study areas to demonstrate the slight variations in place-based knowledge that our workshops captured.

Workshop	# of Participants	ʻŌiwi/Kamaʻāina from region (Kaʻūpūlehu Ahupuaʻa/ Haleleʻa Moku)	ʻŌiwi/Kamaʻāina from adjacent regions	Conservation Professionals working in region
Kaʻūpūlehu	13	8	3	2
Hāʻena	19	15	1	3

Each workshop opened with Hawaiian cultural protocol, a thorough discussion of the "ground rules" or expectations of participants, then 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 break-out 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 (Table 3) and were asked to write each response that came to mind on a blank response card. Responses were then grouped by either the author or by workshop facilitators. Back in the large group setting, participants were asked to discuss and to agree upon groupings and to assign a title to each group (Figure 3).

In the second workshop activity, a break-out group activity, each group discussed a different land-use determined by the popular land-use considerations for the area (provided by either the land-owner or by informed resource managers). Participants were allowed to self-select their group based upon their level of comfort/familiarity with the land-use. Participants were provided with a second set of prompts and asked to document and subsequently present their answers back to the larger group (Table 3).

In Hāʻena, participants were knowledgeable about a variety of the land-use considerations and did not feel comfortable limiting their input to one specific group, thus the larger group contributed additional responses to what the break-out groups had initially provided. The workshops closed with a discussion of next steps, including the scheduling of follow-up discussions.

Figure 3. Snow Card Activity. After responding to the prompt, participants were asked to group their responses into categories based upon any similarities that emerged (shown here).

Table 3. Workshop Activity and Follow-up Discussion Prompts. The Hāʻena workshop prompts differ slightly from the prompts used in Kaʻūpūlehu because questions were modified after the first workshop to reduce confusion and to more directly elicit CES.

	Activity	Prompt
Kaʻūpūlehu	Snow Card	What are the ways you interact with/are sustained by ʻāina? What supports your relationship to place?
	Break-out Groups	What are the ways you interact with/are sustained by this specific type of ʻāina? What supports your relationship to this type of ʻāina?
	Follow-up Discussions	If this type of land weren't around anymore, what would be missing from your life? If one land-use was converted to another land-use what would be some of the negatives associated with that change? If you can think of benefits associated with changing land-uses, what would they be?

Hā‘ena	Snow Card	What are the ways that ‘āina sustains you?
	Break-out Groups	How does this practice/environment sustain you? In other words, if this practice (environment/land-use) weren’t around, what would be missing from your life? What would the environment look like if it was in its best, middle, and worst conditions for this practice? What kind of plants and animals would those conditions include?
	Follow-up Discussions	N/A. Based upon reformatted prompts, follow-up discussions were not necessary.

A workshop summary was provided to participants within two weeks of the workshop completion. Follow-up discussions were conducted in Ka‘ūpūlehu during May 2015 to clarify and build upon the information shared. At the culmination of the project, community presentations in both locations were scheduled for late 2015/early 2016 in order to share the information gathered with those who contributed to the project.

3.4 Data Analysis

Data collected in the community workshops were compiled then analyzed with qualitative methods including both selective coding (for snow card activity results) and open coding (for overall workshop and break-out group results/discussions) (Maxwell 2005). During the selective coding process, snowcard data was combed for the 12 common CES categories and associated benefits described in Table 1. Some workshop responses related to multiple CES categories/benefits, thus they were counted towards as many themes as necessary in order to capture cross-cutting and overarching ideas. During open coding process, the data from the break-out group activity and larger workshop discussions were combed for emerging themes including novel CES categories and benefits. These emerging themes were used to refine the preliminary (pre-workshop) CES framework.

4. Results

4.1 How can we create a process to capture place-based cultural ecosystem services? One key output of this research is a documented process of identifying place-based and indigenous CES from the ground up by revealing important local expert and practitioner perspectives. Based upon our own experiences, the steps to best identify place-based CES using participatory methods should include:

1. Identify a small group of subject matter experts based upon knowledge of socio-ecological systems and/or experience in focal areas.
2. Convene the working group to create preliminary conceptual framework of CES by identifying the key concepts in paired human-environmental interactions in the region
3. Identify and engage knowledgeable and respected local experts/practitioners by first developing a basic understanding of socio-ecological interactions in the area then understanding acceptable methods of communication for that area. Community and researcher recommendations are often helpful during this step.
4. Organize and conduct a community workshop to learn about CES in the places that they occur. Funding is an important consideration in this step as it can be used towards a

community hire for additional on the ground support and towards supporting community resource centers and food establishments to build further rapport.
5. Allow ample time to integrate the small working group results and community workshop results into an appropriate communication tool (in our case, a framework of Hawai‘i-based CES). Multiple iterations and either community or small working group follow-ups may be necessary during this step.
6. Create a process for participants to review information and determine what is appropriate to share with a given audience

4.2 What CES are revealed using this approach and how might those services compare to common CES categories and associated benefits?

4.2.1 Compiling CES in a Hawai‘i-based CES framework

Here we briefly discuss specific components of the framework to describe how we organized and conceptualized the CES that emerged in both the small working group and community workshops. Our framework delves into place-based and indigenous CES by presenting the benefits that result from having a reciprocal relationship with land (Table 4). The versions of the framework specifically produced for the community participants also include place-specific examples not included here to protect potentially sensitive information. Benefits are organized into four overarching categories of CES: *‘Ike* (Knowledge), *Mana* (Spirituality of Landscapes), *Pili Kanaka* (Social Interactions), and *Ola Mau* (Physical/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 Pili Kanaka category acknowledges the CES tied to social interactions. The last category, Ola Mau, speaks to physical and mental wellbeing.

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 in their respective study sites.

Table 4. A Hawai‘i-based Cultural Ecosystem Service Framework. All information presented here incorporates results from both the small working group and community workshops. The table includes a brief introduction to the framework, which stresses the reciprocal nature of CES in Hawai‘i. Examples of each CES are provided when available.

A Hawai‘i-based Cultural Ecosystem Service Framework

Cosmological and genealogical origins of Hawaiian people in Hawai‘i establish the familial connection between kānaka and ‘āina. Aloha ‘āina, the reciprocal kinship between people and environment, governs our ability to exist in this place as well as our ability to be fruitful and thrive. Through this reciprocal relationship, kānaka demonstrate appreciation and respect by caring for ‘āina which, in return, provides for the kānaka. If we think about ‘āina as all of the components of the ecosystem that nurture us as human beings, what are the various ways ‘āina sustains?

Categories of Ecosystem Services			
‘Ike Knowledge	Mana Spiritual landscapes	Pili Kanaka Social Interactions	Ola Mau Physical and Mental Wellbeing

Benefits based upon traditional values, proverbs/sayings, & cultural practices			
Ma ka Hana ka ‘Ike Opportunities to learn place-based practices by actually doing them *e.g. salt gathering, gathering of seasonal limu*	Ho‘omana/ Mauli Ola Spiritual beliefs and practices that allow people to interact with the mana of a landscape *e.g. formal ceremonial practices, informal interactions, perpetuation of mele, oli, hula, and pule of/for place*	Ho‘olako Perpetuation of practices/skills that allow individuals to provide for their families *e.g. goods for household, goods for sharing, income from occupation, jobs that require knowledge of traditional practices or the discipline required to do them well*	Lako/Momona Availability and access to subsistence resources rich enough for people to thrive *e.g. quantity and quality of water, presence and abundance of species of cultural value, fertile soil*
Nānā i ke Kumu Opportunities to observe familiar natural processes and seasonal occurrences	Wahi Pana Existence of, appropriate access to, and understanding of place-specific practices associated with storied	Ike Aku, ‘Ike Mai Opportunities to share traditional/local knowledge and values	Ho‘oikaika Kino Opportunities for an active lifestyle to support the physical demands of specialized practices

e.g. characteristic weather, timing and intensity of rain, plant/animal cycles	landscapes (wahi pana). *e.g. important cultural sites like birth place (one hānau) and family resting places/burial sites(kulaiwi), places where specific practices occur*	*e.g. formal and informal apprenticeships, place-based fishing/gathering practices, acknowledgement of young leaders*	*e.g. outdoor activities that promote health & strength*
Hālau ʻIke Opportunities for diverse (formal and informal) learning *e.g. scientific research, experiential, culture-based/ ʻāina-based education, learning from elders*	Kinolau Presence and recognition of plants/animals/elements that represent/symbolize akua *e.g. hoʻokupu for ceremony, ceremonial lei, hula altar plants, fresh water, rain*	Kōkua Aku, kōkua Mai Presence of strong social ties/ social networks *e.g. network of people you share with and receive from, gifting/exchange of upland and coastal goods, the many hands that help when something needs to be done*	ʻOihana Opportunities for engaging in family roles and occupations *e.g. lawaiʻa (fishing), mahiʻai (farming), paniolo (ranching)*
	ʻAumakua Presence and recognition of familial gods/ancestors; resources themselves recognized as kin *e.g. honu, pueo, manō*		Moʻokūʻauhau/Noho Papa Opportunities for multi-generational presence on and/or interaction with lands. *e.g. by lease, access, ownership, and/or occupation*
	Hōʻailona Presence of environmental signs/indicators and the ability to		

recognize them. *e.g. Types of rainbows to signal events, Species that signal the cycles of another plant/animal species (bioindicators)*
I ka ʻŌlelo nō ke Ola, i ka ʻŌlelo nō ka Make Presence of place-based Hawaiian terms/names describing environment *e.g. Place names, species names, environmental process names, rain names, creating new ʻōlelo noʻeau to describe these observations*

4.2.2 Novel categories of CES emerging from community workshops

The snowcard activity in the community workshops revealed important categories and examples of CES from practitioner perspectives. In Kaʻūpūlehu, a total of 77 responses were grouped into 13 categories and in Hāʻena 79 responses were grouped into 11 categories, this time with additional sub-categories (Table 5). With respect to the number of categories in each location, in Kaʻūpūlehu, we required participants to place their response into a single category, while in Hāʻena participants requested that responses be listed as overarching/cross-cutting categories and sub-categories when necessary.

Table 5. Card response categories and sample responses. Participants were asked to respond to the prompt, "What are the ways you interact with/are sustained by ʻāina? What supports your relationship to place?" This table lists the response categories discussed and agreed upon at each workshop and provides a sample response for each category (when applicable). "N" represents the total number of responses at each workshop while "n" is the number of resulting category groupings.

Kaʻūpūlehu (N=77, n=13)	Hāʻena (N=79, n=11)
1. Ola Mau (Sustaining, Realigning) "Spiritual balance, physical order, breath of life, sense of security and pleasure, family unity."	1.Provides all that is needed (including food and identity) (Overarching category)
	2.Sharing (Overarching category)
2. Kamaʻāina "Knowing that my ancestors stepped upon, traversed, and honored these same lands supports my relationship to place."	3.Spiritually "So I start with pule. And we connect with the rain, water, to help grow our kalo, fish, limu, plants, and everything that helps us live."
3. Moʻolelo "Stories-they draw direct connection to what I do for a living and how I live. I need to protect the element of the stories for collectively, they are culture."	4.Mentally "Quiet places to gather my thoughts and set myself back to normal."
4. Working "The ʻāina invigorates me to work to protect ʻāina so that my children, my grandchildren will have the same connection with this place that my ancestors had."	5.Security "Know that people close to me will always have a place to return to."
5. Seasonality "I breathe in and the fragrance of the season comes into me, a certain flower, dry ground, rain coming near, and I know the time of the year, I know the season of my life."	6.Wai "Clean streams to swim in and drink from." a. Mauka/Makai Connections (Sub-category) "Native plants for healthy forests."

6. Hoʻomana (Ceremonial Practices) “The ceremonial activities (mele, oli, hula, pule, etc.) support my relationship to place.”	7.Physically "Food for body, place to exercise health."
7. Hui ʻana "Collective kuleana."	a. Meaʻai (Sub-category) "Provides seasonal foods to feed my family." b. Hana (Sub-category) " Hiking/surfing rejuvenates body, mind, and soul."
8. Physically going to wahi pana "Wahi pana: Wai ʻulaʻula, Kahuwai, Puʻuanahulu, Kīholo, Wai puhi, Hainoa, Kohākohau, Honuaʻula, Waiauli, Kipaheʻe."	8.Identity a. Culture (Sub-category) "Time and place to connect with ancestors." b. Aloha (Sub-category) "Balance- spiritually, mentally, physically." c. Sense of place/belonging (Sub-category) "Comfort "Home", all senses, sight sound smell."
9. Kino lani "Sun-beauty rise and set, energy- for man, energy- for land and sea."	9.Mālama "Pono stewards. Important to keep ʻāina/ecosystems in balance, like we were taught. What happens up mauka affects ma kai."
10. Air “Fresh air-need it to grow, to live, to be well.”	10. Intergenerational Transfer of Knowledge "Time and place to pass on ancestral traditions."
11. Wai "Fresh water- life giver and an exhaustible resource."	11. Seasonal Changes "Place to observe: where I can note/reference change over time."
12. Mea ʻai "Food- sustaining life, practiced sustainably."	
13. Kai "Kai- enjoyment riding waves."	

Card responses from each workshop were selectively coded to determine how they compare to the 12 common categories of CES (derived from Costanza et al. 1998, MEA 2003, Chan et al. 2011). Figure 4 shows that the place-based CES that emerged in the community workshops fit into all categories defined in existing CES research. They also suggest novel and emerging categories of CES that are not currently captured in the literature on CES. Though most studies

consider Material/Subsistence benefits as a provisioning ecosystem service, these were the most frequently mentioned category of CES. This finding highlights the connections between CES and other ecosystem service assessment categories (like provisioning services) and strengthens the argument for including material/subsistence benefits as CES (originally suggested by Chan et al. 2011). Results from our subsequent open coding of other workshop results showed that security and traditional values (denoted with asterisks) were also important emerging CES. Though they are not yet considered common CES, security and values both appear as often as other important CES like place/heritage values, knowledge, and identity. It is important to note that while results are presented in descending order in Figure 4, they are not intended to suggest relative importance over any other service as this was not the intent of our prompt.

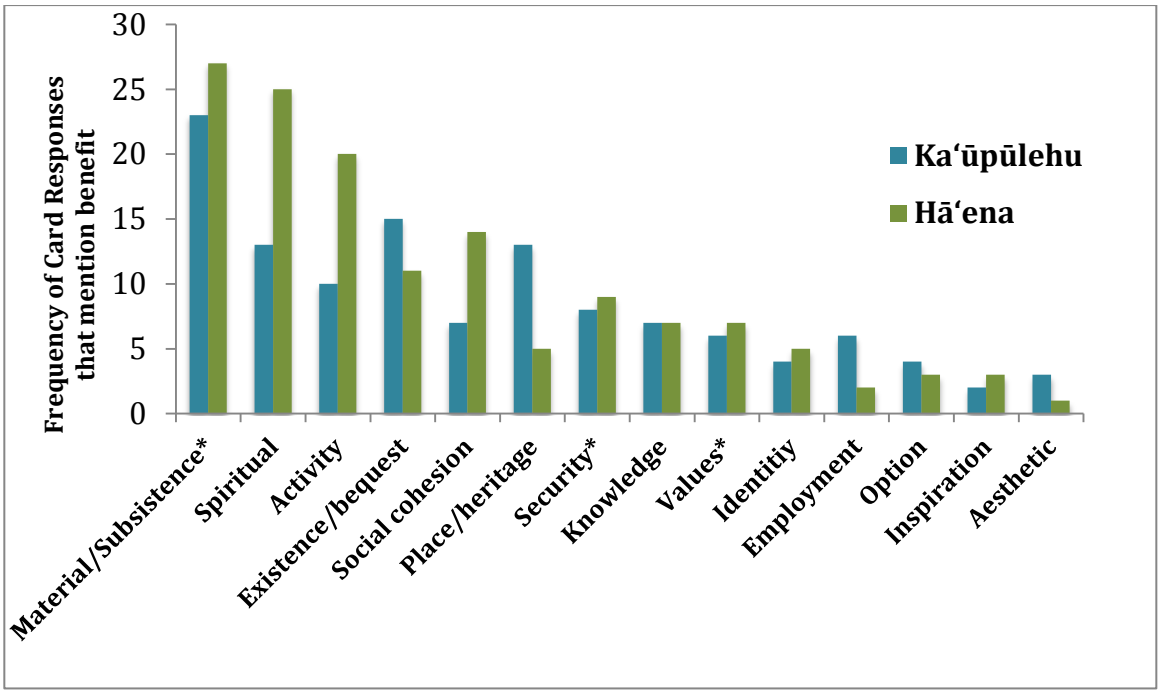

Figure 4. Selective coding of card responses demonstrated the complexities of participant responses, which covered the 12 common CES categories but also included novel/emerging CES categories.

The break-out group activity revealed important CES relating to specific land-use practices and environments (Figure 5). Figure 5 highlights several important points. First, Material/Subsistence, Place/Heritage, and Activity emerged as important CES in both locations, independent of the land-use type. Second, in terms of differences between sites, "Knowledge" was mentioned across all land-uses in Kaʻūpūlehu and not as frequently in Hāʻena, while "Social Cohesion" was mentioned across all land-uses in Hāʻena but did not emerge during the short discussions in Kaʻūpūlehu. However rather than showing these CES to be more important in one location than in the other, this result reveals important insight into the ways communities engage in socio-ecological interactions. For example, in Kaʻūpūlehu, educational collaborations are the main form of community engagement, while in Hāʻena, social cohesion plays an important role in the ways community members are able to care for and derive subsistence from natural resources. The results shown here come from brief one hour activity that may not have allowed

enough time for respondents to create an exhaustive list of all services related to a given land-use. With that in mind, this figure is intended to be a starting point for delving into just a few of the important CES or those that are most threatened by land-use or environmental change (i.e. climate change).

	Kaʻūpūlehu				Hāʻena			
	Native Forest	Pasture	Agriculture	Nearshore/Marine	Native Forest	Pasture	Agriculture	Nearshore/Marine
Material/Subsistence*	✓		✓	✓	✓	✓	✓	✓
Place/Heritage	✓	✓	✓	✓	✓	✓		
Activity	✓	✓		✓	✓	✓	✓	✓
Spiritual	✓	✓	✓		✓			
Inspiration								
Knowledge	✓	✓	✓	✓	✓	✓		✓
Existence, Bequest		✓	✓			✓		
Option		✓						
Social Cohesion					✓	✓	✓	✓
Aesthetic						✓		
Employment	✓					✓		
Identity		✓	✓	✓	✓	✓		

Figure 5. A glimpse into the important CES by land-use as defined by workshop participants. Response time was limited therefore it should be noted that this is not an exhaustive list of all services by land-use/environment in each focal location.

4.2.2 Modifying the framework based on workshop results

The framework developed in this study was originally intended as a novel contribution to CES research, as no comprehensive framework of CES related to a specific location currently exists. The community workshops were originally intended to ground-truth and verify the framework that had been created in the small working group so that the framework could be one stand-alone product. However after the community workshops it became apparent that the framework was just one small component of a more important process to capture and communicate place-based CES. A total of 10 framework iterations were created in the small working group before the community workshops and several revised versions were created and shared with community members following the workshops.

There were a number of ways the workshops contributed to the framework. First, in both workshops, participants stressed the importance of reciprocal socio-ecological interactions that contribute to the production and realization of CES. While this was indeed an initial component of our framework, participant responses made it clear that the idea of reciprocal relationships between people and the places they come from is a cross cutting component that is foundational in every place-based CES we document. Second, open coding of the community workshop results revealed four new emerging CES that were added in to the framework including spiritual practices that allow individuals to interact with and reconnect to spiritual landscapes, existence of/ and appropriate access to storied landscapes, families' roles and occupations and multigenerational presence/interaction with land. Other important changes in the framework that resulted from the workshops included the addition of traditional values and genealogical connections to land in the overarching explanation of CES in Hawai‘i and the inclusion of place-specific examples for each service mentioned in the workshop.

5. Discussion

Here we discuss both the process and outcomes associated with this investigation, outline some of the challenges and solutions encountered, and conclude by describing how this approach can transform resource management in other place-based communities.

5.1 How can we create a process to capture place-based cultural ecosystem services?

CES research is heavily tied to the socio-ecological interactions in a specific location (Darvill and Lindo 2015, Liu and Opdam 2014) and is subject to a particular interpretive lens (Baulcomb et al. 2015) thus knowledge of these intricacies is critical in CES research. Our research used a small-working group of experts and community workshops to demonstrate that a place-based CES can be revealed using participatory methods if the researchers engaged have appropriate connections to the focal biocultural landscape and proceed in a thoughtful and respectful manner when engaging communities in participatory work. The researchers engaged in this work were unique in that cumulatively, they possessed years of experience working with both communities, which provided context and understanding for the social, cultural, historic, economic, and environmental factors that influence cultural services in the region. These existing relationships were critically important as they provided a foundation of rapport and trust between community members and the researchers, and they also informed researchers in guiding CES discussions. As this is not often the norm, we strongly encourage other CES researchers to identify individuals that can provide a comparable level of experience and engage them as paid research assistants, community hires, or other equivalent position.

One important note about the framework is that there are different final versions of the framework intended to inform different audiences. The version published here is for academic audiences so that they might inform their own CES research, the respective communities engaged received versions with examples specific to their place to contribute to their repositories of local knowledge, and the decision-makers like land-owners and resource managers will receive a summarized version that highlights the services at risk of being impacted by the decisions in question. In this sense, there may never be a single commonly accepted framework, as the needs of different audiences will always differ.

5.2 What CES are revealed using this approach and how might those services compare to common CES categories and associated benefits?

This process revealed a number of important findings which enhance and advance our understanding of common CES. First, the snowcard activity results touched upon each of the common CES and expanded that list to include completely novel CES such as Security and Traditional Values. The results also strengthened the argument originally posed by Chan et al. 2011 for including Material/Subsistence as a CES rather than provisioning or supporting ecosystem service. Additional CES emerged from the subsequent open coding process for all workshop notes (interaction with spiritual landscapes, access to and knowledge of storied landscapes, and family roles and occupations), which contributed to the three post-workshop category additions to the preliminary CES conceptual framework. These results suggest that the CES that already exist in the literature are a helpful guide but should not be used as the only criteria in assessing the CES impacted by resource management and land-use planning.

Second, the breakout group activity in the workshop demonstrated the similarities (including material/subsistence, place/heritage, and activity CES) and differences (including knowledge and social cohesion) in CES across different places. This raises an important point about the potential variation in CES across different socio-ecological regions and spatial scales. This suggests that there is much room for expansion in compiling and sharing different types of CES as they relate to different socio-ecological systems.

Third, in highlighting linked and overlapping CES and associated benefits, this process revealed the strong connections between CES and other types of ecosystem services including provisioning and regulating ecosystem services. For example, material/subsistence was our most frequent mention in the snowcard activity, yet as explained earlier, most CES researchers would consider food/water as a provisioning service. As our workshop participants highlighted the paired human practices associated with gathering, sharing, and consuming food/water, they highlighted important CES considerations associated with a provisioning resource. Our results also highlight the necessity of regulating services like climate and water regulation to support cultural practices like planting and sailing, thus strengthening the link between CES and regulating ecosystem services. These results suggest that CES should indeed be considered as equally important as other ecosystem services and that assessments should carefully consider the unintended, yet linked impacts on CES if resource management and land-use planning affect other types of ecosystem services (provisioning, regulating, and supporting).

Last, this process revealed the importance of understanding reciprocal socio-ecological systems in order to fully understand how CES are realized in place-based communities. Reciprocal relationships between people and natural resources emerged in our discussions a number of times, but are not often mentioned in CES research. For instance, the terms "service" and "benefit" were perplexing for some because they suggest a one way flow of experiences from the environment to humans rather than a reciprocal relationship between humans and environment- as is characteristic of many place-based/indigenous value systems. A number of scholars discuss the epistemological divide between the neo-classical economic assumptions in CES research and place-based/indigenous value systems (Adamowicz et al. 1998, Andersen et. al 2012, Bunse et al. 2015, Gould et. al 2015, Venn and Quiggin 2007, Winthrop 2014). Our research team encountered the epistemological clash of values firsthand in both our small working group and

during our community workshops. The ecosystem service terminology was challenging to use at times because it conflicted with the place-based value system recognized in both the small working group and the community workshops. This result suggests that in doing place-based research, researchers should be cognizant of the potential limitations posed by the theoretical, production function assumptions surrounding CES. Failure to recognize the importance of reciprocal relationships may result in a shorter and less accurate list of CES that will be impacted by a given decision.

5.3 What challenges and opportunities are encountered using this integrated approach?

5.3.1 Identifying the community

Baulcomb et al. (2015) note that CES assessments must include a form of verification and ground-truthing to ensure that the benefits and services discussed are indeed meaningful to the sample population. The sample population in our study included rural community members as they possess valuable insight into natural resource management gained from generations of first hand interaction with the surrounding resources. In this study community members were few, yet easily identifiable as both locations had a small core group of individuals who live, work, and or come from the area. At our two focal sites, the community was largely comprised of ancestral descendants, multi-generational residents, and natural resource educators/researchers that work closely with the residents.

5.3.2 Methods of Communication

Communicating with the key participants was a challenge itself. Each community has its preferred method of communication, which may be extremely difficult to ascertain without previous experience in that community. In Kaʻūpūlehu, we were fortunate to have a community partner hired through the university. This individual was an essential member of our research team, particularly because both of our study sites were off-island (not located on our island of residence). Most of the Kaʻūpūlehu community was responsive to email communication. Others could be more easily contacted by phone or via text message and some were most attentive to face-to-face reminders. Because our team committed to allowing community members to review all the materials we produced before the documents were sent out to broader audiences, it was important to maintain open communication. In Hāʻena, most of our communication took place through word of mouth, which made it challenging for our research team to identify and recruit participants. We looked to the few community contacts we already had to contact others via email, text message, and face-to-face interactions. In Hawaiʻi, these communication considerations are of utmost importance when working with local communities as they ultimately influence both trust and researcher reputation. The key takeaway for communication is to be cognizant and respectful of established communication norms for the respective community.

5.3.3 Commitment to Community-researcher Relationship

As mentioned earlier, our research team was somewhat unique in that many had years of experience working with the communities we engaged through this project. Yet the specific steps we took to maintain this relationship should be a common practice in research within any community. For instance, our research team recognized the importance of returning our results back to the community not only as a written report but also as a face-to-face presentation.

Budget was set aside from the beginning to ensure that our team would be able to return to the focal communities to present our findings. These in person presentations allowed community members to provide final approval of the accuracy of information and to determine what information could be shared with broader audiences. It also allowed them to see the products they helped to produce.

5.3.4 Defining Scale

Ecosystem service assessments should define their spatial scale according to the boundaries most relevant to their focal process (Millennium Ecosystem Assessment 2003). In this place-based approach it was difficult to match bio-geographic boundaries with social scales of resource use, which becomes problematic when looking at paired human-environmental interactions. For example, on Hawai‘i Island our study was meant to focus on the ahupua‘a of Ka‘ūpūlehu, however the bio-geographic characteristics of the area meant that the kalana (larger traditional land division) of Kekaha was more relevant to the types of questions we asked. The same can be said of Hā‘ena ahupua‘a and the relevancy of the larger Halele‘a moku (larger social division). In response, we were flexible with what we included in our framework however we included ahupua‘a specific examples of benefits when possible. These issues of scale are best solved with input from knowledgeable community members.

5.3.5 Setting Clear Expectations

The communities engaged through this project were unique in that both have experience with a variety of natural resource management projects. As we talked to the community about various land-use types and the intent of this study to inform sustainable land-use planning, we needed to be cognizant of our role as researchers and not as decision-makers. We made it clear that our objective was to provide information for resource management decisions but that ultimately the onus lay with decision-makers to incorporate that information. Although we needed to be transparent about realistic expectations, we were able to confidently commit to a thorough community review process for all materials that we created. Community members were provided with a workshop summary, preliminary results, and a final draft of all materials to be published to provide comments and revisions. They were also able to provide final feedback at the in-person presentations. This ensured that the information we compiled was accurate and appropriate for sharing with broader audiences including academics, resource managers, and decision-makers.

5.3.6 Workshop Duration and Participant Fatigue

As mentioned earlier, the communities engaged through this project are heavily engaged in natural resource management projects with the government, non-government organizations, conservation organizations, and universities. With this in mind, we determined that our workshop should be no longer than one day in length and that the workshop scheduling would need to take place on a date that best accommodated community members. While the time constraint and limited timeframe for scheduling did make it difficult on our end, considerations like these are of highest importance when working with communities in Hawai‘i. We worked with the information we could gather in the short time allocated, while recognizing that the time constraint may have limited the depth of conversations and the resulting information that emerged. Follow-up discussions were scheduled as necessary and helped to provide clarification and additional information.

5.3.7 Eliciting Trade-offs

The standard approach to ecosystem service research attempts to elicit trade-offs in service production as a result of threats to those services including land-use change, environmental degradation, and climate change (Chan et al. 2011). One initial objective of our project was therefore to determine what CES might be traded or lost with land-use changes. However after initially proposing the idea to respondents, it quickly became apparent that identifying trade-offs might not be possible. This is consistent with other studies that found that trade-offs can be challenging to elicit when services are interconnected (Baulcomb et al. 2015) and when respondents do not recognize ownership of natural resources (Adamowicz et al. 1998). As mentioned earlier, the economic assumptions surrounding CES valuation suggest that one service might be substituted for another, however we see in practice that some services are so sacred that they cannot be substituted. For example, the opening genealogical chant shared at the Kaʻūpūlehu workshop spoke about Hāloa, the common ancestor of all Native Hawaiians and the younger sibling of the *kalo* (taro). As the older sibling of the Hawaiian people, environmental kinship with the taro plant is a CES that cannot be substituted. In addition to the consideration of sacred values, workshop respondents brought up the site-specific nature of each service/benefit by stating that some benefits could not be traded as the bio-geographic conditions of the area would not allow for it. One example from our Kaʻūpūlehu follow-up discussions is the limitations of commercial cultivation of orchard crops (without irrigation infrastructure) in lands historically used for ranching. However, our workshops did reveal specific instances when communities demonstrated adaptability and nimbleness resulting in enduring and resilient socio-ecological systems. For example in Hāʻena, pasture lands were converted to resorts and vacation homes as tourism became the primary economy, thus community members shifted subsistence practices away from ranching and increased their fishing efforts to be able to provide for their households. While not necessarily considered a trade-off, the concepts of adaptability and resilience are key considerations in examining how land-use or climate change will impact CES.

5.3.8 Navigating Use of Native Hawaiian Cultural Terminology

After a number of back and forth discussions, our team decided to selectively incorporate Native Hawaiian terms and concepts for services and benefits with the caveat that in order for this framework to be accurately applied in natural resource management, these services must be interpreted by respected ancestral descendants or multi-generational residents. This ensures that both Native Hawaiian terms and larger concepts are defined with respect to place-based, practitioner knowledge. Raymond et al (2013) note that if the goal is to engage diverse groups, the language must be adequate for decision-makers but must also remain relevant in their respective social settings. Umemoto (2001) notes that these language considerations are an important determinant of continued participation or withdrawal from resource management processes, thus future research must be cognizant of the appropriate use of ecosystem service terminology with respect to given audiences.

5.4 How can this process improve resource management in other place-based communities?

A number of CES papers have stressed the importance of understanding CES at regionally appropriate scales rather than resorting to large-scale aggregations of information (Adamowicz et al. 1998, Darvill and Lindo 2015, Liu and Opdam 2014, Raymond et al. 2013). While some of the examples included in the framework are community-specific, the categories and benefits are

aggregated in a way that the framework can be used in place-based communities across Hawai‘i. More broadly, the framework may also be relevant in place-based and indigenous communities throughout the globe. The services and benefits presented in our framework share similarities with key cultural socio-ecological interactions affected by natural resource management in other place-based indigenous communities. For example, 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 Tierney 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.

6. Conclusion

Participatory methods that engage subject matter experts contribute to improving CES research (Baulcomb et al. 2015, Bunse et al. 2015, Lo and Spash 2012, Raymond et al. 2014, Winthrop 2014). This study builds upon those methods and demonstrates important contributions to the current approaches in CES research. Through this research we present a process that utilizes a regionally appropriate scale (in our case, moku *and* kalana land divisions in Hawai‘i). We also present new overarching CES categories that could apply in ecosystem service assessments in other place-based and indigenous communities (like knowledge, spiritual landscapes, social cohesion, and physical and mental wellness). 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. Lastly, we present a process that we hope will encourage both budding and established researchers to engage local experts in accurately and appropriately identifying place-based CES.

The Hawai‘i-based CES framework presented here makes important cultural values and their paired customary and contemporary practices visible so that they can be considered by resource managers and decision-makers. While the framework itself is valuable, the approach and process in which the framework was developed is an equally important product from this research. In order for this framework to be accurately used in decision-making it cannot be taken out of context, and needs to be interpreted by culturally knowledgeable kama‘āina or kama‘āina of Hawai‘i. The process, however, could be applied in similar place-based/indigenous communities throughout the globe. Our team hopes that by documenting this process, we will empower other researchers to implement or, at minimum, consider similar approaches that engage community/cultural groups when conducting CES research.

While CES are one of four main categories of ecosystem services, there is far less documentation of CES due to the factors we describe throughout this study. Yet CES are tremendously important to identify and consider in resource management and land-use planning because of their strong ties to human dimensions like wellbeing and quality of life. This novel interdisciplinary, mixed methods approach provides concrete recommendations for overcoming

obstacles that have impeded other CES researchers in assessing CES, while explaining the challenges and opportunities encountered in this process. Ultimately we hope that this process can make these otherwise illusive sociocultural considerations visible when they need to be and considered equally with other types of ecosystem services in natural resource management and land-use decision-making.

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8. Appendices

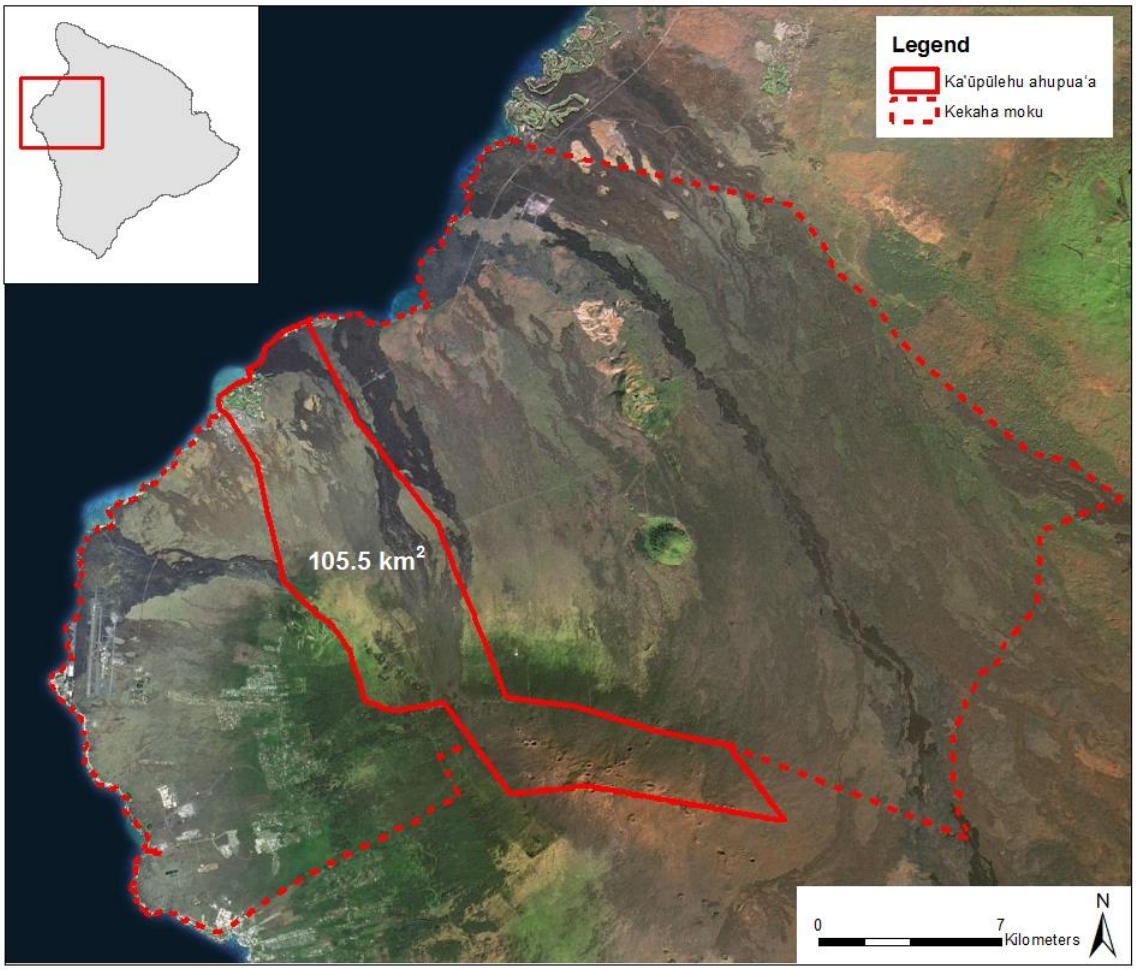

Figure 6. Enlarged map of Kaʻūpūlehu, Hawaiʻi Island.

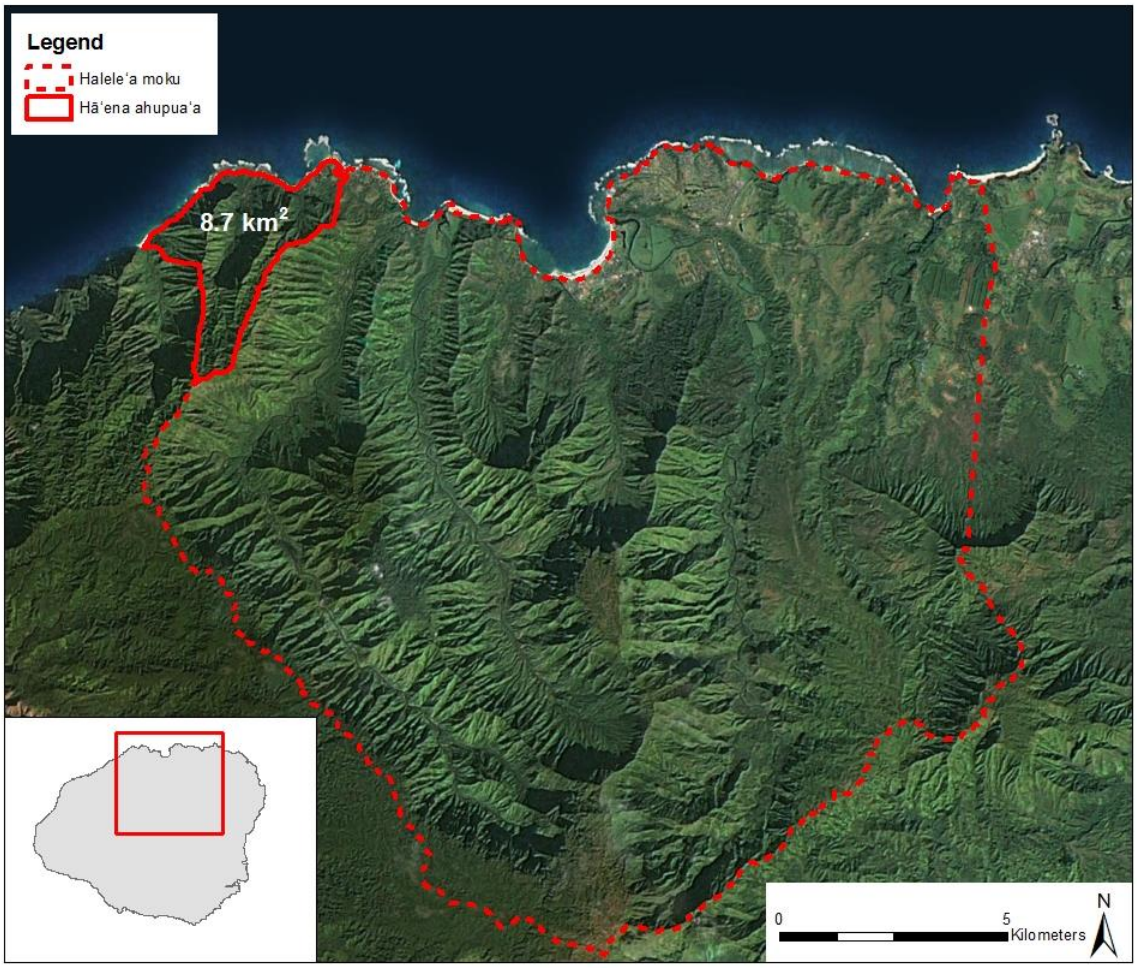

Figure 7. Enlarged map of Hā‘ena, Kaua‘i.