Associazione Italiana di ArcheoZoologia

Dipartimento di Scienze Archeologiche

Atti del 6° Convegno Nazionale di Archeozoologia

Centro visitatori del Parco dell'Orecchiella

21-24 maggio 2009

San Romano in Garfagnana - Lucca

a cura di

Jacopo De Grossi Mazzorin
Daniela Saccà
Carlo Tozzi

2012

Francesco Boschin[1]
[1] Dipartimento di Scienze Ambientali "G. Sarfatti" - U.R. Ecologia, Università degli Studi di Siena

Animal remains from Schloss Prösels (Bozen/Bolzano, Italy, 16th -17th century)

I resti archeozoologici di Schloss Prösels (Bozen/Bolzano, Italia, XVI-XVII sec.)

Summary - The site of Castel Prösels is located near Fiè (Bolzano, Italy). About 1800 specimens of macro and micro mammals, birds, amphibians and fishes have been identified. They date from the second half of the 16th century to the first half of the 17th century. The sample is mainly composed of food refuses, associated with other carcasses and rare intrusive species. The death assemblage is mostly represented by domestic ungulates and other subordinated *taxa* (domestic poultry, domestic goose, game birds and mammals). Domestic mammals devoid of alimentary relevance and fishes are very scarce. Butchering signs and the relative frequency of skeletal parts testify a different behaviour on the carcasses of different species, and some evidence probably confirm the interest in the horny tissues for manufacturing activities. Diet has been varied, and the game consumption testifies the high social status of the castle residents. The presence of some game animals should be explained by hawking activities. Thanks to some analyses both on archaeological and modern materials, strong similarities between sheep remains and the modern alpine "Steinschaf" breed have been identified.

Riassunto - In questo lavoro vengono analizzati i resti animali provenienti dal sito di Castel Prösels presso Fiè (BZ), datati a cavallo tra il XVI e il XVII secolo. Il lotto conta 1800 reperti determinabili, riferiti ad una trentina di taxa *tra macro e micromammiferi, uccelli, anfibi e pesci. Essi sono costituiti per la maggior parte da rifiuti alimentari, cui si aggiungono altre carcasse e alcuni resti intrusivi. La tanatocenosi è costituita principalmente da ungulati domestici, cui seguono gli uccelli da cortile e la selvaggina da pelo e da penna. I mammiferi domestici privi di interesse alimentare sono estremamente rari, così come i resti di pesci. Le tracce di macellazione e l'abbondanza relativa delle parti anatomiche testimoniano un diverso trattamento delle carcasse a seconda delle specie e in alcuni casi potrebbero indicare anche una certa attenzione verso il recupero del materiale corneo sfruttato a fini artigianali. La dieta risultava molto variegata in quanto arricchita da vari animali selvatici, testimoniando l'importanza sociale degli abitanti del castello. La presenza di alcune specie potrebbe testimoniare pratiche di falconeria. Grazie all'analisi di altri materiali recenti e archeozoologici è stato possibile individuare nei resti di pecora forti somiglianze con la "Steinschaf", razza diffusa ancora oggi nell'arco alpino.*

Key words: Schloss Prösels, South-Tyrol, 16th -17th century, animal remains.
Parole chiave: Schloss Prösels, Alto Adige, XVI-XVII sec., resti faunistici.

Introduction

The castle of Prösels/Presule is located on the top of a hill at an altitude of about 856 m on the sea level, near Völs (Fiè) in the Isarco Valley (BZ, South-Tyrol, Northern Italy). Its origin dates back to the beginning of the 13th century, when the Lords of Völs (ministerial lords of the Bishops of Brixen-Bressanone) were allowed to build a fortress on this hill. During the 16th century, one of its most eminent owners, Leonhard von Völs (1458-1530), decided to turn the fortress into a prestigious castle. After a renovation plan, a pile of rubble and rocks was removed from the lower levels of a circular tower located on the south-eastern side of the outer wall. A layer of organic sediment was discovered about 7 m under (Amt für Bodendenkmäler-Ufficio Beni archeologici 2009). It followed an archaeological excavation, monitored by the Archaeological Heritage Office of Bolzano. The soil was screened through a 1-cm sieve, which allowed for the recovery of numerous finds (bones, pottery, glass, metal objects). Numerous coins were also unearthed, thus suggesting that the site could be dated between the second half of the 16th century and the first half of the 17th century. The original floor of the tower also unearthed other archaeological findings, such as pottery dating back to the Bronze Age (Amt für Bodendenkmäler-Ufficio Beni archeologici 2009). In this paper, all the animal bones dating back to the Renaissance are analysed: an important faunal assemblage, also considering the lack of archaeozoological data referred to this historical period in the whole region of Tyrol.

Quantitative comparisons between *taxa* are based on the number of identified specimens (NISP), on the minimum number of elements (MNE, *sensu* Lyman, see Reitz, Wing 1999: 215) and on the minimum numbers of individuals (MNI, *sensu* Chaplin, see Reitz, Wing 1999: 195).

Since available age data based on teeth eruption and wear are few, a simple method has been used to obtain reliable data: in table 2, the symbol "+/-" means "tooth

in eruption", whilst the symbols "+", "++" and "+++" represent an increasing level of wear from "slightly worn" to "heavily worn".

Taxonomic identification, possible intrusive species and faunal composition

3992 finds were recovered. Bone conservation is homogenous, except for few unidentified remains characterised by strong surface modifications due to weathering processes and partly to soil composition. They probably came from the underlying Bronze Age layer. Moreover, some bones were anatomically connected, thus testifying the lack or scarcity of post depositional disturbance. About 45% of the specimens have been identified according to their genus, species, subfamily or family. Other remains have also been identified and associated to generic categories like "*pisces*", "*aves*", "large ungulates" and "small ungulates" (Tab. 1).

Two *Capra* metacarpals look very massive (see the list of measurements), bigger than the others recovered at the site. Although the possible presence of ibex has to be considered, it is not possible to confirm this hypothesis with certainty, as a large goat male could also be likely to have entered the site. The GLl (von den Driesch 1976) of a *Sus* astragalus is 50.0. It is larger than the pigs from Salzburg (GLl = 45, 45.5, 41.5, 40.1, Pucher 1991) and from Hauenstein (GLl = 37.5, 37.5, 40, 36, 36, Pucher, Schmitzberger 2006). It is also larger than the ones from the Austrian-Roman site of Traismauer (min = 37,6, max = 41,4 n = 9, Riedel 1993). Moreover, the size of other pig skeletal elements from Prösels is similar to the ones of the abovementioned domestic populations. Therefore, on the basis of various considerations relating to the size of this specimen, it may be a wild boar. Moreover, according to the metrical measurements, few lagomorph bones may be related to rabbits, as they are smaller than the hare remains recovered at the site. The Bp and the Bd (von den Driesch 1976) of a femur are respectively 15.0 and 13.1, whilst the same measurements of a hare femur are respectively 26.7 and 20.6. Hare bones represent almost one third of wild mammal remains (NISP = 71, MNI = 5), but due to the absence of diagnostic elements, the specimens are identified to genus. The stone marten (*Martes foina*) has been identified following the morphological criteria proposed by Hans & Steiner (1986). Among bird bones, it is very difficult to distinguish between wild and domestic goose on the basis of the bones (Bacher 1967). The great amount of goose bones among all bird species and the absence of other Anseriforms can be explained through the presence of domestic animals. One adult humerus shows evidence of a healed fracture that probably inhibited flying. It also reinforces the hypothesis of the presence of domestic animals.

Few pigeon remains have also been recovered. All the taxonomic identifications are uncertain between the species *C. livia* and *C. oenas*. Among birds of prey, the genera *Buteo* and *Milvus* have been identified; according to Otto (1981), these species may be *Buteo buteo* and *Milvus milvus*. Four long bones belong to an unidentified small owl, whose size is similar for instance to *Otus scops* or *Athene noctua*. Among big game, two *Ciconia* bones have been recovered. The specimens correspond morphologically (according to Gruber 1990) to the white stork (*Ciconia ciconia*). A small passeriform humerus can be associated with genus *Turdus* (Wójcik 2002). Only 3 fish remains have been recovered, and all of them seem to correspond with unidentified *Cyprinidae*.

Black rat (*Rattus rattus*) remains are 54. They are well preserved, fragmentation is absent and no one shows traces of digestive processes. Therefore, it is unlikely that they come from owl pellets. Anyway, the presence of this *taxon* at the site has to be carefully considered, also taking into account a possible intrusive origin.

Toad remains (*Bufo bufo*) are 75. They are well-preserved, mostly with no fragmentation, and all of them do not show surface modifications. According to the crests morphology on the distal humerus, 14 males and 34 females specimens have been identified. Sexual determinations are confirmed by metric data (see list relating to measures). Total MNI is 34. Frequency of skeletal portions has been scored with reference to the MAU% (see Reiz, Wing 1999: 216). The humerus is the most frequent element, whilst the other anatomical parts are very scarce (see Fig. 3). Some elements are scarce – probably since a 1-cm sieve has been used – but this does not explain the scarcity of other elements (such as the femur or tibiofibula) whose size is similar to the humerus. Moreover, collected remains of hibernated frogs skeletons (obtained without sieving), show a very different body part profile (Kyselý 2008). Therefore, the scarcity of some elements cannot be related to the excavation procedure. Toad is a *taxon* that buries itself to live out the winter (Kyselý 2008) and - on the basis of this consideration - its presence at the site can be considered intrusive. Nevertheless, the aim of this paper is a simple documentation of the observed data, pointing out that more studies are needed to understand the real significance of amphibian bones from archaeological sites.

Faunal composition from Prösels is mainly characterised by domestic animals. The most frequent *taxa* are cattle, domestic caprines and pig (as far as mammals are concerned), and domestic hen and goose among birds. Wild game remains represent 15.8 % of the total mammal NISP (*Rattus* excluded) and 12.8 % of the bird NISP. Among mammals, hare, red deer and chamois are the best represented *taxa*. Brown bear is mostly represented by head elements.

Morphology of domestic animals

Cattle size is quite similar to contemporary cattle population from other sites in the Eastern Alps, like Salzburg (Pucher 1991) or Hauenstein (Austria, Pucher, Schmitzberger 2006). They are smaller than the Roman Age imported populations that established, for instance, in Austria at Treismauer/Augustiana (Riedel 1993) or Nickelsdorf (Riedel 2004).

Sheep horn cores are characterised by a triangular cross section, a flat dorsal surface and a very sharp edge between the dorsal and the medial surfaces (Fig. 2). They are not curved and relatively short. They are very similar to the ones recovered from another site of the region (Summersberg, still being studied by the author), where the peculiar depositional conditions allowed the preservation of the horny tissues. Their identification was assisted by the comparative material of the *Adametz Sammlung* of the Natural History Museum of Vienna. It is a collection of about 1300 skulls and mandibles of domestic animals of different species, breeds, ages and sexes. The remains from Prösels and Summersberg show very similar characteristics to the modern alpine *Steinschaf* breeds group. It is a small high mountain sheep which had developed characteristics that made it perfect for life in the high mountains meadows of the Eastern Alpine regions (Haller 2000). Sheep, goat and pig size data are few, but look similar to the ones from Salzburg (Pucher 1991) and Hauenstein (Pucher, Schmitzberger 2006).

All the hen tarsometatarsal bones (n = 7) are without spur, and have been identified as females; they are small in size. These findings fit very well with the size of the female hens from the medieval Verona (Riedel, Rizzi 2000) and look similar to the female individuals dated to the 12th-13th century from Italy (De Grossi Mazzorin 2005). They are also similar, even if slightly smaller, to the individuals from Salzburg (Pucher 1991) and Hauenstein (Pucher, Schmitzberger 2006).

Main identified taxa	**NISP**	**MNE**	**MNI**	**Body parts**	**Cattle**	**Sheep/Goat**	**Pig**
Bos taurus	419	280	15	Horn cores	-	12	-
Capra hircus vel *Ovis aries*	420	379	15	Skull	29	58	37
Capra hircus	78	-	-	Upper teeth	23	12	8
Ovis aries	35	-	-	Mandible	17	34	10
Sus domesticus	170	104	9	Lower teeth	28	15	16
Equus caballus	1	1	1	Unidentified teeth	2	-	6
Canis familiaris	9	5	2	Hyoid	5	-	-
Felis catus	58	55	3	Atlas	8	9	-
Oryctolagus cuniculus	5	5	1	Axis	4	3	4
Cervus elaphus	40	30	3	Cervical vertebrae	14	20	11
Rupicapra rupicapra	37	37	3	Thoracic vertebrae	19	28	4
Cfr. *Sus scrofa*	1	1	1	Lumbar vertebrae	15	38	8
Martes foina	25	23	2	Sacrum	3	3	1
Vulpes vulpes	29	26	2	Caudal vertebrae	9	-	-
Ursus arctos	9	7	3	Rib	2	-	-
Lepus sp.	71	47	5	Scapula	30	20	6
Sciurus vulgaris	11	8	2	Humerus	26	18	10
Gallus domesticus	122	112	14	Radius	23	20	5
Anser anser	117	98	7	Radius+ulna	-	10	-
Meleagris gallopavo	13	13	2	Ulna	16	10	8
Columba livia/oenas	8	8	1	Carpal	14	5	1
Grus grus	2	2	1	Metacarpal	7	34	3
Ciconia cf. *ciconia*	2	2	1	Pelvis	22	26	2
Milvus cf. *milvus*	3	3	1	Femur	14	27	8
Buteo cf. *buteo*	1	1	1	Patella	-	-	-
Corvus corax	7	7	2	Tibia	7	18	7
Corvus corone/frugilegus	5	5	1	Fibula	-	-	3
Garrulus glandaris	3	3	2	Astragalus	9	9	-
Turdidae?	2	2	1	Calcaneum	11	12	-
Strigidae	4	4	2	Other tarsals	3	3	2
TOT	**1707**	**1270**	**104**	Metatarsal	4	29	3
Other identified taxa	NISP	MNE	MNI	Metapodial	13	8	1
Rattus rattus	54	54	8	First phalanx	19	38	1
Bufo bufo	75	74	34	Second phalanx	12	9	4
Partially identified remains	Numer of remains			Third phalanx	11	5	1
Large ungulates	308			**TOT**	**419**	**533**	**170**
Small ungulates	608						
Aves	123						
Pisces	3						

Tab. 1. Faunal composition and anatomical representation (NISP) of the main domestic mammalian *taxa*.

Age-at-death data and carcasses treatment of the main domestic mammals

Age-at-death data, obtained through tooth eruption and wear, are few, but reveal different kill-off patterns for cattle, caprines and pigs (Tab. 2). Ruminant data cover a broad spectrum of age classes, whilst mostly pig mortality data are restricted around two age classes (second molar hardly worn and third molar in eruption).

About 20% of Cattle remains show signs of butchering. As for the vertebrae, around 80 % of them (except for caudal ones) shows evidence of butchering. Especially for this *taxon*, it is visible the necessity to remove rapidly some anatomical parts in order to prepare meat portions. The scars visible on the lower jaw indicate that it was rapidly separated from the skull, probably in order to remove the tongue: cut marks are also observed on hyoid bones. Other elements (e. g. distal scapula, proximal humerus, carpal bones, distal tibia, talus) were roughly cut off. On the other hand, slight cut marks are observed on the phalanges, which were probably butchered more carefully. An interesting cut mark is located on the *solea* of a third phalanx. It can be related to the removal of the horny tissue for handicraft activities. Moreover, the lack of cattle horncores at the site can be associated to this. In contrast to this, only 3% of the remains among the domestic caprines specimens, and 0.5% among pig specimens show sings of butchering. Such evidence testifies a completely different slaughtering method. The small dimension and the young age of the individuals probably made easy the carcasses treatment. Mostly sheep and goat horncores show deep cuts on the base, probably in order to remove the horny tissue. This could provide further evidence of an interest in horn handicraft. Body part profiles of the main mammalian domestic *taxa* (using MAU % see figure 1) are scored. The anatomical categories of good meat quality (Uerpmann 1973), are well represented (low identification of axial elements have to be considered: 863 vertebrae and rib fragments are simply ascribed to categories such as "large ungulate" and "small ungulate"). A strong difference comes out for the elements of category C (poorest meat quality): on one hand, the scarcity of pig and cattle metapodials can be observed, whilst on the other hand sheep and goat metapodials are the most common elements. As for phalanges, carpals and tarsals (the cattle ones are more represented than the others), their abundance can be influenced by dogs (gnawed bones are common throughout the site).

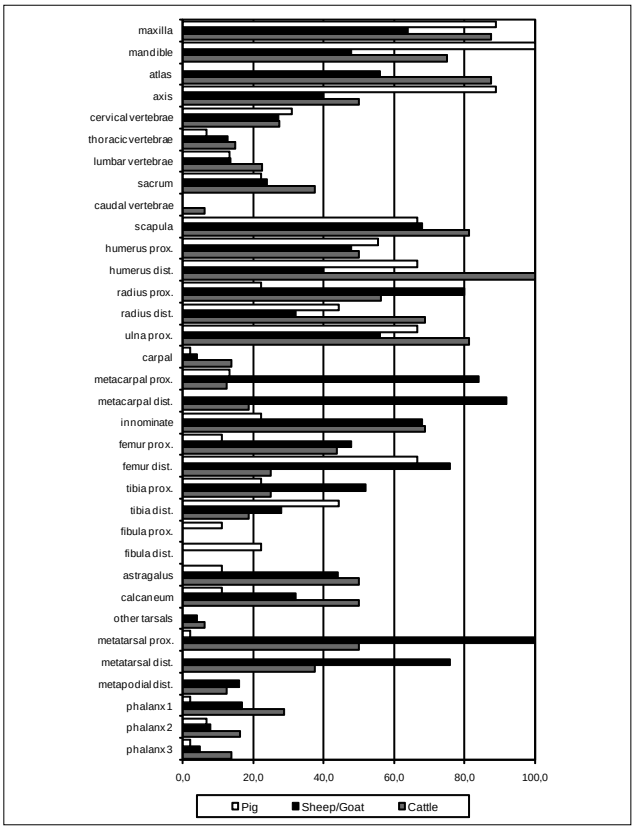
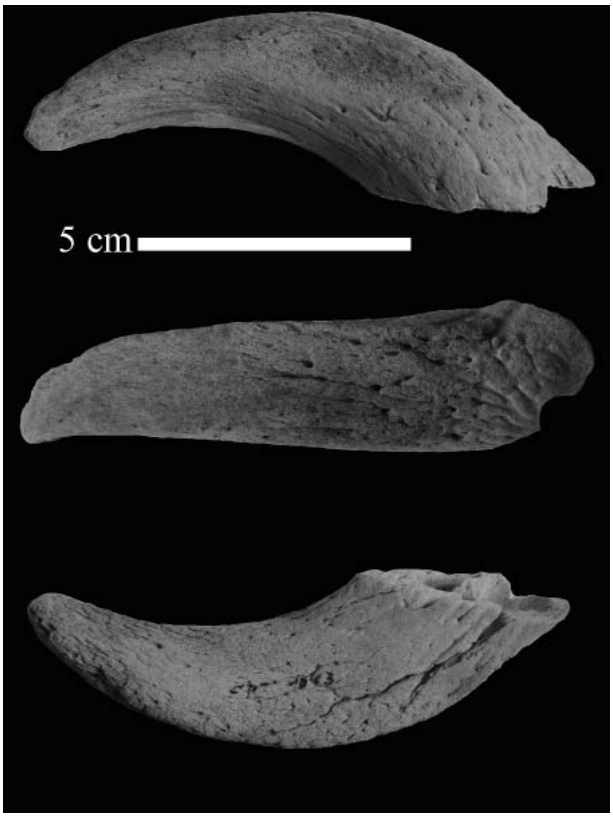


Fig. 1. Body part profiles (MAU %) of the main domestic mammalian *taxa*.



Sheep horn core: lateral view (up), dorsal view (middle), medial view (down).

	D4 0	D4+	M1+/-	M1+	M2+/-	M2+	M3+/-	M3+	M3++	M3+++
Cattle	0	0	6	1	0	2	0	3	3	0
Sheep/ Goat	4	0	0	0	1	1	1	1	6	0
Pig	0	0	1	0	0	3	3	1	1	0

Tab. 2. Age profile (MNI) of the main domestic mammals.

Discussion and conclusions

The sample that has been analysed is mainly composed of food refuses, associated with other carcasses and intrusive species. The presence of wild game testifies the high social status of the castle's owners. The large wild mammalian *taxa* can be divided into two groups: ungulates (red deer, chamois, wild boar, and perhaps ibex) on one hand and carnivores (bear, fox, marten) on the other hand. With reference to the ungulates, hunting them was a privilege of the aristocracy, strictly regulated by several laws (Gasser 1994). Only rarely was the right to hunt extended to other social classes. It is for instance the case of the chamois (Gamsjagd) in the "*vier Freigerichten*" in the Oberinntal (Austria) and in the Passeiertal (South Tyrol), an animal that the peasants were allowed to hunt till the 16th century (Gasser 1994). Hunting restrictions, imposed by the local ruler, represented a strong obstacle for the farmers to the protection of the cultures from wild games. Sometimes, even dogs were not allowed for this purpose (Gasser 1994). Probably as a consequence, an interesting and particular social phenomenon developed regularly in Tyrol when a local ruler died: people began to deliberately chase wild game, in the name of an ancient right. For instance, red deer and wild boar were decimated by the population after the death of the *Erzherzog* Maximilian I in 1519 (Gasser 1994). Legal and illegal hunting caused the extinction of some species in Tyrol: wild boar and red deer disappeared around the end of the 17th century. The ibex disappeared around the middle of the 18th century because of hunting (Gasser 1994). It is therefore difficult to say whether Prösels' wild game composition is the result of human action or of natural prey availability, but the scarcity (and/or absence) of wild boar and roe deer remains may show evidence of their dramatic status at that time.

Carnivores were hunted as they were considered as harmful animals and prizes were given when "wild beasts" were killed. In some cases, their carcasses were displayed in public and some anatomical parts (e. g. skin, head, right paw) were given to aristocracy (Gasser 1994). With the exception of a scapula and of a *baculum*, only skull and mandible fragments of brown bear have been recovered at the site. Although the sample is very small in size, a possible connection between brown bear skeletal representation and the aforementioned "social rituals" should be taken into consideration (even if this hypothesis should be discussed carefully). After skinning the animal, *baculum* could possibly have remained connected to the pelt.

Hare, squirrel, Corvines, thrushes, pigeon and crane are often considered typical preys of birds of prey (Prummel 1997). The squirrel, in particular - but not only- is hunted by the goshawk and the sparrow-hawk in wood areas. Both species were largely used for falconry in Tyrol (Gasser 1994). At Prösels two bone whistles, probably used for calling the birds of prey have been recovered (Amt für Bodendenkmäler 2009). Evidence of the high social status of the castle's owners is also provided by the presence of the domestic turkey. It appeared at the beginning of the 16th century in Europe and in Italy around 1520 (Crawford 1992).

The different age and body part profiles of the main domestic mammals, along with the faunal composition, could provide an interesting overview of social choices and interactions. The only problem is that this faunal assemblage represents an isolated case, because of the lack of data from other surrounding sites relating to the same period.

As a conclusion of this paper, it have to be underlined that the faunal remains from Prösels are interesting from many different points of view, as they provide an important key to understand the social complexity of the Early Modern Age in the region of Tyrol. Although more excavations and data are needed, these remains offer an unusual and valuable perspective. These archaeozoological materials are also useful to analyse the loss of biodiversity (species extinction) in this region during a determined historical period. Lastly, modern bone assemblages are interesting to reconstruct the history, development and dispersal of local domestic breeds which may be still living today or have been recently extinct (see Pucher 1998)

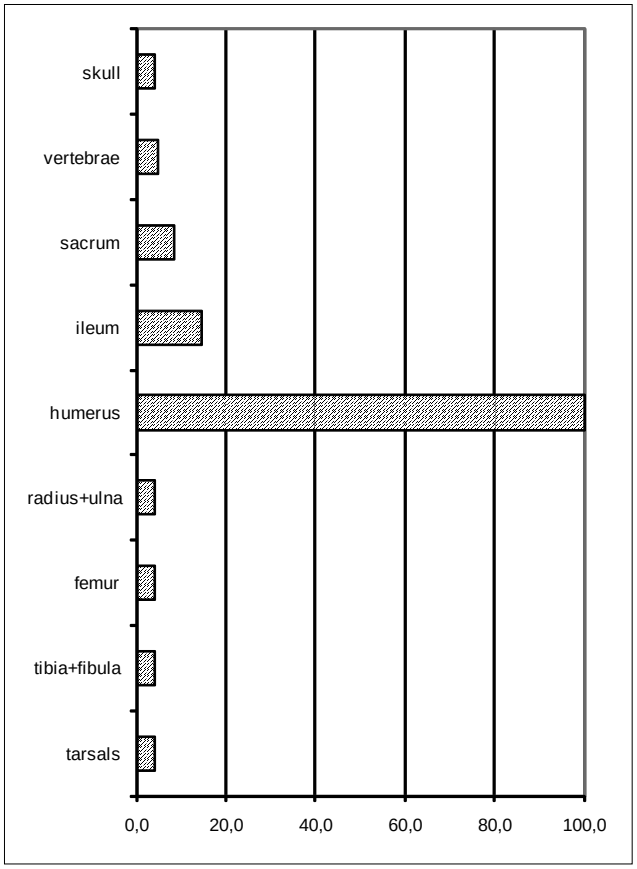


Fig. 3. Toad body part profile (MAU %)

Acknowledgments

I would like to thank dott. Umberto Tecchiati for giving me the possibility to analyse Prösels materials; prof. Jacopo Moggi Cecchi and dott. Chiara Corbino for helping me in the bird bone identification; dott. Erich Pucher for helping me in the analysis of the sheep horn cores.

References

Amt für Bodendenkmäler 2009. …fünff maiolica schaln… Burgen und Stadtpaläste: gehobenes Wohnen der frühen Neuzeit in Südtirol. Katalog der Ausstellung des Amtes für Bodendenkmäler, Merkantilmuseum, 8.-26. April 2009. Folio Verlag Bozen/Wien.

Bacher A. 1967. *Vergleichend morphologische Untersuchungen an Einzelknochen des postkranialen Skeletts in Mitteleuropa vorkommender Schwäne und Gänse*. Inaugural-Dissertation zur Erlagerung der tiermedizinischen Doktorwürde der Tierärztlichen Fakultät der Ludwig-Maximilians-Universitäts München, München.

Crawford R. D. 1992. Introduction to Europe and diffusion of domesticated turkeys from the America. *Archivos de zootecnia*, 41, 154 (extra): 308.

De Grossi Mazzorin J. 2005. *Introduzione e diffusione del Pollame in Italia ed evoluzione delle sue forme di allevamento fino al Medioevo*. In: Atti del 3° Convegno Nazionale di Archeozoologia (Siracusa, 2000), *Studi di Paletnologia II, Collana del Bullettino di Paletnologia Italiana*: 351-361.

Driesch A. von den 1976 - A Guide to The Measurement of Animal Bones from Archaeological Sites. *Peabody Museum Bullettin* 1. Harvard University, Cambridge, Massachusetts.

Gasser C. 1994. *Zur Geschichte des Weidwerks in Tirol vom Mittelalter bis zum 18. Jahrhundert*. In C. Gasser, H. Stampfer, *Die Jagd in der Kunst Alttirols*. Athesia Vlg., Bolzano, pp. 7-77.

Gruber A. 1990. *Vergleichend morphologische Untersuchungen an Einzelknochen in Ägypten vorkommender Ciconiidae.* Inaugural-Dissertation zur Erlagerung der tiermedizinischen Doktorwürde der Tierärztlichen Fakultät der Ludwig-Maximilians-Universitäts München, München.

Haller M. 2000. *Seltene Haus- & Nutztierrassen*. Leopold Stocker Verlag, Graz.

Hans M., Steiner F. M. 1986. Die nicht-metrische Unterscheidung von Schäden mitteleuropäischer Baum- und Steinmarder (Martes martes und Martes foina, Mammalia). *Ann. Naturhist. Museum Wien*, 88/89B: 267-280.

Kyselý R. 2008. Frogs as a part of the Eneolithic diet. Archaeozoological records from the Czech Republic (Kutná Hora-Denemark site, Řivnáč Culture). *Journal of Archaeological Science*, 35: 143-157.

Otto C. 1981. *Vergleichend morphologische Untersuchungen an Einzelknochen in Zentraleuropa vorkommender mittelgrosser Accipitridae I. Schädel, Schultergürtel und Vorderextremität.* Inaugural-Dissertation zur Erlagerung der tiermedizinischen Doktorwürde der Tierärztlichen Fakultät der Ludwig-Maximilians-Universitäts München, München.

Pucher E. 1991. Der frühneuzeitliche Knochenabfall eines Wirtshauses neben der Salzburger Residenz. *Salzburger Museum Carolino Augusteum – Jahresschrift*, 35/36: 71-135.

Pucher E. 1998. Die Tierknochenfunde von der Plankenalm. *Mitteilungen der ANISA*, 4: 261-274.

Pucher E., Schmitzberger M. 2006. *Die Tierknochen aus einer frühneuzeitlichen Kulturschicht der Burgruine Hauenstein (Steiermark)*. In: Lasnik E.: *Das Obere Kainachtal, Aus der Geschichte der Gemeinden Kainach, Gallmannsegg und Kohlschwarz*. Gemeinden Kainach, Gallmannsegg und Kohlschwarz, pp. 608-623.

Prummel W. 1997. Evidence of Hawking (Falconry) from Bird and Mammal Bones. *International Journal of Osteoarchaeology*, 7: 333-338.

Reitz E. J., Wing E. S. 1999. *Zooarchaeology*. Cambridge Manuals in Archaeology. Cambridge University Press. Cambridge, UK.

Riedel A. 1993. Die Tierknochenfunde des römerzeitlichen Lagervicus von Traismauer /Augustiana in Niederösterreich. *Ann. Naturhist. Museum Wien*, 95A: 179-294.

Riedel A. 2004. Tierknochen aus der römischen Villa rustica von Nickeldorf im Burgenland (Österreich). *Ann. Naturhist. Mus. Wien*, 106A: 449-539.

Riedel A., Rizzi J. 2000. *Studio preliminare su resti ossei di avifauna di Verona medievale (scavi di piazza Mercato Vecchio e del Tribunale)*. In: *Atti del 2° Convegno Nazionale di Archeozoologia (Asti, 1997)*, Forlì: 341-348.

Wójcik J., D. 2002. The comparative osteology of the humerus in European thrushes (Aves: *Turdus*) including a comparison with other similarly sized genera of passerine birds - preliminary results. *Acta zoologica cracoviensia*, 45(special issue): 369-381

Uerpmann H-P. 1973. Animal bone finds and economic archaeology: a critical study of "osteo-archaeological" method. *World Archaeology* 4/3: 307-322.

List of measurements

Bos taurus:

D/4 GL: 31.6, 33, 31.9, 31.8, 31.7; M/3 GL: 32; scapula: GLP: 65.8 LG: 57.7 BG: 49.6; GLP: 64 LG: 55.8 BG: 43.7; humerus: Bd: 73.2 BT: 67; Bd: 69.5 BT: 62; ulna: BPC: 40.6 LO: 75.1 SDO: 42.1; innominate: LA: 77.2; LAR: 63; metatarsal: Bp: 44.4, 46.2, 43.4, 45, 47.1; Bd: 49.2, 48, 46.5; astragalus: GLl: 61.5 Tl: 33 Bd: 37; phalanx1: Glpe:51.6 Bp:28.3 SD: 22.8 Bd: 26.6; Glpe:53.1 Bp:25.8 SD: 20.3 Bd: 23.6; Glpe:54 Bp:26.5 SD: 22.5 Bd: 26.8; Glpe:54.5 Bp:29.4 SD: 24.4 Bd: 27.9; Glpe:58.9 Bp:30.4 SD: 23.9 Bd: 28.8; Glpe: 55 Bp: 24.3 SD: 20.5 Bd: 22.7; Glpe: 53.8 Bp:26.4 SD: 22 Bd: 25; Glpe:57.5 Bp:32.3 SD: 25 Bd: 29; Glpe: 50.4 Bp: 23.8 SD: 19.8 Bd: 22.7; Glpe: 54.4 Bp:27.4 SD: 23.1 Bd: 26.9; Glpe:52.9 Bp:26.4 SD: 22 Bd: 25.5; phalanx2: GL: 36.7 Bp:29 SD: 23.7 Bd: 25.9; GL: 36.2 Bp:27.5 SD: 20.4 Bd: 20.6; GL: 35.4

Bp:27 SD: 21.4 Bd: 24.5; GL: 36.4 Bp:27 SD: 20.9 Bd: 24; GL: 40.1 Bp:34.7 SD: 27.5 Bd: 25; phalanx3: DLS: 57.3 MBS: 19.2 LD: 47.3.

Ovis vel *Capra:*

scapula: SLC: 16.3 GLP: 30.4 LG: 24 BG: 18.7; SLC: 17.7 GLP: 29.4 LG: 23.5 BG: 21.5; SLC: 15.8; metacarpal: Bp: 24.3, 24.9, 25.2, 19.3; pelvis: LA: 30.5 LAR: 25.7; LA: 30.2 LAR: 22.4; tibia: Bd: 24.7.

Capra hircus:

horn cores: 41: 31 42: 22; 41: 32 42: 21; 41: 31.2 42: 20.2; 41: 30 42: 19; mandible: 7: 73.2 8: 47.7 9: 24.8 10L:21 10B: 8.7; 8: 46.1 10L: 21.3 15a: 33.5, 15b: 23.5, 12: 71.8, 13: 69.4, 14: 102.4; 8: 41.4, 10L: 17.3, 10B: 7.2, 12: 56.8, 13: 56.6, 14: 91.4 15a: 31.2 15b: 20.1; 10L: 23.2 10B: 8.4 15:36.9; radius: Bp: 31.8 BFp: 30.4; Bp: 30.5 BFp: 29.6; Bp: 31 BFp: 29.4; Bp: 32.4 BFp: 31; ulna: BPC: 23.7 LO: 42.4 SDO: 23.3 DPA: 27; BPC: 25.1 LO:45.9 SDO: 25.5 DPA: 29.6; BPC: 23.4. metacarpal: GL: 134.3 Bp: 30 SD: 20.2 Bd: 34.2; GL: 118.4 Bp: 25.1, SD: 16.5, DD: 10.4, Bd: 28.8; GL: 120.4, Bp: 26.7, SD: 15.5, DD: 12.7, Bd: 28.4; Bp: 30.4; Bd: 27.5; femur: Bp: 44.6 DC: 21.2; Bp: 42.2; calcaneum: GL: 62.1 GB: 21.2; GL: 60.1 GB: 20.6; metatarsal: GL: 128.5 Bp: 22.5 SD: 13.2 DD: 11.3 Bd: 25.7; GL: 128.4 Bp: 22.5 SD: 13.6 DD: 10.8 Bd: 25.7; GL: 131.6 Bp: 20.3 SD: 12.8 DD: 10.5 Bd: 25.7; Bp: 20.8, 20.6, 23.6; phalanx1: Glpe: 37.2 Bp: 13.1 SD: 10.5 Bd: 12; Glpe: 39.7 Bp: 13.8 SD: 11.9 Bd: 13.2; Glpe: 41.4 Bp: 13.6 SD: 11.2 Bd: 12.8; Glpe: 40.4 Bp: 13.9 SD: 11.2 Bd: 14.1; Glpe: 40.2 Bp: 13.4 SD: 10.2 Bd: 12.7; Glpe: 40.7 Bp: 14 SD: 11.2 Bd: 13.5; phalanx2: GL: 26.2 Bp: 12.4 SD: 9.2; GL: 28.4 Bp: 14.2 SD: 10.5 Bd: 11.4; GL: 25.9 Bp: 12.6 SD: 8.2 Bd: 9.8; GL: 27 Bp: 12.1 SD: 8.6 Bd: 9.5; GL: 29.1 Bp: 14.5 SD: 10.1 Bd: 11.8; phalanx3: DLS: 34.2 MBS: 5.4 LD: 27.3; DLS: 35.5 MBS: 6 LD: 27.3; DLS: 33.8 MBS: 5.3 LD: 26.6.

Ovis aries:

scapula: GLP: 36.4 LG: 23.5 BG: 23.7; radius: Bp: 25.9 BFp: 24; Bp: 31.5 BFp: 28.9; ulna: BPC: 19.1; metatarsal: GL: 132.1 Bp: 18.8, SD: 10.9, DD: 9.5, Bd: 21.8; astragalus: GLl: 32.6 GLm: 32.2 Bd: 21.1 Tl: 18; GLl: 30.8 GLm: 27.5 Bd: 19.4 Tl: 15.6; GLl: 32 GLm: 29 Bd: 19.5 Tl: 16.7; phalanx1: Glpe: 30.8 Bp: 10.4 SD: 7.4 Bd: 9.1; Glpe: 30.9 Bp: 10.1 SD: 7.4 Bd: 9; Glpe: 31.4 Bp: 10.9 SD: 8.6 Bd: 10.5; Glpe: 31.7 Bp: 11.2 SD: 9 Bd: 10.5; Glpe: 30.9 Bp: 10.4 SD: 8.2 Bd: 9.4; phalanx2: GL: 20.5 Bp: 9.9 SD: 7.1 Bd: 8.8; GL: 23.4 Bp: 10.6 SD: 7.7 Bd: 8.5.

Sus domesticus:

humerus: Bd: 37.6; tibia: Bd: 33.3; phalanx 2: GL: 23.2 Bp: 18.7 SD: 14.4 Bd: 16; GL: 23 Bp: 16.2 SD: 12.9 Bd: 13.5. CFR.

Sus scrofa:

astragalus: GLl: 50.

Cervus elaphus:

phalanx1: Glpe: 58.8 Bp: 21.5 SD: 17.4 Bd: 21.8; Glpe: 58.4 Bp: 22 SD: 17.2 Bd: 22.3; Glpe: 57.5 Bp: 21 SD: 17 Bd: 21.2; Glpe: 58.5 Bp: 22 SD: 17.2 Bd: 22.2; Glpe: 57.4 Bp: 21.5 SD: 16.6 Bd: 21.2; Glpe: 57.6 Bp: 21.4 SD: 17.2 Bd: 21.6; phalanx2: GL: 40.9 Bp: 22.2 SD: 15.5 Bd: 19.5; GL: 38.7 Bp: 18.9 SD: 12.7 Bd: 15.8; GL: 43 Bp: 21.4 SD: 16 Bd: 18.2; GL: 42.4 Bp: 21.7 SD: 16.3 Bd: 19; phalanx3: DLS: 46.1 MBS: 12.5 LD: 43.7; DLS: 48.8 MBS: 12.2 LD: 43.3; DLS: 45.2 MBS: 12.6 LD: 42.8.

Rupicapra rupicapra:

humerus: Bd: 32.8 BT: 30.7; Bd: 32.8 BT: 30.8; radius: GL: 186 Bp: 31.2 BFp: 29.1 SD: 20.2 Bd: 31.1 BFd: 27.4; Bd: 30.8 BFd: 27.2; metacarpal: GL: 152 Bp: 26 SD: 16.5 DD: 11.3 Bd: 30.2; tibia: Bd: 30; metatarsal: GL: 169 Bp: 23.9 SD: 14.3 DD: 12.2 Bd: 30.8; GL: 169 Bp: 23.9 SD: 14.3 DD: 12.6 Bd: 31; Bp: 23.6, 23.2; astragalus: GLl: 32.2 GLm: 30.9 Tl: 18.4 Tm: 19.3 Bd: 21.3; GLl: 32.3 GLm: 31 Tl: 18.3 Tm: 19.4 Bd: 21.4; phalanx1: Glpe: 47.7 Bp: 14.4 SD: 11. Bd: 13.9; Glpe: 52.6 Bp: 14.6 SD: 10.7 Bd: 13.6; Glpe: 52.3 Bp: 14.5 SD: 10.7 Bd: 13.7; Glpe: 47.5 Bp: 14.5 SD: 11 Bd: 13.9; Glpe: 49.5 Bp: 15 SD: 11 Bd: 13.8; Glpe: 52.2 Bp: 14.2 SD: 10.5 Bd: 13.6; phalanx2: GL: 32.4 Bp: 14.2 SD: 9.8 Bd: 11; GL: 34 Bp: 14.4 SD: 8.6 Bd: 11; GL: 30 Bp: 13.9 SD: 9.4 Bd: 11.3; GL: 30.5 Bp: 14.2 SD: 8.9 Bd: 10.9; GL: 30.3 Bp: 14.4 SD: 9.2 Bd: 10.8; GL: 34.2 Bp: 14.3 SD: 9.2 Bd: 11; GL: 32.9 Bp: 14.1 SD: 9.2 Bd: 10.8; phalanx3: DLS: 38.7 MBS: 7.5 LD: 33; DLS: 38.8 MBS: 7.3 LD: 34.5; DLS: 39.7 MBS: 7.6 LD: 34.2; DLS: 39.1 MBS: 7.5 LD: 33.5; DLS: 39.3 MBS: 7.3 LD: 33.7; DLS: 38.2 MBS: 7.9 LD: 32.8; DLS: 38.5 MBS: 7.4 LD: 33.2.

Lepus sp.:

mandible: 2: 19.6 3: 41.7 4: 23.2; scapula: BPC: 9 DPA: 12.9; humerus: Tp: 22.1 Bp: 19.4 SD: 6.1; Bd: 12.1, 12.6, 12.3; radius: Bp: 9.5, 8.3, 9.9, 9.4; ulna: BPC: 9 SDO: 11 DPA: 11.5; BPC: 8.7 SDO: 11.8 DPA: 11.9; pelvis: L: 101.2 LAR: 12.3 LS: 25.9 SC: 12 SB: 8; L: 91.4 LAR: 11.5 LS: 26.7 SC: 10.4 SB: 5.9; LAR: 13 SC: 11.1 SB: 6.9; LAR: 12.6 SC: 11.9 SB: 8.4; femur: GL: 135.5 GLC: 130 Bp: 26.7 Btr: 25.5 TC: 11 SD: 9.7 Bd: 20.6; Bp: 26.9 Btr: 23.8 TC: 11; Bp: 26.5 Btr: 26.1 TC: 10.5 SD: 9.6.

Oryctolagus cuniculus:

pelvis: DiA: 12.6; LAR: 8.4 SC: 7.4 SB: 5.1; LAR: 8.3 SC: 7.3 SB: 5.5; femur: Bp: 15 Btr: 15.2 Tc: 7.3 SD: 7; Bd: 13.1; tibia: GL: 83.6 Bp: 14.6 SD: 6 Bd: 12.

Gallus domesticus:

coracoid: GL: 59.4 Lm: 57 Bb: 15.2 BF: 12; GL: 53.3 Lm: 50.6 Bb: 14 BF: 10.9; GL: 49.7 Lm: 47 Bb: 14.7 BF: 12.9; GL: 49.9 Lm: 47.4 Bb: 14.3 BF: 11.2; GL: 47 Lm: 44.9 Bb: 12.8 BF: 10.5; GL: 48.8 Lm: 46.2 Bb: 13.4 BF: 11.2; humerus: GL: 64 Bp: 16.9 Bd: 13.4; GL: 68.1 Bp: 17.9 Bd: 14.1; GL: 61.2 Bp: 16.6 Bd: 12.8; GL: 65.1 Bp: 17.1 Bd: 14; GL: 66.4 Bp: 17.4 Bd: 13.3; GL: 67.9 Bp: 18.1 Bd: 14.5; GL: 65 Bp: 16.9 Bd: 13.8; GL: 67.5 Bp: 17.4 Bd: 14.3; GL: 70.2 Bp: 19.4 Bd: 14.5; radius: GL: 58.1 SC: 2.7 Bd: 6.2; GL: 58.7 SC: 2.7 Bd: 6; ulna: GL: 71.1 Bp: 9.7 Dip: 12.8 SC: 4 Did: 8.3; GL: 61.6 Bp: 7.9 Dip: 10.6 SC: 3.6; GL: 65.1 Bp: 8.4 Dip: 12 SC: 3.8 Did: 7.5; GL: 59.9 Bp: 7.9 Dip: 11 SC: 3.8 Did: 7.3; GL: 64.8 Bp: 8.2 Dip: 11.5 SC: 3.5 Did: 7.4; GL:65.8 Bp: 8.1 Dip: 12.4 SC: 4.1 Did: 7.3; carpometacarpal: GL: 36.7 Bp:11.3 Did: 7; GL: 36.2 Bp:10.9 Did: 6.5; GL: 36.9 Bp:11.4 Did: 6.8; GL: 33.5 Bp:10.6 Did: 6.5; femur: GL: 72 Lm: 69.2 Bp: 14.3 SC: 5.8 Bd: 14.2 Dd: 12.3 Dp: 9.6; GL: 75.9 Lm: 72.2 Bp: 15.3 SC: 6.5 Bd: 14.3 Dp:10.7; GL: 71.5 Lm: 68.2 Bp: 13.9 SC: 5.9 Bd: 13.9 Dd: 12.3 Dp: 9.8; GL: 75.7 Lm: 72.6 Bp: 15.1 SC: 6.6 Bd: 14.4 Dd: 12.4 Dp: 10.6; GL: 73.5 Lm: 71 Bp: 14.4 SC: 5.5 Bd: 13.8 Dd: 11.5 Dp: 9.3; GL: 74.5 Lm: 70.7 Bp: 15.4 SC: 6.2 Bd: 15.4 Dd: 12.5 Dp: 10.2; GL: 71 Lm: 67.7 Bp: 14.8 SC: 5.8 Bd: 13.8 Dd: 11.5 Dp: 9.6; tibiotarsus: GL: 107.9 LA: 105.2 Dip: 19.3 Bd: 11.2 Dd: 11.5 SC: 5.4; GL: 100.9 LA: 97.6 Dip: 18.7 Bd: 10.7 Dd: 11.7 SC: 5; GL: 107.9 LA: 105.3 Dip: 19.3 Bd: 11.8 Dd: 11.6 SC: 5.7; GL: 118.2 La: 104.7 Dd: 11.1 Bd: 10.9 Dip: 18.6; tarsometatarsal: GL: 75.2 Bp: 12.5 SC: 5.8 Bd: 12.5; GL: 67.2 Bp: 11.8 SC: 5.5 Bd: 12.4; GL: 67.9 Bp: 12.2 SC: 5.6 Bd: 12.1; GL: 67.6 Bp: 12.1 SC: 5.5 Bd: 12.1.

Anser anser:

coracoid: GL: 69.6 Lm: 63.1 BF: 28.9 Bb: 30.5; GL: 67.2 Lm: 60.8 BF: 25.8 Bb: 27.7; GL: 64.8 Lm: 61.7 BF: 26.1 Bb: 27.6; GL: 66.7 Lm: 60.7 BF: 27.1 Bb: 28.7; GL: 64.8 Lm: 60.9 BF: 27.3 Bb: 28.4; scapula: GL: 95 Dic: 15.5; Dic: 15.8, 15.4, 16.4, 15.7; humerus: GL: 158 Bp: 33 SC: 11 Bd: 22.1; radius: GL: 127.1 SC: 4.3 Bd: 9.7; GL: 134.1 SC: 4.7 Bd: 10.5; GL: 133 SC: 5 Bd: 10.4; GL: 130.8 SC: 4 Bd: 9.4; GL: 142 SC: 4.5 Bd: 10.4; ulna: GL: 136 Bp: 16.3 Dip: 18.6 SC: 7.8 Did: 12.2; GL: 137 Bp: 14.8 SC: 7.6 Did: 11.9; GL: 139.5 Bp: 15 Dip: 17 SC: 7.2 Did: 11.9. carpometacarpal: GL:83.2 Bp: 21.1 Did: 11.9; GL: 82.9 Bp: 21.5 Did: 10.8; GL: 79.4 Bp: 18.8 Did: 10.5; GL: 86.1 Bp: 21.3 Did: 11.2; GL: 78.9 Bp: 20.1 Did: 11.1; GL: 81.6 Bp: 19.5 Did: 10.6; femur: GL: 78.3 Lm: 74.2 Bp: 18.2 SC: 8.1 Bd: 19.4; GL: 77.2 Lm: 77.6 Bp: 19 SC: 8.4 Bd: 19.5; GL: 74.7 Lm: 70.1 Bp: 19.7 SC: 8.1 Bd: 19; GL: 77 Lm: 72.3 Bp: 18.3 SC: 8.2 Bd: 19.9; GL: 78.7 Lm: 74 Bp: 18.7 SC: 8.1 Bd: 19.8; GL: 77.5 Lm: 72.6 Bp: 18.7 SC: 8 Bd: 19.3; GL: 75.1 Lm: 69.8 Bp: 18.4 SC: 7.8 Bd: 18.1; tibiotarsus: GL: 139 La: 129.4 Dip: 22.9 Dd: 15.7; tarsometatarsal: GL: 83.1 Bp: 17.5 SC: 7.6; GL: 76.1 Bp: 17.1 SC: 6.7 Bd: 17.9; GL: 78.5 Bp: 17.1 SC: 7.3 Bd: 17.7; GL: 79 Bp: 17.6 SC: 7.9 Bd: 17.3; GL: 85.1 Bp: 17 SC: 7.8 Bd: 19.3; GL: 86.3 Bp: 17.5 SC: 8 Bd: 19.9.

Meleagris gallopavo:

coracoid: GL: 72.4 Lm: 69 Bb: 21.8 BF: 18.2; humerus: Bp: 29.4; Bd: 21.6. carpometacarpus: GL: 54 Bp:15.4 Did: 11; femur: SC: 12.6 Bd: 27 Dd: 22.

Columba livia/oenas:

humerus: GL: 45.8 Dip:185. SC: 5.1 Bd: 11; ulna: GL: 54 Bp: 7.2 Dip: 8.4 SC: 3.3 Did: 5.9; GL: 54 Bp: 7.2 Dip: 8.5 SC: 3.6 Did: 5.9.

Milvus cfr. milvus:

humerus: Bd: 21; radius: GL: 138.2 Bd: 9.2 SC: 3.8; ulna: GL: 147.5 Bp: 14.9 Dip: 16.4 SC: 6.4 Did: 11.

Buteo cfr buteo:

humerus: GL: 12.4 Bp: 20.4 Dip: 25.9 SC: 7 Bd: 16.9.

Grus grus:

ulna: Bp: 23.4 Dip: 26.5; Did: 16.

Ciconia cfr. ciconia:

ulna: Bp: 21 Dip: 25; humerus: Bd: 30.4.

Corvus corax:

humerus: Bd: 22.8; radius: GL: 111.6 Bd: 9.3 SC: 3.6; GL: 109 Bd: 9 SC: 3; ulna: Bp: 16.1 SC: 6.8 Did: 13.2.

Corvus corone/frugilegus:

humerus: GL: 69 SC: 6.1 Bd: 16.8; radius: GL: 76.2; ulna: GL: 84 Bp: 11 Dip: 11.9 SC: 4.9; carpometacarpal: GL: 51.2 L: 6.2 Bp: 11.4 Did: 12.

Bufo bufo:

humerus: greatest breadth of the distal end: males: 5.8, 7.4, 5.4, 6, 6.1, 7, 6.7; females: 8.4, 8.5, 9, 9.1, 9.2, 7.6, 8.6, 9, 9, 9, 9, 9.3, 9.6, 9.6, 9.6.