

Chapter 13

Episodes of Magdalenian Hunter-Gatherers in the Upper Gallery of Tuc d'Audoubert (Ariège, France)



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Abstract The Tuc d'Audoubert cave (Ariège, France) offers unique insights into the life of Late Pleistocene hunters-gatherers due to its exceptionally good preservation conditions. This is especially true for the 300 footprints in the upper gallery of the cave. Even for the layperson, some trackways are easily recognized. Short episodes of past life become tangible. The spectrum of scientific analytic methods used in western science has not yet provided an option to interpret these visible episodes satisfactorily. For this reason, tracking experts, i.e. indigenous ichnologists, were invited to analyse the footprints in Tuc d'Audoubert. With their dynamic approach of identification, they are able to do justice to the dynamics embodied in the footprints. In total, eight main concentrations in four different locations were studied. Two hundred fifty-five footprints were identified and grouped into 24 events. In view of the group compositions and the assumption that humans did not climb alone into the upper gallery for security reasons, it can be concluded that a maximum of five visits by two to six subjects were carried out. Among the events, the couple of an adult man and an adult woman, who appear together in a total of ten different spots, is particularly noteworthy. Altogether, this study is a first step of a multi-stage procedure. Further analyses based on measurements and plantar pressure analyses will follow.

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Keywords Footprints · Upper Palaeolithic · Event identification

Introduction

Over the past years, ichnology has acquired a new relevance in prehistoric archaeology of caves, as shown in a number of scientific studies (e.g. Ledoux 2019; Romano et al. 2019; Ortega Martínez and Martín Merino 2019; Pastoors et al. 2017; Pastoors et al. 2015) and the International Conference on Prehistoric Human Traces held in Germany (Cologne, May 2017). It is within this framework that the prehistoric human tracks in Tuc d'Audoubert are analysed in a multi-stage procedure, combining static with dynamic approaches. In the first phase the tracks have been studied by indigenous ichnologists in 2018, and their results will be presented in this contribution. As static analyses, i.e. Cussac, Fontanet, Bâsura Cave and Pech-Merle of human footprints in caves have shown, this method is not appropriate for exploring the entire information potential of human tracks (cf. Ledoux 2019; Romano et al. 2019; Duday and García 1983). A dynamic method of reading footprints in a morpho-classificatory way offers significantly more possibilities. The good preservation of most of the footprints in Tuc d'Audoubert provides an ideal framework for this investigation.

Quantitative, static analyses are not yet done but will in a next step serve as an important complement and cross-check. In this way, a maximum of information can be drawn from the prehistoric footprints of Tuc d'Audoubert.

At this point, it is important to note that this contribution focuses exclusively on the footprints which are not directly related to the making of drawings or clay models, in the broader sense of art. This clear separation of the aforementioned spoors in terms of activity and space makes such a distinction meaningful. The results of the analysis of the spoors from the Salle des Talons are only included here in particular cases as far as they are published.

The following chapter examines traces that document the locomotion in space and the interaction between humans and bear bones in the various locations along the upper gallery. But it is the intention to go beyond the reconstruction of the activities of every subject. The focus is on the identification of events from the lives of the individual subject as well as groups.

Design of the Project

For the study, three indigenous ichnologists were engaged who have already worked in the Tracking in Caves project (Pastoors et al. 2015, 2017; Lenssen-Erz et al. 2018) but also as professional trackers for commercial hunting and, especially, as economic support for their families and villages through traditional hunting practices. Eight main concentrations of human tracks in the upper gallery of Tuc d'Audoubert

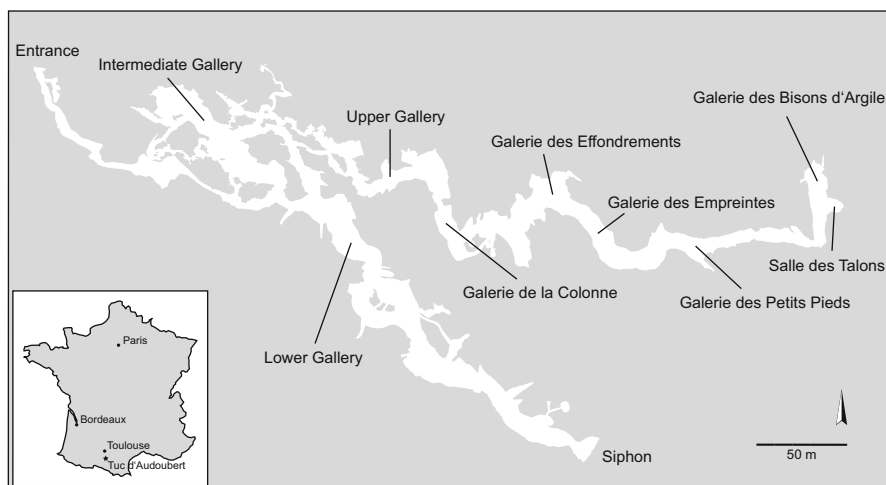


Fig. 13.1 Simplified plan of Tuc d'Audoubert with designation of the locations mentioned in the text. (Illustration Association Louis Bégouën)

were selected according to a list of priorities for the quality and quantity of human footprints in the following locations: Galerie des Effondrements, Galerie des Empreintes, Galerie des Petits Pieds and Salle des Talons (Fig. 13.1). There, the three ichnologists were asked to investigate the discernible footprints and other traces, while the archaeologists accompanying them were assigned to document their analysis. The research in Tuc d'Audoubert took place from 10 to 21 October 2018.

Participants

The main researchers of this project were three indigenous ichnologists from the Nyae Nyae Conservancy around Tsumkwe (Namibia): Thui Thao, /Ui Kxunta and Tsamgao Ciqae. The first two of them are certified Master Trackers of the CyberTracker system (see www.cybertracker.org), while the third, having learned tracking in a traditional way, has mainly helped to translate into English the analysis of the other two ichnologists, which were in Jul'hoansi language. In addition, T. Ciqae also holds a level 2 certificate as a tourist guide and is currently preparing a Namibian hunting licence, so he is very familiar with species terminology (English and Latin).

Materials

The Volp Caves

The three caves of the Volp, Enlène, Trois-Frères and Tuc d'Audoubert, have already been widely described in previous publications (cf. Bégouën et al. 2009, 2014, 2019) and will be presented here only in short form.

The caves are located in the extension of each other under a limestone massif mostly forested, covered with dolines and bizarre rocks with channel-like furrows (southeastern France, Ariège). The limestone massif runs from east to west in this northern Pyrenean part formed of parallel ranges between the Plantaurel in the north and the Arize massif in the south. It is placed in the territory of the community of Montesquieu-Avantès, 14 km southwest of Mas d'Azil. The landscape is contrasted, since the regular and undulating forms of the Cenomanian hills are brutally opposed to the classical phenomena of karst. Under one of these hills, only a few kilometres after its source, the Volp has carved out a large three-level hydrographic network. The lower gallery is the one where the Volp flows, interspersed with two impassable siphons, making the 875 m course impossible to navigate between its loss and its resurgence. The intermediate gallery only exists in the downstream zone at 3 m above the Volp bed. It is in the uppermost level that the upper gallery of Tuc d'Audoubert and the caves of Enlène and Trois-Frères are located.

The Cave of Tuc d'Audoubert

The cave of Tuc d'Audoubert is 640 m long with the resurgence of the Volp as its entry, and because the Volp did not flow during certain periods of the late glacial (Bégouën et al. 2009), this allowed humans easy access to the intermediate gallery (Fig. 13.1). This gallery has preserved many archaeological findings and parietal art, remains of diverse prehistoric activities. A 12-m-high chimney leads from the Salle Nuptiale to the upper gallery, which extends over 465 m. The course in this network, sometimes very difficult, is closely marked for preservation reasons by two cords up to the Bisons d'Argile, a unique masterpiece of its kind. Throughout the route, traces of the humans' passage are visible on either side of the trail: footprints and heels of adults and children, fingerprints in the clay on the ground, broken bear skulls with extracted teeth, jewellery objects placed on the ground, etc. Parietal art is present in the entire intermediate gallery and in the first part of the upper gallery.

Archaeological Context

From 1992 to 2009 a comprehensive research project was carried out in Tuc d'Audoubert (Bégouën et al. 2009). The aims of this 17-year project were to carry

out a broad prospection to evaluate the archaeological potential; to develop a systematic investigation of diverse find categories, their documentation and analysis (rock art, depositions, excavations, sondages and dating); and to publish an encompassing monography (Bégouën et al. 2009).

According to this publication, a total of 356 graphic elements were recorded, 101 of which show motifs from the animated world. Among these, depictions of steppe bison (41%) clearly dominate over horse (16%). Reindeer, ibex, snake, lion, bear and unreal beings complete the ensemble of these motifs. In addition, the 140 P- and Q-shaped claviform signs stand out. Apart from these numbers, the multiple depictions of bison couples (male and female) is exceptional. But, most spectacular are the clay sculptures preserved in Tuc d'Audoubert. They represent a male and a female bison, each being 60 cm long and placed in the centre of the last chamber of the upper gallery. On their surfaces human traces as marks of the production process are well preserved (e.g. smoothing with hands and fingerprints on the mane). Furthermore, technical details of the production are still visible: Horns and ears were attached, eyes modelled as craters or elevations and beards cut with a sharp tool.

The cave walls were not only used as canvas for drawings, but their niches and fissures serve for the deposition of various artefacts. A total of 18 objects were found in Tuc d'Audoubert in such situations. Usually these are bone fragments, but lithic artefacts, projectiles and red ochre were also found. The objects are wedged or ready to hand. Only in rare cases they are hidden and difficult to find.

Human presence in Tuc d'Audoubert is evinced for autumn-winter, between 17,200 and 16,500 calBP. Only one single find layer was found at each of the five limited excavations in different chambers. Remarkable is the diversity of the reconstructed activities, their probable contemporaneity and relation to the cave topography (Pastoors 2016).

Various reconstructed activities reflect concrete movements in space and show that the cave as a natural structure has been anthropogenized. This is important to memorize for the analysis of the prehistoric footprints in the upper gallery.

In Tuc d'Audoubert, 21 specific find concentrations were identified at which, on the one hand, substantial activities ($N = 2$) and, on the other hand, limited, qualified activities were carried out (Fig. 13.2). These limited, qualified activities include drawing activities ($N = 16$) and the consumption of introduced provisions ($N = 2$). All 21 find concentrations are in the dark zone of the cave.

The selection of chambers for the various activities of prehistoric humans in Tuc d'Audoubert shows a clear pattern (Fig. 13.2). While substantial and consumption activities were carried out in chambers that were wide and high, drawing activities were carried out in the entire spectrum of chamber types used in Tuc d'Audoubert. It is noticeable, however, that concentrations with only drawing activities are located in narrow or low chambers. From the picture emerge two chambers with substantial or consumption activities in narrow, low chambers (Galerie du Bouquetin and Diverticule des Dessins).

Find concentrations with substantial or consumption activities do not show any pattern at first sight due to their placement in the path network (Fig. 13.2). They are

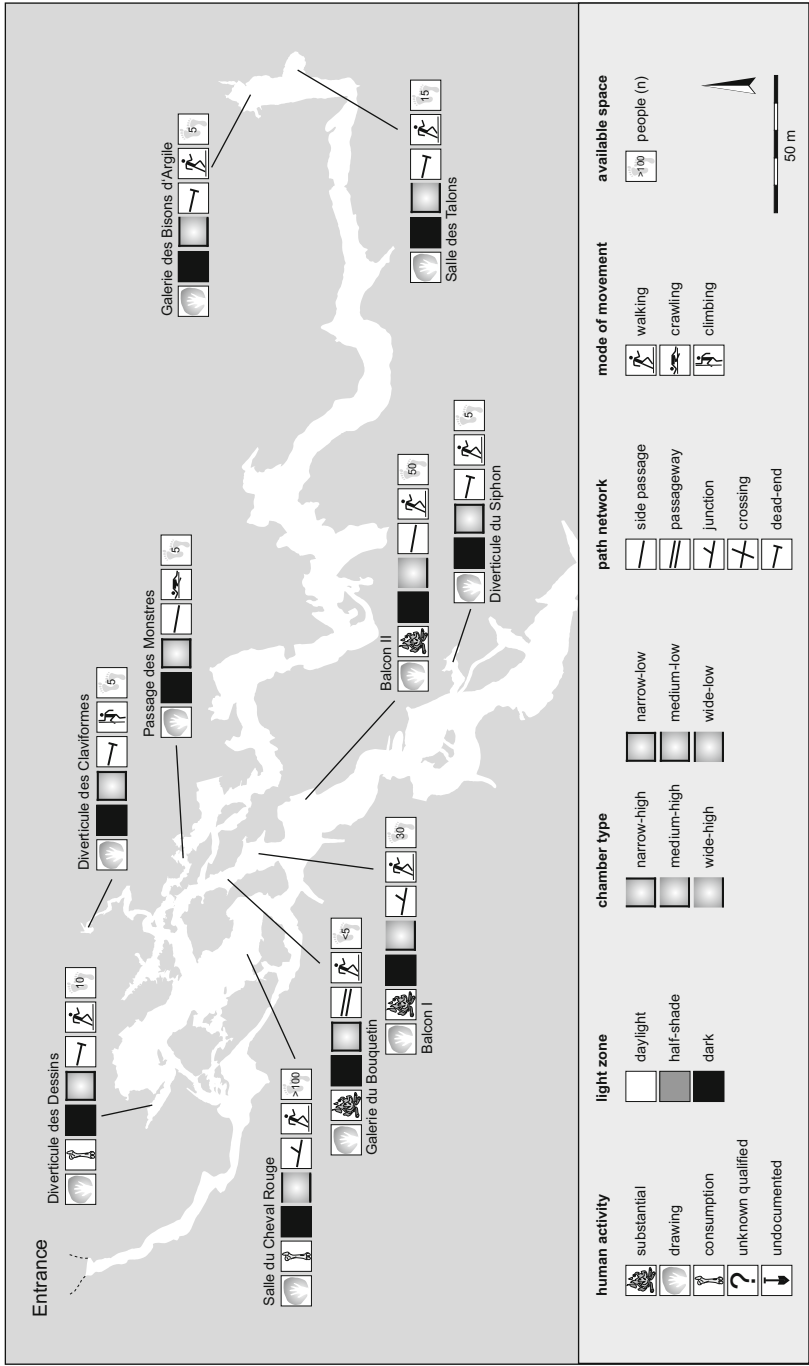


Fig. 13.2 Distribution of concentrations of prehistoric remains with structured information on the use of space in Tuc d'Audoubert. (Illustration Association Louis Bégouën)

located at junctions, at a side passage, at passageway and in a dead end. The differentiated consideration of the two types of activities shows that at least the concentrations with substantial activities are in a strategically favourable position in Tuc d'Audoubert path network due to their immediate proximity to the central traffic axis of the lower gallery. The concentrations with drawing activities, on the other hand, show a clear relation to certain components of the path network. In particular, dead ends and side passages were selected. It is interesting to note that junctions were selected for drawing activities when also other activities were carried out there. Passageways seem to have been of little interest.

The concentrations with substantial or consumption activities are comfortably accessible upright (Fig. 13.2 'mode of movement'). This also applies to the majority of concentrations of drawing activities. In addition, two concentrations can only be passed crawling. Another two concentrations have to be climbed. A total of three concentrations require combined modes of movement: walking and crawling or climbing and crawling.

For the substantial and consumption activities, premises were selected that offer sufficient space for several people at the same time (Fig. 13.2 'chamber type'). Small chambers were avoided for these activities. Exactly the opposite is true for the drawing activities. Here, space was selected that could accommodate a maximum of five people at the same time.

The spatial distribution of the depots corresponds very well with that of the concentrations with substantial or consumption activities. Here a direct relationship between the different activities seems to be evident. The only exception is a fragment of bone deposited at the branch of the Diverticule des Claviformes diverting from the Galerie du Bouquetin in a niche 6 m above the ground in a shaft leading upwards.

The analyses of the archaeological finds exhibit a short stay in Tuc d'Audoubert with different activities of basic supplies, consumption, raw material extraction and drawing activities. In the course of this stay, the entire cave was explored with sporadic visits to the upper gallery. This large spectrum of qualified activities in connection with substantial activities is similar to base camp activities in open-air sites. Thus Tuc d'Audoubert plays a comparable role within the network of sites of Magdalenian hunter-gatherers in the Pyrenees for a limited period of time and represents in this respect an autonomous subsystem.

The inferences from this detailed picture for the basic understanding of the episodes fossilized in the floor of the upper gallery are the following:

- Base camp activities suggest the presence of the entire group of hunter and gatherers with members from each age class.
- The anthropization of the intermediate gallery of the cave testifies to a behaviour based in experience with the conditions of a complex cave system.

Human Tracks

Tracks of humans and cave bears were noticed and respected right from the first day of the discovery of the upper gallery (10 October 1912). This is a very thoughtful behaviour for that time and the basis for the preservation of all tracks into the twenty-first century. For the monograph of 2009, a first tentative count of the human tracks was carried out (Table 13.1).

Of the total of 302 human footprints, passage-related traces are by far the most abundant, and among them, the heels are mainly grouped in the Salle des Talons. Apart from the latter, whose count corresponds to all that is visible in this place, the 87 feet inventoried elsewhere represent only a sample. To preserve the soil, the distant identification of human tracks in the vicinity of bear tracks has proven to be difficult, sometimes impossible (human presence always after that of the cave bear). Moreover, the entire gallery could not be prospected because the virgin surfaces were too fragile. The actual number of footprints must be significantly higher.

Moving towards the deep part of the cave, the first footprints appear in the Salle des Lacis. They can be related to the last engravings when coming from the entrance but also to the first displaced bear bones and accumulated concretions. This association of footprints and manipulated objects, moved or broken, becomes a constant phenomenon in the deep part of the upper gallery. However, two categories can be distinguished: on the one hand, footprints reflecting dynamic movement and, on the other hand, concentrations of imprints over small areas, indicating a stopover or short-distance comings and goings. The former are related to the progression of humans in the gallery and the latter to activities requiring a stopover. The activities during the stopover were sparse because there is no intense trampling as the footprints are clearly discernible and overlaps are infrequent. Thus in the Galerie des Effondrements, about 20 footprints, fingerprints and broken concretions encircle the mandible of a cave bear. Further on, about 40 footprints are spread over 30 m in four concentrations: about 20 in the first, then 8 around the broken cave bear skull, 19 at least in an area with scattered manipulated cave bear bones and finally some at

Table 13.1 Number of prehistoric human tracks in the upper gallery of Tuc d'Audoubert (Bégouën et al. 2009)

Location	Footprint	Heelprint	Div. spoors	Total
Salle des Lacis		1		1
Galerie du 10 Octobre		1		1
Galerie de la Colonne		1	1	2
Galerie des Effondrements	11	6	8	25
Galerie des Empreintes	72	3	1	76
Galerie des Petits Pieds	4	1		5
Galerie des Bisons d'Argile			4	4
Salle des Talons		183	5	188
Total	87	196	19	302

the end of the gallery. Five footprints are concentrated at a prominent location in the Galerie des Petits Pieds.

The next important concentration is none other than the Salle des Talons (Fig. 13.1). Since 1912, these prints have raised many questions, most of which remain unanswered. We have seen that the asymmetrical shape of the cups and their level of sinking into the ground correspond well to heels. Rare circular cups represent knee imprints. It was until more than 100 years after the discovery that complete footprints were discovered for the first time by indigenous ichnologists (Pastoors et al. 2015) in 2013. The distribution of heel imprints indicates activities around the extraction of clay and the making of various drawings on the cave floor (Bégouën et al. 2009; Pastoors 2016).

In summary, for the Salle des Talons initially there were the assumptions that young individuals have left behind five to six sequences of tracks. According to Bégouën, ritual dance or initiation (Bégouën 1928) was the motivation for this. Vallois is much more neutral and sees here young individuals, deliberately walking on heels (Vallois 1931). A further interpretation of the events in the Salle des Talons that led to the distribution of the footprints was carried out by the indigenous ichnologists in 2013 and 2018. They identified two subjects who crossed the chamber twice to a clay extraction pit (Pastoors et al. 2015). In addition, further footprints are associated with drawing activities on the floor.

Investigations about the identity of the trackmakers in the upper gallery of Tuc d'Audoubert were carried out only unsystematically up to the present work. Vallois examined a selection of the best-preserved footprints and took the first measurements. Two complete footprints measure 218 mm or 200 mm in length and 53 mm or 62 mm in heel width. Further dimensions were taken from heel prints, which accumulate at various points in the cave. Accordingly, the examined heels have a maximum width of 72, 68, 67, 60, 54 and 52 mm (Vallois 1931). The step width of these heel imprints is between 25 and 28 cm. In the Salle des Talons, also measures of the maximum width of the heels were taken. Thus they are 58, 55, 53, 52 and 50 mm wide. The step width of these prints examined is a maximum of 20 to 25 cm.

Methods

Prehistoric human traces are considered to be the most personal, nonmaterial legacies that have remained. These are mainly footprints, but also traces of hands, knees and other body parts. Curiously, it does not yet seem possible to do justice to these information-rich traces with synthetic classification and quantitative methods. A critical inspection of the possibilities and above all the limits of current methods clearly shows that on empirical basis only the number of different trackmakers can be calculated (Bennett and Morse 2014; see Chap. 2). In the ideal case, statements about the gait and the walking speed are also possible. On the basis of quantitative analyses, it is currently not possible to say anything dependable about the identity of people and the episodes stored in the tracks. It looks as if these static analyses are not

appropriate for exploiting the information potential of this multifaceted find category of dynamic processes (see Chap. 6).

To pursue this issue more closely, the methodological process for the analysis of prehistoric footprints in Tuc d'Audoubert follows a multistage procedure. This includes the identification of the traces left behind by prehistoric humans according to the principle of the preiconographic description by Panofsky (see next paragraph; Panofsky 1962). Traces are recognized, put in relation to each other and summarized as events. In a further step, the identified human tracks are analysed quantitatively following basic measurements (cf. Bennett and Morse 2014). Footprint outline- and landmark-based geometric-morphometric analysis (cf. Bennett et al. 2009; Bennett et al. 2016) and pixel-based quantitative analysis of the whole plantar pressure (cf. Crompton et al. 2011) are also planned.

Practical experience (familiarity with objects and phenomena) is an absolute prerequisite for a successful application of the preiconographic description, from which a positive correlation between experience and descriptive accuracy can be derived. In the case that the spectrum of personal experience is not sufficient, this spectrum must be extended by consulting publications or experts. Practical experience, in turn, helps to determine which publication or expert is to be consulted (Panofsky 1962: 9). In prehistoric archaeology, it is a common practice to compensate the lack of practical experience with experiments (e.g. Bourguignon et al. 2001). In the layout of the current research project we decided against the generation of experience through experimental archaeology. Instead, we use expert knowledge of indigenous ichnologists building on their outstanding experience in reading tracks (Liebenberg 1990; Gagnol 2013; see also Chap. 6 and 19).

The process of recording the workflow of the indigenous ichnologists in reading prehistoric human spoors has been substantially further developed compared to the one applied in 2013. First of all, lists were compiled with information on each individual footprint examined. The following aspects were documented:

- Subject number: The subject number identifies each individual (trackmaker) independently of the study area within the cave. This makes it easy to follow each subject through the cave.
- Age: The results of the morpho-classificatorical analysis of age are given very precisely by the indigenous ichnologists. In consideration of the fact that such a precise age indication by means of footprints seems problematic and should always be seen against the background of the reference collection used or personal experience, the data of the indigenous ichnologists are grouped together in age classes according to Martin (Martin 1928) – neonatus, infans I (0.5–6 years), infans II (7–13 years), juvenis (14–20 years), adultus (21–40 years), maturus (41–60 years) and senilis (>60 years).
- Sex: If the sex of the subject can be identified, it is recorded as female or male.
- Physique: Under this aspect, information about the body shape is given. Here, too, it is more a matter of deviations from a normal physique than of a precise definition of a certain shape.

- **Handicap:** Under handicap, observations are recorded that relate to deviations from a well-balanced human being. No statements are made about the medical causes.
- **Spoor number:** The spoor number designates each individual human trace examined and listed in the project. Subject and spoor number together form a distinctive unit. They are continuous and thus allow an unambiguous assignment of the human traces in each part of the cave.
- **Spoor type:** Specifies the exact body part that caused the traces. This includes the foot, hand, knee, elbow and others (e.g. tools).
- **Side:** If the side of the body part can be identified, it is recorded as left or right.
- **Additional weight:** The additional weight refers to the characteristics of a subject that deviate from the normal gait or depth of imprint.
- **Gait:** Under this point, statements are made about the manner of the executed locomotion. This includes safety and speed, as well as movement in a group or alone.
- **Direction:** The direction of movement is documented in cardinal direction. Specific local information is given for better orientation in the cave.
- **Trackway:** Hereunder it is noted whether the footprint is part of a series of footprints of the same subject or whether it is isolated.
- **Event identification:** Summary of traces of individual or several subjects in temporal, spatial and content-related connection with each other.
- **Taphonomy:** This aspect refers to the state of preservation of the various traces which can be influenced by both natural and anthropogenic factors.
- **Substrate:** The substrate refers to the sediment in which the spoor was formed.
- **Reliability of identification:** Particularly important for the comprehensibility of the analysis is the judgement of its reliability on the basis of preservation and visibility. For this purpose, a subjective five-stage classification was carried out from very good (1) to unsatisfactory (5). The intermediate stages are good (2), satisfactory (3) and sufficient (4).
- **Remarks:** An open field for comments of any kind.

The position of every spoor was located on plans or sketches. All work sequences were recorded on film. In this way, not only the results can be checked and compared with each other, but also further linguistic research can be carried out. At the end stands a database (catalogue) with the results of the morpho-classificational analysis and event identification. For future work, photogrammetric records of the examined footprints will be generated with the help of Structure from Motion (e.g. Mallison and Wings 2014).

In order to understand how a combination of footprints is identified as a track, and how several tracks sometimes are being interpreted as a coherent event, it is helpful to look at perception psychology and Gestalt principles in particular. By Gestalt is meant:

a unitary whole of varying degrees of detail, which, by virtue of its intrinsic articulation and structure, possesses coherence and consolidation and thus detaches itself as a closed unit from the surrounding field. (Maynard 2005: 501 citing Gurwitsch 1964).

The concept of Gestalt was introduced by Max Wertheimer (Wertheimer 1923), and since then research into Gestalt formation focuses on the perception and interpretation of grouped objects as well as on small entities within larger environments and is of relevance still today (Wagemans et al. 2012a, b). So-called Gestalt laws (Fitzek and Salber 1996) or principles are particularly vital in the advertisement industry (e.g. Graham 2008), and, besides psychology (e.g. Wörgötter et al. 2004), they have also received quite some attention in computer science and mathematical approaches (e.g. Zhu 1999; Elder and Goldberg 2002; Wen et al. 2010). Some of the Gestalt principles are figure-ground articulation, proximity, common fate, similarity, continuity, closure, past experience and good Gestalt (Todorovic 2008). All these principles are at work in perception when regarding spoor, single or in trails, and making sense of their complex and combining information.

Results

In the following part, the results of the identifications of the prehistoric footprints from Tuc d'Audoubert by the indigenous ichnologists are presented in spatial units, advancing into the depth of the upper gallery. Starting point in each section is the specification of the chamber with its prominent finds and features, which are based on the descriptions by Bégouën et al. (2009). After this intro, the results are grouped according to the events identified. In this chapter, two different systems are used to identify the individual spoors. On the one hand, the numbering of the spoors as published by Bégouën et al. (2009) (e.g. TUC-291) is used as a reference while on the other hand, since it is more detailed, the project-internal numbers of the tracks (e.g. S8-1, S8-2 ...) (for cross-references, see Table 13.2). The rating of the reliability of identification is assembled in the same table.

Galerie des Effondrements

This gallery is about 50 m long and comprises a passage between various geological phenomena that have marked this place (Fig. 13.3). Prehistoric humans followed this itinerary, leaving their traces throughout this same passage. The floor of the Galerie des Effondrements is largely made up of stalagmitic floors, especially on the southern side of the path. On the northern side there are clay areas with various human spoors. Apart from these traces, the most spectacular testimonies are the bear bones removed from their original deposits and placed along the path. After a large chute, the gallery widens but remains marked by bear bone deposits, still located in the axis of the passage.

Just after a stalagmitic obstacle, the path makes a sharp turn to the right. On its left side, at 60 cm from the passage, a human heel (TUC-266) is visible with its well-marked clay ridge. Not far from the previous one, over a length of about 1 m, there

Table 13.2 List of prehistoric tracks identified by the indigenous ichnologists in the upper gallery of Tuc d'Audoubert

Spoor n°	Reliability of identification				Event	Cross- reference	Location
	Toes	Ball of foot	Midfoot	Heel			
S3-1	1	2	2	2	E24	TUC-331	Galerie des Petits Pieds
S3-2	3	4	4	4	E15	TUC-308	Galerie des Empreintes – eastern centre
S3-3	5	5	5	3	E15		
S4-1	1	1	1	2	E24	TUC-332	Galerie des Petits Pieds
S4-2	5	4	4	3	E21	TUC-330	
S5-1	3	4	4	3	E22	–	
S6-1	2	3	3	3	E23	–	
S7-1	5	3	3	1	E17	TUC-308	Galerie des Empreintes – eastern centre
S7-2	5	5	4	4	E17		
S7-3	5	5	4	3	E16		
S7-4	2	3	3	3	E16		
S7-5	1	3	3	2	E17		
S7-6	4	4	4	4	E17		
S7-7	5	5	5	2	E13	TUC-303	
S7-8	5	5	5	2	E13		
S7-9	5	5	2	2	E13		
S7-10	5	4	2	2	E13		
S7-11	4	4	3	2	E13		
S7-12	4	4	4	3	E14	–	
S7-13	1	3	5	5	E11	TUC-293	Galerie des Empreintes – western centre
S7-14	5	5	4	4	E11		
S7-15	3	3	3	3	E10		
S7-16	5	5	3	2	E10		
S7-17	4	4	5	5	E10		
S7-18	4	4	4	4	E8	TUC-291	Galerie des Empreintes – western end section
S7-19	5	5	5	4	E8		
S7-20	2	3	5	5	E8		
S7-21	4	4	3	3	E8		
S7-22	4	4	4	3	E7		
S7-23	5	5	4	3	E7		
S7-24	4	4	3	3	E7		
S7-25	1	1	1	1	E2	TUC-273	Galerie des Effondrements
S7-26	1	1	1	1	E2		
S7-27	5	5	1	1	E2		
S7-28	1	1	1	1	E2		
S7-29	1	1	1	1	E2		
S7-30	3	2	1	1	E4	–	
S7-31	5	5	2	1	E1	TUC-267	Galerie des Effondrements
S7-32	buttock (2)				E1		

(continued)

Table 13.2 (continued)

Spoor n°	Reliability of identification				Event	Cross- reference	Location
	Toes	Ball of foot	Midfoot	Heel			
S7-33	5	4	3	3	E18	TUC-324	Galerie des Empreintes – eastern end section
S7-34	4	4	4	4	E18		
S7-35	1	1	4	3	E19		
S7-36	4	3	4	2	E19		
S7-37	2	4	2	4	E19		
S8-1	4	3	2	1	E17	TUC-308	Galerie des Empreintes – eastern centre
S8-2	5	5	4	2	E17		
S8-3	2	4	4	3	E16		
S8-4	2	3	4	5	E16		
S8-5	1	3	4	5	E16		
S8-6	1	2	5	5	E11	TUC-293	Galerie des Empreintes – western centre
S8-7	5	4	4	1	E10		
S8-8	4	4	4	1	E10		
S8-9	5	4	4	2	E10		
S8-10	4	4	4	3	E10		
S8-11	4	4	4	2	E9	–	Galerie des Empreintes – between western centre and western end section
S8-12	4	4	3	1	E9	–	
S8-13	5	3	2	2	E8	TUC-291	Galerie des Empreintes – western end section
S8-14	5	3	2	2	E8		
S8-15	2	2	1	1	E8		
S8-16	2	3	3	1	E8		
S8-17	2	4	4	3	E8		
S8-18	1	2	4	4	E8		
S8-19	1	3	4	4	E8		
S8-20	1	4	4	4	E8		
S8-21	5	5	2	1	E7		
S8-22	5	5	4	2	E7		
S8-23	5	3	2	1	E3	–	Galerie des Effondrements
S8-24	1	1	2	2	E4	TUC-285	
S8-25	5	3	1	1	E1	TUC-266	Galerie des Effondrements
S8-26	4	3	3	2	E18	TUC-324	Galerie des Empreintes – eastern end section
S8-27	4	4	4	4	E18		
S8-28	4	4	4	3	E18		
S8-29	4	4	4	3	E18		
S8-30	5	5	2	2	E19		
S8-31	1	2	3	3	E19		
S9-1	3	3	3	2	E20		
S10-1	3	3	3	3	E15	TUC-308	Galerie des Empreintes – eastern centre
S11-1	4	4	4	2	E15		
S12-1	5	5	5	3	E15		
S13-1	3	5	5	5	E15		

(continued)

Table 13.2 (continued)

Spoor n°	Reliability of identification				Event	Cross-reference	Location
	Toes	Ball of foot	Midfoot	Heel			
S14-1	2	3	4	4	E12	TUC-293	Galerie des Empreintes – western centre
S14-2	2	3	4	4	E5	TUC-291	Galerie des Empreintes – western end section
S14-3	3	3	2	2	E6		

Table 13.3 Quantification of tracks identified during the Tracking in Caves project in 2018; the published data refer to Bégouën et al. (2009). Tracks from Salle des Talons were not analysed equally detailed as all other tracks

Location	Number of footprints		
	Published	Identified in 2018	Proportion of published footprints
Galerie des Effondrements	25	11	44%
Galerie des Empreintes	76	67	88%
Galerie des Petits Pieds	5	5	100%
Salle des Talons	188	172	91.5%
Total	294	255	86.1%

are at least one footprint and a slide (TUC-267), on a relief near a depression. According to the indigenous ichnologists, the traces described above came from one single event.

The most visible human footprints are on the northern side of the passage, two small heels of probably identical dimensions and appearance (TUC-280 and TUC-281) heading to the east, facing the deep part of the cave. Another footprint (TUC-285) is 1.5 m from the path, close to a natural crack in the clay, perpendicular to the axis of the gallery. It is a right foot well printed in clay with five clearly visible toes. The most prominent area with human spoors is 3 m to the north from the path, in the largest part of the gallery (TUC-273). Their presences indicate human activities over an area of 6 m². Apart from footprints, the edges of a depression have retained two parallel and aligned finger marks, one of them near to a cave bear mandible without its canine. In this area there are about 15 well-preserved footprints.

So far, 25 human tracks have been published of the Galerie des Effondrements (Bégouën et al. 2009). In the course of the investigations by the indigenous ichnologists, two further footprints were discovered, so that now overall 27 footprints are known. Of these, only 11 were interpreted more closely by the trackers (44%) (Table 13.3). The other footprints were either hidden or there was nothing reliable to report about them. The 11 footprints were made by 2 adults, 1 female (subject S8) and 1 male (subject S7), and derived from 4 events:

- Event 1: Just in the sharp turn, two subjects, subject S7, male adult, and subject S8, female adult, walked together fast in direction to the entrance (Fig. 13.4). From subject S7, male adult, is a left footprint that results from slipping (S7–31) and led to a curiosity. The trackmaker couldn't keep his balance and has sat down on his buttocks (S7–32) right on the edge of the depression mentioned above.
- Event 2: The second event happened in the most prominent area with human spoors in the Galerie des Effondrements (Fig. 13.3). Here subject S7, male adult, has left several spoors in a sequence of five successive footprints – left (S7–25), right (S7–27), left (S7–26), right (S7–29) and left (S7–28). The subject was standing there, picking something up, probably the mandible of the cave bear that is in front of the footprints (Fig. 13.4). While working there with the body aligned to the northern wall of the gallery, the trackmaker was alone at the place. No footprints of other subjects are visible in this restricted area.
- Event 3: Just around 3 metres from the first event, there is a new isolated left footprint from subject S8 (S8–23), female adult (Fig. 13.3). It is on the north side, about 1.5 m from the path. The subject was walking in the direction of the deep part of the cave. At this point, the subject slipped a little and walked with slow speed.
- Event 4: The last event identified by the indigenous ichnologists is located near the natural crack in the clay perpendicular to the axis of the gallery (Fig. 13.3). Here, on a slightly rising ground, subjects S7, male adult, and S8, female adult, walked fast together to the entrance of the cave. Both trackmakers were carrying little additional weight at that place. From subject S8, female adult, a right isolated footprint has been identified (S8–24). The right isolated footprint (S7–30) from subject S7, male adult, was hitherto unknown.

The footprints in the Galerie des Effondrements document very well a short-term activity of a male adult (subject S7) in the environs of the mandible of the cave bear, a dynamic locomotion of a female adult (subject S8) in direction to the deep part of the cave and a dynamic and fast locomotion of the two adults (subjects S7 and S8) together carrying each a little additional weight back to the entrance of the cave.

Galerie des Empreintes

On a wide and not very calcinated surface, contrasting in this respect with the previous gallery, the Galerie des Empreintes measures nearly 60 m long and 7 to 8 m wide and high (Fig. 13.3). Coming from the Galerie des Effondrements, the entrance to the gallery is marked by an impressive stalagmite cascade. Shortly afterwards, the eye immediately catches the long marked path that follows the central axis of the gallery to its right. The left part is made up of a vast clayey expanse entirely covered by bear tracks. There is also evidence of human activities, but the fragility of the soil has not allowed a full exploration of this area. The omnipresence of the bear is evident throughout the entire path of the Galerie des Empreintes. Its

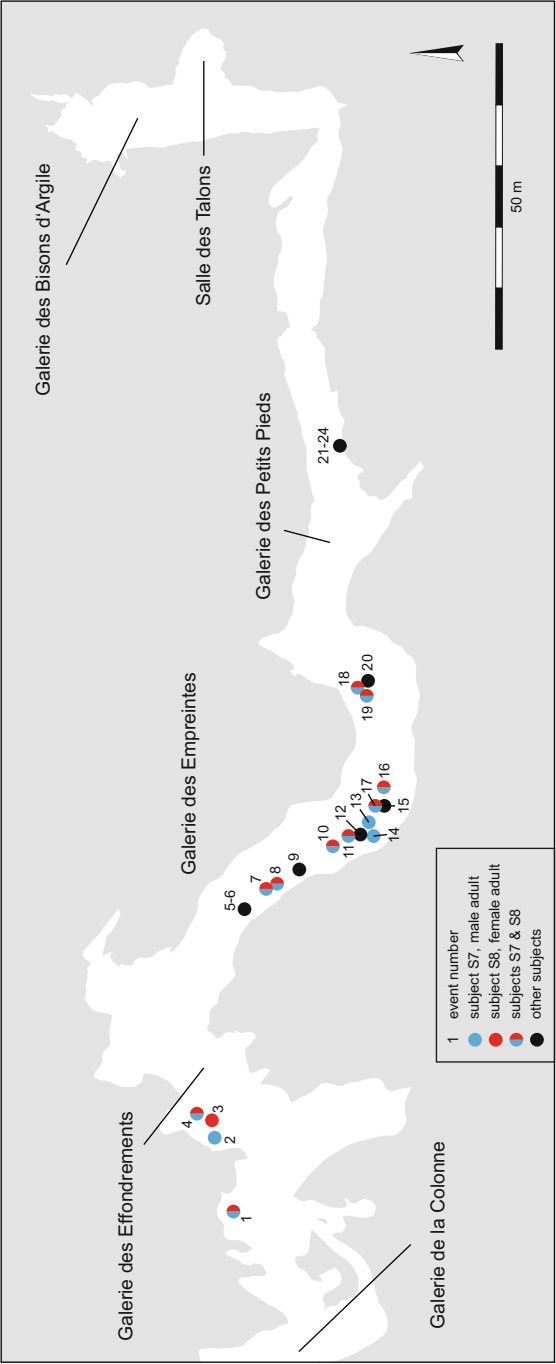


Fig. 13.3 Localization of the events in the upper gallery of Tuc d'Audoubert. (Illustration Association Louis Bégouën/Tracking in Caves)

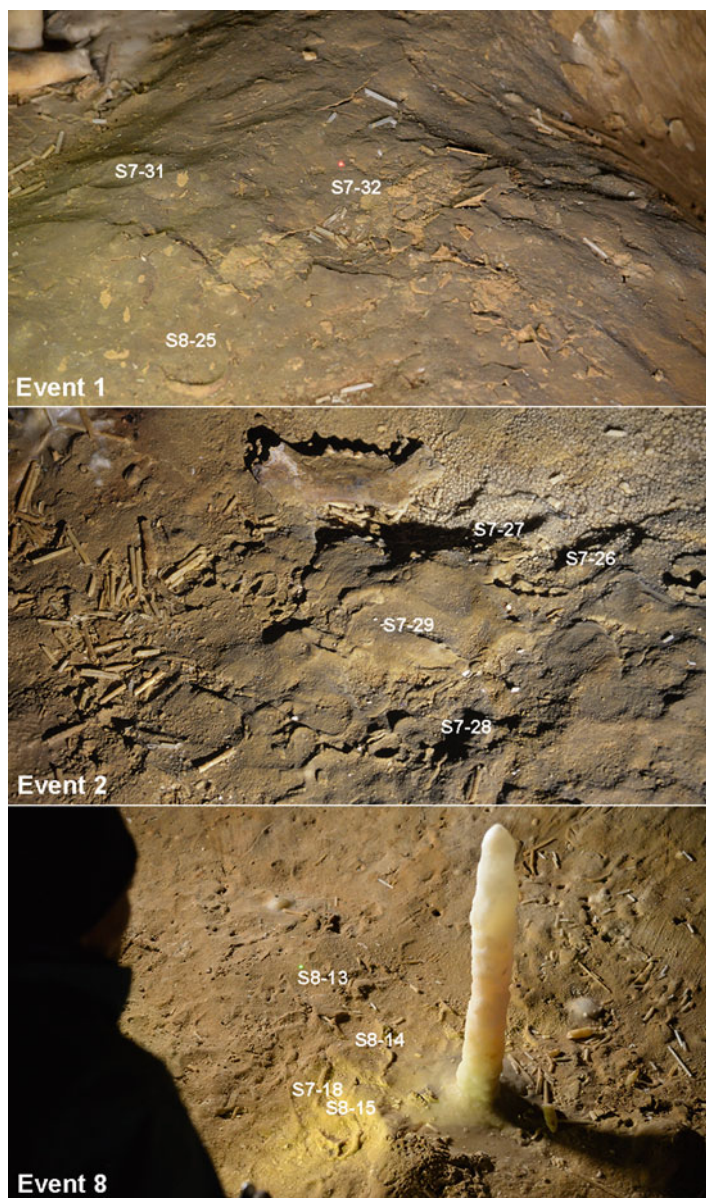


Fig. 13.4 Complete events 1 and 2 and excerpt of event 8 in the upper gallery of Tuc d'Audoubert with the respective spoor number. (Photo Association Louis Bégouën/Tracking in Caves) – the *red laser* points to a part of the buttock imprint (S7-32) of event 1, whereas the *green laser* points to the slip track (S8-13) in event 8

scattered bones are visible all over, and its tracks, slips and traces of hair and claws in the clay and on the walls, broken concretions, make the presence of the bear almost tangible.

A total of 76 human footprints were recorded during an initial counting. These tracks are mostly concentrated in a total of four well-defined sections (Fig. 13.3). At first, the right part of the path runs along a low ceiling (1.4 m) under which footprints are visible (western end section) in spatial relation to a drawing made by fingers on the floor. After about 20 m, the gallery widens to the right into a semicircular room. Here and a few metres before it, the soil has kept traces of passages and intense prehistoric human activities (TUC-293 to TUC-327) (western and eastern centres) (Fig. 13.3).

In the second part of the *Galerie des Empreintes*, the gallery then becomes slightly open where another concentration of prehistoric human activities is visible (eastern end section) (Fig. 13.3). A few metres further on, before a narrowing of the space between barriers of concretions, the right wall marks its end. This narrow place has been chosen to deposit three perforated teeth and red ochre on the floor, right against the wall.

Western End Section

Coming from the *Galerie des Effondrements*, on the right side, under the lower roof, 21 footprints printed in the loamy soil were counted over a length of 3 m, some of them later calcined (TUC-291). Nineteen of them were interpreted by the indigenous ichnologists. The most complete, a right foot, is located very close to the path (Fig. 13.3).

In the western end section, three subjects were identified. These are the same two subjects (S7 and S8), who were already identified in the *Galerie des Effondrements* and were underway together. There are four trackways with up to eight footprints of this couple. Furthermore, a third subject (subject S14) left two isolated footprints in the western end section. According to the observations of the experienced trackers, subject S14 was solo on this spot. The western end section is a passage zone along a low ceiling with various blocks and stalagmites on the floor. The passage was used for the way into the deep part of the cave as well as to the entrance. In total of four events can be summarized:

- Event 5: The isolated left footprint (S14–2) of subject S14, female infans II, describes the first event within this section of the *Galerie des Empreintes*. With a fast speed the trackmaker moved to the deep part of the cave, lost her grip and slipped with the toes against a rock which probably caused some pain.
- Event 6: From the same subject S14, female infans II, a second footprint is from her right foot (S14–3). Again with fast speed, she moved this time towards the entrance (Fig. 13.3).
- Event 7: The next event happened in a corridor with a low roof close to the right wall. Here the two subjects S7, male adult, and S8, female adult, walked fast

together in direction to the deep part of the cave (Fig. 13.3). From this event is left a first trackway of subject S7 that is composed of three footprints – right (S7–22), left (S7–23) and right (S7–24). In a shorter trackway with only two footprints, the way of subject S8 – left (S8–21) and right (S8–22) – is documented. Since the roof is very low in this part of the cave, subject S8 – moving through the lowest passage – had to walk bent over.

- Event 8: The last event in this section of the Galerie des Empreintes took place close to the actual path in the central axis of the gallery. Again, the two subjects S7, male adult, and S8, female adult, walked fast together, each carrying little additional weight in direction to the entrance (Fig. 13.3). Subject S7 is documented by a trackway of four footprints – right (S7–18), left (S7–19), right (S7–20) and right (S7–21). From subject S8, female adult, is the longest trackway known in the upper gallery – left (S8–13), left (S8–14), right (S8–15), left (S8–16), right (S8–17), left (S8–18), left (S8–19) and left (S8–20). Some tracks are missing due to the changing substrate conditions. Close to a stalagmite that disturbs the direct passage of subject S8, an interesting incident took place (Fig. 13.4). With her left foot (S8–13), subject S8 lost her grip and slipped. But it did not end in a fall because she found the balance by an interruption of her forward movement, regaining a firm stand again – (S8–14) and (S8–15) by putting both feet side by side. Quite rare in Tuc d'Audoubert are identifications of overlapping footprints. A very good example is provided within the described event 8. Footprint S7–18 was clearly overstepped by S8–15 and S7–19 by S8–19 (Fig. 13.4). This proves that subject S7 went in front of subject S8 at this point of the cave when walking back to the cave entrance.

Between western end section and western centre just close to the finger drawing (Bégouën et al. 2009: 262), no tracks were left by the artist. The only identifiable footprints come from subject S8, female adult who has passed this section. This short event is evinced by a short trackway with two footprints.

- Event 9: Subject S8, female adult, left two footprints – right (S8–11) and left (S8–12), which lead to the entrance (Fig. 13.3). She was solo at this point and passed fast this section close to the actual path.

Western Centre

Near the path, still on the right, about 15 footprints remain around a small prehistoric excavation (TUC-293), 11 of them interpreted by the ichnologists. On the left side at this point of the path, on the previously mentioned trampled slope, three barely visible footprints seem to descend towards the path (TUC-294 - TUC-296). They are too far from where one can regard them without damaging the substrate to identify any details.

The western centre, according to the footprints, is a passage zone that three subjects have passed. The path leads over a limestone block on the ground and past a second one. In three events the same subjects appear as already met in the

western end section (S7, S8 and S14). They are represented here with three trackways with up to four footprints and two isolated footprints. The identified walking directions lead, in both directions, to the depth of the cave as well as to the entrance.

- Event 10: In the first and most complex event in this section, the two subjects S7, male adult, and S8, female adult, walked fast together one after another in direction to the entrance, both carrying something (Fig. 13.3). From subject S7 three footprints have been identified – left (S7–15), right (S7–16) and left (S7–17). The trackway with four footprints of subject S8 is longer – left (S8–7), right (S8–8), left (S8–9) and right (S8–10). It seems that the trackmaker has probably supported herself in the vicinity of the footprints S8–9 and S8–10 with her left hand on the rock jutting into the passage. On the basis of superposition – S8–7 and S8–8 were overstepped by S7–15 – it can be concluded that subject S8 was the first to pass this spot.
- Event 11: Beyond the limestone block crossed by both, traces of the subjects S7 and S8 can be found again, this time pointing in the other direction (Fig. 13.3). The two went together almost in the direction to the deep part of the cave. Subject S7, male adult, has left a short trackway of two footprints – right (S7–13) and left (S7–14). This time subject S8 has left only an isolated left footprint (S8–6).
- Event 12: The third event in this section happened in the same area as that of event 10, but this time with subject S14, female infans II, that has left only an isolated right footprint (S14–1) (Fig. 13.3). She was moving fast slightly slipping, in the direction to the deep part of the cave.

Eastern Centre

On the right side of the small room, the flat floor has abundant animal tracks, including very large claws. Over a distance of about 10 m, human activity focused on collecting and handling bear bones that would stick out from the clay soil. On the natural anvil formed by a nascent stalagmite, a skull of a bear was smashed with the probable purpose of extracting the teeth, none of which remain nearby (TUC-302). Eight footprints (TUC-303) are printed in the clay to the left-hand side of the skull. The face broke into fragments scattered all around the skull. A prehistoric excavation located 1 m further to the left (TUC-305) can reasonably be considered as the extraction site of the skull. On a strip 1.5 m wide, along the path, at least 19 footprints mark the bottom of a slight depression (TUC-308), all covered with calcite. A little further on to the deep part of the cave, 50 cm from the path, scattered on the ground, there is a coxal bear bone, a bear rib and a complete left human footprint (TUC-318). On the rib, there are clear traces of the brown clay crust that coated it before it was extracted. Twenty-three out of the mentioned 28 footprints have been identified by the indigenous ichnologists.

In the *Galerie des Empreintes*, the eastern centre represents the main activity area in which seven subjects left their footprints. It seems that there was the couple subject S7 and S8 again relocating bear bones, but also another group of subjects

(S3, S10, S11, S12 and S13) on their way. In total four trackways with up to five footprints and ten isolated footprints have been identified that constitute altogether six events.

- Event 13: The following sequence of footprints is certainly one of the most spectacular events (Fig. 13.3). These are five consecutive footprints of subject S7, male adult. The sequence begins with an isolated right footprint (S7–7). The following two belong together and indicate a squatting position – left (S7–8) and right (S7–9) (Fig. 13.5). The same applies to the following two footprints: right (S7–10) and left (S7–11). In this posture, an activity was performed close to the floor, turned in direction of the entrance. Since the skull of a cave bear described above is located directly in front of the footprints, a direct connection is most likely. At this point subject S7 acted alone.
- Event 14: Just behind the described event an isolated left footprint of subject S7, male adult (S7–12), is found (Fig. 13.3). The path leads in direction to the cave wall. Subject S7 was at this point alone.
- Event 15: Several metres deeper in the cave, a group of subjects (S3, S10, S11, S12 and S13) were identified that walked together at that point. The picture left by the footprints is not to be interpreted as clearly as it was the case in other events. The footprints point in different directions and are most likely to be understood as walking around the gallery (Fig. 13.3). Subject S3, male infans I, is represented by two isolated footprints. The first is a right isolated footprint (S3–2). With fast speed he went to the deep part of the cave. The second isolated footprint of subject S3 derives again from a right foot (S3–3). It also shows a fast walking speed towards the deep part of the cave. In the same area, a left footprint (S10–1) from subject S10, female infans I, is leading into the direction of the deep part of the cave. Furthermore, a left footprint (S11–1) comes from subject S11, female adult, who walked fast in direction to the entrance and carried something. She stepped over two footprints of the subject S7 (S7–1 and S7–6) (Fig. 13.5). Apart from this, a right footprint (S12–1) comes from subject S12, male juvenis, who walked in direction to the wall of the gallery. The last isolated track in this event comes from subject S13, male infans I, and represents a non-specific footprint (S13–1) pointing towards the deep part of the cave.
- Event 16: In the same area in which event 15 happened, the two subjects S7, male adult, and S8, female adult, walked fast together in direction to the entrance (Fig. 13.3). Subject S7 is present with a trackway that consists of only two footprints – left (S7–3) and right (S7–4). The best visible and even recognizable for a layperson is the trackway of subject S8, female adult, consisting of three footprints – right (S8–3), left (S8–4) and right (S8–5) (Fig. 13.5).
- Event 17: The last event identified in this section of the Galerie des Empreintes happened again with the two subjects S7, male adult, and S8, female adult (Fig. 13.3). This time they walked fast together towards the deep part of the cave after subject S7 had picked up probably some cave bear bones. This particular trackway from subject S7 consists of three footprints – left (S7–5), right (S7–6) and right (S7–1) (Fig. 13.5). From the squatting position (S7–5 and

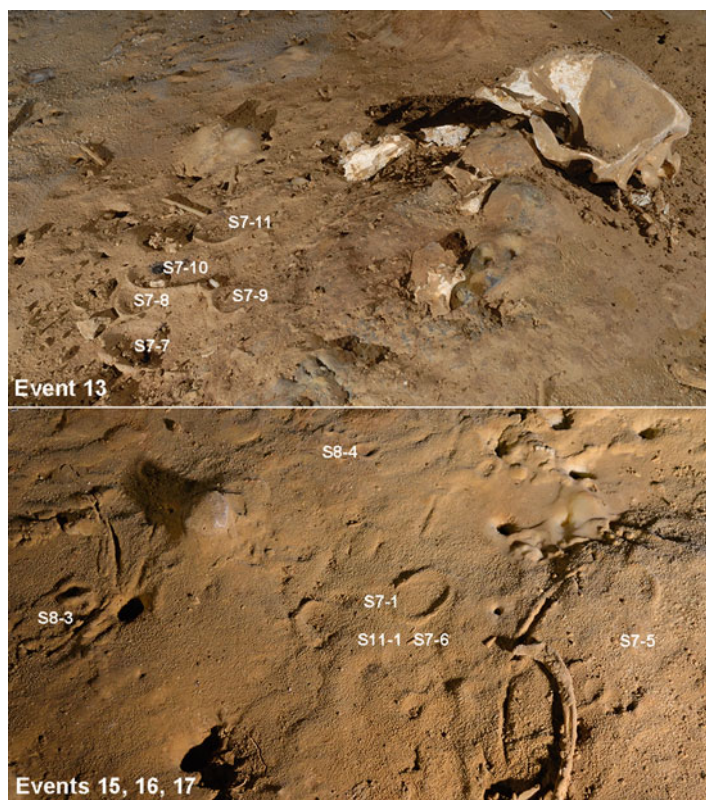


Fig. 13.5 Complete event 13 and excerpt of events 15, 16 and 17 in the upper gallery of Tuc d'Audoubert with the respective spoor number. (Photo Association Louis Bégouën/Tracking in Caves)

S7-6), facing the centre of the gallery, subject S7 turned the right foot to the right and produced the footprint S7-1. From here the subject moved towards the deep part of the cave. While sitting in a squatting position, subject S7 probably did something with the bone in front. Just close to this a right footprint (S8-1) of subject S8, female adult, was identified. Some metres from the described scenario the couple left again their traces. According to the indigenous ichnologists, they belong to the same event 17 as the other footprints just described. Subject S7 left an isolated left footprint (S7-2). Close to it a right footprint (S8-2) from subject S8 was identified.

Eastern End Section

Having passed the narrow passage at the sinter basin with the colubrid skeleton, the gallery widens again (Fig. 13.3). There are bear bones scattered around, including a

right mandible placed on a rock, deprived of its canine tooth. Three metres further on, on the left, heels and footprints (TUC-324) precede a young bear skeleton (TUC-325) lying in the clay soil. The vertebral column is anatomically connected. There are also two holes made by a flat tool used as a lever to loosen the bones. Two vertebrae taken by prehistoric humans are deposited next to it. By its dimensions, a left mandible with missing teeth recalls the first one located 6.5 m away. Due to the connection with the results of the investigations at this place by the indigenous ichnologists, the following location 6 metres further on is remarkable. Here on the left side of the path, another bear skeleton (TUC-326) is scattered over a small area at the foot of the cave wall. The distance from walkable areas prohibits detailed observation, but it is an accumulation of diverse bones that are no longer in anatomical connection. At the end of the Galerie des Empreintes, three perforated teeth, two bison incisors and a fox canine, are aligned on the floor along the wall. Ten centimetres before these teeth, a niche in the wall is completely stained with red ochre.

According to the footprints, three subjects were on their way in this area. The indigenous ichnologists identified three events: again the couple of subjects S7, male adult, and S8, female adult, whose trackways lead exactly to a cave chamber in which bear bones were dug out and back towards the entrance of the cave. Furthermore subject S9, male infans II, has not yet been identified in Tuc d'Audoubert. The three subjects have left a total of four trackways with up to four footprints and one isolated track.

- Event 18: The first event describes a walk over a short distance of subjects S7, male adult, and S8, female adult, towards a passage to the chamber where bear bones have been excavated (Fig. 13.3). Subject S7 left one trackway of two footprints – right (S7-33) and left (S7-34). Another trackway of four footprints – left (S8-26), right (S8-27), left (S8-28) and right (S8-29) – has been identified.
- Event 19: The couple of subjects S7 and S8 appear in a second event (Fig. 13.3). This time their passage points from the bear bone site to the entrance of the cave. Both walked fast together. Subject S7, male adult, has left a trackway of three footprints – left (S7-35), right (S7-36) and left (S7-37). One footprint indicates that its trackmaker lost for a short moment the grip and started slipping (S7-37). From subject S8, a trackway with two right footprints (S8-30, S8-31), missing the connecting left footprint due to a change of the soil conditions, is documented.
- Event 20: The last event in this section of the Galerie des Empreintes happened with subject S9, male infans II, who has left only a single right footprint (S9-1) (Fig. 13.3). It is located in close proximity to the vertebral column of the young cave bear; however, an immediate interaction could not be detected. Subject S9 walked slowly in direction to the deep part of the cave.

Of the 76 footprints published so far in 2009 (Bégouën et al. 2009) for the Galerie des Empreintes, indigenous ichnologists identified 67 (88%) (Table 13.3). In the course of the investigations, a concentration of footprints in the eastern centre that had previously been considered human was not confirmed. According to the indigenous ichnologists, these are imprints of a bear (TUC-308). Some human footprints were newly discovered, so that in total about 70 footprints are still counted in the

Galerie des Empreintes. These come from a total of eight subjects: four adults (two male subjects S7 and S12 and two female subjects S8 and S11), one female subject infans II (S14) and two subjects infans I (one male S3 and a female S10). No precise statements on identity could be made about another subject (S13).

Galerie des Petits Pieds

Just after passing through the passage with the perforated teeth that marks the end of the Galerie des Empreintes, the visitor enters the Galerie des Petits Pieds (Fig. 13.3). Continuing the path to the deep part of the cave, a series of large sinter basins obstructs the passage. To their right, on clay-coated sinter formations, five human footprints are located (TUC-331, TUC-332).

At 23 cm from the edge of the stalagmitic platform, a heel (TUC-330) is clearly visible. Near the edge of the same platform, a little further in the direction of the current path, there are small parallel footprints (TUC-331, TUC-332).

Four subjects have left their footprints in this relatively small area creating four events. These include two female adults (S5 and S6), one infans II (S4) and one infans I (S3). Not a single trackway could be detected. Only isolated footprints indicate slipping on the slanting ground (S3, S4, S5). Subject S6 stepped on a rock and stopped. The following events were identified:

- Event 21: Coming from the Galerie des Empreintes, a first footprint was identified (Fig. 13.3). It comes from subject S4, male infans II, and is found a few metres away from the concentration of footprints described later. It is a complete right footprint (S4–2) that is oriented towards the cave wall.
- Event 22: The next event is represented by a complete left footprint (S5–1) from subject S5, female adult that points to the entrance of the cave (Fig. 13.3). On slanting ground the footprint indicates that the trackmaker lost for a short moment the grip, which led to a slight slip.
- Event 23: Subject S6, female adult, provides a complete left footprint (S6–1) directed to the entrance of the cave (Fig. 13.3). Subject S6 touched the rock, which certainly irritated her.
- Event 24: The last event in the gallery is an often-described scenery (Fig. 13.3). Footprints of slipping younger subjects were seen as evidence of the presence of very young children in Tuc d'Audoubert. Vallois saw according to their little dimensions in the footprints S3–1 and S4–1 a single subject, a child of 4 years old (Vallois 1931). Following the indigenous ichnologists the trackmakers represent two different subjects with also different ages (infans I and infans II) nevertheless acting in a single event (Fig. 13.6). Subject S3 (S3–1), male infans I, left a complete left footprint. He slipped towards the centre of the gallery due to the slanting floor. Subject S4, male infans II, has also left a complete left footprint (S4–1) at the same location as subject S3. Like subject S3, subject S4 also slipped

Fig. 13.6 Event 24 in the upper gallery of Tuc d'Audoubert with the respective spoor number. (Photo Association Louis Bégouën/Tracking in Caves)



towards the centre of the gallery, due to the slanting floor. It is obvious that the footprint of subject S4 was stepped over by that of subject S3.

Salle des Talons

After passing the Galerie des Petits Pieds, at 620 m from the daylight zone, a sharp left turn marks the entrance to a long gallery where the bears have once again left their marks on the ground (Fig. 13.3). From the beginning of the gallery, it seems that the atmosphere of the cave has changed. The concretions, omnipresent until now, are suddenly rare, and only a row of stalagmites follows a longitudinal fault towards the middle of the gallery, limiting the view. The nature of the limestone also marks a rupture; the cretaceous limestone leaves the place now to a friable rock of the Middle Jurassic. Here is where the clay models and other remnants of human activities can be found in the Galerie des Bisons d'Argile and the Salle des Talons. The other human traces, finger dots (TUC-333), aligned lines engraved on the ground (TUC-336), digital dots on the ground (TUC-337) and impacts of baguettes demi-rondes (TUC-338) (cf. Bégouën et al. 2009), were not part of the investigations of the indigenous ichnologists.

After about 20 m in the gallery, the ground suddenly plunges to the right, towards a small room, 3 m below. The bears left their marks on the clay slope that dominates the place. Following a path in the clay, one reaches the threshold of a rotunda whose arched roof gradually drops to the bottom, so that very soon standing upright is no longer possible. The rotunda measures 8 m in its maximum width and 6 m deep from the edge of the current path area delimiting the Magdalenian soil. Being absolutely flat, it evokes the small clay pond that the room once was, after the passage of the bears, because no trace of them is visible there while they abound on the slope that

leads to it. This virginity of the soil and the quality of the very fine clay obviously attracted the Magdalenians.

According to the first inventory, 183 more or less marked depressions (heels) in the ground were counted (Bégouën et al. 2009). Others may exist, but they were out of sight during the first investigations. The heels are mainly distributed in the right half of the chamber (where the roof is the lowest), while the majority of the drawings is on the left (claviform and barbed signs) and on the far right, beyond the clay extraction pit.

After an initial review in 2013, the indigenous ichnologists identified two subjects in this Salle des Talons whose tracks were not found elsewhere in the cave (Pastoors et al. 2015). These are subject S1, male adult, and subject S2, male juvenis, which went in two passages to a clay extraction pit, deliberately walking on their heels. While the footprints on the way towards the pit are only a little deepened into the clay, on the way back they are up to 5 cm deep. This shows that an additional weight probably in the form of lumps was taken up at the pit. This clay was transported to the adjacent Galerie des Bisons d'Argile and there modelled into the sculptures.

Due to the complexity and scope of the episodes, the detailed results of the identification of the spoors associated with the creation of art in the broadest sense by the indigenous ichnologists resulting from research in 2018 will be presented separately. These new results represent an extension of the episodes already identified in 2013, but the results already published (Pastoors et al. 2015) remain valid and can be included in the overall picture.

Synopsis

Eight concentrations with prehistoric human footprints were examined as part of the project in 2018. A total of 255 footprints were described in more detail, yet the count of 172 footprints in the Salle des Talons was carried out on the basis of the published distribution plan and is only marginally part of the present chapter. Consequently, the detailed identifications presented here are based on a total of 83 spoors. Other footprints visible in these areas were not readable by the indigenous ichnologists. On the one hand this results from the difficult conditions under which they can be inspected and, on the other hand, from the indigenous ichnologists who had nothing significant to say about these footprints, and they were not specifiable from their point of view.

The 83 footprints do not indicate any direct path in the sense of economic mobility, leading from the entrance of the upper gallery to the Galerie des Bisons d'Argile. Rather, the footprints result from numerous movements within the different sections that represent various qualified activities mostly in relation to cave bear bones.

With regard to the authorship of these 255 footprints, the indigenous ichnologists identified a total of 14 subjects. Some subjects were represented only by a single spoor (subjects S5, S6, S9, S10, S11, S12 and S13), whereas the maximum of

99 traces represents subject S2 (Table 13.2). The number of spoor per subject can be arrayed into two groups: one with a maximum of three footprints (subjects S3 to S6 and S9 to S14) and another with a larger number (subjects S1, S2, S7 and S8).

The different sections are linked by three subjects: subject S3 (Galerie des Petits Pieds and Galerie des Empreintes), as well as subjects S7 and S8 (Galerie des Empreintes and Galerie des Effondrements). This is not surprising, as there is only one access to the upper gallery, but it shows the exceptional perception of the indigenous ichnologists. It is interesting to note that subjects S1 and S2 were not identified in other parts of the cave, as access to the Salle des Talons inevitably passes through the other gallery. There are several possible explanations: Either the footprints are among the number of footprints that the indigenous ichnologists could not say anything about, or the passages followed other paths (the part of the cave that was inaccessible to us), or traces have been destroyed by the following visitors (prehistoric or modern). On the other hand, the observation that, in the Salle des Talons, no footprints of the other 12 subjects can be found seems to reflect a fact, as it is located outside the central axis and must be deliberately searched. Therefore, the 12 subjects had a priori nothing to do with the activities in the Salle des Talons.

Identity of the Trackmakers

Examination of the demographic data of the 14 identified subjects shows a negligible majority of male subjects, of which seven were identified (Table 13.4), while six

Table 13.4 Identity of the trackmakers in the upper gallery of Tuc d’Audoubert grouped in age classes according to Martin (1928)

Subject	Age class (Martin 1928)			
	Infans I (0.5–6)	Infans II (7–13)	Juvenis (14–20)	Adultus (21–40)
S1				Male
S2			Male	
S3	Male			
S4		Male		
S5				Female
S6				Female
S7				Male
S8				Female
S9		Male		
S10	Female			
S11				Female
S12			Male	
S13	–	–	–	–
S14		Female		
Total	2	3	2	6

subjects were counted as females. Sex could not be recorded for a single subject (S13).

With regard to the age of prehistoric explorers, a wide range of age classes from infants I (up to 6 years) is present up to adultus (21–40 years) with a clear focus on the last age class. It is interesting to note that the footprints of subjects in the mature age class (41 to 60 years) are missing. Perhaps a whole family – without the elders – was therefore involved in the visits to the upper gallery of Tuc d'Audoubert. As far as the physical aspect is concerned, all subjects seem to have been normally proportioned. In the group as a whole, no anomalies could be detected in relation to a possible handicap of the locomotive system.

Identified Events

In the upper gallery, 24 events were identified by the indigenous ichnologists (Table 13.5). The events with only one acting subject ($N = 12$) are equally frequent as those in which several subjects were involved ($N = 12$). Events in which subjects S7 and S8 acted together should be emphasized. Both parts of the couple do the same thing at ten different places where they were together (Fig. 13.3). They were both carrying something (E10) probably something light (E4, E8); they were both looking for bones (E18) or both walking through the cave in direction to the deep part (E7, E11, E17) or to the entrance (E1, E4, E8, E10, E16, E19). It is noticeable in this context that in all locations where bear bones were picked up, only subject S7 was active (E2, E13, E17) – even if subject S8 was around and part of the event (E17). This speaks for a clear specialization.

Another striking event (E15) in the upper gallery of Tuc d'Audoubert is the visit of a group of at least five subjects (subjects S3, S10, S11, S12 and S13). Based on the observation that subject S4 acted in the Galerie des Petits Pieds together with subject S3, it can be assumed that subject S4 belongs also to the large group, especially as subject S4 is a child of the age class *infans II*. The group did nothing else than going through the Galerie des Empreintes.

Track Details

After the synopsis of the identified events in the upper gallery of Tuc d'Audoubert, the focus here will be on the most notable track details.

Spoor Type, Side and Trackways

Among the 83 identified spoors, there is interestingly a trace of the buttocks of subject S7 (S7–32) (Fig. 13.4). All other 82 are footprints – 41 left, 40 right and 1 without determination. Although postulated in a previous publication (Bégouën et al. 2009), there are no knee traces in this part of the upper gallery that the

Table 13.5 Results of the event identification in the upper gallery of Tuc d'Audoubert

Event	Identity	Walk	Slip	Stand	Squat	Sit	Total	Direction	Note
Galerie des Effondrements		3	2	5		1	11		
	E1	S7 (S7-31, S7-32)	1			1	2	Entrance	
		S8 (S8-25)					1	Entrance	
	E2	S7 (S7-25 to S7-29)		5		5	5	Side	Picking bones
E3	S8 (S8-23)		1			1	1	End	
E4	S7 (S7-30)	1					1	Entrance	Carrying something light
	S8 (S8-24)	1				1	1	Entrance	Carrying something light
Galerie des Empreintes (WES)		12	3	2		19			
E5	S14 (S14-2)		1			1	1	End	Bump on a rock
E6	S14 (S14-3)	1					1	Entrance	
E7	S7 (S7-22 to S7-24)	3				3	3	End	
	S8 (S8-21, S8-22)						2	End	Walking bent
E8	S7 (S7-18 to S7-21)	4					4	Entrance	Carrying something light
	S8 (S8-13 to S8-20)	4	2	2			8	Entrance	Carrying something light, keeping balance
Galerie des Empreintes (WES-WC)		2					2		
E9	S8 (S8-11, S8-12)	2					2	Entrance	
Galerie des Empreintes (WC)		10	1				11		
E10	S7 (S7-15 to S7-17)	3					3	Entrance	Carrying something
	S8 (S8-7 to S8-10)	4					4	Entrance	Carrying something, hand on a rock
E11	S7 (S7-13, S7-14)	2					2	End	
	S8 (S8-6)	1					1	End	
E12	S14 (S14-1)		1				1	End	

Galerie des Empreintes (EC)		16		7	23	Entrance	Picking bones
E13	S7 (S7-7 to S7-11)			5	5	Entrance	Picking bones
E14	S7 (S7-12)	1			1	Side	
E15	S3 (S3-2) + (S3-3)	2			2	End	
	S10 (S10-1)	1			1	End	
	S11 (S11-1)	1			1	Entrance	Carrying something
	S12 (S12-1)	1			1	Side	
E16	S13 (S13-1)	1			1	End	
	S7 (S7-3, S7-4)	2			2	Entrance	
	S8 (S8-3 to S8-5)	3			3	Entrance	
	S7 (S7-1, S7-5, S7-6) + (S7-2)	2		2	4	Centre, end	Picking bones
Galerie des Empreintes (EES)	S8 (S8-1) + (S8-2)	2			2	End	
		11	1		12		
	S7 (S7-33, S7-34)	2			2	Side	Looking for bones
	S8 (S8-26 to S8-29)	4			4	Side	Looking for bones
E19	S7 (S7-35 to S7-37)	2	1		3	Entrance	
Galerie des Petits Pieds	S8 (S8-30, S8-31)	2			2	Entrance	
	S9 (S9-1)	1			1	End	
	S4 (S4-2)		4	1	5		
	S5 (S5-1)		1		1	Side	
E21							
E22			1		1	End	Slanting ground
E23	S6 (S6-1)		1		1	End	Stepping on a rock
E24	S3 (S3-1)		1		1	Centre	Slanting ground
	S4 (S4-1)		1		1	Centre	Slanting ground
	Total	54	11	8	7	1	83

indigenous ichnologists could identify. All footprints are from barefoot subjects, whereas no statement could be made about the buttocks regarding clothing.

Most of the 82 footprints belong to connected trackways (59 footprints), of which 18 were determined. Trackways consist of two to eight footprints; in mean, it is 3.3 footprints per trackway.

Carrying Additional Weight

Of the 14 subjects, 5 carried additional weight, at least temporarily. These are subjects S1 and S2 in the Salle des Talons; subjects S7 and S8 in the Galerie des Effondrements, in the western end sector and in the western centre of the Galerie des Empreintes; and subject S11 in the eastern centre of the Galerie des Empreintes as well. It is difficult to say anything valid about what was carried, but according to the indigenous ichnologists, very plausibly clay was transported in the Salle des Talons and probably cave bear bones, a child or something else in the other locations.

With the exception of the trackways in the Salle des Talons, all other trackways with 19 footprints and 3 isolated footprints where the subjects carried additional weight lead towards the entrance of the cave. Even if the data basis is not very extensive, a pattern becomes apparent, namely, that things were carried out of the cave.

Body Postures and Gait

In addition to basic information on particular subjects, the indigenous ichnologists were able to identify the particularities of body postures reflecting various activities.

We distinguish between dynamic and static postures, even if in the static posture qualified activities were performed. Among the dynamic ones, the tracks from walking activity ($N = 56$) dominate. Two of them result from a bent walking posture as adaptation to the low room height (S8–21, S8–22). Also from the interaction with the spatial conditions, two footprints result where the trackmaker has supported herself on a rock jutting into the path (S8–9, S8–10). Eleven footprints indicate that the respective trackmaker lost the grip on the ground and slipped. On the loamy, partly slanting ground, this is not surprising (S5–1, S3–1, S4–1). The loss of the grip on the ground also led to the loss of balance several times. In one case, the trackmaker had to interrupt the forward movement by taking a stable stand (S8–14, S8–15); another time the trackmaker slipped and landed on the buttocks (S7–32) and in still another case bumped the foot on a rock (S14–2). In this way dynamic postures are connected with static ones. This may also be demonstrated by the standing posture of a trackmaker directly on a pointed stone on the cave floor (S6–1). In addition to the above-mentioned happenings, the trackmakers have mainly dealt with cave bear bones lying on the ground. These were achieved both standing (E2) and squatting (E13, E17).

During the dynamic postures, the speed of locomotion including slipping was fast at over 50% of the footprints. Only 13 footprints indicate a slow speed. For the indigenous ichnologists, fast speed means an expeditious, safe walk without searching and hesitating.

Group Configuration

In addition to the observations already described, the indigenous ichnologists identified, based on the spatial distribution and references of the footprints to each other, various subjects who moved in groups. Three small and one larger group could thus be identified:

- S1 (male, adultus), S2 (male, juvenis)
- S3 (male, infans I), S4 (male, infans II)
- S7 (male, adultus), S8 (female, adultus)
- S3 (male, infans I), S10 (female, infans I), S11 (female, adultus), S12 (male, juvenis) and S13 (nothing to say)

The data basis is too small to make statements about general human behaviour. Nevertheless, interesting observations can be made with regard to Tuc d'Audoubert. None of the mentioned groups included S5 (female, adultus), S6 (female, adultus), S9 (male, infans II) and S14 (female, infans II). Whether they were really on their own or in another unidentifiable constellation must remain open. In any case, with these hypothesized groups, it can be concluded that a maximum of eight visits in small to very small groups took place in the upper gallery. However, this is only true under the assumption that subjects climbed into the upper gallery alone. With a minimum size of two subjects per visit, in the given configuration of two pairs of a woman and a child, the total number of visits to the upper gallery reduces to a maximum of six expeditions (but see section *Superimposition of Human Tracks*). The difficulties in navigating the upper gallery make the latter number probable for safety reasons alone and because it would seem unlikely that children aged 7–13 years (infans II) would explore such a cave on their own.

Axis of Locomotion

The consideration of the axis of locomotion of the dynamic postures (walking and slipping) confirms the central observations already described. The two motivations for visiting the cave – passing through and looking for cave bear bones – become apparent. The fact that there are significantly more footprints pointing in the direction of the entrance of the upper gallery ($N = 36$) than into the deep part of the cave ($N = 20$) is to be seen as a logical consequence of the chronological sequence of events. The chronologically most recent footprints lead out of the upper gallery and partially overlap those that lead into the cave.

Human Interaction with Cave Bear Bones

Irrespective of how the bear bones were picked – standing or squatting – it was always the same trackmaker (subject S7, male adult) at work in all these places (Fig. 13.3). In the Galerie des Effondrements, a mandible was manipulated (E2), and in the Galerie des Empreintes, a rib (E17) and a skull (E13) were moved. In addition, footprints in the eastern end section of the Galerie des Empreintes which must not be entered today testify to the specific search for further cave bear bones, because the tracks point to exactly one spot where bones lie on the surface and where they were manipulated by humans.

Superimposition of Human Tracks

A total of eight superimpositions were identified where the identity of both trackmakers is known (Table 13.6). Subjects involved are S7 (male adult), S8 (female adult), S11 (female adult), S3 (male infans I) and S4 (male infans II). Against the background of the group configurations, it looks as if the subjects S7 and S8 were alternating in walking in ahead of each other. After the visit of these two, the large group with the subjects S3, S10, S11, S12 and S13 came into the upper gallery. Based on the observation that both subjects S3 and S4 were together in the Galerie des Petits Pieds, it can be assumed that subject S4 also belongs to the aforementioned large group. As a result, the maximum number of visits to the upper gallery would be reduced from six to five visits (cf. section Group Configuration).

General Conditions and Reliability of Identification

The general conditions for the generation and preservation of prehistoric footprints in the upper gallery are similar. All areas where spoors have been preserved are covered with a thin layer of calcite that has formed over time. Only in a few places this layer is more massive (E8 – S7–18, S7–19, S8–14, S8–15, S8–16), but also here details of the footprints are visible.

Table 13.6 Track superimpositions; each individual subject has a specific colour for better visualization

Footprints								
Upper	S7-15 ♂		S8-6 ♀	S8-15 ♀	S8-16 ♀	S11-1 ♀		S3-1 ♂
Lower	S8-7 ♀	S8-8 ♀	S7-13 ♂	S7-18 ♂	S7-19 ♂	S7-1 ♂	S7-6 ♂	S4-1 ♂

The quality of the identified footprints is extraordinarily good. Of the 83 tracks examined, 48 have a reliability of identification of the toes and at the same time the heel is at least sufficient, which makes it possible to take the necessary measurements of the identified footprints. The 48 footprints were left behind by 12 different subjects which will make a cross-check with scientific approaches possible. Problematic are the footprints of the two subjects S12 and S13 because only one footprint of each was identified with insufficient reliability of identification which will impede further measurements.

Discussion and Conclusion

This paper is a first step of a multi-stage analysis of prehistoric human spoors in the upper gallery of Tuc d'Audoubert. Only those traces that are related to the making of art are excluded in this presentation due to research strategy reasons. The wide range of events of dynamic processes – some of which can be easily grasped even by non-experts – call for appropriate dynamic research methods. Static methods, which usually are used to investigate prehistoric human footprints, are important tools to enrich the discourse about footprints with empirical data but should not keep the prerogative of interpretation alone. For this reason, the prehistoric human spoors in Tuc d'Audoubert have been first read by indigenous ichnologists and will then in a second step be completed by classical scientific analysis. In a morpho-classificatory way, the experienced trackers identified the trackmakers as well as the events stored in their spoor. The focus of the project was the identification of the cave explorers and the investigation of movements of humans in the cavity and their interaction with cave bear bones and between humans themselves.

Eight main concentrations in four different locations of the upper gallery with the most important spoors were selected for this project, which were studied by three indigenous ichnologists in October 2018.

Fortunately, important details are known about the context of the prehistoric spoors in Tuc d'Audoubert. Rock art, for example, consists of a specific, distinctive spectrum of motifs, execution and style which indicate their homogeneity. Excavations regularly show single-layer locations dating between 17,200 and 16,500 calBP. Archaeological analyses prove that the visit in the cave took place in autumn-winter season. Furthermore, conspicuous distribution patterns between different parts of the cave, consistent material culture and best preservation and conservation conditions testify to a short stay of a single group of people in the entire cave system of Tuc d'Audoubert. The panoply of various analyses allows the control of the results through cross-check. So far, there have been only complementary results that allow a colourful mosaic of insights into the settlement history of Tuc d'Audoubert (Bégouën et al. 2009; Pastoors 2016).

Even without the inclusion of spoors in the upper gallery, it is evident that people have moved throughout the entire cave and have completely anthropogenized it by active interventions. The kind of installation in the cave testifies to the existence of a

previous planning or system that speaks of great experience in dealing with cave systems. Evinced by excavations, in some parts of Tuc d'Audoubert, base camp activities similar to open-air sites took place. Thus the cave becomes an autonomous subsystem within the prehistoric subsistence network. In addition to substantial activities, qualified activities such as drawing activities and consumption of introduced provisions were carried out in the cave.

This mesh of information about the context of the prehistoric spoors in the upper gallery is consistent. It can be assumed that a single group of cave-experienced hunter-gatherers with members of all ages stayed in Tuc d'Audoubert over a short time.

After first interpretations of the spoors in the upper gallery, only a few visits to this difficult part of the cave took place (Bégouën et al. 2009). According to this first estimations, five to six subjects (female and male adults plus one child of age class infans I) are said to have made in total two visits. First, they realized an exploration of the upper gallery and second an expedition to execute the clay sculptures and further drawings (Bégouën et al. 2009: 415). This small group of five to six persons is said to have been part of a larger group who stayed in the intermediate gallery. Considering the small amount of archaeological material, it is estimated that this total group counted 15–20 subjects (Bégouën et al. 2009: 395.). The new counts based on the work of the indigenous ichnologists have modified these first estimates. Thus, in the upper gallery, there were 14 subjects from adults to infans I, but no subject from *maturus* age class. Not only a small part of the whole group climbed into the upper gallery, but at least three-quarters of the estimated group size did the difficult climbing. Maybe the subjects with *maturus* age did not go along or were not in the cave at all. Interestingly, the locations where substantial activities were carried out offer sufficient space for this number of subjects. According to calculations of the available space, a maximum of 30 to 50 subjects fit into the relevant locations at the same time: certainly enough space for a group of 15–20 subjects.

Of the 14 subjects that climbed up in the upper gallery, only four could not be assigned to a group of at least two subjects. Accordingly, ten subjects entered the upper gallery as part of at least a small group, and it can be assumed that the other four subjects were also not alone in this problematic terrain. In view of the group compositions and the assumption that humans did not climb alone into the upper gallery, it can be concluded that a maximum of five visits by two to six subjects were carried out. Among the visitors was a couple, subjects S7 and S8, who were walking together in ten locations and showed a certain repetitive pattern in their behaviour. It was only the male subject who manipulated the bear bones, although at every place they did the same things with the woman possibly managing the light. Even without considering the detailed observations of the spoors that are directly related to the making of drawings or modelling, an equally high resolution of the events that happened in Tuc d'Audoubert is not available at any comparable site.

The direct comparison of the results of the identifications of the prehistoric spoors by the indigenous ichnologists and western academic scientists shows deviations mainly in the identity of the trackmakers (see Chap. 1). This concerns the number of subjects as well as age and sex. Events are identified by both groups of specialists,

whereas those of western academic scientists are much more fragmentary than the often consistent event identifications of experienced trackers. These aspects have to be discussed in detail but make more sense on a broader database from Tuc d'Audoubert that is under construction as part of the multi-stage studies on the prehistoric human spoors. Based on photogrammetric images, prominent landmarks of the plantar imprints will be systematically measured. In addition, complex morphometric analyses and plantar pressure analyses will follow. In the same way, the events related to drawing activities will be investigated. Only on the basis of all data available a more intensive analysis of the differences and similarities of the results of the indigenous ichnologists and western academic scientists seems to be reasonable.

But the first step of the multi-stage analysis of human spoors already brought important new insight that fits into the general picture of the use of the upper gallery of Tuc d'Audoubert as well as the settlement pattern in the entire cave system. Tuc d'Audoubert has shown several times in the past that the excellent preservation and handling allow high-resolution analyses. This unique characteristic will also mark the future work in Tuc d'Audoubert.

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