

## **A Teppa di U Lupinu Cave (Corsica, France) – human presence since 8500 years BC, and the enigmatic origin of the earlier, late Pleistocene accumulation**

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**Abstract.** The A Teppa di U Lupinu Cave (Haute-Corse, France), about 15 m deep and 2 m high, is a remnant of a very ancient karst. It contains a large volume of sediments ( $8 \pm 1 \text{ m}^3$ ) in the deepest part of the southern diverticulum, comprising millions of fossil remains of small vertebrates, extinct and extant, including a small proportion of burnt bones, and abundant charcoal fragments and ash. Faunal associations and absolute ( $^{14}\text{C}$ ) dates allow us to assign most of the fossil accumulation to latest Pleistocene (17,000-13,500 BC) and earliest Holocene dates. Archaeological materials, remains of recently established mammals, and radiocarbon dates attest to reworking of the accumulation during the Holocene. Here we present the results of the paleontological study of this accumulation, and propose interpretations for its formation. Four dates obtained on the shed deer antler, charcoal fragments and burnt bone, yielded results ranging from ca 8500 years BC through to the middle Holocene. We demonstrate that their origin is anthropic, which points to the presence of man in the early Holocene, in line with what is known in other localities. However, the origin of the main accumulation of small vertebrates, dated to the latest Pleistocene, remains enigmatic, with two plausible scenarios. In the first one, it would be an accumulation by owls (*Tyto alba ernesti*, *Bubo insularis*). Man-made fires would have later produced charcoal, ash and burnt bones, which were subsequently mixed with the bulk of fossils by massive reworking. However, some taphonomic characteristics are inconsistent with this origin, such as the anatomical representation of amphibians, and the lack of evidence for sufficiently profound reworking. This leads us to favour a second hypothesis, where man would have cooked, consumed and accumulated most of the vertebrates in the earlier period, including the abundant shrews. Charcoal fragments, ash and burnt bones would have been mixed initially with the bulk of fossils (unburnt bones), and more moderate reworking would have followed until modern times. Such a diet for prehistoric man, although odd, cannot be excluded on the basis of present-day arguments. However, dating evidence for older fires is lacking so far. Therefore, continued investigations will be needed to confirm one or the other scenario. A late Pleistocene human presence in the cave would be one of the earliest in Corsica. Roughly contemporaneous presence of humans is known in nearby Sardinia, which was contiguous during cold periods of the Pleistocene. This hypothesis would also be consistent with some recent results in population genetics.

**Key words:** Fossils, Holocene, karst, lithics, Palaeolithic, Mesolithic, Neolithic.

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## I. INTRODUCTION

The A Teppa di U Lupinu Cave (Santu Petru di Tenda, Haute-Corse, France) (Fig. 1) was rediscovered in 2001 by the speleologist Association «I Topi Pinnuti». Charles FORSYTH-MAJOR, looking for evidence of Palaeolithic human presence in Corsica, explored the cave twice, in 1911 and 1923. He excavated it briefly in 1923 and found fossil remains of mammals, as well as lithic artefacts, now stored in the Naturhistorisches Museum Basel (Switzerland), and the Museum of Bastia (Corsica). The inadequate lighting (oil lamps, candles?), and the poor visibility at the bottom of the cave, certainly constituted an obstacle to excavations at that time. The mention by FORSYTH-MAJOR of the extinct Corso-Sardinian endemic cervid *Megaloceros* (*Nesolepoceros*) *cazioti* DEPÉRET, 1897 (FORSYTH-MAJOR 1913) needed to be verified, and was important because this species would indicate that at least part of the accumulation dated to the earliest Holocene, or earlier. Several paleontological localities in Corsica have yielded fossils of this cervid, that establish its presence from the Middle Pleistocene (Castiglione 1, SALOTTI et al. 1997) to the end of the Late Pleistocene (La Coscia, BONIFAY et al. 1998; Castiglione 3PL, SALOTTI et al. 2000; Gritulu, Monte Leone, VIGNE 1999a,b,c; COSTA 2005). The species is by contrast consistently absent from younger, Mesolithic levels dated to the VIIIth millenium BC (Torre d'Aquila, Strette, Araguina-Sennola, Monte Leone, VIGNE 1995; VIGNE et al. 1997, 1998). Thus, the importance of A Teppa di U Lupinu appeared critical to better understand the late Pleistocene paleocommunities, and to investigate a possible human presence at this time on the island. The Late Pleistocene in Corsica is still a rather poorly documented period, with only four localities known at present. In Sardinia, the presence of man is attested at the end of the Late Pleistocene (20,000 BP and 13,000 BP) at Corbeddu Cave (SONDAAR et al. 1984, 1993, 1995; KLEIN-HOFMEIJER et al. 1987; KLEIN-HOFMEIJER 1997; SONDAAR 2000), and SPOOR (1999) did not question the date at 20,000 BP. In Corsica the presence of man earlier than the VIIIth millennium is debated and very controversial, the most recent data attesting to the first human presence starts during the Mesolithic (9000 BC, VIGNE 1999a,b,c, 2000; COSTA 2005). In this paleontological and archaeological context, excavations were conducted in the southern diverticulum of the cave in 2003 and 2004. In parallel, all the material of the FORSYTH-MAJOR collection in Basel and Bastia was re-examined.

## II. GEOGRAPHICAL, GEOLOGICAL AND STRATIGRAPHICAL CHARACTERISTICS

The karstic cavity of A Teppa di U Lupinu opens in a small cliff of metamorphic limestone and calc-schist, at the northern edge of the village of Santu Petru di Tenda (Haute-Corse), at an altitude of 350 m (Fig. 2). It dominates the Lavandaghju River. The cavity was formed within the geological unit of the Monts de la Torre, which comprises metamorphic limestone and quartzites associated with calc-schist, and was dated to the Triassic-Jurassic (ROSSI et al. 2001a,b). The cavity comprises

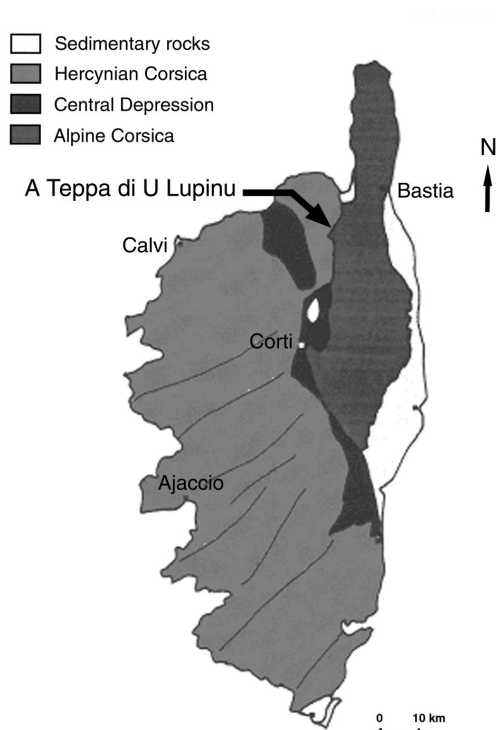


Fig. 1. Simplified geological map of Corsica (modified after GAUTHIER, 1983) with location of A Teppa di U Lupinu cave.



Fig. 2. Opening of the cavity of A Teppa di U Lupinu and cliff, viewed from outside.

two diverticuli (Fig. 3): the northern one, with a nearly horizontal floor devoid of sediments, and the southern one, the one considered here, which is rich in extremely fossiliferous sediments. It consists of three parts:

- A part close to the opening of the cave, relatively steep, with as a consequence no sediments. The wall rock (metamorphic limestone) outcrops are covered with calcite;
- A middle, sub-horizontal part, covered, before the start of the new excavations, with wood, stone and earth debris, and constituting the stratigraphic units U.S. 1 (Unit of Stratigraphy 1), U.S. 2 and U.S. 3 (surface U.S. not considered further here);
- A deep part (Fig. 4) constituting a voluminous mound of sediment in which charcoal is very abundant in every level. The volume of this accumulation of sediments, occupying all the back of this diverticulum, is estimated at  $8.4 \pm 1 \text{ m}^3$ .

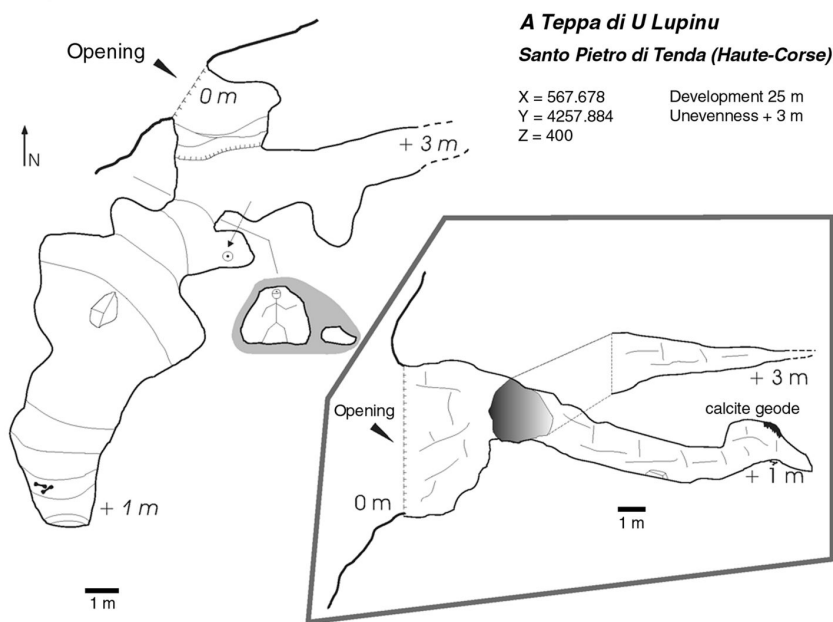


Fig. 3. Topography of the cavity of A Teppa di U Lupinu. Sections from above and from the western side. Created by the speleology society "I Topi Pinnuti" (J.-N. DUBOIS, 10 November 2001. Scale 1/100).

A north-south and west-east grid was installed in the southern diverticulum with  $1 \text{ m}^2$  squares (Fig. 5). The stratigraphic units and the anthropic materials were systematically recorded. Every unit was numbered and located according to squares within the grid. We describe here the results of the study of the squares A, A', A2, B, B', C and C2 in the mound (Fig. 5; Table I). The depth of sediment excavated is not homogeneous across the squares, and the thickest part (slightly over 1 m) is located towards the back of the cavity (Fig. 4). Cross sections of the mound show inclined layers, which together constitute a cone (Figs 6, 7). U.S. 4, the surface layer, extends over a wide surface, and covers the entire mound unconformably (Fig. 6). Its thickness varies from a few centimetres to ca 20 cm. Situated below U.S. 4, U.S. 7 is a more compacted unit, formed of clay, with millimetric fragments of calcite, small stones, some faunal remains, and a few Neolithic and historical artefacts. With a thickness of ca 7 cm, it contains relatively few fossils. The units situated below U.S. 7 were split and indexed with different numbers according to squares, areas delimited by large stones, or the presence of a particular fossil (Figs 6, 7).

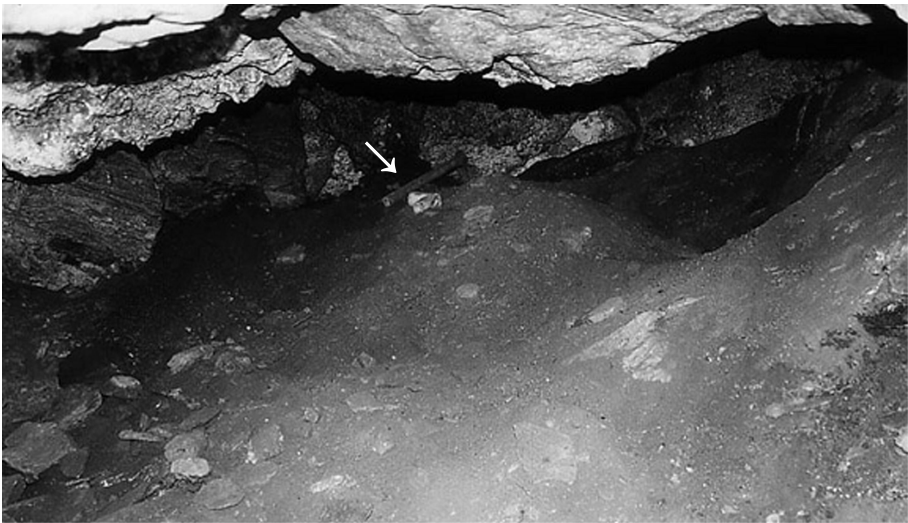


Fig. 4. A Teppa di U Lupinu. Mound of sediments before excavations, in 2003. The hammer indicates the scale.

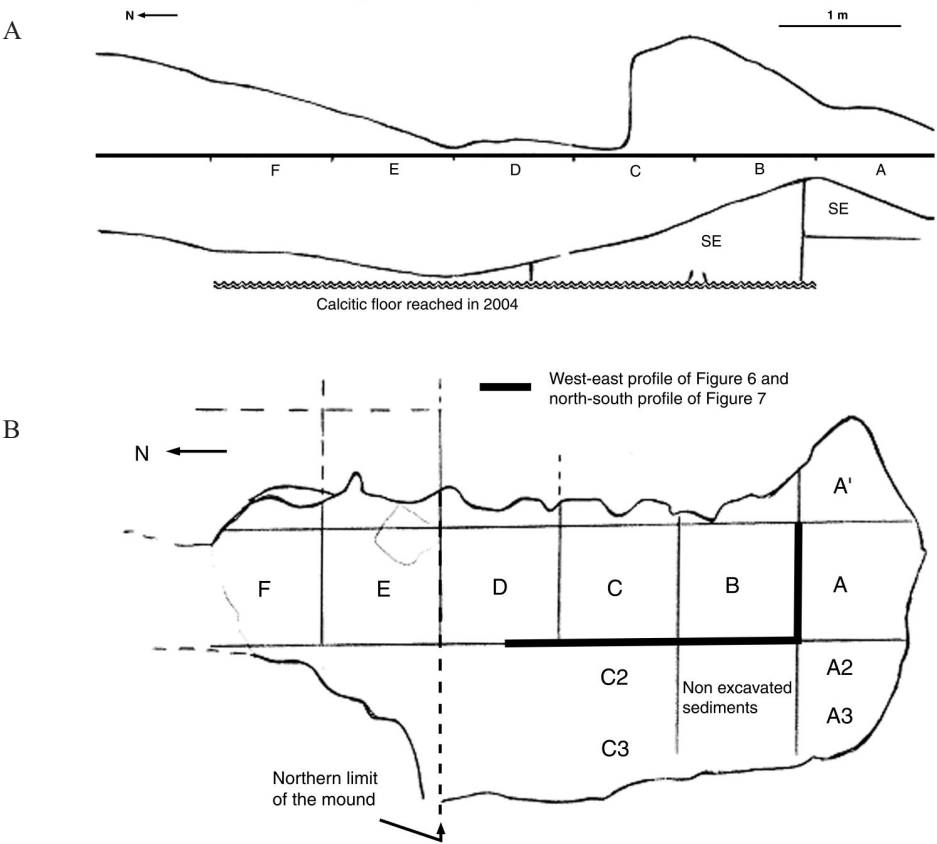


Fig. 5. Sections of the main diverticulum. a – Top: N-S vertical median profile before excavations; b – Bottom: horizontal section with the grid, viewed from above; SE – sediments excavated below the mound.



Table I

Relative position of the different stratigraphic units (U.S.) of the mound, according to levels and squares

Square in the grid	A'	B'	A	B	C	A2	C2	
Unit lying over the whole surface of the mound	U.S. 4	U.S. 4	U.S. 4	U.S. 4	U.S. 4	U.S. 4	U.S. 4	
Unit hardened on surface	Absence of deposit (wallrock)		U.S. 7	U.S. 7	U.S. 7	U.S. 7	U.S. 7	
Excavated units constituting a homogeneous grouping			U.S. 11	U.S. 10	U.S. 6		U.S. 6	
			U.S. 14			Non-excavated sediments		
			U.S. 16/17	U.S. 20				
			U.S. 21	U.S. 22	U.S. 12			
				U.S. 24				
			Calcitic floor					

Three of the U.S. shown in Figs 6 and 7 (U.S. 13 and 18) or Table III (U.S. 19) are not mentioned in Table I. This is because they are very limited in volume and were defined only for containing a particular item, but are poor or devoid of fossils. U.S. 18 was named due to the presence of a fragment of white pottery but contains very few fossils. U.S. 13 is a thin level of rather compact argillomiceaceous sediments. U.S. 19, meanwhile was determined solely by the presence of a striker next to which were found a few osseous fragments of birds and large mammals.

All the units except for the hardened U.S. 7 are made up of the same soft, relatively homogeneous sediment, with an earthy, clay-sand-loam matrix. The colour of this sediment is more or less brown or reddish. The sediment is drier at greater depths. It always contains relatively large stones, generally many flat centimeter-sized rock fragments, and finer debris, all deriving from the bed-rock, as well as fragments of calcite, and abundant charcoal fragments in all levels. Charcoal was collected in every U.S., at all depths. The size of the charcoal fragments varies, from 0.5 mm to 3 cm, the smaller ones being by far the most abundant. The sediments also contain coprolites (under study), which are very abundant in U.S. 4 and 6, and less so in the deeper levels. The majority of these coprolites, with a shape close to that of modern Lagomorphs, are presumably attributable to *Prolagus sardus* WAGNER, 1829.

A radiocrystallographic analysis was performed on a sample of sediment collected from U.S. 10, at the Laboratoire Environnement et Minéralurgie, Ecole Nationale Supérieure de Géologie de Nancy (France). Three X-ray diffraction spectra were obtained: they indicate the presence of phyllosilicate mineral phases: muscovite (62.6 %), chlorite (15.5 %), paragonite (7.5 %), and kaolinite (14.4 %). Given the context, the first three probably derive from the alteration of the bed-rock (schists, calc-schists, prasinities). The last phyllosilicate, the only neo-formed argillaceous mineral, is probably derived from the alteration of potassic feldspars that are abundant in the granodiorite and the gneiss constituent of the Massif du Tenda. The sediment also included non-argillaceous mineral phases (quartz, calcite, gypsum) that would also derive from alteration of the bed-rock (quartzites, quartzose schists, calc-schists and limestones containing siliceous beds). Therefore, the sediment is not a decalcification clay but an earthy sediment that derives from an external source. It lies over a thick calcitic floor, which levels at 1.32 m away from the N-S, W-E grid (Figs 6, 7) and slopes eastward (Fig. 5). U/Th dating of a stalagmite overlying the floor indicates that the overlying sediment is younger than 1 to 1.5 Ma.

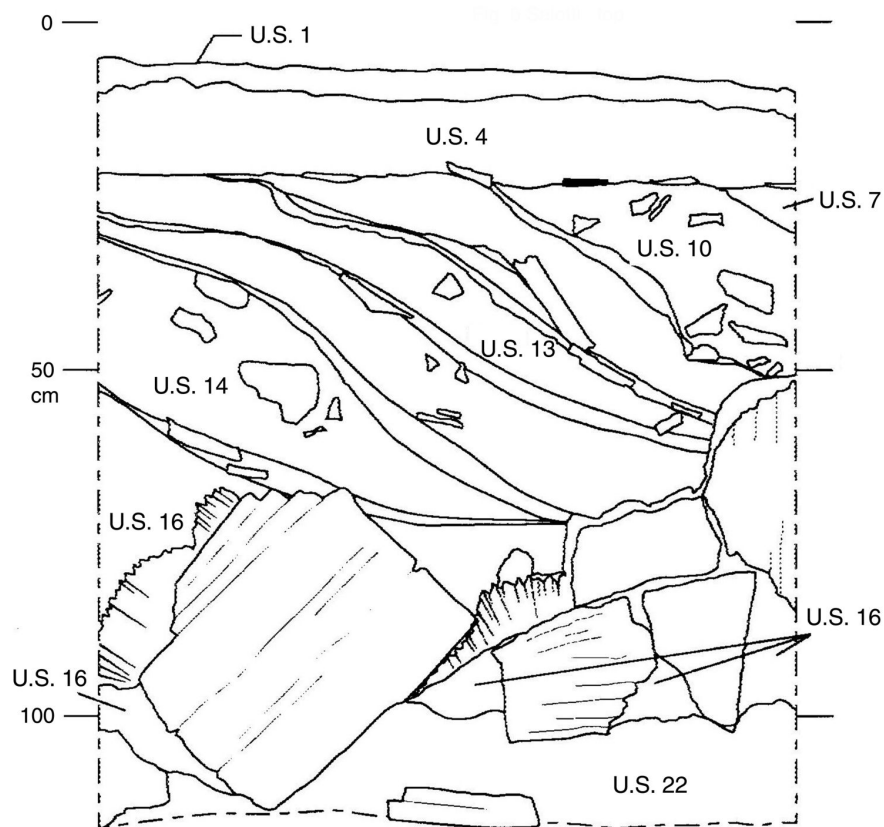


Fig. 6. East-west section of the eastern part of the mound (see Fig. 5b).

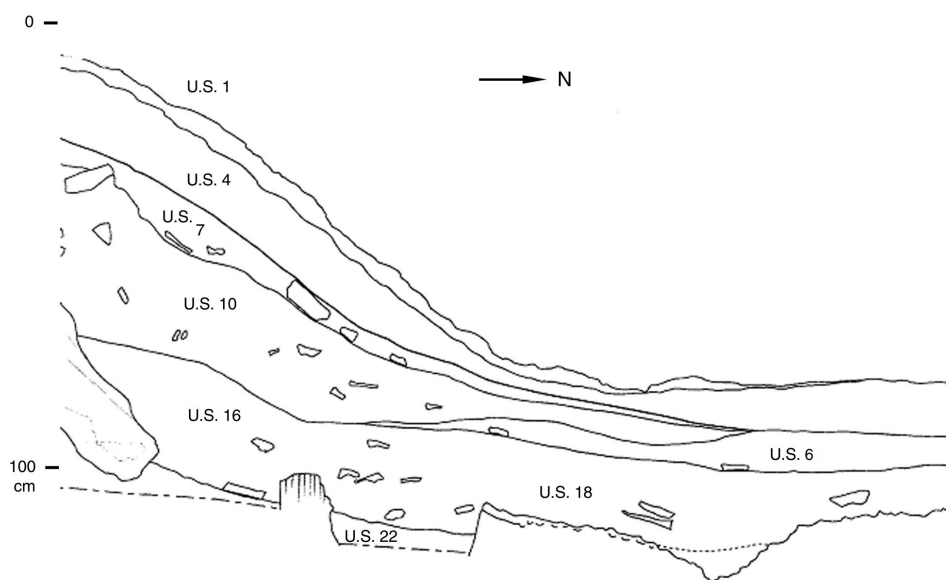


Fig. 7. South-north section of the eastern part of the mound (see Fig. 5b).

### III. THE PALEOFAUNA OF THE MOUND

This accumulation is of remarkable paleontological interest. The sediment contains tens of millions of bones (cranial and postcranial). It contains remains of the extinct insular deer *M. (N.) cazioti* and of the extinct insular eagle *Aquila nipaloides* LOUCHART et al., 2005. In addition, remains of the large extinct insular shrew *Episoriculus corsicanus* BATE, 1944 (Soricidae) are extremely abundant. All the skeletal elements of the micromammals are present with little distortion in representation, but no articulation was observed. Due to the very large number of micromammal bones collected, they are still being sorted and identified. We have sorted most of the bones of the extinct insular lagomorph *Prolagus sardus*, the mandibles of the other extinct insular small mammals (the vole *Microtus (Tyrrenicola) henseli* FORSYTH-MAJOR, 1882, the field mouse *Rhagamys orthodon* HENSEL, 1856, the shrew *E. corsicanus*), all remains (cranial and postcranial) of macromammals, birds, fish, amphibians and reptiles, and the few gastropod shells. The larger charcoal samples and the coprolites were also collected and sorted.

Among the macromammals, a single extinct species was identified, the deer *M. (N.) cazioti*. U.S. 4 yielded a proximal end of a fully grown right antler (naturally lost by a male after the period of reproduction). The morphology and biometry of this antler are compatible with those of the most important known fossil population of this species on the island (from the Late Pleistocene of the Coscia Cave, Cap Corse; PEREIRA 2001). Two phalanges and a few isolated teeth (an adult 4<sup>th</sup> lower premolar, four milk teeth, a lower incisor) were also recovered from U.S. 4 and 6. The presence of this extinct deer in the cave is further confirmed by the morphometric study of the 21 remains stored in the Naturhistorisches Museum Basel (PEREIRA et al. in prep.). The most frequent elements are phalanges (NR:12). Long bones are rare and mostly consist of proximal or distal ends. Only one bone is complete (a radius). No whole antlers are stored in Basel, and only two antler tines, very characteristic of the species, are present in the collection. Some bones seem to have undergone sedimentary pressures and packing (presence of longitudinal fissures, and traces of exfoliation of the cortical surface). The exact provenance of these bones within the cave is unknown (none of the manuscripts of FORSYTH MAJOR mentions it), but they attest to the presence of at least two individuals.

In U.S. 4, ca one hundred bones, often broken, of modern mammals were found close to rare remains of *M. (N.) cazioti*. They belong to two foxes (one adult and one juvenile), one adult dog, two boars (one adult and one juvenile), one adult cow and one adult goat. Among the unidentified species are a carnivore foetus, and an artiodactyl (ovine or caprine) represented by three individuals of different age (juvenile, young, and adult; age estimated from the degree of ossification of the epiphyses of long bones). Each of these taxa is represented by only a few bones. Within the mound, below the hardened U.S. 7, these species are very rare: only U.S. 10, 16, 22 and 24 of square B yielded any remains, albeit less than 10 specimens, and representing a cat foetus, an adult boar, an adult cow, and a young sheep or goat. The state of the cortical surface of some bones (aspect, colour, position of fractures...) suggests that they are from the same individuals as those in U.S. 4. Three mandibles of *Rattus rattus* (surface U.S. and U.S. 10), and two mandibles of *Eliomys quercinus* (U.S. 10) were also recovered. These recently established mammals confirm reworking that has occurred, at least in part, during the last two or three millennia.

The 23,662 other mammal mandibles collected in the main U.S. of the mound (U.S. 4, 6, 10, 16, 20, 22) represent 11,834 individuals of the four extinct insular species *P. sardus*, *M. henseli*, *R. orthodon*, and *E. corsicanus*. The large shrew *E. corsicanus* is by far the most dominant, represented by 7297 individuals. Its relative abundance varies slightly according to U.S. and is always close to 60 % (Table II). Charred or superficially and partly burnt bones are frequent. For *P. sardus* the remains consist essentially of mandibles and vertebrae.

In the mound, around 1000 fossils of birds were collected, which are identifiable at least at the level of order or family, and many to the genus and species. The bird fossils attest to the presence of at least 53 different species within U.S. 4 to 22 (see Table III). Two extinct species are represented, in most of the U.S.: the extinct insular eagle *A. nipaloides*, and the small extinct insular eagle-owl



Table II

Small mammals and coprolithes from the U.S. rich in fossils. Numbers of mandibles (except last row: estimation of numbers of coprolithes)

	U.S. 4	U.S. 6	U.S. 10	U.S. 16	U.S. 20	U.S. 22	Total
<i>P. sardus</i>	1859	95	346	148	92	74	2614
<i>E. corsicanus</i>	9896	982	1821	942	602	350	14,593
<i>M. (T.) henseli</i>	1276	116	223	175	98	36	1924
<i>R. orthodon</i>	3231	260	506	301	140	93	4531
<i>R. rattus</i>	1		2				3
<i>E. quercinus</i>	1		1				2
Chiroptera indet.	very rare			very rare	very rare	very rare	
Total mandibles	16,264	1453	2899	1566	932	553	23,667
Coprolites (quantity)	very abundant	abundant	regularly present	rare	rare	rare	

*Bubo insularis* MOURER-CHAUVIRÉ & WEESIE, 1986. Some diagnostic elements allow firm identifications (e.g. mandibular symphysis and pedal phalanges for *A. nipaloides*; complete tarsometatarsus and pedal phalanges for *B. insularis*), despite the fragmentary nature of the remains. Both species are known in Corsica and Sardinia from the Middle Pleistocene (Corsica only for the eagle) to the Late Pleistocene (for both islands) (LOUCHART 2002; LOUCHART et al. 2005). Within U.S. 4 to 22, *B. insularis* is represented by a minimum of nine individuals, and *A. nipaloides* by a minimum of two individuals (plus 10 *Aquila* sp. indet., a category that probably includes some elements of *A. nipaloides*). Around 5 % of the bird bones bear marks of burning.

The presence of amphibians and reptiles in a large part of the U.S. is also noticeable: the toads *Discoglossus sardus* and *D. montalentii*, the tree frog *Hyla sarda*, the green toad *Bufo viridis*, the Corsican euproct *Euproctus montanus*, the Corsican salamander *Salamandra salamandra*, the snakes *Coluber viridiflavus* and *Natrix corsa*, a gecko, probably *Tarentola mauritanica*, the Corsican montane lizard *Archaeolacerta bedriagae*, and the Tiliguerta lizard *Podarcis tiliguerta*. All these species are still present in the modern Corsican herpetofauna, having colonised the island in remote periods (SALOTTI et al. 2000). From U.S. 4 to U.S. 20, 1413 amphibian bones (representing 227 individuals), and 124 reptile bones (representing 36 individuals, including 27 montane lizards and 6 Tiliguerta lizards), were recorded. Among the amphibians and reptiles, the genus *Discoglossus* is by far the most abundant in the locality: 1330 remains (86.6 % of the total of amphibian and reptile bones), representing 204 individuals (77.5 % of the total of amphibian and reptile individuals). All the material of amphibians and reptiles is in a good state of preservation. Traces of burning occur on the bones but are very rare. Finally, one fish vertebra (unidentified species) was recovered from U.S. 10, square B, just above the calcitic floor.

The abundance of microvertebrate fossils in the accumulation is remarkable. 12,000 micromammal skeletons, one hundred bones representing seven different species of macromammals (a total of 11 individuals), numerous bones of birds, amphibians, reptiles as well as one fish bone, were collected. Most skeletal elements are represented for the micromammals and the total number of bones collected greatly exceeds a million. This is a very high concentration of bones, particularly of micromammals, in a volume evaluated at ca 5 m<sup>3</sup> of a sediment also very rich in charcoal fragments.

Table III

List of the identified bird fossils from the U.S. 4 to 22 of A Teppa di U Lupinu cave. Presence of a taxon in a U.S. is indicated by a cross; ‘cf.’ indicates tentative identification; ‘juv.’ means juvenile remains, and when in bold characters very juvenile (pulli); ‘incl’ means including

Family	Genus, species	U.S. 4	U.S. 6	U.S. 7	U.S. 10	U.S. 11	U.S. 13	U.S. 14	U.S. 16	U.S. 17	U.S. 19	U.S. 20	U.S. 22
Accipitridae	<i>Buteo buteo</i>	cf.											
	<i>Aquila</i> sp.	X			X		X	cf.	cf.				
	<i>Aquila nipaloides</i>	X			X								
Falconidae	<i>Falco tinnunculus</i>	X						X					
	<i>Falco tinnunculus</i> / <i>F. subbuteo</i>	X											
	small sized <i>Falco</i> sp.	X											
	<i>Alectoris</i> sp.	X											
Phasianidae	<i>Coturnix coturnix</i>	X	X incl. juv. cf.	X	X				X			X	
	Phasianidae indet.											cf.	
Rallidae	<i>Porzana porzana</i>	X			X				X	cf.			
	<i>Porzana porzana</i> / <i>Rallus aquaticus</i>	X											
Scolopacidae	<i>Gallinago gallinago</i>	X										X	
Columbidae	<i>Columba livia</i>	X	cf.						cf.				
	<i>Columba livia</i> / <i>C. oenas</i>	X			X				X				X
	<i>Columba palumbus</i>	X							X				
	<i>Columba</i> sp.	X incl. juv.											
	<i>Streptopelia turtur</i>	X incl. juv.											
Tytonidae	<i>Tyto alba</i>	X incl. juv.	X incl. juv.						juv.			X	X
Strigidae	<i>Otus scops</i>	X incl. juv. cf.			X								
	<i>Bubo insularis</i>	X	juv. cf.		X			X				X	X
	<i>Athene noctua</i>	X incl. juv.			juv. cf.				X				
Apodidae	<i>Apus apus</i> / <i>A. pallidus</i>	X											X
Picidae	<i>Jynx torquilla</i>	X											
	<i>Dendrocopos major</i>	X											
Alaudidae	<i>Melanocorypha calandra</i>	X											
	<i>Calandrella</i> sp.	X											
	<i>Alauda arvensis</i>				cf.				cf.				
	Alaudidae indet.	X											
Hirundinidae	<i>Hirundo</i> sp.	X							X				
Motacillidae	<i>Motacilla cinerea</i>	cf.											
cf. Prunellidae	<i>Prunella modularis</i>								cf.				
Turdidae	<i>Erithacus rubecula</i>	X											
	<i>Luscinia megarhynchos</i> / <i>L. luscinia</i>	X											
	<i>Phoenicurus</i> sp., size of <i>P. ochruros</i>	cf.			cf.								
	<i>Saxicola</i> sp.	X	X		X				X				
	<i>Oenanthe</i> sp.	X											
	<i>Turdus iliacus</i>	X							cf.				

Table III cont.

Family	Genus, species	U.S. 4	U.S. 6	U.S. 7	U.S. 10	U.S. 11	U.S. 13	U.S. 14	U.S. 16	U.S. 17	U.S. 19	U.S. 20	U.S. 22
Turdidae	<i>Turdus viscivorus</i>	X											
	<i>Turdus</i> sp., size group 1	X			X								
	<i>Turdus</i> sp., size group 2	X							X				
	<i>Turdus</i> sp., size group 3	X											
	<i>Turdus</i> sp.	X incl. juv. cf.	X		X inclus juv. cf.	X			X incl. juv.			cf.	
Sylviidae	<i>Sylvia</i> cf. <i>S. sarda</i> / <i>S. undata</i>	cf.			X								
	<i>Sylvia</i> sp. A (size <i>S. communis</i> )	X	cf.						cf.				
	<i>Sylvia</i> sp. B (size <i>S. atricapilla</i> )	X											
	small <i>Sylvia</i> sp. / <i>Phylloscopus</i> sp.	X	cf.						X				
	<i>Regulus</i> sp.	cf.							cf.			cf.	
	Sylviidae indet.	X							X				
Muscicapidae	<i>Muscicapa striata</i>	cf.											
	<i>Ficedula</i> sp.	cf.											
Paridae	<i>Parus caeruleus</i>	X											
	<i>Parus major</i>	X											
Oriolidae	<i>Oriolus oriolus</i>							X					
Laniidae	<i>Lanius collurio</i> / <i>L. senator</i>										X		
Corvidae	<i>Pyrrhocorax pyrrhocorax</i>	X incl. juv. cf.	X									juv. cf.	
	<i>Corvus monedula</i>	cf.						cf.					
	<i>Corvus corone</i>	X											
	<i>Corvus corone</i> / <i>C. frugilegus</i>	X	juv.										
	medium sized indet. Cor- vidae	X incl. juv.	X		X				X				
	small sized indet. Corvidae	cf.			X incl. juv.								
cf. Sturnidae	<i>Sturnus</i> cf. <i>S. vulgaris</i>	cf.											
Passeridae	<i>Passer montanus</i>	X											
Fringillidae	<i>Fringilla</i> sp.				cf.								
	<i>Serinus</i> sp.				X				cf.				
	<i>Carduelis carduelis</i> / <i>C. cannabina</i>	X											
	<i>Fringilla</i> sp. / <i>Carduelis</i> <i>chloris</i>	X											
	<i>Serinus</i> sp. / <i>Carduelis</i> <i>carduelis</i>	X											
	<i>Loxia curvirostra</i>												X
	<i>Coccothraustes cocco-</i> <i>thraustes</i>	X											
	Fringillidae indet.	cf.											
Emberizidae	<i>Emberiza</i> sp., size of <i>E. cia</i> / <i>E. citrinella</i> / <i>E. cirulus</i> / <i>E. hortulana</i>	X							X		X	X	
Passeriformes, family indet.	small sized indet. passer- ine.	X incl. juv.	X		X incl. juv.				X			X	X incl. juv.
	medium sized indet. pas- serine.	X incl. juv.	X		X				X incl. juv.			X	X incl. juv.

IV. AGE AND ORIGIN OF THE ACCUMULATION

Age of the accumulation

Seven <sup>14</sup>C dates on bones and charcoal fragments (Table IV) performed by the Centre de Dations Radiocarbone (Villeurbanne, France), help delimiting the age of deposition. Four of the five dates on bones are considered reliable. Two of them were made on bones of *B. insularis* from U.S. 20 and 10 and yielded ages of respectively 17,109-16,968 years BC and 16,095-15,821 BC (all BC ages are calibrated). One was made on a *Prolagus* bone, collected at the base of U.S. 16, at a level near the calcitic floor, relatively rich in ash and also containing the fish vertebra, and yielded an age of 13,689-13,399 BC. Finally, one was made on a *M. (N.) cazioti* antler, collected on the surface of the mound in U.S. 4, and yielded an age of 8718-8300 BC. These dates confirm the significant reworking undergone by the whole deposit, and reveal a relatively recent occurrence of *M. (N.) cazioti*. The two dates made on charcoal fragments gave very different ages. That from U.S. 24 indicates an age of 8227-7791 BC. That from U.S. 16 yielded an age of 4768-4547 BC. This appears to conflict with the date on the *Prolagus sardus* remains from the same U.S., the latter being more congruent with the approximate age evaluated using the composition of the fauna (see below). The dates on burnt micromammal remains, of reasonable reliability, yielded an age of 6440-6088 BC. These results confirm again the extensive reworking undergone by the sediments, following different episodic human occupations.

Table IV

Datings of materials extracted from the accumulation in the cave, in chronological order (BC dates are calibrated using the international referential derived from the study of growth marks of Caribbean corals)

Laboratory code	Sample	Location	<sup>14</sup> C age BP	Calibrated age BC: 95% confidence interval
Lyon-3985 (GrA)	Bone <i>B. insularis</i>	U.S. 20 square B	15,800±60	17,109-16,968
Lyon-3984 (GrA)	Bone <i>B. insularis</i>	U.S. 10 square B	14,760±60	16,095-15,821
Lyon-2780 (Poz)	Bone <i>P. sardus</i>	U.S. 16 (base of)	12,856±75	13,689-13,399
Lyon- 2779 (Poz)	Antler <i>M. (N.) cazioti</i>	U.S. 4' square A	9292±58	8718-8300
Lyon-3987 (GrA)	Charcoal	U.S. 24 square B	8865±45	8227-7791
Ly-13549	Burnt micromammal bones	U.S. 16 square A	7435±80	6440-6088
Ly-13550	Charcoal	U.S. 16 square A	5795±35	4768-4547

The two extinct species *A. nipaloides* and *B. insularis* are useful as chronological indicators. Hitherto, the most recent dated occurrences are as follows: *A. nipaloides*: latest Pleistocene of Corsica and Sardinia (Corsica: Castiglione 3PL; Sardinia: Corbeddu, Rapaci and Dragonara; LOUCHART 2002; LOUCHART et al. 2005); *B. insularis*: early Holocene (9500-8500 BPcal in Corsica; undated Holocene in Sardinia; MOURER-CHAUVIRÉ & WEESIE 1986; VIGNE et al. 1997; LOUCHART 2002). Both of these extinct species are present in a majority of the U.S. of Teppa. *B. insularis* bones from Teppa are indeed dated to ca 17,000 and 16,000 BC (Table IV). The temporal placement of the accumulation is also supported by the presence of *M. (N.) cazioti*. According to VIGNE (2000), the species went extinct before the beginning of the VIII<sup>th</sup> millennium BC. Its presence at Teppa di U Lupinu is dated to ca 8500 BC. These dates, pointing to latest Pleistocene and

earliest Holocene ages, are reinforced by the presence in every U.S. of a high proportion of the extinct shrew *E. corsicanus* (61 % of the micromammals). According to VIGNE et al. (1998), during the Late Glacial-Holocene transition, there was an anomalously high abundance of these shrews, at a level that was never reached during the Late Glacial period nor later, during the Holocene, and this probably reveals a perturbation of the ecological equilibrium at the transition. The high abundance recorded at Teppa is in accordance with this temporal placement. The presence of remains of the extinct bird species described above in most of the U.S., and the high abundance of the fossils of the shrew in all the U.S., suggest that almost all the accumulation was formed during this transitional period.

However, the more recent dates which reveal reworking in U.S. 16 as well as the rest of the sequence, indicate that part of the accumulation, in particular the charcoal fragments, dates to the first half of the Holocene. A Neolithic human presence is indeed attested by six obsidian artefacts, two strikers, a heel of an axe and ca 50 flakes (PAOLINI-SAEZ et al. in prep.) and by the presence of fossils of micromammals unknown in Corsica before the Holocene. The latter materials, less mineralized, are not abundant, which implies that the Neolithic human presence was of limited duration. Two human incursions occurred in the cave probably during the Iron Age and others are attested during modern times. Evidence of the latter occupations includes candles, modern tools, earthenware, wooden slats, etc. The cave accumulation was excavated at the beginning of the XX<sup>th</sup> Century by FORSYTH-MAJOR and also served as a refuge for the population in 1943 during bombings. According to the villagers, it has always served as a play ground for children and teenagers. However, given the darkness at the back of the cave, these people probably mostly stayed towards the opening and rarely reached the deepest part, which helped save the accumulation studied here.

Therefore, almost the whole accumulation can be attributed to a period comprising the end of the late Pleistocene and the beginning of the Holocene. Nevertheless, significant secondary reworking occurred at periods subsequent to the final Palaeolithic and Mesolithic.

#### Origin of the accumulation: late Pleistocene – earliest Holocene

The cave has no opening above the accumulation. Therefore, it cannot have functioned as a trap for animals. The accumulation cannot be the result of the circulation of water in a karstic network, since the clay is not a decalcification clay. In addition, the bones show slight fragmentation, and no signs of rolling or abrasion, as they would do if they had been transported by water. Concerning fragmentation, a large proportion of the amphibian bones (ca 50 % of humeri, femurs and tibiofibulas), are complete or slightly fragmented at the extremities. This even applies to the more fragile bones such as the small, gracile long bones of *Hyla* or juvenile *Discoglossus*. The origin of the accumulation is not from animals living and dying *in situ* in the cave. The most abundant animals represented are not species that live in caves, fissures or karsts, but species from different habitats, that would never, or very rarely, frequent the inside of caves (e.g. *Discoglossus*, *Hyla*, the micromammals, and birds such as Common Buzzard *Buteo buteo*, Common Quail *Coturnix coturnix*, the marsh or swamp birds, European Turtle Dove *Streptopelia turtur*, Wryneck *Jynx torquilla*, Greater-spotted Woodpecker *Dendrocopos major*, larks, wagtail, small Turdidae, thrushes, warblers, flycatcher, tits, Eurasian Golden Oriole *Oriolus oriolus*, shrike, Hawfinch *Coccothraustes coccothraustes*, Red Crossbill *Loxia curvirostra* and other Fringillidae, and buntings. The fauna cannot have been accumulated as the prey of Mustelidae, because none existed in Corsica at this period (except fish-eating or marine invertebrate-eating otters). The interpretation of the accumulation as a den of the Cuonid *Cynotherium sardous*, present in Corsica until the end of the Pleistocene (dates: 11,864 to 11,521 BC; SALOTTI et al. 2000), is also excluded. Carnivores leave digestion marks on the bones and teeth of their prey preserved in scats, and such marks are absent on the fossils of the accumulation. In addition, fossils of *C. sardous* are totally absent at Teppa di U Lupinu. Diurnal birds of prey leave digestion marks, although less so than Carnivores (ANDREWS 1990). It is unlikely that the accumulation derives from their predation on animals. The diet of the species that nest or roost in caves or crevices (such as some eagles, falcons or marginally buzzards) does not in-



clude most of the high diversity of small birds widespread in the accumulation. In addition, these raptors would not generally live at the depth in the cave where most of the accumulation occurred. Neither do the characteristics of the assemblage correspond to those of vulture accumulation (ROBERT & VIGNE 2002).

Another explanation could be that the assemblage represents an accumulation through regurgitation pellets of owls (ANDREWS 1990). The owls may have been either *Tyto alba*, or *B. insularis*, both present at this period in Corsica, and represented themselves in the accumulation. They are sufficiently large to be potential predators of the bulk of the animals. Some of the animals are too large to have been preyed on by *T. alba* (e.g. large birds such as the eagle and buzzard, the macromammals, and perhaps *Prolagus*, large-sized in this northern part of Corsica; PEREIRA 2001; LOUCHARTE 2002). *B. insularis* on the other hand would have been a potential accumulator for all the taxa, including the prey that would be too large for *T. alba*. Its modern, continental relative *B. bubo*, the Eurasian Eagle-owl, is opportunistic, and catches small prey like rodents, as well as larger species, the size of juvenile Roe deer. However, *B. insularis* was only about half the weight of the small, Mediterranean subspecies of *B. bubo* (LOUCHARTE 2002). It was therefore not capable of catching large prey such as *Aquila* (although the latter might have nested or roosted and died in the cave). More importantly and arguing against the *B. insularis* hypothesis, is the fact that all *Bubo* species today avoid shrews. The ecology of the extinct *B. insularis* is unknown but there is nothing to suggest that it would have differed in this regard. For instance, THÉVENOT (2006) found no specimens of Soricidae among 1221 vertebrates (1149 mammals) derived from pellets of *B. bubo* in Morocco, while the local fauna comprises six species of shrews (THÉVENOT & AULAGNIER 2006). Finally, species of *Bubo* leave frequent, moderate marks of digestion on regurgitated teeth, especially on rodent incisors (ANDREWS 1990), whereas no such marks were detected on the material from Teppa di U Lupinu. It is therefore unlikely that *B. insularis* was the main accumulator of the fauna. *T. alba*, the Barn-owl, is on the contrary a predator of shrews, which are consumed in great proportions when abundant. *T. alba* also leaves few or no etching marks (ANDREWS 1990), which would be compatible with our observations on rodent incisors. *T. alba*, as well as *B. insularis*, are represented as pulli (nestlings) in the accumulation, which suggests that they nested there at some periods. However, this is not necessarily the case, as for instance *T. alba* may have been preyed on by *B. insularis*, or both owls may have been caught by man. Even if *T. alba* was the accumulator of the shrews, it would have been unlikely that it preyed on *Prolagus*, which is the second most abundant animal in the accumulation. Therefore, this would imply alternating occupations by the two species of owl at different times, and the subsequent complete reworking and homogenisation of all remains, which does not seem very likely to us. Finally, considering Amphibians, about 85 % of the identified bones of *Discoglossus* are elements corresponding to the posterior half of the body (ilia, femurs, tibiofibulas and tarsi). This anatomical selection of *Discoglossus* bones is very difficult to explain without anthropic intervention, and indeed anthropic accumulations of these amphibians are known to have yielded similar representations (BAILON 1993).

Therefore, the last plausible explanation is an anthropic accumulation. Several facts would initially appear to be against this hypothesis, but are not completely decisive. 1) No bones modified by human agency were found. However, this is true of most otherwise confirmed prehistoric anthropic accumulations in Corsica, and more widely in many insular anthropic contexts where late Palaeolithic industries were rare or non-existent (SONDAAR 2000; COSTA 2006). 2) Indeed, no pre-Neolithic artefacts were found, but again this is not unusual and is not proof against human presence and activity. In addition, the two strikers found cannot be definitely assigned to the Neolithic. 3) The presence of large quantities of *Prolagus* coprolites may also argue against these animals being brought in by humans. But this would be true only if we accept that *Prolagus* were always gutted before being cooked and/or consumed, which cannot be considered as an *a priori* certainty. For example today, game such as hare and pheasant is not gutted before being hung, cooked and consumed, in several regions (PLOUVIER 2000). Furthermore in Corsica today, woodcock, blackbird and thrush, are not gutted before being cooked. As remarked by PLOUVIER (2000), it is necessary to admit that our knowledge of prehistoric cooking is mostly speculative, where imagination has to compensate

for the lack of objective information. 4) A small mammal fauna accumulated by humans and dominated (61 %) by shrews (*Episoriculus*) seems most unusual. Shrews are known to produce a repellent substance that makes them unpalatable to many predators. But several facts allow us to consider that consumption of *E. corsicanus* by prehistoric man cannot be ruled out. Not all shrews today are known to produce such a substance. It may be that *E. corsicanus* did not, even though mammalian predators coexisted with it in Corsica and Sardinia. These substances are not known to be toxic or poisonous to any predator and shrews producing such substances still have regular predators including mammals such as foxes and Mustelidae. The substance is excreted by lateral and ventral skin glands, and it is possible that man may have prepared them and eaten the meat after removing the skin and glands. The XIXth century victorian naturalist Frank BUCKLAND tasted and ate prepared shrews, although he found the meat had an acidic taste. Prehistoric diets often prove strange, or even inconceivable according to modern standards. For instance late Palaeolithic diets in Europe included tiny birds the size of swallows, and animals generally considered unpalatable (see examples and references in LOUCHART & SOAVE 2002). A taste considered bad in some cultures can be considered palatable in others, and examples in Europe include the consumption of completely decayed meat in southern France today (e.g. woodcocks, pheasants). Consequently, the consumption of the extinct shrew by prehistoric man can seem odd, but must not be considered impossible *a priori*.

The rare remains of *M. (N.) cazioti*, especially the antler, provide an independent constraint on the minimal age of human incursions. This antler, naturally lost by an adult male, could probably not have been transported into the cave without human intervention. No predator would have brought an isolated antler into the cave and the deer could not have lost it in the cave, which is inaccessible to this kind of animal. It must have been brought to the cave soon after it was shed, because it would have been eaten or decomposed rapidly in the open outside the cave. This antler was dated to ca 8500 BC and is therefore thus far the earliest dated evidence of human presence in the cave, at the end of the main fossil accumulation.

#### Origin of the accumulation: fires *in situ* and human presence

The presence of burning marks on a homogeneous proportion of the bones, throughout all levels, constitutes one of the most important characteristics of the accumulation. They vary from partly burnt and brown in colour, to more deeply burnt and black, and can sometimes be covered with ash (Fig. 8). In all, this applies to ca 5 % of the bird bones, representing all anatomical elements, and many taxa in different U.S., in direct proportion to their relative abundances. Such marks also exist on some of the Amphibians bones, although very rarely. High numbers of micromammal bones also show marks of burning, including for instance bones of the shrew, and mandibles of *Prolagus*. Given the considerable numbers of bones, the exact proportion of burnt bones of micromammals was not calculated precisely, but we can estimate it generally around 5-10 %. The other critical observation is the very high quantities of charcoal fragments and ash through the accumulation, including in levels situated under the hardened surface, as well as the deepest ones (U.S. 16, 21, 22). In this context, deep inside the cave, they cannot derive from natural fires. In addition, the bones must have been burnt *in situ*, and thus the fires must have been sustained and maintained. The only plausible explanation for such sustained fires inside the cavity is an anthropic origin. The two dates on charcoal fragments and the date on burnt bones yielded ages of ca 8000, 4700 and 6300 years BC respectively, and thus are more recent than the main fossil accumulation.

Two interpretations of these observations may be proposed. Most of the burning may be of Neolithic age, in line with the age of the charcoal dated. In this hypothesis, during the latest Pleistocene and earliest Holocene, owls (*T. alba* and *B. insularis*) nested or roosted in the cave and large numbers of bones of small vertebrates accumulated on the floor, through food remains and regurgitation pellets. During the Neolithic (and possibly also the Mesolithic) humans occasionally entered the cave, leaving a few artefacts. At this time fires were lit on the cave floor creating considerable amounts of charcoal and burning a small proportion of the bones, in the upper layer. At a still later time (probably during the last 2000 years) the deposits were extensively disturbed, spreading the



Fig. 8. Examples of burnt bones from the U.S. 22, square B. Scale bars: 1 cm. A: Fragmented mandibles and postcranials of *P. sardus*. B: Fragmented mandibles and maxillaries of *P. sardus*. C: Fragmented skulls and mandibles of *E. corsicanus*. D: Fragmented mandibles of the field mouse *R. orthodon* and the vole *M. (T.) henseli*.

charcoal fragments, burnt bones, and remains of recently introduced species deep into the deposit. Alternatively, the marks of burning, the charcoal and the ash, could result from *in situ* man-made fires, and may correspond to the cooking and consuming of the animals preceding the accumulation of their partly burnt remains, all during the older period (latest Pleistocene–earliest Holocene, ca 17,000 to 8500 BC). In this case, a large part of the charcoal should date from this period, and the younger dates actually obtained would not be representative of the age of the bulk of the charcoal and burnt bones. Secondly, the accumulation would have been reworked probably several times since the early Holocene (at least during the Neolithic, Iron Age, and modern times), and this reworking has affected even the deepest levels.

In the first scenario, the Palaeolithic elements of the fauna, and the older dated fossils that are in accordance with this temporal assignment, indicate that the numerous bones dating from this period, would then have been burnt secondarily during the Neolithic. It seems rather unlikely to us, however, that numerous bones of Palaeolithic age already accumulated would have been burnt during the Neolithic by man-made fires. Even with important subsequent reworking, such fires would probably not have burnt so many bones already buried in the sediment, resulting in homogeneously distributed burnt bones down to the deepest levels. In addition, the artefacts independently attest to

rather sporadic Neolithic and subsequent human incursions, whereas such complete reworking would presumably imply more evidence of prolonged settlements in the Neolithic and later, especially in the last 2000 years. It is not unexpected that the proportions of burnt bones remain below ca 20 % or less in the hypothesis of man having cooked and consumed the animals, because they had to avoid burning the complete animals with meat, and indeed very few bones should actually be burnt. Then, after the meat was consumed, some of the uneaten remains including bones may have been thrown into fires, contributing to the amount of burnt bones. The observed proportions thus seem reasonably in accordance with an anthropic origin of the main, older fossil accumulation. For these reasons, we tend to favour the second scenario, although we acknowledge that older dates for charcoal or burnt bones are lacking. More datings will be needed to help resolve this issue.

## V. CONTEXT OF REGIONAL HUMAN SETTLEMENT

In the hypothesis of man as responsible for the primary accumulation, through activities of cooking and consumption of animals from inside or near the cave, Teppa di U Lupinu would be the second witness on the island of a human presence during the Late Pleistocene since ca 17,000 BC. No other accumulation of this type, involving such a high number of remains, is known on the island. Another late Pleistocene settlement left traces of man-made fires on the outside terrace of the Coscia Cave in the Cap Corse (BONIFAY et al. 1998). At the Pleistocene–Holocene boundary, the cave of Teppa di U Lupinu was much further from the sea than it is today, since at 11,300 BPCal the sea level was 55 meters lower than at present (PLUQUET 2006). Given the very high number of remains involved, the human presence would have been prolonged, perhaps sporadically but over hundreds or thousands of years, and perhaps seasonally. Almost all the animals represented (mammals, birds, amphibians, reptiles, fish) were potential prey for man, including possibly the large shrew *E. corsicanus*. Small mammals would have formed the major part of the fauna presumed to have been consumed. The presence of man in Corsica at this period is all the more probable since it is already known in Sardinia at similar and slightly older times (Grotta di Corbeddu; SONDAAR et al. 1984, 1991, 1993, 1995; SONDAAR 2000; SPOOR 1999). It was contemporaneous there with *M. (N.) cazioti* and *A. nipaloides*, two early extinct species present at Teppa di U Lupinu. The late Pleistocene presence of man in Sardinia, although disputed by VIGNE (1989), was very well supported by the direct dating of a human phalanx to ca 20,000 BP (SONDAAR et al. 1995). Sardinia, very close to Corsica, was united to it and together the islands formed a large island during the glacial periods of the Pleistocene, allowing easy faunal exchanges and migrations. The hypothesis for early settlement is also in accordance with genetic results obtained recently from human autosomic markers (MEMMI 1999), and from human uniparental markers; mitochondrial DNA and the Y chromosome. These results highlighted the diffusion of the haplogroups V and H for the mtDNA and the haplogroup 3.1G for the Y chromosome, starting from SW Europe (Cantabrian refugium) (VARESI et al. 2000; SCOZZARI et al. 2001). These studies reveal that the Corsican population underwent a single episode of demographic expansion between 40,000 and 15,000 BC. Furthermore, FALCHI et al. (2005) analyzed the mutations responsible for  $\beta$ -thalassemias in Corsica and Sardinia. Their study showed a strong association between the haplotype II of the  $\beta$  globin cluster and the mutation b0-39. Their results again support the hypothesis of a common origin of the populations of Sardinia and Corsica in the Middle or Upper Palaeolithic and could be interpreted as a founder effect. Finally, numerous elements had already allowed us to assume a human presence during the same period, latest Pleistocene – earliest Holocene, in a geographically closely situated cave of Castiglione, a few kilometers to the north (SALOTTI et al. 2000). Later, a human presence in Corsica is attested in the nearby locality of Barbaghju (Abri de Strette, Corsica, level XXII, dating Ly 2837: 9140 $\pm$ 300 BP, i.e. 9015 – 7538 BC; MAGDELEINE & OTTAVIANI 1986). Thus, the human incursions at Teppa di U Lupinu since ca 8500 BC are not unexpected. This is also the latest known synchronous presence of man, *M. (N.) cazioti* and *A. nipaloides* in Corsica.



## VI. CONCLUSIONS

Incursions of man in the cave are attested since ca 8500 BC (deer antler), then around 8000 BC and later sporadically through the first half of the Holocene (charcoal and burnt bones produced by man-made fires, artefacts etc.), and even later until modern times. On the other hand, the main fossil accumulation is dated to an older period (ca 17,000-13,500 BC). It comprises extremely abundant microvertebrate remains, and its origin remains enigmatic. Two scenarios are plausible. (1) The owls *T. alba* and *B. insularis* might have been responsible for most of the accumulation through food remains and regurgitation pellets, and later since the IXth millenium BC man-made fires would have produced abundant charcoal and ash, and burnt an upper layer of bones already accumulated. Later on, anthropic reworking would have homogenised the whole accumulation. (2) Man would have made fires, cooked and consumed most of the microfauna in the earlier period, simultaneously producing the fossil accumulation, charcoal, ash and burnt bones. This would have continued sporadically after 8500 BC, yielding the more recent obtained dates on charcoal and burnt bones. Anthropic reworking would also have affected the whole accumulation until modern times. Only the anthropic accumulation hypothesis seems to explain the particular anatomical representation of amphibians. The consumption of shrews may seem odd, but should not be ruled out *a priori*. The owl-made accumulation hypothesis would imply profound subsequent anthropic reworking to completely mix the abundant charcoal, burnt bones and ash with the bulk of fossils down to the deepest layers. This may seem difficult owing to the apparently sporadic nature of human incursions in the second half of the Holocene. Thus, we tend to favour the anthropic accumulation hypothesis, although we acknowledge that the dates obtained so far on charcoal and burnt bones are too recent to support it. More datings will be needed to resolve this issue.

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## REFERENCES

- ANDREWS P. 1990. Owls, Caves and Fossils. British Museum National History Publications, London, 231 pp.
- BAILON S. 1993. Quelques exemples de la consommation d'amphibiens à travers le temps. [In:] APDCA (ed.) – Exploitation d'animaux sauvages à travers le temps, XIII<sup>ème</sup> rencontre internationale d'Archéologie et d'Histoire d'Antibes, Juan les Pins, Pp: 319-326.
- BONIFAY E., BASSIAKOS Y., BONIFAY M. F., LOUCHART A., MOURER-CHAUVIRÉ C., PEREIRA E., QUINIF Y., SALOTTI M. 1998. La grotte de la Coscia (Rogliano, Macinaggio): étude préliminaire d'un nouveau site du Pléistocène supérieur de Corse. *Paleo*, **10**: 17-43.
- COSTA L. J. 2005. Les premiers Corses. *Stantari* **2**: 11-16.
- COSTA L. J. 2006. Questions d'économie préhistorique. Modes de vie et échanges en Corse et en Sardaigne. CRDP Editions, 106 pp.
- FALCHI A., GIOVANNONI L., VACCA L., LATINI V., VONA G., VARESI L. 2005. Beta-globin gene cluster haplotypes associated with beta-thalassemia on Corsica island. *American Journal of Hematology*, **78** (1): 27-32.
- FORSYTH-MAJOR C. 1913. Observations sur la faune des mammifères quaternaire de Corse et de Sardaigne. [In:] IX<sup>ème</sup> Congrès international de zoologie, Monaco, 594 pp.
- GAUTHIER A. 1983. Roches et paysages de la Corse. Publications du Parc Naturel Régional de la Corse, 144 pp.
- KLEIN-HOFMEIJER G., MARTINI F., SANGES M., SONDAAR P. Y., ULZEGA A. 1987. La fine del Pleistocene nella Grotta Corbeddu in Sardegna. *Rivista di Scienze Preistoriche*, **41**: 1-36.



- KLEIN-HOFMEIJER G. 1997. Late Pleistocene deer fossils from Corbeddu cave: implications for human colonization of island Sardinia. *British Archaeological Reports, International Series*, **663**.
- LOUCHART A. 2002. Les oiseaux du Pléistocène de Corse et de quelques localités sardes: écologie, évolution, biogéographie et extinctions. *Documents des Laboratoires de Géologie de Lyon*, **155**: 1-287.
- LOUCHART A., BEDETTI C., PAVIA M. 2005. A new species of eagle (Aves: *Accipitridae*) close to the Steppe Eagle, from the Pleistocene of Corsica and Sardinia, France and Italy. *Palaeontographica Abt. A*, **272**: 121-148.
- LOUCHART A., SOAVE R. 2002. Changement d'ampleur de l'exploitation des oiseaux entre le Magdalénien et l'Azilien : l'exemple du Taï 2 (Drôme). *Quaternaire*, **13**: 297-312.
- MAGDELEINE J., OTTAVIANI J. C. 1986. L'abri préhistorique de Strette. *Bulletin de la Société des Sciences Historiques et Naturelles de la Corse*, **650**: 61-90.
- MEMMI M. 1999. Etude génétique de la population corse et sa relation avec les populations euro-méditerranéennes. Thèse de Doctorat, Université de Corse, Pascal Paoli.
- MOURER-CHAUVIRÉ C., WEESIE P. D. M. 1986. *Bubo insularis* n. sp., forme endémique insulaire de grand duc (Aves, Strigiformes) du Pléistocène de Sardaigne et de Corse. *Revue de Paléobiologie*, **5**: 197-205.
- PEREIRA E. 2001. Le peuplement mammalien quaternaire de Corse (Post-glaciaire exclu), son contexte environnemental, biologique et physique. Thèse de Doctorat, Université de Corse, Pascal Paoli.
- PLOUVIER L. 2000. L'Europe se met à table. [In:] Multiculturalité, identité européenne et habitudes alimentaires, DG Education et Culture, Initiative Connect, Commission européenne, 124 pp.
- PLUQUET F. 2006. Evolution récente et sédimentation des plates-formes continentales de la Corse. Thèse de Doctorat, Université de Corse, Pascal Paoli.
- ROBERT I., VIGNE J. D. 2002. Bearded Vulture *Gypaetus barbatus* contributions to the constitution of two different bone assemblages: Modern reference data and an archaeological example in Corsica. *Acta zoologica cracoviensis*, **45**: 319-329.
- ROSSI P., DURAND-DELGA M., LAHONDÈRE J. C., LAHONDÈRE D. 2001a. Carte géologique de France (1/50 000), feuille Santo-Pietro-di-Tenda (1106): Notice explicative, Orléans, BRGM, 224 pp.
- ROSSI P., DURAND-DELGA M., LAHONDÈRE J. C., BAUD J. P., EGAL E., LAHONDÈRE D., LAPORTE D., LLUCH D., LOÏE M. D., OHNENSTETTER M., PALAGI P. 2001b. Carte géologique de France (1/50 000), feuille Santo-Pietro-di-Tenda (1106): Carte, Orléans, BRGM.
- SALOTTI M., BAILON S., BONIFAY M. F., COURTOIS J. Y., DUBOIS J. N., FERRANDINI J., FERRANDINI M., LA MILZA J. C., MOURER-CHAUVIRÉ C., POPELARD J. B., QUINIF Y., REAL-TESTUD A. M., MINICONI C., PEREIRA E., PERSIANI C. 1997. Castiglione 3, un nouveau remplissage fossilifère d'âge Pléistocène moyen dans le Karst de la région d'Oletta (Haute-Corse, France). *Comptes Rendus de l'Académie des Sciences, Paris, série IIa*, **323**: 67-74.
- SALOTTI M., BELLOT-GOURLLET L., COURTOIS J. Y., DUBOIS J. N., LOUCHART A., MOURER-CHAUVIRÉ C., OBERLIN C., PEREIRA E., POPEAU G., TRAMONI P. 2000. La fin du Pléistocène supérieur et le début de l'Holocène en Corse: apports paléontologique et archéologique du site de Castiglione (Oletta, Haute-Corse). *Quaternaire*, **11**: 219-230.
- SCOZZARI R., CRUCIANI F., PANGRAZIO A., SANTOLAMAZZA P., VONA G., MORAL P., LATINI V., VARESI L., MEMMI M. M., ROMANO V., DE LEO G., GENNARELLI M., JARUZELSKA J., VILLEMS R., PARIK J., MACAULAY V., TORRONI A. 2001. Human Y-chromosome variation in the western Mediterranean area: implications for the peopling of the region. *Human Immunology*, **62**: 871-84.
- SONDAAR P. Y. 2000. Early human exploration and exploitation of islands. *Tropics*, **10**: 203-230.
- SONDAAR P. Y., BOER P. L., SANGES M., KOTSAKIS T., ESU D. 1984. First Report on a Paleolithic Culture in Sardinia. *British Archaeological Reports, International Series*, **229**: 29-47.
- SONDAAR P. Y., ELBURG R., KLEIN-HOFMEIJER G., DE VISSER H., SANGES M., MARTINI F. 1993. Il popolamento della Sardegna nel tardo Pleistocene: nuova acquisizione di un resto fossile umano della grotta Corbeddu. *Rivista di Scienze Preistoriche*, **45**: 243-252.
- SONDAAR P. Y., ELBURG R., KLEIN-HOFMEIJER G., MARTINI F., SANGES M., SPAAN A., DE VISSER H. 1995. The human colonization of Sardinia: a Late-Pleistocene human fossil from Corbeddu cave. *Comptes Rendus de l'Académie des Sciences, Paris, série IIa*, **320**: 145-150.
- SONDAAR P. Y., MARTINI F., ULZEGA A., KLEIN-HOFMEIJER G. 1991. L'Homme pléistocène en Sardaigne. *L'Anthropologie*, **95**: 181-200.
- SPOOR F. 1999. The human fossils from Corbeddu cave, Sardinia: a reappraisal. *DEINSEA*, **7**: 297-302.
- THEVENOT M. 2006. Aperçu du régime alimentaire du Grand-duc d'Afrique du Nord *Bubo ascalaphus* à Tata, Moyen Draa. *Go-South Bulletin*, **3**: 28-30.
- THEVENOT M., AULAGNIER S. 2006. Mise à jour de la liste des mammifères sauvages du Maroc. *Go-South Bulletin*, **3**: 6-9.
- VARESI L., MEMMI M., MAMELLI G. E., CALO C. M., VONA G. 2000. Mitochondrial control region sequence variation in corsican population (France). *American Journal of Human Biology* **12**: 339-351.
- VIGNE J. D. 1989. Le peuplement paléolithique des îles : le débat s'ouvre en Sardaigne. *Les nouvelles de l'archéologie* **35**: 39-42.

- VIGNE J. D. 1995. Préhistoire du Cap Corse: les abris de Torre d'Aquila, Pietracorbara (Haute-Corse): la faune. *Bulletin de la Société préhistorique française*, **92**: 381-389.
- VIGNE J. D. 1999a. L'abri du Monte Leone (Bonifacio, Corse du Sud): vaste site pré-néolithique en contexte insulaire. [In:] V<sup>ème</sup> colloque international UISPP, L'Europe des derniers chasseurs. Peuplement et paléoenvironnement de l'Épipaléolithique et du Mésolithique, Grenoble, 18-23 septembre 1995, Paris, Pp: 645-650.
- VIGNE J. D. 1999b. Luri, grotte de Gritulu. [In:] Bilan SRA Corse 1998. Services Régionaux de l'Archéologie, Ajaccio, Pp: 52-53.
- VIGNE J. D. 1999c. Programme collectif de recherche « Paysages, renouvellements de faunes et anthropisation de la Corse au Tardiglaciaire et au début de l'Holocène ». [In:] Bilan SRA Corse 1998. Services Régionaux de l'Archéologie, Ajaccio, Pp: 16-18.
- VIGNE J. D. 2000. Les chasseurs préhistoriques dans les îles méditerranéennes. *Dossier Hors-Série pour la Science*, Juillet: 132-137.
- VIGNE J. D., BAILON S., CUISIN J. 1997. Biostratigraphy of Amphibians, Reptiles, Birds and Mammals in Corsica and the role of man in the Holocene faunal turnover. *Anthropozoologica*, **25-26**: 587-604.
- VIGNE J. D., BOURDILLAT V., ANDRE J., BROCHIER J. E., BUI THI Mai, CUISIN J., DAVID H., DESSE-BERSET N., HEINTZ C., LANFRANCHI F., RUAS M. P., THIEBAULT S., TOZZI C. 1998. Nouvelles données sur le pré-néolithique corse: premiers résultats de la fouille de l'abri du Monte Leone (Bonifacio, Corse du Sud). [In:] APDCA (ed.) – Rencontres méridionales de Préhistoire récente, deuxième session, Arles, 1996, Pp: 251-260.