Reconnecting with the past and anticipating the future: A review of fisheries-derived cultural ecosystem services in pre-Hispanic Peru

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Abstract

1. Marine ecosystems play a key role in human wellbeing, particularly in the Global South through small-scale fisheries (SSF). While many have speculated that such activities are central to the provision of cultural benefits (such as cultural identity and heritage values), there are key information gaps regarding SSF cultural contributions to societies and their historical importance.

2. In this paper, we sought to identify and characterize the historical cultural benefits derived from SSF in Peru and their transformative role for early societies’ development.

3. We carried out an extensive review of archaeological literature focusing on early coastal Peruvian settlements, cultures and civilizations (i.e. pre-Hispanic period: 13,000 BCE–1532 CE).

4. Our results suggest that the interaction between coastal dwellers and marine ecosystems in Peru is ancient, reciprocal and dynamic. These interactions were crucial for social transformation in Peru across millennia. Through fisheries, the first coastal Peruvians enjoyed multiple cultural benefits that entail a range of experiences, identities and beliefs. These benefits were susceptible to social and environmental changes, while the same benefits allowed early dwellers to gain more capabilities to evolve socially and to shape their environment.

5. Understanding the evolving interaction between environmental spaces and cultural practices may provide valuable insights for improving current and future marine resources and seascape management.

6. Through this paper, we call for a reflection on the past, present and future of SSF, and their valuable role within society. Based on ample evidence we conclude that SSF are not only a food-producing activity, but also a highly important cultural practice for coastal Peruvians.

KEYWORDS
archaeology, cultural benefits, cultural ecosystem services, marine ecosystems, pre-colonial Peru, pre-Hispanic Peru, small-scale fisheries
INTRODUCTION

We are currently living in a period of crisis, when the overexploitation of natural resources and structural inequality pose serious threats to the survival and well-being of all non-humans and human beings (IPBES, 2019). This global scenario, is having profound effects on ecosystems’ health and integrity, but also has the potential to affect how we relate and value nature (Chan et al., 2020). By losing ecosystems and biodiversity we are losing critical opportunities for sustaining reciprocal and dynamic relationships with nature, which in turn compromises our commitment to keep and protect such relationships (Chan & Satterfield, 2016; Chan et al., 2012; Plieninger et al., 2014).

Marine ecosystems have been fundamental for the wellbeing, survival and progress of humans and societies since the origin of humanity (Bailey, 2004). These ecosystems are still vital to many coastal countries’ economies, identities and food security; particularly for those in the Global South (Chuenpagdee & Jentoft, 2019; United Nations, 2017). Nonetheless, anthropogenic misuse is globally threatening these environments, by practices such as fisheries overexploitation, coastal urbanization and marine pollution, which in turn lead to the degradation of ecosystem services (Martin et al., 2016). These threats also jeopardize the cultural ecosystem services (CES) that arise from our relationships with marine and coastal ecosystems.

Cultural ecosystem services are defined as ecosystems’ contribution to the nonmaterial benefits (e.g. experiences and capabilities) that people derive from human–ecological relationships (Chan et al., 2011; Chan, Satterfield, et al., 2012). Examples of CES include heritage value, cultural identity, aesthetic, spiritual and recreational experiences (Daniel et al., 2012). However, most of what we know regarding CES is limited to terrestrial ecosystems in Europe and North America, and chronologically to the most recent past decades (Martin et al., 2016; Ruiz-Frau et al., 2013). This leaves critical information gaps for understanding CES in Global South nations and how these human–nature relationships have changed through time, particularly within the marine and coastal context (Martin et al., 2016).

Cultural ecosystem services studies tend to focus on people’s current relationships with nature (by current we mean ongoing relationships at the time of the study), overlooking historical and long-term interactions (Hernández-Morcillo et al., 2013; Martin et al., 2016; Milcu et al., 2013). Past relationships between people and nature may be explored in other literature, such as anthropology and geography, however that literature has not been used for deepening our understanding of how our relationships with nature have changed throughout time and how those changes affect what we deem appropriate of such interactions. Moreover, a long-term perspective of human–nature relationships may allow us to better comprehend long-term environmental cycles and socio-ecological processes (Chan, Guerry, et al., 2012; Jackson et al., 2001; Pauly, 1995).

Within this context, this paper aims to showcase the transformative role of fisheries for early coastal dwellers in Peru; highlighting how this activity allowed for the development of dynamic and reciprocal relationships between humans and marine and coastal ecosystems. Our main focus is the pre-Hispanic period, which starts around 13,000 BCE (first evidence of humans in the Peruvian coast) until 1532 CE (year of the Spanish conquest of Peru).

Peru is a fascinating case-study for exploring CES derived from marine and coastal ecosystems through a historical lens. Peru is home to one of the six oldest civilizations in the world (i.e. Caral–Supe also known as ‘Norte Chico’ civilization; Shady et al., 2001). However, unlike other core civilizations that grew primarily based on agriculture (e.g. Mesopotamia or Indus Valley), fisheries played a key part in the early flourishing of the Andean civilizations (Moseley, 1992; Moseley & Willey, 1973; Rostworowski, 2005; Sandweiss, 2009). Consequently, traditional or small-scale fisheries (SSF) gain a new dimension of importance, tightly linked to peoples’ identities, traditions and heritage values (Smith et al., 2009).

Currently, fisheries are still of vital importance for Peru. This country is the world’s second largest fishing nation based on total landings (industrial and SSF combined; FAO, 2020); more than half of the Peruvian population lives in coastal regions; and seafood plays an essential role in the economy, food security and identity of coastal Peruvians (Christensen et al., 2014; López De La Lama et al., 2018; Matta, 2014). When comparing industrial and SSF are the main providers of seafood for direct human consumption along the Peruvian coast and they generate most job opportunities (Christensen et al., 2014; Palacios-Abrantes et al., 2018). Unfortunately, due to the magnitude of industrial landings and their national economic importance (mainly focused on fishmeal production for exportation based on anchovies—Engraulis ringens), SSF have not been politically nor socially prioritized (De La Puente et al., 2020; McKinley et al., 2018). Thus, SSF are presently subject to mismanagement and overexploitation, while their fishers are growing into poverty (De La Puente et al., 2020). By exploring the deeply rooted and historical relationships coastal Peruvians have with marine and coastal ecosystems, we hope to contribute to a revaluation of SSF’s overall importance: not only regarding SSF as a food-producing activity, but also as a way of life derived from our ancient relationships with the sea that needs active protection (Acheson, 1981; Chuenpagdee & Jentoft, 2019).

METHODS

2.1 Framework

In the ecosystem services literature, there is agreement on a cascade logic as a pathway for illustrating the delivering of ecosystem services (Haines-Young & Potschin, 2010). This pathway shows how ecosystem services are generated by biophysical structures and ecosystem functions, which then produce benefits (valued goods and experiences) for people (Potschin & Haines-Young, 2016). In turn, based on perceptions and experiences, people assign value to those benefits (i.e. the degree of importance people attach to benefits). This cascade showcases how ES are the link between ecosystem
functions and human well-being (de Groot et al., 2010; Potschin & Haines-Young, 2016).

However, CES may not align well with the linearity of the cascade logic (Pröpper & Haupts, 2014). Unlike other ES, CES are co-produced and co-created by peoples’ relationships with their environmental settings (Chan et al., 2011). Thus, they should not be seen as a separate category of services (Chan, Satterfield, et al., 2012; Klain et al., 2014), rather as a dynamic lens through which cultural meaning is derived from ecosystems (Chan, Guerry, et al., 2012; Pröpper & Haupts, 2014). The unique role of culture within ecosystem services led to the framework of ‘nature’s contributions to people’ (NCP), which recognizes the key and prevalent role that culture plays in shaping all links between people and nature (Díaz et al., 2018).

Due to the intangibility and intertwined aspects of the nonmaterial contributions of nature (or CES) to people, their valuation is not best suited through the mainstream economic appraisal methods used for ES (Pröpper & Haupts, 2014; Satterfield et al., 2013). This is particularly relevant in terms of heritage and identity, as they are not the end goals of such relationships (Chan et al., 2016). Therefore, it is also important to consider relational values alongside instrumental and intrinsic values when evaluating CES (Chan et al., 2016).

Relational values, defined as the preferences, principles and virtues about human–nature relationships (Chan et al., 2018), help to explain the contributions of ecosystems and human activities beyond the scope of CES. As relational values do not focus on cultural values as the end product of peoples’ relationship with their environment, rather focus on their dynamism and reciprocity, they allow us to explore the transformative potential of such relationships. Hence, a relational approach acknowledges that CES can be transformative to culture at societal scales, which changes the way in which cultural meaning itself is derived from ecosystems (Chan & Satterfield, 2016; Pröpper & Haupts, 2014).

Within this context, we have decided to follow Fish and colleague’s framework, which approaches CES as relational and nonlinear (Fish et al., 2016). This framework aligns with the cascade logic, by contributing with knowledge that can populate and discern the links between the underpinning natural capital and human welfare (Fish et al., 2016; Potschin & Haines-Young, 2016). Yet, this framework accepts the co-production and reciprocity of culture–nature relationships and postulates that an understanding of CES can reflect and create a wider set of cultural values, making explicit the different feedback loops between services, benefits and values (Fish et al., 2016).

In this framework, environmental spaces (i.e. places in which people interact with each other and the natural environment) and cultural practices (i.e. expressive, symbolic and interpretive interactions between people and natural environment) are mutually reinforcing CES through which cultural benefits (i.e. dimensions of human well-being that can be associated with the interactions between nature and people) contribute to well-being. In addition, this framework categorizes cultural benefits as: (a) the capabilities they help equip–ecological phenomena play a crucial role in shaping individual and social capacities for understanding and doing things, such as knowledge acquisition and development of skills; (b) the identities they help frame–ecosystems are full of cultural meanings through which people understand themselves and their relationship with the world around them; and (c) the experiences they help enable–interactions with nature resulting in mental and physical benefits for people. By adopting this framework, researchers and decision-makers may be better equipped to understand the cultural significance of ecosystems for people (Fish et al., 2016).

This framework suits our aim to assess the dynamism and evolution of coastal Peruvians’ relationships with marine and coastal ecosystems along 15,000 years of interactions. Here we explore how the exchanges between different environmental spaces and cultural practices (mainly fisheries) allowed early dwellers to improve and master the different cultural benefits they gained from such relationships. We also highlight how such relationships were affected by social and environmental phenomena, which in turn also affected peoples’ cultural benefits and values. Thus, allowing us to explore the transformative potential of SSF through a historical lens.

### 2.2 Literature review

To identify historical CES, we conducted an extensive literature review focused on early coastal Peruvian settlements and cultures as well as on ancient and traditional fishing practices (Figure 1). For that, we have limited our scope to when humans first appeared on the Peruvian coast (around 13,000 BCE) up until the Spanish colonization (1532 CE). We concentrated our efforts mainly on archaeological data, as this discipline can provide critical insights into the transformation of socio-ecological systems across time, shedding light into different aspects of early communities’ lifestyles (Flatman, 2009; Leeuw & Redman, 2002; Moleón et al., 2014; Wing & Wing, 2001). Although there are some limitations with archaeological data (e.g. not all archaeological sites have the same quantity and quality of information, or some sites are prioritized by researchers and governments over others), we consider it as appropriate for our specific purpose of broadly illustrating how early Peruvians interacted with marine and coastal ecosystems. Nonetheless, this is by no means a comprehensive review of such interactions. For a comprehensive characterization of the interactions between pre-Hispanic Peruvians and marine and coastal ecosystems, see Prieto (2013) and Rostworowski (2014).

Literature was identified by searching the following keywords in Web of Knowledge, JSTOR and Google Scholar: ‘cultural ecosystem services’, ‘marine ecosystem services’, ‘coastal settlements’, ‘early civilizations’, ‘Peru’, ‘pre-Hispanic fisheries’ and ‘pre-Columbian fisheries’. In total, 179 scientific articles, both in English and Spanish, were identified. After reviewing their abstracts, 129 articles (73 in English and 56 in Spanish) were included in this study. A list of data sources used in the study are provided in the Data Sources section. These articles were selected as they presented and discussed findings regarding fishing and sailing, seafood remains and artistic
expressions inspired in marine resources and ecosystems (e.g. ceramics with seabirds, walls painted with marine deities).

Papers were analysed qualitatively, through an inductive approach (Creswell, 2007). Hence, we used an inductive logic, studying the topic within its context and using an emerging design (Creswell, 2007). Throughout the literature review, we employed descriptive coding to document and categorize our findings, reviewing our codes multiple times throughout the process (Saldana, 2016). Then, based on the Fish et al., (2016) framework, we identified three broad themes and organized our eleven codes as follows: (a) **Environmental spaces**, with ‘different types of habitats’ and ‘climatic events’ codes; (b) **cultural practices**, with ‘fishing gears’ and ‘type of practices’ codes and (c) **cultural benefits**, with ‘traditional ecological knowledge’, ‘skills regarding seafood processing’, ‘skills regarding sailing’, ‘fishers’ identity’, ‘myths and rituals’, ‘artistic inspiration’ and ‘spirituality and religion’ codes. All results were organized chronologically, and coding was conducted in ATLAS.ti.

**3 | FINDINGS**

In this section we present our main findings based on the qualitative analysis of the reviewed archaeological literature. These are organized according to Fish et al. (2016) framework (i.e. environmental spaces, cultural practices and cultural benefits), paying particular attention to the changes and progress of ancient and traditional fisheries. Out of the 129 reviewed articles, 9% were coded exclusively for environmental spaces, 15% for cultural practices and 23% for cultural benefits; 18% were coded for both environmental spaces and cultural practices, 16% for cultural practices and cultural benefits.
and 8% for environmental spaces and cultural benefits. The final 10% were coded for all three themes.

### 3.1 | Environmental spaces

Marine ecosystems along the Peruvian coast have experienced multiple environmental changes over the past few millennia. These changes pertain to sea-level stabilization, ecosystem productivity and frequency of El Niño events (Contreras, 2010; Fehren-Schmitz et al., 2014; Haas & Creamer, 2006; Salvatetti et al., 2019; Sandweiss et al., 2020; Figure 2). Despite these changes, coastal settlements of early Peruvians can be found throughout the late Pleistocene until the Spanish conquest (1532 CE), with variations in size, complexity and location (Rostworowski, 2005; Sandweiss, 2009; Yesner, 1980). The quasi-permanent (i.e. seasonal patterns) coastal occupation by early Peruvians is due to their capacity to supply their needs by using resources from multiple coastal ecosystems, complementing those provided by marine environments when ocean conditions were unfavourable (Jessup, 1990; Llagostera, 1992; Sandweiss & Reid, 2016; Yesner, 1980; Zaro, 2007).

During the pre-Hispanic period, coastal Peruvians used rocky shorelines, sandy beaches, coastal cliffs, the intertidal zone, the water column, the open ocean, the benthic areas over the continental shelf, Lomas, mangroves, saltmarshes, wetlands, coastal valleys, lagoons and dry forests, among others (Dillehay et al., 2017; Rostworowski, 2005, 2014). Lomas were essential sources of water and animal protein during this period (Engel, 1973). They are seasonal botanical complexes that thrive for 4–5 months per year, capturing water from fog, on some extremely arid occidental-facing slopes of the lower Andean ridges (Engel, 1973).

It is worth noting that coastal and highland ecosystems were not isolated. Trade fuelled the process of cultural evolution that took place along the Peruvian coastline by connecting marine, coastal and more elevated terrestrial ecosystems (DeFrance, 2016; Zaro, 2007).

### 3.2 | Cultural practices

Interactions between marine and coastal ecosystems and Peruvians have yielded marine cultural practices for at least 14,000 years (Dillehay, 1992; Sandweiss, 2009). These cultural practices first emerged from the most basic interaction between humans and the ocean: food procurement (Jacquet, 2009). These activities include gathering, hunting, fishing, diving, sailing, processing and trading marine resources (i.e. fish, invertebrates, algae, sea birds and marine mammals). Activities were linked to the different habitats occupied by early dwellers. For example, hook and line fishing was practiced from cliffs before fishing vessels were available, or seafood preservation using salt extracted from coastal marshes made trade possible in some sites before others. Due to the importance of fishing as the first step for building the human–nature relationship, we explore the evolution of fisheries throughout pre-Hispanic times (Figure 3).

### 3.3 | Evolution of fisheries

The oldest evidence of primitive fishing has been found in Huaca Prieta, a coastal site that dates back to 13,000 BCE (Dillehay et al., 2017). Here, early coastal dwellers ventured in shallow waters and estuarine environments, using reed baskets and traps to catch fish (Reitz, 1988). These methods were efficient enough to satisfy the nutritional needs of scarce and low-density coastal settlements (Dillehay et al., 2012, 2017). Early dwellers complemented fishing with shellfish gathering along beaches. The latter being a very accessible activity with minimum required energy input that provided a reliable and nutritious staple (Quilter, 1992; Yesner, 1980).

Shellfish gathering was vital for multiple early settlements along the Peruvian coast (Llagostera, 1992). For example, food remains and the extensive shell midden of macha clams Mesodesma donacium found in the terminal Pleistocene settlement of Quebrada Jaguay (11,000–6,000 BCE), show that diets changed very little over 5,000 years (Reitz et al., 2015; Sandweiss et al., 1999). In this settlement there is also

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**FIGURE 2** Key environmental and social events that shaped pre-Hispanic Peruvian history
evidence for a fishery specializing in drums (Sciaenidae), where the reconstructed size of fish hints the use of nets for their capture, however not found on site (Sandweiss et al., 1998). This site is presumed to have been a seasonal base camp occupied by coastal nomads, mostly during austral summers (Sandweiss et al., 1998).

The use of fishhooks marks the start of a new fishing era, moving past primary seafood collection and gaining access to deeper environments and thus a more extensive diversity of marine resources (Llagostera, 1992). In El Anillo (10,850–5,500 BCE), a residential base camp with long-term occupation, virtually all animal protein originated from sea. Seafood was primarily caught by ‘hook and line’ (Reitz et al., 2015; Sandweiss et al., 1989). Archaeologists identified over 20 fish species at this site. Still, remains of Lorna Sciaena deliciosa and Corvina Cilus gilberti—two medium demersal fish—were the most frequently found (Reitz et al., 2015, 2016).

Nonetheless, early Peruvians also took advantage of marine resources on land. In Quebrada Tacahuay (~10,700–2,300 BCE), there was a temporary settlement where early Peruvians would hunt, process and eat seabirds (deFrance & Umire, 2004; Keefer et al., 1998). Seabirds, such as cormorants Phalacrocorax bouganvilli, were likely caught with flying nets (DeFrance, 2005; DeFrance et al., 2001). The use of fishing nets is further confirmed by the abundant anchoveta E. ringens vertebrae remains. Anchoveta is a small schooling pelagic fish, currently caught with seine nets, and highly unlikely caught by hand lines or traps in the past (deFrance et al., 2001; Quilter et al., 1991).

Beyond fishing with hooks and lines or nets, early coastal Peruvians were also skilled divers. In Huaca Prieta a 9,000-year old human male skeleton was uncovered, showing evidence of external auditory osteomas, an abnormal growth of bone around the ears, which tends to occur when people are exposed to high pressure during diving (Wise et al., 1994). In La Paloma, a settlement located in the Chica Valley, multiple skeletons with similar conditions were found (~5,200–2,800 BCE; Quilter & Stocker, 1983; Reitz, 1988). The high incidence of external auditory osteomas together with significant shellfish remains found in these sites, suggests that diving was part of people’s life, gaining access to abundant invertebrate species found in deeper environments (Wise et al., 1994).

However, floating nets were the most significant technological advancement for fishing communities in the preceramic Peruvian economy (12,000–1,800 BCE; Moseley, 1992; Moseley & Willey, 1973). These nets increased their productivity substantially. An increase in species diversity and individual fish sizes is registered on archaeological records when fishing nets started to be used (Béarez, 2000). However, the widespread use of cotton around 3,100–2,900 BCE contributed to advancing fisheries culture (Prieto, 2014). The production of cotton was particularly crucial for lighter and more resistant fishing nets, complemented with the cultivation and use of gourds for fishing floats (Dillehay, et al., 2012). This critical technological development occurred in the Norte Chico area of Peru. The increased fisheries yield of highly nutritious small pelagic fish—anchoveta and sardine (Sardinops sagax)—led to a surplus of food. This surplus led to a significant increase in population density, and the development of a complex and non-egalitarian society, with labour specialization between fisheries and agriculture (Dillehay, 1992; Haas & Creamer, 2006; Moseley, 1992; Prieto, 2013; Wells & Noller, 1999). Thus, the extensive use of floating nets facilitated the emergence of the Andean Civilizations (Dillehay, 1992; Solis, 2006).

The Norte Chico was the main area for cultural evolution in the Andes until 1,800 BCE when a mega El Niño event took place (Sandweiss et al., 2009). This event weakened the Norte Chico civilization, while larger polities started to emerge to the south and the north (Chu, 2006; Haas et al., 2004). Nonetheless, the primary
3.4 | Cultural benefits

As we explore the relationship between ancient people and marine ecosystems, we can only make inferences about these ecosystems’ contributions to society through archaeological evidence found to date. Here we present the following cultural contributions to early Peruvian societies, sorting them by capabilities, identities and experiences.

3.5 | Capabilities

3.5.1 | Development of traditional knowledge systems for fisheries

Early coastal Peruvians experienced a cumulative learning process regarding the extraction of marine natural resources (Csirke, 2013). The evolution of this traditional knowledge system (from early seafood gathering and coastal gleaning to the development of ‘hook and line’ fishing, and then to cotton nets with floats) took roughly 10,000 years. The resulting technological innovations around fisheries produced a surplus of seafood along the coast, where the sea guaranteed food security, access to sufficient quantities of good quality food (FAO, 2006), for coastal communities. Seafood was fundamental for Peruvians in such settlements, due to its high nutritional value, abundance, widespread distribution and resilience to environmental dynamics (DeFrance, 2005; Moseley, 1992; Salvatteci et al., 2016; Sandweiss, 2009). Seafood surplus allowed coastal dwellers to develop complementary traditional knowledge systems on land, such as new cooking practices, seafood processing and storage techniques and eventually trade with distant Andean communities (DeFrance, 2016).

3.5.2 | Skills regarding seafood processing

Seafood processing became a critical cultural practice for coastal people in Peru as a result of the surpluses they achieved through the advancement of their fishing capabilities. For example, there is evidence of fishmeal production in La Paloma (5,200–2,800 BCE; Quilter & Stocker, 1983). The labour-intensity of this practice and a large number of fishmeal storage pits (over 500) found on site highlight the importance of fish transformation and storage for later consumption at the time (Benfer et al., 2014; Quilter & Stocker, 1983; Reitz, 1988). More recent examples of seafood processing have been found in Cerro Azul (1,100–1,470 CE), where evidence of fish drying in sand-filled storage rooms (mainly anchoveta and sardine) has been extensively documented (Marcus, 1987; Marcus et al., 1999). Also, in San Gerónimo, where the Chiribaya people once lived (700–1,476 CE), there is evidence that they would dry and smoke fish in circular sand-filled rock enclosures (Reitz et al., 2016; Zaro, 2007).

3.5.3 | Skills regarding sailing

Different types of vessels were eventually crafted to gain access to offshore marine resources and continue increasing fisheries’ productivity (Rostworowski, 2005; Yesner, 1980). The first evidence of rafts, made of reed, has been found in Gramalote (1,550–1,250 CE; Prieto, 2013, 2016). These one-person rafts were probably used for fishing blue sharks Prionace glauca, which accounted for 50% of the seafood remains found on site (Prieto, 2013). Reed rafts continued to evolve into larger, more complex structures (Prieto, 2016; Sandweiss & Reid, 2016). Large wooden rafts were especially crucial for long-distance maritime trade in the 600 CE to 1,500 CE (Prieto, 2013). These could transport heavy loads and more crew members (Rostworowski, 2005). The Chimu Empire (900–1,470 CE) improved their navigation skills, connecting northern and southern communities along the coastal Peruvian desert (Flores-Galindo, 1981; Rostworowski, 2005). The ocean thus became a route for communication, exchange and migration, allowing for social integration and development (Bailey, 2004). The evolution and improvement of the practice of fishing enabled the growth of additional capabilities related to marine travel and navigation, which then enabled much more. Hence this is a clear example where incremental gains in boat technology and navigation skills were largely driven by the needs of fishing.

3.6 | Identities

3.6.1 | Fishers’ identity

The development of cotton nets—and the food surpluses they enabled—led to labour specialization (Prieto, 2014; Shady, 2002). Fishers invested most of their time fishing, increasing their dependence on inland farmers for cotton and gourds—the raw materials for elaborating their fishing gear (Rostworowski, 1970, 2005). Labour division is a distinctive feature of innovative complex societies as evidence of cooperation, coordination and decentralized roles (Richerson & Boyd, 1999). From 1,800 BCE onwards, labour division was a constant feature of coastal societies, expanding it to agriculture, commerce and other specializations (Zaro, 2007). Historians recording the Spanish conquest describe the outcome of this division in detail, highlighting that by the time Spaniards arrived in Peru, coastal fishers and inland valley dwellers (i.e. farmers) had very distinct cultural practices, dialects and ways of living (Rostworowski, 2005). These cultural practices and the resulting cultural diversity can be traced largely—albeit sometimes indirectly—to marine CES.
3.6.2 | Myths and rituals

Marine-themed myths and rituals denote the importance of the ocean for spiritual purposes in Peruvian coastal societies (Prieto, 2014; Rostworowski, 2005). Some examples of these include:

- **Mullu**: The spiny oysters *Spondylus calcifer* and *Spondylus princeps*, or ‘Mullu’ in Quechua, were one of the most valuable possessions during pre-Hispanic times and even during the beginning of colonial times (Bauer, 2007; Rostworowski, 1970; Figure 4). This tropical bivalve mollusk was not present in Peru but rather imported from Ecuador at least since 3,000 years BCE (Davidson, 1980; Stahl, 2003). Registers of *mullu* are rare until 600 CE. It was the Chimu Empire that developed a maritime commercial network around it, building a complex system for its management, import and distribution within Peru (Hocquenghem, 1993; Pillsbury, 1996; Sandweiss & Reid, 2016). Coastal cultures believed that *mullu* had supernatural powers over the weather and was used in rituals to predict El Niño events (López Cuevas, 2005; Pillsbury, 1996).

- **Sharks**: Considered marine deities in multiple sites and cultures along the Peruvian coast. In Huaca Pucllana is where the best example of their ‘sacredness’ can be found (200–700 CE; Altamirano-Sierra & Vargas-Nalvarte, 2014; Prieto, 2014). Here shark meat consumption was limited for festive banquets associated with human sacrifices (Altamirano-Sierra & Vargas-Nalvarte, 2014; Apolín & Vargas-Nalvarte, 2006). Archaeologists speculate that shark fishing was reserved only for special occasions in Huaca Pucllana (Apolín & Vargas-Nalvarte, 2006; Prieto, 2014). On these occasions, only particular species (e.g. blue sharks, shortfin makos *Isurus oxyrinchus*, and copper sharks *Carcharhinus brachyurus*) were directly targeted (Apolín & Vargas-Nalvarte, 2006; Prieto, 2014). These were accompanied by several depictions of sharks in ceramics, textiles and jewelry (Prieto, 2014).

- **Islands**: Considered religious and mythical places, due to their spiritual and economic importance (Rostworowski, 2005). There are more than 25 islands along the Peruvian coast, with evidence of long-term human occupation during pre-Hispanic times (Kay & Arana, 1999). These islands, according to magical tales and myths, were the places where the souls of the dead would go to rest, guided by sea lions (Kay & Arana, 1999; Nalvarte, 2015; Rostworowski, 2005). In addition, islands were also crucial for agriculture, due to significant accumulations of guano (a natural organic fertilizer derived from seabird faeces) whose use continued to date (Hudtwalcker, 2009). Only skilled fishers would go to the islands and harvest the guano. They would fast for two days before and after guano extraction, to thank the islands and their associated deities (Rostworowski, 2005).

3.7 | Experiences

3.7.1 | Artistic inspiration

Multiple representations of rafts, waves, sharks, seabirds, marine mammals, fishes, marine invertebrates and other marine elements have been commonly found in pottery, textiles, jewelry and embedded in the walls of public buildings, gaining more and more importance since 200 CE (Altamirano-Sierra & Vargas-Nalvarte, 2014; Gayoso et al., 2016; Prieto, 2013). Despite coastal settlements moving further inland during this period (200 CE and forward), the people never stopped acknowledging the importance of the sea (Prieto, 2013; Silverman & Isbell, 2008). For instance, miniatures of small wooden rafts are frequently found in funerary offerings of the Chiribaya Culture (700–1,476 CE), suggesting the importance of navigation even in the afterlife (Holiday et al., 2003).

3.7.2 | Spirituality and religiosity

Architecture was an essential conduit for expressing adoration for the sea (Kornbacher, 1999). For instance, in *Bandurria* (3,100–1,600 BCE), early mounds were constructed as a means to express spirituality with the ocean (Chu, 2006, 2008). While in *Huaca Prieta* (13,000–2,000 BCE), mounds were constructed facing the sea for ritualistic purposes (Dillehay et al., 2017). Two sites on the central

![Figure 4](https://example.com/f4.jpg)
coast of Peru deserve special attention: Chan Chan and Pachacamac. Chan Chan (850–1,000 CE) is the second-largest mud city of the world, with walls covered by marine iconography, including wave-like patterns, fish, seabirds, marine mammals and gillnets (Figure 5; Pillsbury, 1996). Pachacamac, on the other hand, was a large settlement used mainly for spiritual and religious purposes for over 1,000 years (Figure 6). The long-term occupation experienced at this site was uncommon in the pre-Hispanic Andes (Eeckhout, 2013). Records show that this site experienced seamless transitions between four successive cultures from 200/300 CE, up to the Spanish conquest (Ramirez, 2008). Its primary purpose was to celebrate and adore the ocean, and although there is evidence of changes in religious beliefs and practices at Pachacamac, the sea, and marine elements were maintained as central features of its architecture (Eeckhout, 2013).

4 | DISCUSSION

This paper addresses the need for more research on CES derived from interactions between people and marine ecosystems in the Global South, and the need for macro-historical assessments that shed light on the transformative role of such relationships at the societal level. Further research would benefit from adopting a more holistic cultural lens (Pröpper & Haupts, 2014), where culture is not seen as a separate ES category rather as a layer of meaning for ecosystems (Chan, Guerry, et al., 2012; Chan & Satterfield, 2016) and where cultural benefits are not the end products of people and nature relationships, but the manifestations of dynamic and ongoing interactions that are vital for peoples’ good life (Chan et al., 2016). Using SSF as our focus of attention, allowed us to comprehend how fishing practices led to different and improved types of environmental interactions in favour of early coastal communities. Hence, the quantity and quality of cultural benefits increased over time and even transcended the realm of marine and coastal ecosystems. For instance, cultural benefits among coastal communities fostered a deep adoration for the sea among inland communities, which extended to the Inca Empire.

Moreover, this paper differs from other literature regarding cultural benefits and human–marine interactions as it has mainly relied on archaeological literature. The use of archaeological studies expands the current tool-box for assessing CES, which allows a grounded
historical approach (Bryce et al., 2016; Fletcher et al., 2014; Gee & Burkhard, 2010; Ruiz-Frau et al., 2013). Furthermore, it highlights the need to adopt a spatio-temporal approach for CES assessment, as the supply of cultural benefits to coastal societies varies with social and ecological change (Chan & Satterfield, 2016; Jackson et al., 2001; Pauly, 1995; Sandweiss et al., 2020), as well as demonstrates that the CES framework (Fish et al., 2016) is suitable for historical assessments.

4.1 | Fisheries role in societal transformation

Marine ecosystems and the development of fishing abilities were vital for the evolution of complex coastal societies in pre-Hispanic Peru (Richardson III, 1998; Sandweiss, 2009). Strengthening fishing abilities led to the diversification of ways in which early Peruvians could interact with marine environmental spaces (i.e. navigation, rituals, artistic inspiration, among others), which further re-shaped their societies through labour specialization and the development of the fishers’ identity and myths (Figure 7).

This specialization is an excellent example of a positive feedback loop between ecosystems and cultural practices, where both ecological and social sub-systems enabled and shaped each other (Bryce et al., 2016; Chan & Satterfield, 2016). The development and evolution of fisheries fostered human and environmental wellbeing. For example, the coastal islands of Peru—key breeding sites or nursery areas for fish, invertebrates, seabirds and marine mammals used by pre-Hispanic Peruvians—are believed to have been fisheries’ ‘no-take zones’, via closures enabled through myths (Kay & Arana, 1999; Nalvarte, 2015; Rostworowski, 2005). The knowledge of implementing no-take zones was lost for almost 500 years since colonization, as it is only since 2009 that these sites received official governmental protection and were included within the Reserva Nacional Sistema de Islas, Islotes y Puntas Guaneras (RNSIPG).

However, ecosystems can also be important drivers of change regarding cultural practices, with long-term impacts on cultural benefits. For example, marine and coastal ecosystems of Peru are highly dynamic (Gutiérrez et al., 2017). El Niño events are known to cause decreases in fisheries productivity and increases in rainfall and flooding (Bertrand et al., 2008; Timmermann et al., 2018). Thus, a leading hypothesis explaining some abrupt cultural adaptations experienced in Norte Chico, including changes in deities and the abandonment of monumental temples after 3,000 years of uninterrupted development, is the increased frequency and magnitude of El Niño events at the time (Fehren-Schmitz et al., 2014; Jennings, 2008; Sandweiss et al., 2001; Wells & Noller, 1999). Changes in these environmental conditions marked a new era for coastal societies, moving them further inland and increasing their dependence on agriculture for food production (Béarez, 2000; Silverman & Isbell, 2008). During this time, fishing communities became more specialized and relied on trade with inland communities that specialized in agriculture for cotton and gourds used for fishing (for making nets and floats respectively; Beresford-Jones et al., 2018; Haas & Creamer, 2006; Reitz et al., 2008).

FIGURE 7 Marine cultural ecosystem services framework (adapted from Fish et al., 2016)
Nonetheless, not all interactions between pre-Hispanic Peruvians and the sea would have resulted in a heightened supply of cultural benefits or environmental health. Some interactions, like the long legacy of historical overfishing of coastal fish stocks (Jackson et al., 2001), might have hindered the provision of such cultural benefits in the past, leading to environmental degradation and loss of capabilities, identities or experiences. For instance, a decrease in fish sizes and species diversity has been found in various archaeological sites in southern Peru, suggesting that overfishing was taking place (Reitz, 1988). In the Caribbean, there are similar indications of early overfishing (Wing & Wing, 2001). Identifying when and where overfishing took place is the first step to assess whether it led to measurable ecological and social simplification and whether pre-Hispanic cultures were able to overcome the challenge of achieving—or returning to—sustainability.

Furthermore, there is ample evidence that Spanish colonization changed the Peruvian seascape. By the time Spaniards arrived in Peru, the Inca Empire (1,000–1,532 CE) had incorporated the coastal adoration of the sea as a central part of their Andean ideology (Cobo, 1653/1964). Also, the allocation of area-based fishing rights was the mechanism by which the Incas controlled fishing efforts (Rostworowski, 2005). The latter scheme being quite similar to the Territorial Use Rights for Fisheries (TURFs) approach, which is rapidly gaining global support as a way to limit overfishing and to recover collapsed fisheries in the present (FAO, 1992; Gelcich et al., 2012). However, Spaniards regarded fisheries as an ‘inferior occupation’ and looked down upon the indigenous spiritual connection to the ocean (Flores-Galindo, 1981). This discrimination resulted in the abandonment of important religious coastal sites and the loss or stagnation of fisheries and navigation-related knowledge (Flores-Galindo, 1981; Rostworowski, 2005).

Additionally, the arrival of the Spaniards reduced existing internal trade dynamics and further reduced and isolated fishing communities (Flores-Galindo, 1981)—despite active pre-Hispanic trade between coastal and highland dwelling peoples (Dulanto, 2013; Reitz et al., 2008; Richardson III, 1998; Silverman & Isbell, 2008; Stanish et al., 2010). Colonization, together with other social processes that followed, led to ecological degradation (Gutiérrez et al., 2017), and had significant repercussions for small-scale fishing communities (Rostworowski, 2005). The effects of colonization are not unique to the Peruvian seascape. In Canada, for example, colonization simultaneously changed the environmental space and severely weakened the inter-generational transmission of traditional ecological knowledge regarding local food production among First Nation people (Turner & Turner, 2008).

### 4.2 Present cultural benefits and future interactions

Small-scale fisheries are still quite important for Peru. They are responsible for 73% of the fishing sector’s contribution to national employment (Christensen et al., 2014) and produce 96% of all the seafood consumed in Peru (Palacios-Abrantes et al., 2018). Yet, as capture production by SSF is a small fraction of the industrial catch, the latter’s contribution to society is underplayed by decision-makers (De La Puente et al., 2020). Due to a myopic focus on total catch rather than food security or employment, SSF continue to be systematically neglected within political processes, with little success at protecting, regulating or adequately managing them over the last 70 years, resulting in problems such as overfishing and profit dissipation (De La Puente et al., 2020; Gutiérrez et al., 2017; López de la Lama et al., 2018; Nakandakari et al., 2017).

Seafood is vital for local food security, a central component of the Peruvian identity, and the crown jewel of the recent Peruvian Gastronomic Boom (López de la Lama et al., 2018; Matta, 2014). Additionally, the pre-Hispanic traditions of sailing in reed rafts or wind sailing are still very much alive in central and northern Peru, and acknowledged as a cultural heritage of Peru (Actualidad Ambiental, 2018; ANDINA, 2013; Figure 8). However, most Peruvians are not aware of their cultural dependency on SSF and the seas (López de la Lama et al., 2018; McKinley et al., 2018). It has been suggested in the literature that disregarding cultural benefits can limit the overall success of management initiatives (Chan, Satterfield,
et al., 2012), and can lead to reduced environmental resilience and weakened social capital over time (Bryce et al., 2016).

Here we propose that it would be worth exploring if the recognition of cultural identity and heritage values derived from SSF, through communication campaigns aimed at coastal Peruvians, could help foster the restoration of ecological functions in marine ecosystems or marine health and drive SSF’s proper management and social value. Further deepening our understanding of Peruvians’ historical relationships with the sea could lay the ground for working towards a sustainable and equitable blue economy (Bennett, 2018; McKinley et al., 2018). We hope that by having presented a relational approach of cultural benefits throughout time, the complexity around CES has been reduced, and may be useful for the efforts of those seeking sustainable SSF as well as the recovery of marine ecosystems—both globally and in Peru.

5 | LIMITATIONS

First, as we have used archaeological data for populating our framework, our results are representative only of the reviewed literature. Thus, there might be other cultural benefits and practices that are not accounted for here, as other archaeological settlements might not have been discovered yet or known sites may lack available scientific information. Second, as this article has focused on a specific framework that prioritizes the identification of environmental spaces, cultural practices and cultural benefits, there might be a broader set of relationships between coastal dwellers and marine and coastal ecosystems that have not been accounted for here. Finally, as we have focused on the evolution of fisheries through time, it is highly likely that our results would change based on a differently used lens, such as coastal agriculture or trade.

6 | CONCLUSION

This paper has managed to identify historical CES derived from the interaction between seascapes, coastal landscapes and early coastal dwellers in Peru. Changes in the sease and coastal ecosystems together with the ongoing evolution of cultural practices, led to diverse cultural benefits that contributed to the complex societal development of coastal Peruvians. These benefits include capabilities, identities and experiences that still shape how people, especially small-scale fishe rs, approach their relationships with the oceans today.

Our results are mainly grounded on archaeological literature to approximate historical social dynamics. Through archeology we hope to have demonstrated a long, robust and always-changing human–nature relationship mediated by the cultural practice of fishing. Based on our findings, we seek to showcase the importance of having a long-term historical perspective of human–nature relationships that might allow decision-makers and researchers to better comprehend environmental and social cycles (Pauly, 2018; Plieninger et al., 2014). By acknowledging who we were in the past and who we are now—as individuals and as a society—we can choose to manage the ocean in ways that go beyond basic economic terms, considering their historical contributions and adopting a more biocentric view. Furthermore, framing CES as cultural benefits highlights their direct role in contributing to human well-being; which is expected to facilitate their inclusion in ecosystems and natural resource management towards a blue economy (Bennett et al., 2019; Chan et al., 2011). Finally, by recognizing the cultural benefits derived from fisheries we may manage to actively care for those cultural values derived from such traditional practice, which has the potential to grant future generations the opportunities for cultural expression based on the sease.

ACKNOWLEDGEMENTS

The authors thank Dr. Daniel Sandweiss for providing key archaeological literature for this paper, Juan Carlos Riveros for the elaboration of the map, and Meaghan Efford, Cecily Maller and Guillermo García-Montufar for reviewing the manuscript and providing valuable feedback that led to its improvement.

CONFLICT OF INTEREST

Kai Chan is a Lead Editor at People and Nature. He did not have any involvement with the peer review and decision-making process of this article.

AUTHORS’ CONTRIBUTIONS

R.L.d.L.L., J.C.S., S.d.I.P. and K.M.A.C. conceived the ideas and developed the research. R.L.d.L.L., J.C.S. and K.M.A.C. collected the data; R.L.d.L.L. and S.d.I.P. analysed the data and led the writing of the manuscript; K.M.A.C. and J.C.S. revised the manuscript for important intellectual content. All authors contributed critically to the drafts and gave final approval for publication.

DATA AVAILABILITY STATEMENT

As a review-based analysis, this article does not include data. A list with all references used for this article is available in the Data Sources section.

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How to cite this article: López de la Lama R, de la Puente S, Sueiro JC, Chan KMA. Reconnecting with the past and anticipating the future: A review of fisheries-derived cultural ecosystem services in pre-Hispanic Peru. People Nat. 2021;3:129–147. https://doi.org/10.1002/pan3.10153

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