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# Exploitation of faunal resources by marine hunter–gatherer groups during the Middle Holocene at the Copaca 1 site, Atacama Desert coast

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ABSTRACT

The article presents the results of a study conducted on an assemblage of archeofaunal remains from the Copaca 1 archeological site, located on the arid coast of Northern Chile. The site corresponds to an extensive shell midden that was used generally as an occupational site and specifically as a funerary one by specialized marine hunter–gatherers exclusively during the Archaic period.

The analysis of the faunal remains enabled a general description of the use of local fauna throughout the site's cultural sequence, which range from 7866 to 5040 cal. BP. According to the results obtained, marine and terrestrial fauna, including marine and terrestrial mammals, sea birds, pelagic and oceanic fish, mollusks, crustaceans and equinoderms, were used as a source of both food and technological implements during the Middle Holocene. This implies that the human groups that inhabited Copaca 1 accessed most of the ecoanthropic spheres of the Southern Cone of the Southwestern Pacific coast from early times onward, an adaptation dated since 12,000 BP in the south-western coast from southern Peru and northern Chile.



## 1. Introduction

Archeological investigations conducted in recent years offer a wealth of data on the coastal societies that inhabited the hyper-arid, extreme desert coast of northern Chile (from the Loa River in the north to the Salado River in the south) throughout the Holocene. Using the marine hunter–gatherer contexts identified, we have systematically studied the use of the rocky shore system along this stretch of coast between 24 and 27°S, which holds an extremely productive ecosystem that contains a wide range of resources including fish, shellfish, seaweed, and marine mammals. Abundance and predictability of these resources has allowed the development of a human history of 12,000 years, both in what is now Peruvian and Chilean territory (Llagostera, 1979, 1989, 2005; Sandweiss et al., 1998; Llagostera et al., 2000; Sandweiss, 2008). Despite this, human populations in dry coasts have had to cope with a complex and extreme environment. This area is one of the driest in the world due to low rainfall and the absence of permanent freshwater springs reaching the sea (Bittmann, 1986; Llagostera, 1989), which strongly contrasts with the rich marine ecosystem. Water resources are only available in small springs along the coastal terrace and/or the coastal mountain range (Nunez and Varela, 1967–1968), or from the coastal low fog that allows the development of hill ecosystems (e.g. Marquet et al., 1998).

These environmental conditions have allowed a continuity and conservatism in the economy and social organization of human groups that inhabited the region from ca. 12,000 BP until the nineteenth century, except for some technological innovations (Llagostera, 1979, 1982, 1989, 2005). However, such continuity and resilience in Holocene coastal lifestyle is a relevant research question, given that resources and environmental conditions are important variables to understand the decisions made by human

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groups in marginal or extreme environments as the interfluvial coast of northern Chile (Avery, 1995).

Thus, to approximate the variables of change and continuity in the archaeological context registered in the archaeological site of Copaca 1, is necessary, in the first place, to identify strategies for resource exploitation and subsistence of the inhabitants from Copaca used during Middle Holocene, studying the faunal component recovered in the excavations of the site. This will allow us to identify the high variability and technological expertise that these human groups developed since early times in such complex and extreme environmental conditions.

## 2. The Atacama Desert coast environment

The Pacific coast of the Atacama-Sechín desert stretches for approximately 3000 km from Northern Peru (5°S) to Northern Chile (27°S). The southernmost "absolute desert" section (24–27°S) is known as Atacama Sur and is presently one of the driest zones on the planet. Hyper-arid conditions remain constant throughout the year and rainfall is extremely low (3–4 mm annual average) (Vargas et al., 2000). While arid ecological systems are characterized by low productivity and species richness (Noy-Meir, 1973) along with high spatial heterogeneity (Kelt et al., 1996; Tongway et al., 2004) in our study area, the coastal fog (locally known as "Camanchaca") generates an environment sufficiently humid to sustain relatively abundant and diverse communities of perennial and endemic plants, such as lichens, annual herbaceous, shrubs and cactus (e.g. Follman, 1967; Rundel et al., 1991; Pliscoff and Luebert, 2008), which have been used by humans as food, fuel and medicine, among others.

In contrast to the inhospitably arid coastal desert and the limited resources available there, the coastal waters of Atacama Sur represent one of the most productive ecosystems on the globe thanks to the cold waters of the Humboldt Current, which rise to the surface from the seabed, generating a nutrient-rich environment that attracts a wide variety of marine species, most notably neritic–benthonic, neritic–pelagic, and oceanic–epipelagic species. The zone furthest from the shoreline plays host to a wide variety of migratory species including swordfish and tuna, among others (Mann, 1954; Fonseca and Farías, 1987; Santibáñez et al., 2005; Fariña et al., 2008).

Nevertheless, the productivity of the Atacama Desert coastal waters is frequently altered by the El Niño Southern Oscillation (ENSO), defined as a change in the oceanic-atmospheric system that causes significant alterations in climatic behavior along the South American coast. ENSO affects different areas differently, depending on its magnitude, duration and coverage (Wyrtki et al., 1976), and one of its key indicators is ocean surface temperature, which can rise by 1–4 C° during an ENSO event, altering environmental conditions and marine ecosystems and having a consequent effect on fishing activity (Santibáñez et al., 2005).

The origin, strength, and frequency of ENSO events in the past has been the subject of extensive discussions, especially during the Early and Middle Holocene (Rollins et al., 1986; DeVries and Wells, 1990; Sandweiss et al., 1996; DeVries et al., 1997; Carré et al., 2011). Various proxies have been used to propose that this phenomenon was initially established between 9000 and 7900 BP with short and intense events that altered the characteristics of the cold upwelling system conditions of the southern coast of Peru (Carré et al., 2005). From ~5000 to 2000 BP, the occurrence of ENSO would have been intensified and more variable, both in coastal Peru and Chile (Veit, 1996; Marchant et al., 1999; Sandweiss et al., 2001). It is possible that these changes have affected coastal adaptations during the Middle Holocene not only in South American, but also in other parts of the Pacific, as has been noted in the arid coast of Australia (Williams et al., 2008). In any case, the occurrence of ENSO events significantly affected the development and reproduction of efficient marine adaptation in the coastal Atacama Desert. In this context, the dynamic interaction between ENSO, the freshwater springs in the area and the dense fog that typically blankets the coast in this zone have produced a unique environment (Follman and Weisser, 1966) that has enabled human groups to subsist here uninterruptedly since the Early Holocene by making use of the rocky coastal system's abundant variety of fish, mollusks, seaweed and marine mammals and by hunting terrestrial mammals in the coastal mountains.

## 3. Archaeological context of Copaca 1 site

Copaca 1 is located at 22° S on the hyper arid, arheic desert coast of Chile (Fig. 1), and corresponds to a shell midden 5000 $m^2$ in area situated at 22 m a.s.l. upon an ancient terrace formed by marine erosion (Fig. 2). The site is easily accessed from the present-day shoreline. The settlement has been defined as a residential camp that was occupied semi-permanently, primarily to take advantage of marine resources (Castro et al., 2012, 2014; Olguín et al., 2013).

This sequence includes at least eight occupational events dated between 7966 and 5040 cal BP ($C^{14}$ date) (Table 1 and Fig. 3). The occupations show that the site's inhabitants made extensive use of faunal resources, primarily eared seals, dolphins, cetaceans, mollusks, and fish and, to a lesser extent, terrestrial fauna such as camelids and birds. The instruments they used to catch and process these resources included, among others, projectile points, harpoon barbs, fishing weights and hooks, scrapers and knives (Santander, 2010; Varela et al., 2010; García-Albarido, 2012; Olguín et al., 2013). Notably, during the V and VI occupational events, the site was used as a funerary repository associated with stone architecture (Fig. 4) (Castro, pers. comm. 2013; Olguín et al., 2013).

The occupation at Copaca was preceded by small groups of people that colonized the coast of Taltal by camping inside little caves, dated 10,290–10,040 B.P. These groups originated cultural processes that allowed people to cope with the ecological instability, which later in the Archaic made it possible to establish little hamlets with stone masonry structures along the coast. Like other coastal groups along the littoral of northern Chile, the Copaca people based their economy and diet on marine resources, which is reflected in the wide variety of artifacts, linked to fish, shellfish,

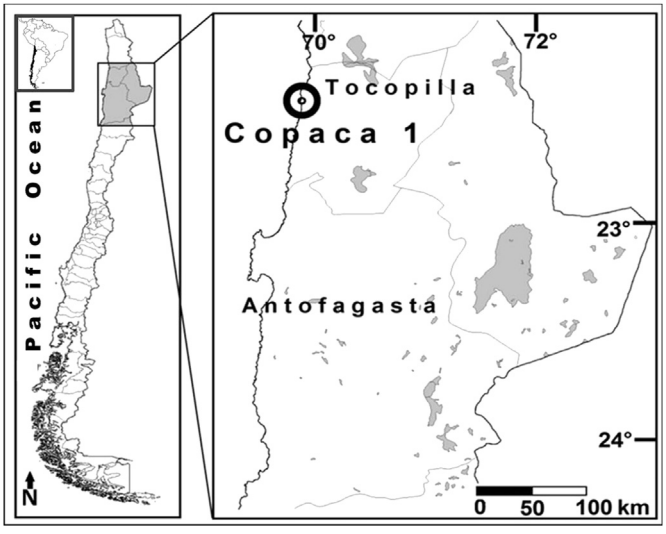


**Fig. 1.** Location of the area of study.