Brown bear remains in prehistoric and early historic societies: case studies from Austria

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Abstract

Remains of brown bear (*Ursus arctos* Linnaeus, 1758) are seldom recovered within archaeological assemblages. Nonetheless, interactions with bears and remains from this animal in past human societies are diverse, as will be reflected in this paper through the discussion of a number of archaeozoological case studies from Austria. The aim of this study was to detect the varying roles of bears in pre- and early historic agricultural societies and to identify the importance of 'rare' elements. The study presents an investigation of the osteological indications of this particular species, within a defined area and across time. Bears did not supply an important contribution to daily consumption but this species was incorporated within varying contexts, suggesting a variety of different practices.

Zusammenfassung

Überreste von Braunbären (*Ursus arctos* Linnaeus, 1758) werden in archäologischen Fundstellen selten geborgen. Interaktionen mit Bären und deren Überresten sind in früheren menschlichen Gesellschaften dennoch vielfältig, wie in diesem Artikel anhand einer Reihe von archäozoologischen Beispielen aus Österreich gezeigt wird. Ziel dieser Studie ist es, die unterschiedlichen Rollen von Bären in vor- und frühzeitlich historischen landwirtschaftlichen Gesellschaften zu erkennen und die Bedeutung von „seltenen" Elementen zu identifizieren. Die Arbeit präsentiert eine Untersuchung der osteologischen Indikationen dieser besonderen Art in einem abgegrenzten Gebiet und über die Zeit hinweg. Bären lieferten keinen wichtigen Beitrag bei der täglichen Nahrungsaufnahme, sind jedoch in unterschiedlichen Kontexten eingebunden, was auf eine Vielzahl unterschiedlicher Praktiken hindeutet.

Key words: Brown bear, *Ursus arctos*, archaeozoology, human interaction, Austria

Introduction

Nearly driven to the edge of extinction in many parts of Europe, brown bear populations are recovering slightly today. Probably since the time of their first encounter, the relationship between bears and humans has been inconsistent and fallen somewhere between respect, fear and condemnation.
In contexts as early as the Palaeolithic, modified bear bones and teeth indicate skinning, meat con-

sumption and use as pendants (Pacher, 2005). Occasionally brown bears occur in Palaeolithic cave art. Late Glacial and Mesolithic finds of associated human and bear skeletons from Central Europe (Morel, 1993), as well as bone points created from these animals (Bárta, 1990), may provide evidence that this species was actually hunted. Other relationships are also apparent: a possible example of a tamed bear is proposed at a Mesolithic site in France (see Chaix et al., 1997).

In Austria, bear bones occur regularly in archaeological assemblages from the Neolithic period (c. 5600-2000 BC, including the Copper Age or Chalcolithic c. 4000-2000 BC) to the High Medieval period (c. AD 907-1250). Apparently, there are no important bone assemblages containing bear remains from later historical periods but information concerning human-bear relationships can be obtained from written sources and visual imagery, such as rock art. Aside from Palaeolithic cave art (see above), such additional sources are provided from Roman times onwards, such as the stone reliefs from the Roman town of Virunum (Gugl, 2004) and Medieval petroglyphs from Upper Austria depicting a bear hunt (Mandl, 2004). From neighbouring Germany, a vivid illustration of a market scene with a butchered bear can be found in the so-called Richenthal Chronicle (dating to the late fifteenth century AD; Richental, 1964).

In archaeozoological contexts the remains of bear bones and teeth provide the primary evidence for human-bear relationships, although exceptional cases, such as the fur cap of the Tyrolean Iceman (Egg & Spindler, 1992), can provide further evidence. Bear bones are easily identified because of their large size and morphological characteristics and only occasionally can they be confused with other animal or human bones; for example in cremation burial contexts (Wahl, 2001). Bones from single individuals are easy to recognize and to refit and operation chains (sequences of human actions), such as the processes of skinning, dismembering and filleting, can be reconstructed from preservation patterns and bone modifications.

The brown bear in the Austrian archaeological record

Archaeological sites with brown bear remains are not equally distributed across the territory of present-day Austria (Fig. 1). This picture is related to former human settlement patterns and archaeological activities rather than to the historical distribution of this species. Current knowledge of recent bear populations connects the occurrence of these animals with sparsely populated, ‘remote’ (i.e. inner-Alpine) areas, where archaeological data are often ephemeral and faunal remains are largely restricted to natural places, such as caves. Hence, the recent known modern-age distribution of the brown bear, before its extinction as regularly reproducing species, exhibits little congruence with the identified distribution patterns present in the archaeological record of prehistoric and early historic times, as bear remains have been recovered in a variety of landscape contexts.

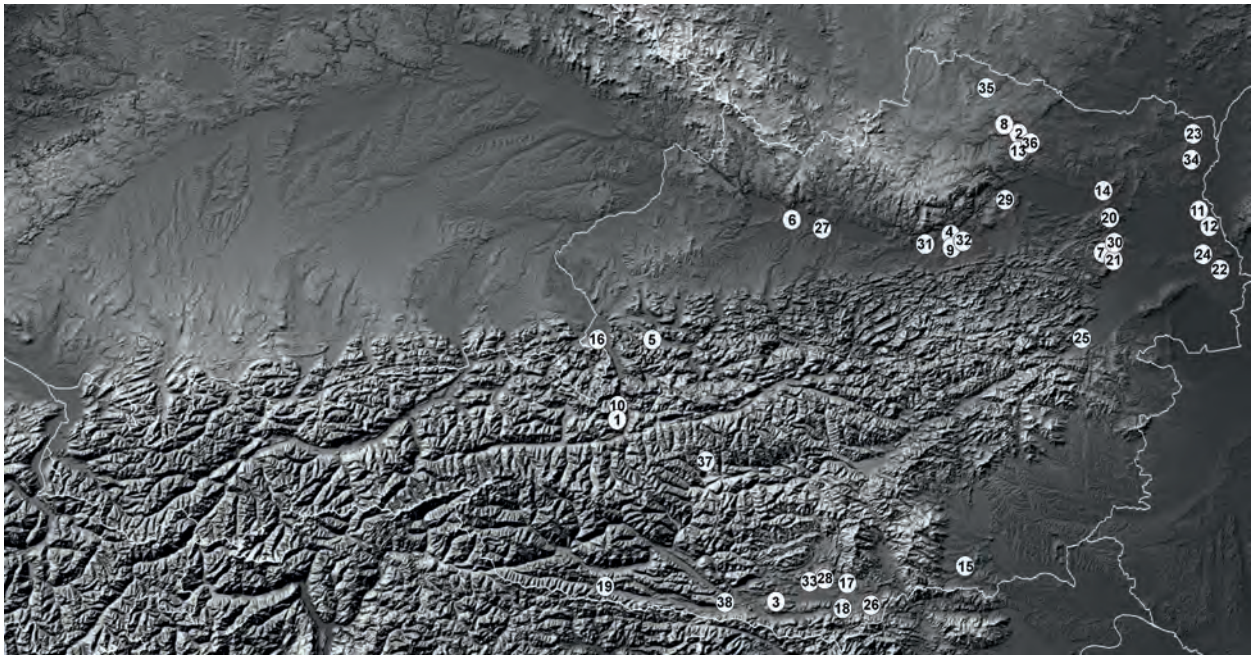

Fig. 1: archaeological sites with brown bear remains from Austria. Neolithic: 1 - Götschenberg, 2 - Ertl, 3 - Keutschach, 4 - Melk-Winden, 5 - Mondsee, 6 - Ölkam, 7 - Perchtoldsdorf, 8 - Poigen, 9 - Nussdorf. Bronze Age: 10 - Bischofshofen, 11 - Buhuberg, 12 - Stillfried, 13 - Thunau, 14 - Unterhautzental. Iron Age: 15 - Burgstallkogel, 16 - Dürrnberg, 17 - Führholz, 18 - Gracarca, 19 - Gurina, 20 - Leopoldsberg, 21- Perchtoldsdorf, 22 - Prellenkirchen. Roman period: 23 - Bernhardsthal, 24 - Carnuntum, 25 - Gerasdorf, 26 - Hemmaberg, 27 - Lauriacum, 28 - Magdalensberg, 29 - Mautern, 30 - Perchtoldsdorf, 31 - Pöchlarn, 32 - Traismauer, 33 - Virunum. Medieval: 34 - Gaiselberg, 35 - Sand, 36 - Thunau, 37 - Thurnschall, 38 - Villach.

It may, nevertheless, be the case that bears became rare or extinct in the densely settled and farmed lowlands much earlier (Spitzenberger, 2001), as has been suggested for the Roman period in neighbouring Switzerland (Deschler-Erb, 2001). Likewise, in the area of Perchtoldsdorf, situated just south of Vienna, which has been continuously populated since the Early Neolithic, bear remains have been found in five archaeological sites dating from the Neolithic, Iron Age and Early and Late Roman periods.

Altogether, 15 localities in Austria are known to have yielded 5 or more identified bone fragments (NISP > 5) of *Ursus arctos* (Figs. 2 and 3). Apart from a Middle Neolithic circular ditch, all belong to some type of settlement structure. As some sites were excavated in the early twentieth century or even earlier, the quality of the materials and the character of the resulting publications differ markedly and context information is rarely provided for the assemblages. In several of the settlements, the bone material could not be attributed to defined features and, as a consequence, the bone samples could not be categorised into context groups and were treated as one assemblage. The collections from the lakeside dwelling Mondsee yielded the largest samples. They resulted from underwater surveys or were dredged from the lake bottom but appeared, nevertheless, suited for further analysis, including small fragments and broken specimens (Pucher & Engl, 1997, Wolff, 1977; Fig. 4).

Considered chronologically, the majority of the bear material from the 15 Austrian sites discussed can be attributed, in roughly equal amounts to either Neolithic or Roman sites (c. 200 identified bone specimens within each category).

Site	Period	Type	Mammals	Wild Mammals		Brown Bear				source
			n	n	% total	n	% total	n corr.	% wild	
Ölkam	Middle Neolithic	circular ditch	3462	3145	90,8	15	0,4	15	0,5	Schmitzberger 2001
Melk-Winden	Middle Neolithic	rural	2204	1478	67,1	5	0,2	5	0,3	Pucher 2004
Mondsee 1	Late Neolithic	lakeside	8688	3341	38,5	108	1,2	108	3,2	Wolff 1977
Mondsee 2	Late Neolithic	lakeside	5094	1514	29,7	47	0,9	47	3,1	Pucher & Engl 1997
Keutschach	Late Neolithic	lakeside	838	599	71,5	14	1,7	14	2,3	Pucher 2003
Götschenberg	Late Neolithic	hilltop	1695	322	19,0	7	0,4	7	2,2	Peters 1992
Buhuberg	Bronze Age	rural	1738	305	17,5	8	0,5	8	2,6	Pucher 1996
Magdalensberg	Early Roman	urban/hilltop	59526	3215	5,4	87	0,1	87	2,7	Hornberger 1970, Ehret 1964
Gerasdorf	Early Roman	?	82	45	54,9	7	8,5	7	15,6	Kunst, unpublished
Traismauer	Roman	vicus	12607	162	1,3	15	0,1	13	8,0	Riedel 1993
Virunum	Roman	urban/theatre	3461	255	7,4	89	1,5	48	18,8	Galik 2004
Hemmaberg	Late Roman	sanctuary	7734	202	2,6	10	0,1	10	5,0	Gaggl 1996
Perchtoldsdorf	Late Roman	rural	150	14	9,3	6	4,0	1	7,1	Kunst 2005
Sand	Early Medieval	hilltop	3137	1293	41,2	16	0,2	16	1,2	Pucher & Schmitzberger 1999
Thunau	Early Medieval	hilltop	2672	330	12,4	23	0,9	23	7,0	Kanelutti 1990, 1993

Fig. 2: Austrian archaeological sites with >5 brown bear remains (NISP); n corr.: reduced number for samples with articulated units; Middle Neolithic c. 4700-4000 BC; Late Neolithic c. 4000-2000 BC; Bronze Age 2000-750 BC; Early Roman (here) c. 50 BC – 70 AD; Roman 15 BC – 476 AD; Late Roman 378-476 AD; Early Medieval (here) c. 600-1000 AD.

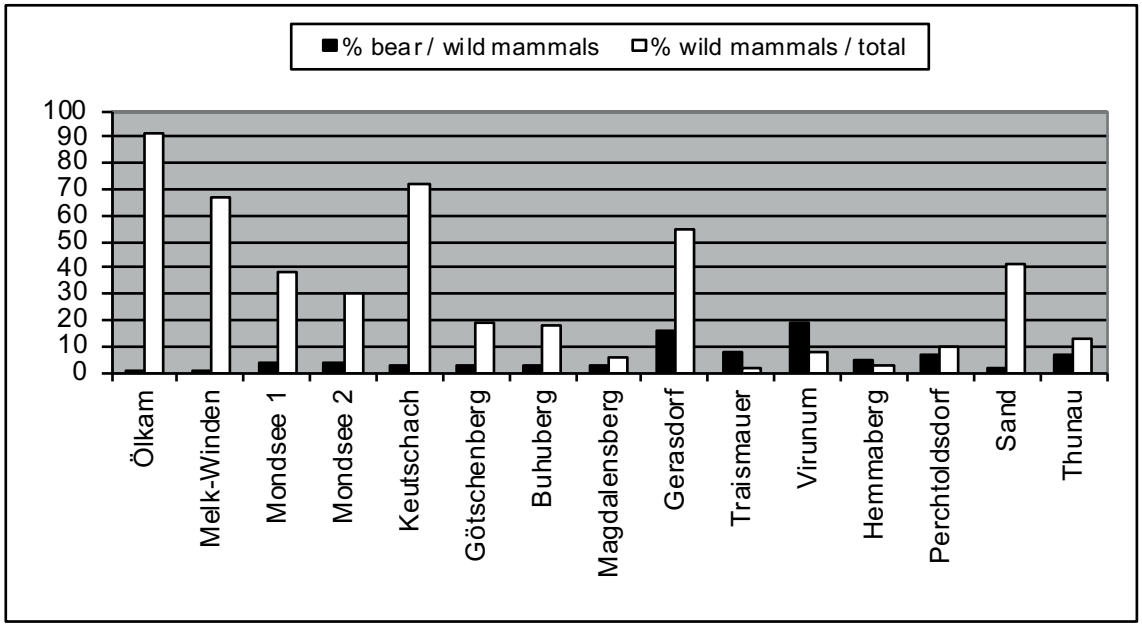

Fig. 3: percentages of bears/wild mammals and of wild mammals/total mammals for sites mentioned in Fig. 2.

Although this may be partly linked to the fact that these two periods have received most scholarly attention and often yield large samples, this abundance evidently reflects human behaviour as well. In the case of the Roman material, the large number may also be attributed to the occurrence of articulated units and the bear assemblages exhibit more signs of patterning as well (Fig. 5). A third, smaller, 'peak' in sample sizes can be found for the two Early Medieval hilltop settlements.
The total number of bear remains used for this study, either from the literature or inspected individually, amounted to a reduced (taking account of the articulated bones) NISP of 425 from the collections, including smaller samples which contained less than five bear bones. Compared with the main domesticates and other wild mammals, such as hare and red deer, the brown bear can be regarded as a rare, but consistently appearing element of faunal materials from Austria. At two sites, Perchtoldsdorf-Aspetten (Middle Neolithic) and Prellenkirchen (La-Tène), human engagements with the remains of brown bear is evidenced through the recovery of a bone tool and an ornamental worked claw bone, respectively (Kunst, 2005, Karwowski, 2010). The faunal record for the Mesolithic is, in contrast, rather poorly known in Austria, and no comparisons regarding the importance of the brown bear in pre-agricultural societies can therefore be drawn.

Bone samples and the human-bear relationship

The primary question for this study can be defined as follows: what can a 'rare' species tell us about human-animal interactions from an archaeozoological viewpoint? Studies of large bone assemblages are the most revealing in this respect. For instance, in the Germanic settlement of Bernhardsthal (c. second and third centuries AD; Riedel, 1996), two bear bones, a fragmented radius and an ulna, were recovered and these two specimens make up c. 0.01% of the whole sample, which numbered nearly 8000 identified remains. These bear fragments exhibit some taphonomical modifications, such as abrasion and carnivore damage, and contribute little historical information other than extending the species list. Their very occurrence may simply be a 'side-effect' of the overall large faunal assemblage from this locality. At the other extreme, the 47 brown bear specimens from the excavations of the Late Neolithic site of Mondsee (Pucher & Engl, 1997), which included some complete long bones, has been most informative, revealing data on age and skeletal part distribution, osteometrics, and bone modifications (Fig. 4). Some clues regarding human consumption and disposal behaviour regarding this species could therefore be obtained. In some cases, however, a small number of specimens provided certain insights as well. Examples include the partly connected, heavily butchered elements of a forelimb from Perchtoldsdorf-Aspetten (Kunst, 2005) and several instances where bear remains appear as grave-goods or artefacts (see according chapters below).
When examining the literature and some of the material, the criteria listed below appeared to be most relevant in characterizing the bear bone samples. In general, they did not differ from ordinary procedures in faunal analysis, but some were particularly useful for the present study (Fig. 6), while others played

only a minor role. For example, metric variation was found to be great, even within the same materials (e.g. Mondsee and Magdalensberg; Hornberger, 1970, cf. Pucher & Engl, 1997, Wolff, 1977). This feature is common in bears but was not thought to be important for the present investigation regarding human-bear interaction.

Fig. 4: overview of the brown bear remains from the Neolithic lakeside dwelling Mondsee, recent excavations (Natural History Museum Vienna, Archaeozoological Collection).

Absolute and relative frequency

It must be kept in mind that the different assemblages are not comparable in terms of the excavation and recovery techniques and overall numbers. However, what is noteworthy is the frequency of other wild mammals within the assemblages, especially the occurrence of other large carnivores (e.g. wolf and lynx).

Age structure

Occurrences of juvenile (infant) and sub-adult individuals were noted. As the brown bear reaches full

skeletal maturity at a comparatively late age, bones with incompletely fused epiphyses are frequent.

1. **Skeletal part distribution**

Any over-representation of certain body parts or elements may provide clues regarding human interactions with the carcass. If three bones out of a sample of eight are claws, this is not a major trend in a statistical sense, but it is nevertheless an important observation.

2. **Articulated units or bones from the same individual**

In rare species, it is easier to check an assemblage for articulating bones, an occlusal fit of tooth rows or matching pairs of symmetric elements; sometimes, articulated units are in fact reported by the excavator.

3. **Butchery marks**

Cut and chop marks provide immediate evidence of carcass treatment. In many situations, particular types of procedure (e.g. skinning and dismemberment) can be reconstructed.

4. **Special modifications**

Bones may display anthropogenic manipulation other than that related to butchering, such as manipulation into artefacts, unfinished objects and any bones exhibiting wear or polish. Within this group of criteria, two aspects deserve particular attention in the case of bears: the presence of claw bones or other elements with traces of heat influence; and the use of canine teeth, including their possible intentional extraction from the skull and mandible.

5. **Pathological conditions**

Pathological conditions, such as exostoses or dental diseases, were worth noting.

Faunal samples with bear remains

The following overview of Austrian faunal assemblages containing brown bear remains, grouped by archaeological periods, is certainly incomplete, but contains all the published and unpublished post-Mesolithic occurrences of *Ursus arctos* within archaeological contexts known to the authors. The abbreviations ‘LA’ and ‘UA’ stand for Lower Austria and Upper Austria respectively.

The Neolithic

Bear remains were present in the settlement debris from the Early Neolithic site of Franzhausen (LA; Lenneis, 1995). In this period, wild species are often poorly represented in archaeological assemblages. For the Middle Neolithic (the ‘Lengyel Culture’), the single-context site at Melk-Winden (LA; Pucher, 2004) and the circular ditch at Ölkam (UA; Schmitzberger, 2001) produced a few specimens. The species is also represented in a similar ditch context at Perchtoldsdorf (LA; Kunst, 2005). As already mentioned, important materials have been collected from Late Neolithic lakeside dwellings, now all submerged, particularly from a number of sites at Mondsee (UA; Pucher & Engl, 1997; Wolff, 1977) and from Lake Keutschach (Carinthia; Pucher, 2003). From the contempora-

neous hilltop settlements at Götschenberg (Salzburg; Peters, 1992) and Ertl (Schweighofer Mauer, LA; Maurer, 2011, 2014), there were seven bear bones and two worked bear teeth, respectively.

The Bronze Age

There are no large samples of brown bear from this period in the study area. Hence, the Early Bronze Age settlement at Buhuberg (LA; Pucher, 1996), which produced eight bones, may be regarded as an important site in this respect. The Early Bronze Age site Unterhautzenthal (LA; Pucher, 2001), and the two Late Bronze Age (Urnfield period) fortified settlements, Thunau (LA; Kanelutti, 1993) and Stillfried (LA; Pucher, 1982), yielded less than five bear bones per site. Regarding the inner Alpine area, the recently published Middle Bronze Age site of Saalfelden-Katzentauern (Salzburg; Pucher, 2019; not indicated in the map), which produced a single bear remain, has to be added.

The Iron Age

In this period, *Ursus* is also only occasionally present in archaeological assemblages. The species occurred in small number at the Hallstatt period hilltop settlements of Gurina and Gracarca (both Carinthia; Galik, 1998), Burgstallkogel (Styria; Peters & Smolnik 1994) and Leopoldsberg (Vienna; Kunst, unpublished), at the Celtic salt miners' occupation site of Dürrnberg (Salzburg; Pucher, 1999; Schmitzberger, 2012) and at the lowland late Hallstatt period settlement of Perchtoldsdorf (LA; Talaa, 1993, Christandl, 1998). Another lowland, but La-Tène period site, Prellenkirchen, produced a single worked clawbone (LA; Karwowski, 2010). The apparent absence of the species from other Iron Age lowland settlements of the area (LA: Göttlesbrunn, Roseldorf) is otherwise remarkable. A concentration of burnt bear bones from the Hallstatt period cremation cemetery Führholz (Carinthia) contained two middle phalanges (Kanelutti in Renhart, 1990).

The Roman period

Regarding context types and configuration of the skeletal assemblages, this period is the most diverse of all; it also includes the greatest number of sites with bear remains. Bernhardsthal, the only site outside the Roman Empire, and north of the Danube, has been described above. From the Early Roman period, the small bone assemblage from the rural context of Gerasdorf/Steinfeld (LA; Kunst, unpublished) and the Late La-Tène/Roman town on the Magdalensberg (Carinthia; Ehret, 1964, Hornberger, 1970), were both rich in bear remains, but represent very different archaeological situations. Parts of the latter site were excavated in the middle of the twentieth century, and Ehret (1964) mentions the possible occurrence of infantile bear bones within a ritual context, being deposited inside an urn. Later, more 'typical', Roman sites contained large bone collections, such as the *vicus* of Traismauer/Augustiana (LA; Riedel, 1993), which produced 15 bear remains, with some deriving from the same individuals.

The species was also present at other sites along the Danubian Limes, such as at the civilian sett-

lements of Mautern/Favianis (LA; Kunst, 2006), Pöchlarn/Arelape (LA; Hofer, pers. comm.) and Lorch/Lauriacum (UA; Müller, 1967, Böhm, pers. comm.). In the town of Carnuntum, ten, possibly connected, remains were recovered from rubble layers underlying a street pavement.

Fig. 5: overview of the brown bear remains from the Roman vicus of Traismauer (Natural History Museum Vienna, Archaeozoological Collection).

The only well stratified item, a metapodial bone, is from a restoration layer dating to the second century AD (Radbauer & Humer, 2004). More recently, bear remains were identified from further contexts of the civil town of Carnuntum (baths, house II: Kirchengast, pers. comm.), and from a pit within the sanctuary of Jupiter Heliopolitanus (Gál, pers. comm.). The most peculiar

Roman period bear assemblages, however, were collected from debris in the area of the amphitheatre of Virunum (Carinthia; Galik, 2004, Gostenčnik, 2008). It comprises more than 50 specimens, mainly attributable to articulated units or residual skeletons. Elements of an articulated unit were also found within a Late Roman settlement structure from Perchtoldsdorf (LA; Kunst, 2005), and a first century AD pit from an earlier phase of the same settlement produced a single bone. Another Late Roman site, the Early Christian sanctuary Hemmaberg (Carinthia; Gaggl, 1996), yielded a moderate number of bear remains. A bear skull was reported from layers dating to the second - third century AD from the Roman town of Aguntum (East Tyrol). It was interpreted as a sacrifice or an apotropaic device by the excavator (Kofler, 1979).

Although the number of Roman sites studied archaeozoologically in Austria is far smaller than in neighbouring Switzerland, and the state of research is, therefore, not strictly comparable, the percentage of Roman sites with bear remains appears higher in Austria. In Switzerland, less than 5% of all bone assemblages from this period yielded bear bones (Schibler et al., 2002).

site	skeletal parts overrepresented	articulated units	mark types	tools	burnt claws	pathologies	juveniles & subadults	other Carnivores		
								wolf	lynx	n other species
Ölkam	balanced, few autopodials		?	+				+		3
Melk-Winden	long bones		?cut				+		+	4
Mondsee 1	isolated teeth, front leg, autopodium		perforation, cut	+	+	+	+	+	+	6
Mondsee 2	balanced; limbs		?	+	+		+		+	5
Keutschach	limbs	+	cut, ?chop	?					+	4
Götschenberg										
Buhuberg	autopodium, clawbone		cut, polish	?	+			+	+	
Magdalensberg			?				+			5
Gerasdorf	forelimb		cut				+			
Traismauer	skull, mandible	+	cut			+	+	+		1
Virunum	balanced?	+	cut, chop			+	?	?		1
Carnuntum	balanced	+	chop				+			
Hemmaberg	balanced		many; type?				+			
Perchtoldsdorf	hindlimb	+	cut, chop							1
Sand	balanced		cut, chop	?	+					4
Thunau	skull; balanced		cut, chop, sawn	+		+	+	+		

Fig. 6: archaeological sites with >5 brown bear remains, showing additional features of bear remains and associated carnivore species.

Medieval

The only noteworthy medieval assemblages are from two similar sites from the same area in northern Austria. One is the Early Medieval hilltop settlements of Thunau (LA; Kanelutti, 1993) and the other is the settlement Sand/Oberpfaffendorf (LA; Pucher & Schmitzberger, 1999). The sites were regional centres and both were destroyed in the tenth century AD. The High and Late Medieval records are surprisingly poor in bear remains. Thurnschall Castle (Salzburg; Zohmann, 2005), Villach (Carinthia; Galik, pers. comm.) and a motte-and-bailey at Gaiselberg (LA; Spitzenberger, 1983) are the only sites which have produced brown bear bone specimens. This may reflect local extinctions of the species, as well as other issues, which led to a decline in brown bear populations in this period. It must be stated, however, that these later periods, as well as the post-Medieval period, are insufficiently studied.

The characteristics of the different assemblages will now be discussed in terms of the criteria outlined above (Fig. 6). It will become evident that some of the criteria work only on the scale of large assem

blages, and are not always applicable to small samples, where they may nevertheless exhibit some kind of patterning.

Absolute and relative frequency of material

In Figure 2, the absolute and relative specimen counts are given for assemblages with at least five bear remains. Carnuntum had to be omitted because overall faunal data were lacking and the Mondsee material was divided into old (Mondsee 1; Wolff, 1977) and new (Mondsee 2; Pucher & Engl, 1997) elements. For Virunum, Traismauer and Perchtoldsdorf, the presence of articulated units was demonstrated and a reduced specimen number was used for further calculations, counting associated units as single specimens. Again, it must be remembered that the materials from the various sites differ markedly, not only in terms of overall numbers, but also in terms of archaeological context. For example, some sites are represented by a single context only (e.g. Melk-Winden, Gerasdorf) while others contain a complex stratigraphy, and some of the assemblages (e.g. from Magdalensberg) were collected over the course of many years of excavation. The percentage of bear remains varies from between 0.1% and 8.5% of the total mammal material and between 0.3% and 18.8% of the wild mammals (the maximum values were displayed in the samples from Gerasdorf and Virunum, respectively). The correlation between overall wild mammal percentages and the role of bears among the wild species is shown in Figure 3. Generally, Central European sites with important relative amounts of wild species are confined to older prehistory, especially to certain Neolithic periods or cultures (Pucher, 2004, Benecke, 1994), although it is difficult to recognize a uniform trend. Furthermore, the trends shown in Figures 2 and 3 may be somewhat biased, as only bone assemblages containing bear remains were included in this study. Regarding more recent periods, Gerasdorf is a small sample from the first century AD and probably contains specialized hunter's refuse, and Sand has been defined as a high-status site with a rather diverse wild fauna assemblage (Pucher & Schmitzberger, 1999, Saliari & Felgenhauer-Schmiedt, 2017). It appears that high bear frequencies among wild species are not linked to high values for game in general (Fig. 3), as Ölkam and Melk-Winden produced particularly low values for bears. In Neolithic and Bronze Age assemblages, the maximum values for bears among the wild species were slightly higher than 3% (Mondsee 1), being somewhat lower in four other sites. It is only in the Roman and Early Medieval periods that higher percentages are reached. Among the richer materials (excluding Gerasdorf and Perchtoldsdorf), Virunum produced the highest figures (18.8%), followed by Traismauer, Thunau and Hemmaberg (8-5%). Magdalensberg displayed equally low figures for both wild species and bears. Ironically, the game-rich assemblage from Sand produced the lowest percentage of bear remains out of all the early historic sites considered. As for its prehistoric counterparts (Ölkam, Melk-Winden and Keutschach), this pattern was caused by the high amount of artiodactyls, mainly red deer, remains. In Sand, there was also a large percentage of European bison. It therefore appears that societies relying to a greater extent on wild animals, or

engaging in prestige hunting, accumulate greater amounts of wild herbivore bones in their domestic refuse, causing low values of rarer elements, such as bears. On the other hand, the hunting of wild artiodactyls plays a less important role in most of the Roman sites and in Thunau, allowing bears, possibly also acquired for other reasons, to reach higher relative percentages. Bear or bear products may have been held in higher esteem in these latter sites for various reasons. Possible explanations include bears being held as captive animals (Virunum, Thunau) or being consumed in greater quantities due to a preference for bear hide and meat (Traismauer, Perchtoldsdorf). For example, in Thunau, the remains of three individuals were found within one single context (Kanelutti, 1990), and two incomplete skeletons were associated in Virunum (Gostenčnik, 2008). In most of the prehistoric assemblages, the bear bones were accompanied by the remains of wolf or lynx, or both of these species, often occurring together with smaller carnivores (e.g. red fox, wild cat and various mustelids). There is far less regularity concerning the simultaneous appearance of these species in the Early Historic sites, again pointing towards a more specific role of the bear in these later periods.

Age distribution

Given the rather long adolescence in bears, sub-adult bone specimens with unfused epiphyses are a common feature in most of the richer assemblages (Fig. 6), with Keutschach and Sand being the only possible exceptions. The presence of actual bear cubs or of individuals in their first year, however, is only mentioned for Magdalensberg (Ehret, 1964, Hornberger, 1970), Virunum (Gostenčnik, 2008) and Early Medieval Thunau (Kanelutti, 1990). According to Wolff (1977), 'young' animals account for one-fourth of the total sample from Mondsee.

Skeletal part representation

The prehistoric period

Among the large prehistoric assemblages assessed by the authors, the sample from the Late Neolithic site of Mondsee, stored at the Natural History Museum (Pucher & Engl, 1997), appears to be relatively balanced, in that all body parts are represented, although a prevalence of long bones is indicated. The relative scarcity of vertebrae and ribs is possibly explained as a result of taphonomical loss; a common feature in many archaeological bone samples. In comparison with other sites, head elements appear slightly underrepresented. Judging from the literature, the opposite is true for the material from the older excavations, where isolated teeth account for almost half of the 106 remains (Wolff, 1977). However, long bones, mainly from the front leg, and distal limb parts, figure prominently as well. The sample from the other lakeside dwelling, Keutschach, very much resembles Mondsee in its state of preservation, but is almost entirely built up of greater parts of long bones and metapodials. The material from Ölkam comprises skull and axial elements and long bones, but is almost devoid of

autopodial elements. Among the smaller prehistoric samples, some patterning is recognizable in the Middle Neolithic assemblage from Melk-Winden, where there is a prevalence of proximal, potentially meat-bearing, leg parts, and also in the Bronze Age assemblage from Buhuberg, where autopodial elements, especially clawbones (three out of a total of eight bones) prevail. In Götschenberg, more than half of the remains are from the distal limbs. There is a marked difference in average fragment size between the 'protective' lake sediments, where even complete long bones occur, and settlement sites, where the influence of taphonomic processes is more strongly felt.

The Roman period

Judging from the literature (Ehret, 1964, Hornberger, 1970), the material from the Iron Age/Early Roman site of Magdalensberg appears to be relatively balanced, although there is some emphasis on the head parts and the forelimb, and the vertebral column is entirely absent from the assemblage. In Traismauer (Fig. 5), skull and mandible fragments dominate the assemblage; the remaining bones consist of proximal and distal limb elements. Some elements are connected, consisting of articulated units, and this phenomenon is discussed further below along with the remains from Virunum, Perchtoldsdorf and Carnuntum. For the remaining Roman samples, a trend can be observed in Gerasdorf, where five out of the seven bear remains consist of long bone fragments from the (lower) forelimb. It must be remembered, however, that in ursids, certain long bone shafts, such as the radius and ulna, are still well recognizable when in a broken condition, more so than other elements or in other species, and this may explain the good representation of these skeletal parts within several samples.

The Medieval period

The Early Medieval assemblage from Sand comprises, apart from a rib fragment, mandibles and isolated teeth, meat-bearing limb bones, and autopodials in almost equal portions. Whereas the autopodials (three consist of phalanges) are complete, the other remains are fragmented or butchered. A very similar distribution of body regions was observed in the assemblage from Thunau, although in this instance, there were also largely complete skull parts (Kanelutti, 1993, Böhm & Kunst, 2007) and the axial skeleton was not recorded. The Late Medieval sample from Gaiselberg is unique as it only comprises three rib fragments.

Articulated anatomical units and bones from the same individual

It seems likely that some metacarpals from Keutschach belong to the same paw, indicating little skeletal dispersal after disposal. Articulated bone groups are more frequent in the Roman materials, and examples of anatomical units exist in the assemblages from Virunum, Traismauer, Perchtoldsdorf and probably also from Carnuntum. Galik (2004) describes three different sets of articulated elements in

the Virunum assemblage. These were documented by the excavators and comprise the following sets: one cervical and thoracic vertebral column with an associated pair of mandibles; one partial cervical column and the residual of a skeleton made up of ribs; one humerus and the pelvis. A similar situation was found in the backfill of a water supply system beneath a city street in Carnuntum, although this unit exhibits some traces of butchering. Eleven bones (vertebrae, ribs, a near-complete scapula, femur with proximal epiphysis, various autopodial elements) were found associated within the same structure. These bones presumably belong to a single sub-adult individual, being compatible in size and ontogenetic developmental stage and forming the only bear remains within this excavation trench. A similar interpretation may be offered for a set of six, partially butchered, elements from a left hindlimb (femur, two tarsals, two metatarsals, proximal phalanx) which were recovered within a Late Roman pit from Perchtoldsdorf (Kunst, 2005). In this instance, direct re-articulation was possible among some of the autopodial elements. In the vicus of Traismauer, a maxilla fragment and a pair of mandibles with most of the dentition in place could be reassembled (Fig. 7). A special case of refitting was reported from the Neolithic site of Ölkam (Schmitzberger, 2001). Here, two fragments of the same bear humerus were found to be matching, and these parts were deposited in the concentric inner and outer circular ditches of the system, possibly demonstrating the contemporaneity of the ditch fills. Bears are not represented among the spectacular Late Bronze Age depositions of wild mammals at Stillfried, which mainly comprise skeletons of red deer and wolf (e.g. Pucher, 2017).

Anthropogenic marks and human activities

Anthropogenic bone modifications may be considered as primary evidence of carcass treatment. Marks concerning the processing of carcasses, as well as the production of tools and other artefacts, are discussed in this chapter. According to an analysis of the literature and to the personal experience of the authors, the presence of human marks on bear bones appears to be a widespread phenomenon. Even in small sample sets, bone modifications can usually be observed (e.g. Gulde, 1985, Zeiler, 1997). Therefore, for the present study, a considerable amount of data, not necessarily mentioned in detail in the respective reports, could be collected from the accessible samples. Some of these marks may be partly caused by certain constraints imposed by the anatomy of a bear carcass. Firstly, in comparison with most similar-sized ungulates, the muscle mass is more evenly distributed along the extremities and hence bone modifications should be expected equally on all limb bones. Secondly, some body parts, such as claws, hide, and teeth are often held in high esteem, and their removal and processing is frequently accompanied by specific marks. Even without experimental testing, the characters of the cut and chop marks are usually self-explanatory and interpreted as evidence for particular activities, such as disarticulation, filetting or skinning.

The prehistoric period: marks related to carcass treatment

Among the Neolithic and Bronze Age materials, the remains from the lakeside dwellings at Mondsee 2 (Pucher & Engl, 1997) and Keutschach (Pucher, 2003) were analysed and the study proved very revealing; Mondsee 2 yielded 15 modified specimens (32% of the bear sample) and Keutschach yielded 7 (50% of the bear sample). The modifications found were, almost exclusively, cut marks inflicted with stone tools. Usually, the cut marks occurred as dense groups of short parallel grooves (Fig. 8), but cut marks were also sometimes loosely scattered across the bone surfaces. At Mondsee, such marks were found on the zygomatic arch of a skull fragment, laterally on a mandible corpus, on the cranial articular area of a lumbar vertebra and on the corpora of two ribs. All other modified elements were limb bones (scapula, two ulnae, three radii, tibia, two metapodials and a proximal phalanx). These marks imply a range of activities, but most appear to be related to butchery (e.g. disarticulation and filetting). The potential skinning marks appear on the skull, mandible, phalanx and possibly on the metapodials, but these latter modifications are mostly on the proximal parts and point, instead, at a dissection of the hand and feet for culinary purposes. On a distal juvenile tibia and a complete adult radius, three and four discrete clusters of cut marks were observed, indicating intense butchering activities at these spots (Fig. 9). In the case of the radius, the modifications left the bones relatively intact and the marks were located close to the proximal articulation (Fig. 8) or coincided with areas possessing muscle attachments, as indicated by Davis (1964) for *Ailuropoda*.

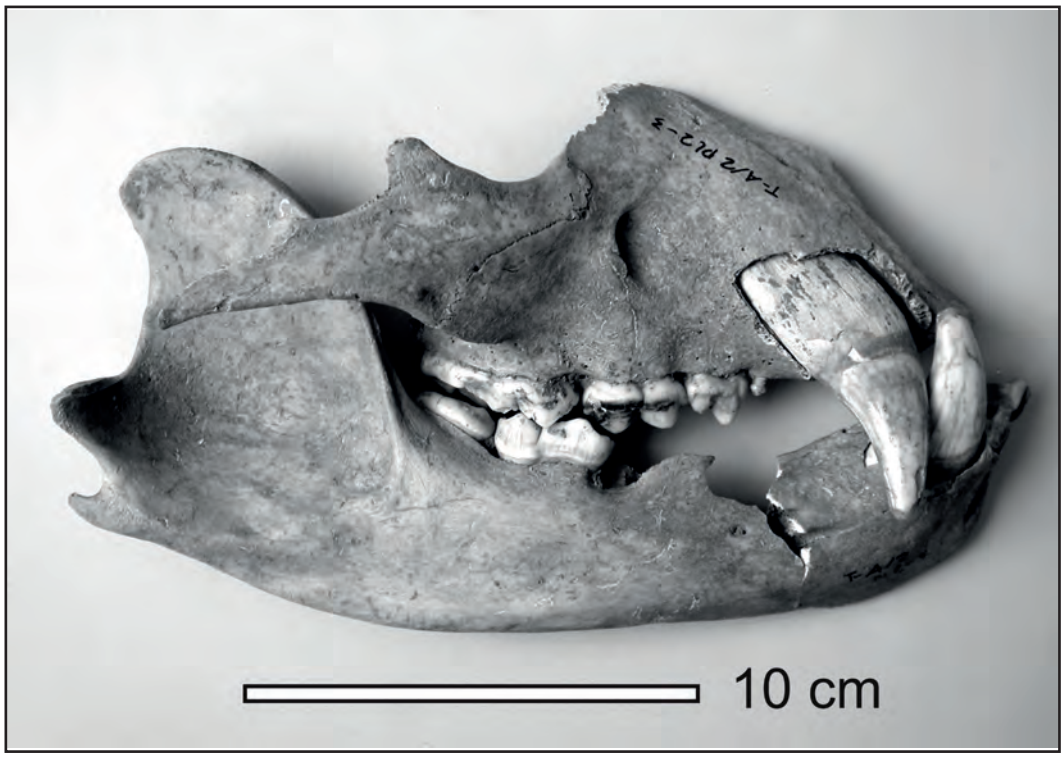

Fig. 7: re-assembled skull and mandible of brown bear from the Roman vicus of Traismauer (Natural History Museum Vienna, Archaeozoological Collection).

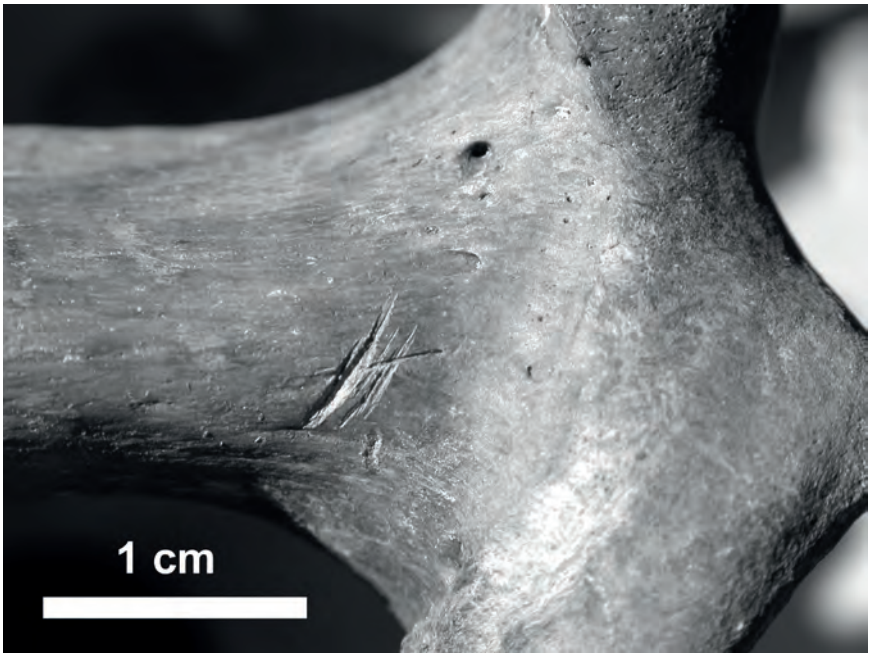

Fig. 8: tightly clustered group of cut marks on a right radius of brown bear from Mondsee, medio-proximal end (Inv.Nr. MS 29/J, Natural History Museum Vienna, Archaeozoological Collection).

There was one more complete radius and one radius diaphysis with cut marks from Mondsee, and another complete specimen with two sets of traces from Keutschach.

Jéquier (1963), Wolff (1977) and Pucher & Engl (1997) have observed that bear bones from lakeside dwellings are generally less fragmented than bones from large artiodactyls (see also Fig. 4). If the bones were incorporated within consumption activities, it is possible that bear long bones were not fractured for marrow, as allegedly these bones contain limited quantities of bone marrow which are difficult to access (Jéquier, 1963). It is also tempting to argue that bear bones were left intact deliberately, possibly due to some cosmological scheme, as this behaviour has been observed in recent Siberian hunter-gatherer groups (e.g. Jordan, 2003). Whatever the reason, the fact that long bones may survive intact seems the most noteworthy observation regarding the processing of bear bones at the lakeside dwellings of Mondsee and Keutschach. The pattern of cut marks found in Keutschach strongly follows the situation in Mondsee, although at the former site there is one modification on a pelvic bone which resembles a chop mark. Because of the skeletal part representation, the locations of the marks are completely restricted to the articular areas and shafts of long bones and also to distal metacarpals, indicating butchering and possibly skinning.
Modification patterns are not so clear in the remaining early prehistoric samples, and only shallow striations were observed on some of the bones from the Middle Neolithic site at Melk-Winden and the Early Bronze Age site at Buhuberg. It is only in the Late Bronze Age that unequivocal cut marks become apparent once again, such as on the material from Stillfried.

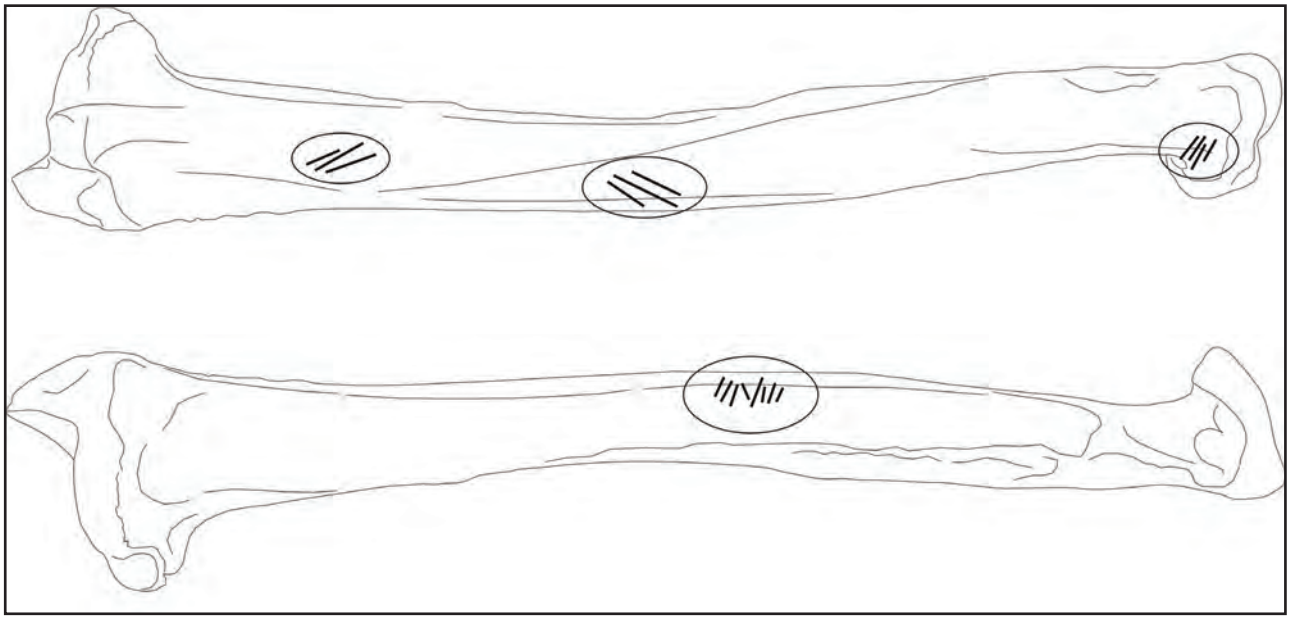

Fig. 9: distribution of cut marks on a right radius of a brown bear from Mondsee: top; dorsal view, bottom; palmar view (Inv.Nr. MS 29/J, Natural History Museum Vienna, Archaeozoological Collection).

In this case, the marks were clearly inflicted by metal, i.e. bronze, blades. A sequence of fine cut marks was observed on the body of a rib and proximally on an ulna, the diaphysis of which was chopped through distally. These marks represent the earliest observation of two-step butchering, involving different types of action and, possibly, tools, on a single bear bone.

The Roman period: marks related to carcass treatment

Anthropogenic modifications were present in all Roman materials analysed in this study and, with the exception of Magdalensberg, observations of cut marks are frequently reported in the publications. In Traismauer, 9 out of 15 remains show traces in the form of knife cuts. For the skulls and mandibles, fine and short cut marks were found on the zygomatic arch, and, in particular, in the snout area of both the upper and lower jaws. Such marks were exhibited on all three elements of the re-articulated, young adult skull fragment described above, comprising the right maxilla and mandibles. Another maxilla possessed a set of long cut lines which ran parallel to the border of the maxillary and the nasal bone. It therefore appears that the patterns on the skulls and mandibles indicate a skinning procedure carried out by a skilled butcher. Taking into account the fineness of the lines, which were often almost invisible to the naked eye, it would appear that people engaging in skinning activities at this time were eager to avoid any unnecessary contact between the knife and the bone, possibly to avoid dulling the blade. Given the rostral position of the cuts in the first individual, it appears that a major aim was to remove the skin as complete as possible. There are no signs of deliberate dissection of skulls and mandibles from one another and most teeth were left in place.

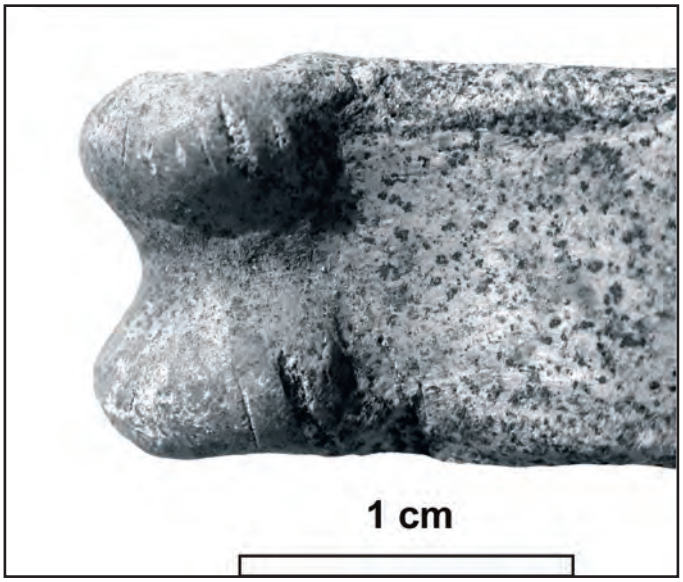

Fig. 10: proximal phalanx of brown bear, distal part in plantar view, with cut marks on distal articulation; Roman vicus of Traismauer (Natural History Museum Vienna, Archaeozoological Collection).

Fig. 11: left femur of brown bear, proximal view, chop marks on femoral neck (left) and greater trochanter (right); Perchtoldsdorf-Aspetten, Late Roman period. Scale in cm

A dense cluster of transversally running cut marks on the palmar/plantar side of a distal articulation of a proximal phalanx points at the disarticulation of the proximal interphalangeal joint, also produced during the skinning process (Fig. 10). The other marks observed in the sample from Traismauer appear more related to butchering, e.g. to the severing of the scapula from the rib cage, and to the filetting of meat along the femoral shaft area. It would appear that knives were the only tools employed in the processing of bear carcasses at Traismauer. A similar pattern is evident at the first century AD site at Gerasdorf, where a cut mark on a radius was the only one observed in the collection. The range of marks and their locations found among the red deer bones from the same site, including both cut and chop marks, suggest a versatile attitude to the processing of the carcasses of other wild mammals.
Two different types of cut marks could be discerned on two preserved elements of a left hindlimb

from the Late Roman site at Perchtoldsdorf. On the proximal femur, the greater trochanter and caput were severed from the rest of the bone by several heavy blows (Fig. 11), indicating dismemberment. The implement involved was probably a chopping tool with a heavy blade, an instrument which was commonly used in Roman butchery. Moving to the distal elements of the limb, on the proximal phalanx of the first digit, there are very fine, parallel cut marks running diagonally on the plantar side and on the distal articulation. They are probably related to either skinning or slicing flesh off the paw area by using a knife. These two sets of marks, generated in the course of processing a single carcass, were interpreted as elements of an operational sequence (chaîne opératoire; KUNST, 2005). This type of two-step butchering, involving two different types of tools, is common in Roman butchery, particularly of larger domestic species, such as cattle.

The associated bear bones from the Carnuntum sewer, which included an almost complete scapula, are devoid of modifications except for one femur fragment. This latter piece received several chop marks on its diaphysis, which would eventually lead to its breakage at midshaft. This pattern is not easily explained, apparently most of the bones of this putative skeleton have been lost.

GALIK (2004) reports that many bear bones from Virunum exhibit chop and cut marks which indicate systematized disarticulation and the consumption of bear meat. At Hemmaberg, 6 out of 10 remains displayed signs of butchering (GAGGL, 1996).

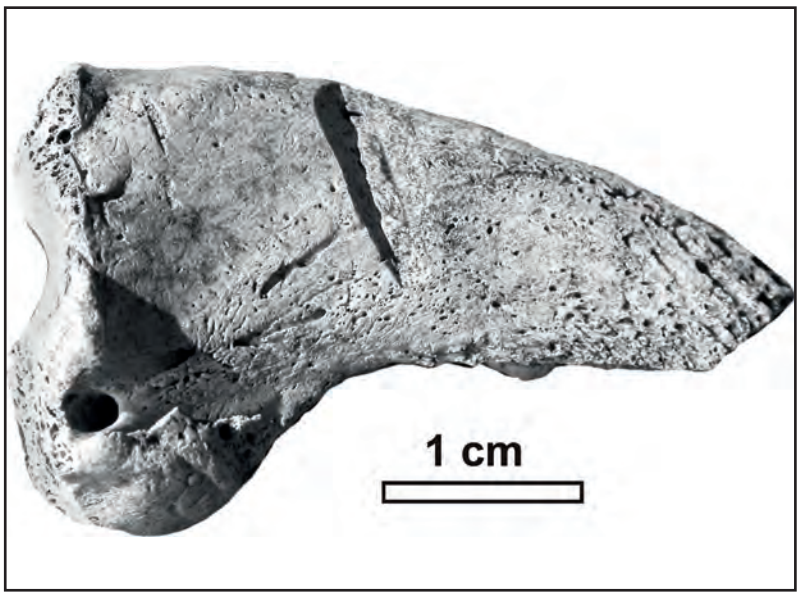

Fig. 12: distal phalanx (claw bone) of brown bear with chop marks; Sand/Oberpfaffendorf, Early Medieval (Natural History Museum Vienna, Archaeozoological Collection).

Therefore, in Roman bear processing, three combinations of butchering marks can be observed: cut marks; chop marks (e.g. Carnuntum); and a combination of these two categories. It must be noted that the presence of certain marks is doubtlessly also related to skeletal part representation. In most cases, the processing of a bear carcass may have been an exceptional event, thus lacking a defined 'butchering tradition' as, e.g. in cattle.

The Medieval period: marks related to carcass treatment

The two Early Medieval hilltop settlements Sand and Thunau provide a wide array of anthropogenic marks allowing for a range of processes to be reconstructed. In Sand, half of the remains are modified, mostly by cut marks. The modified bones are all from the limbs, comprising both proximal and distal elements and indicating different human actions. Knife cuts suggest the severance of articular areas and bones from one another (scapula from thorax, elbow joint). Once again, the presence of very fine and short knife cuts in the autopodial area (corpus of metacarpal, os pisiforme) cannot be interpreted easily, although it may be related to the skinning or butchering of the paws. One of the claw bones displayed a deep cut or chop mark which may possibly result from this practice (Fig. 12).

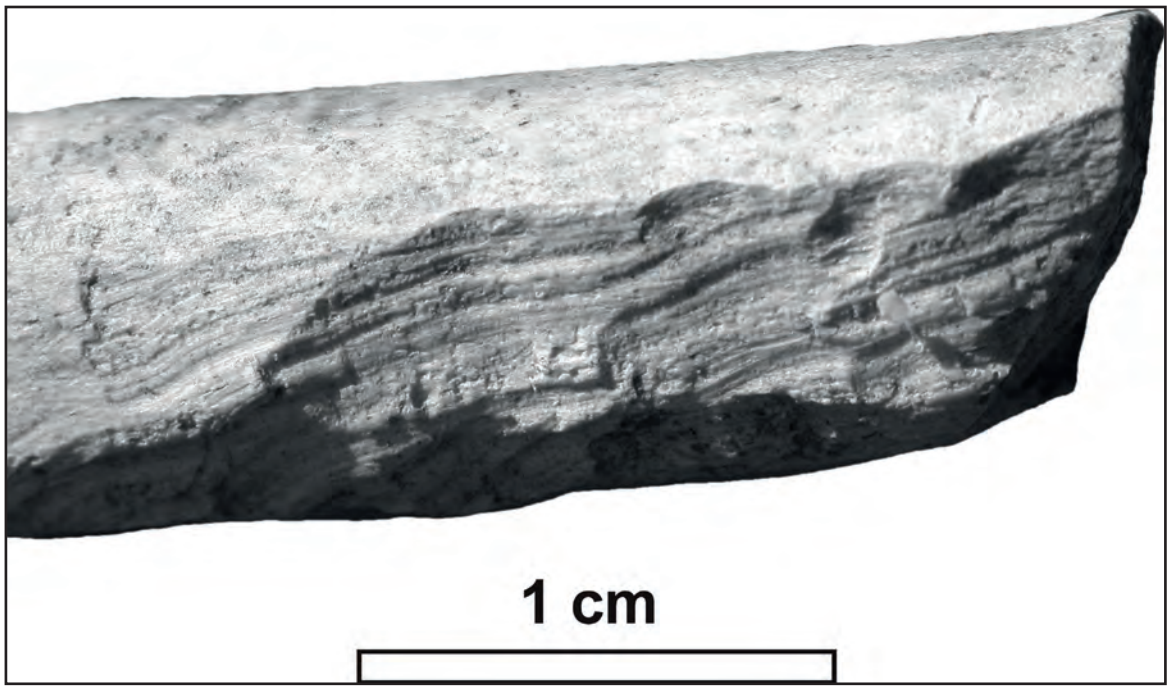

Fig.:13: distal fragment of an ulna of brown bear, proximal end, fracture edge reworked with metal blade; Sand/Oberpfaffendorf, Early Medieval (Natural History Museum Vienna, Archaeozoological Collection).

Scar-lines also indicate that swing percussion was applied from the side, with the obvious intention of removing the claw from the rest of the paw. On the same claw bone and on a second, burnt, specimen, additional cut marks in the articulation area can be discerned. These examples demonstrate that paw elements were sometimes dissected from the rest of the skeleton.

The most peculiar example, however, is represented by an ulna from Sand, comprising about the distal two-thirds of the shaft (Fig. 13). Fine transversal knife cuts on the medial side, close to the distal end of the diaphysis, may be related to skinning, or to the severing of muscle attachments, on the palmar side of the carpal joint. Major parts of the fractured edges delimiting the fragment proximally, however, have been purposefully reworked by a series of blows generated by a metal blade.

These chop marks, characterised by internal striations produced by nicks in the blade, were directed in a distal-proximal direction. As the existing edges of the distal ulna had already been reshaped, it is difficult to identify a possible reason for this activity. Moreover, this body part does not appear to be well suited for being worked into a tool, and there are no traces of use-wear. It is possible that the whole, skeletonised or dried distal segment of the forelimb served some unknown symbolic purpose, for example as a trophy. KANELUTTI (1990, 1993) also reports a special treatment of certain bones from Thunau. The upper part of one skull and the ascending ramus of one mandible were sawn or chopped off, possibly for decorative reasons. These examples may, in a way, be regarded as borderline examples of bone artefacts. There are, however, many more traces among the Thunau material, mostly comprising cut marks on skulls, mandibles and limb bones that are clearly related to skinning and butchery. In one instance, a skull was separated from the cervical column by a series of oblique blows, aimed at the occipital and directed from the basal side (KANELUTTI, 1990).

Marks related to symbolic, ornamental and artefactual use of skeletal parts

As noted above, it is not always easy to draw a clear distinction between marks related to definite butchery and carcass treatment, and more special manipulations where certain elements are formed into objects. There are, nevertheless, clear examples of parts of the bear skeleton being utilised as ornaments, or worked into decorative pieces or bone tools. Such objects are often associated with unworked bear remains within the same sites (e.g. Mondsee and Thunau). There are, however, some samples which are devoid of worked specimens (e.g. Traismauer) or contain only indirect evidence for such activities (e.g. Virunum), as well as two prehistoric sites where the bear is only represented by artefacts (e.g. Perchtoldsdorf-Aspetten and Prellenkirchen).

Generally speaking, there are two skeletal elements that are more likely to be selected for manipulation into valued objects: teeth, especially canines, and the claw bones or claws (distal phalanges). Modified objects, and marks related to the extraction of these elements from the rest of the carcass, also appear in the archaeological record. In certain periods and regions, such as the Iron Age of northern France, the brown bear is only represented through canine pendants and burnt claw bones from burial contexts; this species is alternatively completely absent in occupation deposits at settlements (MÉNIEL, 2001). The following discussion will consider the individual types of bone modification present in our data sets.

Canines and other teeth

Bear canines have been worked into pendants or other decorative objects from the Palaeolithic period onwards (see PACHER, 2005 for a recent overview). Normally, canine pendants are easily recognized

by the excavators and do not find their way into faunal assemblages investigated by archaeozoologists. Among the literature studied, there appears to be only one exception from Mondsee (Wolff, 1977). An overview of their chronological and geographical distribution is, therefore, beyond the scope of this paper. Within the collection analysed at the University of Vienna (Department of Prehistory and Historical Archaeology), at least one specimen was identified – this example derived from the Late Bronze Age settlement at Thunau, and the root of the specimen had been fully perforated. A mandible from this site exhibited some partial destruction of the area of the canine alveolus, possibly indicating the intentional extraction of the canine. Similar damage is reported for mandibles from Virunum (Galik, 2004) and was also observed in the collection from Sand. In the Early Medieval period at Thunau, some tool marks were observed in the alveolar region of some specimens and have been interpreted in the same way (Kanelutti, 1993). In contrast, some collections display no evidence for such practices, such as Traismauer and other examples from Virunum (see also Gostenčnik, 2008), where the canines were left in their original positions in both upper and lower jaws. This situation is likely to indicate an indifference towards the canine as a valued object, unless these particular skulls and mandibles were deliberately left intact, being used as a trophy. This latter interpretation may be offered for the mandible from Thunau, which exhibited a sawn-off ramus (see above), and which still possessed its canine. Admittedly, in one of the skulls from Virunum presented by Gostenčnik (2008) one canine, still *in situ*, had been heavily worn down, thus becoming unattractive for further use or display.

Among the more recent excavations, the site Schweighofer Mauer (LA; Maurer, 2011, 2014) must be mentioned. From the debris accumulated down the slope underneath a hilltop settlement of the Late Neolithic Mondsee group, besides fox and wild boar tooth pendants, three worked bear teeth could be collected (Maurer, 2011: Table 15, Maurer, 2014: Fig. 26-28). Apart from a classical canine pendant with a perforated root, a canine from a young individual had the surface of its partly undeveloped and hollow root covered all over with small pits. These exhibit a very regular arrangement. The shiny surface of the tooth indicates its use as a pendant. Maurer (2011) reports a very similar object from 19th c. excavations at the classical site of Mondsee. In this case, the pits still exhibited traces of a black colouring resulting from birch tar. These may therefore also have been present originally in the specimen from Schweighofer Mauer. The third worked bear tooth from this site was made from a second lower molar (M_2). Its occlusal surface and one root were completely smoothed or grinded down, and the remaining root was perforated. This object, which somehow resembles the miniature model of a modern mountain boot (Maurer, 2011), was therefore also used as pendant.

Modified claw bones

Distal phalanges with special alterations are present in prehistoric, Roman and Medieval contexts. In one specimen from an Early Bronze Age context at Buhuberg, the tip of the claw bone had been

evenly smoothed. Evidently, a fine-grained abrasive surface had created this affect, as no scratch lines were visible, and it is possible that the polishing represents use-wear, with the specimen forming part of a garment or personal adornment that was worn for a long period of time. Partial smoothing of the articulation area of another claw bone was reported in an Early Medieval context at Thunau. In this case, the claw bone served as a natural socket for the claw itself, which protected the distal part of the bone from abrasion. A similar pattern was observed on one specimen from the La-Tène settlement at Prellenkirchen. Here, the articular area displayed evidence of heavy abrasion and was slightly polished, whereas the distal area of the phalanx remained in an unworn condition. There are, however, two mediolateral perforations with a diameter of 4-5mm (Karwowski, 2010). These latter two examples clearly indicate the ornamental use of claw bones which possessed claws *in situ*.

Burnt claw bones

Claw bones with traces of burning are present at the sites of Mondsee (several specimens; Fig. 4), Buhuberg and Sand, and the intensity of the heat influence on the bones ranges from local blackening to total calcination. The presence of burnt claw bones deserves attention; they are often reported in cremation burials (e.g. Lehmkuhl, 1987), and they are usually interpreted as representing the remains of skins with third phalanges still attached, which were burnt together during cremation ceremonies

(e.g. Méniel, 2001). In the sites under discussion, however, the material was not recovered in defined grave contexts. It is unclear why these elements have been more regularly exposed to heat than any other bone. Alternative explanations for this pattern include some form of roasting procedure involving paw elements, or alternatively, this abundance may be related to the better preservation of the compact bones during burning. For instance, in an Iron Age cremation burial mound at Führholz (Carinthia; Kanelutti in Renhart, 1990), two calcined middle phalanges were recovered, and these bones were associated with other autopodial elements (astragali, phalanges, sesamoids) from cattle and sheep/goat.

Bone tools

Although not particularly apt for working into tools, there are many examples of long bone diaphyses, particularly from the lower extremities, being worked into points and chisels, and rich assemblages have been recovered from the Swiss Neolithic lakeside dwellings (see Schibler, 1980). At least one proximal tibia fragment from the Late Neolithic collection from Mondsee can be interpreted as a haft: the bone was broken at the midshaft, and the fracture edges were well rounded. Another object made from a proximal tibia was recovered from the Middle Neolithic circular ditch at Perchtoldsdorf-Aspetten (Kunst, 2005), representing the only bear remain from this structure (Fig. 14).

In this instance, the central shaft was ground down with stone tools and shaped into a wedge-like tip. This object was possibly also used as a haft or as a socket for some kind of point. In comparison with long bones and metapodials of ruminants, the marrow cavity of the bear tibia is rather narrow in its central area and appears particularly useful for the insertion of a fine point.

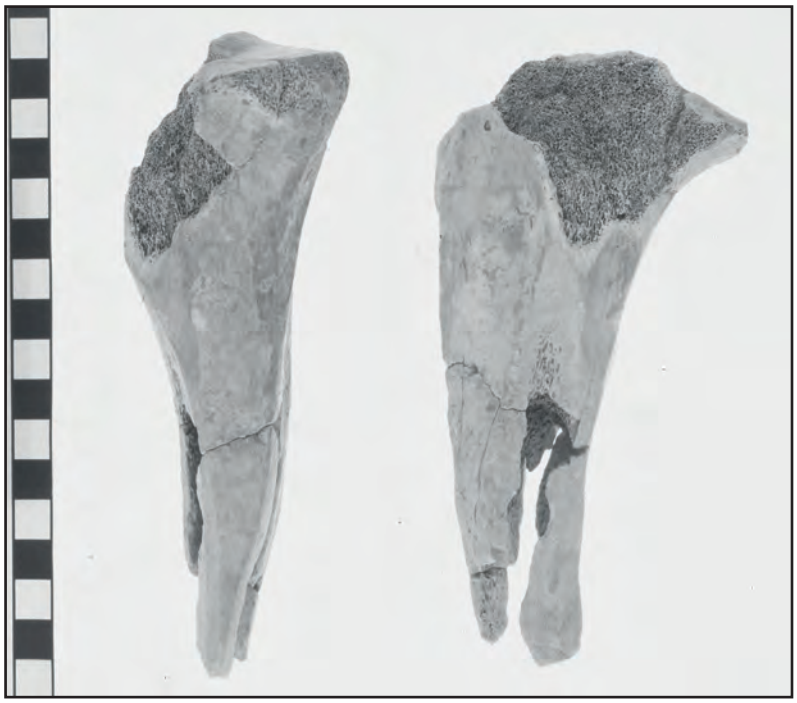

Fig. 14: bone tool made from a left tibia of brown bear - plantar and lateral view; Perchtoldsdorf-Aspetten, Middle Neolithic (Photo: R. Gold).

Pathological conditions and their implications

Being a powerful and sturdy omnivore, the brown bear can easily survive pathological conditions that are lethal in other carnivores and herbivores which depend on, for example, fast locomotion or an intact dentition. Therefore, bear remains exhibiting loss of teeth, minor pathological lesions such as exostoses on metapodials, or even healed fractures of long bones, are frequently reported from both cultural and non-cultural contexts. For instance, Wolff (1977) reports several examples among the old collections from Mondsee. In Virunum, a distal humerus and a rib from the same animal were characterized by arthritic deformations, and a further individual exhibited heavy lesions in the upper dentition (Galik, 2004). Two other sites deserve further discussion here – Traismauer and Thunau – as some elements of the assemblages displayed pathologies that were interpreted as illuminating specific human-bear relationships. On the right mandible of the associated maxilla and mandible pair from Traismauer, a deep furrow is visible between the first and second molar, and this was accompanied by the loss of the fourth premolar on its left counterpart (Fig. 7). According to Riedel (1993), these conditions are reminiscent of modern zoo animals and it can be argued that this particular animal was held in captivity, as has previously been suggested for similar observations at other Roman sites (e.g. Gulde, 1985). The furrow present on the mandible is also similar to a deformation observed by

Chaix et al. (1997) on a Mesolithic specimen from France. In this instance, it appears that a thong had been tied around the mandible. In the Early Medieval assemblage from Thunau, the high frequency of pathological conditions found in the bear remains differs from the low frequency identified on domestic mammals, with more than one-fourth of the bear bones being affected (Kanelutti, 1993). These frequencies are unusual and are considered to be too high for a wild population. The lesions observed comprise loss of teeth, inflammation in the area of the tooth rows, hyperostosis of long bone shafts and badly healed fractures. Some of these conditions are interpreted as resulting from malnutrition, and hence it has been argued that some of the animals may have spent longer periods of time in captivity. In contrast, no pathologies were identified in the assemblage from Sand, which is located nearby and is roughly contemporaneous with Thunau (Pucher & Schmitzberger, 1999). This suggests that the bears at Thunau were exposed to different, seemingly special, conditions. The frequency of pathologies in wild brown bear populations, however, is poorly studied and while it is, therefore, difficult to draw comparisons between bears kept in captivity and those living under natural conditions, the significance of these patterns should not be underestimated.

Concluding remarks

The evaluation of the occurrence of a 'rare' species, such as the brown bear, in the archaeological record from a specific geographical region, can provide invaluable insights which are relevant to both cultural and faunal history. For instance, if we consider another wild, but not necessarily 'rare', mammal, the brown hare (*Lepus europaeus*), the repeated occurrence of (partial) skeletons within settlement pits has been recognized as a widespread phenomenon in the Middle Neolithic and Early Bronze age of Europe (Manhart & Vagedes, 1999, Schmitzberger, 2009). Certain trends, however, may appear more defined for 'rare' species in comparison to the assemblages of the main domesticates, where the large amount of bone material often obscures individual, specific preservation patterns. On the other hand, the low occurrence of 'rare' species in archaeological assemblages often leads to the recovery of small sample sets, the compositions of which are likely to be driven by chance, and may not therefore exhibit any patterning. The observations of the sample characteristics of brown bear assemblages discussed in this paper, such as complete long bones in lakeside dwellings, or the high frequencies of burnt phalanges and human modifications elsewhere, is, therefore, remarkable. Potential human influences on the assemblages must be considered against other taphonomic agents, such as differential destruction and the overall impact of the immediate archaeological and sedimentary environments (e.g. buildings, settlement layers).

As the main differences found between the samples and/or periods analysed here concern the relative abundance and frequency of skeletal parts, the issue of data quality has to be addressed first. Among all the European game animals, bears present some particularly unique features. In contrast to the

wild species of artiodactyls, equids and canids, bear remains cannot be confused with domesticated congeners. Unlike the brown hare and birds, they appear to be little affected by recovery biases and preservation conditions. The data quality may, therefore, be regarded as generally good – an absence of bear remains within a large bone sample may therefore indicate that this animal had little or no relevance to local residents. Such an issue touches upon an important question: can the distribution, extinction or rarefying of a species be inferred from the archaeological record? In a recent survey, Schmitzberger (2009) analysed 101 Neolithic sites from the Austrian Danube area, 22 of which yielded bear remains. If NISP-counts for the 30 sites with more than 50 determinable bones are calculated, bear remains account for 0.25% of the total. These figures appear moderate for a period when the distribution of the species was widespread, but its availability or importance, for whatever reason, was limited. Nevertheless, there are very few rich prehistoric assemblages that do not contain bear remains. An interesting exception was the Late Iron Age sanctuary at Frauenberg (Styria; Urban, 2000) which had an NISP of over 23,000 faunal remains, including several species of large wild mammals and birds (Grill, 2009). It is against this prehistoric background that the more complex picture of the Roman period can be interpreted. Here, we have rural contexts, which exhibit a sensible reliance on hunting (Perchtoldsdorf), sometimes even producing specialized hunters' refuse (Gerasdorf; although poorly documented), and military and civilian centres which display a varying reliance on natural resources. For example, in Mautern-Favianis, the bear, like other large carnivores, was an exceptional element and was not found within the contexts selected for study. However, red deer remains were consistently found within large refuse pits, with a NISP ranging from 0.5% to 4% of the main domesticates (Kunst, 2006). At the similar setting at Traismauer-Augustiana (Riedel, 1993), red deer was once again the dominant species among the wild mammals (0.7% of total NISP). The respective value for the bear was, in contrast, c. 0.1%. At both sites, the remains of this species occurred mostly as anatomical sets, underlining the exceptional status of this material against the more even distributed, processed remains of red deer. A very different picture was rendered by the large bone assemblage (NISP >12.000) from the substructures of a city street from Carnuntum, which mirrored the consumption and discard behaviours of an urban population. A single bear bone with documented stratigraphic affiliation resulted in less than 0.01% of the total NISP from this site, but the other large game species (e.g. red deer, roe deer and wild boar) were only slightly more frequent. Generally, the contexts excavated (e.g. the backfill of sewers or construction horizons) provided a favourable taphonomic environment for small fragments, but also for primary butchery refuse and kitchen remains. The diversity of fish and wild birds, therefore, was high, with animals such as the brown hare rivalling in numbers with domestic fowl within certain layers, while large wild mammals occurred in smaller numbers than in both sites described above. Thus, in the Roman period, reliance on natural resources in general (e.g. Carnuntum) and large wild mammals in special circumstances (e.g. Mautern) are not necessarily linked with an occurrence of bears. Significant quantities of bear remains normally appear with larger-than-average quantities of wild mammals (e.g. Gerasdorf and Perchtoldsdorf), with Hem-

maberg and Traismauer being possible exceptions. At this latter site, bears may have played a certain role within the local economy and social life. This can certainly be proposed for the amphi-theatre of Virunum, which has produced the most important bear assemblage from Austria: raised absolute and relative NISP abundances may be interpreted as being directly linked to the function of this site (Galik, 2004).

In regards to faunal history, the presence of bears is neither linked to topography nor to the geographical distribution of the sites. The highest numbers of brown bear either derived from densely populated areas (e.g. Perchtoldsdorf and Traismauer) or from administrative centres (e.g. Virunum). These patterns may also reflect trading networks, rather than real distribution patterns of this species, with the animals or their parts entering the sites as exchange items. Although it must be stated that there are no Roman sites yielding bear remains as worked objects only. It must further be added that wild mammals are generally rare in Germanic sites from the area north of the Danube, which was never included into the Roman Empire. At the Early Medieval hillforts, bears show up as minor elements among high NISP abundances of wild mammals (e.g. Sand) or exhibit high absolute values themselves (e.g. Thunau). Contrary to the Roman samples and in accordance with some prehistoric materials, butchered remains and worked bones and teeth appear to be equally important. Both sites represent small central strongholds within a hitherto sparsely populated area, and the wild mammal remains probably reflect the hunting activities of the local elite. Bear bones occurred at these sites, alongside other 'rare' elements, such as the European bison, aurochs and European elk. These species, despite surviving the Roman period in the areas to the north and south of the Danube, possibly became extinct in the territory of present-day Austria, not long after AD 1000 (Spitzenberger, 2001). Hence, the animal bone samples from those sites may indeed reflect the over-exploitation of the local wild fauna. From the High Medieval onwards, written sources provide more detailed information concerning human–bear relationships. No remains of this species have been recorded among bone samples from Late Medieval and Early Modern layers from urban centres. This pattern may be attributable to the state of archaeological research in these periods, the dwindling numbers of bears in general or their decreasing availability, brought about by particular legal restrictions.

From the Neolithic onwards, the NISP-percentages of bears within archaeological samples in Austria are likely to reflect the amount of interaction between some people in these communities and these animals, rather than the actual population and distribution patterns of these animals. Following the Neolithic lakeside dwellings, it is only in the 'developed' societies of the Roman and Early Medieval periods that bears appear both in greater relative numbers and in peculiar configurations, such as complete skulls, articulated units, and so on. Therefore it seems that at least until the High Medieval, no regional extinctions occurred. Nevertheless, whereas bear remains can be expected in earlier prehistoric assemblages, later prehistoric assemblages, in particular from the Iron Age, may often be

devoid of this species, suggesting a range of human-bear relationships which are specific to particular periods, regions and sites.

The archaeological bone record should, therefore, be treated with caution in the reconstruction of faunal history (e.g. Kunst, 2014). Wild animals portray a different pattern and 'behaviour' in the archaeological assemblages than domesticates. For example, species like the European pond terrapin, the European elk, the aurochs and the European bison became rare in later Austrian prehistory, being mostly absent during the Roman period, only to 'reappear' in the Early medieval period.

Further insights have been provided in this paper through the consideration of a single 'rare' species. Similar to the treatment of red deer antler and bones, a dichotomy can be constructed for body parts of the bear with a potential symbolic or decorative value, such as teeth, skulls and claws, and the post-cranial skeleton incorporated within food consumption activities. In contrast to red deer, which is often represented by antler alone, bear is usually represented by both 'symbolic' and 'mundane' remains, at least in settlement contexts. Only at the Neolithic site of Perchtoldsdorf and the Iron Age site of Prellenkirchen, evidence for brown bear was indicated exclusively by the presence of worked objects – with only one specimen being recovered from each site. Similar to worked antler, these objects could represent objects that were highly valued and exchanged. Another important observation is the high frequency of anthropogenic modifications present on bear bones in general, which can be expected on virtually any skeletal element. This pattern, known from the Late Palaeolithic onwards (see Fiore & Tagliacozzo, 2008 for a recent example), is probably related to the practicalities of engaging with the peculiarities of the ursid anatomy (e.g. butchery marks) and the high esteem held for certain body parts (e.g. skinning marks, extraction of teeth and claws).

More work is needed, however, so that certain questions can be addressed. The low fragmentation of bear long bones in the Late Neolithic lakeside dwellings of Mondsee and Keutschach stands in contrast to the Swiss site of Arbon-Bleiche, where fragmentation was reportedly intensive, being similar to the cattle remains from the same site (Deschler-Erb & Marti-Grädel, 2004). It is unknown whether differences in carcass treatment, or in taphonomic pathways, are responsible for these different patterns. Likewise, it is undecided whether the high frequency of burnt claw bones outside of burial contexts in different periods, is due to the differential preservation rates of these materials or to specific human behaviours associated with the treatment of bear claws.

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