CONGENITAL ANOMALIES OF ANIMALS IN WRITTEN AND PICTORIAL SOURCES

AZ ÁLLATOK VELESZÜLETETT RENDELLENESSÉGEI ÍROTT ÉS KÉPI FORRÁSOKBAN

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Abstract

Sources concerning various human congenital malformations are well known from early Antiquity to the Modern Times, but what about the animals? The first known source is the Šumma izbu, an ancient Mesopotamian compendium of around 2,000 teratological omens from 1300 BC. In these texts first descriptions of many disorders can be found such as different types of conjoined twinning or polydactyly. Some of these omens appear in the Roman Period by Julius Obsequens, Valerius Maximus and Tacitus. The thesis, that the Babylonian-Assyrian point of view spread through Asia Minor to the Greeks, and Romans originates from Morris Jastrow jr. (1914). The Latin term monstrum reflects the idea, that such phenomena sign some upcoming event to demonstrate the will of a deity. We have many more written and pictorial sources from the late Middle Ages from Ambroise Paré, Thomas Bartholinus and Ulisse Aldrovandi. The scarcity of comparable archaeological materials can be answered with four reasons:

1. Minor anomalies on the bones are hard to detect in the animal.

2. Many major abnormalities resulted in the animal's perinatal death. In this stage of development the bones are poorly mineralized, resulting a rapid dissolution.

3. Many inherited deformities affected the soft tissue, nearly always missing from archaeological materials.

4. Malformed stillborns were often fed to the dogs or thrown into rivers.

Kivonat

Az emberi torzszülöttekről számos forrás ismert az ókortól napjainkig, de vajon mi a helyzet az állatokkal? Az első ismert forrás a Šumma izbu, egy i.e. XIV. századi mezopotámiai jóslatgyűjtemény, amely nagyjából 2000 teratológiai óment tartalmaz. Ezek az eddig ismert első írásos emlékek olyan születési rendellenességekről, mint például a polydactylia, vagy a sziámi ikerség különböző formái. Ezek a jóslatok a római korban Julius Obsequens, Valerius Maximus és Tacitus munkáiban bukkannak fel újra. Morris Jastrow jr.-tól (1914) származik az az elmélet, miszerint a babilóniai-asszír szemlélet terjedt tovább kis-ázsiai és görög közvetítéssel Rómába is. A latin 'monstrum' terminus azt a hitet tükrözi, hogy egy ritka természeti jelenség olyan eljövendő eseményre utal, amelyben majd az isteni akarat megmutatkozik. A középkori babonák háttérbe szorulásával és a humanista orvostudomány fejlődésével többek között Thomas Bartholinus, Ulisses Aldrovandi vagy Ambroise Paré hatására egyre több olyan tudományos igényű mű született, amelyek képi ábrázolásokkal gazdagították az esetleírásokat. A forrásokkal összehasonlítható régészeti leletanyag hiánya négy pontban összegezhető:

1. A kisebb elváltozásokat nehéz azonosítani.

2. A nagyobb-fokú kóros elváltozások miatt a perinatális időszakban az állat elpusztul. Mivel ezen a fejlődési szinten a csontok mineralizációja még kezdeti stádiumban van, azok hamar feloldódnak a talajban.

3. Sok rendellenesség csak a lágyszöveteket érinti, ami szintén hamar elbomlik, így régészeti anyagban legtöbbször nem található meg.

4. A torz újszülötteket gyakran vetették állatok elé, vagy dobták őket folyóba.

KEYWORDS: TERATOLOGY, CONGENITAL MALFORMATIONS, CONJOINED-TWINS, BIRTH-OMENS

KULCSSZAVAK: TERATOLÓGIA, VELESZÜLETETT RENDELLENESSÉGEK, SZIÁMI IKREK, SZÜLETÉSI OMENEK

Introduction

The study of congenital anomalies and malformations is collectively called teratology. The term comes from the Greek word teras (τέρας), meaning 'omen, divine sign', and logos (λόγος), meaning 'the study of'. During Antiquity and the Middle Ages it was more about a discourse on monsters and prodigies, anything that was different from the normal. The name of the study reflects the concept of the times, when inexplicable phenomena of nature, birth of a 'monstrous' human or animal, were read as divine signs (Jastrow 1914, 60; Berndorfer 1960, 104; Pataricza 2011, 21). Pioneers of early Modern Age teratology are, among others Ambroise Paré, Conrad Lycosthenes, and Ulisse Aldrovandi who already used their own scientific results in embryology and anatomy, and criticized previous myths and legends (Berndorfer 1960, 111). Modern teratology founded by Johann Friedrich Meckel, the younger and Geoffroy St. Hilaire in the 19th century is more complex. It uses the results of embryology, obstetrics, clinical genetics and comparative anatomy in deciphering congenital anomalies (Berndorfer 1960, 103). There are three main factors which lead to such malformations: teratogens (environmental impacts), chromose deformations and genetical disorders (Czeizel 1986, 9; Pataricza 2011, 19). Because the complex interrelationships between these factors, there are still many unanswered questions concerning the causes of resulting diseases.

Extraordinary and unexplainable things have always been in the center of attention, therefore there are always more sources treating the unusual than the normal. I cannot undertake the task to present all the collected material in this short paper, but will try to give a comprehensive view of different sources through demonstrating a few examples, especially from pictorial sources.

The beginning

The first known source concerning congenital anomalies is the Šumma izbu, which is an ancient Mesopotamian compendium of around 2,000 teratological omens from 1300 BC. It offers an insight on the highest levels of medical science practiced by Assyrian scholars (Esztári 2012, 1).

The birth omens are interpretations of any birth defects in animals or humans as a divine sign. They are the first descriptions of many malformations and birth defects such as intersex (Jastrow 1914, 11), different forms of conjoined twining (Jastrow 1914, 14-17), polycephaly (Jastrow 1914, 23) or polydactyly (Jastrow 1914, 23). The cases are noted primarily on sheep, which shows, that sheep played the most important role in food production, but are also clearly applicable to other domesticates (Jastrow 1914, 18). There are several unrealistic statements in the text such as: „If an ewe give birth to ten…" (Jastrow 1914, 18). This is the last omen of a series about an ewe giving birth from one to ten lambs. As a matter of fact, this is hardly imaginable in the case of sheep, but it is common with dog or cat. This makes the idea somewhat more realistic. Another major group of the omens deals with cases of animals or women giving birth to neonates from another species (Jastrow 1914, 23-28).

"If an ewe gives birth to a lion, the abandoned weapons will make an attack (again), the king will be without a rival." (Jastrow 1914, 23).

Morris Jastrow jr., the first collector of these sources presumes, that behind these sentences there is the resemblance of features between animal species instead of the belief in the real opportunity of such an event (Jastrow 1914, 23-26). He mentions, that in many cases the direct equation is lifted by the preposition 'like' (Jastrow1914, 26). There is no doubt assumed to interprete the omens do not containing 'like', a comparison as well, and not like an extreme belief in cross-breeding. Some scholars raise doubts regarding the degree to which Mesopotamian medical texts were rooted in empirical experience (Fröhlich & Bácskai 2010, 9).

Some of these omens also appear during the Roman Period by Julius Obsequens, Valerius Maximus and Tacitus. The thesis that the Babylonian-Assyrian point of view spread through Asia Minor to the Greeks and Romans also originates from Jastrow (Jastrow 1914, 64, 79). The term monstrum, comes from the Latin verb monstrare 'pointing', reflecting the idea, that such phenomena signify some upcoming event and demonstrate the will of a deity (Jastrow 1914, 60; Pataricza 2011, 21). These 'signs' became divine warnings or punishments for sins in Christian philosophy (Jastrow 1914, 73, 79; Berndorfer 1960, 108, 110; Pataricza 2011, 21). During the Middle Ages the search for causes was overshadowed by narrow-minded Christian theology and the rise of demonology (Tóth G. 2009, 7, 9-10).

The imagery of human congenital malformations is well known from early Antiquity to Modern Times (Józsa 2006a, 2006b, 2007, 2008, 2011, 2012). In the following part of this paper I will attempt to demonstrate animal congenital disorders in pictorial sources, and compare them with modern clinical cases.

Conjoined twins

Conjoined twins are well-known among humans, in domesticated animals and even in wild species (Kompanje 2005a; Kompanje & Hermans 2008). There are different types of conjoined twins according to one of the eight possible points at which their bodies are conjoined (Kompanje & Hermans 2008, 177).

In horse breeding even twins are considered pathological, thus undesirable and in cattle the likelihood of giving life more than one calf, is between 1-4% (Zöldág et al. 2012, 74-75). The twin pigs shown in **Fig. 1.** belong to the syncephalus thoracopagus type: they have one head with a single face but four ears, and two bodies. This type is also mentioned in the Šumma izbu (Jastrow 1914, 13).

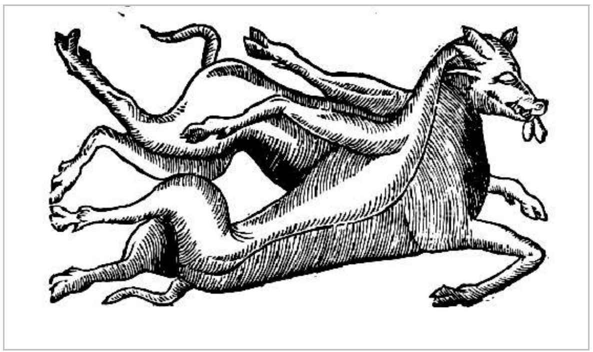

Fig. 1.: *Syncephalus thoracopagus* type conjoined pigs (Paré 1652, 653)

1. ábra: *Syncephalus thoracopagus* típusú összenőtt sertésikrek (Paré 1652, 653)

There are numerous engravings by Aldrovandi, illustrating such animals in older age (Aldrovandi 1642, 616-617., 620., 625-626), which may result from using an older source, or rooted in a rumour, but the picture of the stillborn conjoined cats on **Fig. 2.** is clearly based on personal observation by the author.

A special form of conjoining when the bodies are united laterally is called parapagus. This condition has two forms: 1. parapagus dicephalus - one shared body and two heads (also known as polycephaly); 2. parapagus diprosopus: one shared body and two faces on the head (Kompanje & Hermans 2008, 177). The first known appearence of this formation is a 120 million-years-old embryonic or neonate reptile fossil from northeastern China (Buffetaut et al. 2007). In some fortunate cases the animal also have the chance to survive and live with this kind of conjoining (Caulfield 2011). Parapagus dicephalus is well documented by Aldrovandi in domesticated animals (**Fig. 3.**) and also in fish, bird and reptile species (Aldrovandi 1642, 416-430). The malformation is also well known and documented in recent times in both wild (Gould & Pyne n. d., 157; Dabin et al. 2004; Kompanje 2005b) and domestic animals (Hámori 1974, 345). An intresting aspect of symbolism of the two-headed animals is that in Šumma izbu the two heads mean some kind of a division, and are thus always recorded as a bad sign (Jastrow 1914, 14-15), while in Antiquity and in the Middle Ages the double-headed eagle became the symbol of unity in the iconography of many noble and royal families in Europe and Asia (Hohenlohe-Waldenburg 1871, 17).

Dysmelia

Dysmelia is a collective name for various congenital diseases of the locomotor system. It can be caused by abnormal genes, inbreeding, external causes during pregnancy, infections and many other effects (Hámori 1974, 62-66).

Fig. 2.: Stillborn conjoined cats (Aldrovandi 1642, 621)

2. ábra: Halva született sziámi-iker macskák (Aldrovandi 1642, 621)

In the case of polymelia the individual has one or more supernumerary limbs (Moura & Pimpão 2012, 84). Jastrow (1914, 23) mentions omens, which possess supernummerary limbs and joints, but unfortunately he didn't publish the relevant omen. Julius Obsequens writes about a foal, born in 137 BC with five legs (Obsequens 24). This anomaly is richly documented by Aldrovandi (1642, 537, 539-569), but we also have modern examples in wild as well as domestic animals (Hámori 1974, 464; Denholm et al. 2011; Moura & Pimpão 2012, 73). In some of the illustrations there is no doubt, that the malformations represented are rather parasitic conjoined twins (Kompanje 2005a), which could be easily identified as polymelia (Aldrovandi 1642, 544-548).

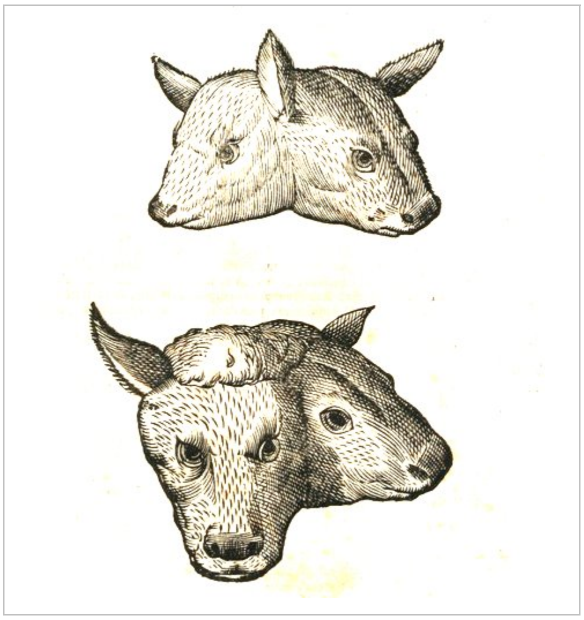

Fig. 3.: *Parapagus dicephalus* calves (Aldrovandi 1642, 423)

3. ábra: *Parapagus dicephalus* típusú ikerborjak (Aldrovandi 1642, 423)

Fig. 4.: Dog with amelia (Aldrovandi 1642, 428)

4. ábra: Kutya veleszületett végtaghiánnyal (*amelia*) (Aldrovandi 1642, 428)

Apodia is a collective term describing disorders when the individual has completely or partly missing legs, such as arthrogryposis, phocomelia or amelia. It is result of the limb formation process being disrupted very early in its development. It could also be also caused by grave malnutrition, toxicity or radioactivity (Hámori 1974, 464). Amelia is a homogene hereditary anomaly, in which the forelimbs are completly missing. It has been described in recent cattle, pigs, goats, dogs and cats (Hámori 1974, 465; Zöldág 2003, 175). Aldrovandi (1642, 527-528, 526) reported three cases of amelia: two in dogs (one shown in **Fig. 4.**) and one in the case of a calf.

Polydactyly (having supernumerary digits) is a minor hereditary anomaly, well known both in human and veterinary medicine (Józsa 2006c, 58). It is usually associated with other genetic mutations such as syndactyly (the fusion between digits; Hámori 1974, 464), but it has only little of no effects on the animal's quality of life (Moura & Pimpão 2012, 76). Even so there is only one secondary reference to polydactyly by Aldrovandi (1642, 539) taken from the Historiae monstris of Honorius Beatus without any further usable information (**Fig. 5.**). Baker & Brothwell (1980, 41) mention without refenrence, that the Incas bred camelids with polydactyly. This minor anomaly is known even in wild guanaco populations (Zapata et al. 2008).

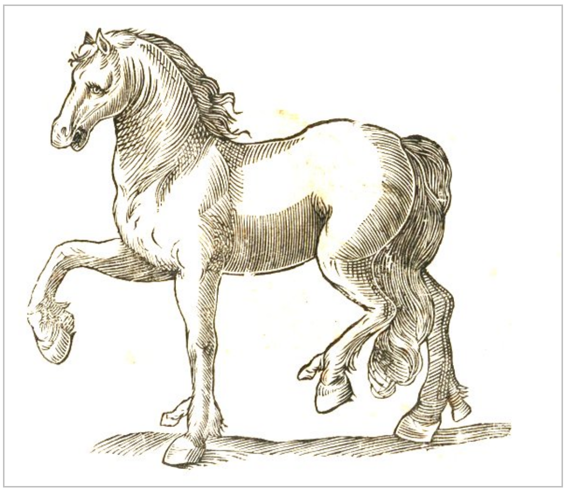

Fig. 5.: A horse with polydactyly (Aldrovandi 1642, 438)

5. ábra: Ló polydactyliával (Aldrovandi 1642, 438)

Missing material

The imagery of human dieseases is more common, but there can be different reasons: why? Thanks to the human medicine we have always had better chances to survive with a non- lethal malformation or defect than an animal. For example, dwarfs have been in the centre of attention since the dawn of civilisation (Józsa 2011, 21), and many were denoted for their outstanding intelligence (Józsa 2006c, 57). This also applied to conjoined twins. Unfortunately I have found only a few hungarian reports of such anomalies, but none of these deals with animals, but humans.

Baker & Brothwell (1980, 33) explained the lack of comparable archaeozoological material with three simple reasons. These factors are common both in human and animal paleopathology:

1. The discovery of minor bone anomalies requires a very detailed knowledge of anatomy and solid research. However, they are still hard detect not only during analysis, but already when collecting bones in the field (Józsa 2006, 55).
2. Many abnormalities result in the animal's death already within the perinatal period. At this early stage of development the poorly mineralized young bone is prone to taphonomic loss, such as scavenging or rapid dissolution (Józsa 2006, 55).
3. Genetic deformities often affected the soft tissue, which is nearly always missing from the archaeological material.

There is another aspect, that Baker & Brothwell (1980) included in the second group: stillborns are also often fed to the dogs or thrown into rivers (Jastrow 1914, 72; Baker & Brothwell 1980, 33). In my opinion this is a fourth reason worth distinguishing, because it is related to the contemporaneous cultural context rather than to natural (physiological or environmental) factors.

Conclusions

Currently, archaeozoological evidence for such disorders is limited to the rare evidence of non-lethal malformations such as syndactily in the form of fused distal phalanges of an undated pig reported from Osborne House (Romsey, England; Siegel 1976, 369, Fig. 8/c). Late Bronze Age cattle metatarsi from Dun Aonghasa (County Galway, Ireland) showed signs of polydactily in the form of minor outgrowths on the side. These two distal fragments probably originated from the same adult individual (Murphy 2005, 11, Fig 4). In sheep and goat archaeological finds of multiple horns (polyceratia) are not considered pathological and have in fact been embraced by breeders in various periods (Putelat 2005). They include a three-horned bock, a childhood pet of the Grand Duke of Saxony in the 1820's (Wussow 1997, 84, Abb. 3).

It is clear, that there is a need for a more expansive and systematic collection of the written and pictorial sources as well as careful observation recording of rare archaeozoological finds to answer all questions relevant to the topic and develop a better understandig of animal breeding in the past and the historical perception of congenital disorders.

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HU ISSN 1786-271X; urn: nbn: hu-4106

MEAT SUPPLIES OF THE MARKETS OF MEDIEVAL AND EARLY MODERN AGE DEBRECEN (NE HUNGARY)

DEBRECEN KÉSŐ KÖZÉP- ÉS KORA ÚJKORI PIACAINAK HÚSELLÁTÁSA

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Abstract

The aim of this paper is to compare animal bone material from seven different sites in and around the Old-Town of Debrecen. During the analysis over 13,000 bone fragments were identified from the Middle and Early Modern Ages. These impressive numbers offer an opportunity for drafting the organization of meat supplies in Debrecen during these historical periods, and help understanding butchery techniques and conventions.
The other goal of the paper was to reconsider the concept of workshops and use it in the case of butcheries. Are they real workshops or not? And if they are, is it possible to investigate them by the "general workshop identifier" criteria? Possibly yes, because, like the other workshops, butchery has special processes.

Kivonat

A tanulmány célja hét különböző lelőhely állatcsont anyagának összehasonlítása Debrecen óvárosából. Az elemzések során több, mint 13.000 állatcsont töredéket sikerült meghatározni a lelőhelyek késő közép- és kora újkorra keltezett objektumaiból. A leletek nagy számának köszönhetően megkísérelhetjük felvázolni Debrecen városának húsellátását, a mészárlás módját és szokásait ebben a két történeti időszakban. A vizsgálatok másik célja újraértelmezni a műhely fogalmát és koncepcióját a mészárszékek esetében. Értelmezhetőek-e a mészárszékek műhelyekként, vagy sem? Ha igen, úgy használhatjuk-e a műhelyek lokalizációjára használt általános kritériumokat? Nagy valószínűséggel igen, hiszen a mészárszékek ugyanolyan sajátos műveleti folyamatokkal rendelkeznek, mint a műhelyek általános típusai.

KEYWORDS: DEBRECEN (NE HUNGARY), MEAT SUPPLIES, MEDIEVAL, EARLY MODERN, BUTCHERY

KULCSSZAVAK: DEBRECEN, HÚSELLÁTÁS, KÖZÉPKOR, KORA ÚJKOR, MÉSZÁRSZÉK

Introduction

Between 2000 and 2004 archaeologists of the Déri Museum in Debrecen performed many rescue excavations in and around Debrecen (NE Hungary, **Fig. 1.**). During these excavations a large number of animal bones came to light.

During the course of the last subsequent years the author of this paper identified more than 13,000 animal bone fragments from seven different sites in the Old Town of Debrecen. These bones were dated to the Medieval or the Early Modern periods.

The city of Debrecen occupied a very peculiar position during the Middle and the Early Modern Ages. Debrecen was not a real city, rather an *oppidum*, but had all the privileges of a city in this "city-less" non-urbanized area of the Hungarian Kingdom (Kubinyi 1989, 230).

Debrecen was first mentioned in the written sources in the *Regestrum* of Várad in 1235. (**Fig. 2.**) Later on, in 1361, King Louis I. granted privileges to the town (Módy 2006, 53). From the middle of the 15th century onwards the town played a very important role in the intensive cattle export of the Late Middle and the Early Modern Ages.

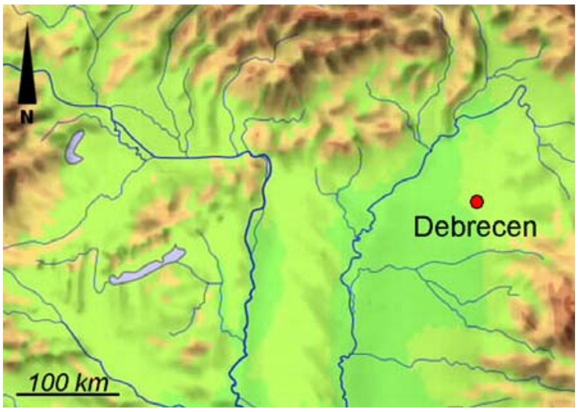

Fig. 1.: Map of the Carpathian Basin (after the geographical map by László Zentai 1996)

1. ábra: A Kárpát-medence térképe. Zentai László (1996) alapján

On account of the Late Medieval demographic explosion in the western parts of Europe, there was a huge demand for meat and livestock markets opened for the trade. This phenomenon stimulated Hungarian cattle exports which grew strong by the 16th century (Bartosiewicz & Gál 2003, 365).

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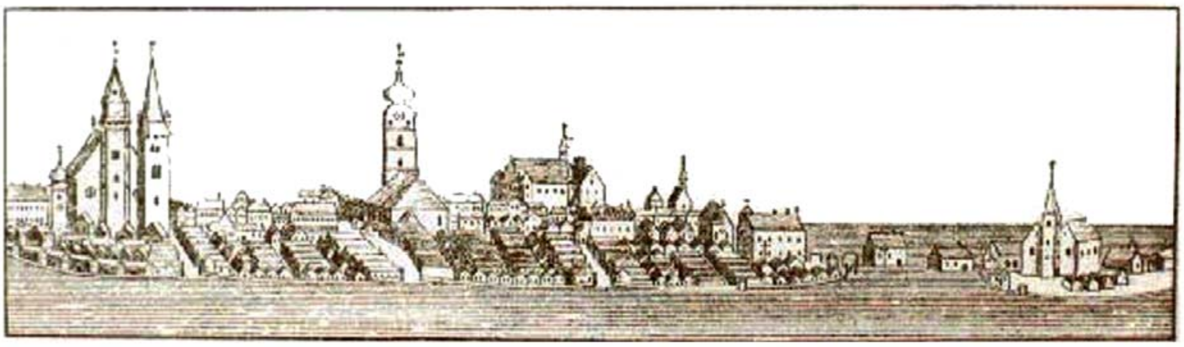

Fig. 2.: The town of Debrecen in the Early Modern Age

2. ábra: Debrecen az újkorban
(http://portal.debrecen.hu/varosunk/varostortenet/debrecentortenete1_varostortenet.html)

Thousands of the "fatty-beef" Hungarian cattle were herded on foot to Central-European transit markets (Venice, Austria, Hanseatic cities). On the basis of the customs records we have a lot of data concerning this intensive trading activity (Bartosiewicz 1997-1998, 41).

The presence of the *primigenius* cranial type of cattle began to become common, as a non-demanding but strong form providing good beef. Breeding of these types was ideal for the characteristic of the development of the different *primigenius* cattle-types, such as the Hungarian Grey that appeared later (Matolcsi 1975, 141).

Debrecen, as a town involved in trade and animal husbandry, emerged as an important market and redistribution centre for all forms of livestock in the Middle and Early Modern Ages. Cattle, however, was most important of all (Balogh 2006, 476).

Material, method and results

Almost all investigated sites are located within the current Old-Town of Debrecen. (**Fig. 3.**) This is very important, because comparisons between the sites show potential differences between the human populations inhabiting different parts of the city. On the basis of written sources we know, that the different areas and streets had their own herds (Balogh 2006, 478). The town owned common greens and the inhabitant smaller or bigger lots. The farthest greens were actually guarded by gunmen (Balogh 2006, 479).

The main aim of this paper is the analysis of similarities and differences between the butchery practices as well as the animals themselves observed at the seven sites.

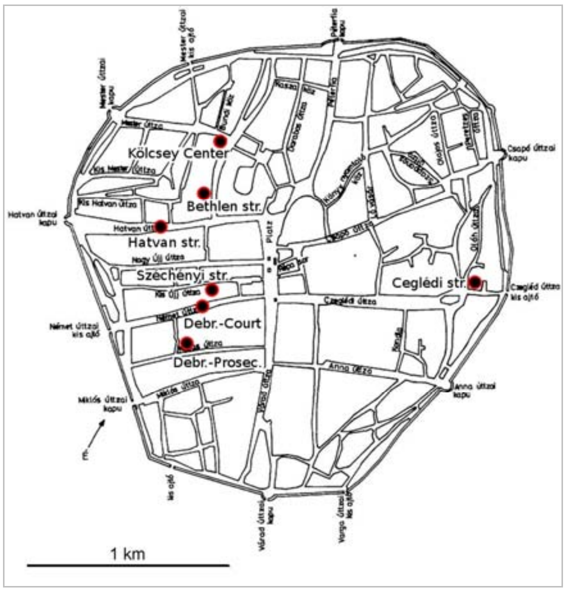

Fig. 3.: Location of the sites in the Early Modern Age Debrecen (After the map of György Kováts from 1750, HBML. D vT.2.)

3. ábra: A lelőhelyek elhelyezkedése az újkori Debrecenben (Kováts György 1750-es térképe nyomán, HBML. D vT.2.)

Differences and similarities

Species ratios

Although the representation of the main domestic species and the negligible contribution by game to meat supplies seems to be similar at the studied sites, a Chi-square test indicated statistically significant differences between the proportions of various animals consumed.

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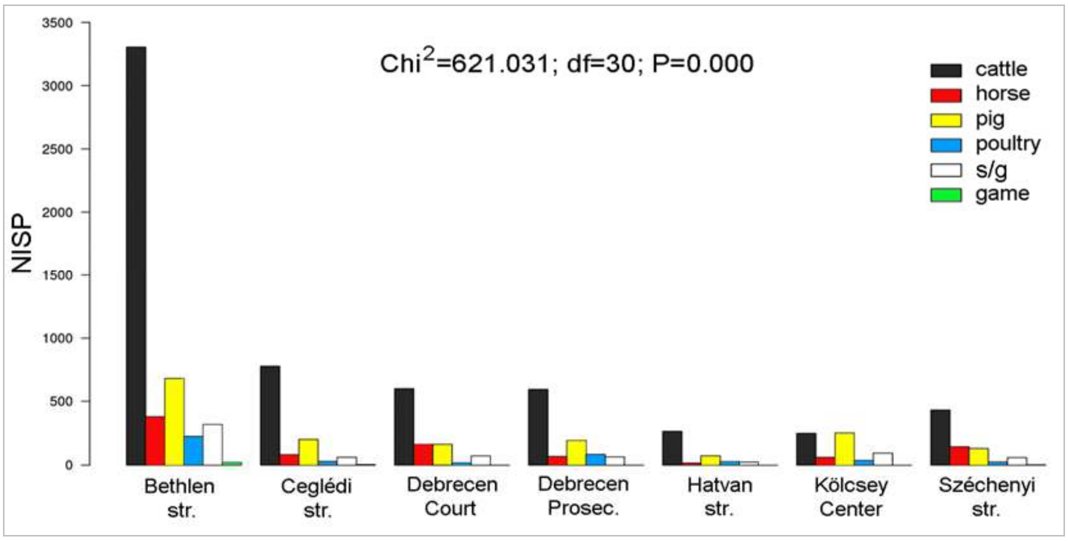

Fig. 4.: Diagram of the most important domestic species and hunted animals

4. ábra: A legfontosabb háziállat fajok és a vadak mennyisége eloszlása a lelőhelyeken

A possible source of this phenomenon may be the different proportions observed between the numbers of small ruminant remains and pig bones. In the Hungarian Middle Ages and Early Modern Age, the dominance of cattle bones was overwhelming and differences between sites often originate from such varying ratios of small stock. (**Fig. 4.**). Moreover the proportion of poultry remains also varies strongly between sites. While the number of poultry bones was hardly affected by contemporaneous taphonomic processes such as butchering, these small bones are more prone to being lost during excavations if the material is not sieved.

Written sources refer to ownership of land in each medieval street. Since differences in habitation mirror potential social differences, everyday meat-eating customs may also have differed between areas in the city and are possibly reflected by differences in the proportion of bones representing various species (Csippán 2008, 305).

Comparison of the sizes

Cattle (*Bos taurus* L.)

Fortunately numerous data are at service for us to calculate the withers heights of the most important domestic species. It is a fine possibility to compare the size of the animals from the distinct sites. (**Fig. 5.**)

On the basis of the comparison of the withers heights of cattle, we can say that essentially, the middle size category of the cattle was very similar between the disparate streets which were represented by the sites. Although the sizes of the cattle had a relatively big spread of withers heights, show the varied characteristics of the cattle stocks.

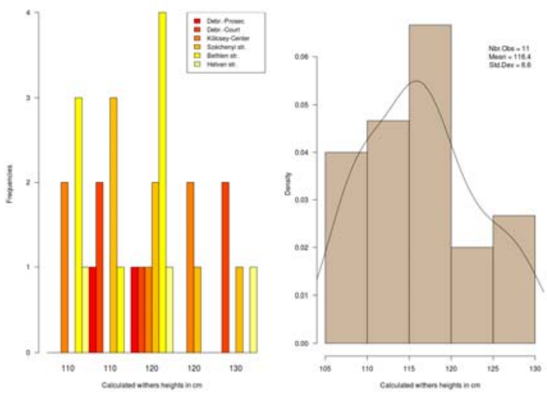

Fig. 5.: Withers heights of cattle from the sites

5. ábra: A számított szarvasmarha marmagasságok

Horse (*Equus caballus* L.)

Horse bone measurements suggest, that the size variability in these animals was similar to that of cattle. Altogether five of the sites yielded comparable data showing that the withers heights of these animals (after Vitt 1952) varied broadly between 130 to 150 cm. (**Fig. 6.**)

Pig (*Sus domestica* Erxl.), dog (*Canis familiaris* L.) and small ruminants (*Ovis aries* L. and *Capra hircus* L.)

Calculations of withers heights was also possible in the case of these domestic species but in smaller numbers. Only eight times in small ruminants (possible sheep) (Mean = 59.9±3.4 cm) (after Teichert 1975), six cases of dogs (Mean = 55.6±9.5 cm) (after Koudelka 1885) and only one case in domestic pig (75.5 cm) (after Teichert 1969).

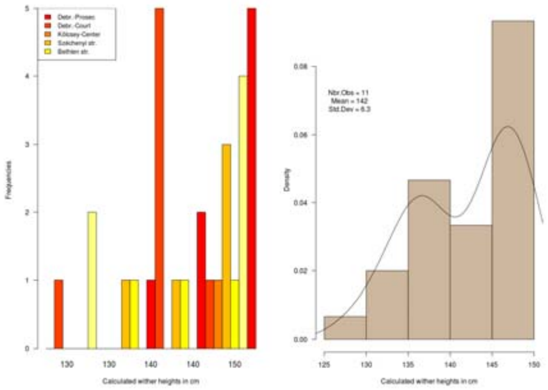

Fig. 6.: Withers heights of horses from the sites

6. ábra: A számított háziló marmagasságok

The size of the small ruminants (possibly sheep) were seemingly balanced. The body size of these animals were typically small and they were under the mean of the periods (Bökönyi 1974, 171).

The sizes of small ruminants (possibly sheep) seem to be balanced. The body size of these animals was small with their withers heights not reaching the average of other periods (Bökönyi 1974, 171). The withers heights dogs were diverse, medium and medium-large size dogs were common.

Age at death of the animals (kill-off patterns)

Kill-off patterns at the sites seem to be different, although the representations of the species are not equal in terms of the numbers of ageable teeth and bones.

Cattle were usually killed in their subadult and adult ages, except at the site of Széchenyi street where the proportion of juvenile individuals was equal with the proportions of adult and subadult individuals.

The ages of slaughter for sheep and goats are almost the same as those of cattle, but food refuse from the site of Debrecen –Prosecution shows a preference for meat from young lambs/kids. The high proportion of adult and subadult pigs remains noted at almost all sites is uncommon. Pigs tend to be killed at a younger age than other domesticates, since their sole form of exploitation is meat and fat. (**Fig. 7.**)

There is a huge ratio of adult and subadult pigs at almost all sites. It is very uncommon, because the exploitation possibilities of this species are limited to meat utilization only.

Butcheries as special meat-packing workshops

Written sources reveal, that seven of butcheries operated in the Debrecen during the late 18th century. Various streets represented in this study had potentially differing meat consumption habits or different access to meat. The question is whether one can recognize the location of butcheries or not?

If we can generalize butcheries like product-manufacturing workshops, the answer is probably yes.

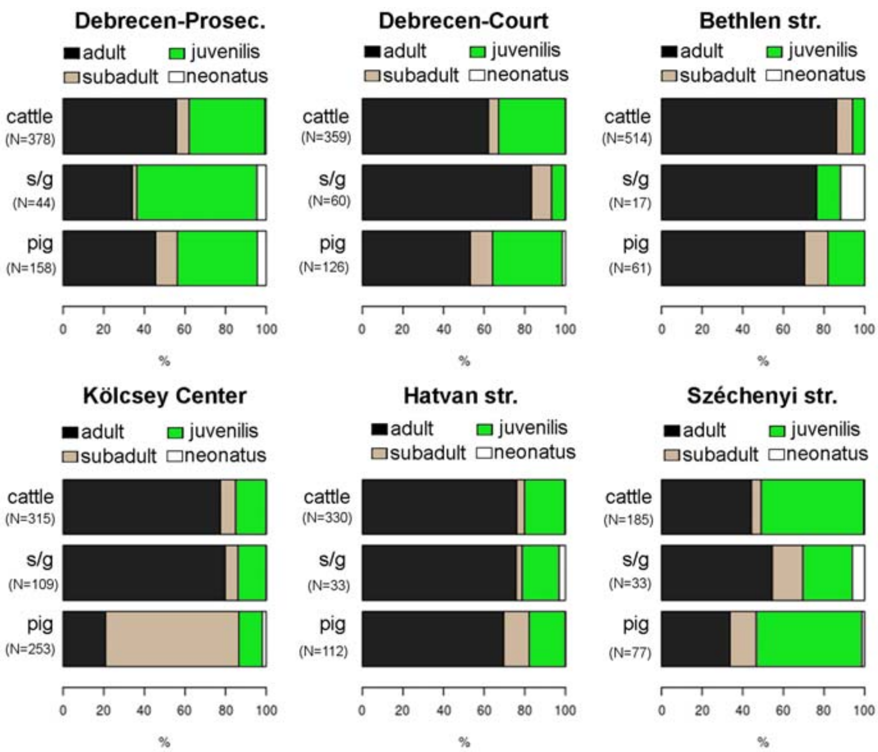

Fig. 7.: Kill-off patterns of the main domestic species

7. ábra.: A főbb gazdasági haszonállatok leölési életkora

The localization of workshops has six main criteria in archaeology (Csippán 2010, 32):

- Archaeological features which strongly connected to the activity in question

- Special tools
- Raw material(s)
- End product
- Workshop waste:
    - semi-finished product
    - reject
    - real debris
- Complementary information I written and iconographic sources.

For interpreting this method, we have to modify the criteria for the special case of the butcheries as follows:
- Special features (the butchering is not associated with archaeologically identifiable special features)
- Special tools (the butchers are not using only very special tools, markedly different from those found in common households or other workshops.
- Raw material and waste (the tangible raw material of butcheries is equal with archaeologically observable waste: animal bones)

In the case of the Debrecen butcheries another “localization criterion” may be used: the dominance of cattle bones with a near absence of butchering waste from other species.

The explanation of this phenomenon is that during the Middle- and Early Modern Ages only cattle were processed in butcheries. The rules of the guilds prescribed, that small stock (pigs, small ruminants) be killed by a sticker at home. If such rules are reflected in the find materials of butcheries they may be considered special workshops (Frecskay 1912, 266).

Because animal remains offer the only possibility to identify butcheries as workshops, the quality and quantity of the bone finds need further analysis..

Localization of a Pre-Modern Age butchery in the centre of Debrecen

During the analysis of the animal remains from the Ceglédi street site, located at the edge of Old Town, remarkable differences were noted in the proportions of several body parts. The massive dominance of bones from practically meatless body regions was noticed. These finds are not typical kitchen waste but tend to originate from primary butchering. Skull fragments, horn cores and „dry limb” bones came to light in large numbers (D. Szabó–Csippán 2006, 49). (**Figs. 8-9**)

On the basis of the hypotheses presented above we can interpret the differences in the presence and absence of species and/or body regions.

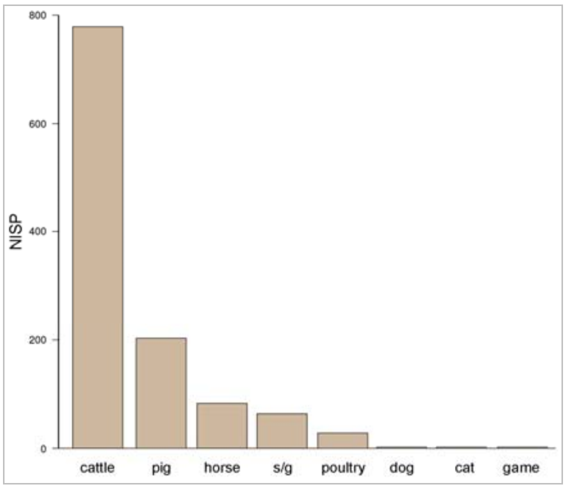

Fig. 8.: Diagram of the most important domestic species and hunted animals from the site of Ceglédi street

8. ábra: A főbb gazdasági haszonállatok és a vadászott állatok aránya a Ceglédi utcai lelőhelyen

In addition to the conspicuous presence of meatless cattle bones in a few features, the absence of remains representing other species is also notable.

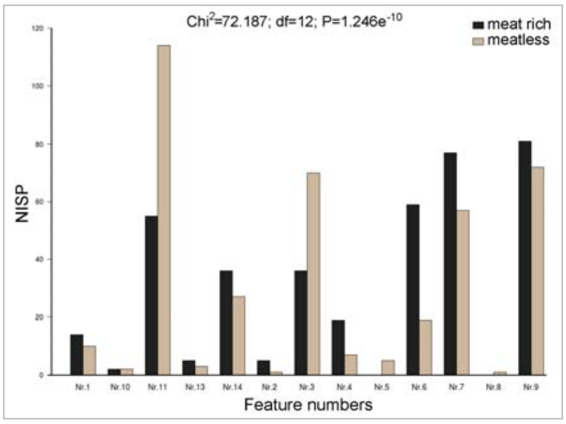

Fig. 9.: Distribution of meat-rich and meatless body regions in the features

9. ábra: A húsban gazdag és a húsban szegényebb régiók eloszlása az egyes objektumokban

The overrepresentation of meatless regions is significant in features Nr. 3 and Nr. 11. The composition of find material recovered from these features seems to be totally different from those the other as skull fragments, horn cores, metapodia, phalanges etc. constitute the majority of finds. The absence of other mammals and of poultry strengthen the argument, that finds from these two features are strongly connected to primary butchering of cattle.

Aside from this osteological evidence, there are fortunately numerous written sources concerning Ceglédi street. In 1770, the royal commissioner Miklós Forgách ordered the establishment of new butcheries inside the town and all of these butcheries had to slaughter four cattle a day (Gyimesi 1981, 370).

We know, that seven butcheries worked in Debrecen in the 1780s, and one of them was near by the gate of the town in the Kis-Cegléd street (Zoltai é. n., 187).

It is also known that seven butcheries worked in Debrecen during the 1780s, and one of them near operated near the city gate opening to Kis-Cegléd street (Zoltai é. n., 187). The owner of this butchery was the town itself. János Nagy rented it in 1825 (HBML IX. 22.2). Finally, the butchers' activity was prohibited by the Town Council in 1854 (Szűcs 1976, 48).

Conclusion

Animal bones were compared between seven different sites from the centre of Late Medieval and Early Modern Age Debrecen, Hungary. Written sources attest to the great importance of livestock trade in this town during the discussed periods. The seven sites represent the diversity of meat consumption in different parts of the *oppidum*. This diversity, however, not only shows the prevailing customs of meat consumption.

Animal remains also offer information on the body dimensions of domestic animals. Some sites yielded the remains of smaller individuals than others, although on the basis of the t-tests, we can conclude the homogeneity of size distributions. The small differences may originate from the different composition of animals in the refuse deposits in terms of age and sex. The sizes of dog, albeit based only on five measurements only, are indicative of tall or medium size animals.

The relative lack of bones from the meat rich body parts of cattle in certain features suggested, that the finds from Ceglédi street are not ordinary kitchen waste. Using the "General workshop localization criteria" these bones may be considered refuse of primary butchering activity. On the basis of the diversity of animal bone finds a draft of differential meat consumption could be sketched at the seven sites excavated in the city of Debrecen. Considering the quality and quantity of meat represented by the animal remains, not only consumption, but also beef production and the location of a butchery could be reconstructed using the evidence of animal remains.

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Appendix

Table 1.: Basic statistics of the withers heights of cattle from the sites

1. táblázat: A szarvasmarha marmagasságok alapstatisztikai adatai

	Bethlen str.	Hatvan str.	Debrecen Prosec.	Debrecen Court	Kölcsey Centre	Széchenyi str.
Number	8	3	2	5	5	7
Mean value	113.6	117.1	114.9	119.5	116.7	117.3
Standard deviation	5.8	11.5	0.5	8.2	7.4	5.1

Table 2.: Basic statistics of the withers heights of horses from the sites

2. táblázat: A háziló marmagasságok alapstatisztikai adatai

	Bethlen str.	Debrecen Prosec.	Debrecen Court	Kölcsey Centre	Széchenyi str.
Number	7	5	5	2	11
Mean value	145.7	138.0	143.7	142.5	140.7
Standard deviation	6.0	5.8	9.0	6.7	4.9

Table 3.: Results of the unpaired Student t-test (2-tailed) of cattle's withers heights

3. táblázat: A szarvasmarha marmagasságok összehasonlításának eredményei kétvégű t-próbával

	Debrecen-court N=5 Mean=119.526 Std.er.=3.68	**Kölcsey-Centre N=5 Mean=116.71 Std.er.=3.287**	**Bethlen str N=8 Mean=113.63 Std.er.=2.043**	**Széchényi str N=6 Mean=117.88 Std.er.=2.146**
Debrecen-court N=5 Mean=119.526 Std.er.=3.68	–	t=0.5703 p=0.5841 df=8 confidence int.=0.95	t=1.5261 p=0.1552 df=10 confidence int.=0.95	t=0.4029 p=0.6964 df=9 confidence int.=0.95
Kölcsey-Centre N=5 Mean=116.71 Std.er.=3.287	t=0.5703 p=0.5841 df=8 confidence int.=0.95	–	t=0.8448 p=0.4162 df=11 confidence int.=0.95	t=0.3079 p=0.7652 df=9 confidence int.=0.95
Bethlen str N=8 Mean=113.63 Std.er.=2.043	t=1.5261 p=0.1552 df=10 confidence int.=0.95	t=0.8448 p=0.4162 df=11 confidence int.=0.95	–	t=1.2830 p=0.2219 df=13 confidence int.=0.95
Széchényi str N=6 Mean=117.88 Std.er.=2.146	t=0.4029 p=0.6964 df=9 confidence int.=0.95	t=0.3079 p=0.7652 df=9 confidence int.=0.95	t=1.2830 p=0.2219 df=13 confidence int.=0.95	–

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Table 4.: Results of the unpaired t-test (2-tailed) of horse's withers heights

4. táblázat: A szarvasmarha marmagasságok összehasonlításának eredményei kétvégű t-próbával

	Debrecen-court N=5 Mean=143.73 Std.er.=4.0289	**Debrecen-Prosec. N=5 Mean=138.04 Std.er.=2.572**	**Bethlen str N=7 Mean=145.68 Std.er.=2.25**	**Széchényi str N=11 Mean=140.65 Std.er.=1.482**
Debrecen-court N=5 Mean=143.73 Std.er.=4.0289	–	t=1.1891 p=0.2685 df=8 confidence int.=0.95	t=2.2183 p=0.0508 df=10 confidence int.=0.95	t=0.4542 p=0.6594 df=10 confidence int.=0.95
Debrecen-Prosec. N=5 Mean=138.04 Std.er.=2.572	t=1.1891 p=0.2685 df=8 confidence int.=0.95	–	t=2.2183 p=0.0508 df=10 confidence int.=0.95	t=0.9359 p=0.3652 df=14 confidence int.=0.95
Bethlen str N=7 Mean=145.68 Std.er.=2.25	t=1.5648 p=0.1487 df=10 confidence int.=0.95	t=2.2183 p=0.0508 df=10 confidence int.=0.95	–	t=1.9491 p=0.0690 df=16 confidence int.=0.95
Széchényi str N=11 Mean=140.65 Std.er.=1.482	t=0.4542 p=0.6594 df=10 confidence int.=0.95	t=0.9359 p=0.3652 df=14 confidence int.=0.95	t=1.9491 p=0.0690 df=16 confidence int.=0.95	–

Table 5.: Measurements

5. táblázat: Csontméretek

Site/Species	**Bone**	**Measurements** (in mm)	**Withers height** (in cm)
Debrecen-Prosecution			
Cattle	*Metacarpus III-IV sin*	GL= 185.3; BP= 55.9	114.51; ?
	Metatarsus III-IV sin	GL= 216.0; BP= 46.0	115.12; ♀
Horse	*Metacarpus III sin*	GL= 214.0	133.2
	Metacarpus III dex	GL= 232.0	142.56
	Metacarpus III sin	GL= 234.0	145.21
	Metatarsus III dex	GL= 262.0	137.26
	Humerus sin	GL= 280.0	132.0
Pig	*Astragalus sin*	GL= 42.2	75.53
Sheep/Goat	*Metacarpus III-IV dex*	GL= 121.0	58.56
	Metatarsus III-IV sin	GL= 119.7	53.98

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Table 5.: Measurements, cont.

5. táblázat: Csontméretek, folyt.

Site/Species	**Bone**	**Measurements** (in mm)	**Withers height** (in cm)
Debrecen-Court			
Cattle	*Metacarpus III-IV sin*	GL= 183.0; BP= 50.0	110.35; ♀
	Metacarpus III-IV sin	GL= 212.0; BP= 57.7	127.83; ♀
	Metacarpus III-IV dex	GL= 184.6; BP= 59.0	116.85; ♂
	Metatarsus III-IV sin	GL= 214.0; BP= 47.1	114.06; ♀
	Metatarsus III-IV sin	GL= 235.0; BP= 55.1	128.54; ?
Horse	*Metacarpus III sin*	GL= 246.0	149.98
	Metacarpus III dex	GL= 205.0	128.25
	Femur dex	GL= 425.0	150.0
	Metatarsus III sin	GL= 275.0	144.15
	Metatarsus III sin	GL= 279.0	146.27
Sheep/Goat	*Metacarpus III-IV sin*	GL= 128.1	62.0
	Metatarsus III-IV dex	GL= 135.0	60.8
Hatvan street			
Cattle	*Metacarpus III-IV dex*	GL= 208.9; BP= 63.5	129.1; ?
	Metacarpus III-IV dex	GL= 176.0; BP= 48.2	106.12; ♀
	Metatarsus III-IV sin	GL= 218.0; BP= 44.8	114.48; ♀
Bethlen street			
Cattle	*Metacarpus III-IV dex*	GL= 178.0; BP= 50.0	107.33; ♀
	Metacarpus III-IV dex	GL= 184.0; BP= 48.8	110.95; ♀
	Metacarpus III-IV dex	GL= 199.0; BP= 51.9	119.99; ♀
	Metacarpus III-IV sin	GL= 197.0; BP= 51.8	118.79; ♀
	Metacarpus III-IV sin	GL= 198.0; BP= 49.7	119.39; ♀
	Metatarsus III-IV sin	GL= 200.0; BP= 44.7	106.6; ♀
	Metatarsus III-IV sin	GL= 220.0; BP= 41.6	117.26; ♀
	Metatarsus III-IV dex	GL= 204.0; BP= 42.2	108.73; ♀
Horse	*Radius dex.*	GL= 322.0	132.8
	Metacarpus III dex	GL= 236.0	144.68
	Tibia sin	GL= 377.0	148.8
	Tibia dex	GL= 380.0	150.0
	Metatarsus III dex	GL= 277.0	147.21
	Metatarsus III dex	GL= 280.0	146.8
	Metatarsus III sin	GL= 285.0	149.45
Dog	*Humerus sin*	GL= 187.0	63.02
	Radius dex	GL= 195.0	62.79
	Tibia dex	GL= 219.0	63.95

Table 5.: Measurements, cont.

5. táblázat: Csontméretek, folyt.

Site/Species	*Bone*	Measurements (in mm)	Withers height (in cm)
Kölcsey-Centre			
Cattle	*Metacarpus III-IV dex*	GL= 182.0; BP= 52.6	109.75; ♀
	Metacarpus III-IV dex	GL= 206.0; BP= 60.3	124.21; ♀
	Metacarpus III-IV sin	GL= 200.0; BP= 60.0	123.6; ♀
	Metatarsus III-IV dex	GL= 220.0; BP= 39.4	117.26; ♀
	Metatarsus III-IV sin	GL= 204.0; BP= 41.9	108.73; ♀
Horse	*Radius sin*	GL= 358.0	147.2
	Metacarpus III dex	GL= 223.0	137.79
Sheep/Goat	*Metacarpus III-IV sin*	GL= 126.0	60.98
	Metatarsus III-IV dex	GL= 126.0	56.82
Dog	*Humerus dex*	GL= 117.7	39.66
Széchényi street			
Cattle	*Metacarpus III-IV sin*	GL= 184.0; BP= 52.4	110.95; ♀
	Metacarpus III-IV sin	GL= 208.1; BP= 58.1	125.48; ♀
	Metacarpus III-IV dex	GL= 182.0; BP= 64.7	115.2; ♂
	Metacarpus III-IV dex	GL= 188.0; BP= 56.1	119.04; ♂
	Metacarpus III-IV dex	GL= 190.5; BP= 52.1	114.87; ♀
	Metacarpus III-IV dex	GL= 201.9; BP= 57.0	121.74; ♀
	Metatarsus III-IV dex	GL= 213.0; BP= 45.7	113.53; ♀
Horse	*Humerus sin*	GL= 292.0	136.8
	Humerus dex	GL= 290.0	136.0
	Metacarpus III dex	GL= 219.4	135.88
	Metacarpus III dex	GL= 238.1	145.79
	Femur sin	GL= 400.2	140.08
	Metatarsus III sin	GL= 258.2	135.248
	Metatarsus III sin	GL= 261.9	137.207
	Metatarsus III sin	GL= 277.0	145.21
	Metatarsus III dex	GL= 281.5	147.595
	Metatarsus III dex	GL= 267.2	140.016
	Metatarsus III dex	GL= 281.1	147.389
Sheep/Goat	*Radius sin*	GL= 154.0	61.6
	Metacarpus III-IV dex	GL= 133.8	64.76
Dog	*Humerus sin*	GL= 154.0	51.89
	Humerus sin	GL= 155.1	52.26

HU ISSN 1786-271X; urn: nbn: hu-4106 © by the author(s)

CORRELATION BETWEEN SKULL SIZE AND AGE IN HUNGARIAN GREY CATTLE

A MAGYAR SZÜRKE MARHA KOPONYAMÉRETEK ÉS AZ ÉLETKOR KÖZÖTTI KORRELÁCIÓ

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Abstract

Relationships between age and certain cranial measurements were studied on 108 skulls of Hungarian Grey cattle kept in the Osteological Collection of the Hungarian Agricultural Museum. These skulls originated from individuals of 2 to 16 years of age. The cranial measurements were plotted in diagrams and the character of their relationship to age was studied using linear regression equations. The correlation factor shows a close link between the change of size and the progress of age. In the case of 20 measurement age-dependent increase could be observed, while a decrease occurred only in 3 measurements. Twenty-four measurements were independent of the individuals' age. In case of 14 sizes the correlation is medium, in case of 8 sizes the correlation is closer than medium and in case of 2 sizes the correlation is very close. In general, the widths and lengths of the skull, the frontal bone and the facial cranium vary with age. Among length values the basal size of the cerebral cranium grows to a lesser extent, while the width dimensions change more significantly as age progresses. The total length of the upper cheektooth row [P1-3+M1-3 (measurement 20)], the molar row [M1-3 (measurement 21)] and the upper premolar row [P1-3 (measurement 22)] tend to decrease with age due to intradental erosion. The length and the basis circumference of the horn cores might be expected to grow with age. The length of the horn (47a) grows 10 mm, the circuit of the horn core base (44) grows 4,22 mm annually. Bartosiewicz observed in his studies annual growth of 18 mm in cows, and that of 38 mm in oxen (Bartosiewicz 2005. 310.) Other horn core and horn measurements hardly show any increase. It seems that inheritance plays a role not only in the shape of horns but also in the length of both the horn core and the horn sheath. Horn size is also influenced by the age of castration in oxen. The basal length [St-B (14)] of the neurocranium has an interesting picture. The data of dimensions form two distinct groups, which may represent two different types of skull. The difference between the two size range is higher than 50 mm. Skulls with longer basal neurocraniums are more common.

Kivonat

A koponyacsontok méretének nagysága és az életkor kapcsolatát a Magyar Mezőgazdasági Múzeum magyar szürkemarha-gyűjteményének 108 koponyáján vizsgáltam. A koponyák 2-16 éves állatoktól származtak. A koponyaméreteket diagramon ábrázoltam, és linearis regresszió függvénnyel ellenőriztem a kapcsolat jellegét. A korrelációs együttható megadta a méret és az életkor kapcsolatának szorosságát. Általánosságban elmondható, hogy 20 méret esetében a méret növekedése, 3 méretnél a csökkenése állapítható meg. 24 koponyaméret független az életkortól. Ez alapján 14 méretnél közepesnek, 8 méretnél a közepesnél szorosabbnak és 2 méretnél szorosnak nevezhető a korreláció. A koponya, a homlokcsont, valamint az arckoponya szélességi és hosszúsági méretei, általában az életkorral párhuzamosan változnak. A hosszúság méretek közül az agykoponya basalis mérete kisebb mértékben, a szélességi méretek az életkor előrehaladásával jelentősen változnak. A teljes fogsor [P1-3+M1-3 (20)], a zápfogsor [M1-3 (21)] és a premolaris fogsor [P1-3 (22)] hossza az életkor növekedésével csökken, ami a fogak intradentalis csiszolódásával magyarázható. A vizsgálatok azt mutatják, hogy a tülök hosszmérete és a szarvcsap tövének körmérete növekszik az öregedéssel párhuzamosan. A szarv (tülök) hossza (47a) 10 mm-t, a szarvcsaptő körmérete (44) 4,22 mm-t növekszik évente. Bartosiewicz László vizsgálataiban teheneknél évenként 18 mm ökröknél 38 mm növekedést állapított meg (Bartosiewicz 2005. 310.) A többi szarvval és szarvcsappal kapcsolatos méret növekedése nem függ az életkortól. Véleményem szerint az öröklött tulajdonságok nemcsak a szarv alakjában, hanem a szarvcsap és a szarv hosszában is, döntő szerepet játszanak. Jelentős hatással van a szarv méreteire, hogy a borjút hány éves korában ivartalanították. Ugyancsak érdekes jelenség, hogy az agykoponya basalis hosszának méretei [B-St (14)] alapján két jól elkülönülő csoportot alkotnak, ami két különböző koponyatípust jelenthet. A két mérettartomány közötti különbség 50 mm feletti. A hosszabb basalis agykoponyák a gyakoribbak.

KEYWORDS: HUNGARIAN GREY CATTLE, CRANIAL MEASUREMENTS, LINEAR REGRESSION FUNCTION

KULCSSZAVAK: MAGYAR SZÜRKE MARHA, KOPONYAMÉRET, LINEÁRIS REGRESSZIÓS FÜGGVÉNY

HU ISSN 1786-271X; urn: nbn: hu-4106

Introduction

Studies of osteology and archaeozoology nowadays often raise the question that how accurately can be estimated the age (and if possible) the gender of the animal based on the size of certain parts of the skeleton and the extent of ossification. My study revolves around the skull bones of the Hungarian Grey cattle, because studies regarding the bones of the extremities have been carried out by János Matolcsi (Matolcsi 1967a,b,c., 1969, 1970, Bökönyi et al 1964). Aside from the archezoological benefits of the following examinations, the reader may expand his/her knowledge regarding the domestic animal, which played a key role in the economic history of Hungarians and is still considered to be important nowadays: the Hungarian Grey cattle.

Material

I used the collection of Hungarian Grey cattle skulls of the Museum of Hungarian Agriculture. The majority of the available skulls is well documented including the age of the animal in many cases, thus providing great material for research. The study material contains the skulls of 5 bulls (**Fig. 1.**), 25 oxen (**Fig. 2.**) and 46 cows (**Fig. 3.**), and the skullcaps of 5 oxen and 27 cows respectively. In some cases the skull has not been preserved. In many cases the facial cranium and basal part of the cerebral cranium has been split from the frontal bone including the horn base. I call these parts of the skull with horn bases on it skullcap. The skulls obtained from animals of different age (2-16 years) (**Table 1**).

Aims and objectives of the study

I was looking for the answers for two principal questions in my research:

Do skull dimensions vary by increasing age?

If yes, which dimensions and in what direction change over time?

Methods

For performing the study I utilized the skull measures acquired by a measurement method internationally used in both archezoology and zoology, which was elaborated by J. U. Duerst (1930) and was simplified and revised by A. von den Driesch (1976) After the names of the dimensions, the Driesch number is found in parentheses.

I measured all the skulls for the study using the Duerst and Driesch method completed with my own measures (Kőrösi 2008 49-53 measures.). Average and limit was calculated using the 58 dimension values obtained in such a manner - grouped by gender (**Table 1**).

Fig.1.: Skull of bull - Hungarian Grey cattle

1. ábra: Magyar szürke bika koponyája

Fig. 2.: Skull of ox - Hungarian Grey cattle

2. ábra: Magyar szürke ökör koponyája

Fig. 3.: Skull of cow - Hungarian Grey cattle

3. ábra: Magyar szürke tehén koponyája

Furthermore, I determined the estimated age of skulls according to the extent of teeth change, tooth wear and suture ossification.

HU ISSN 1786-271X; urn: nbn: hu-4106

Table 1.: Limit and average values of skull dimensions in Hungarian Grey cattle - divided by gender

1. táblázat: A magyar szürke marha koponyák méreteinek szélső és átlagértékei nemenkénti csoportosításban

Skull measurement	Bulls			Cows			Oxen		
	pieces	average	end values	pieces	average	end values	pieces	average	end values
The greatest total length [A-P (1)]	4	516.9	462.2-541.0	47	495.1	454.1-555.9	24	542.8	462.1-579.5
Greatest condylobasal length [c-P (2)]	4	495.0	455.8-515.2	47	477.7	446.5-524.5	24	516.7	451.5-547.5
Greatest basal length [B-P (3)]	4	466.6	421.0-483.5	46	447.2	415-490.0	23	486.5	459.6-518.8
Greatest neurocranium length [B-N (6)]	4	257.5	240.0-270.0	35	243.1	218.6-270.0	13	260.0	240.0-280.0
Viscerocranium length (7)	4	273.3	242.3-290.8	47	260.1	206.2-300.1	24	290.2	248.4-311.6
The median frontal length [A-N (8)]	4	247.0	226.0-268.5	49	235.9	203.4-271.2	24	259.1	216.7-280.5
Short upper cranium length [A-Rh (10)]	4	440.1	390.2-458.7	45	405.9	375.9-436.4	22	443.3	394.0-483.4
Greatest length of the nasals [N-Rh (12)]	4	193.8	167.6-213.4	45	168.7	137.8-191.6	22	186.0	164.4-212.2
Basal length of the neurocranium [B-St (14)]	4	232.2	188.5-274.0	45	224.9	158.7-270.5	23	245.2	185.6-280.9
The lateral length of the muzzle [If-P (16)]	4	161.4	143.2-173.0	45	152.0	135.1-168.6	24	163.1	142.8-181.3
Dental length of the palate [P-Pd (17)]	4	273.9	269.4-276.4	46	265.7	245.8-281.7	24	273.9	226.6-289.5
Medial length of the palate [P-St (17a)]	4	279.2	253.2-298.8	47	276.1	257.7-298.0	24	297.1	251.3-316.3
Greatest oral palatal length [P-Po (18)]	4	207.3	185.1-216.9	47	201.5	182.0-218.7	24	216.0	183.5-238.4
Medial length of the palatine bone [Po-St (18a)]	4	75.3	68.1-81.0	47	75.5	64.1-84.9	24	82.3	67.2-96.0
Lateral length of the premaxilla [Ni - P (19)]	4	178.0	164.3-201.4	47	160.9	118.6-195.6	24	171.0	145.7-223.0
Length of the cheektooth row [P^1-M^3 (20)]	4	126.4	118.8-141.5	47	128.3	112.4-141.7	24	132.7	121.4-149.7
Length of the molar row [M^{1-3} (21)]	4	78.0	73.0-86.6	47	78.5	56.1-86.4	24	81.2	73.1-91.6
Length of the premolar row [P^{1-3} (22)]	4	49.7	46.0-57.6	43	51.4	43.5-85.2	23	51.5	44.3-58.4
Greatest inner length of the orbit [Ent-Ect (23)]	4	71.3	64.5-73.7	49	67.0	57.8-73.8	24	72.8	61.1-87.2
Greatest inner heigth of the orbit (24)	4	66.1	63.5-68.6	49	62.9	57.7-69.8	24	68.7	62.2-74.7
Greatest mastoid breadth [Ot-Ot (25)]	4	271.8	227.3-288.6	47	223.7	202.3-258.6	24	251.8	218.8-275.0
Greatest breadth of the occipital condyles (26)	4	122.6	117.9-129.6	48	108.1	92.4-129.0	24	125.6	110.3-198.6
Greatest breadth at the bases of the of the paraoccipital processes (27)	4	191.9	169.9-206.6	48	167.6	147.9-186.9	24	189.1	113.4-221.0
Greatest breadth of the foramen magnum (28)	4	32.8	26.5-35.6	47	40.0	30.7-51.6	24	42.0	27.7-64.3
Greatest height of the foramen magnum [B-O (29)]	4	34.8	32.7-36.3	46	38.0	31.0-43.2	22	47.1	35.7-45.7
Least occipital breadth [Osp-Osp (30)]	4	198.2	180.6-214.0	72	137.9	113.6-173.9	28	161.0	117.7-198.6
Least breadth between the bases of the horncores (31)	4	128.4	115.5-141.0	73	151.3	106.2-199.9	28	157.5	125.0-192.3
Least frontal breadth [fs-fs (32)]	4	207.2	193.6-225.2	67	174.3	157.2-193.4	28	199.2	177.2-230.5
Greatest frontal breadth [Ect-Ect (33)]	4	259.3	222.4-274.5	49	222.4	202.5-247.2	27	244.9	213.7-267.4
Least breadth between the orbits [Ent – Ent (34)]	4	208.0	177.6-229.5	48	170.5	151.7-228.2	24	188.3	158.9-211.2

Table 1., cont.

1. táblázat., folyt.

Greatest facial breadth [M-M (35)]	4	171.8	154.2-180.0	45	156.9	135.2-179.3	24	169.1	141.8-188.5
Greatest breadth across the premaxillae on the oral protuberances (37)	4	103.0	83.4-108.4	44	88.1	76.2-100.7	24	98.5	86.3-109.8
Greatest palatal breadth (38)	4	145.9	132.4-156.2	47	136.4	119.9-153.2	24	143.5	125.0-157.9
Least inner height of the temporal groove (39)	4	249.7	213.3-262.8	47	216.4	198.4-245.5	24	237.1	207.9-257.7
Greatest height of the occipital region [B-A (40)]	4	170.9	146.5-188.6	46	154.8	114.0-171.2	23	168.4	149.3-200.5
Least height of the occipital region [O-A (41)]	4	129.4	114.3-151.2	47	120.5	104.7-156.7	21	127.5	115.8-159.7
Horncore basal cirkumference (44)	3	413.2	248.0-871.0	53	221.8	171.0-308.0	24	93.1	69.9-122.0
Greatest diameter of the horncore base (45)	4	101.1	79,7-115.3	56	68.9	55.4-85.2	23	292.0	225.0-367.0
Least diameter of the horncore base (46)	4	99.2	75.6-132.2	57	64.0	51.4-79.4	25	86.7	63.1-105.3
Length of the outer curvature of the horncore (47)	1	570.0	523.0-617.0	48	489.7	332.0-632.0	17	657.8	498.0-815.0
Greatest length of the horn (47a)	4	733.8	611.0-854.0	67	649.7	475.0-837.0	28	909.0	616.0-1359.0
Oral breadth between the bases of the horncores (48)	4	248.2	238.3-254.6	65	220.5	191.0-261.3	28	253.4	214.5-295.5
Greatest breadth of collum the premaxillae (50)	4	92.9	77.8-98.8	44	81.6	72.4-90.9	24	93.2	81.3-104.3

This was followed by checking the data collection pertaining skull age. Since animal gender affects certain characteristics of the skull (Kőrösi 2008), bulls and cows were accounted separately, as well as oxen, because signs of castration can be seen not only on extremity bones, but also on the cranium. Skull dimensions are represented on diagrams.

Diagrams were created in two steps. First, I used the skulls with their age indicated on the cardboards. These include the skulls of 5 bulls, 26 cows and 4 oxen (**Table 1.**). Only the cardboards of cow skulls contained sufficient information for statistical analysis, therefore the dimensions of cow skulls were examined separately compared to age. Due to the low number of bull skulls and the lack of accurate data on ox skulls these examinations have not been conducted in these categories. Results obtained on the diagram were checked by linear regression function, with the most important results integrated into a table (**Table 3**). This was followed by the age estimation of 47 cows and 21 oxen. The age of these skulls was not indicated on the cardboards (**Table 2**). Completed by the dimensions of these individuals I prepared the diagrams regarding all skulls (selection: **Figs. 4-13**), then I compared the results of the diagrams and the function. Differences of important skull dimensions, and the deviations between diagrams and statistical tests have been separately indicated in the text. If difference was found in the skull dimensions between genders, I noted this in the text.

The diagrams depict the skull dimensions of each available individual in relation to age. By this method we can pictorially represent the connection between age and dimension. Some diagrams demonstrate the values of the same skull dimension measured on differently aged animals. The acquired dot clouds infer whether age and dimension are connected.

Results based on diagrams can be well checked by using linear regression functions (SPSS). The regularity between quantitative criteria is described by regression functions. The model of linear regression is based on the assumption of linear correlation between the two variables. The correlation between age (independent variable) and dimensions (dependent variable), i.e. our hypothesis regarding the steepness of linear regression function was checked by t-test. According to our null hypothesis there is no significant correlation between the increase of age and dimensions. If the steepness does not significantly differ from 0, then our null hypothesis is accepted. If the steeepness of regression function is significantly different than 0, then our null hypothesis is rejected and the alternative hypothesis is accepted, i.e. the given skull dimension changes with varying age.

Table 2.: Distribution of skulls of Hungarian Grey cattle - divided by documented and estimated age

2. táblázat: A magyar szürke marha koponyák megoszlása adatolt és becsült életkorok alapján

Age (years)	cows		bulls	oxen		all
	documented*	estimated	documented	documented*	estimated	
2			1			1
3		2				2
3,5	3				1	4
4	2	3				5
5	3	2			2	7
6		5			5	10
7	4	3			2	9
8		6			1	7
9	3	2	1		3	9
10	6	5	1	3	3	18
12	1	12	2	1	2	18
13					1	1
14		6			1	7
14,5	1					1
15	2					2
16	1	1				2
undefinable					5	5
all	26	47	5	4	21	108

*the exact age found in the inventory book and on the description card (counted on the basis of the date of birth and the time of arrival to the slaughterhouse).

If the steepness is positive, increasing age implies the growth of skull dimension. If the steepness is negative, increasing age implies the reduction of skull dimension. The significance level of 5% has been taken into account in all cases.

The correlation factor shows a close link between the change of size and the progress of age (**Table 3**.). In case of skulls where correlation is apparent between size and age, I made three groups. Medium correlation is apparent between 40 and 60%, closer than medium correlation is apparent between 61 and 80% and there is a close correlation in case of values between 81 and 100%.

Study results

According to the results the skull dimensions can be divided into three groups:

1. Correlation between skull measurements and age is present:

the change can be increasing or decreasing.

2. Correlation between skull measurements and age is not present:

connection between measurement and age increase cannot be proved.

3. Correlation between the changes of measurements and age cannot be observed. The number of available skulls is insufficient in case of certain measurements, thus the examination has not been carried out.

4.1. Correlation between skull measurements and age is present.

4.1.1.Correlation between skull measurements and age increase is present, the change is of the same direction:

21 skull measurements (2, 3, 6, 10, 16, 17a, 18, 19, 25, 27, 30, 32, 33, 34, 35, 37, 38, 39, 44, 47a, 50. Kőrösi 2008. 31-32.) change over ageing according to the studies.

Table 3: Change of the most important skull dimension in cows (Hungarian Grey cattle) according to linear regression function

3. táblázat: A szürke marha tehenek legfontosabb koponyaméretének változása az életkor függvényében a linearis regresszió függvény alapján

Skull measurement		**Unstandardized Coefficients**		**Linear correlation**		**Sig.**
The measure grow with the age		**m**	**Std. Error**	**r**	**t**	**p**
Greatest condylobasal length [c-P (2)]	(Constant)	458.276	8.212		55.805	0.000
	age	2.274	0.946	0.504	2.403	0.028
Greatest basal length [B-P (3)]	(Constant)	427.222	7.690		55.556	0.000
	age	2.467	0.886	0.560	2.784	0.013
Greatest neurocranium length [B-N (6)]	(Constant)	173.221	21.191		8.174	0.000
	age	6.438	2.442	0.539	2.636	0.017
Short upper cranium length [A-Rh (10)]	(Constant)	389.345	7.638		50.974	0.000
	age	2.130	0.814	0.536	2.619	0.018
The lateral length of the muzzle [If-P (16)]	(Constant)	137.885	3.455		39.904	0.000
	age	1.660	0.369	0.747	4.494	0.000
Medial length of the palate [P-St (17a)]	(Constant)	264.830	4.723		56.075	0.000
	age	1.540	0.544	0.566	2.830	0.012
Greatest oral palatal length [P-Po (18)]	(Constant)	184.685	3.467		53.262	0.000
	age	2.086	0.369	0.808	5.648	0.000
Lateral length of the premaxilla [Ni - P (19)]	(Constant)	141.463	8.820		16.040	0.000
	age	2.723	0.939	0.575	2.899	0.010
Greatest mastoid breadth [Ot-Ot (25)]	(Constant)	206.979	5.254		39.396	0.000
	age	2.039	0.605	0.633	3.368	0.004
Greatest breadth at the bases of the of the paraoccipital processes (27)	(Constant)	159.308	4.281		37.213	0.000
	age	1.064	0.453	0.465	2.347	0.029
Least occipital breadth [Osp-Osp (30)]	(Constant)	124.486	5.756		21.628	0.000
	age	1.790	0.656	0.486	2.727	0.012
Least frontal breadth [fs-fs (32)]	(Constant)	164.533	4.089		40.237	0.000
	age	1.138	0.439	0.484	2.591	0.017
Greatest frontal breadth [Ect-Ect (33)]						
	(Constant)	200.005	12.954		15.440	0.000
	age	3.433	1.506	0.473	2.280	0.035
Least breadth between the orbits [Ent – Ent (34)]	(Constant)	153.060	4.022		38.057	0.000
	age	1.787	0.448	0.717	3.989	0.001
Greatest facial breadth [M-M (35)]	(Constant)	141.090	4.022		35.082	0.000
	age	1.869	0.428	0.727	4.363	0.000
Greatest breadth across the premaxillae on the oral protuberances (37)	(Constant)	144.927	4.820		30.067	0.000
	age	1.541	0.555	0.558	2.773	0.013

Table 3., cont.

3. táblázat, folyt.

Greatest palatal breadth (38)	(Constant)	123.407	2.175		56.726	0.000
	age	1.526	0.232	0.848	6.584	0.000
Least inner height of the temporal groove (39)	(Constant)	203.488	3.371		60.372	0.000
	age	1.384	0.359	0.683	3.856	0.001
Horn core basal cirkumference (44)						
	(Constant)	181.598	16.781		10.822	0.000
	age	4.122	1.747	0.533	2.360	0.033
Greatest length of the horn (47a)						
	(Constant)	561.982	32.079		17.519	0.000
	age	10.021	3.659	0.488	2.739	0.011
Greatest breadth of collum the premaxillae (50)	(Constant)	71.359	2.005		35.590	0.000
	age	1.105	0.214	0.782	5.176	0.000
The measurement decreases with the growth of age						
Length of the cheektooth row [P^1-M^3 (20)]						
	(Constant)	138.969	3.213		43.259	0.000
	age	-1.440	0.370	-0.686	-3.888	0.001
Length of the molar row [M^{1-3} (21)]						
	(Constant)	82.288	1.912		43.035	0.000
	age	-0.493	0.220	-0.477	-2.238	0.039
Length of the premolar row [P^{1-3} (22)]						
	(Constant)	57.391	1.617		35.502	0.000
	age	-0.865	0.186	-0.748	-4.641	0.000
No correlation between mesaurements and the growth of age						
Greatest total length [A-P (1)]						
(1-16 years old cows)	(Constant)	478.421	9.758		49.030	0.000
	age	2.122	1.125	0.416	1.887	0.076
Greatest total length [A-P (1)]						
(1-10 years old cows)	(Constant)	481.640	12.556		38.359	0.000
	age	2.022	1.792	0.272	1.129	0.276
Viscerocranium length (7)						
Nasion (N) in medium position	(Constant)	244.471	14.002		17.460	0.000
	age	1.486	1.383	0.308	1.074	0.306
Viscerocranium length (7)						
Nasion (N) in aboral position	(Constant)	243.703	9.662		25.222	0.000
	age	2.921	1.495	0.699	1.954	0.122

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Table 3., cont.

3. táblázat, folyt.

Median frontal length [A-N (8)]						
All included	(Constant)	224.933	9.280		24.237	0.000
	age	1.618	0.988	0.369	1.637	0.120
Median frontal length [A-N (8)]						
Nasion (N) in medium position	(Constant)	231.129	10.920		21.165	0.000
	age	1.008	1.079	0.271	0.935	0.370
Median frontal length [A-N (8)]						
Nasion (N) in aboral position	(Constant)	221.610	12.609		17.575	0.000
	age	0.852	1.950	0.213	0.437	0.685
Greatest length of the nasals [N-Rh (12)]						
All included	(Constant)	160.315	6.907		23.211	0.000
	age	0.788	0.736	0.251	1.071	0.299
Greatest length of the nasals [N-Rh (12)]						
Medium nasals	(Constant)	168.764	4.445		37.965	0.000
	age	0.679	0.596	0.339	1.140	0.281
Greatest length of the nasals [N-Rh (12)]						
Short nasals	(Constant)	150.116	6.933		21.652	0.000
	age	0.734	0.617	0.470	1.190	0.288
Basal length of the neurocranium [B-St (14)]	(Constant)	196.573	24.269		8.100	0.000
	age	3.218	2.585	0.289	1.245	0.230
Dental length of the palate [P-Pd (17)]	(Constant)	262.941	2.988		87.997	0.000
	age	0.380	0.318	0.278	1.194	0.249
Medial length of the palatine bone [Po-St (18a)]	(Constant)	90.332	13.588		6.648	0.000
	age	-1.152	1.438	-0.176	-0.801	0.432
Greatest inner length of the orbit [Ent-Ect (23)]	(Constant)	66.505	1.797		37.001	0.000
	age	-0.026	0.194	-0.032	-0.135	0.894
Greatest inner heigth of the orbit (24)	(Constant)	61.201	1.812		33.775	0.000
	age	0.243	0.195	0.281	1.244	0.229
Greatest breadth of the occipital condyles (26)	(Constant)	158.858	4.894		32.458	0.000
	age	1.155	0.564	0.445	2.048	0.056

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Table 3., cont.

3. táblázat, folyt.

Greatest breadth of the foramen magnum (28)	(Constant)	40.850	2.821		14.482	0.000
	age	-0.046	0.300	-0.037	-0.152	0.881
Greatest height of the foramen magnum [B-O (29)]	(Constant)	36.704	1.806		20.324	0.000
	age	0.180	0.192	0.222	0.938	0.361
Least breadth between the bases of the horn cores (31)	(Constant)	145.981	7.520		19.412	0.000
	age	0.852	0.810	0.210	1.052	0.303
Greatest height of the occipital region [B-A (40)]	(Constant)	146.600	6.531		22.448	0.000
	age	1.009	0.696	0.332	1.450	0.165
Least height of the occipital region [O-A (41)]	(Constant)	121.921	5.938		20.533	0.000
	age	-0.090	0.618	-0.036	-0.145	0.887
Greatest diameter of the horn core base (45)						
	(Constant)	62.338	3.668		16.997	0.000
	age	0.847	0.418	0.477	2.028	0.062
Least diameter of the horn core base (46)						
	(Constant)	60.982	3.922		15.549	0.000
	age	0.320	0.428	0.184	0.748	0.465
Length of the outer curvature of the horn core (47)						
	(Constant)	467.966	31.077		15.058	0.000
	age	1.276	3.505	0.100	0.364	0.722
Oral breadth between the bases of the horn cores (48)	(Constant)	216.046	4.845		44.592	0.000
	age	0.472	0.522	0.182	0.905	0.375

Cranial lengths with different increase rate can be observed.

The combined length of the frontal bone and nasal bone [A-Rh (10)] is growing over ageing (**Table 3.**). This growth in case of cows is approx. 2.13 mm per year.

Condylobasal [c-P (2)] and basal [B-P (3)] lengths of the skull base reveal slight increase of basal length, which is verified by the linear regression function (**Table 3.**). The growth is more than 2 mm per year in case of both measurements. It can be stated that cranial lengths grow gradually by ageing.

Widths of the frontal bone vary in different ways.

The "slenderness", i.e. the least breadth [fs-fs (32)] of the frontal bone, the greatest breadth [Ect-Ect (33)] of the frontal bone and the distance between the orbits [Ent-Ent (34)] display increase. These results have been verified by statistical tests (**Table 3**.). The first two measurements grow in case of cows 1.1-1.5 mm per year, however, the distance between the eyes revealed a more remarkable increase of 3.43 mm. It can be stated that the frontal bone gets more wide by ageing. The distance between the two zygomatic archs [Zy-Zy (39)] also widens, in cows 1.384 mm per year.

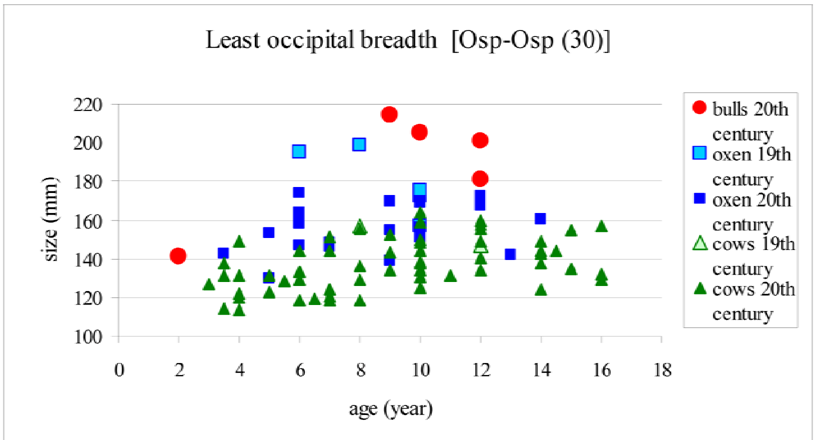

Fig. 4.: Least occipital breadth in skulls of Hungarian Grey cattles

4. ábra: A szürkemarha-koponyák nyakszirti régiójának legkisebb szélessége

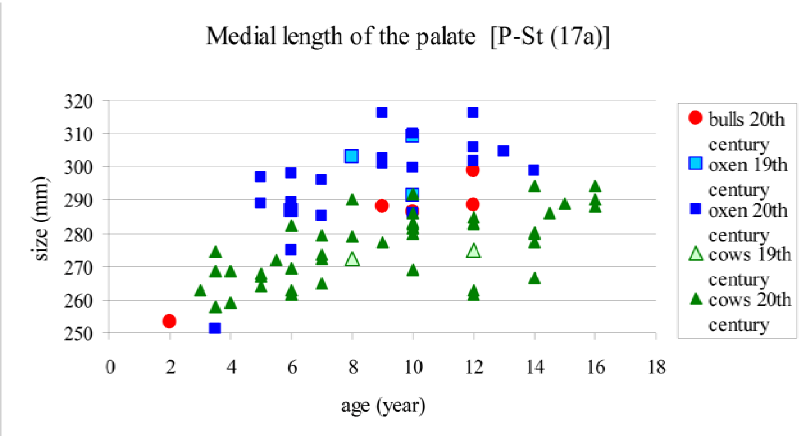

Fig. 5.: Medial length of the palate in skulls of Hungarian Grey cattles

5. ábra: A szürkemarha-koponyák medialis szájpadláshossza

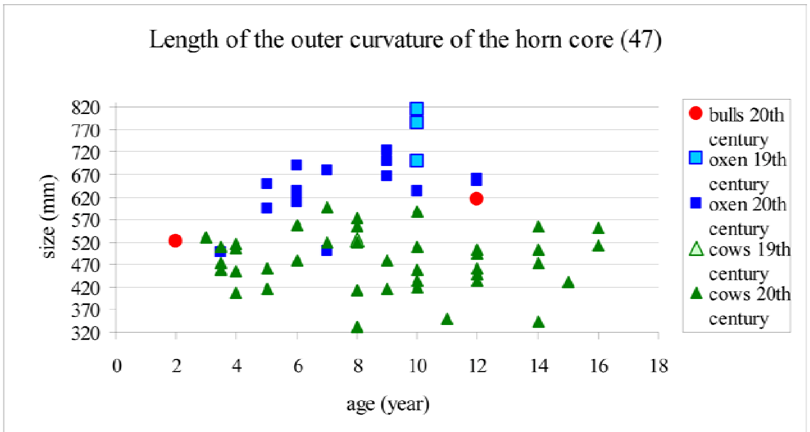

Fig. 6.: Length of the outer curvature of the horn core in Hungarian Grey cattles

6. ábra: A szürkemarha-szarvcsapok legnagyobb hossza

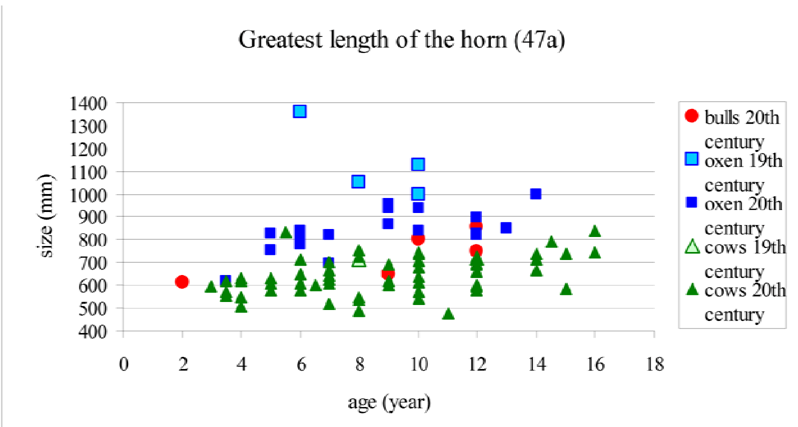

Fig. 7.: Greatest length of the horn in Hungarian Grey cattles

7. ábra: A szürkemarha-koponyák szarvának legnagyobb hossza

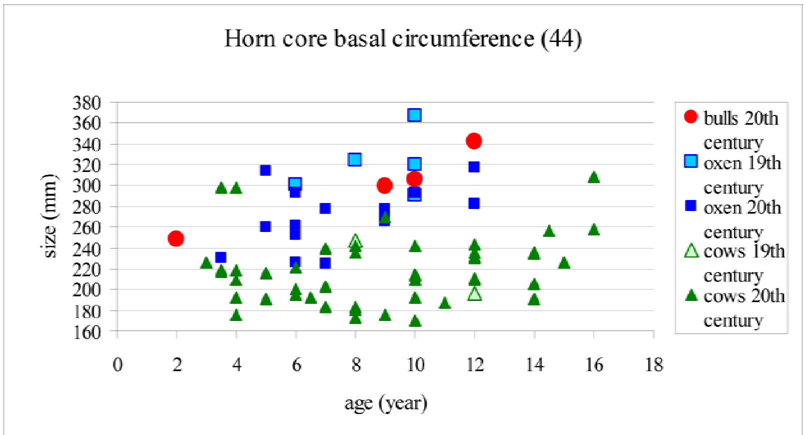

Fig. 8.:
Horn core basal cirkumference in skulls of Hungarian Grey cattles

8. ábra:
A szürkemarha-koponyák szarvcsaptövének körmérete

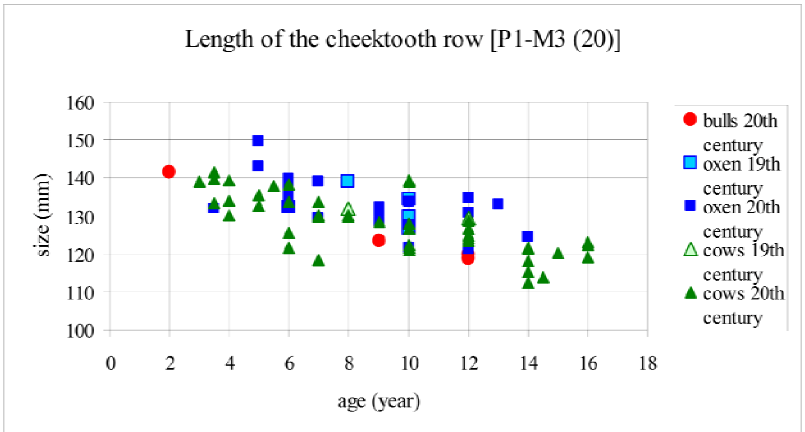

Fig. 9.:
Length of the cheektooth row in skulls of Hungarian Grey cattles

9. ábra:
A szürkemarha-koponyák zápfogsorának hossza

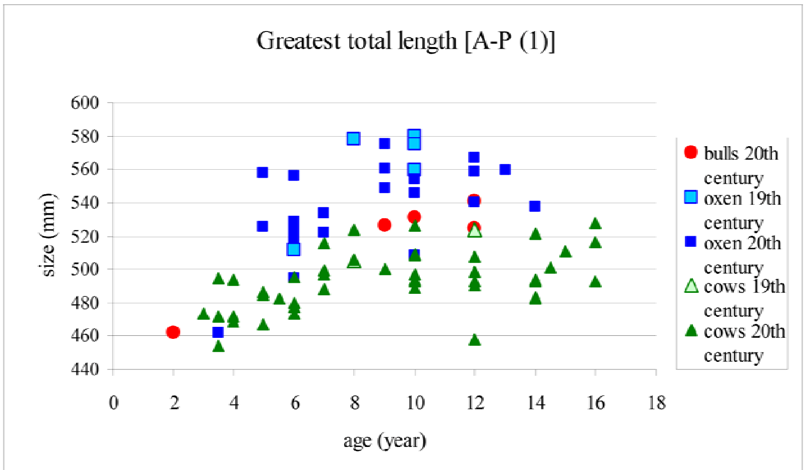

Fig. 10.:
Greatest total length of Hungarian Grey cattles

10. ábra:
A szürkemarha-koponyák frontalis hossza

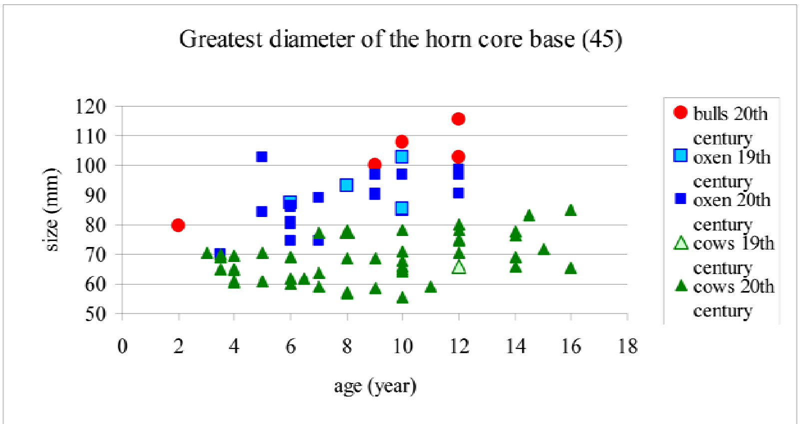

Fig. 11.:
Greatest diameter of the horn core base in skulls of Hungarian Grey cattles

11. ábra:
A szürkemarha-koponyák szarvcsaptövének szélessége

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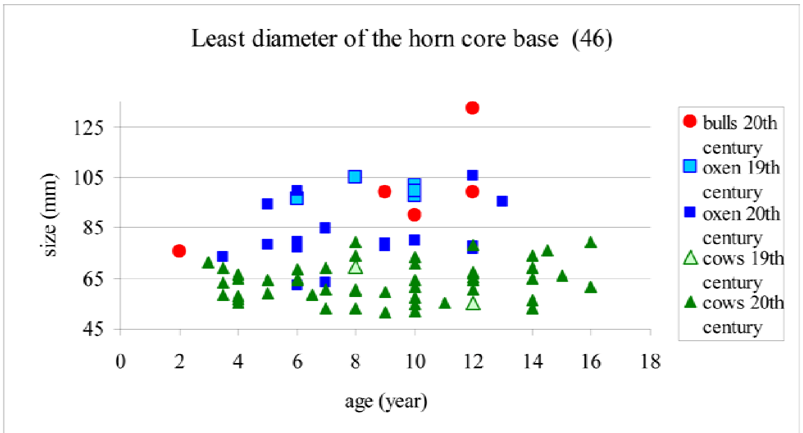

Fig. 12.: Least diameter of the horn core base in skulls of Hungarian Grey cattles

12. ábra: A szürkemarha-koponyák szarvcasptövének magassága

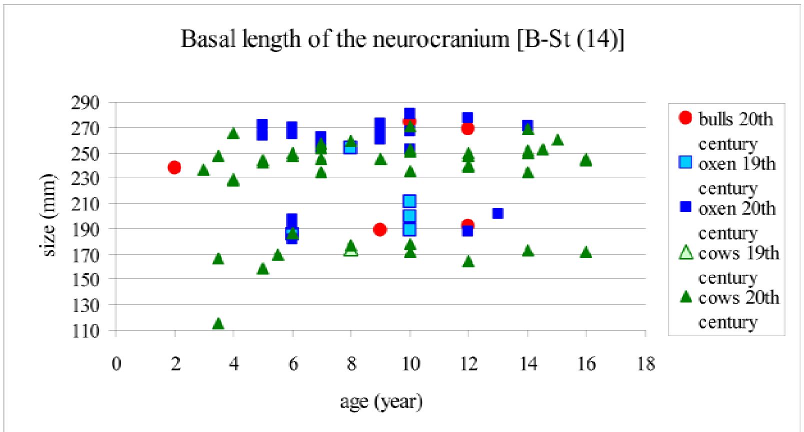

Fig. 13.: Basal length of the neurocranium of Hungarian Grey cattles

13. ábra: A szürkemarha-agykoponyák basalis hossza

The rates of the facial cranium vary differently as well.

The lateral length of the muzzle [If-P (16)] on the facial part of the skull grows gradually with age. Within cows of the same age the values may vary over a wide range.

The greatest breadth of the facial cranium [M-M (35)] grows with age. This growth can be only partially attributed to the widening of jawbones, it is in part caused by the gradual protrusion of the tuber malare (M). Its annual growth in cows is 1.87 mm. Similar width growth can be observed in the greatest breadth of the premaxillae (incisive bones) (37). Along with this the collum of premaxillary bones also gets wider (50).

The nasal process of the premaxillary bone (nasal process of the incisive bone) [P-Ni (19)] can be short, medium or long. The measurement can be performed only on skulls with medium nasal process (51 pcs – 67,5 %), the nasal process grows with age. This growth is remarkable with 2.72 mm per year in cows.

In case of short nasal process the intermaxillary bone does not reach the nasal bone, therefore nasointermaxillary (Ni) and nasoliberal (Nl) points are not present on the skull. Therefore in skulls with short nasal process the dimensions 19, 51, és 52 cannot be measured. If the nasal process is long, it reaches the lacrimal bone. In this case nasointermaxillary (Ni) point is not formed, it is located in the of the lacrimomaxillary oral/nasomaxillary (Lmo/Nm) spots. In this case dimensions No. 52 and 53 cannot be measured.

This change can also be observed in the bones of the nuchal part of the neurocranium. The breadth of the occipital region [Ot-Ot (25)] and jugular processes (27) slightly grows with age. The first dimension grow more then 2 mm, the second one grow only 1.064 mm per year in cows (**Table 3.**).

During the examination of different skulls it appeared presumable that the shortest breadth of the occipital region (temporal fossa) [Osp-Osp (30)] widens with age (**Table 1.**). The temporal fossa of cow skulls with known age is widening until the age of 10 – then the reached size becomes permanent. Cows with estimated age showed the slow growth of the dimension (1.79 mm per year), whereas no correlation has been revealed regarding oxen, and decrease of the dimension could be observed on bulls. The latter is presumably attributed to individual characteristics, leaving no place for generalization. The linear regression function revealed growth of the dimension with age, i.e. the decrease of slenderness.

Changes in the widths and lengths of the palate vary. The greatest breadth of the palate (38) grows slightly. In case of individuals both with known and estimated age an increase could be scrutinized in the medial length of the palate [P-St (17a)] (**Table 2.**). The combined length of the palatine process of maxilla and the premaxillary bone [P-Po (18)] exhibited significant growth substantiated by statistical tests. The dental length of the palate [P-Pd (17)] and the medial length of the palatine bone [Po-St (18a) vary independently (see 4.2).

The length and width growth of the horn base and horn is presumed with age. However, the measurements of the horn base and horn are different than expected (see 4.3 for details). The length of horn/horn base and the diameter of horn base radix display controversial results. No growth can be observed in the length of horn core base (47) (**Fig. 6.**), but the horn length (47a) grows remarkably with age (**Fig. 7.**). Bartosiewicz examined the horn growth of 24 cows and 15 oxen. In his studies he observed annual growth of 18 mm in cows, and that of 38 mm in oxen (Bartosiewicz 2005. 310.). In my present research an annual growth of 10 mm has been revealed (**Table 3.**).

Unequivocal growth can be observed at the circumference of the horn core base radix (44) in bulls (**Fig. 8**.), which is caused by forceful bone deposition on different parts – including the horn base – of the bull skull, called horn rose. This growth is safe to say in spite of little data. In my opinion the growth of the horn base radix is stopped after reaching a certain age according to observations performed on other parts of the skull. In case of a larger number of bull skulls it would be recommended to find out the duration of this ossification and the moment when the thickening stops. No unequivocal growth of circumference of horn base radix is revealed by the diagram in cows and oxen. However, in my opinion in elderly age (approx. after 12 years) with the progression of ossification it may show slight growth. The growth of circumference of horn base radix is also confirmed by regression function, though independence has been revealed in the case of width and thickness of horn radix (**Table 3**.). The change of three measurements correlate with each other, thus this statistical result can only be accepted with doubts. It may be verified or confuted by studies performed with more data. The dimensions of the horn base radix is connected with genetics, what may also affect the results.

In case of the examined sizes the linear regression functions give the approximate annual growth of the size. Based on this the greatest growth is observed at the longest size of the horn, horn core and the greatest length of the neurocranium [B-N (6)]. The length of the horn (47a) grows 10 mm, the circuit of the horn core base (44) grows 4,22 mm annually.

4.1.2 Correlation between skull measurement and age increase is present, but the change is of different directions:

Three lengths (20, 21, 22, Kőrösi 2008) of the facial cranium decrease with age.

The most interesting change is found in the length of the cheecktooth row [P1-M3 (20)] and in the length of premolar [P1-3 (22)] and molar [M1-3] (21)] dentures. All of these denture sizes decrease a great deal by ageing (**Fig. 9.**). The scale of decrease is the highest in the length of the premolar [P1-3 (22)]. The statistical tests of these three dentures revealed the decrease of sizes with age, with a value of 0,5-1,4 mm in the case of cows (**Table 3**.). C. Grigson also reported the decrease of denture lengths in his reaserch, explained by the intradental grinding of molars leading to thinning from the crown in the direction of the root (Grigson 1974). As a result of the horizontal abrasion of the occlusal surface of the palm that is narrowing towards the root of the tooth the neighboring teeth are drawing closer to each other. That is the reason for shortening.

4.2 No correlation between age and size.

24 skull measurements (1, 8, 11, 12, 13, 14, 17, 18a, 23, 24, 26, 28, 29, 31, 39, 40, 41, 45, 46, 47, 48, 49, 51, 52. Kőrösi 2008. 31-32.) no correlation could be revealed between size and ageing. This statement has been verified by statistical tests (**Table 3.**). Dimensions of more importance highlighted only:

Among the lengths and widths of the skull, the median-saggital length [A-N (8)] of the frontal bone and the least breadth between the bases of the horn cores (31) are not age-dependant, no tendencies were observed in their growth. The median-saggital length of the frontal bone is measured between the acrocranion (A) and the nasion (N). According to the position of the Nasion (N) it may be in oral, medium or aboral position. The Nasion (N) was 62% in medium position, 28.5% in aboral position and 9.5% in oral position of the skulls examined. The examinations have also been carried out separately on medium and aborall positioned craniums. In both cases the regression function revealed the independence of size from age (**Table 3.**). Due to the low number of skulls with orally positioned Nasion (N), no separate scrutinization has been performed. The position of the Nasion (N) also affects the length of the viscerocranium [P-N (7)]. First I conducted the studies with all skulls, followed by the separate examinations of skulls with medium and aboral positioned Nasion (N). In all cases the studies revealed the independence of size from age (**Table 3.**).

The same can be stated on the longest [B-A (40)] and shortest [O-A (41)] height of the occipital region, which do not change with age as well. However, in the case of some dimensions the picture is not so clear. The frontal (total) length [A-P (1)] of the calvaria appears to grow until approx. 8-10 years according to the diagrams. Then it reaches its maximal length and stops changing (**Fig. 10.**). Th statistical tests did not reveal connection between age and size in all (1-16 years) individuals. I conducted the study without individuals older than 10 years, i.e. with the date in the age group of 1-10 years. According to the examination size remains to be independent from age. It is worth-trying to perform the study on a larger number of skulls under the age of 10, succeeded by the comparison of the results obtained. L. Bartosiewicz's research carried out on Red Pied Hungarian cattles revealed that there is no correlation between the growth of the frontal skull length and ageing (Bartosiewicz 1980. 23.)

The medial length of the palatine bone [Po-St (18a)] and the dental length of the palate [Po-Pd (17)] is independent from age.

Among dimensions independent from age I would highlight the dimensions of the horn, because it was presumed that there was a correlation between dimensions and age, but this assumption has been confuted. There is no increase in the width (45) and thickness ("height" 46) of horn core base radix according to the diagrams (**Figs. 11-12.**), despite the fact that the oldest cows had the largest horn bases. This may be caused by the genetic determination of the horn core size, as well as the low number of subjects. A subject with higher numbers may modify this presumption. In my opinion, hereditary attributions play a major role not only in the shape of the horn, but also in the length of the horn core and horn. Statistical tests revealed no correlation in all but one dimension (horn length (47a) with age, i.e. horn and horn core dimensions are independent from age. According to the statistical function, only horn length shows parallel growth (47a) with age (**Table 3.**).

The basal length [St-B (14)] of the neurocranium has an interesting picture. According to the diagrams the basal length does not change with ageing, what is also demonstrated by statistical analysis (**Table 3.**). However, the data of dimensions form two distinct groups (**Fig. 13.**), which may represent two different types of skull. The smaller skull type has a shorter basal length ranging from 158.7 to 175.8 mm, the larger type has longer basal length, ranging between 228.7 and 260.7 mm. The difference between the two size range is higher than 50 mm. Skulls with longer basal neurocraniums are more common.

At the horizontal [Ent-Ect (23)] and vertical (24) inner length of the orbita the decrease of sizes would be expected due to the age-related ossification. This change can be observed on bulls, but not on cows and oxen. This decrease occurring on bulls is caused by the extremely powerful ossification on he frontal bone and around the orbita (Photo 1). In my opinion, this thickening accompanied by bone deposition, and thus decrease of the size increases only to a certain age (about 10 years). The thickening stops after reaching a certain level of bone depositions. Because of the low number of bull skulls, this may be accepted only with doubts, and should be checked on a material containing more subjects. In my view, however, it is likely that based on the observed unified and powerful ossification of bull skulls, we would get the same result - a reduction of the internal dimensions of the orbit until a certain age, then stagnation - in case of more subjects. The horizontal [Ent-Ect (23)] and vertical (24) changes of the inner length of the orbita cannot be revealed on cows and oxen. This may mean the independence of dimensions from age, but may be the reason for this that in the case of cows and oxen the thickening or significant bone deposition in the orbital area cannot be observed (Photos 2-3), and the orbita of the Hungarian gray cattle may be of different shapes (oval, rectangular, round and oval), which may affect the examination results.

According to the diagrams the length of the nasal bone [N-Rh (12)] does not change with ageing, what is also demonstrated by statistical analysis (**Table 3.**). According to the length of nasal bone there are three types: skulls with long, medium and short nasal bone. Long-and medium-size ranges are distinguished in the diagram displaying no growth. Due to the small number of skulls with long nasal bone (2 pieces), those changes can not be observed. The linear regression analysis of skulls with medium (12 pieces) and short (7 pieces) nasal bones showed independence of changes in size and age (**Table 3.**).

4.3 Correlation between the changes of measurements and age cannot be observed:

Some of the studies carried out on a given skull size do not provide real results, as different types of skull sizes can be distinguished. Consequently, there is little data available for statistical analysis, thus in the case of 7 sizes (36, 42, 42a, 43, 43a, 49, 53. Kőrösi 2008.31-32.) examinations were not carried out.

Such sizes among the dimensions pertaining horn and horn basis are the distance between horns and horncora apexes (42, 42a), scale of expansion (43, 43a), because the value of these sizes depends on the shape of the horn and its stance (horn formation). Individual genetic endowments play a major role in shaping the Different horn transformations. Such testing could only be performed if individuals with the same horn formations were included in the study in higher numbers. Due to the small number of different horns and skull position, it makes no sense to carry out studies regarding the shape of the horn and the sizes of expansion (42, 42a, 43, 43a) in connection with ageing.

In case of other dimensions the test can be performed only if groups are created in advance within the given size complying to the type, and tests are performed within these groups, e.g. greatest breadth of the nasal bones [Fo-Fo (36)]. These dimensions can only be tested if adequate numbers of animals are available within a given type. Due to the small number of samples within the collection these dimensions were not examined.

The growth of the dorsal skull length of [N-P (7)] and the longest median-sagittal length of the frontal bone [A-N (8)] is not worth investigating, because both lengths are measured from the Nasion (N) measuring point. According to its location, Nasion (N) may be situated in different positions: top, middle and bottom positions. This significantly affects the length of the skull and the face.

The same can be said for the greatest breadth of the nasal bones [Fo-Fo (36)]. According to their width, nasal bones can be narrow and wide. The age-related changes would be worth investigating only if they were divided into two groups. The accurate distinction between the two groups would be possible by performing further analysis, therefore this examination was not carried out in this study.

Shape diversity of the lacrimal bone can be observed on the skull of the Hungarian Grey cattle. The lacrimal bone may be triangular or L-shaped, within the latter category it can have divergent, convergent and parallel versions of the lower stems. As a result, the dorsal length of the lacrimal bone [Fo-Lmo (49)] is not worth investigating in relation to age.

Summary

The connection between skull dimensions of the Hungarian Gray cattle and age brought new results in several ways. Generally speaking, increased size can be observed in 21 cases, while decreased dimension can be scrutinized in 3 examples. 24 skull dimensions were independent of age, while in the case of 7 sizes a greater number of data is needed to perform the examination.

In general, the widths and lengths of the skull, the frontal bone and the facial cranium vary with age. Among length values the basal size of the cerebral cranium grows to a lesser extent, while the width dimensions change more significantly as age progresses. The area of the occipital region does not grow with age.

The correlation factor shows a close link between the change of size and the progress of age (**Table 3.**). In case of skullssize where correlation is apparent between size and age, I made three groups. Medium correlation is apparent between 40 and 60%, closer than medium correlation is apparent between 61 and 80% and there is a close correlation in case of values between 81 and 100%.

In case of 14 sizes (2, 3, 6, 10, 17a, 19, 21, 27, 30, 32, 33, 37, 44, 47a, Kőrösi 2008.31-32.) the correlation is medium, in case of 8 sizes (16, 20, 22, 25, 34, 35, 39, 50, Kőrösi 2008.31-32.) the correlation is closer than medium and in case of 2 sizes (18, 38, Kőrösi 2008. 31-32.) the correlation is very close.

The most unexpected changes occurred in several dimensions of denture and horn core bases. The length of the whole cheektooth row [P1-3+M1-3 (20)], premolar row[P1-3 (22)] and molar row [M1-3 (21)] is reduced due to intradental grinding as age progresses (Grigson 1974). As a result of the horizontal abrasion of the occlusal surface of the palm that is narrowing towards the root of the tooth the neighboring teeth are drawing closer to each other. That is the reason for shortening.

In the case of horn core dimensions one would expect that its size growth is correlated with age. However, studies have shown that in the case of cows and oxen only the horn length and the circumference of horn core radix increases with age. In case of the examined sizes the linear regression functions give the approximate annual growth of the size. Based on this the greatest growth is observed at the longest size of the horn and horn core.The length of the horn (47a) grows 10 mm, the circuit of the horn core base (44) grows 4,22 mm annually. Bartosiewicz observed in his studies annual growth of 18 mm in cows, and that of 38 mm in oxen (Bartosiewicz 2005. 310.).

The other dimensions pertaining horns and horn core are not changed. In my opinion, hereditary attributions play a major role not only in the shape of the horn, but also in the length of the horn core and horn. It has also a significant impact on horn dimensions, that what age was the calf castrated (Bartosiewicz 2005. 304.). This seems to be confirmed by the fact that in the Hungarian Grey Cattle collection in the Museum of Hungarian Agriculture one can see two ox skulls with extremely thick and long horns aged only 4-5 years (Kőrösi 2008. 204. 4th -5th oxen). These horn cores and horns are considerably longer than those of old skulls.

The expansion of studies regarding horn and horn core is necessary, because apart from the size of the horn base, the horn core diameter should also be scrutinized. Also, the testing should be carried out on a greater number of skulls, which may be used to verify or confute the changes observed in this article.

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HU ISSN 1786-271X; urn: nbn: hu-4106 © by the author(s)

EARLY BRONZE AGE AND ROMAN PERIOD ELK (*ALCES ALCES* LINNÉ, 1758) REMAINS FROM THE AREA OF BUDAPEST, HUNGARY

KORA BRONZKORI ÉS RÓMAI KORI JÁVORSZARVAS (*ALCES ALCES* LINNÉ, *1758*) MARADVÁNYOK MAGYARORSZÁGRÓL, BUDAPEST KÖRZETÉBŐL

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Abstract

This article presents recently unearthed bones of European elk in Hungary. Bones of this large cervid regularly occur in Pleistocene assemblages. Archaeological finds of this species, however, are curiosities in our area as the natural distribution of elk has been much further north during the Holocene. Elk remains found in the Csepel–Duna-dűlő site (Early Bronze Age, Bell beaker culture) and in the XI. district of Budapest, preventive excavations at the Allee shopping center (early Roman Imperial Period) probably originate from stragglers.

Kivonat

A cikk a jávorszarvasok újabb régészeti előfordulásait mutatja be Magyarországon. E nagytestű szarvast számos maradvány képviseli pleisztocén leletegyüttesekben. A hazai holocén leletanyagban azonban kuriózumnak számít, mert természetes élettere ma jóval északabbra helyezkedik el. Kóborló egyedek maradványait sikerült azonosítani a korabronzkori Harangedényes-kultúra Csepel–Duna-dűlői telepén, valamint a XI. kerületi Allee bevásárlóközpont építését megelőző feltáráson előkerült egyik kora császárkori objektumban..

KEYWORDS: EUROPEAN ELK (*ALCES ALCES*), RARE SPECIES, HUNGARY, EARLY BRONZE AGE, BELL BEAKER CULTURE, EARLY ROMAN IMPERIAL PERIOD

KULCSSZAVAK: EURÓPAI JÁVORSZARVAS (*ALCES ALCES*), RITKA ÁLLATFAJ, MAGYARORSZÁG, HARANGEDÉNYES-KULTÚRA, KORA-CSÁSZÁRKOR

Introduction

The *Cervoidea* superfamily, which includes the family of present-day Cervidae, appeared in the Oligocene in Eurasia and North America, and became especially important during the Pleistocene. This superfamily can be sub-divided into five families: the *Moschidae*, the *Palaeomerycidae*, the *Hoplitomerycidae*, and *Cervidae*. To date only the Cervidae, *Antilocapridae* (pronghorn) and *Moschidae* family (represented by a single species in the Himalayan region) have survived, the others went extinct. The family of cervids or deers (Cervidae) consists of four subfamilies (*Hydropotinae, Muntiacinae, Capreolinae, Cervinae*), 19 genera, and includes 54 species. Since the Pleistocene, elks have been the largest species in this family (Géczy 1993, 406-408).

Elks prefer the riverine wetlands, marshes, dense wooded environments with bushy undergrowth. They occur in hilly areas, but avoid steep hillsides. After the Ice Age elks were distributed as far south as the Alps. Subsequently, however, only stragglers seem to have wandered into Eastern Central Europe. Today eight subspecies of elk are distributed in North America (4, a.k.a. moose), Siberia, Manchuria and Mongolia (3) and in Europe (1). European elk is common in Scandinavia, the north of Eastern Europe including Poland, and it occurs in the hilly regions of Slovakia (**Fig. 1.**).

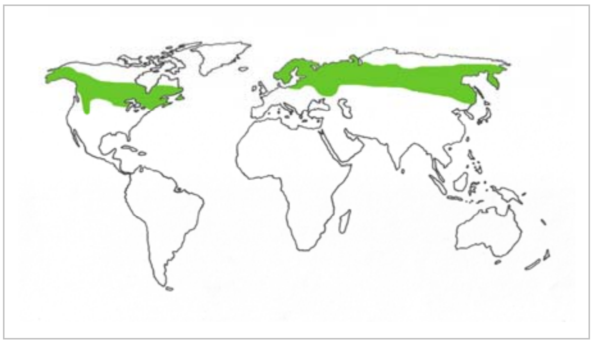

Fig. 1.: The geographical distribution of the elk/moose today (graphics by the author)

1. ábra: A jávorszarvas elterjedésének földrajzi eloszlása napjainkban (a szerző rajza)

Elks are the largest living cervids: the bull's shoulder height is above 2 m, its total body length is more than 2.5 m and its weight may exceed 450 kg. The female is slightly smaller and has no antlers. Elks occasionally form herds, but both males and females tend to be solitary animals (Pearson & Burton 1986, 187). They are not territorial; their movements occasionally cover broad geographical areas. However, their occurrence in the Holocene archaeological material (including the modern fauna) has been very infrequent in Hungary.

Table 1.: Pleistocene elk finds in Hungary

1. táblázat: Pleisztocén jávorszarvas maradványok Magyarországon

Faunal Phase	**Site**	**Reference**
Varbó faunal phase (Prae-Würm)	Lambrecht-barlang IV–V layer	Jánossy 1979, 125
	Tarkői kőfülke 2-7 blocks	Jánossy 1979, 126
	one layer of Ságvár–Horhos	Jánossy 1979, 148
Subalyuk faunal phase (Lower Würm)	Kiskevélyi-barlang layer 4	Vörös 2000, 151
	Lambrecht-barlang layer III,	
	Poroszló–Tisza river bed	
Szeleta faunal phase (Würm I)	Büdöspest-barlang	Vörös 2000, 151
	Herman Ottó-barlang layer 2	
	Szelim-barlang layer 3. „C”	
	Fegyvernek–Tisza river bed	
	Kiskunfélegyháza–Téglagyár	
	Ikrény–Rába river bed	
	Ságvár	
	Szolnok–Tisza river bed	
	Tiszakécske–Tisza river bed	
	Tiszasüly–Tisza river bed	
	Vezseny–Tisza river bed	
Istállóskő faunal phase (Middle Würm: Würm II-II/III)	Istállóskői-barlang layer III	Jánossy 1979, 141
	Jankovics-barlang	Vörös 2000, 151-152
	Kiskevélyi-barlang layer 3	
	Peskő-barlang	
	Pilisszántói II. kőfülke layer 7	
	Solymár–Kőfejtő	
	Szelim-barlang layer B2	
	Tarkői kőfülke Block II upper „2”	
	Bodrogkeresztúr-Henye	
	Dunaszekcső	
	Füzesabony–Kavicsbánya	
	Füzesabony–Homokbánya	
	Fokoru–Tisza river bed	
	Kőtelek–Tisza river bed	
	Lovas–Festékbánya	
	Madaras–Téglagyár	
	Mályi–Kavicsbánya	
	Nagybátony	
	Nagymaros	
	Pilismarót–Öregek-dűlő	
	Polgár–Tisza river bed	
	Romhány	
	Szolnok-Sárnyak–Tisza river bed	
	Szolnok-Sokorú–Tisza river bed	
	Tiszalök–Rázom puszta	
	Tószegi-szikla–Tisza river bed	

Fig. 2.: The phalanx I from Tiszalúc–Sarkad in the collections of the Hungarian National Museum (graphics by the author)
2. ábra: Jávorszarvas 1. ujjperce - Tiszalúc – Sarkad, a Magyar Nemzeti Múzeum gyűjteményéből. (a szerző rajza)

Elk remains from the Ice Age of Hungary

Pleistocene the conditions were favorable for this species in the Carpathian basin therefore its rate of incidence is high (**Table 1.**). Pleistocene occurrences of elk are connected to two periods in Hungary: the first is the middle Pleistocene Biharian faunal stage, where the earliest elk species originated (Osztramos, Tarpa hill, Solymár–Ördög Cave, Győrújfalu), while the second the Upper Pleistocene Utrecht faunal stage, when the number of elk remains increased tenfold at some sites. Elk is known from the relatively early Riss-Würm and Würm periods even in the form of its worked bones (Dobosi & Vörös 1979).The last third of this fauna phase (Würm III) is an exception, because elk occurred with varying intensities (Vörös 2000, 151). By the maximum of the Würm III period (Pilisszántó fauna phase) elks disappeared from the fauna of Hungary.

Elk in the Holocene of Hungary

Between the Mesolithic and the Iron Age several settlements yielded elk finds in Europe (Topál & Vörös 1984, 83-84; Vörös 2000, 157-158), and during the Neolithic and Copper Age rare elk finds were reported from sites in the Alpine Foreland in Switzerland and Austria and the Copper Age/Early Bronze Age settlement of Ig in the Ljubljana Marshland Slovenia (Bartosiewicz 2005, 340).

Until now a single find of elk was known from the territory of Hungary following the Holocene emergence of agriculture. It was identified from Level K2 at Tiszalúc–Sarkad (Middle-Copper Age, Hunyadihalmi group). Approximately two thirds of the animal bone material found at the site was identified, 92.68% of those remains originating from domestic animals and only 7.32 % representing game. Cattle (40438) is overwhelmingly dominant among the domestic species, and after the cattle are the pig remains (3543). Among small ruminants (1675), the aegagrus tipe goats are present in great number. The domestic horses (116) and dogs (44) are of small size. Single finds of Persian Lion, Mesopotamian fallow deer and elk (phalanges I; **Fig. 2.**) are very interesting colouring faunal elements in the Holocene macromammalian fauna (Vörös 1987, 127).

The elk phalanx II from Csepel–Duna-dűlő

The distribution of the species was the smallest during the Bronze Age in Europe. No elk bones were known from Hungary representing this time period. Excavations at Csepel–Duna-dűlő took place in 2013, yielding 1448 animal remains. They were dated to the Middle Neolithic, the Late Copper Age and the Early Bronze Age, respectively. Stratigraphic dating for some bones remains questionable.

A total of 606 remains could be attributed to the Early Bronze Age (ca 2700/2500–1900/1800 BC) Bell beaker culture. The bones originated from all parts of the body (head, trunk, meaty limbs and dry limbs, including phalanges) and probably are food refuse.

Among the mammals only 3,8 % of the identifiable bones originated from wild species. The number of the horse remains (212) was the highest, followed by cattle (147), small ruminants (42), pig (15) and dog (4). Among game the number of aurochs bones (14) were the highest, followed by red deer (5), roe deer (1) and elk (1). The elk middle phalanx (**Fig. 3.**) was found in a pit (Stratigraphic Unit 193) along with 78 other animal bones including aurochs (1) and red deer (1). Domesticates in this feature were represented by cattle (10), small ruminants (7), pig (1) and horse (37). In addition remains of a carp were also found. Some highly fragmented remains (1 bone of a dog-size mammal and 19 bone fragments of large ungulates) could not be accurately identified.

Fig. 3.: The phalanx II from Csepel–Duna-dűlő (graphics by the author)
3. ábra: Jávorszarvas 2. ujjperce - Csepel–Duna-dűlő (a szerző rajza)

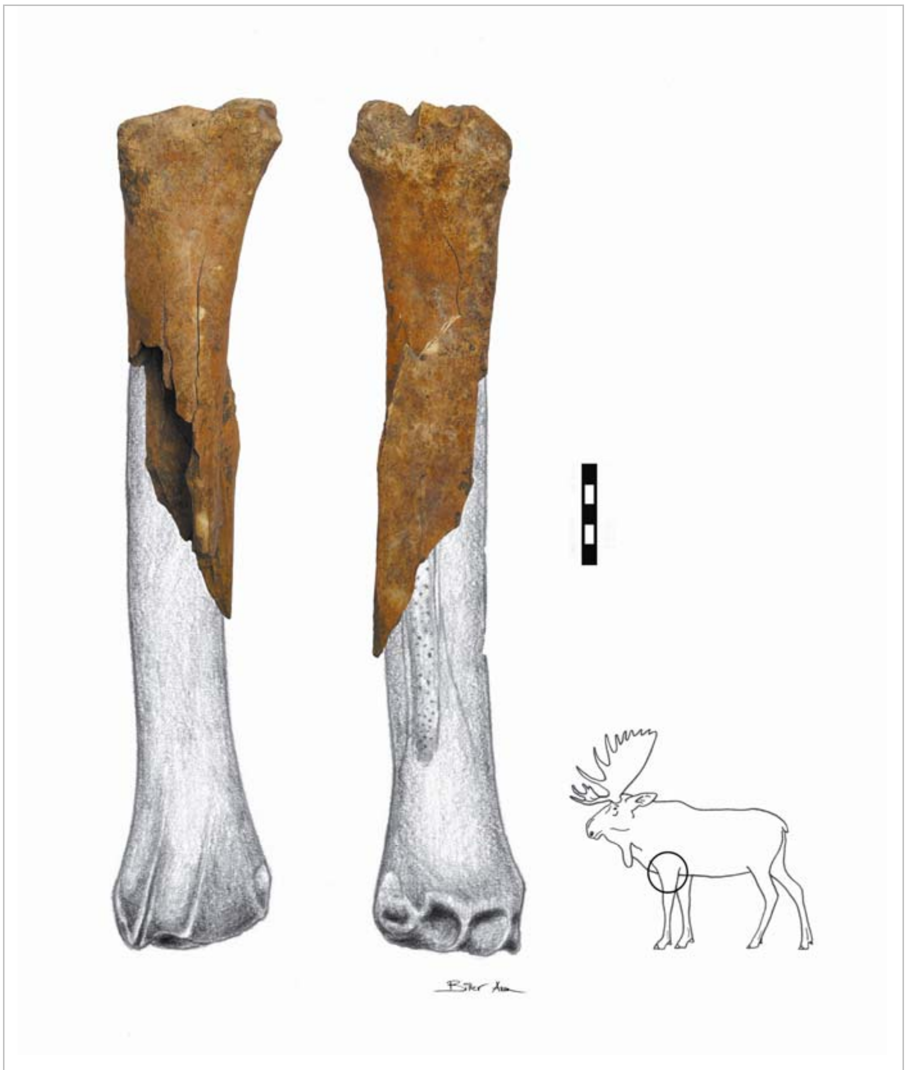

Fig. 4.:
The elk radius from Budapest–Október 23. utca
(graphics by the author)
5. ábra:
Jávorszarvas orsócsont - Budapest – Október 23. utca
(a szerző rajza)

The elk radius from Budapest–Október 23. utca

During the Iron Age and Roman Period elk remains began occurring more commonly in Central Europe, e. g. in the form of characteristic "axes" made from elk antler found at Late BA/Hallstatt Period Brixlegg–Hochkapelle, and Innsbruck–Hötting in neighbouring Austria (Bartosiewicz 2005, 347). An elk antler knife handle from the Iron Age type site of Hallstatt is kept in the Naturhistorisches Museum, Wien. Until now, however, elk remains illustrating this increasing trend were missing from the Carpathian basin.

Table 2.: Summary of Holocene elk bone measurements (mm)

2. táblázat: A holocén jávorszarvas csontok méretadatai (mm-ben)

Archeological site	**Tiszalúc–Sarkad, 1974**	**Csepel–Duna-dűlő, 2013**	**Budapest–Október 23. utca, 2007**
Period	Middle Copper Age (Hunyadihalmi group)	Early Bronze Age (Bell Beaker culture)	Early Roman Imperial (1st–2nd c. AD)
Skeletal part	Phalanx I	Phalanx II	Radius
fragment length	complete	complete	268.0
greatest length	73.5	66.0	-
breadth of the proximal epiphysis	31.5	31.0	79.0
depth of the proximal epiphysis	36.0	39.0	46.0
smallest breadth of the diaphysis	23.5	22.0	49.0
smallest depth of the diaphysis	19.0	29.0	-
breadth of the distal epiphysis	28.5	24.0	-
depth of the distal epiphysis	23.0	35.0	-

In District XI of Budapest a car park was excavated prior to the construction of the Allee Shopping Centre in 2007 (Beszédes & Horváth 2008, 141-157). Small additional excavations also took place in 2008–2009 (Beszédes & Horváth 2008, 155; Beszédes 2010, 113-114). A total of 11,873 animal remains were recovered from the almost 400 features during the 2007 field season. They represented seven major periods (Neolithic, Copper Age, Bronze Age, Iron Age, Roman Imperial Period, Ottoman Period and Early Modern Age). The 2008–2009 excavations yielded an additional 160 and 29 remains respectively. The site offered an opportunity for the long-term diachronic study of animal exploitation in the same location.

Altogether 5239 animal remains were dated to the Roman Imperial Period. The majority came from provenances representing the second half of the 1st century and the first part of the 2nd century AD. The indigenous Celtic population of the settlement lived here undisturbed under Roman rule. Because of the formation of the urban settlements in the region which began in the 2nd century the settlement was abandoned by the 3rd century (Beszédes & Horváth 2008, 154-155).

Animal bones originated from all parts of the body and must have been leftovers of meat consumption. Among the domestic mammals the number of cattle bones (1157) was the highest. There were remains of pigs (708), small ruminants (615), horses (301), dogs (119) and a cat (1) as well. The contribution of wild mammals was very low. In addition to the single elk bone, the remains of red deer (116), wild boar (21), aurochs (6), roe deer (6), hare (5), fox (2), wolf (1), badger (1), hamster (1), and squirrel (1) bones were found.

A left elk radius proximal fragment (**Fig. 4.**) came to light from a Early Roman Imperial Period pit, which was dated by the vast majority of artefacts representing the 1st-2nd century AD. Prehistoric shards occurred only sporadically (Feature 8). In the pit 73 animal remains were found: cattle (8), small ruminants (3), pig (5), horse (11), dog (23). Wild mammals included red deer (3). There was a non-identifiable bird bone, as well as some poorly preserved bone splinters from small (13) and large ungulates (5).

The significance of elk remains in Hungary

The newly discovered Early Bronze Age (Csepel–Duna-dűlő) and early Roman Imperial Period (Budapest–Október 23. utca) elk remains are the first occurrences of the species in Hungary from these two archaeological periods, increasing the number of known Holocene finds to three (**Fig. 5.**). The measurements taken on the three bone specimens following the protocol published by Angela von den Driesch (1976) are summarized in Among the elk remains from Hungary Pleistocene finds far outnumber Holocene osteological evidence. This may be the complex result of changes in the climate and vegetation as well as a general decrease in elk stocks due to deforestation and agricultural expansion.

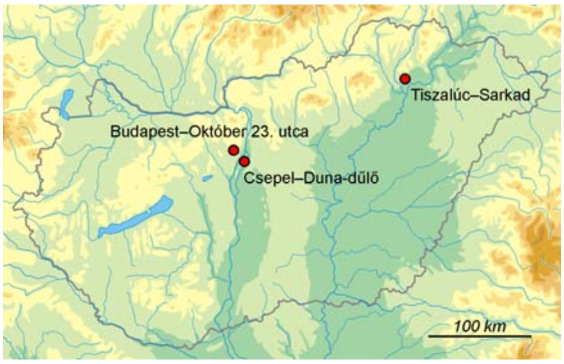

Fig. 5.: Holocene elk bone occurrences in Hungary (base map: Visy ed. 2003)

5. ábra: Holocén jávorszarvas lelőhelyek (alaptérkép Visy ed. 2003. alapján)

Given the rarity of Holocene elk finds in Hungary, the matter of sampling must also be briefly addressed, especially because the three sites that yielded these bones represent diffarnt orders of mangnitude in terms of the number of identifiable specimens (NISP). Among the mammalian remains, the largest assemblage of Tiszalúc–Sarkad yielded 7.3% wild animal remains. Due to the recovery of almost 50,000 bones, the taxonomic richness of the site was also impressive including rare remains of Persian Lion and Mesopotamian fallow deer in addition to the elk phalanx under discussion here (Vörös 1987). Even if the contribution of wild mammal bones to this Copper Age assemblage did not reach 10%, it seems that hunting was of at least cognitive importance at the site. The two later sites where elk was found relied steadily on domesticates in meat provisioning (wild mammals: Csepel–Duna-dűlő: 5.6%, Budapest–Október 23. utca: 4.9%; **Fig. 6.**). At these two settlements, especially in the small bone assemblage from Csepel–Duna-dűlő the occurrence of elk is far more surprising, showing that the odd stragglers killed by ancient people would be difficult to predict on a purely statistical basis.

A Chi square test carried out on all three assemblages shown in **Fig. 6.** has proven that due to its large, representative size, the Tiszalúc–Sarkad assemblage stood out with its slightly higher percentage of wild animals. The set of three sites therefore is not homogeneous in terms of the domestic/wild dichotomy (Chi2=15.758, df=2, P=0.0003). Removing the unusually rich Copper Age assemblage from the calculation showed that the remaining two smaller sites, Csepel–Duna-dűlő and Budapest–Október 23. utca, were not significantly different from each other in their small percentages of wild mammals (Chi2=0.348, df=1, P=0.555). The occurrence of elk in the “ordinary” food refuse of these “agrarian” settlements is therefore even more surprising.

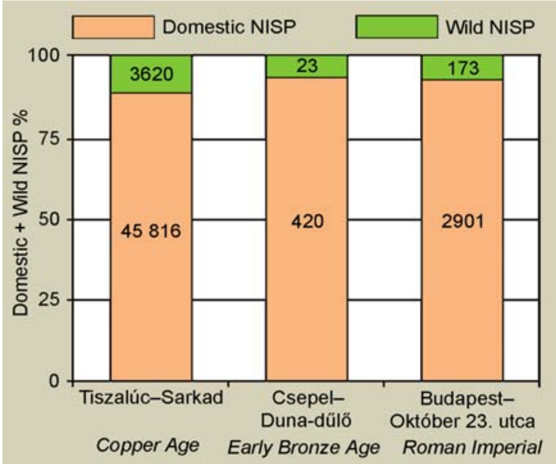

Fig. 6.: The percentual contribution of domestic and wild mammalian remains to the three Holocene assemblages that yielded elk remains

6. ábra: A házi- és a vademlős maradványok százalékos megoszlása a három vizsgált jávorszarvasos holocén lelőhelyen

Conclusions

The occurrence of elk in Hungary during milder Holocene periods may be related to climatic/vegetation changes. Elks, however, tend to roam over broad areas regardless of the actual climate. In addition, one may speculate of exotic imports in the Roman Period, although hunting by the indigenous Celtic population may be a more realistic source of the find under discussion here. To date no medieval elk remains have been found in the territory of present-day Hungary. Sporadic bones from this later time period occurred in Lower Austria and a single medieval find was reported from the lowlands of Romania, while elk was still mentioned as royal game in mountainous Transylvania in the 16th century (Bartosiewicz et al. 2010, 95). In general, because elks migrated into our territory only occasionally, fewer fell victim to opportunistic hunting and thus there is a rather slim chance to recover elk remains from ancient settlements. Elk, never-the-less, has always had a broad geographical range, stragglers cover long distances. Four such individuals were killed in Hungary between 1979 and 1981, as this rare visitor is not even listed as an endangered species. Their occurrence can definitely be attributed to random migration (Topál and Vörös 1984, 84-86), also a possible source of the chance find of elk bones known from archaeological sites in Hungary.

Acknowledgements

I would like to thank Dr. István Vörös who gave detailed professional advice on elks, Dr. László Bartosiewicz, who encouraged the publication of finds and helped with the translation, and archaeologists in the Budapest History Museum: Attila Horváth, excavator of Csepel–Duna-dűlő, József Beszédes, excavator of Budapest–Október 23. utca and Alexandra Nagy, who helped with professional advice and observations.

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HU ISSN 1786-271X; urn: nbn: hu-4106 © by the author(s)

CUMANIAN DOGS FROM CSENGELE (SE HUNGARY)

A CSENGELEI KUN KUTYÁK

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Abstract

During the excavation of Csengele-Bogárhát 12/14/A/2 site (Csongrád County, SE Hungary) Cumanian settlement (Árpád Period, 13th century), remains of nine dogs were found in feature no. 38 (oven), no. 98 (ditch), no. 99 (ditch), no. 113 (pit), and no. 136 (ditch). The withers heights of the Cumanian dogs from Csengele varied between 44.3 and 58.9 cm, indicative of medium-small and medium body-height.

Looking at the craniometrical parameters of three individuals (feature no. 99/I, feature no. 113 and feature no. 136) belonged to the morphological group of Canis familiaris intermedius *(Woldřich 1878), which includes hound-type dogs. The fourth dog (feature no. 98) belonged to the morphological group* Canis familiaris matris opitimae *(Jeittneles 1877), which also contains the shepherd dogs.*

Kivonat

Csengele-Bogárhát 12/14/A/2. lelőhely (Csongrád megye) kun település (Árpád-kor, XIII. sz.) feltárása során összesen 9 kutya csontmaradványai kerültek elő a 38. objektumból (tűzhely), a 98., 99., 136. objektumokból (árok) és a 113. objektumból (gödör). A csengelei kun kutyák 44,3 cm és 58,9 cm közötti marmagasságúak, kisközepes és közepes testméretűek voltak.

Craniológiai jellemzőik alapján 3 egyed (a 99. objektum/I. egyed, 113. objektum, 136. objektum/ I. egyed) a kopóféléket is magába foglaló Canis familiaris intermedius *(Woldřich 1878) alakkörbe tartozott. A negyedik kutya (98. objektum/I. egyed) a juhászkutyákat is felölelő* Canis familiaris matris opitimae *(Jeittneles 1877) alakkörbe tartozott.*

KEYWORDS: DOG SKELETON, CUMANIAN, 13TH CENTURY ÁRPÁD PERIOD

KULCSSZAVAK: KUTYACSONTVÁZ, KUN, ÁRPÁD-KOR, XIII. SZÁZAD

Introduction

The excavation of Csengele-Bogárhát 12/14/A/2 site (Csongrád County) began in 1975 under the direction of Ferenc Horváth (Szeged, Móra Ferenc Museum). The work continued as part of preventive excavations along the track of the M5 motorway in 1998. That time a western slice of a concentric ditch-system (marked as roundels 25th, 26th, 27th) was discovered, that once had surrounded an Árpád Period church found during the course of the 1975 excavations (**Fig. 1.**). 37 Cumanian graves and two houses were excavated at the site. A partial skeleton of a dog was lying on the baking surface of an oven in the "northern house" (feature no. 112) placed between the outer (25th) and the middle (26th) roundels (Horváth 2001, 79, Fig. 25). Three complete dog skeletons and a partial skeleton of a dog were found in three features (feature no. 98, 99, 136) in the outer roundel (25th). The head of a dog came to light from feature no. 113 in the middle roundel (26th).

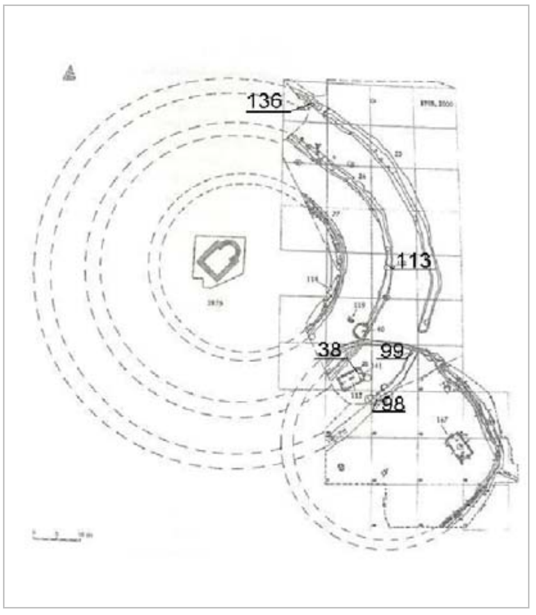

Fig. 1.: The drawing of Csengele-Bogárhát site no. 12/14/A/2 (Horváth 2001 p. 79)

1. ábra: Csengele-Bogárhát 12/14/A/2. lelőhely rajza (Horváth 2001, 79. oldal)

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Table 1.: Csengele 12/14A/2 Anatomical distribution of the bones of the Árpád-Period dog individuals

1. táblázat: Csengele 12/14A/2. Árpád- kori kutyák csontjainak anatómiai megoszlása egyedenként (db)

Feature/ pieces	Feature no. 112 oven no. 38		Feature no. 98	Feature no. 99		Pit no. 113	Feature no. 136		
Individual	I.	II.	I.	I.	II.	I.	I.	II.	III.
neurocranium			1	1		1	1		
viscerocranium					1				
upper teeth					2				
mandible		1	2	2		2	2		
lower teeth	2				3				
	3		3	3	6	3	3	0	0
v. cervicalis			7	7			5		
v. thoracalis	2		13	13			9		
v. lumbalis	1		2	7			6		
sacrum				1			1		
v. caudalis				3			1		
vertebrae					1				
costa	5		25	21	4		18		
sternum			4	2	3		3		
	8		51	54	8		43	0	0
scapula	2		2	2			2		
humerus	2		2	2					
radius	2		2	2			1	1	
ulna	2		2		1		1		
os carpale	5		7		5		4		
metacarpus	4		8	7			8		
	17		23	13	6		16	1	0
pelvis				2			2	1	
femur			1	2	1		2		
patella					2				
tibia			2	2			2		1
astragalus			2	1			2		
calcaneus			2	1			2		
os tarsale			6	2	2		5		
metatarsus			8	4			7		
metapoium					1		3		
sesamoideum				4			1		
ph.I.	2		10	9	5		14		
ph.II.			2	4	3		15		
ph.III.			6	2	2		9		
	2		39	33	16		64	1	1
Total:	**29**	**1**	**116**	**103**	**36**	**3**	**126**	**2**	**1**

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Zoological characterization of the dogs

"Northern House" (Feature no. 112), oven 38

The remains of two individuals could be distinguished among the dog bones found on the baking surface of the oven in the "northern house", located between roundels 25 and 26. Mandible of individual no. I and the frontal body section of individual no. II could be recovered (Horváth 2001, 127). The rear half of individual no. II was destroyed. The remaining bones were burned and calcined by the high temperature (Horváth 2001, 128, Fig. 46). A total of 30 bone fragments were found of the two individuals (the anatomical distribution of the skeletal remains is shown in **Table 1.**). In addition to the dog bones eight sheep bones and a fish bone were also identified from the oven.

Individual no. I

Head: mandibula sin. + P2-4

The mandible is short, the premolars are slightly crowded. The corpus of the mandible is medium high, the ventral edge is slightly wavy. The incisura vasorum sharply arches up, medium deep. The processus angularis is a strong hook, the condylus is broad (measurements of the mandible are shown in **Table 3.**).

The dog was an adult individual.

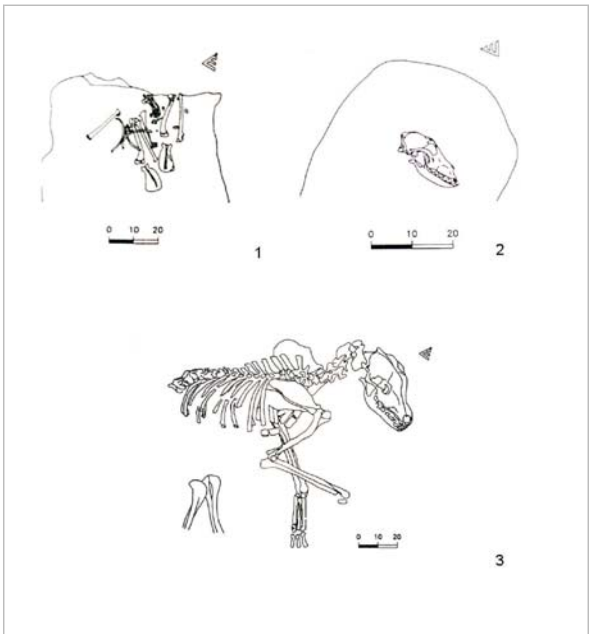

Fig. 2.: Csengele 12/14/A/2 Drawings of the dog finds/I (Horváth 2001 p. 142) 1: oven no. 38 (feature no. 112), 2: feature no. 113., 3: feature no. 98

2. ábra: Csengele 12/14/A/2. A kutyaleletek rajzai/I (Horváth 2001, 142. oldal) 1: 38. tűzhely (112. objektum), 2: 113. objektum, 3: 98. objektum

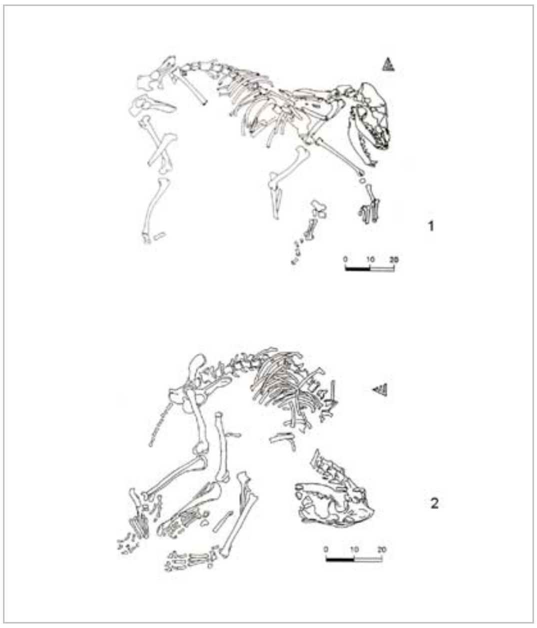

Fig. 3.: Csengele 12/14/A/2 Drawings of the dog finds/II (Horváth 2001 p. 144) 1: feature no. 99/I dog, 2: feature no. 136/ I dog

3. ábra: Csengele 12/14/A/2. A kutyaleletek rajzai/II. (Horváth 2001, 144. oldal) 1: 99. objektum / I. egyed, 2: 136. objektum / I. egyed

The alveolus of the M1 is loosened. Due to an inflammation, which caused intra vitam tooth loss, the margin of the alveolus extended to the buccal side of the mandible. The corpus in this section is thickened. The inflammation reached the M2-3. Exostosis is observable on the buccal side of the processus articularis (**Fig. 6/1.**).

Individual no. II (Fig. 2/1.):

Head: I3, P4 sin.

Trunk: 2 v. thoracalis, 1 v. lumbalis 5 costa

Limbs: scapula sin-dext., humerus sin-dext., radius sin-dext., ulna sin-dext., 5 os carpale, metacarpus II-V. sin., 2 phalanx I.

The age of the individual is between 8 months and 1 year, according to the ossification phases of epiphyses of the long bones (Schmid 1972). The average withers height is 58.9 cm calculated from the greatest lengths of 4 long bones (Koudelka 1886).

The long bones are large, slender, the individual could be similar to the present shepherd dogs (**Figs. 7/1, 8/1, 9/1.**). The measurements of the bones are shown in **Tables 5-15**.

Feature no. 98

A nearly complete skeleton of a dog lay in the SE part of the outer (25th) roundel. Beside the bones of the dog a cattle phalanx was in the feature.

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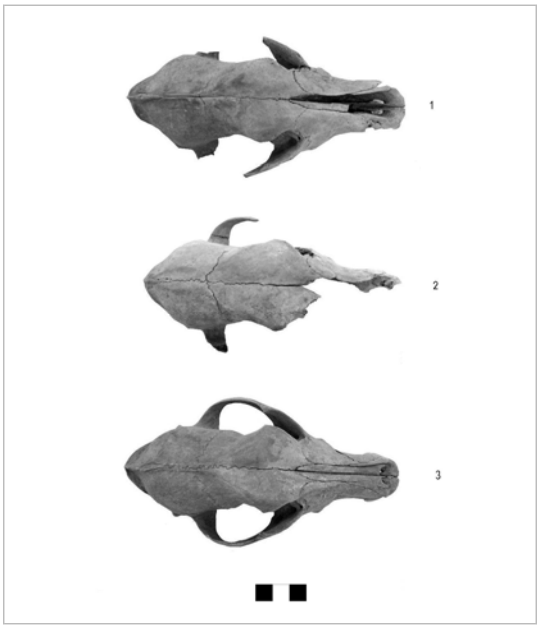

Fig. 4.: Csengele 12/14/A/2 Skulls of the dogs from the 1: feature no. 98, 2: feature no. 99/I dog, 3: feature no. 113

4. ábra: Csengele 12/14/A/2. Árpád-kori kutyák koponyái. 1: 98. objektum, 2: 99. objektum / I. egyed, 3: 113. objektum

The dog skeleton was lying on its left side, the head directed to E-NE. The skeleton was lying in anatomical order from the head to the lumbalis region, the spine was unbroken, the limbs rested on each other, the pelvis missed. The shins, the tarsals and the metatarsals were lying further from the skeleton (Horváth 2001, pages 141-142, Figs 52-53/1) (**Fig. 2/3.**). 116 pieces of bones belonged to that individual (the anatomical distribution of the bones is shown in **Table 1.**).

Head: skull (I1-3 + P 2-4 + M 1-2 sin., I 2-3 + P 2-4 + M1-2 dext.)

mandibula pair (I3 + C inf. + P2-4 + M1-2 sin., I3 + C inf. + P3-4 + M1-2 dext.)

Trunk: 7 v. cervicalis (phys. length: 172 mm), 13 v. thoracalis (phys. length: 242 mm), 2 v. lumbalis, 24 costa, 4 sternebra

Limbs: scapula sin-dext., humerus sin-dext., radius sin-dext., ulna sin-dext., 6 os carpale, metacarpus II-V. sin-dext., caput femoris, tibia sin-dext., astragalus sin-dext., calcaneus sin-dext., 6 os tarsale, metatarsus II-V. sin-dext., 10 phalanx I., 2 phalanx II., 6 phalanx III. (**Figs.7-8-9/2, 11/1.**)

The skull is long, strong, and broad. The occipital is concave, triangle shape, the foramen magnum is wide, almost circle shape. The parietals are convex, the interparietal is short, the crista sagittalis externa is strong, slightly high, bends aborally, beyond the plane of the occipital.

Fig. 5: Csengele 12/14/A/2 Skulls of the dogs from the Árpád Period 1: feature no. 98, 2: feature no. 99/I dog, 3: feature no. 113

5. ábra: Csengele 12/14/A/2. Árpád-kori kutyák koponyái. 1: 98. objektum, 2: 99. objektum / I. egyed, 3: 113. objektum

The frontale is slightly broad, the front halves protrude, then meet in an aboral deepening sulcus along the suture. The processus zygomaticus is short, rounded, the orbita is angular. The linea temporalis is flat, short and closes shortly after the bregma. The profile sharply joins to the nose. The bridge (stop) is observable, not expressed, medium-low standing. The viscerocranium is wide (**Figs. 4-5/1.**).

The mandible is long, thick, the corpus is low, its ventral edge is straight. The incisura vasorum arches highly, shallow, ends into a thin, strong processus articularis (**Fig. 6/2.**). The dentition is regular, the teeth are large.

The age of the individual is between 1.5-2 years according to the ossification phases of epiphyses of the long bones (Schmid 1972). According to the morphological traits of the skull the gender of the dog is male. The average withers height is 54.9 cm calculated from the greatest lengths of 7 long bones (Koudelka 1886). The measurements of the bones are shown in **Tables 5-15**. The withers height is 58.2 cm calculated from the interior length of the cranial cavity (Wyrost & Kucharczyk 1967).

According to the morphological traits and the craniometric data of the skull the animal belonged to the morphological group of *Canis familiaris matris optimae* (Jeittneles 1877), which includes the shepherd dogs also. The skull measurements and indices are shown in the **Tables 2, 3** and **4.**

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Table 2.: Csengele 12/14A/2 Skull measurements of the Árpád-Period dogs (mm) (measurements after Driesch 1976)

2.táblázat: Csengele 12/14/A/2. Árpád-kori kutyák koponyamértei (mm) (méretek Driesch 1976 nyomán)

	Feature no. 98	Feature no. 99/I	Feature no. 113	Feature no. 136/I
Calvaria length (Op-P)	187	179	173	-
Parietal length (Op-Br)	53	52	50	54.5
Interparietal length (Op-L)	35	21.5	35	31
Parietal med.-sag. length (L-Br)	22	33	19.5	24.5
Frontal med.-sag. length (Br-N)	52	56	50.5	-
Neurocranial length (Op-N)	99.5	101	96	-
Viscerocranial length (N-P)	94	88	85	-
Viscerocranial oral length (P-Ect)	108	105	101	-
Neurocranial aboral length (Ect-Op)	88	90	82.5	92.5
Proc. nasalis length (N-Fo)	13	16.5	16.5	-
Op-Fo length	111	117.5	110.5	-
P-If length	59	53	54.5	-
Maxilla dors. length (Fo-Ni)	26	40	18	-
Lateralis length (Fo-Mo)	55.5	53	53	-
Intermaxilla dors. length (P-Ni)	49.5	71	54	-
Lateral length (P-Mo)	33	24	25.5	-
Palate length (P-St)	96.5	-	83.5	-
Os palatinum length (Po-St)	35	-	26.5	-
Base length (B-P)	170	158	151	-
Length of cheektooth row (P-Pd)	93	90	87	103
Dental row length (Pm-Pd)	69	66	61	69
Incisive length (P-Ic)	12.5	10	12	14
Diastema length (Ic-Pm)	16.5	15.5	14	19
C alveolus length	14	11.5	11	15.5
P1-4 length (Pm-Mol)	53	45	46	52
M1-2 length (Mol-Pd)	19	21.5	17	19
P-Mol length	85.5	73	75	82
B-Mol length	96.5	87	86	-
Neurocranium aboral height (B-Op)	51	43	39.5	46
Os occipitale height (O-Op)	30.5	23	26	31
Foramen magnum height (B-O)	18	16.5	17	15
Interior neurocranium length (B-fs ethm.)	87.5	-	85	-
Exterior neurocranium length (B-N)	100	97	90	-
Skull largest width (Zy-Zy)	-	-	87.5	-
Neurocranium largest width (Ot-Ot)	65.5	60.5	57.5	63
Neurocranium width (eu-eu)	59	57	52	50
Frontal smallest width (fs-fs)	43	43	35	-
Frontal largest width (Ect-Ect)	50	54	46	-
Distance between the medial canthi (Ent-Ent)	36	36.5	30	-

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Table 2., cont.

2.táblázat, folyt.

	Feature no. 98	Feature no. 99/I	Feature no. 113	Feature no. 136/I
Os nasale width I. (Fo-Fo)	8.5	10	9	-
Os nasale width II. (Ni-Ni)	12	-	9	-
If-If distance	40	-	33	-
M-M distance	51.5	-	47.5	-
Zmi-Zmi distance	72	-	57.5	-
Face shortest width at Pm	35	-	29	-
face largest width at Mol	66	-	55	-
Incisive width	27	-	24	28
C width	37	-	30	-
Distance between proc. jugulare (Ju-Ju)	53	42	43.5	48
Distance between the external auditory meati (po-po)	49	54	56	48
Petrous bone width (Pha-Pha)	17	10	17	18
Fossa mandibularis width	38	40	36	33
Condylus occipitalis width (c-c)	40	35	34	40
Foramen magnum width	20	19	19	19
P4 length (alv.)	14	16.5	18	20
Orbits height	30	-	27	-
Os zygomaticum thickness	-	-	3	-
Skull height (B-L)	59.5	50	50.5	55

Feature no. 99

The feature no. 99 was placed in the SE part of the outer roundel (25th), NE from the feature no. 98. There was an almost complete skeleton of a dog and other dog bones from another individual in it.

Individual no. I:

The skeleton of the dog lay in anatomical order, its head directed E. The front limbs were extended towards the head, the right front limbs were perpendicular to them. The hind limbs lay on each other. The spine bended in an arc, was not broken. From the carpals and the tarsals the bones moved down, scattered (Horváth 2001, page 144, Fig 54/1) (**Fig. 3/1.**). 103 pieces of bones belonged to that individual (the anatomical distribution of the bones is shown in **Table 1.**).

Head: skull (I3 + C sup. + P3-4 + M1-2 sin., C sup. + P3-4 dext.)

Mandibula pair (I2-3 + P1-4 + M1-2 sin., I1-3 + P1 + P3-4 dext.)

Trunk: 7 v. cervicalis, (phys. length: 158 mm), 13 v. thoraclais (phys. length: 200 mm), 7 v. lumbalis (phys. length: 177 mm), sacrum (3), 3 v. caudalis, 21 costa, 2 sternebra

Limbs: scapula dext., humerus sin-dext., radius sin-dext., 8 os carpale, metacarpus II-V. sin, III-V. dext., pelvis sin-dext. (on os ilii sin. pea size dent), femur sin-dext., tibia sin-dext., astragalus sin., calcaneus sin., 5 os tarsale, metatarsus II-V. dext., 4 os sesamoideum, 9 phalanx I., 4 phalanx II., 2 phalanx III. (Figs 7/2, 8/4, 10/1, 11/2)

The left side maxilla is broken, the zygomatic bones are damaged.

The skull is oblong, medium-broad, slender-walled. The parietal is convex, the interparietal short, low, a less-expressed crista sagittalis externa rises on it, slightly bending behind the plane of the occipital. The occipital is triangle shape, the foramen magnum is wide, diamond shape. The frontals are oblong, slightly narrow at the frontostenion. The cristae frontales are plane, the front halves meet in a shallow deepening sulcus and end into rounded, angular processus zygomaticus. A non-expressed stop is observable on the neurocranium (Figs 4-5/12). The dentition is complete, regular. Both sides P3 have a 3rd root on the lingual side.

Table 3.: Csengele 12/14/A/2 Mandible measurements of the Árpád-Period dogs (mm) (measurements after Driesch 1976)

3. táblázat: Csengele 12/14/A/2. Árpád-kori kutyák mandibula méretei (mm) (méretek Driesch 1976 nyomán)

Mandible measurements	**Feature no. 98**	**Feature no. 99/ Ind. no. I**	**Feature no. 113**	**Feature no. 136/ Ind. no. I**
Total length (cm-Id)	142.5	125*	124	-
goc-Id length	141.5	124*	125	-
X –Id length	137	121*	118	-
C aboralis alv.-cm length	122	113	107	125
C aboralis alv.-goc length	121	113	109	128
C aboralis alv. –X length	115.5	110	102	120.5
C aboralis alv.-M3 aboralis alv. length	82	78	73	83
M3-P1	78.5	73	69	77.5
M3-P2	73.5	69	64	72.5
Molar length	37	47	32	38
Premolar dental row length (P1-4)	43	38	38	42
Premolar dental row length (P2-4)	39	32.5	31.5	36
M1 width and depth (on tooth)	22.5:9	21:9	20:7.5	22:9
M1 width and depth (on alveolus)	21.5:8	19:8	19:7	20.5:8
M2 width and depth	10:8	9:6	9:6	-
Greatest thickness of the mandible at M1	12.5	10	10	10
Cm-gov. height	26	23	23	27
Cr-gov height	53	46.5	48	56
Corpus height behind M3	27	25	24.5	26
Corpus height before M1	22	20.5	18	22
Corpus height before P1	20.5	17	15.5	-
Ramus thickness	24.5	23	22	26
Condylus width	25	18	20	24

*: fragmentary bone

Table 4.: Csengele 12/14/A/2 Indices of the Árpád-Period dog skull measurements

4. táblázat: Csengele 12/14/A/2. Árpád-kori kutyák koponyaméret indexei

	Feature no. 98	Feature no. 99/I	Feature no. 113	Feature no. 136/I
Zy-Zy/ P-Op	-	-	50.57	-
Ect-Ect/ P-Op	28.08	30.16	26.89	-
fs-fs/ P-Op	24.157	24.02	20.23	-
eu-eu/P-Op	31.55	31.84	30.05	-
L-Br/ Op-N	22.1	32.7	20.3	-
P-N/ Zmi-Zmi	1.3	-	1.47	-
Pm/M	2.78	2.09	2.7	2.73

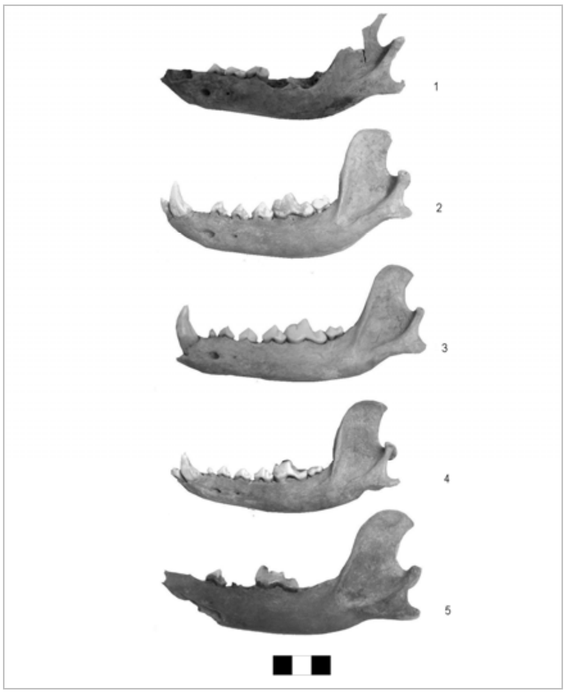

Fig. 6.: Csengele 12/14/A/2 Mandibles of the dogs from the Árpád Period 1: oven no. 38 (feature no. 112) 2: feature no. 98, 3: feature no. 99/I dog, 4: feature no. 113, 5: feature no. 136/I dog

6. ábra: Csengele 12/14/A/2. Árpád-kori kutyák mandibulái. 1: 112. objektum/38. tűzhely/ I. egyed, 2: 98. objektum, 3: 99. obj./I. egyed, 4: 113. obj., 5: 136. obj. /I. egyed

The mandible is long, thin has a low corpus, the lower line of the corpus is straight. The incisura vasorum arches up, short, deep, ends into a medium strong processus articularis. The condylus is not too broad, the ramus is short (**Fig. 6/2.**). The dentition is regular.

The age of the individual is ca. 2 years old according to the ossification phases of articular surface of the vertebrae (Schmid 1972). The average withers height is 49.4 cm calculated from the greatest lengths of 7 long bones (Koudelka 1886). The measurements of the bones are shown in **Tables 5-15**. The long bones are straight and slender.

According to the morphological traits and the craniometric data of the skull the animal belonged to the morphological group of *Canis familiaris intermedius* (Woldřich 1878). The skull measurements and indices are shown in the **Tables 2, 3** and **4**.

Individual no. II:

28 pieces of mostly fragmented bones yielded from the skeleton (the anatomical distribution of the bones is shown in **Table 1.**).

Head: C sup. dext + I1 + 3db I inf. maxilla fragment

Trunk: 1 vertebra fragment, 4 costa, 3 sternebra

Limbs: ulna dext. fragment, 5 os carpale, femur dist. epiphysis fragment, patella sin-dext., 1 metapodial fragment, 2 os tarsale, 5 phalanx I., 2 phalanx II.

The age of the individual is ca. 1.5 years according to the ossification phases of epiphyses of the long bones (Schmid 1972). The measurements of the distal epiphysis of the femur are shown in **Table 11**.

Pit no. 113

The feature was in the E part of an oval pit which was placed perpendicular to the middle roundel (26th). The head was directed to S-SW (Horváth 2001, page 142, Fig 53/2) (**Fig. 2/2.**).

The skull is long, narrow, thick-walled. The parietals oblong, concave, the interparietale is very short, sharp crista sagittalis extrena rises on it, bending behind the plane of the occipital.

The occipital is straight walled, short, triangle shape, the foramen magnum is broad, lump is observable above it. The frontals are broad, the front halves protrude, then meet in an aboral sulcus along the suture. The processus zygomaticus is pointed, the canthi are expressed. The linea temporales rise and close in arc at the bregma. The nose slightly convex, the bridge (stop) is observable, not expressed, middle-standing. The viscerocranium is narrow (**Figs. 4-5/3**).

The mandible is long, thick, the corpus is very short, the ventral edge of the corpus is straight. The incisura vasorum arches deeply, ends into a hooked, strong processus angularis (**Fig. 6/4.**).

Dentition: I1-3 + C sup. + P2-4 + M1-2 sin-dext.

I1-3 + C inf. + P1-4 + M1-2 sin-dext.

The surfaces of the teeth are worn, there is no enamel on the upper quarter of their crown. The aboral cusp of the M1 is worn deeply, forming an integrated surface with the M2. On the basis of toothwear, the age of the individual is determined adultus/maturus.

The withers height is 56.9 cm calculated from the interior length of the cranial cavity (Wyrost & Kucharczyk 1967).

According to the morphological traits of the skull and craniometric data, the animal belonged to the morphological group of *Canis familiaris intermedius* (Woldřich 1878). The skull measurements and indices are shown in the **Tables 2, 3 and 4.**

Fig. 7.: Csengele 12/14/A/2 Humerus 1: oven no. 38, 2: feature no. 98, 3: feature no. 99/I dog

7. ábra: Csengele 12/14/A/2. Humerusok 1: 38. tűzhely 2: 98. objektum 3: 99. objektum / I. egyed

Feature no. 136

This feature was located in the N-NE section of the outer roundel (25th). It contained the remains of three individuals: a nearly complete skeleton of individual no. I and bones from two additional dogs.

Individual no. I:

The skeleton of this dog lay on its left side, the head directed to S. The spine was broken after the cervical vertebrae. The skull and cervical vertebrae were placed further away from the rest of the trunk. The hind limbs slipped next to each other, only the left side front leg remained in place (Horváth 2001, 144, Fig 54/2) (**Fig. 3/2.**). The skull was burnt. The pit contained 126 bone fragments of the dog (the anatomical distribution of these bones is shown in **Table 1.**).

Head: skull (P4 + M1-2 sin., P4 + M1-2 dext.)

mandibula pair (P3-4 + M1 + M3 sin., P 3-4 + M1 + M3 dext.)

Trunk: 5 v. cervicalis, 9 v. thoracalis, 6 v. lumbalis, sacrum (3), 1 v. caudalis, 18 costa, 3 sternebra

Limbs: scapula sin-dext., radius sin., ulna sin., 4 os carpale, metacarpus II-V. sin-dext., pelvis sin-dext., femur sin-dext., tibia sin-dext., astragalus sin-dext., calcaneus sin-dext., metatarsus II-V. sin., II; III; V. dext., 13 phalanx I., 15 phalanx II., 9 phalanx III., 1 os sesamoideum (Figs 8/3, 10/2, 11/3).

Fig. 8.: Csengele 12/14/A/2 Radius 1: oven no. 38, 2: feature no. 98, 3: feature no. 136/I dog, 4: feature no. 99/I dog, 5: feature no. 136/II dog

8. ábra: Csengele 12/14/A/2. Radiusok 1:38. tűzhely (112. objektum), 2: 98. objektum, 3: 136. objektum /I. egyed, 4: 99. objektum /I. egyed, 5: 136. objektum / II. egyed

Fig. 9.: Csengele 12/14/A/2 Ulna 1: oven no. 38, 2: feature no. 98

9. ábra: Csengele 12/14/A/2. Ulnák 1: 38. tűzhely, 2: 98. objektum

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Fig. 10.: Csengele 12/14/A/2 Femur 1: feature no. 99/I dog, 2: feature no.136/I dog

10. ábra: Csengele 12/14/A/2. Femurok 1: 99. objektum /I. egyed, 2: 136. objektum /I. egyed

The skull is long, thick-walled. The neurocranium is broad the parietals are concave, the interparietal medium long, an expressed crista sagittalis externa rises on it, slightly bending behind the plane of the occipital. The occipital is pointed, triangle shape, the foramen magnum is depressed lengthwise. The frontals are fragmented, slightly narrow, the front halves are flat and end in a short, rounded processus zygomaticus. The smooth crista frontalis closed at the bregma.

The mandible is elongated, medium low, thin, the ventral edge of the corpus is slightly curved. The incisura vasorum is shallow, ends into a strong processus articularis (**Fig. 6/5.**). The dentition is regular.

Estimated from the epiphyseal fusion of long bones, the age of the individual was between 1.5-2 years (Schmid 1972). The average withers height is 53.7 cm calculated from the greatest lengths of seven long bones (Koudelka 1886). The original bone measurements are shown in **Tables 5-15**.

According to the craniomorphological traits and its measurements, the skull of the animal belonged to the group of *Canis familiaris intermedius* (Woldřich 1878). The skull measurements and indices are listed in **Tables 2, 3** and **4**.

Fig. 11.: Csengele 12/14/A/2 Tibia 1: feature no. 98, 2: feature no. 99 II dog, 3: feature no. 136/I dog, 4: feature no. 136/III dog

11. ábra: Csengele 12/14/A/2. Tibiák. 1: 98. objektum, 2: 136. objektum /I. egyed, 3: 136. objektum /III. egyed, 4: 99. objektum/I. egyed

Individual no. II:

1 radius sin. of an adult individual, 1 pelvis fragment (**Fig. 8/5.**)

The withers height is 44.2 cm estimated from the greatest length of the radius (Koudelka 1886). Bone measurements are shown in **Table 9**. This was a small individual with slender bones.

Individual no. III:

tibia sin. of an adult individual (**Fig. 11/4.**)

The withers height is 54.2 cm estimated from the greatest length of the tibia (Koudelka 1886). The measurements of the bone are shown in Table 12.

This was a medium-size individual with slender bones.

Three of the dogs from Csengele (feature no. 99/I, feature no. 113, feature no. 136/ I) of belonged to the morphological group of *Canis familiaris intermedius* (Woldřich 1878) according to the morphometric traits of the skull. The fourth dog (feature 98/I) belonged to the craniomorphological group of *Canis familiaris matris opitimae* (Jeittneles 1877) which also includes shepherd dogs.

Tables 5-15.: Csengele 12/14/A/2 Bone measurements and withers heights of the Árpád-Period dogs (mm) (measurements Driesch 1976)

5-15. táblázatok: Csengele 12/14/A/2. Árpád-kori kutyák csontméretei és azokból számolt marmagasság értékek (mm) (méretek Driesch 1976)

Table 5. / 5. táblázat: Atlas

	length	width	arcus length	cranial art. surf. width	caudal art. surf. width
Feature no. 98	36	74	14.5	42	32
Feature no. 99/ I	31	-	14	32*	37
Feature no. 136/I	36	77	15	41.5	31

Table 6. / 6. táblázat: Axis

	length	width	arcus length	cranial art. surf. width	caudal art. surf. width	proc. dens width/length
Feature no. 98	63	38	51	29	31	10:14
Feature no. 99/ I	44	-	48.5	28	24	5.5:12.5
Feature no. 136/I	60	37	50	29	29	8.5:13.5

Table 7. / 7. táblázat: Scapula

	length	collum width	angulus art.width	fac. art. width/depth	withers height
Oven no. 38/II	128*	24	30	27:18	519.68
Feature no. 98	133	25.5	31	27.5:17	539
Feature no. 99/ I	117.5	-	-	-:16	477.05
Feature no. 136/I	138	24.5	28.5	24:18.5	560.28

Table 8. / 8. táblázat: Humerus

	1.	2.	3.	4.	5.	6.	7.	8.
Oven no. 38/II	176.5	31	11	33	42	12	27	594.80
Feature no. 98	169.5	30.5	13	34.5	43	15	27	571.21
Feature no. 99/ I	150	28.5	11	28.5	38	11	23	505.5

1. greatest length, 2. greatest width of the proximal epiphysis, 3. smallest width of the diaphysis, 4. greatest width of distal epiphysis, 5. greatest depth of the proximal epiphysis, 6. smallest depth of the diaphysis, 7.greatest depth of the distal epiphysis, 8. withers height

Table 9. / 9. táblázat: Radius

	1.	2.	3.	4.	5.	6.	7.	8.
Oven no. 38/II	183	18	12	25	13.5	6	19	589.26
Feature no. 98	169	20	13	25.5	13	7	14	544.18
Feature no. 99/ I	152	16	11	22	10	5	12	489.44
Feature no. 136/I	164	20	14	26	13	7	14.5	528.08
Feature no. 136/II	137.5	15.5	10.5	21.5	10	5	12	442.75

1-8. see Table 8.

Table 10. / 10. táblázat: Ulna

	length	proc.cor. width	proc. anc. depth	smallest depth	withers height
Oven no. 38/II	211	18.5	25	20	563.37
Feature no. 98	-	18	27	23	-
Feature no. 136/I	192.5	17	25.5	22	512.64

Table 11. / 11. táblázat: Femur

	1.	2.	3.	4.	5.	6.	7.	8.
Feature no. 99/ I	165	35	11	29	19	11	31	496.65
Feature no. 99/ II	-	-	-	28	-	-	31	-
Feature no. 136/I	181	40.5	13.5	33	24	14	40	544.81

1. greatest length, 2. greatest width of the proximal epiphysis, 3. smallest width of the diaphysis, 4. greatest width of distal epiphysis, 5. greatest depth of the proximal epiphysis, 6. smallest depth of the diaphysis, 7.greatest depth of the distal epiphysis, 8. withers height

Table 12. / 12. táblázat: Tibia

	1.	2.	3.	4.	5.	6.	7.	8.
Feature no. 98	185	36	14	22.5	38	11	17	540.2
Feature no. 99/ I	169	29	11	21	31	10	14.5	493.48
Feature no. 136/I	185	38	13.5	26	37	12	18	540.2
Feature no. 136/III	185.5	32	12	22	36	12.5	16	541.66

1-8. see Table 11.

Table 13. / 13. táblázat: Astragalus

	length	width	depth
Feature no. 98	29	21	16.5
Feature no. 99/ I	25	17	12
Feature no. 136/I	30	23	15.5

Table 14. / 14. táblázat: Calcaneus

	length	width	depth
Feature no. 98	45	18.5	21
Feature no. 99/ I	39	15.5	20
Feature no. 136/I	44	18	21

Table 15. / 15. táblázat: Metacarpus, Metatarsus, Phalanx I. length/pieces / hosszúságméretek

Metacarpus	II.	III.	IV.	V.
Oven no. 38/II	61.5	69	70	59
Feature no. 98		70	69	61
Feature no. 99/ I	54	66	66	55
Feature no. 136/I	60	67	67	58

Table 15. / 15. táblázat: Metacarpus, Metatarsus, Phalanx I. length/hosszúságméretek (cont./ folyt.)

Metatarsus	II.	III.	IV.	V.
Feature no. 98	67.5	75	77	67
Feature no. 99/ I		73	71	63
Feature no. 136/I	66	74	74.5	65

Phalanx I.	length/	length/	length/	length/	length/	length/
Oven no. 38/II	23/1	18.5/1				
Feature no. 98	25/1	24/3	22/1	20/2	19/2	18.5/1
Feature no. 99/ I	26/1	25/1	24.5/1	20/3	18/3	
Feature no. 99/ II	23/1	22/1	17.5/1	17/1		
Feature no. 136/I	24.5/4	24/2	23/2	21.5/1	20/2	19.5/3

The withers heights of Cumanian dogs from Csengele varied between 44.3 and 58.9 cm, which is indicative of medium-small and medium height animals (**Table 16.**). These values belong to the lower and the middle values of the withers heights of the dogs found at 10th-13th centuries. The extremes of withers heights of such Árpád-Period dogs range between 45 and 80 cm, averaging 59.37 cm (Tassi 2002, page 19). According to their withers heights these dogs can be well classified into two groups: smaller dogs whose withers heights fall between 45 and 59.9 cm, and larger dogs with withers heights falling between 60 and 79.9 cm. The previous group of medium-small and medium body size dogs includes the hound-type breeds, the latter group of medium and large body size dogs incorporates different types of shepherd dogs and greyhounds (categories of body sizes in Bárány & Vörös 2008, Table 9). Large amount of dog-skull and skeleton finds are known from the 10th-13th centuries from Hungary. **Table 17.** contains the dog remains found in houses, ovens, pits or ditches.

Large-, medium-, small-body size and in one case, remains of a burrow hunting dog were found at the late medieval Cumanian settlement Szentkirály (Takács 1990, page 108, Nyerges 2004, page 268, Kőrösi 2006, page 374). Based on the identification by István Takács, András Pálóczi Horváth published a skull of a dog whose withers height was estimated 61 cm (Pálóczi 1989, Fig. 69)

Dogs played a remarkable role in the religious life of the Cumanians. Buried dog individuals or only particular dog body-parts could have been sacrificial animals. Known custom of the Cumanians is to swear on dog, whereby the contracting parties strengthened their oath with a dog halved by a sword. The covenant, between 1228 and 1251 of emperor Baduin the 2nd and the Cumanians (the text of Jean de Joinville is published by Ipolyi 1854, Kállay 1864, Eckhardt 1938) and the 1254 marriage of István the 5th (son of King Béla the 4th) and Erzsébet "the Cumanian" (Pauler 1899) are examples for this.

In his book Ferenc Horváth raises the possibility of a connection between the dog remains from Csengele and the aforementioned cult events (Horváth 2001, page 143). The osteological examination of the Csengele dogs, however, does not support this presumption as complete skeletons were found in most of cases. There were no cut marks on any of the bones, and the location of the body parts did not show that they would have been deposited separately. All features containing skeletons (nr 98, no. 99, no. 136) were located on the line of the outer roundel (25th).

Table 16.: Csengele 12/14/A/2 Age and withers heights of the Árpád-Period dogs (cm)
16. táblázat: Csengele 12/14/A/2. Árpád-kori kutyák életkora és marmagasság-értékei (cm)

Individual	Oven no. 38/II	Feature no. 98	Feature no. 99/ I	Feature no. 113	Feature no. 136/I	Feature no. 136/II	Feature no. 136/III
Age	8 months - 1 year	1.5 - 2 years	2 years	adultus	1.5-2 years	adultus	adultus
Withers height	58. 9	54.9	49.4	56.9	53.7	44.3	54.2

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Table 17.: Dog remains from the 10-13th centuries Hungary found in houses, ovens, pits or ditches (from Vörös 1990)

17. táblázat: A X-XIII. századi magyarországi házba, kemencébe, gödörbe illetve árokba helyezett kutyaleletek. (Vörös 1990 alapján)

	house, oven	**pit**	**ditch**
Bóly (Baranya c.) (Mohácsi street S side) 12th c.	complete skeleton (oven no. 4th)		
Csátalja- Vágotthegy (Bács- Kiskun c.) 10-12th c.	maxilla frag. (E outer oven) mandible frag. (house no. 1)		
Csengele (Csongrád c.) 12-13th c.	partial skeleton (feature no. 112, N house, oven no. 38)	head (pi no. 113)	partial skeleton, skeleton (feature no. 98, 99, 136)
Doboz- Hajdúirtás (Békés c.) 10-11th c.			head (7/a ditch) skull (VIIth segm.)
Esztergom- Szentgyörgymező (Komárom-Esztergom c.) 10-11th c.	head (house no. XIII/1)	head (pit no. XIV/c and pit no. XIX/E)	
Fenékpuszta (Zala c.) 10(?)-12th c.	skeleton (house, SE corner)		
Jánosszállás- Katonapart (Csongrád c.) 11-12th c.		complete skeleton (pit no. 23)	
Kardoskút- Hatablak (Békés c.) 12th c.		partial skeleton (house EW corner, pit "b")	partial skeleton
Sály- Lator (Borsod-Abaúj-Zemplén c.) 10-11th c.	skull (house no. 1)	complete skeleton (segm. no. II, pit no. 20)	
Tiszaeszlár- Bashalom (Szabolcs-Szatmár-Bereg c.) 11-13th c.		skeleton (in the line of pit no. 48)	
Tiszalök-Rázom (Sazbolcs-Szatmár-Bereg c.) 11-13th c.	head (house no. 10/8, house no. 11/B, next to house no. 4) mandible (house no. M/I, house no. 12, next to house no. 3) limb-bones (oven no. 2)		

The heads of the dogs were not found in abnormal positions, their bones were complete without any cut marks, the orientations of bodies were not systematic. Pit no. 113, which contained only a dog head (skull + mandibles) located in the eastern part of an oval pit was perpendicular to the middle roundel (26th). This roundel was the only one renovated after the Mongol Invasion, and it is possible that it marked border around the cemetery that belonged to the church (Horváth 2001, page 87). The separate dog's head did not belong to any of the skeletons, because those represented individuals of at most two years of age while the skull originated from an old individual.

As said above the ritual role of the dogs from Csengele is not proven. According to **Table 17.**, partial or complete dog skeletons, head or skull of a dog originating from settlements, are not unique phenomena in this period and could not be connected solely to the Cumanian tradition. The absence of cut-marks on the bones shows that the meat of the animals was not eaten. Although their remains were placed mostly in the ditches surrounding the church and the two houses, their settlement-near "burial" could mean some kind of a (rational/emotional) bonding attached to the animals. This could be strengthened by the fact, that all dogs from Csengele, with only one exception (38/II), were 1.5 years old or older, one of them (in feature no. 113) was an old individual. According to the body size and physical features of the dogs, they could be guard and herding dogs. Their function is justified by the large animal keeping, mobile lifestyle of the Cumans..

Acknowledgements

I would like to thank for István Vörös for allowing me to process the dog-material from Csengele, and for his precious help in the writing of the paper.

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Csengelei kun kutyák

Bárány Annamária

Összefoglalás

Csengele-Bogárhát 12/14/A/2. lelőhely (Csongrád megye) kun település (XIII. sz.) feltárása során előkerült csontmaradványok összesen 9 egyedtől származnak. A 112. objektum 38. tűzhelyén egy kifejlett egyed mandibulája és egy 8 hónap- 1 év közötti, 58,9 cm marmagasságú kutya részleges csontváza feküdt (**2/1. ábra**). 6 kutya maradványait egy templom körüli hármas körkörös árokrendszer (**1. ábra**) külső (25. árok) árka tartalmazta (98., 99., 136. objektumok). A 98. objektumban egy 1,5- 2 éves, 54,9 cm marmagasságú egyed részleges csontváza volt (**2/3. ábra**). A 99. objektumból egy 2 éves, 49,4 cm-es marmagasságú egyed csontváza (**3/1. ábra**) és egy 1,5 éves egyed töredékes csontjai kerültek elő. A 136. objektum egy 1,5-2 éves, 53,7 cm marmagasságú kutya csontvázát (**3/2. ábra**), egy 1,5 évnél idősebb, 44,3 cm marmagasságú egyed csontjait és egy szintén 1,5 évnél idősebb, 54,2 cm marmagasságú egyed tibiáját tartalmazta.

Az árokrendszer középső (26.) árkára ásott gödörben (113. objektum) egy idős, 56,9 cm marmagasságú kutya feje (koponya + mandibula) volt (**2/2. ábra**).

Az Árpád kori kutyák marmagasságainak szélső értékei 45 cm és 80 cm között, átlag 59,37 cm volt (Tassi 2002 19. oldal). Marmagasságuk alapján a kutyák jól körülhatárolhatóan két csoportra különültek el: a kisebb méretű ebek marmagassága 45 cm és 59,9 cm között, a második csoportot képviselő nagyobb kutyák marmagassága 60 cm és 79,9 cm közötti volt. Az előbbiek csoportjába tartoztak a kopófélék, az utóbbiak a különböző típusú juhászkutyák és agarak voltak.

A csengelei kutyák marmagasságuk alapján az első csoportba tartoztak. Craniológiai jellemzőik alapján 3 egyed (a 99. objektum/I. egyed, 113. objektum, 136. objektum / I. egyed) a kopóféléket is magába foglaló *Canis familiaris intermedius* (Woldřich 1878) alakkörbe tartozott. A negyedik kutya (98. objektum / I. egyed), mely a többiekénél némileg vastagabb hosszúcsontokkal rendelkezett, a juhászkutyákat is felölelő *Canis familiaris matris opitimae* (Jeittneles 1877) alakkörbe tartozott. Az egyedek koponyái a **4-5. ábrán**, mandibuláik a **6. ábrán** láthatóak.

ROMAN PERIOD EVIDENCE FOR A SPECIAL FORM OF *PERIMORTEM* TRAUMA IN LARGE LIVESTOCK

A NAGYÁLLATOK LEVÁGÁSÁNAK KÜLÖNLEGES NYOMAI EGY RÓMAI KORI LELETEN

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Abstract

*A peculiar type of injury observed on the second cervical vertebra (*epistropheus*) of an adult cattle in the animal bone assemblage from the Roman fort at Cramond, Scotland, bears a striking resemblance to similar traumatic lesions previously described in Migration Period sacrificial horses. Transversal metal cut marks observed on the* dens epistrophei *of the cattle specimen under discussion here are consistent with the possibility that the animal was disposed of by severing the spine through the dorsal intervertebral space between the atlas and epistropheus. Due to their relatively hidden anatomical position such cut marks are unlikely to have been post mortem, as targeted dismemberment leaves different traces on the cervical vertebrae. This way of killing is still being practiced in contemporary bull fights as a* coup de grâce *using a small knife called the puntilla. Ethnographic parallels to this method are also briefly discussed.*

Kivonat

*A skóciai Cramond római erődítéseiből felszínre hozott ételhulladék elemzésekor különös sérülés nyomait sikerült felfedezni egy kifejlett szarvasmarha második nyakcsigolyájának (*epistropheus*) belső felületén. A vizsgált epistropheus"fog" részének peremén fém pengével ejtett finom sérülések az állat sajátos levágási módjára utalnak: az első és a második nyakcsigolya közötti nyíláson keresztül a védtelen gerincvelő viszonylag könnyen átvágható volt. A fémmel ejtett finom vágásnyomok rendkívül hasonlítanak a népvándorlás kori lovak ugyanezen csigolyáján már korábban leírt elváltozáshoz, amelyet az áldozati állatok levágásával hoztak összefüggésbe. Viszonylag védett anatómiai helyzetüknél fogva kevésbé valószínű, hogy ezek a vágásnyomok a már megölt állat szétbontásakor keletkeztek, mert különböznek a céltudatos* post mortem *feldarabolás nyakcsigolyákon ejtett nyomaitól. Ezt a módszert bikaviadalokon kegyelemdöfésként mindmáig alkalmazzák, elegendő hozzá egy kicsiny, mintegy 10 cm pengehosszúságú kés, a puntilla. A dolgozat kitér a módszer más néprajzi párhuzamaira is.*

KEYWORDS: ARCHAEOZOOLOGY, SACRIFICIAL ANIMAL SLAUGHTER, ROMAN PERIOD, SCOTLAND

KULCSSZAVAK: RÉGÉSZETI ÁLLATTAN, ÁLDOZATI ÁLLATVÁGÁS, RÓMAI KOR, SKÓCIA

Introduction

Domestication has fundamentally altered human attitudes toward animals. While some of these widely discussed cultural changes were technical in nature (steady supply of meat, renewable "secondary" products etc.), others must have been at least partly ideological, which is far less possible to directly interpret on the basis of material remains recovered from archaeological excavations. As hunting played an exclusive role in Palaeolithic and Mesolithic meat procurement, traumatic injuries related to largely pre-Neolithic hunting have been widely discussed in the archaeozoological literature. The ways animals were brought down by various stone axes and projectiles has been well-documented in the osteological record since the mid-19th century (e.g. Babington 1863, Steenstrup 1880, Régnault 1893).

Even unsuccessful attempts to kill animals provide direct evidence in the form of healed injuries on wild animal bone (Noe-Nygaard 1975).

With the onset of domestication perimortem trauma tends to be far more subtle in appearance, as the weapon itself does not remain in the carcass. Frequently, due to the lack of familiarity with forensic evidence and bone breakage patterns (Berryman & Haun 1996: 2), taphonomic effects can obscure the osteological evidence of slaughtering. Domestic animals are regularly handled: as a result of this physical proximity they are also tame enough to be held down so they can be killed in relatively simple ways that leaves no trace on the skeleton. It is therefore of special importance when skeletal injuries in archaeozoological assemblages can be seen in direct association with the animal's death.

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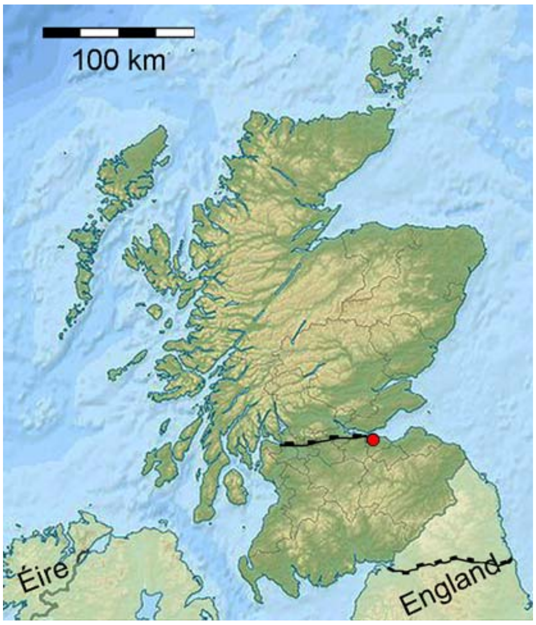

Fig. 1.: The location of Cramond in the map of modern-day Scotland (excl. Shetland). West-East lines mark Hadrian's Wall in England and the Antonine Wall in Scotland. Base map: Creative Commons.

1. ábra: Cramond fekvése Skócia mai területén (a térképen Shetland szigete nem látható). A nyugat-keleti irányok Angliában Hadrianus, Skóciában Antoninus falát jelölik. Alaptérkép: Creative Commons.

In this paper recently discovered Roman Period osteological evidence for a special form of slaughtering large livestock is reported from Scotland and has been studied in light of historical and ethnographic analogies. The thought-provoking find recovered among the cattle bones deposited in ordinary food refuse deserves special attention. This brief preliminary report is the description and possible interpretation of peculiar cut marks identified on a second cervical bovine vertebra.

Chronology and Material

The Roman fort at Cramond was established along the small estuary of River Almond where it flows into the Firth of Forth north of Edinburgh in Scotland. The small military outpost in the north was founded at approximately 140 AD when the Antonine Wall, spanning the approximately 63 km East-West distance between the Firth of Forth and the Firth of Clyde, was constructed. The fort and associated settlement formed fell beyond the Eastern end of the Antonine Wall (Holmes 2003).

Around 170 AD, the Romans were forced to withdraw toward the South to the 117.5 km long line of Hadrian's Wall in England, whose construction had begun in 122 AD (**Fig. 1.**).

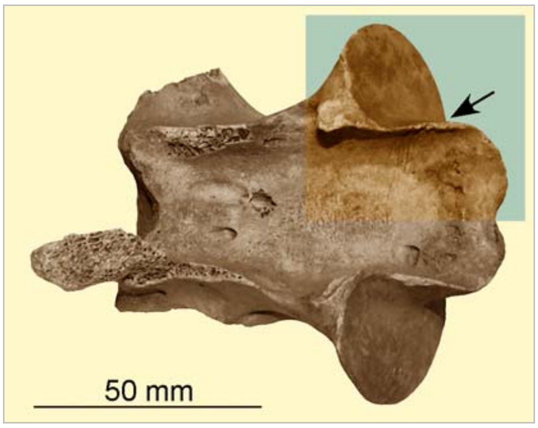

Fig. 2.: Dorsal aspect of the cattle axis. Colouring marks the left cranial section enlarged in Fig. 3. The general location of cutmarks is shown by the arrow.

2. ábra: A szarvasmarha második nyak-csigolyájának dorzális nézete. A színezett rész a kraniális vég 3. ábrán kinagyított darabját jelzi. A nyíl a vágásnyomok helyét mutatja.

A brief second period of occupation at Cramond lasted between 208 to 211 AD.

Hand-collected bone samples from the 1975-1976 excavations, kept in the Osteoarchaeological Collections at the University of Edinburgh, have been available for study. The assemblage of several thousand bones is dominated by the remains of cattle of usually small size. Since Caledonians had been engaging in farming long before the arrival of the Roman conquerors, the stereotypical interpretation of such small-sized animals is that they may represent unimproved indigenous stocks. Equid bones of similarly small size originating from horses or possibly mules were also found. Bones of sheep and pig occurred less commonly. There is a noteworthy presence of bones from large-sized red deer that must have roamed the fertile plains of Mid-Lothian at the time. However, no remains of aurochs or wild pig were identified. Marine mammals are represented by a single small cetacean vertebra. Beef and venison undoubtedly formed a major portion of the Roman Period meat diet at the settlement.

Results

During the macroscopic study of the archaeozoological assemblage from Cramond the probable evidence of a special form of slaughtering was suspected behind the phenomenon observed on the second cervical vertebra (epistropheus, axis) of an adult cattle (**Fig. 2.**).

The find itself was fragmented with the entire arcus vertebrae and the caudal third of the remaining corpus missing. Half a dozen fine transversal cut marks and related damage were noted on the left side of the *dens epistrophei*.

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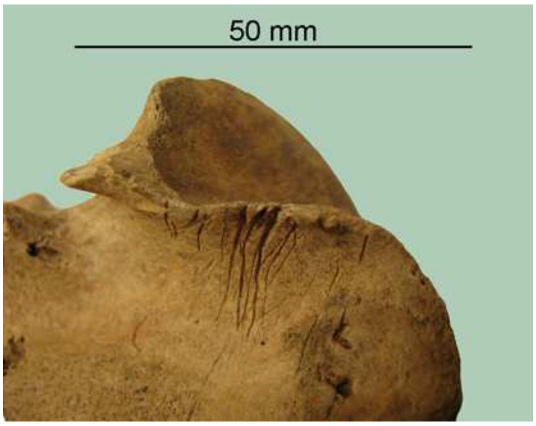

Fig. 3.: Fine, transversal metal cut marks around the left edge of the *dens epistrophei* of the Cramond cattle (Photo: Zsuzsanna Tóth)

3. ábra: Finom, fémpengével ejtett, harántirányú vágásnyomok a cramondi második szarvasmarha nyakcsigolya fognyúlványának bal peremén (Tóth Zsuzsa felvétele)

They were inflicted on the inside of the animal's concave vertebral canal, a region not exposed to ordinary cuts during dismemberment. The clear outline and narrow, "V"-shaped cross-section of the cuts are indicative of the use of a metal blade (**Fig. 3.**).

Discussion and Interpretation

The widely debated transversal cut marks sometimes discovered on the ventral aspect of the first cervical vertebra (atlas) are likely to have been caused during post mortem decapitation. The group of small, bunched cut marks concentrated across the left edge of the *dens epistrophei* sliding inside the vertebral canal are unlikely to have been the result of post mortem butchery. Cut marks caused by the latter, likely would have affected the periphery, i.e. external surfaces, of the vertebrae. While carcass dismemberment as a source of these marks cannot be entirely ruled out, it seems highly improbable given the morphology and location of these cuts.

A strikingly similar lesion was noted on the dorsal surface of the *dens epistrophei* recovered from AD 7th–8th century burials of complete horses at Ammern–Kapellendorf and Kaltenwestheim–Rinderstall (Germany) and Grave 15 from Komárno–Hadovce (Slovakia; Müller 1985: Taf. II–III, 1989). Those were tentatively associated with the killing of the animal. These fine marks, left on the dorsal surface of the articulation between the 1st and 2nd cervical vertebrae, seem to originate from cuts aimed at disrupting the spine from a dorsal direction, where a sharp weapon could be driven in between the vertebrae, bypassing the strong ligament anchoring the head to the trunk (*ligamentum nuchodorsale*), marked by the mane in horses (Fehér 1980; Müller 1989: 295, Abb. 2).

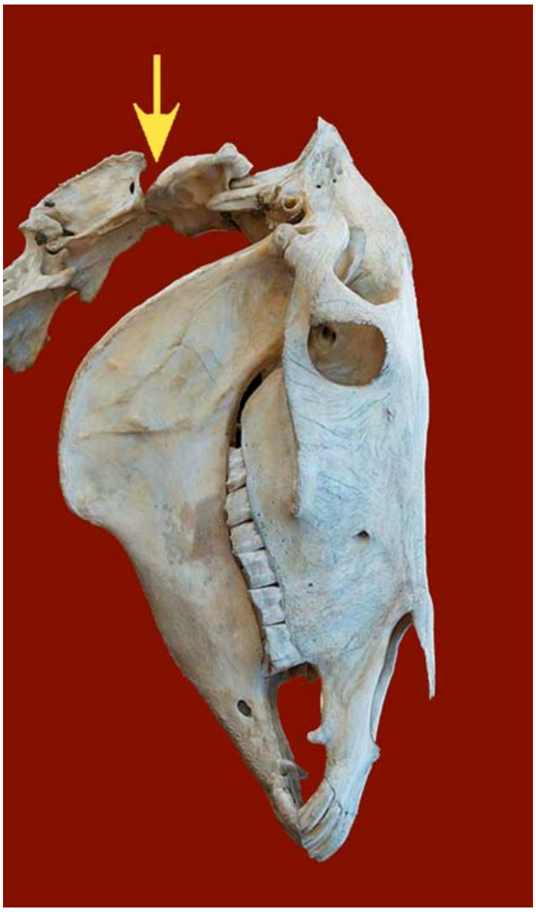

Fig. 4.: The location of the intervertebral opening between the first two cervical vertebrae in horse

4. ábra: Az I. és II. nyakcsigolya közötti nyílás helyzete lóban

This is a point where the animal's spine is vulnerable to pithing, the deliberate destruction of the central nervous system through the largest intervertebral opening in the entire vertebral column (**Fig. 4.**). The horses stabbed in this way were immobilized instantaneously. *Tetraplegia*, the paralysis caused by this type of spinal injury, results in the loss of use of all four limbs and torso. The disfunction is usually sensory and motor, which means that both sensation and control are lost. Since breathing needs active support by the intercostal musculature and the diaphragm this form spinal disruption causes suffocation in a short time. Presuming that this act was performed as horses were already standing in the grave, their final slaughter as well as the characteristically systematic post mortem arrangement of their bodies may have been facilitated by killing them on location this way.

Immobilizing the sacrificial horse by stretching its legs in four different directions with ropes tied to each of the fetlocks then breaking the backbone using a heavy beam was practiced by the Telengets (Amschler 1936: 308) and Cumandians (Zelenin 1928: 84) in the Altai region.

Fig. 5.:

Delivering the *coup de grâce* using a *puntilla* to a bull exhausted by the fight (Photo: Reuters/Victor Fraile)

5. ábra:

A viadalon kimerült bika tarkója mögött ejtett kegyelemdöfés puntillával (Victor Fraile/Reuters felvétele)

This torturous method caused the animal to suffocate. The end result was thus comparable to that of the 'master stab' under discussion in this paper. It took, however, a coordinated group effort and a longer time.

A probable ethnographic parallel was recorded among the Beltir living in the Minusinsk Basin in south-central Siberia where sacrificial horses were killed by thrusting a knife into the nuchal region "between the ears and the nape" (Kralovánszky 1985: 368). Evidently, able-bodied wild animals would be extremely difficult if not impossible to execute this way. Domesticates were either docile or at least easier to approach: a precondition to delivering a precisely aimed stab. It was recorded of the ancient Prussians that – similarly to some Asiatic steppe peoples (U. Kőhalmi 1972) – "before the sacrifice they chased the horses till they were exhausted" (Chantepie de la Saussaye 1925: 528). Although the exact method of killing is not specified in these cases, exhausting the animal is of evident practical significance as will be discussed below.

Kralovánszky (1985: 369) mentioned that until recently cows were also slaughtered in a similar way in the Őrség region of southwestern Hungary. This observation is especially interesting as it concerns cattle in a profane rather than religious context offering yet another contemporary analogy. The theatrical final act formally ending bull fights (*descabello*; Santisteban García 1993) is carried out using a long, slender, sharply pointed sword. The aim is to penetrate into the back of the neck to a depth of ca. 10 cm, dissecting the spinal cord through the intervertebral space between the atlas and axis (Martinez Arteaga 2003). At the very end of bullfights, however, there is another stab performed for the sake of safety. The puntilla, a straight knife of a blade length usually not exceeding 10 cm is driven between the first two cervical vertebrae of the fatally injured and exhausted beast (**Fig. 5.**). Under these circumstances the incapacitated bull can be executed using a well-aimed but very simple weapon.

Conclusions

The special injury on the fragmented Cramond cattle axis under discussion here could not have been inflicted in too many ways. It was established that:

- In appearance the lesion is similar to cut marks found on the *dens epistrophei* of horses found in a sacrificial context
- Ethnographic analogies indicate that the space between the first two cervical vertebrae was a weak point (*locus minoris resistentiae*) well known in archaic cultures: diffusion of knowledge was probably not a precondition for developing the skill of killing large animals this way
- Two inventions facilitating this method of slaughter were domestic livestock and metallurgy (sufficiently thin blades)

Difficulties with interpreting the Cramond find remain:

- Parallels observed on the bones of excavated horses and ethnographic analogies are not directly linked (e.g. by experimental evidence or autopsy in fighting bulls)
- At this point it is impossible to tell whether this lesion observed in cattle for the first time represents local tradition or a method propagated through Roman expansion
- It also remains a question whether the rarely observed lesion represents profane slaughter or is related to ritual killing

To further clarify these problems, similar marks need to be systematically sought and recorded on the dorsal side of the *dens epistrophei* of large livestock in a wide range of archaeozoological assemblages.

Acknowledgements

Grateful thanks are due to Ákos Avar, Ilona Bede, Gergely Csiky and Arturo Morales Muñiz for insightful consultations on the topic. Reuters is thanked for the generous release of **Figure 5** of essential importance free of charge.

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VARIATION IN THE CARBON AND NITROGEN ISOTOPIC SIGNATURES OF PIG REMAINS FROM PREHISTORIC SITES IN THE NEAR EAST AND CENTRAL EUROPE

AZ ŐSKORI HÁZISERTÉS KÖZEL-KELETI ÉS KÖZÉP-EURÓPAI MARADVÁNYAINAK SZÉN- ÉS NITROGÉNIZOTÓP ÖSSZETÉTELÉNEK VÁLTOZÉKONYSÁGA

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Abstract

*The first results of carbon and nitrogen ($\delta^{13}C$, $\delta^{15}N$) stable isotope analyses of domestic pig (*Sus domesticus *Erxl., 1777) remains from three prehistoric sites are presented. Of these, comparison of the datasets from Tell Aqab in Syria and Çamlıbel Tarlası in Turkey suggests different dietary patterns, and possibly different pig husbandry practices, at these sites. The study highlights the need for supporting evidence from archaeobotanical and palaeoenvironmental investigations in the interpretation of stable isotope data.*

Kivonat

*A cikk régészeti házisertés (*Sus domesticus *Erxl., 1777) leleteken mért szén- és nitrogén izotóp ($\delta^{13}C$, $\delta^{15}N$) méréseinek első eredményeit ismerteti. A leletek három őskori lelőhelyről származnak. Ezek közül a szíriai Tell Aqab és a törökországi Çamlıbel Tarlası mintái szignifikánsan különböző takarmányozási módokra utalnak, amelyek a két település eltérő sertéstartási gyakorlatával függhetnek össze. A tanulmány rámutat az eredményeket megerősítő régészeti növénytani és környezetrégészeti kutatások fontosságára a stabilizotóp adatok értelmezésében.*

KEYWORDS: CARBON, NITROGEN, ISOTOPES, PIGS, DIET

KULCSSZAVAK: SZÉN, NITROGÉN, IZOTÓP, SERTÉS, TÁPLÁLKOZÁS

Introduction

Carbon and nitrogen stable isotope values in bone collagen of domestic livestock have been used to infer animal husbandry and stock management strategies (e.g. Pearson et al. 2007; Atahan et al. 2011). Stable isotope analysis of domestic pig (*Sus domesticus* Erxl., 1777) remains was conducted to investigate prehistoric pig management/husbandry practices at three sites, Çamlıbel Tarlası in north-central Anatolia, Tell Aqab in northeast Syria and Kaposújlak-Várdomb in southwest Hungary (**Fig. 1.**).

Çamlıbel Tarlası (ÇBT) was a small-scale settlement occupied between c. 3590 and 3470 cal BC (i.e. Late Chalcolithic) by agro-metallurgists (Schoop et al. 2009; Schoop 2010, 2011). The site is located on a small plateau in a mountainous region that on palynological evidence was heavily forested until the Iron Age (Dörfler et al. 2000).

Fig. 1.: Map indicating the locations of sites discussed

1. ábra: A lelőhelyek földrajzi elhelyezkedése

Tell Aqab (TA) is situated in an area of fertile, alluvial soils within the Khabur River catchment, with sufficient rainfall for dry farming.

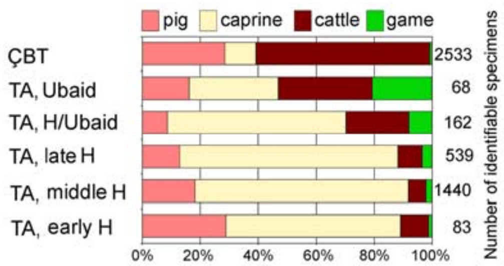

Fig. 2.: The contribution of pig to the numbers of identifiable bones at the two Near Eastern sites

2. ábra: A sertéscsontok részesedése a két közel-keleti lelőhely meghatározható állatcsont anyagából

The occupation of the tell settlement spanned the Halaf and Ubaid periods (i.e. Neolithic into the Chalcolithic) from c. 6000 to 4200 cal BC (Davidson & Watkins 1981). The natural vegetation of xeric Mediterranean forest-steppe (grassland interspersed with areas of mainly pine woodland or forest) reflects a climate with lower annual rainfall than north-central Anatolia.

Kaposújlak-Várdomb (KV) is a Late Neolithic and Bronze Age hillfort site situated in a formerly forested area along the Kapos River valley (Gál 2011). The samples analyzed come from Early Bronze Age Somogyvár-Vinkovci culture contexts (corresponding to c. 2500-2300 cal BC). Although only two samples from this site yielded sufficient quantities of collagen for analysis, they were included in the study for the sake of comparison.

The domestic status of the pigs discussed in this paper is based on the small size of their bones and the fact that hunting played a negligible role in meat provisioning at the studied sites. Even relatively high contributions by game to the smaller Halaf/Ubaid and Ubaid assemblages from TA consisted mostly of gazelle and equid bones; the proportion of pig remains varied between 10 and 30% – see **Fig. 2.** (Bartosiewicz & Gillis 2011; Bartosiewicz unpublished data).

Methods

A c. 1 g sample of bone was taken from each specimen. Collagen was extracted from the samples using a modified Longin (1971) method (Brown et al. 1988). Pre-treatment consisted of sample cleaning by removal of the outer 2 mm of the bone surface, demineralization in 1N HCl at 20°C for a minimum of 24 hours, and gelatinization in 0.03N HCl at 80°C for ~16 hours; the resulting solution was lyophilized. Mass spectrometric analysis was undertaken at the SUERC radiocarbon facility East Kilbride, UK, using a Costech ECS 4010 combustion elemental analyser coupled to a Thermofisher Delta V Advantage gas source isotope ratio mass spectrometer. Mass spectrometric systematic errors are ±0.2‰.

Collagen integrity was assessed according to three criteria:

- The percentage weight yield of collagen relative to original sample weight was determined. Only samples with a %wt yield of >1.00% (quoted for well-preserved bone, e.g. van Klinken [1999]; Brock et al. [2010]) were analyzed.
- Samples with a C:N ratio within the range 2.9−3.6, quoted for well-preserved collagen (DeNiro 1985), were included in the comparative analysis.
- Well-preserved human bone collagen has total %wtC ≥13% and %wtN% ≥4.8%, as described by Ambrose (1990); this criterion was met by the majority of the samples analyzed (see **Table 1.**). Four of the samples have %wtC values in the range 10.1% to 12.9% and five of the samples have %wtN in the range 3.5% to 4.5%. These samples were included in this analysis as they met the two criteria outlined above. Ambrose (1990) indicates that samples should be rejected as diagenetically altered at %wtN<0.5% and %wtC<4.5%.

Results and discussion

A total of 41 pig bone specimens were sampled. However, only 26 of the samples (ÇBT, n = 17; TA, n = 7; KV, n = 2) fulfilled the 'reliability' criteria outlined above. The $\delta^{13}C$ and $\delta^{15}N$ isotope values of the pig bone samples from each of the sites are presented in **Table 1.**, and are plotted in **Figs. 3.** and **4**.

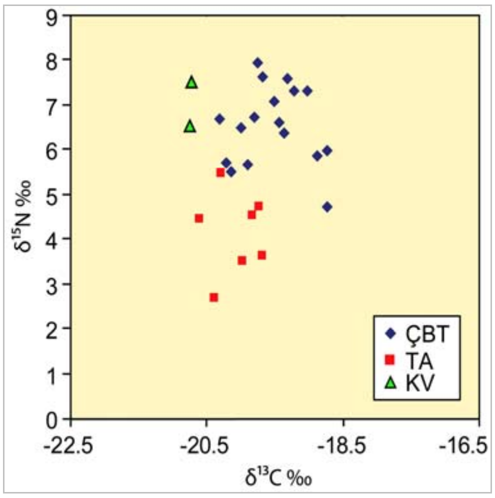

Fig. 3.: Scatterplot of $\delta^{13}C$ and $\delta^{15}N$ values of *S. domesticus* remains from Çamlıbel Tarlası in Turkey, Tell Aqab in Syria and Kaposújlak-Várdomb in Hungary

3. ábra: A házisertés maradványok $\delta^{13}C$ és $\delta^{15}N$ értékei (Çamlıbel Tarlası, Törökország; Tell Aqab, Szíria; Kaposújlak-Várdomb, Magyarország)

HU ISSN 1786-271X; urn: nbn: hu-4106

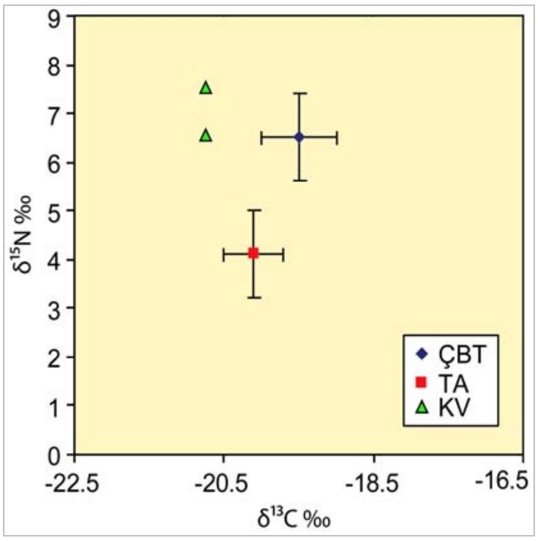

Fig. 4.: Scatterplot of mean with standard deviation $\delta^{13}C$ and $\delta^{15}N$ values of *S. domesticus* remains from Çamlıbel Tarlası in Turkey, Tell Aqab in Syria and Kaposújlak-Várdomb in Hungary

4. ábra: A házisertés maradványok $\delta^{13}C$ és $\delta^{15}N$ értékeinek átlagai és szórásai (Çamlıbel Tarlası, Törökország; Tell Aqab, Szíria; Kaposújlak-Várdomb, Magyarország)

Two of the specimens sampled (GuSi 2663 ÇBT and GuSi 2684 KV) were sub-adults. However, the $\delta^{13}C$ and $\delta^{15}N$ values of these specimens overlap those obtained for the adults. In other words, no suckling enrichment effect is evident in their isotope values and so they have been included in the analysis.

Conventionally $\delta^{13}C$ values in the range -21.5‰ to -20.0‰ are considered characteristic of diets based exclusively on C_3 terrestrial plant species (e.g. Chisholm et al. 1982; Richards et al. 2003), while $\delta^{13}C \geq -18.0$‰ is usually taken as indicative of the inclusion (directly or indirectly) of C_4 plants in the diet (Pearson et al. 2007). $\delta^{13}C$ values for the pigs from ÇBT, TA and KV range between -20.8‰ and -18.7‰ (Table 1) with average values at ÇBT of $\delta^{13}C$=-19.5±0.5‰ and at TA of $\delta^{13}C$=-20.1±0.4‰, which is consistent with diets derived principally from the C_3 plant foodweb. C_4 plants (mainly grasses) are likely to have been present in the local vegetation at ÇBT and TA especially, as indicated by the relatively heavy $\delta^{13}C$ values for some of the cattle and caprines from ÇBT (Pickard, unpublished data). However, pigs generally consume less grass than do cattle and caprines, and therefore will tend to ingest less C_4 plant material. Moreover, C_4 species tend to be less abundant in the shade of trees, a niche that would have been favoured by pigs.

A much larger range (from 2.7‰ to 8.0‰) is observed for the $\delta^{15}N$ values, and inter-site comparison shows that the values for the ÇBT pigs (6.5±0.9‰) and KV pigs (7.5‰ and 6.5‰) are similar and markedly different from the TA population (4.1±0.9‰).

Several factors can lead to variations in the $\delta^{15}N$ profiles of livestock from different localities. For example, $\delta^{15}N$ enrichment has been observed in animals from arid/hot regions and is attributed to heat/water stress (e.g. Ambrose 1991). Elevated $\delta^{15}N$ values have also been observed in consumers of halophytic plants (Britton et al. 2008). However, neither of these enrichment mechanisms is consistent with the geographical locations and soil conditions of the sites sampled nor with the observed enrichment patterns, although the relationship between aridity, temperature and $\delta^{15}N$ enrichment is complex (cf. Fraser et al. 2011). Of the three sites under consideration, TA would have experienced the highest temperatures and lowest rainfall in summer, with obvious implications for levels of heat/water stress in livestock, yet the pig $\delta^{15}N$ values at TA are significantly lighter than at the other two sites (Mann-Whitney U test n_{CBT}=17, n_{TA}=7, U=118.0, $\rho < 0.01$ [ρ= 1.16x10^{-5}] two-tailed test).

Another explanation for the relatively low pig $\delta^{15}N$ values at TA is that they reflect differences in the pig diet compared to ÇBT and KV, which in turn may be a function of the livestock management conditions.

Traditionally, three types of husbandry systems have been used by pig farmers:

(i) allowing the pigs to roam and forage freely;
(ii) keeping them in fields, sometimes with other livestock;
(iii) confining them in pens or 'pig houses' (sties).

The diets of domestic pigs tend to vary according to the management strategy employed. Free-range pigs may have diets that differ significantly from those of animals kept in close confinement. Pigs will naturally forage over a large home range (Studnitz et al. 2007) and consume a wide variety of plant foods, as well as insects, worms, small mammals and even birds' eggs. Thus, like wild boar, free-range pigs are predominantly herbivorous, and their bone collagen $\delta^{13}C$ and $\delta^{15}N$ values tend to be close to those of strict herbivores such as deer, cattle and sheep.

In contrast, penned animals cannot forage for themselves and have to be fed. Their diets will comprise mainly plant fodder (e.g. grain, pulses, hay and straw) and/or domestic food waste. Where the domestic waste fed to pigs includes significant amounts of animal protein (from meat or milk), this can result in enrichment of bone collagen $\delta^{15}N$ values compared to free-foraging animals.

Table 1.: $\delta^{13}C$ and $\delta^{15}N$ values of *S. domesticus* specimens from Çamlıbel Tarlası in Turkey, Tell Aqab in Syria and Kaposújlak-Várdomb in Hungary

1. táblázat: A házisertés maradványok $\delta^{13}C$ és $\delta^{15}N$ értékei. ÇBT=Çamlıbel Tarlası, Törökország; TA=Tell Aqab, Szíria; KV=Kaposújlak-Várdomb, Magyarország)

GUsi No.	Species	Site	Element	Age	$\delta^{13}C$	$\delta^{15}N$	C/N	%N	%C
2203*	*Sus*	ÇBT	Occipital	Adult	-19.0	7.3	3.2	13.1	35.8
2650	*Sus*	ÇBT	Mandible (L)	Adult	-19.3	7.6	3.3	11.8	33.0
2651	*Sus*	ÇBT	Mandible (R)	Adult	-20.1	5.5	3.2	9.8	27.4
2652	*Sus*	ÇBT	Mandible (L)	Adult	-19.5	7.1	3.2	13.7	37.8
2653	*Sus*	ÇBT	Mandible (R)	Adult	-19.9	5.6	3.4	4.5	12.9
2655	*Sus*	ÇBT	Mandible (R)	Adult	-18.7	4.7	3.3	8.5	24.0
2657	*Sus*	ÇBT	Mandible (L)	Adult	-19.2	7.3	3.2	11.8	32.9
2658	*Sus*	ÇBT	Mandible (R)	Adult	-18.9	5.9	3.3	10.2	29.0
2659	*Sus*	ÇBT	Mandible (R)	Adult	-19.4	6.6	3.3	9.7	27.1
2661	*Sus*	ÇBT	Mandible	Adult	-19.8	8.0	3.2	9.7	26.9
2662	*Sus*	ÇBT	Mandible (R)	Adult	-19.8	6.7	3.3	10.9	30.9
2663	*Sus*	ÇBT	Mandible (R)	Sub-adult	-20.2	5.7	3.4	7.3	21.2
2664	*Sus*	ÇBT	Mandible (R)	Adult	-20.0	6.5	3.3	8.9	25.3
2666	*Sus*	ÇBT	Mandible (R)	Adult	-18.7	6.0	3.3	8.7	24.8
2667	*Sus*	ÇBT	Mandible (R)	Adult	-19.4	6.4	3.3	12.6	35.5
2668	*Sus*	ÇBT	Mandible (R)	Adult	-19.7	7.6	3.5	4.0	12.0
2669	*Sus*	ÇBT	Mandible (R)	Adult	-20.3	6.7	3.3	10.4	29.2
2671	*Sus*	TA	Ulna (L)	Adult	-20.0	3.5	3.4	3.5	10.1
2672	*Sus*	TA	Humerus (L)	Adult	-20.6	4.4	3.4	6.5	18.8
2673	*Sus*	TA	Parietal (L)	Adult	-19.7	4.7	3.4	5.1	14.8
2674	*Sus*	TA	Scapula (L)	Adult	-20.3	5.5	3.6	4.5	13.9
2675	*Sus*	TA	Scapula (L)	Adult	-20.4	2.7	3.5	3.5	10.5
2676	*Sus*	TA	Temporal (L)	Adult	-19.7	3.6	3.3	8.8	25.0
2678	*Sus*	TA	Temporal (L)	Adult	-19.8	4.5	3.2	9.7	27.0
2680	*Sus*	KV	Scapula (R)	Adult	-20.7	7.5	3.2	11.3	31.2
2684	*Sus*	KV	Fibula (L)	Sub-adult	-20.8	6.5	3.3	8.0	22.8

* from Channell (2012)

Conversely, if pigs are fed large amounts of pulses as fodder or domestic waste, then (since pulses have lower $\delta^{15}N$ values than cereals and grasses) their bone collagen may show significantly lighter $\delta^{15}N$ values compared to free-range pigs and herbivores; in theory this effect could be masked by manuring using animal dung, which has been observed to elevate the $\delta^{15}N$ signatures of crop plants (Fraser et al. 2011), although it seems that unusually intensive manuring is required to raise pulse $\delta^{15}N$ values significantly and there is little evidence that such intensive manuring was widely practised in prehistoric Europe or the Near East (cf. Bogaard et al. 2013).

In contrast to cattle and sheep (which are ruminants) a diet based on grass is not nutritionally sufficient for pigs, and even field-reared pigs would need their diets to be supplemented by higher protein foods such as cereals, pulses and/or animal products.

It follows that any interpretation of bone collagen stable isotope data for pigs needs to take account of the types of plant food that were available to livestock, including the kinds of crops that were grown and potentially used as fodder. Archaeobotanical evidence from Tell Aqab indicates that cereals (barley and emmer) and a range of pulse crops (lentils, field peas and bitter vetch) were cultivated (McCorriston 1992). It is possible therefore that the lower average δ^{15}N value of the pigs from this site compared to ÇBT and KV reflects intensive foddering with pulses or the waste from crop processing. This could have been done as part of a close confinement or field-rearing system of pig husbandry.

For the moment, this should be regarded as a working hypothesis, which would be strengthened considerably if it could be shown that the remains of domestic cattle and caprines and wild herbivores from the site have more elevated δ^{15}N values than the pigs. Wild herbivores would have had little or no access to pulses, while the herding of caprines and cattle (vs pigs) arguably would have been less reliant on foddering in the forest-steppe environment of Tell Aqab.

Conclusions

In this paper δ^{13}C and δ^{15}N stable isotope domestic pig remains from the three prehistoric sites, Çamlıbel Tarlası, Tell Aqab and Kaposújlak-Várdomb, were compared. The bone collagen δ^{13}C values indicate that at each of the sites studied dietary protein was derived largely from C_3 resources. Inter-site variation in δ^{15}N values is suggestive of variation in dietary constituents, possibly reflecting differences in pig husbandry practices. These findings should be regarded as preliminary for several reasons. First, they are based on relatively small sample sizes. Second, for two of the sites there are as yet no comparative isotopic data for other livestock or wild herbivores/omnivores. Third, investigation of livestock management practices in prehistory should never rely exclusively on bone collagen stable isotope data. A more holistic approach is necessary – ideally, one that combines isotopic data with information on local climate, vegetation and soil conditions as well as the arable components of the farming system.

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KÖZLEMÉNYEK

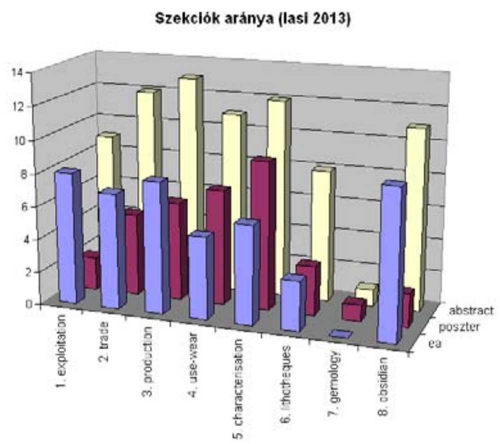
'Stories Written in Stone' International Symposium on Chert and other Knappable Materials

2013. augusztus 20-24 Iasi, Romania

2013. augusztus 20-24 között rendezték meg 5th Arheoinvest Symposium - 'Stories Written in Stone'International Symposium on Chert and other Knappable Materials konferenciát. A fő szervezők Otis Crandell és Vasile Cotiuga voltak

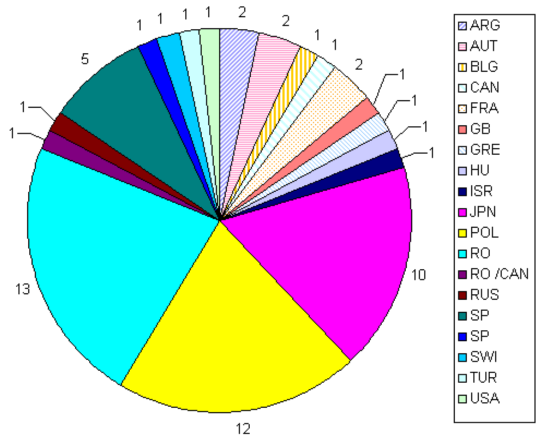
A konferenciát a Iasi Ioan Cuza Egyetem és több társintézmény rendezte (konferencia weblap: http://arheoinvestsymposium.uaic.ro/eng/?cat=142), 178 regisztrált résztvevővel. A gazdag program a kőeszköz vizsgálatok különféle szempontjaival foglalkozott, a következő szekciókban (**1. ábra**):

- Session 1: Raw material exploitation strategies
- Session 2: Ancient lithic trade and economics
- Session 3: Stone tool production and processing techniques
- Session 4: Use-wear analysis
- Session 5: Characterising lithic sources
- Session 6: Lithotheques: collections of comparative raw materials
- Session 7: Gemology – Microcrystaline quartz as a gemstone
- Session 8: Obsidian: methodological issues of obsidian provenance studies and a new perspective of archaeological obsidian



1. ábra: Szekciók, előadások és poszterek megoszlása

A konferencián hagyományos – előadás illetve poszter – részvétel mellett lehetőség volt video-konferencia előadásokra is. A lehetőséggel többen is éltek. Eltekintve attól, hogy a személyes kontaktus valóban lényegi eleme minden konferenciának, a videokonferencia lehetőség hozzájárult ahhoz, hogy a kiterjedt nemzetközi részvétel tovább bővüljön.



2. ábra: Résztvevők országonkénti megoszlása

Összesen 58 fő (ténylegesen jelen levő) résztvevő volt, az **2. ábrán** jelzett megoszásban. A szervezők munkáját egy kisebb csapat diák is segítette, zömében a Ioan Cuza Egyetem hallgatói. Kiemelkedően jelentős számban vettek részt a konferencia munkájában a lengyel és meglepő módon, japán kutatók. Sajnos, a magyar részvétel mindössze egy főre szorítkozott. Két előadásban és egy poszterben voltam érintett:

Katalin T. Biró: The fly in the soup: problems in provenancing long-distance items (előadás)

Zsolt Kasztovszky, Boglárka Maróti, Zoltán Kis and Katalin T. Biró: Prompt Gamma Activation Analysis of the Nyírlugos obsidian core depot find (poszter)

Sándor József Sztáncsuj and Katalin T. Biró: Lithic implements at Ariușd: preliminary results (előadás)

A kivonatok már elektronikusan és nyomtatva is megjelentek, a teljes közlésre a konferenciával kapcsolatosan alapított új elektronikus folyóirat, a Journal of Lithic Studies vállalkozik, amely rövidesen elérhető a következő címen:

(http://journals.ed.ac.uk/lithicstudies)

A konferencia sorozatszerű megrendezésére is történtek kezdeményezések, amiben mi is érintettek lehetünk.

T. Biró Katalin

Magyar Nemzeti Múzeum

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HU ISSN 1786-271X; urn: nbn: hu-4106