

Article

Paleoamerican Occupation, Stone Tools from the Cueva del Medio, and Considerations for the Late Pleistocene Archaeology in Southern South America

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Abstract: Archaeological excavations at the Cueva del Medio performed during the 1980s and 1990s yielded an important record of both faunal and stone tool remains, as well as data, to discuss issues that occurred during the Terminal Pleistocene. Due to that, the shaped Paleoamerican artifacts collected in the author’s excavations were partially informed. The present article provides unpublished data on the field-work, the results of a techno-morphological analysis of the stone tools, and considerations about early hunter-gatherer societies along with their regional paleo-environmental interactions, as well other topics regarding the regional archaeological process during the last millennium of the Pleistocene. Findings from there have been extremely useful for discussing diverse paleo-ecological and archaeological topics and have extended the knowledge and discussions about different Pleistocene scientific issues, mainly related with flora, fauna, and the colonization of southern Patagonia.

Keywords: archaeology; Paleo-Americans; lithic analysis; Late Pleistocene; South America; Patagonia

1. Introduction

During the last millennium of the Pleistocene at ~11–10 kya (11,000–10,000 uncalibrated radiocarbon years before present (BP)) or ~13–12 cal. kya (13,000–12,000 calibrated radiocarbon years BP), an unquestionable fact is that the New World was populated from northern North America to the far south of South America [1,2]. At that time, the “fishtail”, “Fell’s cave”, or simply “Fell” projectile point (FP) had an extraordinary dispersion throughout Central and South America and was becoming a widespread Paleoamerican (PA) marker [2].

Despite isolated finds performed during the 19th century [2], the first FPs in stratigraphic contexts were performed in the southern tip of Patagonia, which is a large geographic region of ~1,000,000 m² shared by the Republics of Argentina and Chile in southern South America. In the history of the PA studies, this region is well known from the pioneering work in the 1930s of Junius Bird, whose discoveries linked the archaeology of Patagonia with the New World colonization process. Just a few years after the revolutionary discoveries at the Blackwater Draw, Folsom, and Lindenmeier sites demonstrating associated finds of Clovis and Folsom points with remains of Ice-Age fauna in the North American Great Plains, nearby the Magellan straight in southern Chile, Junius Bird excavated the Pali Aike and Fell’s caves. There, in the lower stratigraphic layers, he found the distinctive FP in context with the remains of extinct fauna [3–5]. However, since those pioneering discoveries showing that hunter-gatherers using FPs were contemporaneous with the Pleistocene fauna, except for a doubtful claimed PA site excavated during the 1970s [6], no reliable evidence of PA occupations had been found until the 1980s. In fact, after half a century without any clear findings corroborating his discoveries, the southern tip of South America fortunately saw the discovery and excavation of several sites that

confirmed the exploitation and consumption of extinct fauna by hunter-gatherer societies. Thus, the Magellan Strait and its surroundings provided a series of previously unthinkable findings related to the oldest human occupations in the Americas [7–9]. At that time, because of a lack of reliable evidence recovered through careful excavations, the technology and subsistence of the region's oldest human populations were subjected to diverse conjectures and interpretations (e.g., [10–12]).

The archaeological excavations at the Cueva del Medio (CM) that were performed during the 1980s and 1990s yielded an important record of both faunal and stone tool remains, as well as data, to discuss the anthropological, paleontological, and paleo-environmental issues that occurred during that time-span. Accordingly, along with the findings performed at the Tres Arroyos rock-shelter and Lago Sofia Cave [7,9], the CM became one of the first links in a chain of findings that allowed an approach to be established with new perspectives and reliable information on the initial regional settlement. As a result of the aforementioned excavations and recovered vestiges, an important number of investigations were carried out that shed light on very diverse regional chronological, environmental, and cultural topics (e.g., [8,11,13–31]), among others.

Because the shaped PA artifacts collected in the author's excavations were partially informed [13,14,17], the present article provides first-hand unpublished data on the field-work, a techno-morphological analysis of the stone tools, as well as considerations about the early hunter-gatherer societies in southern Patagonia.

2. Research Activities at the Cueva Del Medio

2.1. Location and Historical Brief

Shared by Chile and Argentina in the southern Andean Cordillera (Figure 1), the Southern Patagonian Ice Field is one of two remnants of the Patagonian Ice Sheet, which covered the whole of southern Chile during the last glacial period [32]. On its south-western slope, the orography is characterized by mountain ranges (e.g., Monumento Moore, Señoret, Chacabuco, and Prat) with an average height of ~1500 m asl (Figure 2). Belonging to the Cerro Toro geological complex [33], there is situated the Cerro Benítez (CB), a small hill in Ultima Esperanza Province, Magallanes Region, southern Chile. Situated on its southern flank, the Cueva del Mylodon Natural Monument protects the world-famous Mylodon cave [34–36] and other rock shelters of significant size that yielded an important paleontological and archaeological record (Figure 3).

According to regional historian Mateo Martinic [35], at the beginning of 1895, this locale aroused worldwide scientific interest because in the Mylodon cave, a thick piece of hide with embedded dermal ossicles and long reddish hairs was found in an excellent state of conservation, but not associated with any known living animal. Further visits to the area were made in the next two years, and more bones, skin, and dung were found that were assumed to be the same unknown species. It was identified as a ground sloth, named the mylodon, an animal related to other extinct Pleistocene herbivorous mammals. However, there was some speculation that it was still living in some places in Andean Patagonia [37]. Among the scientists who visited the Benitez hill was Rodolfo Hauthal, a German researcher, who at that time was working at the Museo de La Plata, Argentina. Among other activities performed on the CB, with scientific aims, he made the first excavations at the CM [38]. At the same time, the Daily Express in London organized an expedition with the aim of finding some living exemplars of this mega-mammal. Then, during the period spanning 1899–1902, like the other caves in the hill and also looking for the paleontological remains, the CM was visited by relic hunters who destroyed a significant portion of the cave deposits. In this way, a large number of paleontological specimens were recovered and mostly sold to European museums.

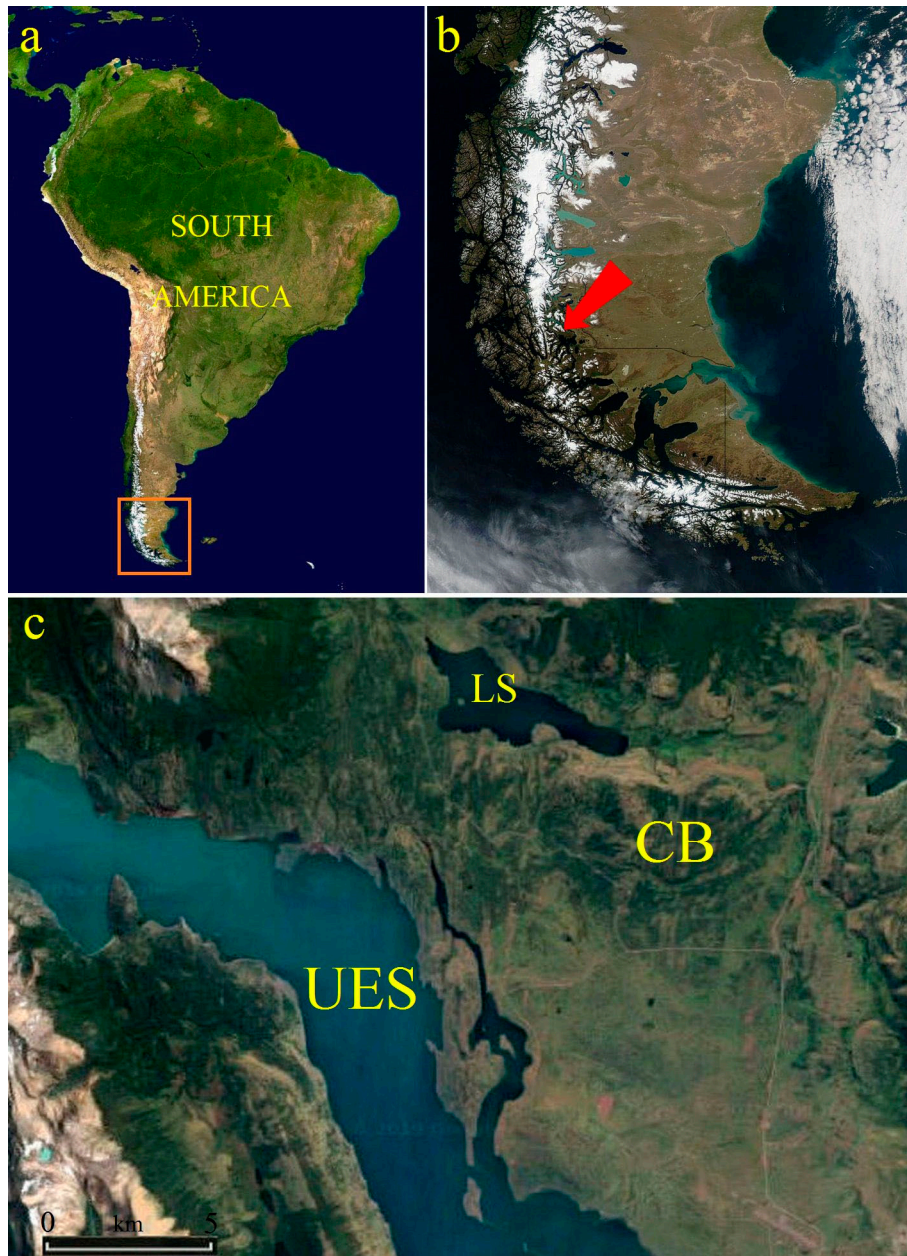


Figure 1. Locations maps of the studied area. (a) South America, (b) southern Patagonia indicating the Cerro Benitez area with an arrow, (c) its location close to the Ultima Esperanza Sound. References: CB: Benitez Hill, LS: Lago Sofía, UES: Ultima Esperanza Sound. Modified after Google and NASA maps.

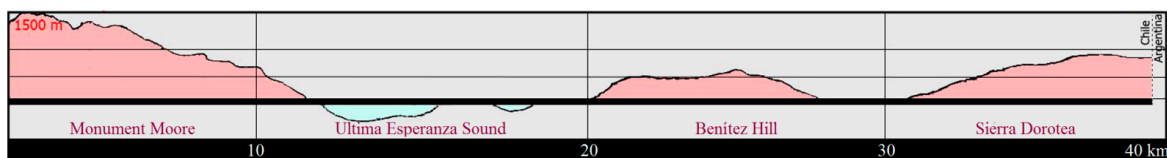


Figure 2. Location of the Benitez Hill and Ultima Esperanza Sound in a schematic geomorphological profile from the Monument Moore hill (west) to Sierra Dorotea on the Chile–Argentina border (east). Graphic design in Figures 2, 3, 6, 7 and 18: H. G. Nami and G. Paez Reina.

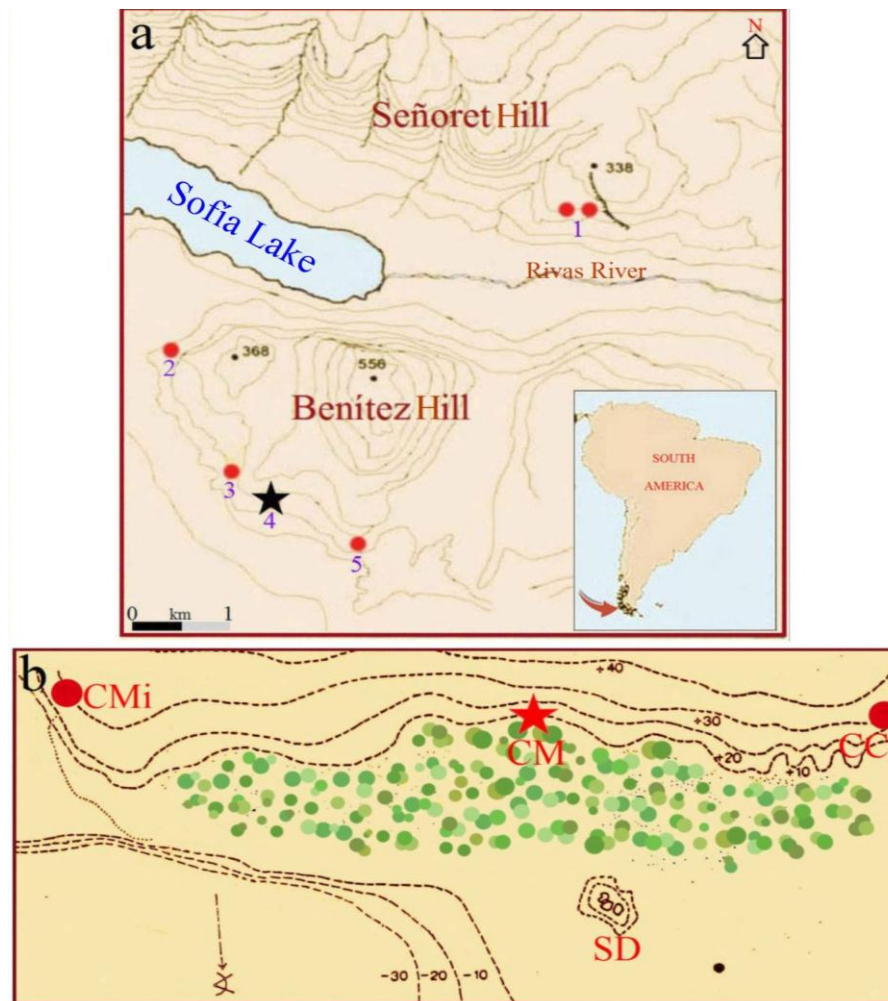


Figure 3. Location maps of the main Late Pleistocene paleontological and archaeological cave sites in the area. (a) The Señoret and Benítez hills. 1. Lago Sofia 1 and 2, 2. de la Ventana, 3. Mylodon, 4. del Medio, 5. Chica. The arrow on the map of South America shows the Ultima Esperanza region, (b) detail of the SW slope of the Benítez Hill with the locations of the Mylodon (CMi), Medio (CM), and Chica (CC) caves in relation to the “Silla del Diablo” (SD) rock formation in the Mylodon Cave National Park.

The CM ($51^{\circ}35' S$, $71^{\circ}38' W$) is situated ~ 1 km from the Mylodon cave in the Mylodon Cave National Park (Figure 3). It is a large cave ~ 90 m long by ~ 50 m wide at its entrance (Figures 4 and 5), which got its name (Cave of the middle) because it is located between the Mylodon cave and the Chica cave, which is the smallest significant shelter on the CB, also, it is medium in size between both of these caves. For most of the 20th century, the CM went into oblivion until the beginning of the 1980s, when Prieto (at that time a graduate student of philosophy and a team member of the IP archaeologist Massone), together with his sister Mónica and friend Romero, re-discovered the cave, whose location, visibility, and accessibility were unknown. Hence, on his behalf, I was invited to perform excavations in Ultima Esperanza by the Instituto de la Patagonia (IP) founder and director, M. Martinic. The field-works were performed between 1986 and 1993 under the auspices and institutional support of the IP, in conjunction with the Universidad de Magallanes (UM). As seen in the respective section below, funding for the field-work and laboratory research were granted to the IP and the author of this paper by different international institutions.



Figure 4. General views of the Cerro Benitez (a), and Cueva del Medio (b–d). (b) entrance, (c,d) frontal and inner portions. Except when clearly stated, all the photographs and drawings are by Hugo G. Nami.



Figure 5. Images of the excavation made at CM during the different field-works. (a) Made during the first expedition. Several looters' pits can be seen around it, one of which was used to start the excavation, (b) Paleo-American level exposed during the third expedition.

It is worth remembering that at that time, due to a lack of a staff archaeologist and with few authors contributing to the IP publication, the writer of this article collaborated extensively in good faith for its continuity as an institution. According to what can be observed in numerous newspaper articles, at

that time the CM finds had a significant impact on the local community. Then, fortunately, after their excavations and discoveries, the IP and some members of the excavation team were incorporated into the UM staff.

Mainly with paleontological and stratigraphic aims, new excavations were recently performed in 2011 and 2012 by deepening the previously excavated area, and an additional small sector close to the cave's western wall [29].

2.2. Excavations and Findings

Due to its size and for purely descriptive and analytical purposes, the cave was divided into three portions as follows: the entrance, the interior and the back [15]. They are respectively located in its mouth sector and drip line, and around and behind the large and important conglomerate blocks that had fallen from the cave walls and ceiling in the center (Figures 4c,d and 5). As mentioned previously, the site was widely disturbed by looters and the initial excavations performed at the turn of the 20th century, which left a lot of holes (e.g., Figure 5), hence, in diverse sections of the cave's sedimentary infilling, important accumulations of sediments had been removed and formed. To investigate the archaeological and paleontological remains that were still potentially present, they were carefully screened and a number of remains were recovered. After this removal, it was observed that covered by them, in the front, there were several intact sections of deposits. Also, surrounding the central large blocks, a layer of pebbles that had detached from them had sealed the sediments, making them impossible to have been excavated by the looters. Further, a small section at the end of the cave was also undamaged. Then, the excavations were performed in the deposits in these sectors, mainly in the center (Figure 6). The grids were planned, bearing in mind a north-south axis, and numbered from the cave's mouth toward the back and from east to west. All of the findings were mapped and recorded.

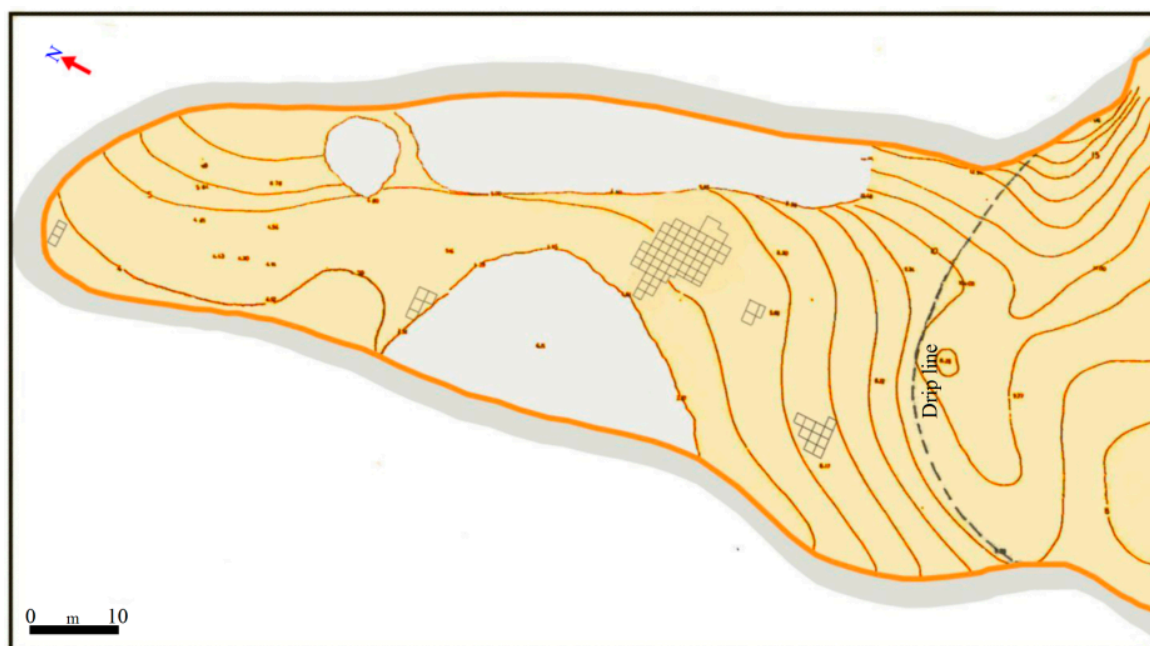


Figure 6. Map of the CM showing the locations of the author's excavations.

With regard to its stratigraphy, the published reports on the CM have only made observations based on the first three expeditions. Furthermore, the excavations carried out in the cave's different sectors revealed a more complex stratigraphy that was formed by sediments of exogene and endogene origin [39,40]. At the entrance and in the central section, the sediments are composed mainly of sand and cobbles originating from the conglomerates that formed the cave. In that area, the stratigraphic sequence containing the archaeological record showed four strata, as follows: the first is a fine a gray

powdery surface level. The second is below the former in the eastern part, it can be observed from the surface towards the west and is composed of clasts and pebbles of various sizes mixed with fragments of conglomerates that originated from the wall and ceiling, in some places this level is highly compacted and acted as a seal for the PA archaeological level (Figures 7 and 8). Underlying this stratum and still having some pebbles, there is a sandy reddish/yellowish level that is not present in the totally excavated surface (Figure 7), hence, in a large part of the excavation the stratum of pebbles and clasts of different sizes overlies layer four. Under a gray sandy layer and below a humid clayed deposit with rounded clasts and pebbles, layer five was identified. Below the archaeological excavations, a redeposited volcanic ash layer from the Reclús volcano that originated in the R1 eruption, which occurred at ~12.6 kya was recently identified [29]. Different from the pre-Holocene deposit, the sedimentary section containing the archaeological remains witnessed a very low deposition rate and non-conformities due to episodic sdimentation [41]. Then, the ~50 cm deposit registered a discontinuous sedimentary and archaeological record with gaps since the last millennium of the Pleistocene and Holocene. Originating in this way, there is a mix of diverse kinds of archaeological and paleontological materials in some sectors e.g. [14,42].

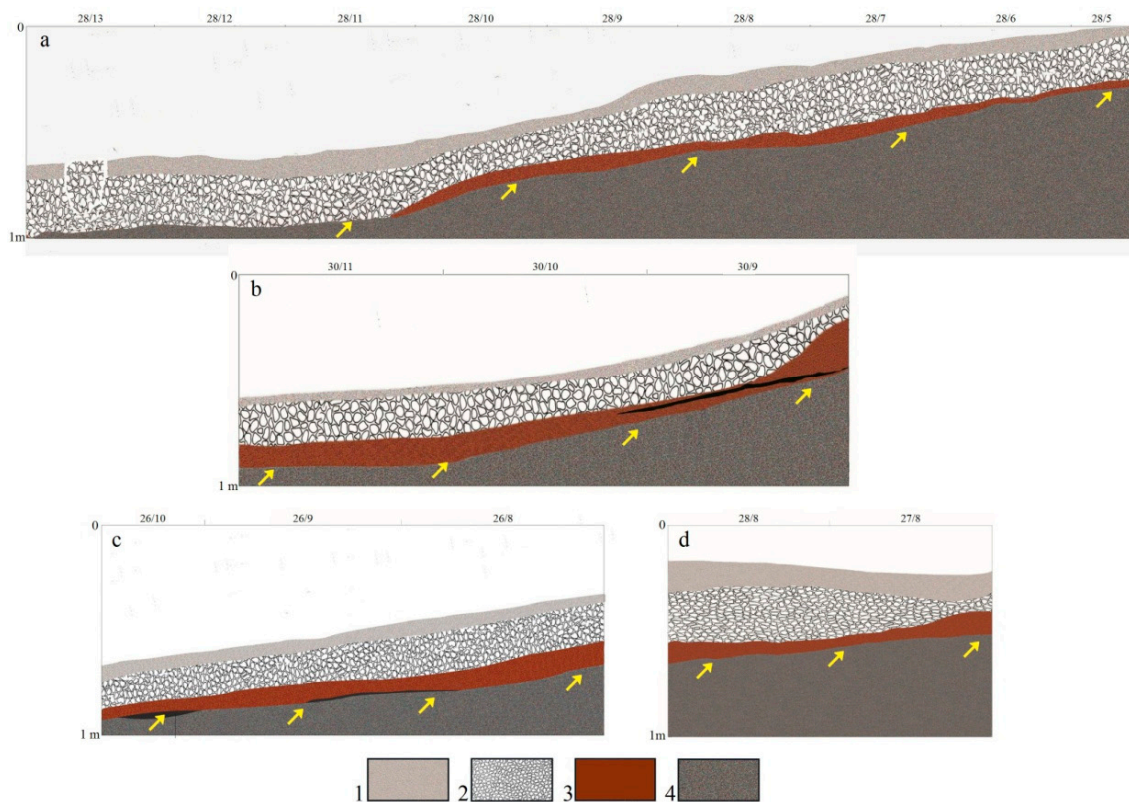


Figure 7. Examples of stratigraphic sections from the excavations of CM. (a–c) East/west direction, (d) north/south direction. References: 0 = Datum, the numbers in the upper part of the datum indicate the grids; the rectangles at the bottom show the layers. The black lenses in (b,c) are carbonized sand and a hearth, respectively. The arrows indicate the position of the PA archaeological level at the top of layer four.



Figure 8. Frontal (a,b) and upper (c,d) views of one of the hearths found at CM, *Hippidion saldiasi* bones and a Fell point indicated by the arrow and red circles in (b,d). Note the pebble layer sealing the archaeological remains pointed with yellow arrows.

The excavations allowed the discovery of a remarkable archaeological level restricted to the excavated area and performed at the front near the entrance, but mainly in the interior in the central section. Because of that, the highly disturbed surface of the cave did not allow us to test whether there was any continuity between the occupation of the frontal and central sectors. It was not possible to know whether there was a specific continuous spatial occupation of the cave. Man-made remains were also found in the grids located behind the blocks underlying a surficial calcareous crust and dated at ~4.2 kya [16], which agrees with similar dates obtained later on [39]. Following the natural slope of the cave's infilling, the PA record overlies layer four, thus, it was only excavated up to its upper part. Due to the dip in the deposit, the measurements from the datum varied in depth from around -20/25 to -125/130 cm according to the excavated sector (Figure 7), as expected.

In a broad sector in the interior, the PA remains were covered by a thick layer of pebbles and cobbles, made up of a disaggregation of blocks which had fallen from the cave walls and ceiling (Figures 7–9). In general, the PA is a widespread archaeological level, suggesting that early hunter-gatherers used a significant portion of the cave, mostly at its center, but also close to the entrance. This level provided a lot of information on the paleoenvironment and the PA way of life. Due to the existence of several hearths, broken bones, red ochre, and various kinds of stone and bone implements (e.g., flaker, tube,

and engraved artifact), the CM could be considered a multiple activity area site (e.g., [14,19]) formed by short-term occupations in different places in the cave.

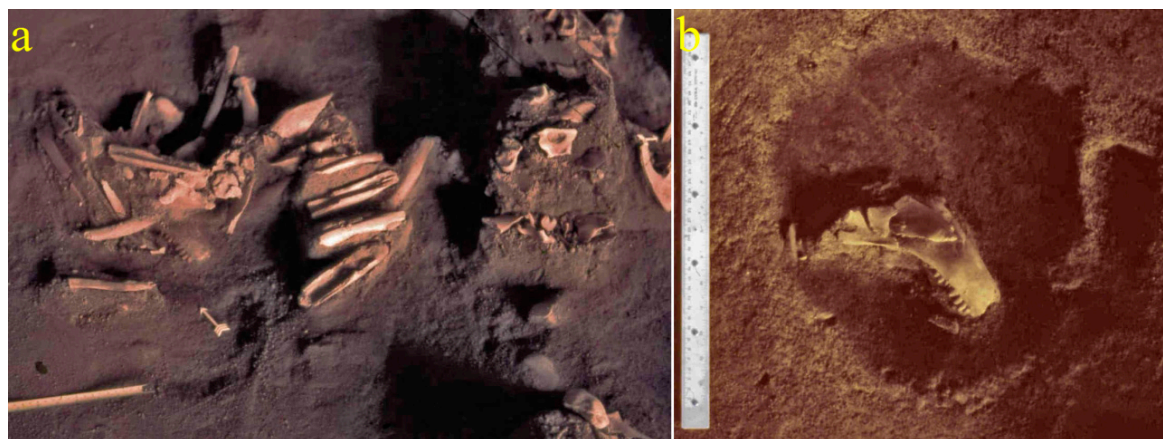


Figure 9. Images of a pile of bones placed (a) over a typical PA hearth with a concave base and a mandible of an infant horse placed on it (b).

Not comparable with bone accumulations that exist in several North American PA sites (e.g., [43,44]), among others, but like other “bone beds” from the southern cone (e.g., [45]), showing diverse clusters of remains, the PA record in the CM is a relatively thin level that follows the natural sediment dip. It shows different degrees of reliability according to its location in the excavation. In several sectors (e.g., at the front), but mostly in those covered by rocks, it was undisturbed (Figures 9 and 10) suggesting a good integrity of the record [31]. Other places showed a palimpsest, or a mix of archaeological materials derived from a variety of animal or human events or actions [46] (p. 9). In fact, in some grids there is a mix of natural (e.g., unmodified *Mylodon* vertebrae, see Figure 1 of [16] and cultural (burn and calcined specimens, or with cut marks) bones (sensu [47]). As observed during the field-work and demonstrated by several taphonomic observations on the bones recovered from the excavations, as well from the surface and sediment accumulations caused by the looters’ activities, many of them were affected by diverse natural and cultural modifications [11,14,22,28,31,48], among others.

Among the most significant finds, a lithic assemblage consisting of diverse unifacial and bifacial artifacts associated with extinct and extant fauna was recovered (e.g., [14,16,22,23]). Faunal remains exhumed at the CM include *Felis onça*, *Mylodon (?) listai*, *Duscicyum avus*, *Smilodon*, *Lycalopex culpaeus*, horse (*Hippidion saldiasi*), *Lama gracilis*, *Lama guanicoe*, and a bigger camelid, initially classified as *Lama morphotype* cf. *L. owenii* [20–23,29,48]. Currently, the latter is considered to be a Camelidae [31] and is present in several archaeological and paleontological sites along the Chilean Cordillera [49]. The initial investigations at the CM showed that during the late Pleistocene there was faunal diversity in southern Patagonia [17,21–23], and that the earliest hunter-gatherers exploited some of the species of this fauna (Figures 8–10). As observed during the archaeological excavations and by bone analysis, its largest accumulation comes from layer four, mostly Camelids, but also *Hippidion saldiasi*, were consumed by the earliest hunter-gatherers [14,17,21–23,31] (Figure 10), Numerous dermal ossicles, several vertebrae and other elements from the *Mylodon* were exhumed at the top of layer four, mainly in the NW sector of the main excavation (grids 27/11, 28/10 to 28/13, 29/12, and 29/13). Nevertheless, there is no evidence of its consumption [31,50].

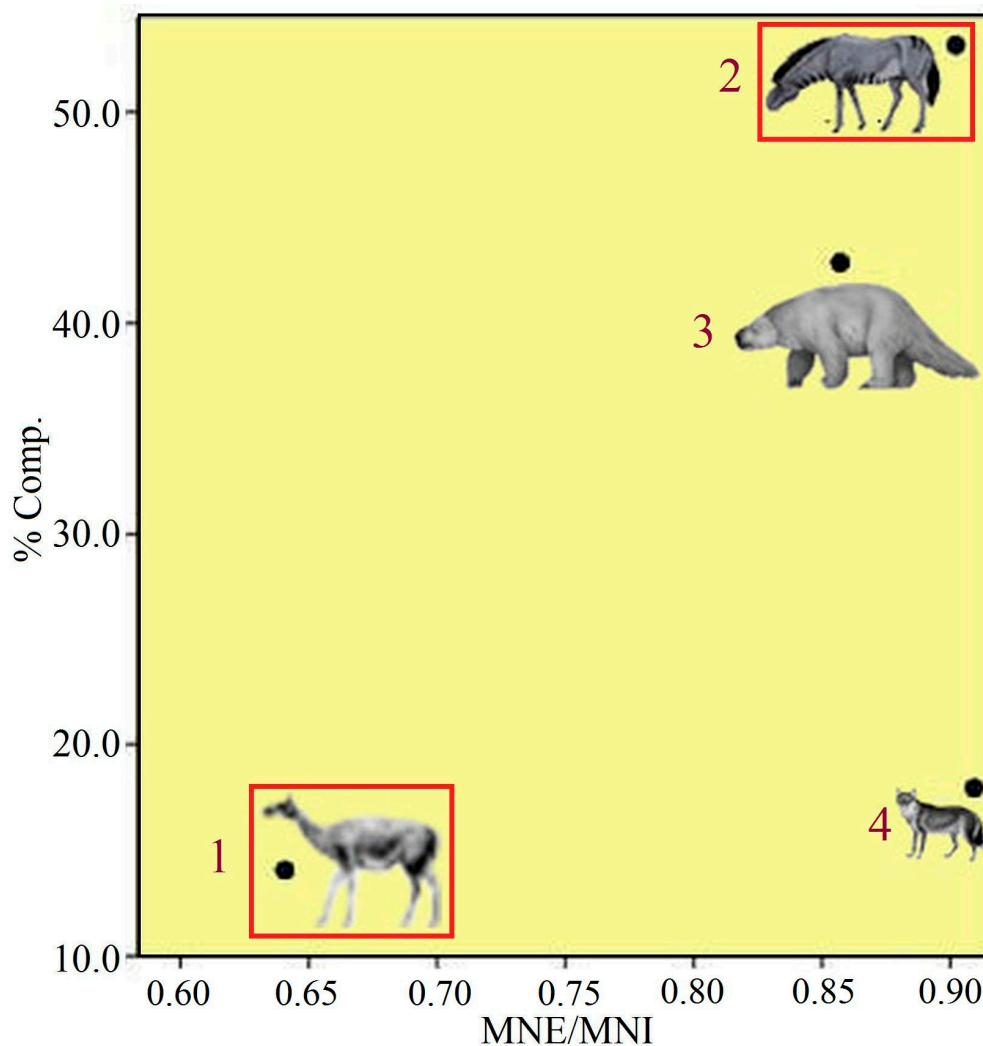


Figure 10. Relationship between the percentages of completeness (% Comp.) and the minimum number of individuals (MNI)/minimum number of skeletal elements (MNE) according to the different taxa exhumed in layer four. The rectangles show the consumed species (modified after Figure 6.2.7 of [31]). References—1: *Lama Guanicoe* and *Lama cf. owenii*, 2: *Hippidion saldiasi*, 3: *Mylodon cf. darwini*, 4: Canidae (enclose at least *Dusicyum avus*).

Different opinions have been expressed about the status of extinct fauna in the consumption behavior of the earliest regional inhabitants (e.g., [6,11,12,51]), and in particular about the exploitation of *Hippidion saldiasi* [52]. However, it is currently accepted that hunter-gatherers living during the Pleistocene/Holocene transition had a generalized diet with regional variations, using extant and extinct fauna as a resource [2,7–9,17–22,31,50,53]. In the southern cone in particular, current research on early sites reveals that a wide range of animals were consumed by humans living at ~11–10 kya [53–59], among others. The above-mentioned fauna were not only exploited for food consumption, their bones were also used as raw materials for making a variety of goods [60].

2.3. Chronological Data

At the CM, more than 50 radiocarbon dates on diverse paleontological and archaeological materials were performed [8,14,16,24,35,39,61,62]. The samples for radiocarbon analysis came from the archaeological excavations as well bone specimens from the looter's pits. Except the three samples coming from the apparently mixed deposit containing stemless triangular points and extinct fauna, the remaining ones all belongs from the PA level. A detailed list of radiocarbon assays spanning the oldest

human occupations is shown in Table 1. It depicts the calibrated ages calculated using the IntCal13 calibration program [63]. In addition, Figure 11 shows the calibrated range of those corresponding to the Late Pleistocene ages. As can be seen in both depictions, except for the two younger dates of ~9.5 and 9.7 kya, the assays related to the PA occupations belong to the last millennium of the Pleistocene range between ~10.3 and 11.0 kya, and the highest number of occurrences varies between ~10.3 and 10.8 kya. The ~9.5 and 9.7 kya dates from the FP level may be considered outsiders from the time span when the FP makers lived [42,53,63–67].

Table 1. List of AMS dates corresponding to the Pleistocene–Holocene transition obtained at CM. The dates in bold fonts comes from a level with mix of triangular points.

Material Dated	Origin	Lab. Id.	Date	Calibrated Range	Reference
Charcoal	29/8d–29/7c	PITT-0344	9595 ± 115	10,595–11,215	[8]
Mammal bones	18/11	Beta-40281	9770 ± 70	10,809–11,329	
Charcoal	23/5ab	Gr-N14912	10,310 ± 70	11,825–12,404	
Burn Mammal bones	27/10d–26/9a	Beta-58105	10,350 ± 130	11,647–12,592	[24]
Charcoal	38/40	Beta 319538	10,410 ± 80	12,073–12,524	[29]
	7/19–8/19	Beta-52522	10,430 ± 80	12,039–12,564	[16]
Camelidae bone	27/10d–26/9a	NUTA-1734	10,430 ± 100	11,988–12,619	[24]
<i>L. guanicoe</i> bone	28/6c	NUTA-1735	10,450 ± 100	12,020–12,637	
Burn Mammal bones	27/10d–26/9a	Gr-N 14911	10,550 ± 120	12,099–12,709	[8]
<i>L. guanicoe</i> bone	Indet.	Oxa-21960	10,630 ± 55	12,435–12,710	[61]
<i>Hippidion saldiasi</i> bone	53/34	Beta 344428	10,680 ± 40	12,571–12,711	[29]
	29/8c	NUTA-1811	10,710 ± 100	12,421–12,767	[24]
<i>L. guanicoe</i> bone	28/6b	NUTA-2332	10,710 ± 190	12,077–13,017	
Canidae bone	54/35	Beta 341903	10,710 ± 50	12,577–12,724	[29]
<i>L. guanicoe</i> bone	Indet.	Oxa-21470	10,720 ± 45	12,587–12,728	[61]
	Indet.	Oxa-21385	10,725 ± 45	12,591–12,730	
		Oxa-21472	10,740 ± 50	12,594–12,737	
		Oxa-21471	10,750 ± 50	12,599–12,737	
<i>Hippidion saldiasi</i> bone		Oxa-26125	10,810 ± 45	12,668–12,766	
Camelidae bone	28/6d	NUTA-1812	10,850 ± 130	12,560–13,037	[24]
Felidae, cf. <i>Panthera</i>	54/35	Beta 344430	10,860 ± 40	12,692–12,798	[29]
<i>Hippidion saldiasi</i> bone	28/5a	AA-100235	10,860 ± 110	12,595–13,008	
<i>Hippidion saldiasi</i> bone	27/10d–26/9a	NUTA-2331	10,860 ± 160	12,432–13,084	[24]
Mammal bone	Non data	AA-13018	10,885 ± 90	12,672–12,996	[35]
<i>L. gracilis</i> bone	Indet.	Oxa-21469	10,925 ± 45	12,702–12,897	[61]
Charcoal	Inner	Beta-39081	10,930 ± 230	12,280–13,300	[22]
Camelidae. bone	26/5a	NUTA-2330	10,960 ± 150	12,639–13,114	[24]
	27/10d-26/9a	NUTA-2197	11,040 ± 250	12,430–13,432	
	25/7b	NUTA-1737	11,120 ± 130	12,726–13,206	

As mentioned previously, despite the archaeological remains with triangular projectile points and their corresponding lithic assemblage being mostly present in layer three, there is a sector in the transition between layers three and four with a mix of triangular points and Pleistocene fauna (see Figure 14 in [8]). Even a few accelerator mass spectrometry (AMS) dates from the bone samples from that level yielded similar ages to those obtained from the FP occupation [24].

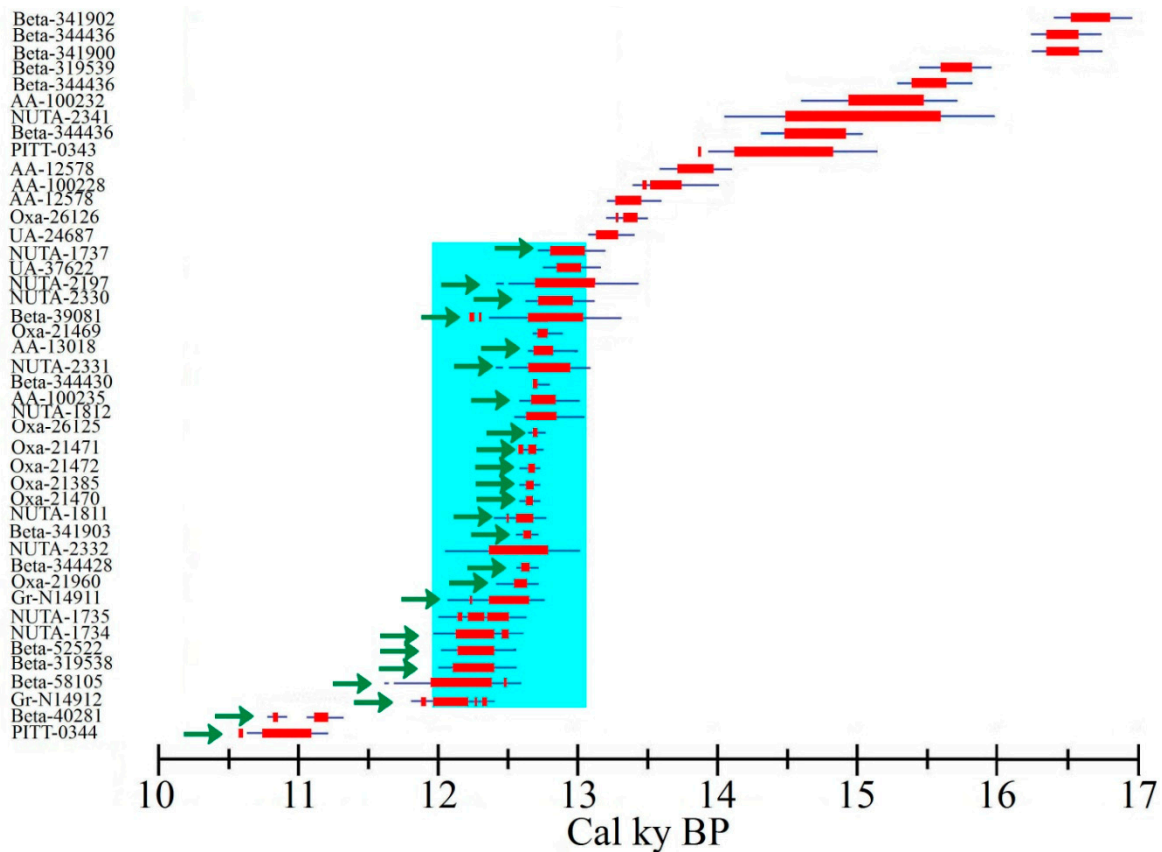


Figure 11. Plot of the calibrated dates obtained from the Pleistocene deposit from CM. The highlighted frame shows the time-span for early human occupation. The green arrows points to the dates obtained from samples coming from the PA occupation.

3. Paleo American Stone Tools at the CM

The stone tools found at the CM came from the surface, old diggings, and the excavations described above. In the central sector, the archaeological finds were as follows: layer two yielded scattered artifacts, a probable early/middle Holocene lithic assemblage with triangular stemless points in layer three, finally, in the upper part of level four were the PA remains at varying depths as they followed the natural dip in the sedimentary infill (Table 2).

Despite some having been previously analyzed, documented, and reported [8,13,18,26] in Figure 3, most of the PA pieces recovered following the third expedition were not reported in detail. Including both bifacial and unifacial flaked implements, the specimens (n = 31) described here came from the grids mainly situated in the central part (Figure 12), principally from the non-mixed sectors covered by the pebbles and blocks that had fallen from the walls of the cave. Pieces that were only considered to be of doubtful PA origin were not accounted for in this article. The collection was analyzed according to the guidelines and record sheet proposed by Aschero [68]. The salient information regarding origin, dimensions, raw materials, tool class, and other salient information is depicted in Table 2. The most notable lithic artifacts are illustrated in Figures 13–16.

Table 2. The salient morphological and technological attributes of the CM lithic artifacts reported in this paper. References: AMR: Artifact with marginal retouch, ARM: Artifact with marginal retouch in a restricted angle, B: Biface, BA: Bifacially flaked artifact, C: Chert, Ch: Chalcedony, EA: Edge angle, FB: Fractured biface, FUA: Fragment of unifacial artifact, FSR: Flake with summary retouch, L: Length, PP: Projectile point, PS: Perimeter scraper, R: Raclette, S: Scraper, SS: Side scraper, Tu: Tuff, T: Thickness, W: Width. Note: All the measurements are given in mm, () indicates a fractured piece.

Piece #	Grid	Depth	Tool	Material	Blank	L	W	T	Figure
-	18/10a	-27	SS	Tu	F	78	50	14	-
-	25/5a-c	-35/-40	PP		B	40	18	8	13a, 14a
141	28/5c	-18	SS		F	37	43	7	-
172	28/5a	-21	SS			92	50	16	-
-	26/6a, d	-45	BA			35	32	8	16b
70	23/6b	-45	PS	Ch		43	35	13	-
187	29/6c	-46	FSR			89	86	36	-
331	30/6a	-40	K			(59)	38	8	15d
378	30/6d	-40	BA	Ch		50	39	8	-
2	25/7b	-25/-30	ARM	C	Ind	(28)	35	12	16a
69	25/7d	-30/-35	BA			(31)	(15)	8	-
189	28/7b	-53	S	Tu	F	69	50	15	14c
160	28/7c	-57	SS			38	53	4	-
76	25/8a	-69	SS		TN	90	46	19	-
196	28/8c	-74	K		F	54	32	16	-
73	25/9a	-71	ARM			100	65	7	-
70	25/9b	-68	SS			(60)	84	10	-
-	25/9c	-71	SS			(50)	(50)	6	-
75	25/9b	-70/-75	SS			(28)	(40)	38	-
69	25/9c	-71	FUA		F	(47)	(47)	7	-
-	26/9a	-86	PP		B	48	27	6	13b, 14b
198	27/9b	-83	K			75	32	8	14d, 16d
-	27/9c	-92	R		F	82	31	3	16e
204	28/9c	-83	AMR			(53)	35	12	-
381	28/9c	-80/-85	PS			62	53	11	15b
-	27/11b	110/-115	SS			73	82	21	-
210	28/11a	-132	SS		Ind.	93	75	23	16c
348	29/11b	-108	SS			102	32	12	15c
383	30/11d	-113	SS			85	95	25	-
365	29/12d	-115	FB			36	42	11	-
361	29/12b	-123	SS		F	56	(37)	10	-

Most of the rocks used for making the PA tools were acquired in the secondary sources that were locally available in the glacial deposits surrounding the CB [8,69]. Despite a lack of scientific provenance analysis studies, it has been suggested that the chalcedony came from the Sierra de Los Baguales, a place located ~108 km north of the site [50]. With regard to the first step in the reduction sequences, throughout the excavated sectors, no evidence of blank obtaining activity was detected. As previously reported up to the second expedition Figures 19 and 20 of [8] and as observed in the following field-work, the lithic debitage suggests that shaping and re-sharpening activities were performed. Then, bearing in mind the evidence from the excavation, like their other survival exploitation activities (e.g., wood for fuel, hunting), the PA groups might have obtained the flakes off site.

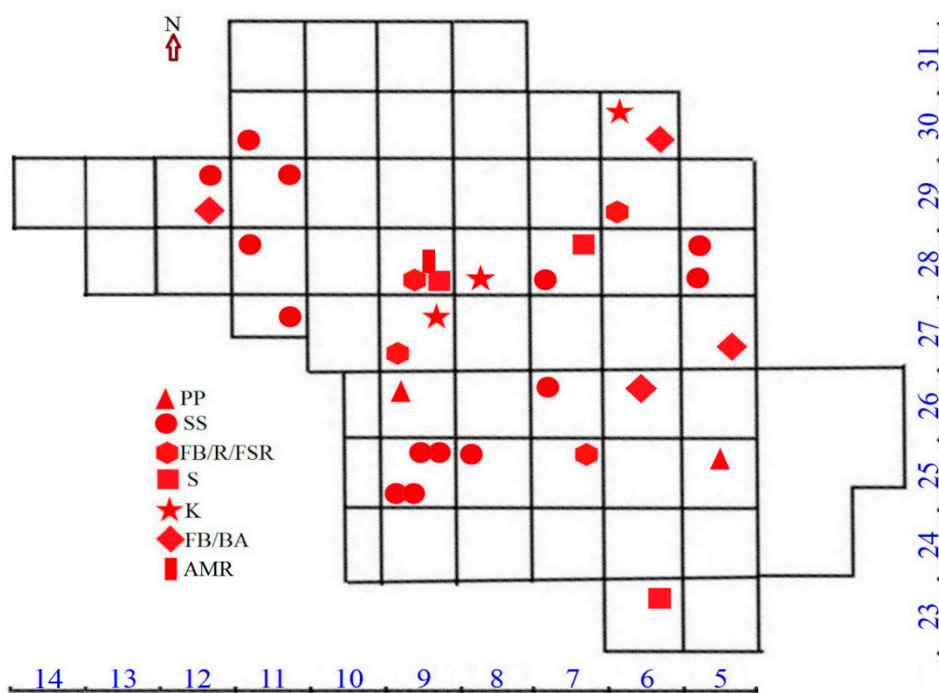


Figure 12. Distribution of the PA artifacts in the main excavation. The detail of each piece is given in Table 2.



Figure 13. Fell points found in the Paleoamerican level from CM. (a,b) from Nami’s excavation, (c) approximate drawing based on photograph after Figure 14 of [29], (d) from the Epullán locality.

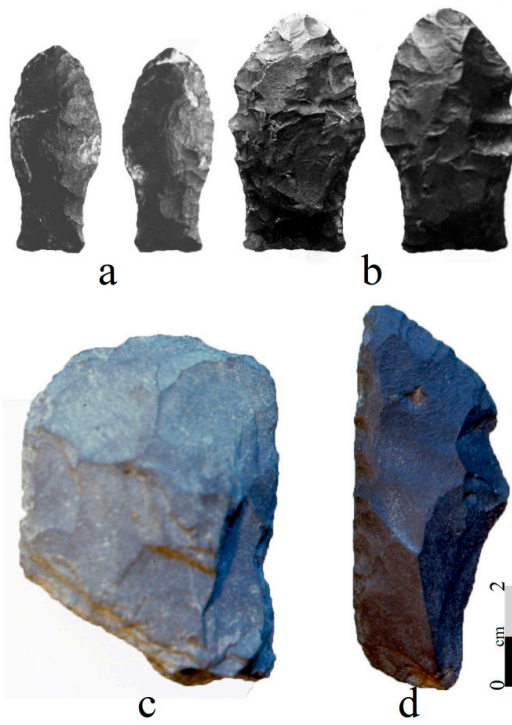


Figure 14. Bifacial and unifacial implements exhumed in the Paleo-American level of CM (a,b) “Fishtail” projectile points, (c,d) unifacial tools.

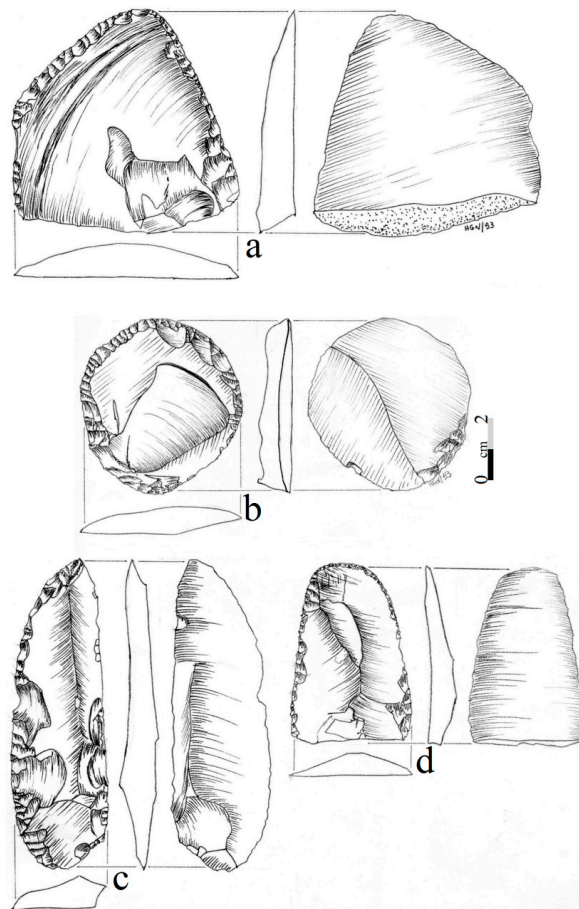


Figure 15. Unifacial tools coming from the Paleo-american level of CM. Depictions (a–d) are given in text and Table 2.

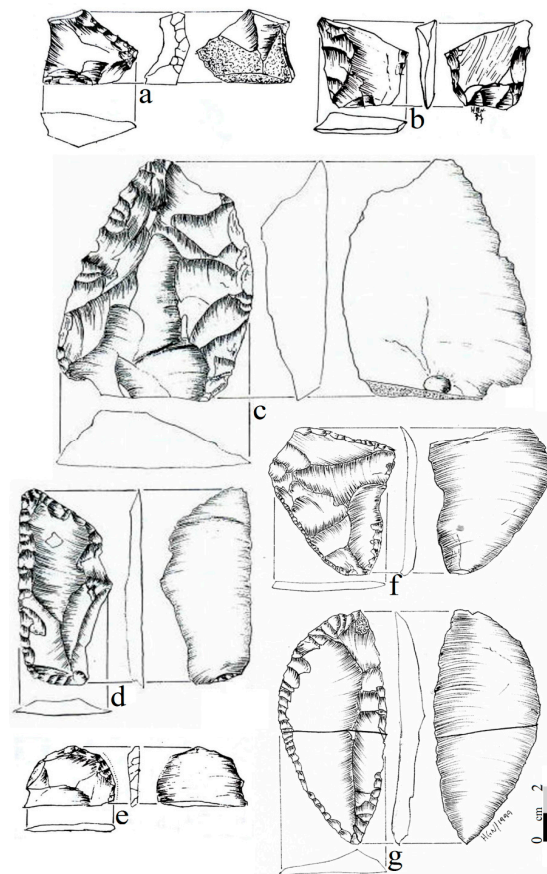


Figure 16. Drawings illustrating diverse Paleo-American flaked artifacts. (a–e) from the CM, (f–g) Fell’s cave. (a,c–g) Unifacial tools, (b) early manufacturing stage of a “fisthail” point.

During the former field-work, two FPs were exhumed (Figures 13a,b and 14a,b), furthermore, an additional broken specimen was recovered [29]. The initial finds were similar in shape with the expected FP “typical” variations previously found in the Fell and Pali Aike caves [3–5]. However, a more recent find has a slight difference in its stem and shoulder (Figure 13c), mainly because in its base it lacks the ears that define “typical” FPs. In this way, it constitutes one of the variations, namely, the contracting stem observed in other South American localities (see Figure 21 of [2]), some at the Jaywamachay rock shelter (see Figure 2c of [66]), El Inga, Ecuador (see Figure 22c of [70]), and Paso Calderón, Uruguay (see Figure 2 of [71]). Interestingly, at that time it was not recognized as an FP, and almost at the same time as the initial systematic work at CM, a similar specimen was found on the surface at one of the surveyed sites in the Epullán locality, NW Patagonia [72]. Coincidentally, in that area, the Epullán cave yielded an archaeological record that spanned the FP makers [19,73,74].

The FPs exhumed in the previous diggings seem to be re-sharpened artifacts, especially one with a clear flute-like impact fracture originating from its tip (Figures 13b and 14b). In this regard, some doubts remain about the smaller one (Figures 13a and 14a), which was probably rejuvenated close to its tip. With a narrow blade, this piece might have been one the lanceolate variants made by hunter-gatherers using this sort of point (see Figure 22 of [2] and Figure 19b of [70]), [21,75] Figure 5d,o. The fracture in the stem as illustrated in Figure 13c was probably produced by an impact [8,76]. As can be seen in Figure 13b,c, from a manufacturing viewpoint the FPs were finished with short irregular retouches achieved by pressure flaking not very carefully applied to a flake blank, a kind of pattern regularly used by FP makers [69,75,77–79]. Like other FPs, the specimens illustrated in Figure 13a,b show abrasions on the edges of the stems (e.g., [53,63,70,77]).

With the exception of the projectile points and a few fractured bifacial specimens, one possibly broken during the early manufacturing stage (Figure 16b) made by bifacial reduction, the remaining

units ($n = 27$) were unifacial, mainly side scrapers and knives of various dimensions. However, the remarkable ones are those that are larger in size (Table 2, Figures 14c,d and 16c,d). In Argentinean lithic studies, “knives” and “side scrapers” are arbitrarily differentiated by the value of the edge angle cf. [80], however, this sort of implement might have had diverse functions, which is why some archaeologists call them “multipurpose tools” [81]. For example, actualistic experimental studies demonstrated that “side scrapers” were highly useful for sawing whale bones [82]. Apparently, the largest unifacials might have not been subjected to repetitive re-sharpening, as they were habitually subjected [83,84]. They were probably shaped and employed at, or near the site, and then left there after use. Bearing in mind the initial distinction between “curated” and “expedient technologies” [85] and other discussions (e.g., [86]), it could be suggested that some of those from the CM might have been curated tools. In fact, as “techno-units” of more complex utensils [87] (p. 8), FPs were part of “personal gear, while large-sized unifacials seem mostly to have been related to a curated behavior for furnishing the site [85].

The unifacial implements were made using tertiary flake blanks obtained by hard hammer, direct percussion flaking, mostly exhibiting flat and diffuse force application bulbs, as experimentally observed in the tuff from the CB [88], the retouches vary from short parallel to scaliform. When a flake’s dorsal and ventral faces are visible, most retouches are direct (Figures 15c,d and 16), and inverse in a few cases (Figure 15a,b). It is highly probable that final shaping was performed by simply retouching a blank’s edges using the same technique, but with another variant and/or holding position, and using soft or semi-soft percussors (e.g., [89]). However, as can be seen in Figure 16c, there is a specimen that shows a more complex manufacture that consisted of flaking the blank, with the covering unifacial flaking likely employing soft percussion, after which it was finished by retouching the edges. A comparable manufacture was observed in coeval assemblages found at the El Ceibo and Los Toldos caves in the Deseado massif in Santa Cruz Province, Argentina (see Figure 7b of [2] and see Figure 91 of [90,91]). Interestingly, a comparable production was recently identified as being early Patagonian Holocene lithic assemblages [89,92,93]. It is worth mentioning that in locations where local raw materials were available, large unifacial tools are present at sites where there is evidence of hunter-gatherers living during the last millennium of the Pleistocene (e.g., see Figure 6 of [63], [94,95]), but also during the middle and late Holocene occupations in southern Patagonia [3–5,89,92,93].

Morphologically, the largest unifacial instruments are akin to the so-called “level 11 industry,” which, without FPs, were found in the lower levels of the El Ceibo and Los Toldos caves, but with a similar chronology [90,91]. There were also some with FPs at the Pali Aike and Fell caves [5] (Figure 16f–g) as well as at the Piedra Museo rock shelter, see (Figure 8.24–8.29 of [95]). Further, the lithic finds at the CM and other sites allowed us to understand locales where there were no FPs, but with other comparable artifacts, earlier attributed to “unifacial flake industries” (e.g., [12,18,91]), see pp. 170–171 of [63]. Advances in research show that several sites without FPs but with unifacial tools (e.g., Cueva del Lago Sofía, e.g., [9,96,97]) may have been part of these sites’ variability, where there were hunter-gatherers who used these kinds of points [19,63,98]. A similar fact might be expected for “unifacial traditions,” with large utensils proposed in other South American countries such as Brazil [99,100], where an important FP surficial record was recently reported [101,102]. Interestingly, a specimen from Bahia State (see Figure 22e of [2], Figure 1k of [78], and Figure 1c of [103]) was found along with large unifacial side scrapers made from the same material [104,105].

4. The Early Inhabitants of the Cueva del Medio and Considerations on Late Pleistocene Archaeology in Southern Patagonia

As a part of the significant changes that were occurring on Earth during the terminal Pleistocene, South America showed a different vegetation and environmental picture than today (Figure 17). Several studies have already been undertaken to provide insights into the paleoenvironment prevailing at the time of the PA occupation. In fact, the studied area was characterized by a periglacial environment with a tundra biome [53,106–108]. The palynological sampling performed during the CM excavations

yielded a pollen and spore diagram that included the late-glacial-Holocene transition to the Late Holocene (Figure S1 in Supplementary Materials). The samples taken from the top of layer four at the PA level show a predominance of Gramineae (grass), following an episode of treeless grass steppe, as observed in levels two and three, while *Nothofagus* (southern beech) in the sample from layer one implies the late arrival of trees at the CM [26]. The archaeological evidence demonstrates that species of this flora were employed by early hunter-gatherers; in fact, andragogical studies on burned wood from PA hearths show that they used *Nothofagus pumilio* and, probably, *Empetrum rubrum* [8]. Bearing in mind the local paleontological record, this sort of vegetation was consumed by different species of herbivorous animals such as ground sloths (*Myiodon* sp.), horses (*Hippidion saldiasi*), camelids (*Lama* cf. *owenii*, *Lama gracilis*, *Lama guanicoe*), and cervids (*Hippocamelus bisulcus*), some of which provided different kinds of resources, mainly food and raw materials for making bone implements [60] and, probably, other goods.



Figure 17. Map of the ecological regions in South America at the Pleistocene–Holocene transition (based on [106,107], and modified after Figure 2 of [109]).

A significant climatic feature of southern Patagonia is the westerlies, which are the prevailing winds in the middle latitudes of the Earth's atmosphere, blowing from west to east between the high-pressure areas of the subtropics and the low-pressure zones over the poles [110,111], a phenomenon that might have had a certain influence on southern Patagonian prehistory [112,113]. During the PA period, regional glaciers were retreating and the area under study was still a harsh environment [1]. Despite this, the archaeological and paleo-ecological evidence shows that this landscape provided a favorable habitat when the earliest foragers arrived at the CB. During the earliest periods, they were possibly not entirely familiar with the surroundings, however, as time progressed, they undoubtedly became more knowledgeable. It has been suggested that it takes considerable time, energy, and experimentation to learn about and know a landscape in-depth [114], so mobility patterns would have needed to be adjusted in order to exploit the available survival supplies more effectively. However, for basic survival resources such as rocks, wood fuel, and some animals, their familiarization with their habitat may have been rapid [63,114]. In this regard, the ecosystem offered significant resources for existence, as well as rock shelters for refuge, mainly when adverse weather made outdoor life difficult.

Despite the harsh environment in the CB at the time of the PA occupation at the CM, this cave offered an excellent shelter for humans, especially during the winter. In order to control the CM's advantage as a refuge, during the fifth and sixth expeditions the temperature of the CM was systematically taken three times a day in the portions mentioned above, as well as outside the cave. As can be observed in Figure S2 of Supplementary Materials, both in the central part and at the rear, temperatures ranging from 8.5–9.5 °C were relatively constant, while those at the front were ~1–2 °C higher, but more variable and related to the outside values, which were generally ~5 to 10 °C higher during the summer. Despite some adverse atmospheric phenomena occurring outside-of course, during the time of the PA occupation these values may have been lower-the CM offers excellent protection, mainly in the central portion, where the influence of what is happening outside is less, especially wind and rain. Like other caves that this author has excavated and lived in southern Patagonia e.g., [115–117], among others, many offer excellent protection for humans and animals. In addition, they also protect from the large and unpredictable daily local climatic variations, because on the same day it can rain, there can be strong winds, and the sun can shine.

It is worth mentioning that the majority of the taxa found at the CB represent species that were affected by the large worldwide Late Pleistocene mass extinction, a highly complex topic in the Earth's history (e.g., [118,119]). Varied theories and hypotheses have been proposed about this sort of event (e.g., [120]). Similar accounts were considered for the phenomenon that occurred at the end of the Pleistocene worldwide, and in particular for southern Patagonia [121]. One that deserves to be mentioned is the "overkill" hypothesis, where prehistoric hunters played an important role (e.g., [122,123]), among others, a widely discussed approach cf. [124,125]. In the southern cone of South America, this alternative is considered to be one of its causes [121,126]. However, regional archaeologists agree that the PA population numbers were apparently low [127,128], and reliable archaeological sites with evidence on its exploitation are scarce. Besides, it is important to bear in mind that hunter-gatherer societies had very simple traditional techniques for hunting and surviving, and the number of projectiles found there is extremely low. Hence, in the complex environmental situation in southern Patagonia, even if there was some human influence on the mega mammals' extinction, it would have been negligible.

When discussing the above-mentioned topics, it is important to bear in mind that close by the CM, paleomagnetic research performed on a terminal Pleistocene-early/middle Holocene sedimentary section in the Mylodon cave recorded a possible geomagnetic field (GMF) excursion [129]. It is defined as a deviation of the virtual geomagnetic pole by more than 40–45° from the geographic pole (Figure 18) and as causing a major deviation in the GMF's behavior during a brief time span [130,131]. Additional evidence has been observed at the CM, and at other sites in Patagonia and southern South America [25,132–135], as well in other parts of the world see [136,137]. As previously discussed [138], paleomagnetic records with anomalous directions may be due to several reasons, but they may also reflect true GMF excursions. This kind of event might have caused major planetary environmental alterations [134,139,140]. In particular, the mechanisms triggered by these magnetic excursions might account for evolutionary discontinuities in humans and other animals, considering the increase in cosmic and ultraviolet radiation. Climate change and biomagnetic dysfunctions have also been proposed as mechanisms that may have accompanied the excursions and reversals [141]. As pointed out by Vizán and colleagues [142], during this sort of phenomenon, there are strong variations in the dipole moment [143] that might lead to a significant modulation of the magnetosphere and its shielding mechanism [144], which could be linked to a flux in the galactic cosmic rays reaching the Earth's atmosphere, thus affecting the terrestrial weather system (e.g., [145]). Of these, increased ultraviolet radiation and biomagnetic disturbance are the most likely causes of biological modification. In this regard, from the perspective of human evolution, by performing a statistical test during the period 125.0–10.0 kya, when the Blake and Mungo excursions took place, Kopper and Papamarinopoulos [141] observed a strong correlation between both these events and times of abrupt physical and cultural changes in Old World prehistory [146–148]. The former coincides with the disappearance of Lower

Paleolithic technology and the appearance of Middle Paleolithic (Mousterian) tools and Neanderthal Man, the latter synchronizes with the Middle/Upper Paleolithic boundary and the decline of *Homo neanderthalensis*, also in concurrence with the rapid high-amplitude climatic fluctuations that led to the Last Glacial Maximum [148]. By considering this and bearing in mind that during the last millennium of the Pleistocene and early Holocene, a significant number of records with intermediate and reverse directions around the world have been reported in North and South America, Eurasia, and Africa (e.g., [136,137,149,150]), a fact that led to the hypothesis of the possible global existence of this GMF anomaly during the time of the PA occupation. Hence, if the “Mylodon excursion” was a real fact, it is important to bear in mind that it happened during a time of crucial local and global transformations that gave rise to the Holocene [151], thus influencing the major paleoecological changes that occurred at that time. Like the reversals, it might also have had some effect on faunal extinctions [152–154]. Thus, the possible ~12–10.3 cal. kya short duration excursion cf. [152,155] might have had some kind of influence on the local archaeological process. In addition to this possible major cause of alterations, north of Ultima Esperanza in southern Chile, multidisciplinary research performed on sediments has suggested that a cosmic-impact generated biomass burning, climate change, and megafaunal extinctions at 12.8 cal. kya [156].

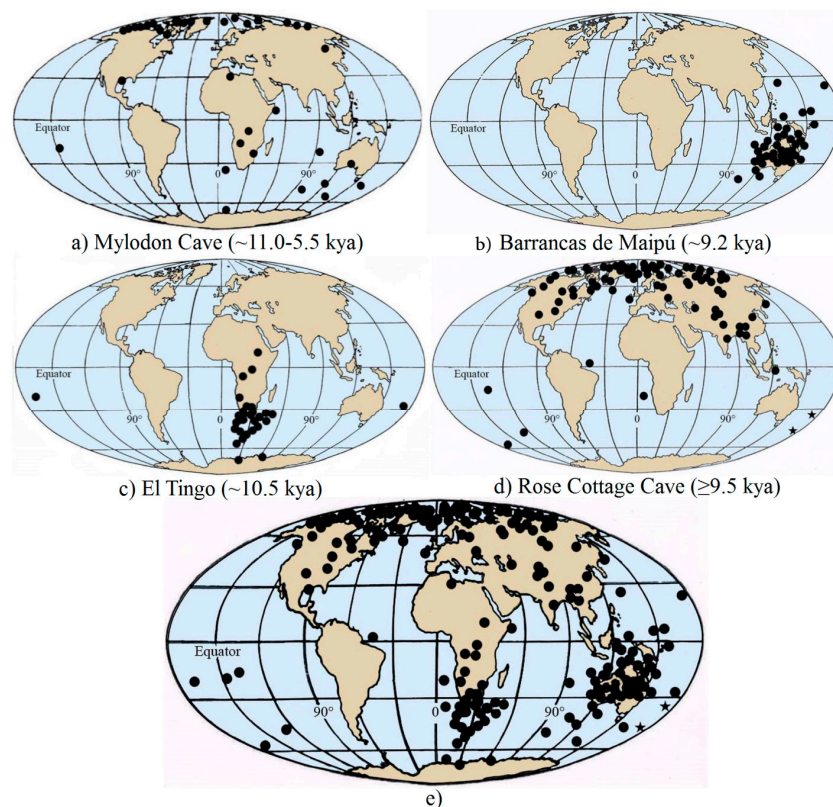


Figure 18. World map and location of the virtual geomagnetic poles calculated from samples with anomalous directions recorded during the Pleistocene-Holocene transition and early Holocene in some sites from: (a) Chile, (b) Argentina, (c) Ecuador, (d) South Africa, (f) The totality of Virtual Geomagnetic Poles from the locales illustrated in (a–d). Modified after [129,136,137,149].

At this point, it would be valid to consider the survival or extinction of PA populations in the region, and lithic technology in particular may help explain this topic. In fact, because stone tools were made by craftsmen and were the results of a particular traditional technological knowledge (TTK) shared by a certain socio-cultural system, they constitute a “fossilized” record of human behavior [157,158]. Maintained in its members’ procedural memory [159,160], among other components, the technical expertise has its own recipes for fabrication, which involve the know-how for making them [157,161,162].

In summary, as part of the recipes for the fabrication of lithic tool making, shaped implements made by a determined socio-cultural group shared particular technological and morphological features. In the light of this theory, it is important to bear in mind that from a morphological and technological viewpoint, there are significant differences between the implements made by the FP makers and the lithic assemblages that came later in time (e.g., [3–5,92,115,116,163]). These dissimilarities are probably evidence that the PA technology was replaced by a different TTK shared by other socio-cultural groups. In fact, FP lithic assemblages were supplanted by others with triangular projectile points made using a different conception of bifacial reduction cf. [163,164] and the use of other forms of unifacial tools (cf. Figures 36–41) of [90], and Figures 8.24–8.29 of [95], some of which were made by employing a particular form of unifacial shaping [89,92]. This change allows us to hypothesize the extinction of PA technological knowledge and, consequently, the disappearance of the human groups that used it. This shift in technological patterns is likely the result of either socio-cultural and/or environmental changes between the Terminal Pleistocene and Early Holocene. Remarkable are the conclusions of a genetic study on South American human bone remains that link the earliest skeletons with those found at the Anzick burial and Clovis cache site [165]. Later, there was a population replacement at ~10 cal. kya with further continuity [166]. The oldest dates of the stemless triangular points in Patagonia are of a similar age [92,115,116] and, due to their distribution in the southern cone of South America, they probably represent human groups that came from the Andean region, probably Peru [53].

Finally, during the last decades several archaeological sites demonstrated the existence of pre-Clovis and pre-Fell occupations dated at ~15 cal. kya in North and South America (e.g., [167–171]) among others. Besides, by ~13–11.5 cal. kya the archaeological remains from that time show that a broad diversity of projectile points was employed in the Americas. Remarkably is that Clovis—the oldest fluted point—had spread throughout North America by ~13.0–12.7 cal. kya [172]. Similarly, in South America, the FP was a widespread lithic marker dating from between ~13–12 cal. kya [63–67,173]. Remarkably, the oldest dates of CM partially overlap the Clovis ages. Like classic Clovis points from the Great Plains, several FPs from Central and South America display true flutes, a reason why some scholars suggested its origin in the North American point [174]. However, most South America researchers conclude that they are technologically distinct in both morphology and reduction sequence [162,175–177]. Additionally, the early South American sites reveal marked diversity in lithic technology and subsistence pursuits [178,179]. The growing information on the New World human colonization shows that this process involved a complex scenario [180,181]. Actually, most scholars now believe that the Americas were peopled more than once [180], and that the different colonizing events produced remarkable technological and adaptive diversity, with the Pacific coast as the main initial entry route [169,182]. However, the Atlantic seaboard and the still-remaining Late Glacial Maximum exposed continental shelves might also have played a significant role in the expansion of the FP users [183–186]. Due to the similarities observed between the Central and South American FPs and the fishtailed specimens from eastern, and mainly southeastern North America, it is possible to hypothesize that there was a certain techno-morphological continuity in both areas [184–186]. Hence, as part of the various colonization events, hunter-gatherers using “fishtailed” points in North America might have been colonizing South America during the terminal Pleistocene by passing along the Central American isthmus and across the exposed continental shelves that existed in the Gulf of Mexico and the Caribbean Sea. The spreading from northern South America might have been followed two main “routes”: one through the Pacific slope and the Andean Cordillera in the west [186], and the other through Atlantic slope in the east [186,187]. In this scenario, despite it is located where the continent became narrower, and both “routes” may converge, in the colonization process of Patagonia, the FPs makers living at CM might belong to the major Pacific/Andean “route”, and being one of the southernmost sites located in western South America witnessed by the finds of Salar Punta Negra [188], Quebrada Santa Julia [189], Valiente [190], Tagua-Tagua [191], and Salto Chico in Chile [167], and those FPs surficial finds performed in the Salta, Catamarca, Mendoza, Neuquén, and Río Negro provinces in Argentina (e.g., [192–195]).

5. Final Remarks

In summary, the re-discovery and excavations at the CM became a turning point in the study of the oldest hunter-gatherer societies living in southern Patagonia, as well in the development and continuity of the regional research and scientific community. Due to the looting and excavations that occurred at the end of the 19th century, a large portion of the CM's archaeologically excavatable surface was destroyed. However, intact deposits yielded evidence that is still useful for reliably discovering the regional and continental human past regarding the peopling of the Americas. Finds from there have been extremely useful for discussing diverse paleo-ecological and archaeological topics and have extended the knowledge and discussions about different Pleistocene scientific topics, mainly to understand the earliest regional human occupations. The finds performed at CM provided insights into the paleoenvironment prevailing at the time of the PA foragers that interacted with an important Late Pleistocene faunal diversity, some of which were exploited for consumption. In this regard, with highly controlled chronological data, the sealed and direct association between the bones of extant and extinct fauna allowed us to discover and discuss the consumption habits of the early foragers who used FPs as part of their weaponry. In particular, from the stone tool analysis perspective, it is one of the few sites yielding FPs in association with the assemblages accompanying them. By this way, the aforementioned investigations expanded our understanding and knowledge of the earliest colonizers of southern Patagonia and human-megafauna interaction before extinction.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2571-550X/2/3/28/s1>, Figure S1: Pollen and spore diagram from the samples taken at CM. The numbers in parentheses on level three indicate depths in cm below the datum. Modified after Figure 4 of [26]. Figure S2: Comparative graphs of the daily temperature recorded at the CM during the morning (a), at midday (b), and during the afternoon (c). References—C: Cloudy, PC: Partly cloudy, R: Rainy, S: Sunny.

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