THE PATTER OF HORSE'S FEET — A SIGN FROM LATENE PERIOD

AN ARCHAEOZOOLOGICAL REPORT

Abstract: The present paper deals with the identification and interpretation of the archeozoological material harvested from the archaeological campaign in 2008 under the supervision of specialists from the National History Museum Alba-Iulia in the area of the Olympic Swimming Pool. The Iron Age settlement (pit no 401) revealed the existence of a grave of a horse, buried along a series of artefacts.

The material presented was in a very poor state of conservation, allowing, in most cases, only partial measurements. Most of the material belonged to one single horse (*Equus caballus*) which was evaluated from an anatomical perspective and an osteometrical as well. According to the concluded data, the bones belonged to a young individual, no more than 3-3.5 years old, with an average height calculated, based on the measured long bones, of 139 cm.

Keywords: *archeozoology, horse, osteometry, La Tène, animals*.

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DOI: 10.14795/j.v7i1.507
ISSN 2360 – 266X
ISSN–L 2360 – 266X

INTRODUCTION

Archaeozoology plays an important role in the reconstruction of past life. Speciality studies stress the importance of the fauna in the development and life of past human populations. A significant part of their life's every-day activity gravitated around animal breeding, regardless of their main occupation- warriors, agriculturers, craftsmen etc. On the other hand, the data obtained by the study of skeletal remains of the antique animals may provide significant information about the microevolution of animal populations and specific local or regional features of different species. More than that, some may indirectly provide data on human population migratory pattern and movements in different historical periods[1],[2], [3],[4].

SOURCE OF MATERIAL. CHRONOLOGY DATA

La Tène is one of the historical periods that marked a significant change in human populations. Being a peaceful period, the signs of power and prosperity mark the rise of large oppida in Europe alongside the development of crafts and an overall rise in the quality of life of ancient populations.

In 2008 a group of archaeologists from the National Museum of Alba-Iulia made a series of survey archaeological diggings on a 5900 sqm in the north area of the Olympic swimming pool in Alba Iulia. A series of settlements were discovered dating from th Bronze Age, second Iron Age, Roman Age and Migration Period. One of the Iron Age settlements discovered (complex no

[1] BOESSNEK *et alii* 1971.
[2] EL SUSI 1996.
[3] POPOVICI ET *et alii* 2002.
[4] BINDEA 2005.

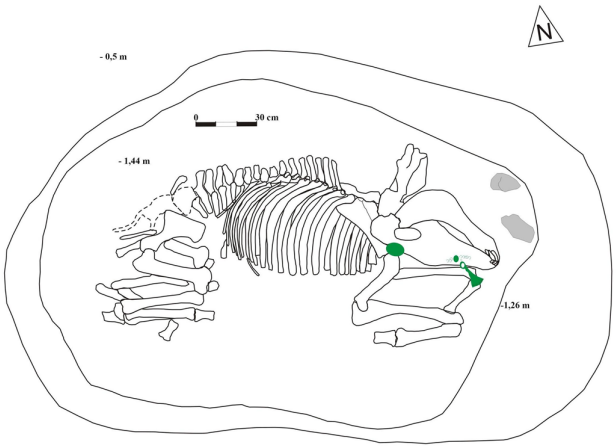

Fig. 1. Drawing of the position of the horse skeleton-pit 401

401) showed a horse burial, as seen in the diagram below (figure 1, 2). An oval-shaped pit of 2x1.75 m was seen at a depth of 0.5 m from the actual stepping level, deepening up to 1.26 m. Under this layer ashes and charcoal were present. From this pit also came out a large number of bronze rings with free endings, hemispherical bronze appliques, head appliques, etc. Analogies for these finds can be seen in a series of late scytic and early sarmatic complexes, dating most likely from the III-rd to I-st BC sites in the north and north-western part of the Black Sea region[5]. Such finds might be an indication for the existence of mercenary barbarians that reached the intracarpatic area north of the Black Sea region. The presumption stands also as far as the origin of the buried horse is concerned, not excluding the origin from the western part of the Carpathian Mountains, as assets of the local warriors that moved briefly in the area of the Black Sea[6].

DESCRIPTION OF MATERIAL

The material was presented to the Laboratory of Comparative Anatomy of the Faculty of Veterinary Medicine Cluj-Napoca, Romania in a very poor state of conservation. The packages were more or less grouped on anatomical parts, as they were extracted, but due to a clear exposure to acid soil, the pieces were very frail and subsequently fragmented. This led to a high degree of post-depositing fragmentation, thing that made the reconstruction and metrical data collection quite a challenge. Some of the fragments were anatomically reconstructed with hot glue material, while for others this was almost an impossible action, despite the evident assignment to a specific anatomical piece or another. More than that, some of the last packages were containing some foreign osteological pieces, most probably originating from topsoil layers, with very good preservation degree of the bones. These pieces were excluded from our investigation.

The measurements were taken in accordance to the standard osteometrical procedures [7],[8] using digital and classical callipers and measuring tape.

[5] BÂRCĂ 2002; BÂRCĂ 2004; BÂRCĂ 2006; BÂRCĂ 2006a; BÂRCĂ/SYMONENKO 2009.
[6] Information kindly provided by Dr. Vitalie Bârcă and Dr. George Bounegru.
[7] VON DRIESCH 1976.
[8] DESSE/CHAIX/DESSE-BERSET 1986.

Fig. 2. The horse skeleton-in situ

REPRESENTATION OF SKELETAL FRAGMENTS

As mentioned earlier, only the bone pieces that were clearly attributed to the horse skeleton were analyzed (a total of 221 fragments out of 245). After an initial assessment of the fragments, each bag was gently opened and the bones displayed on the workbench. A careful flush was performed in order to remove the soil fragments, followed by a very attentive mechanical cleaning. This was done to reduce to a maximum the mechanical stress on the frail pieces and to be capable of identifying the small fragments that might be lost in the normal washing procedure.

After this initial cleaning, a second phase was initiated. The pieces were carefully placed on absorbing surfaces and left for drying in a controlled environment (laboratory). After a minimum time of 24 hours, the pieces were individually checked again and turned face down in order to avoid the uneven drying. After another 24 hours, we got sure the pieces were completely dried off and re-assessed.

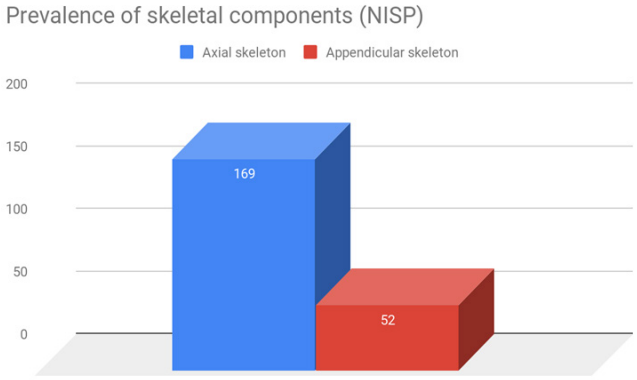

Fig.3. Prevalence of skeletal parts

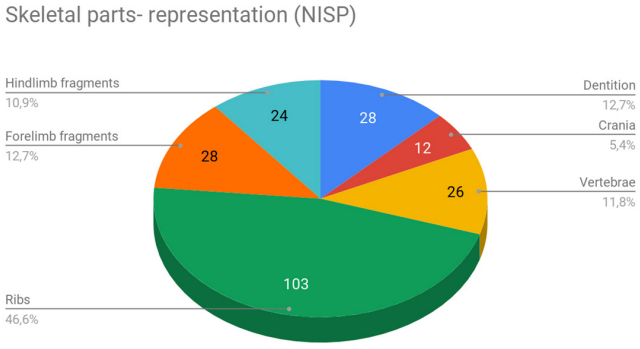

Fig. 4. Representation of different skeletal parts according to anatomic regions

Another stage focused on the possible reconstruction of the fragmented pieces, some being glued back with plastic material to the main piece. The anatomical assessment focused on the correct identification of the anatomical pieces[9], [10], [11] and the separation of the right and left side of the body.

APPENDICULAR SKELETON

All the elements of the appendicular skeleton were present, except for one of the terminal phalanges. Each of the sectors will be described, illustrating the fragmentation and the possible metrical data.

Scapula

Both pieces were present, in a bad state of preservation. Some of the measurements were taken, as seen in the table below (Table 1):

Scapula	R	L
DHA	Approx 312	
SLC	Approx 60	
LG	55	55
BG	47	Approx 45
Lg.Frg		Approx 207

Table 1. Metrical data for scapula

Based on the fact that there was no evident line of fusion at the level of the scapular neck, the only conclusion drawn from this segment is the fact that the individual was older than 10-12 months[12],[13].

Humerus

Both pieces were present and clearly identifiable. The state of conservation is poor, making measurements incomplete. Although there was clearly visible the fact that both epiphyses are ossified, abrasion of the surfaces and mechanical damage made during collection and transportation made the GL measurements quite subjective, only approximate values being given. Other measurements (table 2) were also taken.

Humerus	R	L
Lg.Frg.	Approx 253	Approx 243
Bp	-	-
SD	33	
Bd	81,5	80
BT	70,5	71

Table 2. metrical data for humerus

The closure of epiphyseal plates (proximal and distal) indicates the age group of over 42 months [14],[15]. The available measurements on the length of the humerus allow the calculation of the shoulder height in case of both specimens. The recalculated value is close to 1100 mm, based on Kiesewalter's formula[16] ,[17],[18].

Radius and ulna

Radius	R	L
GL	330	330
PL	~325	~324
Ll	~320	~320
Bp	75	80
BFp	66	72
SD	37	37
CD	115	115
Bd	~66	68,5
BFd	60	59,5

Table 3. metrical dta for radius

The elements of the thoracic zeugopodium were present for both limbs (right and left). Unfortunately, the measurements taken were approximated for the right radius and ulna and the lengths of both radiuses were recorded, allowing an estimation of the shoulder height of 1388 mm for this segment[19],[20].

Ulnar segments were measured (Table 4), but no significant data could be extracted from these.

Ulna	R	L
Lg. FRG	Approx 206,5	Approx 153,5
DPA	59	Approx 49
SDO	40	

Table 4. metrical data for ulna

The ossification stages recorded indicated in case of radius (right and left) a value of more than 42 months, but correlated with the one olecranon segment that still has a slight line of epiphyseal separation, one can state the fact that the individual died at approximately 3.5 years of age (as an age interval of 42 months is mentioned for the ossification closure in horse[21].

From the carpal assembly, the only piece missing is the accessory carpal bone (*os pisiforme*). The rest of the bones were presented more-or-less as a fused block, most probably due to the action of the soil's pH.

Some basic measurements were taken, as seen in the following table (Table 5). Metrical data do not provide direct valuable information in this case.

[9] HILLSON 1992.
[10] SCHMID 1972.
[11] BARONE 1966.
[12] YERNAUX/UDRESCU/CORDY 1993.
[13] UDRESCU/BEJENARU/HRISCU 1999.
[14] YERNAUX/UDRESCU/CORDY 1993.
[15] UDRESCU/BEJENARU/HRISCU 1999.
[16] BÖKÖNY 1974.
[17] DE GROSSI MAZZORIN/RIEDEL/TAGLIACOZZO 1998.
[18] UDRESCU/BEJENARU/HRISCU 1999.
[19] DE GROSSI MAZZORIN/RIEDEL/TAGLIACOZZO 1998.
[20] UDRESCU/BEJENARU/HRISCU 1999.
[21] UDRESCU/BEJENARU/HRISCU 1999.

Carpals	GB-R	GB-L
Scafoid (*os carpiradiale*)	36,5	37
Semilunar (*os lunatum*)	30,5	32
Piramidal (*os carpiulnare*)	33,5	33
Trapezoid (*os trapezoideum*)	24	24
Capitat (*os capitatum*)	41	42,5
Unciform (*os hamatum*)	25	25

Table 5. metrical data for carpal bones

Metacarpals

A relatively good state of preservation was observed on the metacarpal bones (given the situation). The bones are ossified at both extremities, a clear indicator of the origin from an individual that is older than 15 months[22].

Metacarpus	R	Indices	L	Indices
GL	~225		226	
GLl	223		223	
Ll	218		218	
Bp	49	21.77	49	21.77
Dp	32		31,5	
SD	32	14.220	30,5	13.55
CD	100		100	
Ddf	23		22	
Bd	47	20.88	47	20.88
Dd	~33		34	

Table 6. metrical data for the 3-rd metacarpal

The recalculated shoulder height based on the length of the metacarpals (Table 6) is 1397 mm[23],[24],[25], [26]. The diaphyseal index, calculated as a ratio between the length of the bone and minimum breadth of the diaphyses is in between 13.5 and 14.5, a value that is included in the lower limit for the category of slender-legged individuals[27].

Coxal bone

The remnants of the coxal bone were highly fragmented. An overall number of more than 10 pieces were identified, but most of all were fragments appeared post-harvesting. This is the reason why this number was not included in the calculations for NISP.

One single measurement was taken- on the right piece- the length of the acetabulum (LA)- approximate 60 mm. The fusion data were recorded only for the area of acetabulum, indicating only a possible "older than 12 months" category[28],[29].

Femur

Both congeneric pieces were present. Their proximal epiphysis was slightly destroyed- most probably harvesting time- allowing some approximate measurements, as seen in the following table (Table 7).

Femur	R	L
Lg.Frg.	~310	~305
SD		37,5
Bd	89	89

Table 7. metrical data for femur

The closure of epiphysis in distal femur is an indicator of age over 42 months (3.5 years) [30], [31]. The measurements and height calculations indicate the value of 1088 respectively 1077 mm[32],[33] but these calculations should be treated with reserve, as the proximal structures were not measurable.

Patella

For this segment, we have the usual measurements available (Table 8). There is no significant information given by this anatomic piece.

Patela	R	L
GL	65	65
GB	61	61

Table 8. metrical data for patella

Tibia and fibula

The pelvic zeugopodium fragments are quite in a good state of preservation. An almost complete series of measurements were recorded (table 9), as seen in the table below. Significant information is collected as we noticed the epiphyseal distal closure while the proximal one still shows a slight ossification line. This is a clear indicator of a minimum age of over 24 months but close to this closing time at 42 months[34].

Based on the total length of both pieces we recalculated a shoulder height of 1425 mm [35].

Tibia	R	L
GL	352	353
Ll	327	327
Bp	92	91,5
SD	41	40,5
Bd	68	70,5
Dd	42	~46

Table 9. metrical data for tibia

Tarsal bones

The talus was measurable for the right limb only

[22] UDRESCU/BEJENARU/HRISCU 1999.
[23] ONAR ET ALII 2018.
[24] DE GROSSI MAZZORIN/RIEDEL/TAGLIACOZZO 1998.
[25] UDRESCU/BEJENARU/HRISCU 1999.
[26] ONAR *et alii* 2018
[27] DE GROSSI MAZZORIN/RIEDEL/TAGLIACOZZO 1998.
[28] BARONE 1966.
[29] UDRESCU/BEJENARU/HRISCU 1999.
[30] BOESSNEK *et alii* 1971.
[31] UDRESCU/BEJENARU/HRISCU 1999.
[32] UDRESCU/BEJENARU/HRISCU 1999.
[33] ONAR *et alii* 2018.
[34] UDRESCU/BEJENARU/HRISCU 1999.
[35] UDRESCU/BEJENARU/HRISCU 1999.

(Table 10). The left one remained fused with the distal tibia, as a consequence of the geological factors.

Astragalus	R	L
GH	57,5	-
GB	62,5	-
BFd	45	-
LmT	56	-

Table 10. metrical data for tarsals-astragalus

For the calcaneus the ossified tuberosity is an indicator of an individual older than 36 months[36]. The metric data are shown in the following table (Table 11):

Calcaneus	R	L
GL	109	109
GB	50	50

Table 11. metrical data for tarsals- calcaneus

For the reminder of the tarsal bones we managed to collect some metrical (Table 12) data as well:

Tarsals	GB-R	GB-L
Os tarsi centrale	48	-
Os cuneiforme laterale	35	-
Os Cuboideum	36	36
Os cuneifome mediointermedium	34	32

Table 12. metrical data for tarsals

Metatarsals

Both metatarsals were identified and were in quite a good state of preservation, so most of the measurements were taken accurately.

The bone is ossified at both extremities, an indicator of an age greater than 15 months[37]. The lateral length (Table 13) allowed the recalculation of the shoulder height.

Metatarsus	R	Indices	L	Indices
GL	270		270	
GLl	267		267	
Ll	263		263	
Bp	50	18.51	51	18.8
Dp	43		~38	
SD	31	11.48	31,5	11.66
cd	109		110	
Ddf	25		25	
Bd	49	18.14	49	18.14
Dd	38		37	

Table 13. metrical data for the 3-rd metatarsus

[36] UDRESCU/BEJENARU/HRISCU 1999.
[37] UDRESCU/BEJENARU/HRISCU 1999.

The recalculated value is 1423 mm, based on Kiesewalter's formula[38],[39].

The calculated slenderness index indicates an individual with very slender legs, in accordance with the scale of Brauner[40].

Phalanges

The good state of preservation of the phanages allowed a quite precise set of measurements (Table 14,15,16). The closure of epiphyseal plates on the 1-st proximal epiphysis of phalanges indicates the age over 13-15 months. Same for the 2-nd phalanges, this status is an indicator of more than 9-12 months[41], [42]. A note must be made on the distal phalanges, as their state of preservation was quite poor, not allowing all measurements.

Phalanx 1	F1	F1	F1	F1
GL	84	84,5	84	84
Bp	52	53	49,5	50,5
BFp	50	50	48	48
Dp	34	35	33	34
SD	31	31	31	32
Bd	41	40,5	40,5/41	41
BFd	39	39	37	38

Table 14. metrical data for the phalanges- 1-st phalanx

Phalanx 2	F2	F2	F2	F2
GL	50	50	45	42,5
Bp	49,8	48	42	44
BFp	44	43	~44	43
Dp	33	32	28	27,5
SD	39	40	41	40,5
Bd	42	44	43	40

Table 15. Metrical data for the phalanges- 2-nd phalanx

Phalanx 3	F3	F3	F3
GL	50,5		
GB	55		
LF	23	~22,4	~20
BF	48		~42
Ld	45		
HP	36		

Table 16. Metrical data for the phalanges- 3-rd phalanx

Axial skeleton

From the set of vertebrae, most of them were recovered, but in a very poor state of preservation. A number of 6 fragments from the cervical series were present, 13 thoracic vertebrae from the thoracic series as well, 3 lumbar

[38] ONAR *et alii* 2015.
[39] ONAR *et alii* 2018.
[40] DE GROSSI MAZZORIN/RIEDEL/TAGLIACOZZO 1998.
[41] UDRESCU/BEJENARU/HRISCU 1999.
[42] BARONE 1966.

and fragmented sacral fragments were identifiable. We could not identify the coccygeal vertebrae (most probably due to incomplete recovery)

As a very general remark, the state of ossification was clearly visible for the studied fragments. They all were presenting a visible ossification line, a clear indicator of age that is estimated under 4.5 years[43], [44]. Some measurements were recorded only for 1 fragment of the 3-rd cervical vertebrae (table 17), but irrelevant in this situation.

GLPa	110
BPacr	64
BPacd	64
PL	103

Table 17. metrical data-vertebrae

Also a number of more than 100 fragmented ribs were recorded as well, but most of them bring no significant information for this study.

On the other hand, the fragments of the cranian skeleton provide a series of valuable information. Although highly fragmented, no measurements being possible, the fragments- mainly the mandibular and maxilla ones- still show the presence of the lacteal and permanent teeth.

For the splanchnocranian maxillary parts, we noted the high degree of wear for the deciduous incisors (di1-3) and a similar state for the deciduous molars (dp2-4). It is important to note the fact that the permanent incisors were present in the alveolar position, but not erupted. The first definitive incisor (I1) seems to be the one that is in the course of the eruption, but not yet reaching the alveolar level[45].

The only permanent molar that has erupted is the first and the second one (M1, M2), which presents a reduced degree of wear, while the third definitive molar (M3) is still unerupted.

All this data referring to dental eruption can indicate a precise age for the moment of death. The definitive incisor points to more than 2.5 years while the third molar (M3) indicates an age close to the 3,5 years (most probably a little less, as the molar did not reach the alveolar level)[46], [47].

Fig. 5. Mandibular fragment

[43] BARONE 1966.
[44] BOESSNEK *et alii* 1971.
[45] SCHMID 1972.

DISCUSSIONS

Based on the observed morphological aspects of the studied specimens, there are a series of deductions that can be made:

As far as the age of the studied individual is concerned, we can state that the remnants of the horse discovered in complex 401 originate from an individual of 3-3.5 years.

Our conclusions are based on the fusion data of the vertebrae that clearly indicate an age span that points to an age smaller than 4,5 years [48]

Fusion data extracted from the appendicular skeleton that indicates the age of 42 months (3.5 years) as a possible age at death (based on the fusion data of radius and ulna combined with the tibia)[49], [50].

Age estimation based on the dental data suggests an individual within the range of 3-3.5 years old based on the M3 and I1 eruption[51].

Height and conformation estimation provides different values, depending on the anatomic sector and the way the approach in respect to metrical data was applied.

Our recalculated values range from values very close to 110 cm (recalculated for humerus and femur in accordance to classical formulas) to 140-142 cm (calculated on the basis of the formulas suggested by Boessnek and Johnstone for metapodials and radius and tibia)[52], [53], [54].

Fig. 6. METAPODIALS

[46] UDRESCU/BEJENARU/HRISCU 1999.
[47] HILLSON 1992.
[48] BARONE 1966.
[49] BARONE 1966.
[50] UDRESCU/BEJENARU/HRISCU 1999.
[51] UDRESCU/BEJENARU/HRISCU 1999.
[52] ORTON 2014.
[53] JOHNSTONE 2004.
[54] BOESSNEK *et alii* 1971.

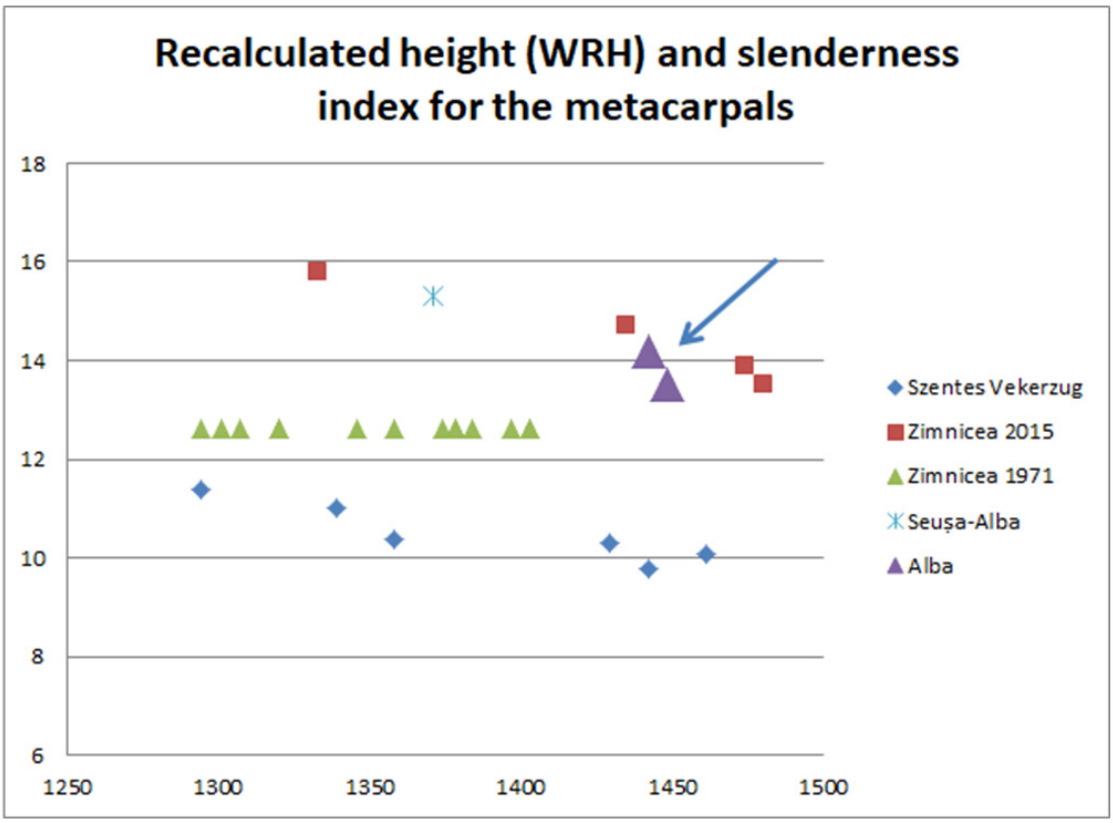

Fig. 7. Metacarpals- slenderness indices and recalculated height

Such a variability in figures (for bones that originate surely from the same individual) calls for the corrected formula suggested by Bartosiewicz[55] that created an algorithm for the calculation of the height based on the three combined sets of data for forelimb components (humerus, radius, metacarpals). The value resulting from this correction is close to 125 cm.

Taking into account that the values for humerus and femur were relative ones (approximate values), we prefer to adopt a calculation method that includes all the reliable data available that are treated altogether as an average value. The calculated medium height for our individual is 139 cm[56],[57].

The overall estimate for the individual, based on the combined data on height recalculation allow the individual to be included in the lower limit of medium-sized category[58].

Evaluation of the slenderness is made on the indices of slenderness[59] calculated on the basis of the metrical data of the metapodials that point to values of 14.22 and 13.49 for metacarpals and 11.48 or 11.29 for metatarsals. These figures combined indicate a framing of the individual in the slender legged group[60].

It seems that the body of the animal has been adjusted to fit the size of the pit by a series of disarticulative cuts at the level of the dorsal carpus and plantar surface of tarsus (fact suggested by the position of the skeleton inside the pit (see arrows on figure 2) but we did not manage to record some cut marks on the indicated skeletal parts.

[55] UDRESCU/BEJENARU/HRISCU 1999.
[56] BOKONY 1952.
[57] DE GROSSI MAZZORIN/RIEDEL/TAGLIACOZZO 1998.
[58] UDRESCU/BEJENARU/HRISCU 1999
[59] DE GROSSI MAZZORIN/RIEDEL/TAGLIACOZZO 1998.
[60] BOUROVA 2006.

CONCLUSIONS

The data referring to the analyzed skeleton originating from the Latene pit 401 from Alba Iulia indicate a slender legged, medium-sized individual that died at the age of 3-3.5 years.

In order to have a larger perspective, data from a series of contemporary sites on the territory were taken as reference.We have processed the results of the analysis made on horses from the getic necropolis from Zimnicea (IV-II BC) (published by S. Haimovici[61] and A. Ganciu&S. Dumitrascu[62]), another LaTene horse skeleton from the same county (Seușa-Alba) published by G.ElSusi[63] and a scythian cemetery on the territory of Hungary- Szentes-Vekerzug[64] (from which we could use some osteometrical data).

The data for the metacarpals calculated with the same formula for the height recalculation and the slenderness index was represented as a box-plot graph. Despite the fact that the comparative elements are not so numerous, one can clearly tell that the studied Alba Iulia horse seems to be situated at the upper part of the set, with similar values to the horses discovered in Seușa[65] and Zimnicea[66], [67]above the values recorded for the individuals identified in Hungary[68].

The values seem different also from the perspective of the slenderness index- one can identify slightly more robust in Zimnicea (2015)[69] and Seușa[70], while the old set of horsees

[61] HAIMOVICI 1971.
[62] GANCIU/DUMITRASCU 2015.
[63] EL SUSI 2004.
[64] BOKONY 1952.
[65] EL SUSI 2004.
[66] HAIMOVICI 1971.
[67] GANCIU/DUMITRASCU 2015.
[68] BOKONY 1952.
[69] GANCIU/DUMITRASCU 2015.
[70] EL SUSI 2004.

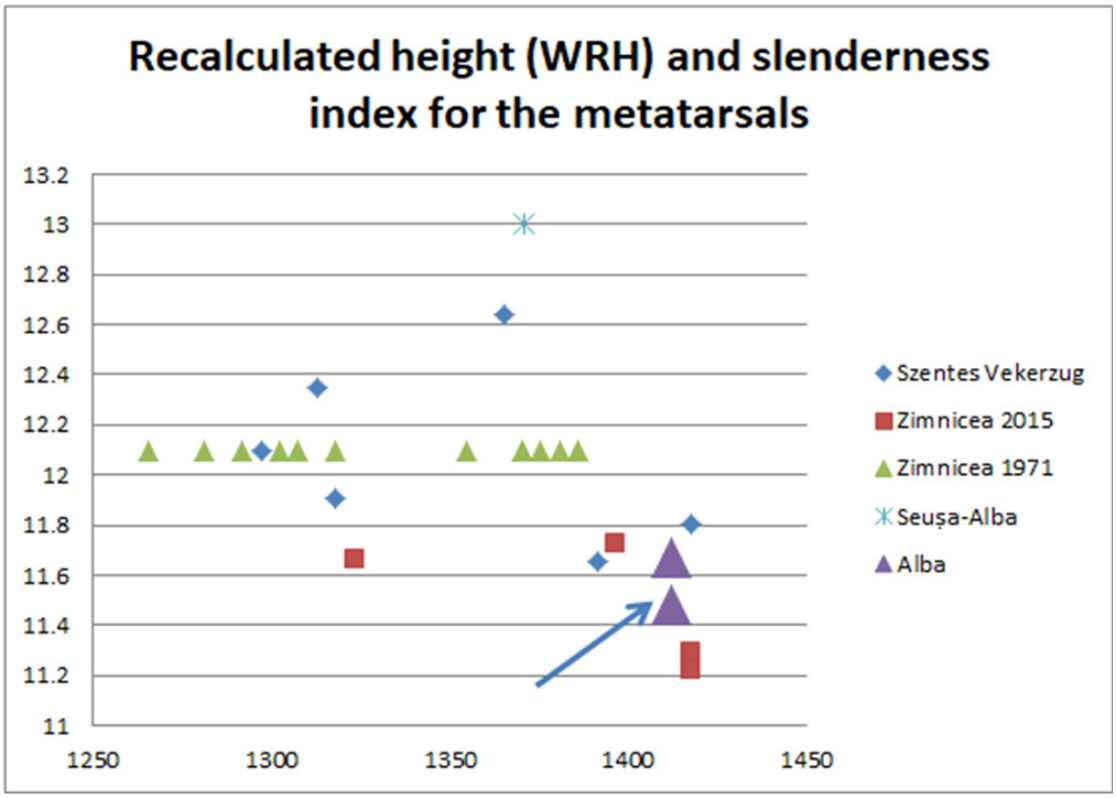

Fig. 8. Metatarsals- slenderness indices and recalculated height

identified in Zimnicea (1971)[71] show slighter smalller values. The smallest values for the slenderness indices were noted in the horses identified in Szentes-Vekerzug[72].

The metatarsals show a slightly different situation. Data is somehow similar to the Zimnicea (2015)[73] sets while the individuals identified in Hungary[74] seem to have a heterogenous distribution, mainly in terms of slenderness. As far as calculated heights are concerned, our sets seem to be slightly higher than the ones identified by Haimovici in 1971 in Zimnicea[75] but quite similar to those analyzed by Ganciu (also originating from Zimnicea)[76].

Even if the La Tène period seems to be representative for the existence of the warrior aristocracy and to be associated with many horse burials[77] (that were hinted to belong to elite ho rse's group), in the light of the insufficient available data it is hard to make a clear framing for the individual discovered in Alba-401 pit. Despite the well-known separation of the horses of the period into the "elite" and "ordinary" groups[78], [79] , [80], the limit in between these two groups is arbitrary set at 140 cm, both groups being slender-legged. Literature mentions the ordinary horses as being smaller in size, heterogenous in respect of morphological characters, while the elite horses are higher than 140 cm, (the figure of 150 cm + is mentioned) with slender legs and (by logical assumption) less heterogeneous as far as their osseous morphology is concerned. More than that, a more recent work o f Georgeta El Susi[81] presents a similar conclusion for some almost contemporary horse bones, assigning the individual to the "eastern group" but with an unclear outlining in respect of "elite" or "ordinary".

[71] HAIMOVICI 1971.
[72] BOKONY 1952.
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