

Reports

Initial Occupation of the Pacific Coast of Chile during Late Pleistocene Times

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The record of the initial settlement of South America has significant geographical gaps, especially along the Pacific coast. The study of small sites with brief occupation spans can open windows on high-resolution contexts in which associations and activities are clear. Through the use of a program designed to identify lacustrine Pleistocene environments in which the initial human populations would presumably have settled, Quebrada Santa Julia, a site attesting to human presence dating to 13,000 calibrated years BP, has recently been located on the semiarid coast of Chile. It is the only known Paleoindian site with fluted projectile points in unambiguous association with extinct megafauna on the Andean Pacific coast. It represents a small lakeside camp with a brief occupation span in which multiple activities, including the processing of prey transported from a nearby location, were conducted. The present of extralocal lithic raw materials argues for movements into the interior, as has been suggested for other early settlements in the Andean region. Notwithstanding its proximity to the littoral, the site has not yielded any evidence of the exploitation of marine resources.

The initial settlement of South America appears to have been a highly diversified cultural process with several geographical gaps in its record (Dillehay et al. 1992; Dillehay 2000). This is especially true along the Pacific coast, where there is little evidence of human occupation attributed to the Terminal Pleistocene. A lack of open-air sites with multiple activities is also characteristic of this context, most probably because of low population densities (Borrero 1999). Numerous alterations are

to be expected, given the age of these contexts, as well as poor visibility because of the brevity of occupations and the length of depositional histories. Cultural associations and dates for many sites have been intensely debated in attention to their complex formation processes (Lynch 1990; Dillehay and Collins 1991; Meltzer, Adovasio, and Dillehay 1994; Meltzer et al. 1997). The study of small sites with brief occupation spans can open windows on high-resolution contexts in which associations and activities are clearer. Thus, identifying early settlements is a challenge which we have addressed by developing a predictive model for locating possible Pleistocene-age sites and human occupations (Jackson and Méndez 2004).

Here we present new evidence of an archaeological site which attests to human presence dating to 13,000 calibrated years BP on the semiarid coast of Chile. Quebrada Santa Julia (LV. 221) is interpreted as a briefly occupied hunting camp associated with a lacustrine environment. It is the only known Paleoindian site with fluted projectile points in unambiguous association with extinct megafauna on the Andean Pacific coast. During the occupation, the climate was locally more humid than today's, although aridity increased afterward (Villagrán and Varela 1990; Lamy, Hebbelen, and Wefer 1999). The azonal condition of the small lake allowed herbivores such as mastodons, *Mylodon*, *Equus*, *Palaeolama*, and extinct deer to gather along its margins, as is suggested by bone evidence in the area and other nearby locations (Núñez et al. 1994a; Méndez, Jackson, and Seguel 2004). Hunters tended to settle in such places, where rich protein resources abounded. An analogous lacustrine system is the Quebrada Quereo, located ~9 km to the south, which functioned similarly. Although initial settlement on the semiarid coast had already been suggested to date to ~13,500 calibrated years BP on the basis of the earliest date from Quereo (Núñez et al. 1994a), Quebrada Santa Julia is the first site to provide definite evidence of human-megafauna interaction in the region during the Terminal Pleistocene.

The study area is situated on the coast of Los Vilos District (31°29'S), Choapa Province, in Chile's northern semiarid zone. The semiarid coast is situated between the hyperarid Atacama Desert to the north and the mediterranean zone of central Chile to the south. The northern semiarid zone is characterized by dry summers and sporadic intervals of rainfall in winter (Van Heusen 1967). The low precipitation rates are due to the pervasiveness of the South-Eastern Pacific Subtropical Anticyclone, the influence of the subantarctic waters of the Peru-Chile Current, and the upwelling of cold waters forced by the dominant southwestern winds, which induce more frequent episodes of coastal fog during the winter (Rutllant, Fuenzalida, and Aceituno 2003; Strub et al. 1998). The dominant vegetation is sclerophyllous scrub (Donoso 1981). Discontinuous patches of swamp forest dominated by dense stands of Myrtaceae occur in some coastal ravines (Maldonado and Villagrán 2002), where pollen profiles have been obtained from Quereo (Núñez et al. 1994a), Ñagué (Maldonado and Villagrán 2002) and Palo Colorado (Maldonado and Villagrán 2006). The Quereo record

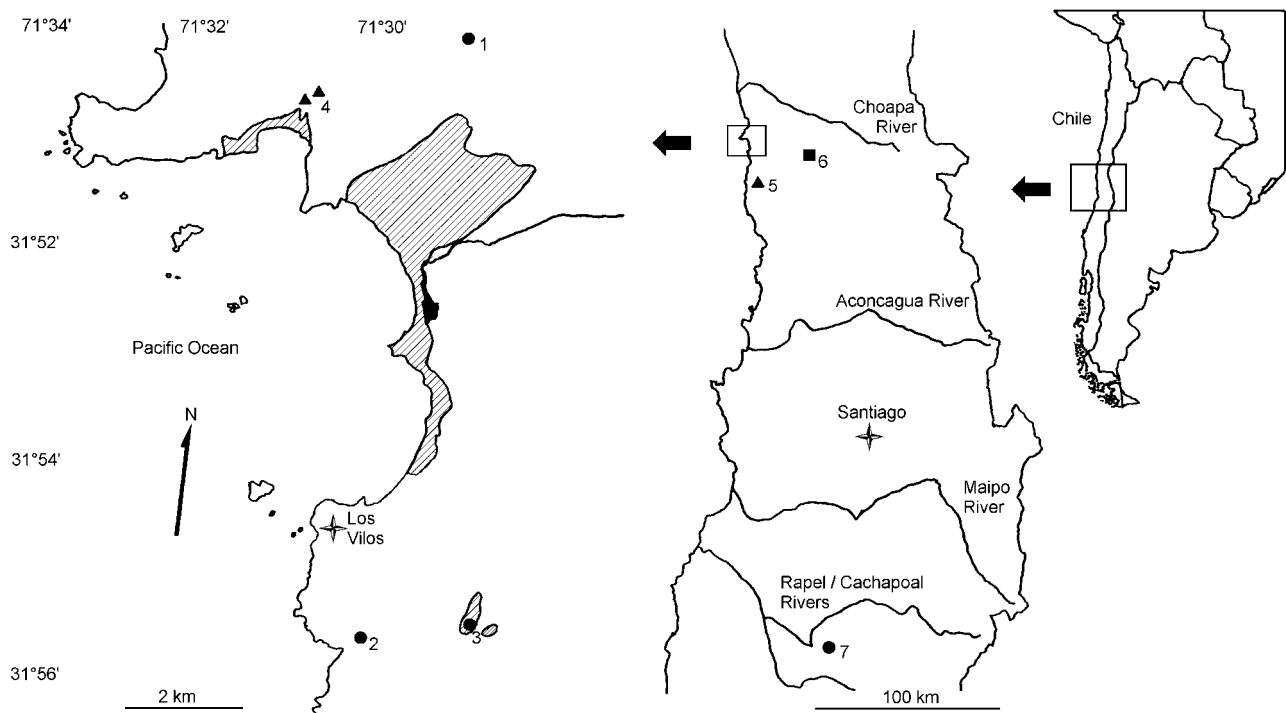


Figure 1. Central Chile and the study area, showing archaeological sites (*circles*), sources of pollen profiles (*triangles*), and lithic sources (*squares*) mentioned in the text: 1, Santa Julia; 2, Quereo; 3, El Membrillo; 4, Ñagué I and III; 5, Palo Colorado; 6, Caimanes, 7, Taguatagua and dune fields (*diagonal lines*).

shows relatively humid conditions with dominant arboreal and aquatic taxa around 13,000 calibrated years BP, followed by a phase of increasing aridity at about 9,400 calibrated years BP in the Palo Colorado profile (Maldonado and Villagrán 2006), with the replacement of swamp-forest taxa by sclerophyllous scrub and the reappearance of taxa indicative of humid environments in two steps at 6,200 and 4,200 calibrated years BP (Maldonado and Villagrán 2002).

The archaeological site was discovered through the use of a specific program designed to identify lacustrine Pleistocene environments in which the initial human populations would presumably have settled (Núñez, Varela, and Casamiquela 1987). Surface and stratigraphic surveys made possible the identification of sites yielding extinct fauna and at least one with human occupation. The research was carried out by an interdisciplinary team including archaeologists, conservators, geologists, palynologists, archaeobotanists, and chemists. At least 24 sites yielding Pleistocene extinct fauna were registered on the Los Vilos coast in an area of only 29 km² (Méndez, Jackson, and Seguel 2004). Among them, only Quebrada Santa Julia and Quereo (Núñez et al. 1994a) exhibit primary stratigraphic records of anthropogenic origin. A third site, El Membrillo, exposes significant evidence of human agency

during the Terminal Pleistocene, but its early dating (16,000 calibrated years BP) and the fact that it is a surface site suggest caution in its interpretation (Jackson 2003). Neither Quereo nor El Membrillo presents diagnostic lithic instruments for the period such as projectile points, but these will not necessarily be present in every settlement.

Quebrada Santa Julia (LV. 221) lies on the edge of a small ravine, oriented east-west, which drains into the Pacific 3.5 km west of the site (fig. 1). Fluvial erosion has exposed a 10-m-high stratigraphic profile (fig. 2). In the upper ~9.5 m, exceptionally well-preserved couplets of massive sandy and fine-grained peat strata are in contact by normal grading, suggesting rare alluvial episodes followed by slow deposition of fine sand, silt, and organic material on the ancient shore of a small lake. This local environment was trapped by a dune field downstream, partly dating to the Terminal Pleistocene; a radiocarbon date of 16,000 calibrated years BP from *Mylodon* sp. remains found at El Membrillo (Jackson 2003) in a conspicuous dune some kilometers to the south. Downstream along the ravine, another site (LV. 220) exhibits similar stratigraphy. Radiocarbon assays from a peat level in the middle segment of this sequence indicate that the local sedimentary system persisted at least up to 4,650 calibrated years BP and suggests that the vertical in-

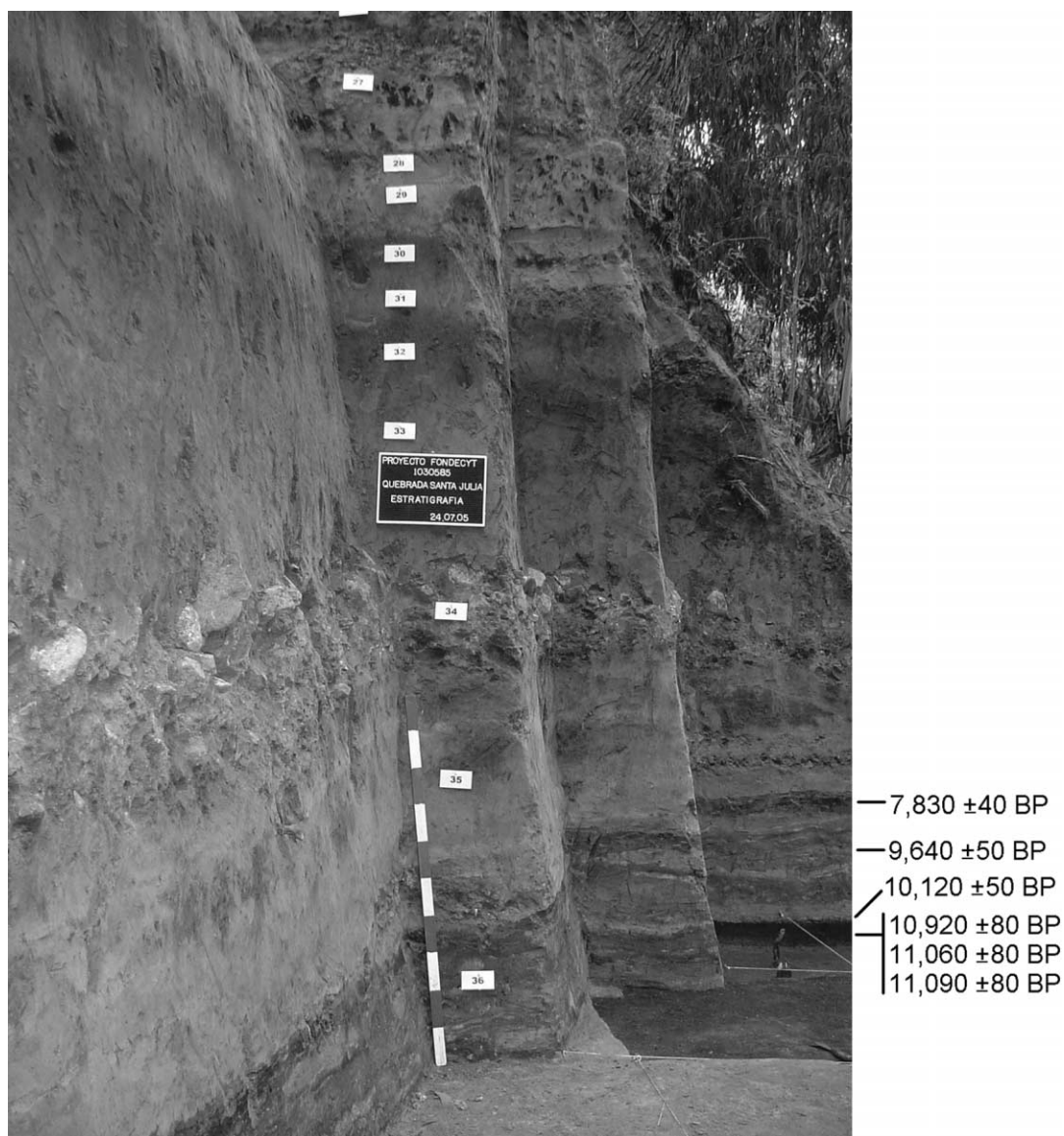


Figure 2. Stratigraphy of Quebrada Santa Julia, showing layers containing mainly sands, silt-clay, fluvial transported rocks, and the Paleoindian level, with radiocarbon dates.

cision of the ravine began during the late Holocene and was probably accompanied by the onset of wetter and cooler regional conditions (Maldonado and Villagrán 2002). The lower ~0.5 m of the sequence consists mainly of peat strata with some thin sandy layers. At the base of the sequence, the cultural level immediately overlies a dune which exhibits an incipient paleo-soil profile containing extinct fauna bones (*Mylodon* sp. vertebrae and cranial fragments of an unidentified mammal) without cultural associations. The Paleoindian occupation itself corresponds to a 5–8-cm-thick peat containing bones of extinct fauna, lithic instruments, and several cultural features. The hu-

man occupation has been dated to ~13,000 calibrated years BP on hearth charcoal and a wood artifact (table 1). No contaminants, such as carbonates, roots, or faunal disturbance, were observed. Another radiometric assay of organic sediments immediately overlying the occupation demonstrates chronological and stratigraphic coherence and indicates very low sedimentation rates at that time. Two radiocarbon dates from peat strata overlying the cultural level by several decimeters indicate discrete depositional events over the Paleoindian occupation. The dominance of these peat layers and the low sedimentation rates at the base of the sequence suggest that in the period of oc-

Table 1. Radiocarbon (AMS) Dates from Quebrada Santa Julia

Site	Stratum	¹⁴ C yrs. BP	Cal. yrs. BP	¹³ C/ ¹² C Ratio (‰)	Lab. No.	Material
LV. 221	37	11,090 ± 80	13,350–12,880	–24.9	215089	Hearth charcoal
LV. 221	37	11,060 ± 80	13,190–12,880	–24.0	215090	Wood instrument
LV. 221	37	10,920 ± 80	13,130–12,880	–24.4	194725	Hearth charcoal
LV. 221	37 superior	10,120 ± 50	12,270–11,350	–26.1	196068	Peat
LV. 221	36 middle	9,640 ± 50	11,180–10,750	–26.7	204524	Peat
LV. 221	36 superior	7,830 ± 40	8,660–8,530	–26.0	20523	Peat
LV. 220	19	4,200 ± 40	4,840–4,600	–18.8	202253	Charcoal lense

Note: All dates were run by Beta Analytic Radiocarbon Laboratory. Calibrated years BP have a 2 δ range.

cupation water was provided by increased local humidity that was probably associated with the intensified coastal cloudiness favored by the low sea-surface temperatures of central Chile (Kim et al. 2002). These conditions persisted at least up to ~8,600 calibrated years BP and occurred in a context of severely limited rainfall events as suggested by very rare to nearly absent alluvial episodes at that time, concomitantly with strong regional aridity in central Chile (Jenny et al. 2002; Villa-Martínez, Villagrán, and Jenny 2003).

During the 2004 and 2005 field seasons, a 22-m² plot was

excavated (fig. 3). The digging strategy involved in situ decapage and piece plotting of all remains, including microdebitage. The excavated area revealed a discrete occupational surface on which parts of native horse (*Equus* sp.) were processed. The bone surfaces were affected by diagenetic processes, restricting observation of cut marks, but several fractures indicate anthropogenic origin. No carnivore or rodent traces or radicles were identified on the specimens recovered. Most significant, these bones were spatially associated with a plain hearth ~80 cm in diameter that yielded abundant char-



Figure 3. Quebrada Santa Julia excavated plot of layer 37, showing the cultural context.

coal, unburned pieces of wood, at least one burned bone, and a sharpened wood artifact. Contiguous to the extinct faunal remains and the hearth we recorded artifacts manufactured by hard-hammer percussion on locally available rock (fig. 4). Four marginally retouched knives and several unretouched flakes of siliceous tufa suggest the local processing of some carcass segments by means of an expedient strategy. A scraper, a graver, a fractured pebble, a unidirectional core, and several flakes make up the lithic assemblage. Low-augmentation ($80\times$) microscopic examination showed microwear traces on several edges. No surface patina or trampling traces were observed on any lithic specimen. The concentration of the lithic artifacts and teeth and fragments of long bones of *Equus* sp. suggests an activity area. A fluted projectile point blank (fig. 5) and a bifacial fragment, both made of quartz crystal, were identified on close spatial association. On the occupational floor, over 190 flakes were observed, the majority attributed to bifacial manufacture from this rock. Additionally, a fluting flake refitting to the blank was found just 81 cm away. The spatial distribution of the lithic remains suggests a limited knapping area. The nearest source of quartz crystal is the Caimanes area, 30 km inland, where this high-quality raw material abounds (Rivano and Sepúlveda 1986). The presence of other siliceous extralocal chipping debris indicates the manufacture of other tools, arguing for a wider range of lithic resource procurement. It is noteworthy that both marginal and bifacial knapping techniques are clearly represented in the assemblage. Excavation also exposed four features whose texture and color clearly differentiated them from the peat. Their irregular morphology, angled contours, and depth suggest an anthropogenic origin (fig. 6, *a*). One of these features resembles the imprint of a buried stake (fig. 6, *b*)

All the remains were found in the same level of the peat layer, from its surface to 8 cm below. There is no evidence of any disturbance or vertical migration of observed elements. Most artifacts were found in horizontal position and pre-



Figure 5. Fluted projectile point blank.

sented very few fractures. Refitting of some lithic pieces within a single reduction sequence argues for a contemporaneous high-resolution context. Quebrada Santa Julia reveals human-made artifacts of several lithic materials associated with faunal remains (some with anthropogenic traces), Terminal Pleistocene dates, and several features on an occupational surface in stratigraphic context. The characteristics of this settlement indicate a small camp with a brief occupation span in which multiple activities were conducted, including the processing of prey transported from a nearby location. These activities took place on the edge of a lake, and therefore the formation of the organic soil continued after the brief occupation.

The evidence presented corresponds to one of the few areas in which Paleoindian occupations are found adjacent to the

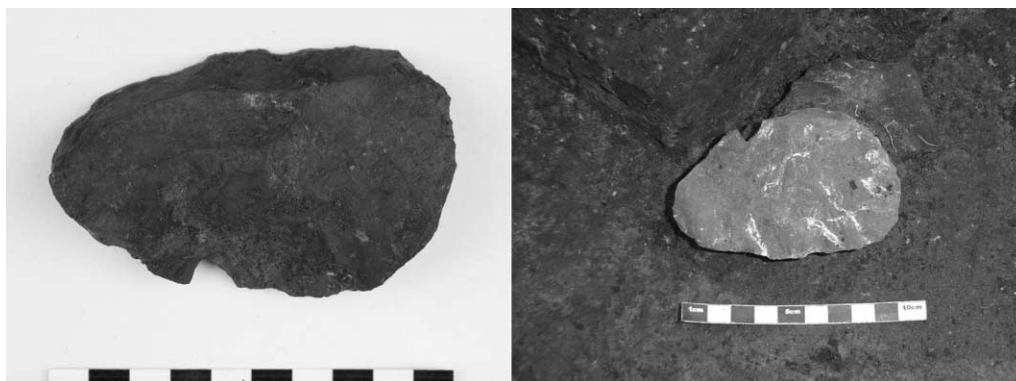


Figure 4. *Left*, expedient retouched flake (silicified tufa); *right*, in situ position of the same artifact.



Figure 6. Excavated features of the occupational floor. *Top*, feature with angled contours; *bottom*, feature resembling stake imprint.

Pacific coast. The extralocal lithic raw materials argue, however, for movements into the interior, as has been suggested for other early settlements in the Andean region (Sandweiss et al. 1998). In these areas lacustrine environments and paleontological records of Terminal Pleistocene fauna allow us to consider the possibility of finding analogous settlement systems.

As was hypothesized by Núñez, Varela, and Casamiquela (1987) for a broader region including the northern semiarid zone, we have found the first evidence of human settlement in a lakeshore location. At similar sites farther south, such as Taguatagua, Pleistocene fauna (over 90% *Stegomastodon humboldti*, with *Antifer niemeyeri* and *Equus* sp. in lesser quantities) has been observed at various kill sites and butchering episodes in association with processing tools and fishtail projectile points (Montané 1968; Núñez et al. 1994b). It is noteworthy that, as at Quebrada Santa Julia, bifacial lithic points were manufactured from quartz crystal. We see this settlement pattern as characteristic of some of the first human groups to enter the region (Jackson, Méndez, and de Souza 2004); it was a foraging pattern that moved these groups toward critical resources. It was not, however, limited to kill sites but also included camps in which a greater diversity of activities took place, both located in the proximity of lake environments.

One central aspect of these new findings is that Quebrada Santa Julia is a classic Paleoindian occupation on the Pacific coast, where contemporaneous sites in South America exhibit a diversified early maritime adaptation (Llagostera 1979; Sandweiss et al. 1998; Keefer et al. 1998; Lavallée et al. 1999; Stothert, Piperno, and Andres 2003). Notwithstanding its proximity to the littoral, no evidence of marine resource exploitation has yet been documented. The distance from the site to the coastal margin during the Pleistocene/Holocene transition did not differ substantially from today's because of the steepness of the continental shelf, suggesting that in these latitudes Paleoindian groups prioritized the hunting of extinct fauna over the exploitation of marine resources. The development of a maritime adaptation has been well documented for the Early Holocene, when coastal gathering, fishing, and sea-mammal hunting have been observed in more than 25 settlements in the same area (Jackson et al. 1999). No technological or typological traits were shared by Terminal Pleistocene and Early Holocene assemblages, implying that this were independent, noncontemporaneous peoples. The discovery of the Paleoindian site of Quebrada Santa Julia close to the Pacific coast fills a gap in the record of early occupation of the Andean region while presenting a solid basis for a discussion of the diversity and adaptive versatility of the first settlers of South America.

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