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The advantage of using independent subdivisions during archaeological excavations for the study of small vertebrate remains

Intérêts de l'utilisation des décapages lors des fouilles archéologiques pour l'étude des restes de petits vertébrés

Aurélien Royer

I wish to thank Odile Romain for giving me access to the collection from Olha 1 (Pyrénées-Atlantiques) at the Musée de l'Homme, Bruno Maureille and Alan Mann for the Pradelles collection (Charente), as well as Mathieu Langlais for Peyrazet (Lot). I also thank Véronique Laroulandie, Luca Sitzia, Emmanuelle Stoetzel and Jean- Pierre Texier for their precious comments which improved this text.

1 - Introduction

1 Prehistorians are regularly called upon to reevaluate series from the early excavations of sites now considered as references. These reevaluations are generally carried out when a "discrepancy" is observed between former interpretations and current knowledge. The latter evolves continuously as a result of new discoveries, leading to the formulation of new issues and the use of new methods, or as a result of the development of new analytic paradigms. The main aim of the renewed study of collections is thus to revise and update the archaeological and stratigraphic interpretations of the site based on material derived from early excavations.

2 The history of a prehistoric site is a subjective reconstruction based on the interpretation of the sedimentary and geomorphological context, as well as on the different unearthed archaeological and paleontological remains. Among these remains, faunal remains in particular allow us to address the exploitation of the animal

environment by Man, to establish biostratigaphies and to reconstruct past environments. For their part, small vertebrate remains present two specific traits:

3 1) they are regularly present in sites with the required conditions for bone fossilization, and 2) they can either be separate from human occupation remains or associated with them. Nonetheless, when they are associated with artefacts, their accumulation rarely results from anthropogenic activities (Chaline 1977). Thus, unlike the large fauna, these assemblages are only exceptionally biased by human predation activities. On the other hand, they can be influenced by the agent(s) responsible for their accumulation (*e.g.*, Mayhew 1977; Andrews 1990; Stahl 1996). In addition, these small vertebrates, mainly represented by rodents (*e.g.* Chaline 1977), occupy many different ecological zones. On account of their small size, wide diversity and rather sedentary behaviour, they reflect a local environment. Given the fact that they react rapidly to environmental variations, small vertebrates provide privileged evidence of environmental changes near sites (e.g. Le Louarn and Quéré 2003; Hernández Fernández 2006; Auffray, Renaud, Claude 2009). In this way, environmental reconstructions were developed from the beginning of the 20th century onwards (e.g. Harlé 1906; Bouchud 1952; Simard 1966; Chaline1972; Jeannet 1978; Marquet 1993; Cuenca-Bescós et al. 2009; Jeannet 2010; López-García et al. 2010; Royer et al. 2013). In most cases, they refer to the archaeological layers defined during excavations.

4 In this article, two questions are broached: 1) what consequences would the recording by layer of data relative to the small vertebrates have on future interpretations and reevaluations? 2) Are the archaeostratigraphic subdivisions sufficiently relevant for the study of small vertebrate palaeo-associations? Based on the analysis of three small mammal collections from sites excavated at different periods (the sites of Olha I in the Pyrénées-Atlantiques, Pradelles in Charente and Peyrazet in the Lot), this work shows that it is preferable to record and collect small vertebrate remains by successive subdivisions (or spits). This method is easy to implement and leads to the conservation of neutral and independent information that can be directly compared to data from the other archaeological remains.

2 - Limits and implications of the archaeological layers

5 An archaeological layer is defined as a soil unit made up of deposits left by Man or containing the remains of his activities (Leroi-Gourhan 1988). The identification of such a layer is based on all the different remains found at the site.

6 The archaeological layer is independent of the geological layer, defined as “a sedimentary unit that accumulated in constant physical conditions” (Reineck and Singh 1975, p. 82). This definition of an archaeological layer is theoretical. In practice, the delimitation of such levels is difficult and involves an interpretation of the site and the material used to identify these layers (Bordes, Rigaud, Sonneville-Bordes (de) 1972). Moreover, archaeological layers are often only defined on the basis of initial field observations, and are thus based on geological, rather than archaeological criteria (*i.e.*; characteristics of the deposits containing artefacts, such as texture or colour). Therefore the definition of archaeological layers is often questionable and doubts often arise as to the reality of such entities. As a result, it is not easy to interpret remains for which the only recorded spatial information is the archaeological layer from which they derive (Villa 2004).

7 From the 1930s, Méroc developed a rating system for objects using orthonormal Cartesian markers (Laplace-Jauretche and Méroc 1954), which was swiftly adopted from the middle of the 20th century onwards (e.g. Leroi- Gourhan 1950; Bordes and Bourgon 1951; Sonneville- Bordes (de) and Mortureux 1955; Vaufrey 1956). With this system, it is possible to record the exact position of remains in a site and thus obtain neutral information. It has become essential in current excavation methods and makes it possible to continue the analysis of archaeological complexes once excavation operations are finished. The collections from early excavations using this system can thus be reevaluated. Nonetheless, this system was only developed for large objects that can be identified at the excavation.

8 Sieving was practiced from the end of the 19th century onwards in order to retrieve objects that went unnoticed at the excavation. However, it was only from the second half of the 20th century that sieving became systematic and was linked to the site grid (*e.g.* Lumley (de) 1969, 1972). In order to recover as much information as possible, Laplace-Jauretche (1971) suggested subdividing the whole site into 5 or 10 cm slices, respectively called half size and full size. According to him, these subdivisions are " *subordinated to the stratigraphy defined by a set of geological and cultural characteristics*" (1971, p.228). Nonetheless, such a definition is contrary to the rules of stratigraphy (Hedberg 1979). These subdivisions must not depend on litho- and archaeo-stratigraphic sequences so that they remain independent and can then be correlated with them. Today, they are known as "subdivisions" or "spits", according to the definition in the dictionary of prehistory (Leroi-Gourhan 1988). They represent the volume of a hexahedron with a surface of 1/9, 1/4 or 1 square metre and a thickness varying between 1 and 10 cm, following the excavation protocols used. This recording mode thus leads to the accumulation of information for pieces recorded directly at the excavation, as well as for those retrieved during sieving and sorting, so that each object can be situated in the site according to Cartesian markers.

3 – How can we interpret an early collection of small vertebrates?

9 Let us take the example of the collection of small vertebrates from Olha I (Pyrénées-Atlantiques). In 1936, Passemard published the results of his excavations of the Olha 1 site, excavated between 1916 and 1919. He described a sequence nearly 7 metres thick, made up of six stratigraphic complexes (Passemard 1936). The study of the small faunal remains showed the presence of four rodent and two insectivore species. These were from a single layer located in an intermediary position between layers FS and FM. The revision of this collection showed that all the bone remains (mandibles, humeri, femurs) are whole, suggesting the selective collection of material. This observation led to questions as to the consequences of this collection and on the representativeness of the material. Moreover, three additional rodent species were identified (tab. 1). As, exceptionally, the current distribution areas of these species overlap, it is reasonable to ask if their association is "real", or if it stems from an excavation artifact linked to the collection of material.

10 Finally, the revision of such a series allows for 1) a more accurate identification of the remains 2) the reconsideration of the integrity of the series and the identification of any possible taphonomic biases. However, the absence of information concerning the

localization of remains, independently of their ascribed layer, is not conducive to environmental or biostratigraphic reinterpretations.

Table 1 - Presence of small vertebrates from the "inter FM-FS" level of Olha 1 (Pyrénées-Atlantiques) identified by Passemard (1936), as well as the minimal number of individuals for small vertebrates identified during reevaluation.

Groupe		Espèces décrites par Passemard (1936)	Espèces identifiées
Insectivore	*Talpa* sp.	x	1
	Sorex sp.	x	
	Sorex coronatus-araneus		1
Rongeur	*Apodemus sylvaticus*	x	3
	Arvicola amphibius	x	
	Arvicola terrestris *Arvicola sapidus*		64
	Castor fiber	x	3
	Microtus agrestis	x	22
	Microtus arvalis	x	30
	Microtus agrestis/arvalis		11
	Microtus Terricola duodecimcostatus		2
	Microtus Terricola pyrenaicus		2
	Microtus Terricola subterraneus		5
	Microtus Terricola sp.		1
Petit carnivore	*Mustela nivalis*	x	2
	Mustela erminea	x	1
Batracien	*Rana* sp.	x	x
	Bufo sp.	x	x

4 – With or without subdivisions: what are the differences?

11 Let us now consider the example from Peyrazet (Lot, France). This site yielded a sequence dating from the Tardiglacial (Langlais et al. 2009). The protocol applied during the excavation enabled us to extract data relating to the location of small vertebrate remains by layer and by spit. Table 2 presents the counts of remains by layer for subsquare L6C, whereas figure 1 illustrates the evolution of the concentrations of each taxon in this same subsquare for each spit. Based on these spits, we observe that the small mammals are distributed unevenly throughout layer 4. Using statistical analysis based on a cluster analysis method and the Bray-Curtis dissimilarity coefficient, we observe a series of complexes (called B to F), that differ from the archaeostratigraphy. Layer 4 is characterized by the presence of four complexes, including two (B and E) which also incorporate spits from layers 3 and 5. Complex D of this layer stands out in particular by the presence of numerous insectivores, including water shrews (*Neomys* sp.) and crowned shrews (*Sorex coronatus-araneus*), as well as birch mice (*Sicista betulina*) and garden dormice (*Eliomys quercinus*). This association denotes a marshy environment, which disappears in the upper part of layer 4 (complex C). In addition, this analysis by spit allows us to question the reality of certain associations. For example, note in table 2 that layer 4 associates the snowy vole

(*Chionomys nivalis*) with the water shrew (*Neomys* sp.), which are taxa from different environments. Nonetheless, an analysis by spit suggests that these taxa did not occur together. In this example, spits allow us to advance a biostratigraphy without the palimpsest effect induced by the archaeological layer.

12 The sequence from the site of Pradelles (Charente) (Maureille et al. 2010) is dated to the end of isotopic stage 4 and the beginning of stage 3. Two taxa predominate; the narrow-headed vole (*Microtus gregalis*) and the common vole (*Microtus arvalis*); representing about 85 % of the determined individuals (Royer *et al.* 2013). Let us now only consider level 5, with large mammal remains accumulated mainly by large carnivores (Costamagno *et al.* 2008). This level 5 is perceived to be homogeneous from a lithostratigraphic and an archaeological point of view. Based on rodents, it is possible to interpret this level differently, either by taking account of the whole level or by dividing it into two sublevels (tab. 3).

13 If we consider the whole level, we observe that the number of individuals identified as common voles (*M.* arvalis) increases, whereas the presence of the narrow-headed vole (*M. gregalis*) is still predominant denoting a dry, steppic continental environment. Nonetheless, the proportions of these rodents are different if we subdivide level 5 into two sublevels (5-1 and 5-2). In sublevel 5-1, the presence of the narrow-headed vole is dominant in comparison to that of the common vole, whereas in sublevel 5-2, this ratio is inversed. Moreover, this second sublevel differs by the presence of the gray dwarf hamster (*Cricetulus migratorius*). Compared to those of sublevel 5-1, these results imply that sublevel 5-2 records a climatic amelioration.

Table 2 - Small vertebrate remains from Peyrazet (Lot) according to archaeological levels.

	Microtus indet.	*Microtus arvalis/agrestis*	*Microtus oeconomus*	*Arvicola* cf. *terrestris*	*Chionomys nivalis*	*Apodemus sylvaticus*	*Eliomys quercinus*	*Sicista betulina*	*Myodes glareolus*
	N m1 inf	N m1 inf	N m1 inf	N m1 inf	N m1 inf	Mand +max	Mand +max	Mand +max	NR
Couche 1	0	0	0	0	0	0	0	0	0
Couche 2	1	2	0	1	0	0	0	0	0
Couche 3	4	202	3	3	0	16	0	0	1
Couche 4	23	586	223	38	1	10	1	2	0
Couche 5	13	142	51	41	0	0	4	2	0

	Sorex coronatus-araneus	*Sorex minutus*	*Crocidura* indet.	*Neomys* Indet.
	mand	mand	mand	mand
Couche 1	0	0	0	0
Couche 2	0	0	0	0
Couche 3	10	5	8	0
Couche 4	64	22	0	9
Couche 5	5	1	0	0

5 – Contribution of subdivisions and application in the field

14 The systematic use of subdivisions presents the advantage of spatially defining the origin of the micro-remains, independently of the archaeological and geological layers,

and provides us with the possibility to reallocate objects recorded with Cartesian coordinates (fig. 2). This recording method also makes it possible to:

1. establish a detailed and independent biostratigraphy, which is not biased by litho- or archaeo-stratigraphic subdivisions (fig. 2) and which can be correlated with the latter, as shown by rare small vertebrate studies (Cochard 2004; Cuenca-Bescós *et al.* 2011; Pasty *et al. 2012) ;*
2. develop an approach comparing the distribution of non-coordinated objects (small vertebrate remains but also all the other micro remains, such as lithic remains and burnt bones), with coordinated pieces. An example of this was obtained from the study of the Tardiglacial site of Peyrazet (Lot), where the lack of correlation between the quantities of lithic material (accumulated by Man) and small mammals (accumulated by a non-human predator) was brought to light (Rho = 0.10; p = 0.55). On the other hand, there is no correlation between the quantities of lithic material and fish (Rho = 0.10; p = 0.52) and a significant correlation between the quantities of small mammals and fish (Rho = 0.57; $p < 0.0001$). These results thus suggest that a large part of the latter were also accumulated by non-human predators. From -150 cm onwards, important quantities of small vertebrate remains are still present, whereas the density of lithic pieces is low, indicating that the cave was mainly occupied by non-human predators (fig. 3). This method thus offers the possibility to characterize site occupation phases, but also phases of human inoccupation of levels considered to be archaeologically sterile.
   This approach was applied to the whole of the excavated site, and allowed for a spatial study of small vertebrate remains, which can then be compared with those of other remains. For example, the Magdalenian layer IIIa from Taillis-des-Coteaux (Vienne) (Primault *et al.* 2010) presents a similar distribution of rodent, bird and fish remains, localized in the cave entrance area. This distribution is different to the remains linked to anthropogenic activities, which are mainly spread out inside the cave and on the slope (Rambaud *et al.* 2011).
   This differential distribution tends to imply that the fish, bird and rodent remains, result mainly from non-human predator accumulation;
3. produce impartial information allowing for an ulterior evaluation of the collection. This can also be compared to a reassessment of the other archaeological remains.

15 Nowadays, systematic sieving is often criticized as it is a fastidious and time-consuming operation. Nonetheless, it is essential for recovering archaeological remains that go unnoticed at the excavation, such as certain lithic or bone remains, indispensable for understanding human behaviour (*e.g.* Freeman et al. 1998; Soressi and Tavormina 2011; Val and Mallye 2011). It is important to underline that recording spits is more time-consuming than layers, but it also provides more information. The recovery of small vertebrates in the field does not only depend on excavation methods, but also on the sieve mesh used by prehistorians. Meshes of 3 to 1.5 mm are generally used to retrieve the smallest lithic armatures, whereas small vertebrate specialists recommend meshes of 1.2 to 0.5 mm, depending on fragmentation. The ideal method is clearly systematic sieving with meshes of 1.2 mm or less, as is the case at other sites, such as Atapuerca (0.5 mm mesh - pers. com. G. Cuenca-Bescós). When this method cannot be applied, two other strategies can be developed, depending on the site and excavation objectives. When the excavation is geared towards spatial analysis, it is appropriate to carry out systematic sieving, with a coarse mesh of 1.2 to 1.8 mm, which is sufficient to assess the distribution of the density of remains. This approach should also include the fine-meshed column sieving of samples in order to refine environmental reconstructions by incorporating the remains of the smallest species. When the excavation does not

involve a spatial approach, such as refreshing a section, it is possible to column sieve samples with a fine mesh, with columns spread out along the section (for example a subsquare every metre). These two strategies present the advantage of being based on spit recording, within the site grid, and it is thereby possible to acquire adequate data for microfauna and to correlate them directly with the archaeological and geological data.

Figure 1 - Taxa counts according to spits and altitudes in subsquare L6C at Peyrazet (Lot). The variations of the three most frequent taxa (Microtus arvalis- agrestis, Microtus oeconomus and Arvicola cf terrestris) are represented as relative percentages. For the rest, each first lower molar and each mandible are represented by a circle to clearly illustrate their quantitative variations within the sequence.

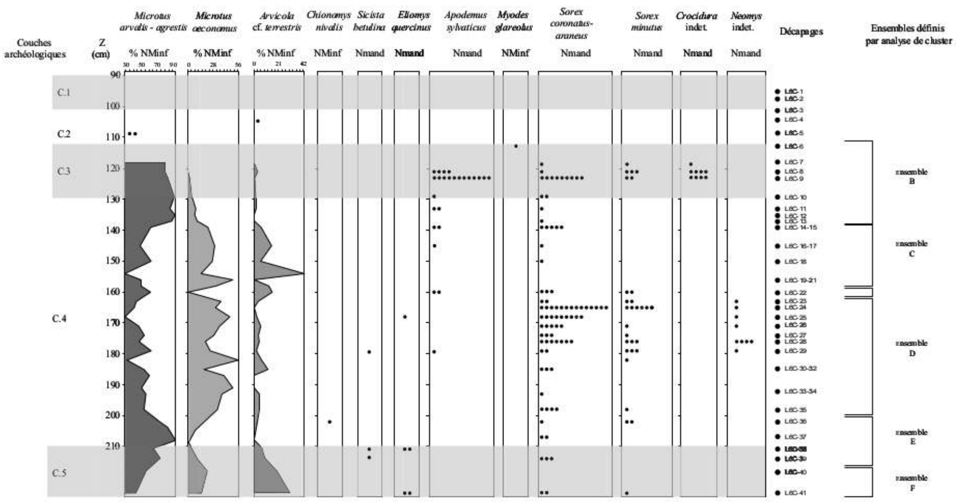


Table 3 - Minimal number of individuals for rodents at Les Pradelles (Charente). Level "5 total" corresponds to both sublevels 5-1 and 5-2.

Espèces / Niveaux	Niveau 2/1	Niveau 2A	Niveau 2B	Niveau 4A	Niveau 4B	Niveau 5-1	Niveau 5-2	Niveau 5 total	Total (NMI=1250)
Apodemus sylvaticus	0	0	0	1	1	0	1	1	**3**
Arvicola terrestris	1	4	1	1	2	2	5	7	**17**
Cricetelus migratorius	0	0	0	1	0	0	4	4	**5**
Dicrostonyx torquatus	0	1	1	4	64	26	18	44	**142**
Eliomys quercinus	0	0	0	0	0	1	0	1	**1**
Glis glis	0	0	0	0	1	0	0	0	**1**
Marmota marmota	0	0	0	1	2	0	0	0	**4**
Microtus arvalis	4	13	3	14	39	31	147	178	**272**
Microtus arvalis/agrestis	0	0	0	0	3	1	3	4	**8**
Microtus gregalis	7	35	8	26	296	168	120	288	**782**
Microtus oeconomus	0	0	1	2	3	1	7	8	**15**

Figure 2 - Theoretical illustration presenting the difference between a biostratigraphy based on archaeostratigraphic levels from the square K7A (Schema A) and a biostratigraphy obtained using successive spits (Dec) from the square K7A, which are independent of the archaeostratigraphy (Schema B).

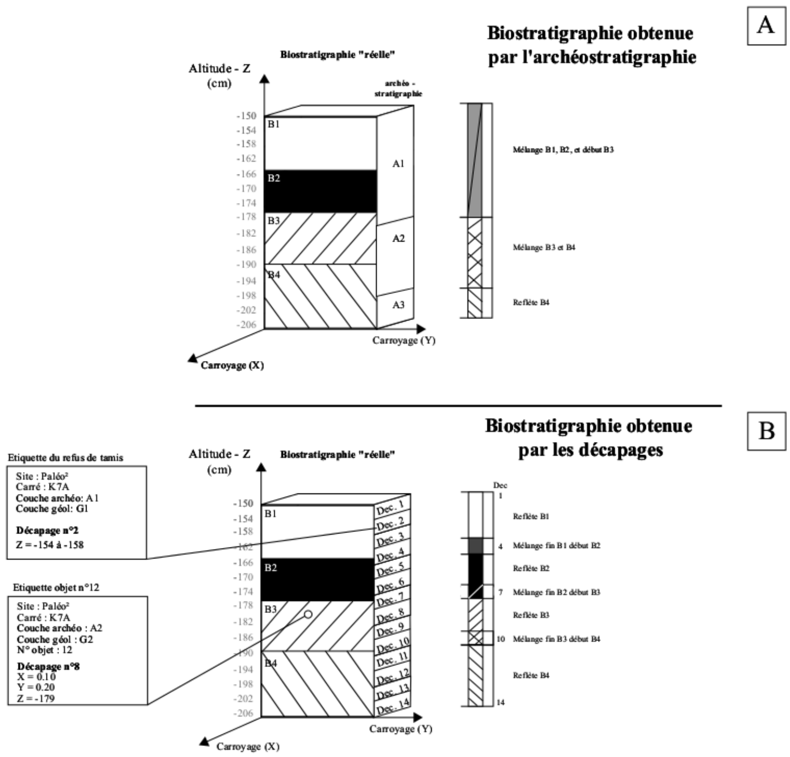
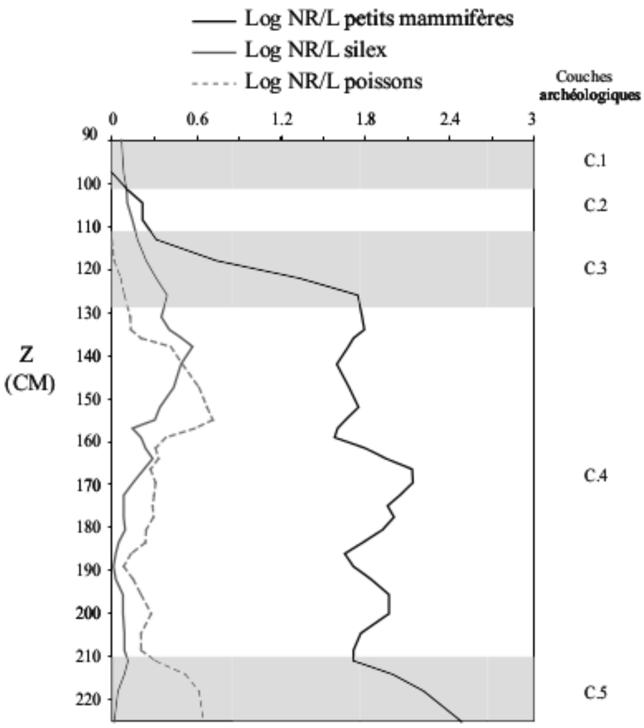


Figure 3 – Quantitative variations in rodent, fish and lithic remains per litre of sediment (expressed in logarithm) obtained by spits from the subsquare L6C of Peyrazet (Lot) according to altitude. NR: Number of remains; L: Litre of sediments; Z: altitude in centimetres. The grey and non-grey fluctuations illustrate the archaeological levels



6 - Conclusion

16 Small vertebrate remains bear important environmental, archaeozoological and taphonomic information. However, their potential to provide information depends on the excavation methods applied to the site. Due to their small size, small vertebrate remains are very rarely recorded with a system of Cartesian coordinates in archaeological sites, as most of them are collected from sieve residues. This article underlines the necessity to acquire impartial spatial information from a spatially referenced hexahedral area in the site. These data are independent of the archaeological and geological layers, and thus allow for the study of the spatial distribution of small vertebrate remains, the proposition of biostratigraphies based on these remains and the recording of information necessary for comparisons with the other archaeological remains and a possible ulterior reevaluation of the collection.

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ABSTRACTS

The remains of small vertebrates are generally recorded and analyzed according to archaeological levels defined during excavations. As a consequence, the study of such assemblages is influenced by these predefined levels, creating possible analytical biases and errors in the characterization of biostratigraphical units. The study of small vertebrate assemblages from Olha 1 (Pyrénées-Atlantiques), Les Pradelles (Charente) and Peyrazet (Lot) demonstrates the benefit of systematically recording detailed spatial information for these types of remains. Independent subdivisions (spits) defined by Cartesian coordinates allow independently defined biostratigraphical units to be correlated with litho- and archaeo-stratigraphy.

Les restes de petits vertébrés de nombreuses collections sont conditionnés et étudiés selon les couches archéologiques caractérisées lors de la fouille. De facto, l'analyse de ces collections est influencée par ces ensembles prédéfinis, ce qui biaise d'éventuelles réévaluations et de nouveaux découpages biostratigraphiques. S'appuyant sur l'analyse de trois collections de petits vertébrés issues de gisements fouillés à différentes périodes (les sites d'Olha I dans les Pyrénées-Atlantiques, des Pradelles en Charente et de Peyrazet dans le Lot), ce travail met en évidence l'avantage d'enregistrer précisément la provenance spatiale de ce type de microvestiges. Cet article propose donc que les restes de petits vertébrés soient systématiquement enregistrés et collectés par décapages successifs (ou passes) dont la situation spatiale est définie non pas par rapport à une couche archéologique, mais par des coordonnées cartésiennes. Ce mode d'enregistrement permet d'établir des biostratigraphies réellement indépendantes des autres stratigraphies (i.e. litho-, archéo-, chronostratigraphies) et corrélables à ces dernières.

INDEX

Mots-clés: biostratigraphie, petits vertébrés, mode d'enregistrement des données, décapages
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