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# Bird exploitation pattern: the case of Ptarmigan *Lagopus* sp. in the Upper Magdalenian site of La Vache (Ariège, France)

Véronique Laroulandie

PACEA- IPGQ, UMR 5199 du CNRS, Université de Bordeaux I, Talence, France

## Abstract / Zusammenfassung

This paper deals with the exploitation of Ptarmigan (*Lagopus* sp.) during the upper Magdalenian and is based on the analysis of the bone remains from La Vache cave, Salle Monique (Ariège, France), the largest Palaeolithic assemblage hitherto collected. Circumstantial evidence suggests that Ptarmigan fowling may have taken place in autumn and winter. Anthropogenic modifications of the bones include traces of dismembering and burning as well as numerous cut marks. Unambiguous evidence for the use of bones as a raw material is lacking, implying that most traces result from food processing. The under-representation of some larger skeletal elements of the distal limbs can be explained best as resulting from activities of the Palaeolithic site inhabitants, whereas excavation bias may account for the absence of certain smaller skeletal elements in the assemblage. Bird carcass processing consisted in dismembering, portioning and filleting. The roasting of smaller portions as well as the removal of cooked meat using stone tools can be evidenced. Discussion focuses on the possible co-existence of different methods of processing, some of which may leave no traces in the archaeological record.

In diesem Beitrag wird auf die Nutzung des Schneehuhnes (*Lagopus* sp.) im Spätmagdalenien eingegangen. Grundlage bilden die in der Höhle La Vache, Salle Monique (Ariège, Frankreich) geborgenen Knochenfunde, die größte paläolithische Ansammlung ihrer Art. Indizienbeweise deuten darauf hin, dass die Schneehuhnjagd hauptsächlich im Herbst und im Winter stattfand. Zu den anthropogenen Veränderungen an den Knochen zählen Zerlegungs- und Brandspuren sowie häufige Schnittmarken. Eindeutige Hinweise auf die Nutzung von Knochen als Rohstoff fehlen, was bedeutet, dass die meisten Spuren im Zuge der Nahrungszubereitung entstanden sind. Die Tatsache, dass einige größere Skelettelemente der distalen Gliedmaßen zahlenmäßig unterrepräsentiert sind, ist auf die Aktivitäten der paläolithischen Siedlungsbewohner zurückzuführen, weil das Fehlen kleinerer Knochen im Untersuchungsgut grabungsbedingt ist. Die Verarbeitung der Vogelkörper bestand in der Zergliederung, Portionierung und Ablösung des Fleisches. Zudem lässt sich das Braten kleinerer Portionen sowie das Entfernen von gekochtem Fleisch mittels Steinartefakte nachweisen. In der Diskussion wird auf die Möglichkeit unterschiedlicher Zerlegungsmodi hingewiesen, wobei nicht alle unbedingt Spuren am archäologischen Material hinterlassen müssen.

**Keywords** Ptarmigan, Magdalenian, France, processing pattern, cooking  
Schneehuhn, Magdalenien, Frankreich, Zerlegungsmodus, Zubereitung

## Introduction

In southern Europe, the end of the Palaeolithic is characterised by changes in subsistence notably an intensification of fishing and small game hunting, particularly toward leporids and birds. As has been discussed extensively in the frame of a recent colloquium (Brugal & Desse 2004), it is essential to identify the exploitation patterns in order to understand the role of these new species in the palaeoeconomies of Palaeolithic hunter-gatherer communities. In this paper it is attempted to contribute to this subject by a zooarchaeological study of the largest sample of Ptarmigan bones recovered from a Palaeolithic context. Issues such as the season of fowling and the patterns of car-

cass and/or meat processing are explored. By doing this, some methodological limits and perspectives can be presented.

## Material and Methods

The La Vache cave is a renowned archaeological site located in the French Pyrenees a few kilometres away from the Ariège valley (Fig. 1). It has been excavated since the middle of the 19<sup>th</sup> century (see Pailhaugue 1993 for the details). In 1952, during R. Robert's fieldwork, a new room named "Salle Monique" was discovered yielding an important Tardiglacial deposit dated by <sup>14</sup>C (Table 1). Excavated over a surface of

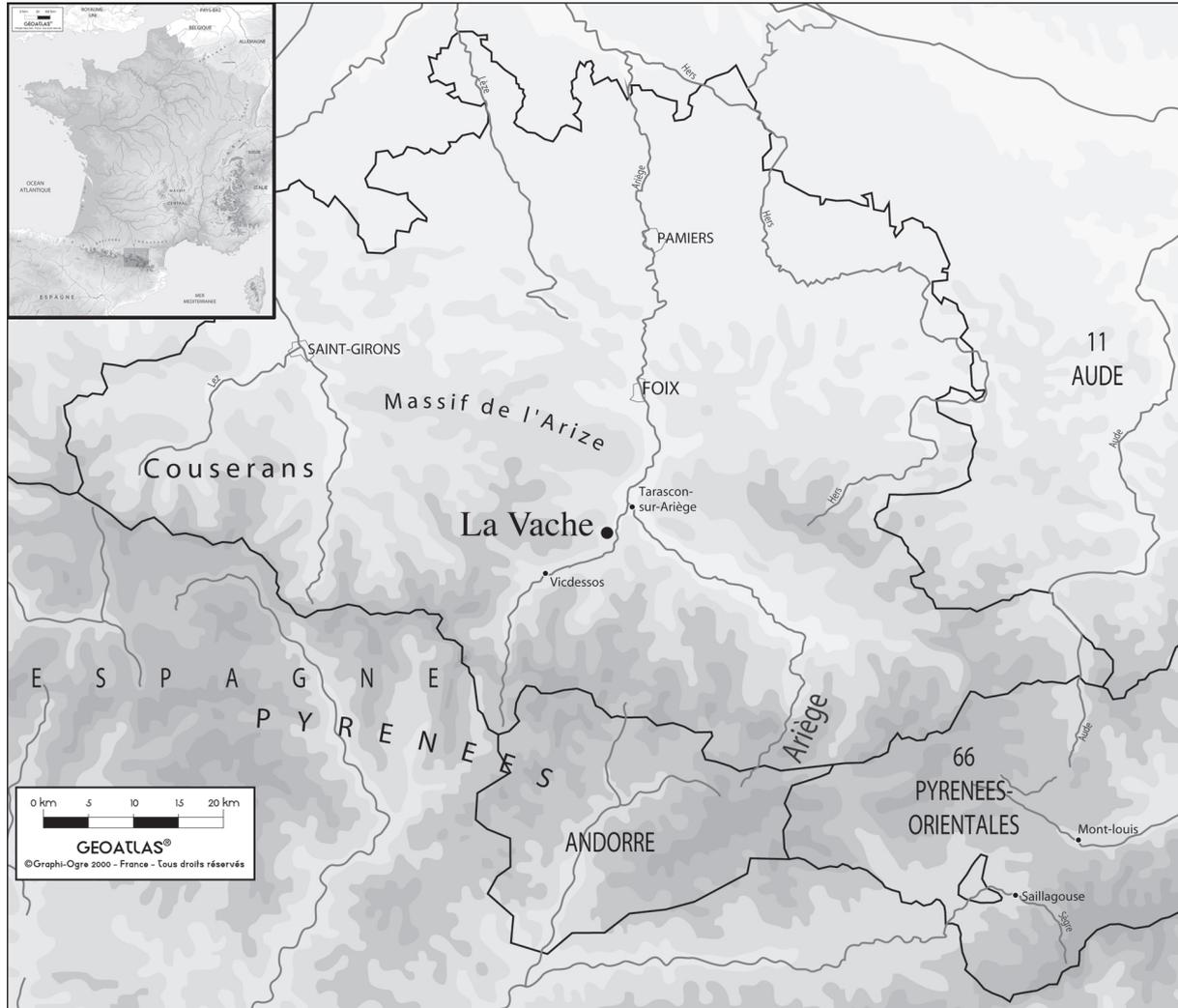


Fig. 1: Location of the site of La Vache (Ariège, France).

Date BP	Material	Reference
11 650 +/- 200	Charcoal	Col 336c
12 540 +/- 105	Charcoal	Gr 2025
12 850 +/- 60	Charcoal	Gr 2026
12 800 +/- 140	Bone	Gif 7603
13 490 +/- 120	Bone	Gif A 96478
13 770 +/- 140	Bone	Gif A 96479
13 650 +/- 130	Bone	Gif A 96480

Table 1:  $^{14}\text{C}$  dates of La Vache, Salle Monique.

about 200 m<sup>2</sup> it contains a rich Upper Magdalenian assemblage with stone and bone tools as well as art objects.

About 140,000 well preserved faunal remains from 29 mammalian and 21 avian species have been identified (Pailhaugue 1993, 1995, 1996, 1998). Ibex *Capra pyrenaica* and Ptarmigan *Lagopus* sp. represent about 90% of the total number of identified specimens (NISP) and minimum number of individuals (MNI) (Fig. 2).

Ibex remains form the bulk of the faunal material with more than 70,000 bones representing at least 1,831 individuals, but the MNI for Ptarmigan is clearly higher, with about 52,000 bones belonging to minimum 4,566 birds.

As such, a distinction between Willow Ptarmigan *L. lagopus* and Rock Ptarmigan *L. mutus* is impossible for most of the bones, since only few morphological and metrical criteria are available (Bochenski 1985). Among these is the tarsometatarsus length, which has been used by Koby in the 1950s in order to evaluate the relative frequency of the two species at La Vache (Koby 1957a, b). According to Koby, the ratio *L. lagopus* to *L. mutus* is about three to one in the Ptarmigan bone sample from Salle Monique. Unfortunately, bones that show a higher frequency of anthropogenic marks are not distinguishable to the species level. Therefore, the genus level is maintained in this study and, as an hypothesis, it will be postulated that the pattern of carcass and meat processing is similar for the two species.

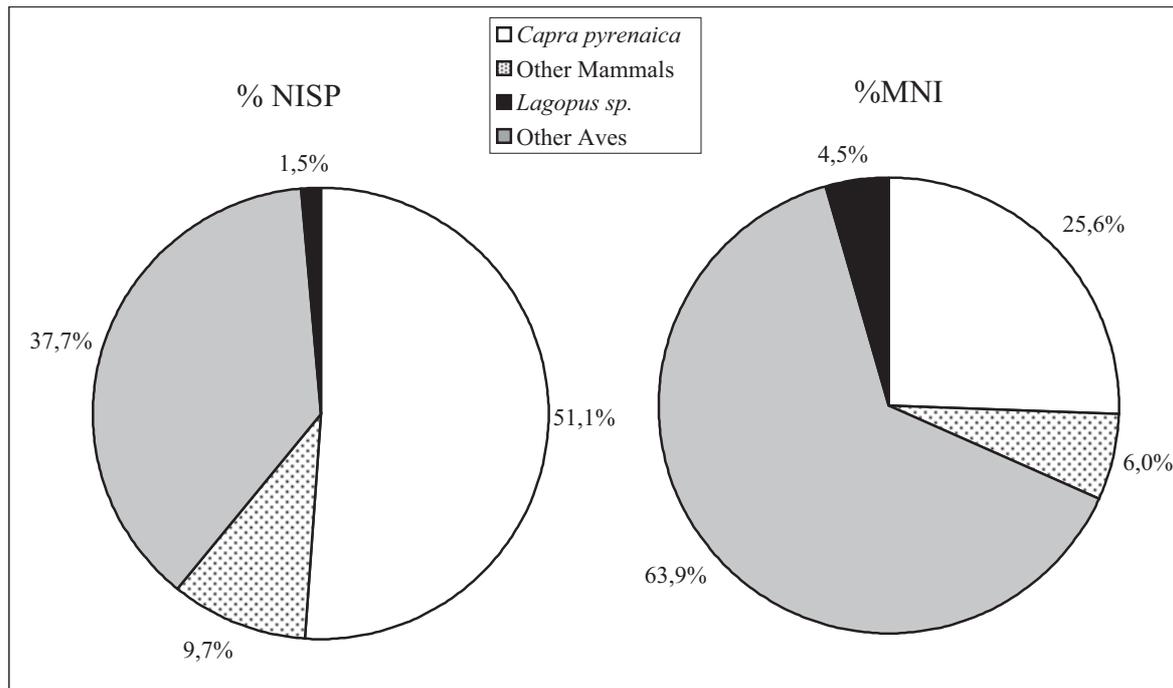


Fig. 2: La Vache, Salle Monique. Simplified species spectrum in % based on Number of Identified Specimens (NISP: 139,753) and Minimum Number of Individuals (MNI = 7,145) (data after Pailhaugue 1998).

Except for the analysis and interpretation of the skeletal distribution that is based on the total assemblage and counts of N. Pailhaugue (pers. comm. 2000), my own taphonomical and zooarchaeological analyses involved but a sample of the Ptarmigan bone accumulation (Laroulandie 2000). This sample (Table 2) corresponds to 37% of the total number of Ptarmigan bones (NISP = 19,527) collected. A part of all the anatomical elements present in the collection was observed except for the cranium. For each skeletal element, several hundred specimens were observed under binocular microscope (x 10) searching for surface modifications. Cut marks were recorded in form of cumulative drawings. For bones showing a high frequency of marks the drawings are based on a sample taking into account the various positions of the cut marks (Laroulandie 2000). In the humerus, coracoid and femur only whole or almost complete specimens were considered, while for the other skeletal elements we also analysed fragments.

The interpretation of the anthropogenic modifications of the Ptarmigan bones and the processing pattern deduced from these data draw to a large extent from an experimental butchering and cooking realised on Grey Partridge *Perdix perdix* carcasses (Laroulandie 2000, 2001).

## Results

### Taphonomic agent

Taphonomic analysis indicates that the inhabitants of the cave are the main if not the only agent responsible for the accumulation of the Ptarmigan remains. In fact, anthropogenic modifications are abundant (Table 2) and there is no clear evidence for activities of raptors or carnivores (see Laroulandie 2000 for details). Considering the excavation methods, in particular the fact that the materials have been collected by hand picking without any sieving of the sediments, it can be assumed that a bias occurred against the smaller skeletal elements, which therefore will be underrepresented (Payne 1975).

### Season of fowling

Did Ptarmigan fowling represented a seasonal activity at La Vache? Serjeantson (1998) mentions three aspects of bird bones that can be used as direct evidence for seasonality. However, among the remains studied, neither immature bones nor specimens with medullary bone have been found. Such specimens should be present if fowling took place during spring and summer. In the study area, Ptarmigan must have been residents and could have been caught all year round. Thus, direct evidence for seasonal fowling is lacking. However, the absence of medullary and immature bones combined with the behaviour of Ptarmigan and contextual data allow for an alternative explanation. Indeed, particularly in autumn will Ptarmigan flocks be in

Anatomical elements		NISP Pailhaugue (1995)	NISP observed	% NISP observed	MNE	% survival Brain (1976)	NISP cut marks	% NISP cut marks	NISP burnt	% NISP burnt
Skull	CRA	22	0	0	22	0,5	-	-	-	-
Mandible	MAN	632	628	99	325	6,9	0	0,0	0	0,0
Vertebrae	VER	0	0	0	0	0	-	-	-	-
Dorsal	DOR	799	804	100	797	17	0	0,0	0	0,0
Synsacrum	SYN	1295	1295	100	1256	26,8	0	0,0	6	0,5
Ribs	COT	0	0	0	0	0	-	-	-	-
Sternum	STE	1892	1894	100	1538	32,8	90	4,8	0	0,0
Coracoid	COR	10498	2157	21	9198	98,2	478	22,2	5	0,2
Scapula	SCA	4604	2334	51	4604	49,1	247	10,6	14	0,6
Furcula	FUR	1553	1567	100	1097	23,4	112	7,1	5	0,3
Pelvis	PEL	518	273	53	518	5,5	13	4,8	0	0,0
Humerus	HUM	12307	2423	20	9084	96,9	1768	73,0	22	0,9
Ulna	ULN	645	303	47	505	5,4	42	13,9	6	2,0
Radius	RAD	1736	761	44	1213	12,9	90	11,8	18	2,4
Ulnar carpal	ULE	0	0	0	0	0	-	-	-	-
Radial carpal	RAL	0	0	0	0	0	-	-	-	-
Carpometacarpus	CMC	1997	965	48	1836	19,6	4	0,4	18	1,9
Femur	FEM	10739	2375	22	7882	84,1	1119	47,1	5	0,2
Patella	ROT	0	0	0	0	0	-	-	-	-
Tibiotarsus	TIB	928	435	47	780	8,3	35	8,0	9	2,1
Fibula	FIB	0	0	0	0	0	-	-	-	-
Tarsometatarsus	TAR	2462	1313	53	2239	23,9	0	0,0	12	0,9
Metatarsal 1	MET	0	0	0	0	0	-	-	-	-
Phalanges	PHA	0	0	0	0	0	-	-	-	-
<b>Total</b>		<b>52627</b>	<b>19527</b>	<b>37</b>			<b>3998</b>		<b>120</b>	

Table 2: Ptarmigan anatomical elements from La Vache, Salle Monique. Absolute frequencies, percentage analysed, survival rate, absolute and relative frequency of bones with cut marks and burnt bones.

good nutritional condition (Dragesco 1989), making fowling much more rentable. Moreover, most of the mammals (Ibex) appear to have been hunted between September and April (Pailhaugue 1998), and this may also apply for Ptarmigan. Nevertheless, an interpretation of the Ptarmigan data in terms of autumn and winter fowling is but an hypothesis for the moment (Vilette 1999).

#### Processing pattern

No direct evidence for the technique(s) used in fowling can be recognized on the material analysed, whereas modifications resulting from carcass processing are abundant. Even if it is likely that Ptarmigan were not used solely as a food item, it is difficult to prove this assumption on the basis of the archaeozoological record available. All the bone modifications observed might result from processes such as butchering, cooking and consumption; none of them can be interpreted as unambiguous evidence for the use of raw materials. Thus, as for the exploitation of bird feathers, the situation is the same as the one described by Cassoli and Tagliacozzo (1997) for birds from the Grotta Romanelli. Finally, although the Magdalenian inhabitants of La Vache used bird bones as a raw material (Nougier & Robert 1966, 1968; Fritz 1999), worked bones of Ptarmigan are completely absent in the collection studied.

In the following I will present the main hypotheses concerning the way carcasses were brought to the site, butchered, prepared and consumed by the cave inhabitants. For those who are interested in more details about the processing pattern, especially the butchering process, we refer to a previous report (Laroulandie 2000).

#### Transport of the carcasses

Compared to unbiased skeletal representations, where it can be expected that all anatomical elements are represented proportionate to their frequency in the living bird, anomalies in skeletal profiles can be interpreted as resulting from inadequate excavation methods and/or analytical techniques, differential survivorship according to bone mineral density or differential transport of carcasses and/or consumption. Thus, in order to verify if the skeletal part frequencies observed reflect human activities, an evaluation of the non-anthropogenic processes is obligatory (Lyman 1994; Dirrigl 2001; Bovy 2002; Cruz & Elkin 2003).

The skeletal profile expressed in terms of relative frequency of survival (Brain 1976) shows a dominance of the coracoid, humerus and femur. Small sized and/or brittle elements such as vertebrae, ribs, carpals and phalanges are absent (Fig. 3). Conceivably this can be explained best by the fact that sieving was not carried out,

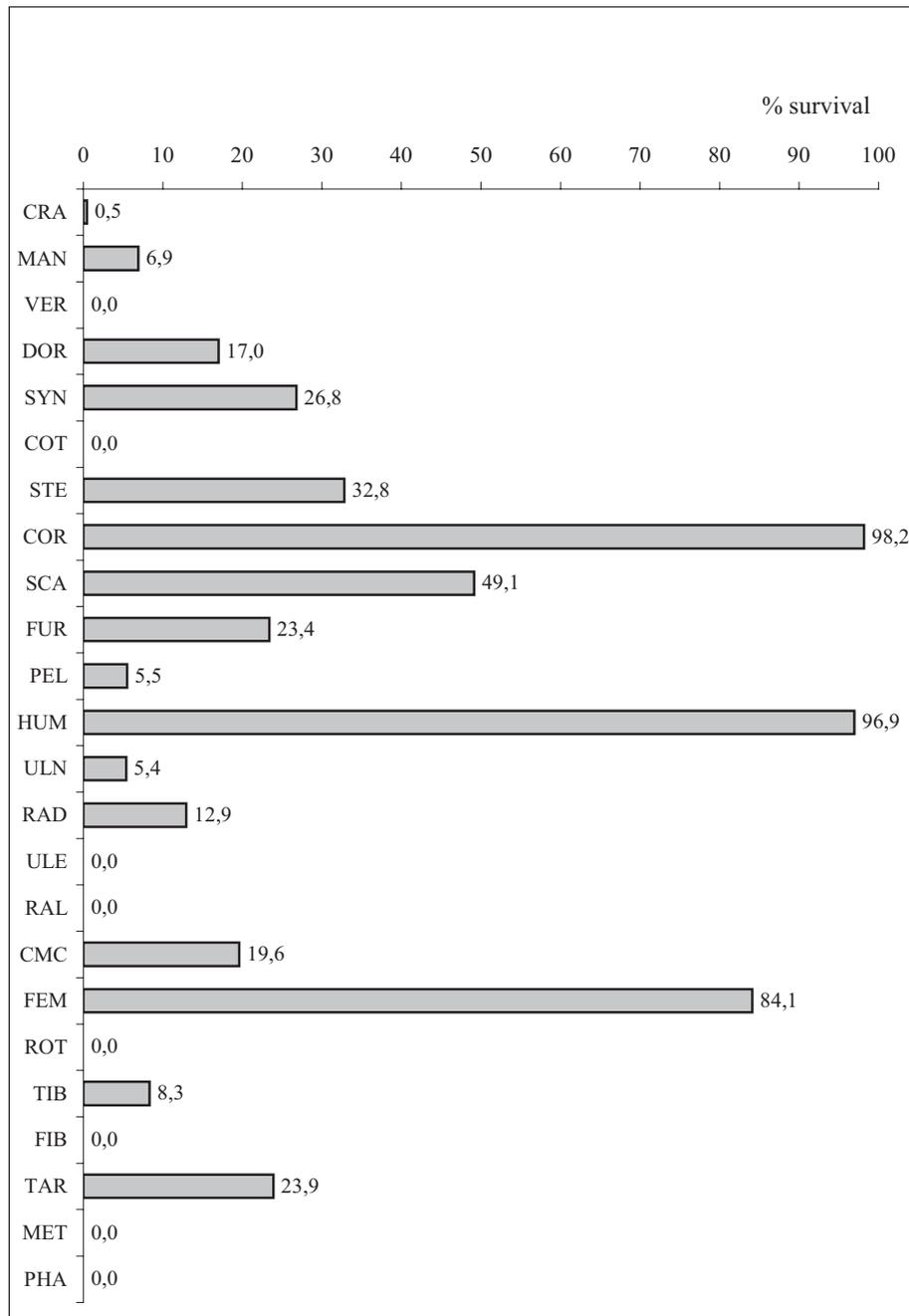


Fig. 3: La Vache, Salle Monique. Survival rate (in %) of the different skeletal elements of Ptarmigan. Abbreviations see Table 2.

considering the fact that elements such as the ulnar and radial carpals are missing, whereas theoretically their frequencies should correspond to the ones of the bones they articulate with, i.e. ulna, radius and carpometacarpus.

The effect of bone mineral density on differential preservation is difficult to evaluate, given the lack of relevant data for the Ptarmigan skeleton. Moreover, considering the few published data available for birds (Dirrigl 1998, 2001; Trapani 1998; Higgins 1999; Cruz & Elkin 2003), it can be seen that the relationship between the relative density of the bones will differ between species. However, as relative bone density seems to be related to be-

haviour (Bovy 2002; Cruz & Elkin 2003), it can be expected that the bone density pattern in Ptarmigan will be closer to that observed in terrestrial birds (Dirrigl 1998, 2001; Trapani 1998) rather than to the one in flightless (Cruz & Elkin 2003) or in water birds (Higgins 1999). Correspondingly I used the data obtained by Dirrigl (1998, 2001) on four species of gallinaceous birds in order to evaluate the Ptarmigan assemblage. As such, Dirrigl observed that both average areal bone mineral density and volume bone mineral density are equal or higher in carpometacarpus and tarsometatarsus shaft compared to femur and coracoïd shaft. Provided this also applies to the Ptarmigan skeleton, it can be postulated that if at La

Vache bone mineral density affected skeletal element survival, tibiotarsus and carpometacarpus would either outnumber femur and coracoid or at least be present in the same proportion. At La Vache, however, the tibiotarsus and carpometacarpus are far less frequent compared to the femur and coracoid. Because the tibiotarsus is the most fragmented long bone (Laroulandie 2000) and taking into account the method of sampling (see above), it can be argued that the negative bias observed relates to these two factors. But this argumentation does not hold for the carpometacarpus. We, therefore, have difficulties to believe that bone mineral density is appropriate to explain the skeletal profile observed.

It is noteworthy, however, that in the anthropogenic Ptarmigan assemblages studied so far proximal elements of the wings and legs outnumber distal ones (Mourer-Chauviré 1975, 1983; Vilette 1983, 1999), and this also applies to our material. If this pattern results exclusively from human activities, two alternative hypotheses can be proposed. On the one hand the transport and introduction, from the kill site to the settlement, of partial carcasses of which the body parts poor in meat have been removed (Diez Fernandez-Lomana et al. 1995). This hypothesis means that butchery differed in time and space. On the other hand the utilisation of these anatomical segments as raw materials or for decorative purposes elsewhere (Laroulandie 2000). At this stage of research it is impossible to choose between the two hypotheses, but whatever waste or raw material, limbs extremities of main carcasses are out of the excavation area.

#### *Butchering practises*

Bone modifications due to butchering consist in cut marks and perforations of the olecranon fossa of the humerus (Laroulandie 2000, 2001, 2005). The frequency of cut marks varies between skeletal elements. Except for the tarsometatarsus, cut marks are present on bones of both the fore and the hind limbs. Moreover, they are present on the sternum and on bones of the pectoral and pelvic girdles (Table 2). Although for the moment some of the cut marks observed cannot be interpreted properly, most butchering marks result from carcass dismembering and filleting (Table 3). As such, the repeated pattern of the fracturing of joints and the under-representation of articulation ends may partly result from dismembering. However, consumption of the cartilage and/or marrow (Lefèvre & Pasquet 1994) and differential preservation due to structural density may also contribute to this pattern (Cruz & Elkin 2003).

Dismembering of carcasses is documented for the scapular joint as well as the ulnar, carpal, pelvic and knee joints (Fig. 4). For example, the disarticulation of the wing at the scapular joint using a stone tool is attested by the many striae visible on the surface of the proximal articu-

lation of the humerus (Fig. 5a-c, e, g), the scapula (Fig. 6d) and cranial part of the coracoid (Fig. 7a-c). In absence of any cut marks, the few burning traces observed at these extremities also evidence a dismembering at this level. Cut marks present at the distal humerus (Fig. 5d, e, g) and sometimes on the proximal articulations of the ulna (Fig. 8) and radius (Fig. 9a, b) indicate a disarticulation of the elbow joint. Moreover, dismembering of this articulation by over-extension is shown by the numerous perforations of the humeral olecranon fossa (c. 7% of the cases) (Fig. 10). Some distal humeri (2%) evidence both the use of a stone tool and over-extension. A good deal of the fractures of notches located at the proximal extremities of scapula, coracoid and carpometacarpus and of both articulations of the ulna (Fig. 11) might be due to the process of disarticulation (Laroulandie 2000, 2005). Several humeri show traces of dismembering at both proximal and distal ends (Fig. 5e, g), indicating a portioning of the carcasses in smaller pieces.

The removal of the muscles from the meaty parts of the carcasses using stone tools is documented by numerous cut marks (Table 3; Figs. 4-9, 12-15). In the case of the long bones, the humerus most frequently exhibits cut marks (Fig. 5f, g), followed by the femur (Fig. 12c-e). Only few ulnae (Fig. 8), radii (Fig. 9c) and tibiotarsi (Fig. 13) document such a filleting procedure (Table 3). Cut marks on the sternum (Fig. 15) and the bones of the scapular girdle (Figs. 7e, f, 14) evidence the removal of the pectoral muscles. Some skeletal elements, but mainly the humerus, carry both marks of filleting and dismembering at proximal and/or distal ends, evidencing the minuteness of the butchering process (Figs. 5g, 12c, d).

#### *Cooking and consumption*

Traces of burning are present on few bones (Table 2). Most of them are located at the extremities of the bones (Fig. 16) and evidence cooking in direct contact with fire (Vigne et al. 1981; Vigne & Marinval-Vigne 1983; Lefèvre & Pasquet 1994) as well as the consumption of cooked meat. Looking for the localisation of some of the traces, it can be concluded that portioned carcasses have been cooked. For example, burnt areas located at the proximal ends of the scapula and coracoid (Fig. 16 a-d) attest the cooking of (parts of) carcasses from which the wings had been removed. Traces of burning found on the proximal end of a femur (Fig. 16n) testifies that sometimes upper legs were roasted. Similar traces located at the distal end of the same bone (Fig. 16o, p) indicate the preparation of carcasses from which the calf had been separated. Burnt areas at the proximal humerus (Fig. 16e, f) and radius (Fig. 16i, j) illustrate the cooking of part of the wing including the humerus in the first case, and without it in the second case. The cooking of small portions including single skeletal elements is also attested. Evidence for this can be found in humerus which show both dismembering by over-extension of the elbow (oc-

	NISP with cut marks due to disarticulation		NISP with cut marks due to filleting	NISP with cut marks due to disarticulation and/or filleting
	proximal	distal		
STE	-	-	90	-
COR	96	-	150	234
SCA	23	-	176	104
FUR	-	-	112	-
PEL	-	-	-	13
HUM	743	620	1371	-
ULN	11	-	33	-
RAD	48	2	40	-
CMC	3	-	-	1
FEM	5	442	790	-
TIB	-	-	35	-

Table 3: Absolute frequencies of Ptarmigan anatomical elements showing cut marks due to disarticulation and/or filleting.



Fig. 4: La Vache, Salle Monique. Carcass processing of Ptarmigan.

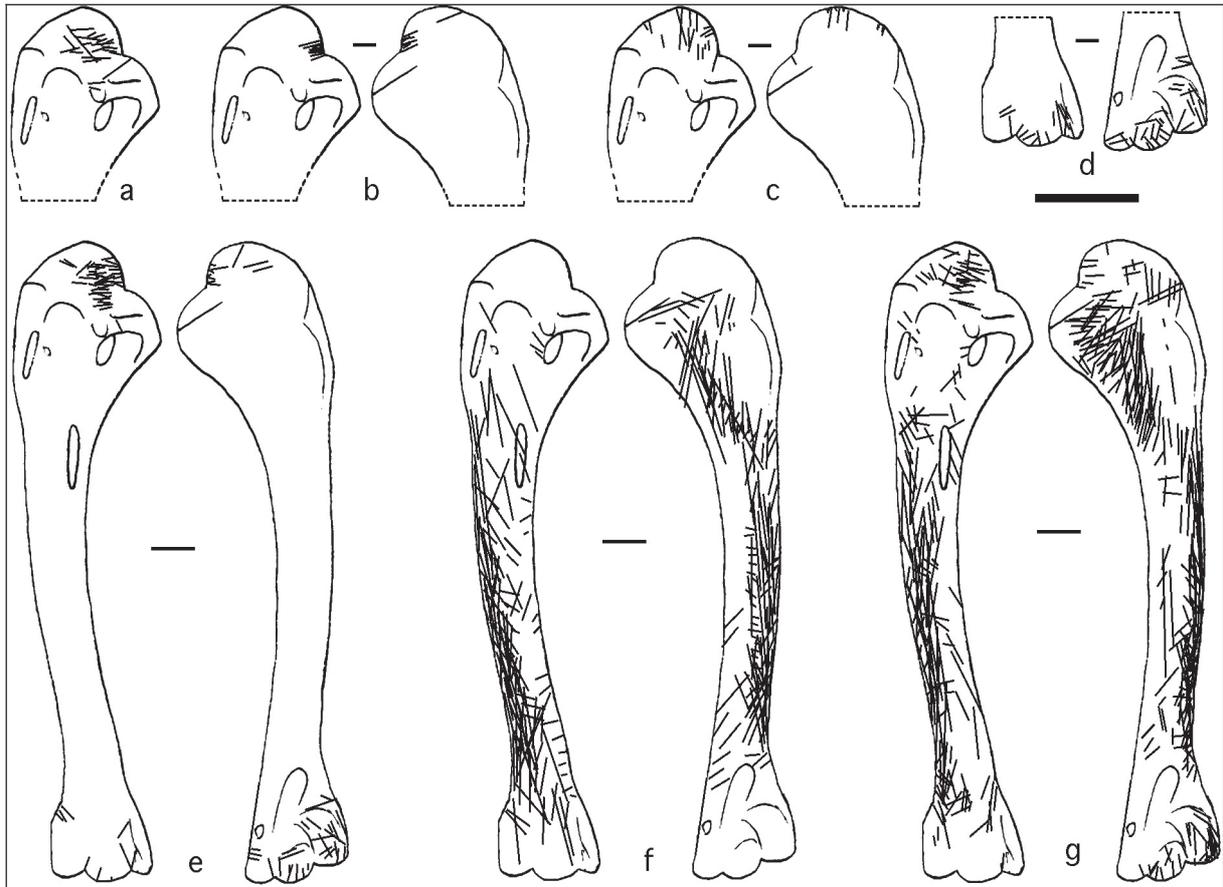


Fig. 5: La Vache, Salle Monique. Overview of the cut marks observed on a series of Ptarmigan humeri: a = 18, b = 6, c = 5, d = 27, e = 22, f = 30, g = 30. Scale = 1 cm.

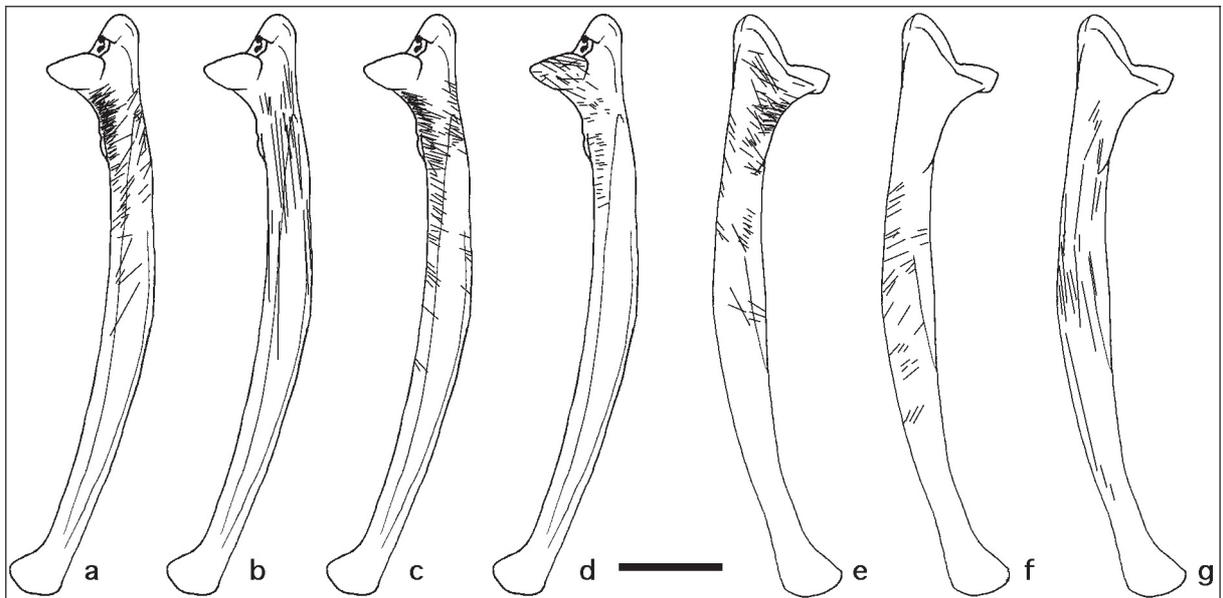


Fig. 6: La Vache, Salle Monique. Overview of the cut marks observed on a series of Ptarmigan scapulae: a = 40, b = 30, c = 30, d = 9, e = 8, f = 8. Scale = 1 cm.

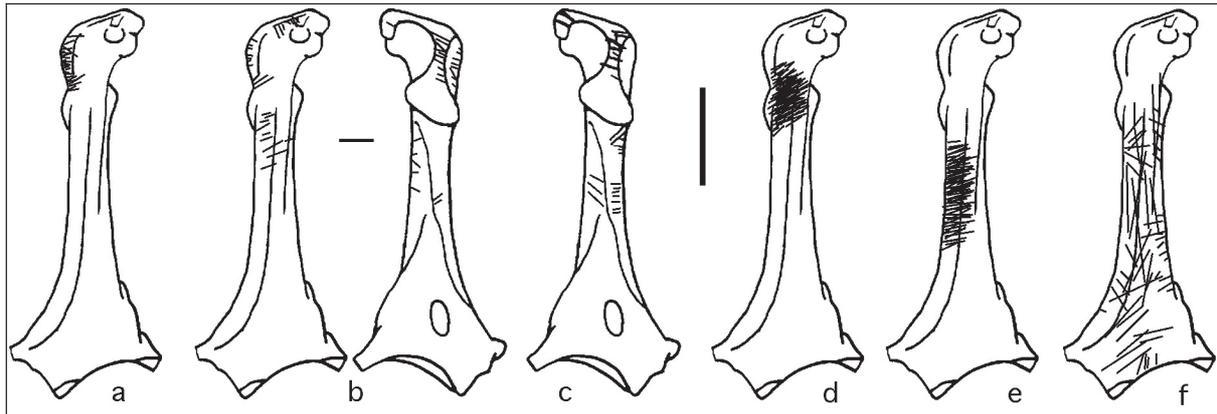


Fig. 7: La Vache, Salle Monique. Overview of the cut marks observed on a series of Ptarmigan coracoids: a = 20, b = 12, c = 10, d = 30, e = 30, f = 13. Scale = 1 cm.

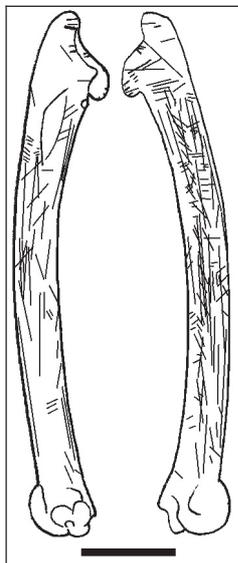


Fig. 8: La Vache, Salle Monique. Overview of the cut marks observed on 41 ulnae of Ptarmigan. Scale = 1 cm.

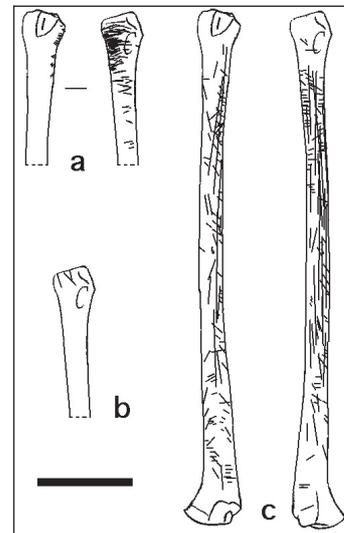


Fig. 9: La Vache, Salle Monique. Overview of the cut marks observed on a series of Ptarmigan radii: a = 25, b = 3, c = 42. Scale = 1 cm.



Fig. 10: La Vache, Salle Monique. Different degrees of perforation of the olecranon fossa of Ptarmigan humeri. Scale = 1 cm.

curs on fresh carcass) and burning marks at the proximal ends (Fig. 16e, f). Cooking of whole or nearly complete carcasses is possible but difficult to demonstrate. In fact, burning traces found at the distal end of the tibiotarsus (Fig. 16q-s) and the radius (Fig. 16k, l) may indicate either that part of the legs and wings were cooked separately or together with the rest of the carcass from which the meatless parts of the extremities had been removed.

Few humeri (NISP = 13) show traces of burning and cut marks of filleting (Fig. 16e, f). This indicates that body parts were cooked before stripping off the meat, as has been described earlier for the avian assemblage from the Grotta Romanelli (Cassoli & Tagliacozzo 1997).



Fig. 11: La Vache, Salle Monique. Breakage pattern of Ptarmigan ulnae. Scale = 1 cm.

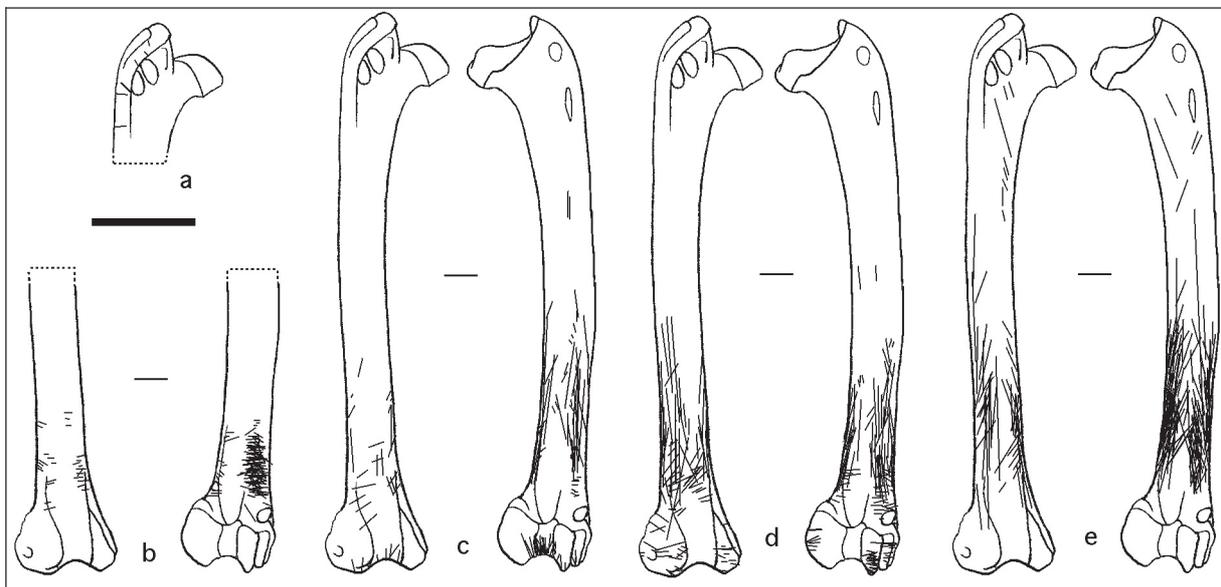


Fig. 12: La Vache, Salle Monique. Overview of the cut marks observed on a series of Ptarmigan femurs. Number of bones drawn: a = 5, b = 30, c = 18, d = 35, e = 40. Scale = 1 cm.

## Discussion

According to Lyman (1994) and as documented by our butchery experiments with bird carcasses (Laroulandie 2000, 2001), marks occurring in the course of food processing are epiphenomenal. This means that for a single processing pattern, modifications will not occur on all the bones, since the aim is not to leave marks on the bones but to get consumable products. As a consequence, it can be assumed that dismembering and portioning as well as filleting and roasting occurred more frequently than has been registered in the archaeological record, and hence recognised by the zooarchaeologist. Furthermore, it can be expected that the probability for a single bone to show both traces of dismembering, filleting and burning marks is low. Such bones, however, have been recovered at La Vache

because of its large sample. These specimens not only attest the meticulousness of food processing, they are also important elements for exploring the consecutive steps relative to food processing. Obviously dismembering took place before cooking, which in turn preceded filleting. But even if filleting of cooked body parts can be documented, can we exclude the possibility that it also occurred with uncooked meat? Dismembering was practiced before cooking, but did it also take place after cooking? In this respect, the underlying question is the following: Did people always process the carcasses the same way, or did several patterns exist? At this stage of our research, it cannot be excluded that the site inhabitants of La Vache processed Ptarmigan in different ways. However, in order to explore this matter further, the use of predictive models based on actualistic data could be helpful.

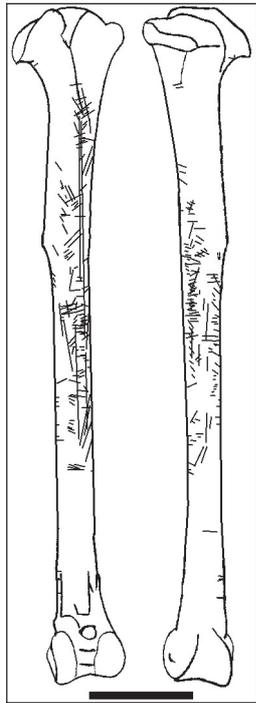


Fig. 13: La Vache, Salle Monique. Overview of the cut marks observed on 35 tibiotarsi of Ptarmigan. Scale = 1 cm.

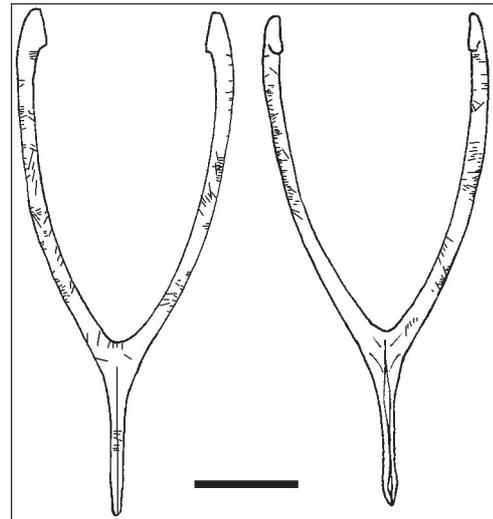


Fig. 14: La Vache, Salle Monique. Overview of the cut marks observed on 112 furculae of Ptarmigan. Scale = 1 cm.

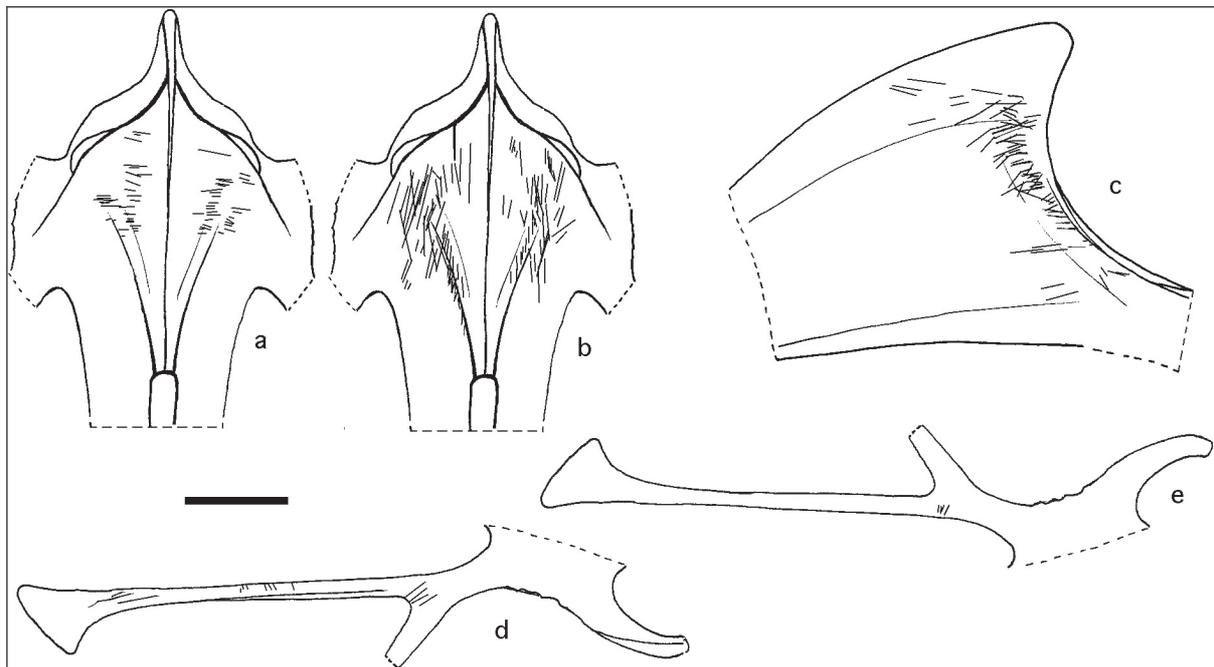


Fig. 15: La Vache, Salle Monique. Overview of the cut marks observed on Ptarmigan sterna. Number of bones drawn: a = 27, b = 31, c = 41, d = 3, e = 1. Scale = 1 cm.

Nevertheless, as could be demonstrated by the high frequency of bone modifications, Ptarmigan processing at La Vache appears to have been time consuming, whichever the way of processing chosen. Commonly a high frequency of cut marks is interpreted as an evidence of storage practices (Diez Fernandez-Lomana et al. 1995). Frequency of humerus with filleting marks

and burning is close to frequency of unburned humerus with filleting marks (around 60 %). As a result, except if roasted meat was for a differed consumption, the high frequency of cut-marked bone constitutes an ambiguous proof of storage. Once again the insufficiency of the models presently at our disposal is underlined.

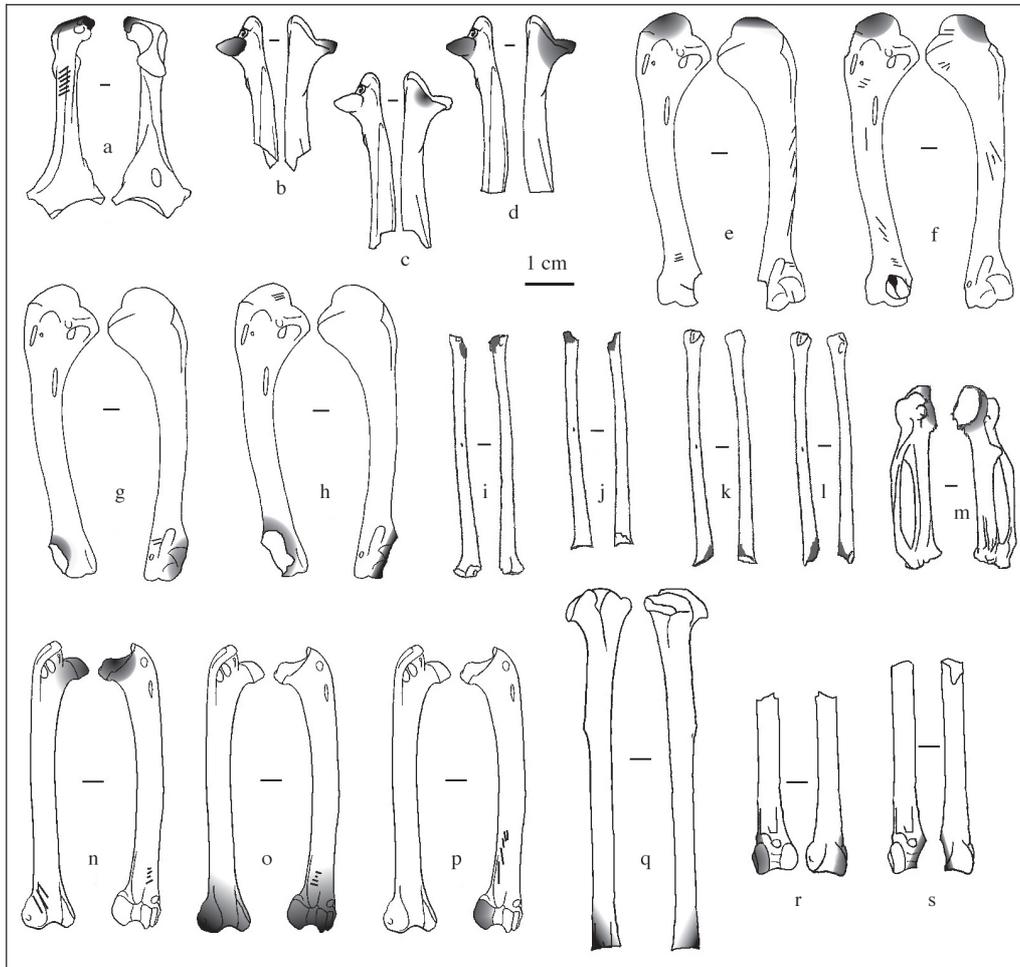


Fig. 16: La Vache, Salle Monique. Burning traces observed on some Ptarmigan bones. a = coracoid, b to d = scapula, e to h = humerus, i to l = radius, m = carpometacarpus, n to p = femur, q to s = tibiotarsus.

High frequencies of cut marks have been recorded from other Ptarmigan assemblages dating to the Magdalenian, such as Gazel and Tournal (Vilette 1983), Berroberria (Diez Fernandez-Lomana et al. 1995) and Taï2 (Louchart & Soave 2002). However, variations are observed between sites and depending on the skeletal element. For example, most of the ulnae and radii collected at Taï 2 exhibit cut marks (Louchart & Soave 2002), which is not the case at La Vache (Table 2). Such a high frequency is also in clear contrast with the much lower number of cut marks observed on Ptarmigan bones from Les Eglises (Laroulandie 1998), a chronologically closely related cave site nearby. Given the large number of variables that potentially can influence the formation of cut marks (Lyman 1994) as well as the different taphonomical histories of the avian assemblages considered here and the way they have been studied, make an interpretation of the differences observed difficult. And it is not the aim of this paper to resolve this question. However, in the case of La Vache and Les Eglises, I wanted to show that contextual data provide information that can be of interest (Laroulandie 2000, 2003). These two assemblages have been studied under similar conditions and in both

cases the bird bone surfaces are well preserved, minimising the risk of taphonomical and analytical bias. Based on the study of the Magdalenian stone industry, the siliceous raw materials found at Les Eglises seem to originate from another region (Clottes & Simonnet 1979), whereas for La Vache the acquisition of raw materials for stone tool production appears more local (Simonnet 1998). Supposedly the differences in bird carcass processing at these two sites relate to different needs and/or techno-cultural traditions.

## Conclusions

The archaeozoological analysis of several thousands of Ptarmigan bones from the upper Magdalenian of La Vache provides information about the pattern of exploitation of this small game bird. With respect to the season of fowling it can be argued that it occurred in autumn and winter. Since this assumption is based on the absence of remains of immature birds and of specimens with medullary bone as well as other contextual data, it has to be considered with caution.

Bone modifications produced ample evidence for food processing, but there is no clear proof for the use of Ptarmigan bones as a raw material. The under-representation of the skeletal elements of the fore and hind extremities could indicate that dismembering partly took place outside the area excavated or even outside the cave at the kill site and/or that these body parts have been utilised in another place. Intensive butchery involving dismembering and filleting and portioning of carcasses into smaller pieces is well documented. Roasting of smaller portions from which cooked meat – at least occasionally – had been removed with the aid of a stone tool, illustrates the meticulousness of bird processing by the Magdalenian site inhabitants. Yet it not clear whether only a single butchering and/or cooking process was known to them, hence the development of interpretative models based on modern studies would be of great help in order to solve this question. Integrating such models with contextual data will be necessary in order to understand the variation in bone modifications observed between the different Ptarmigan bone assemblages of anthropogenic origin and to trace with greater precision the role of birds in the economy of late/final Palaeolithic hunter-gatherer communities.

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