SIZE RANGES OF PREHISTORIC CATTLE AND PIG AT SCHELA CLADOVEI (IRON GATES REGION, ROMANIA)

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Abstract

This paper summarizes osteometric data for cattle and pig from Late Mesolithic and Early Neolithic contexts at Schela Cladovei in an attempt to distinguish between the wild and domestic forms of these animals. The data are compared to empirical size ranges published by Bökönyi for aurochs (*Bos primigenius*) and wild pig (*Sus scrofa*). The results suggest the overwhelming majority of the bones measured fall below the median values of the wild forms. No cattle bones were recovered from secure Mesolithic contexts and the size-range data are congruent with the view that most of the cattle from the site were domestic. There is a clear overlap between the size-ranges of the pig bones from Mesolithic and Neolithic contexts, which does not contradict the idea of interbreeding between wild and domestic populations put forward in previous studies.

Introduction

The Iron Gates section of the Danube valley occupies a special zoogeographical area in east-central Europe between Romania and Serbia. It is at this point that the Danube leaves the Carpathian Basin flowing southeast. Post-processual theories of the adoption of agriculture, based on data from northwestern Europe, have sought to emphasize ideology as the major source of change. Material culture seems to have transformed rather

rapidly. Subsistence, on the other hand, was hypothesized as being more conservative. This line of reasoning has three implications as summarized by Rowley-Conwy (*2004*):

1) Mesolithic foragers intensified subsistence;

2) Neolithic people were mobile and subsisted mainly on wild resources;

3) Subsistence change across the ideological transition was smooth and continuous.

Traditionally, however, the area under discussion in this paper has been considered a natural corridor, important for the transmission of cultural influences from the eastern Mediterranean northwestward toward the landlocked territory of the Carpathian Basin (Figure 1). In the latter area the intensity of Mesolithic subsistence is difficult to study in the absence of sufficiently detailed archaeobiological data, while Early Neolithic peoples relied more heavily on domesticates than previously thought (*Bartosiewicz L., 2005*), exploiting wild resources on a seasonal/opportunistic basis (*Pike-Tay A., et al. 2004*). The spread of food production from the Balkans seems to have been relatively rapid in this area. Therefore, in addition to the distribution of Early Neolithic Starčevo-Criş-Körös ceramics, diffusionist theories have also been predicated on the osteological evidence of newly introduced domestic sheep (*Ovis aries* L. 1758) and goat (*Capra hircus* L. 1758), i.e. sheep and/or goat, *Caprinae Gray* 1821), originating from the Near East as no wild progenitors of these species existed in Europe.
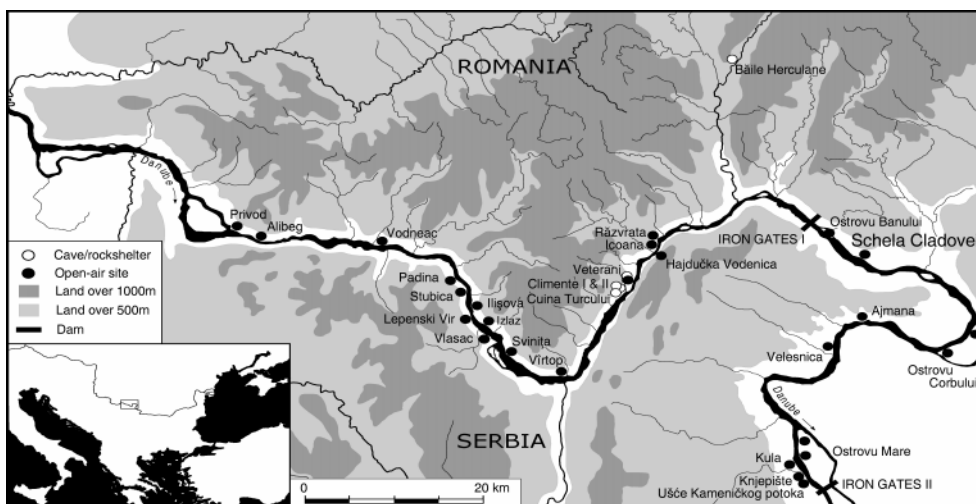

Fig 1: Locations of Schela Cladovei and other Late Stone Age sites in the Iron Gates region

A more formidable problem is represented by the appearances of domestic pig (*Sus domesticus* Erxl. 1777) and cattle (*Bos Taurus* L. 1758) which potentially were products of local domestication, since both wild boar (*Sus scrofa* L. 1758) and aurochs (*Bos primigenius* Bojanus 1827) appear, from osteological evidence, to have been common in the Iron Gates (*Bartosiewicz L., et al. 1995*). DNA analyses of Neolithic cattle bones from 33 archaeological sites spread over Central Europe, the Balkans, Thrace and the Near East support the Near East as a centre of origin. No signs of autochthonous domestication or subsequent crossbreeding with aurochs could be established (*Bollongino R., et al.* 2005). On the other hand, possible cross-breeding with local wild boar has blurred the genetic picture in the case of pig as mitochondrial DNA sequences from wild and domestic pig reveal multiple centres of domestication across Eurasia and that European, rather than Near Eastern, wild boar are the principal source of modern European domestic pigs (*Larson G., et al. 2005*).

It is this duality that makes the morphometric identification of the 'first' domestic cattle and especially pig nearly impossible in the area under discussion here. This paper is a brief review of metric distinctions between wild animals and their domestic forms in the archaeozoological record from Schela Cladovei, a Mesolithic/Early Neolithic site on the left bank of the Danube, located a few kilometres downstream of the Iron Gates gorge.

Material

This study is based on animal remains recovered in excavations at Schela Cladovei between 1992 and 1996. The vast majority of the animal remains belong to two distinct occupation phases which are radiocarbon dated to *c.* 7100–6300 cal BC (Late Mesolithic) and *c.* 6000–5600 cal BC (Early Neolithic), respectively. The gap of *c.* 300 years between the Mesolithic and Neolithic occupations suggests a period when the site was unoccupied (*Bonsall C., et al. 2002*). The 3918 early prehistoric animal bones identifiable in the settlement material are listed, both taxonomically and chronologically, in Table 1 (a small set of 72 identifiable Iron Age animal bones is beyond the topic of this paper).

Table 1: Faunal remains identified from Late Mesolithic and Early Neolithic contexts at Schela Cladovei.

	Species	**Mesolithic**		**Neolithic**	
		N	**W(g)**	**N**	**W(g)**
aurochs	(*Bos primigenius* Boj. 1827)	12	299	53	3800
red deer	(*Cervus elaphus* L. 1758)	157	3260	230	3857
red deer antler		77	952	66	883
roe deer	(*Capreolus capreolus* L. 1758)	33	160	41	167
roe deer antler		2	9		
wild pig	(*Sus scrofa* L. 1758)	48	821	39	674
brown hare	(*Lepus europaeus* Pall. 1778)	6	9	14	26
cattle	(*Bos taurus* L. 1758)	75	1454	400	11297
sheep	(*Ovis aries L.* 1758)	9	28	35	231
sheep/goat	(Caprinae Gray 1821)	111	193	292	879
pig	(*Sus domesticus* Erxl. 1777)	67	286	66	410
dog	(*Canis familaris* L. 1758)	21	129	29	184
wolf	(*Canis lupus* L. 1758)	3	24	1	3
red fox	(*Vulpes vulpes* L. 1758)			1	2
badger	(*Meles meles* L. 1758)	2	26	1	5
brown bear	(*Ursus arctos L.* 1758)			1	9
wild cat	(*Felis silvestris Schreb.* 1777)	2	2		
greek tortoise	(*Tortuga graeca* Boulanger)	64	161	28	37
frog/toad	(*Anura sp.)*	2	<1	5	2
sturgeon sp.	(*Acipenseridae)*	265	1292	102	209
sterlet	(*Acipenser ruthenus* L. 1758)	50	59	29	15
catfish	(*Silurus glanis* L. 1758)	46	283	30	66
pike	(*Esox lucius* L. 1758)	13	9	19	12
pikeperch	(*Stizostedion lucioperca* L. 1758)	2	1	4	4
undermouth	(*Chondrostoma nasus* L. 1758)				
barbel	(*Barbus barbus* L. 1758)				
carp	(*Cyprinus carpio* L. 1758)	466	563	303	240
bream	(*Abramis brama* L. 1758)	18	13	14	9
orfe	(*Leuciscus idus* L. 1758)	2	<1	1	<1
small cyprinid	(*Cyprinidae)*	329	137	232	73
Total identifiable	(NISP)	1882	10169	2036	23095
large mammal	(*Mammalia indet.)*	429	1587	752	3102
small mammal	(*Mammalia indet.)*	491	346	546	540
bird indet.	(*Aves)*	18	8	13	16
fish indet.	(*Pisces)*	306	116	346	77

The total weight of the material analyzed so far has been almost 34 kilograms. Owing to the greater contribution of fish and more heavily fragmented mammalian bones in the Mesolithic assemblage, in spite of the comparable numbers of fragments (NISP≈2000), these remains weigh only half as much as the Neolithic sample.

There is no clear stratigraphic separation between the Mesolithic and Neolithic occupation phases, owing to subsequent pedogenic alteration of the deposits and reworking by people during the Neolithic and later periods (e.g. by pit digging). Furthermore, soil forming processes have led to blurring of the outlines of archaeological features which may account for the presence of bones of domestic sheep and/or goat in purportedly Mesolithic contexts (*Bartosiewicz L., et al.* 1995, 9). Nevertheless, even the existing provisional chronological subdivision of the material shows a marked diachronic decline in the exploitation of game and aquatic resources. This evidence may be compared to that from stable isotope (δ^{13}C and δ^{15}N) analyses of human remains from Lepenski Vir higher up the gorge which suggests a heavy emphasis on aquatic food sources during the Mesolithic but increased exploitation of terrestrial resources during the Early Neolithic (*Bonsall C., et al. 1997; 2000; 2004*).

Of the identifiable domestic animals, cattle and caprinae are represented by the greatest numbers of identifiable bone specimens. As has been mentioned before, the latter are definitely the remains of domestic animals since the wild ancestors of neither sheep nor goat are known in this part of Europe (*Bökönyi S., 1974*).

The problem of cattle and pig is even more complex. In addition to the potential bias caused by bones in unrecognizable secondary positions, in this case there are difficulties in zoological distinction between remains of the domestic forms and the wild ancestors of these species which also inhabited this area. Encouraging recent results in the distinction between mitochondrial DNA in morphologically similar subfossil bones of sheep and goat (*Loreille O., et al. 1997*), would not be applicable in the case of early domesticates and their wild ancestors since they belong to the same species and are thus genetically continuous.

Stochastically speaking, some domestic cattle and pig bones may have been mis-classified as Mesolithic (to the same degree as with the remains of caprinae). However, it is also possible that some of the 'domestic' cattle or pig bones in the Mesolithic material originate from smaller specimens (esp. females) of the wild ancestor, since there is a

considerable size overlap between the wild and domestic forms of both cattle and pig.

Had the bones been better preserved, this uncertainty could be reduced on the basis of osteomorphological observations. Many of the remains, however, are so fragmented that identification beyond the level of genus was often impossible. The negative effect of fragmentation on the identifiability of animal species is evident (*Bartosiewicz L., 1998*, 227). Potential mis-identifications are more likely to occur in poorly preserved assemblages.

Measurements used in this study are summarized in Table 2. Bovine data comprise measurements from 12 bones deriving from contexts that could not be dated precisely but which are very likely to represent either the Mesolithic or the Neolithic. Furthermore, 12 bones originate from datable Neolithic deposits. Suid bone measurements are more evenly spread chronologically, including only two bones from imprecisely dated strata, four from Neolithic and five from Mesolithic deposits. The measurements are listed in Table 2.

Table 2: Selected Bovine and Suid bone measurements (*von den Driesch 1976*) from Schela Cladovei to be compared to size ranges by Bökönyi (*1995*).

Bovine, Neolithic									
	Age	**Grid**	**Unit**	**Context**	**GL**	**Bp**	**Dp**	**Bd**	**Dd**
M_3	adult	1 AII		1	38.2				
M_3	adult	3 AII	1.02-1.12	12	40.9				
radius	adult	1 BIII	0.97-1.02	17				83.6	55.0
metacarpus	adult	1 BII		1				62.0	31.1
metatarsus	adult	1 BII		1				64.1	35.1
tibia	adult			1				67.2	53.0
astragalus	adult	1 BII		1A	91.3			59.7	48.9
astragalus	adult	2 AIII	0.92-0.97	17	57.3			36.1	31.1
astragalus	adult	2 AII		1	62.9			40.2	34.1
astragalus	adult	1 AII	1.27-base	6B	70.6			43.2	38.8
astragalus	adult	2 BII	0.64-0.72	1	71.0				
astragalus	adult	1 BII		1A	83.6			56.2	46.9
metatarsus	subadult	1 BII		1				70.3	37.5
Bovine, Period unknown									
	Age	**Grid**	**Unit**	**Context**	**GL**	**Bp**	**Dp**	**Bd**	**Dd**
M_3	adult	2 AIV	0.53-0.64		39.4				
radius	adult	2 AIII	0.45-0.53			83.9	42.9		

					GL	Bp	Dp	Bd	Dd
metacarpus	adult	1 BII	0.77-0.82			62.2	42.1		
metacarpus	adult	1 BII	0.45-0.53		215.6	60.7	37.0	62.3	34.6
metacarpus	adult	2 BII	0.45-0.53			70.2	43.5		
metacarpus	adult	1 BIII	0.53-0.64					73.3	36.5
tibia	adult	3 BI	0.45-0.53			91.1	84.6		
astragalus	subadult	2 AI	0.64-0.72		48.1			30.8	26.1
astragalus	adult	2 AI	0.64-0.72		60.6			36.3	32.2
astragalus	adult	1 BII	0.45-0.53		73.1			45.5	41.7
astragalus	adult	2 BII	0.45-0.53		76.5			47.5	43.8
astragalus	adult	2 BII	0.45-0.53		84.0			54.0	45.3
Suid, Mesolithic									
	Age	**Grid**	**Unit**	**Context**	**GL**	**Bp**	**Dp**	**Bd**	**Dd**
epistropheus	adult	2 AI	0.77-0.82	15		56.1			
scapula	adult	2 AI	0.77-0.82	15				34.9	46.2
scapula	adult	2 AII	0.77-0.82	15				40.8	60.6
radius	subadult	2 BII	0.77-0.82	15				27.5	20.3
astragalus	subadult	2 BII	0.77-0.82	15	47.5			25.2	26.1
Suid, Neolithic									
	Age	**Grid**	**Unit**	**Context**	**GL**	**Bp**	**Dp**	**Bd**	**Dd**
M_1-M_3	adult	1 AII		1	78.5				
M_3	mature	1 BI		1A	43.8				
tibia	adult	1 AII		1				35.6	29.8
tibia	adult	1 BII		1				37.2	33.1
Suid, Period unknown									
	Age	**Grid**	**Unit**	**Context**	**GL**	**Bp**	**Dp**	**Bd**	**Dd**
M_1-M_3	mature	1 AI	0.53-0.64		61.0				
radius	adult	2 BII	0.72-0.77		199.9	34.2	25.5	45.0	32.2

Methods

To date, most distinctions between domestic animals and their wild ancestors have been based on size differences. The onset of domestication is known to usually have brought about a considerable body size decrease that is also manifested in bone measurements. To illustrate this effect of domestication, reconstructions of Late Neolithic cattle and pig according to Uerpmann (*1983*) are worth citing here (Figure 2). In addition to its evidently smaller size, however, the aforementioned DNA studies indirectly suggest that the general appearance of domestic cattle may have been somewhat less similar to local aurochs, if domestic stock was of Near

Eastern origins. This does not influence the fact, however, that very large bones can be unambiguously recognized as remains of wild individuals, while those from small mature animals are by default assigned to the domestic form in both species.
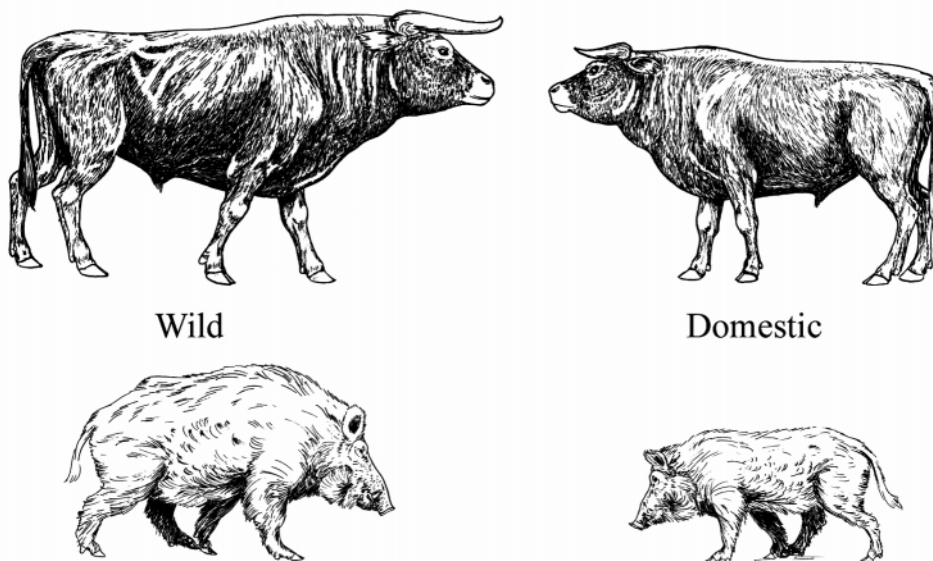

Fig 2: A graphic reconstruction of Neolithic cattle and pig in relation to their wild counterparts (after Uerpmann 1979)

Although the osteometric standard developed by Angela von den Driesch (*1976*) thirty years ago has become a convention in archaeozoology, comparisons between bone measurements are often hampered by the lack of widely published standard specimens or populations whose measurements would make the uniform treatment of osteometric data derived from heavily fragmented material possible. Since traditional estimations of withers height and sex (*Nobis G., 1954, Calkin V.I., 1960* for cattle; *Teichert M., 1969* for pig) require bones preserved in full length, any method utilizing information from fragmentary remains is of additional use.

On the basis of over three decades of hands-on experience in central and south-eastern Europe, Bökönyi (*1995*) summarized

empirically established size ranges for wild pig and aurochs. Given the situation, his results were considered worth applying to the material under discussion here. Characteristics to be considered before using the empirical size ranges published by Bökönyi may be summarized in the following SWOT list:

a) *Strengths*: The use of parameters based on local wild populations is indispensable in domestication studies (*Rowley-Conwy P., 1993*, 115). Bökönyi's ranges encompass metric variability observed in the area between the Carpathian Basin and the Balkans where relevant studies were carried out (cf. *Bökönyi S., Bartosiewicz L., 1987*).

b) *Weaknesses*: Bökönyi's guidelines consist of nothing but minimum and maximum values, hampering in-depth statistical analysis. These are, however, not concrete, individual measurements, but reflect Bökönyi's personal expertise on what is "small" or "large".

c) *Opportunities*: Based on *en masse* regional observations made on Neolithic materials, these size limits offer the only local benchmark for the gross evaluation of fragmentary data from Schela Cladovei, a site within the same time period and region.

d) *Threats*: These limits were written up on the basis of adult individuals, but without distinction by sex and do not directly refer to source materials or the number of specimens. Their direct, mathematical use may thus lead to cumulative bias.

While the statistical applicability of these values is considered difficult, empirical size limits for the few *measurable* aurochs and wild pig bones recovered at Schela Cladovei are cited in Table 3. Bökönyi's (*1995*, 7-10) selected size ranges listed in this table have been completed with median values for the purposes of this study.

Owing to sexual dimorphism, the size distributions of wild animals under discussion here are certainly bimodal, a trend that tends to diminish only with the advancement of domestication (*Bartosiewicz L., 1997*, 53). As a gross tendency, however, it may be assumed that adult aurochs and wild pig smaller than the median would originate from females, while the values above the mid-point of Bökönyi's ranges represent males. Given the fact that Bökönyi's theoretical size ranges do not derive from a concrete, biological population, the possibility that differential sex composition may distort medians in pooled samples is less likely to be a source of bias.

Table 3: Minima∕maxima (*Bökönyi S., 1995*) and median values (parenthesized, bold) of aurochs and wild pig relevant to the measurable skeletal elements available at Schela Cladovei.

Aurochs	Length	Proximal breadth	Distal breadth	Proximal depth	Distal depth
M$_3$ tooth	41.0-49.5 (45.3)				
radius		91.0-122.0 (106.5)	81.0-111.0 (96.0)	44.0-63.0 (53.5)	48.0-81.0 (64.5)
metacarpus	219.0-259.0(239.0)	66.0-89.5 (77.8)	68.5-88.0 (78.3)	42.0-65.0 (53.5)	37.0-51.0 (44.0)
tibia		112.0-133.0 (122.5)	68.5-90.0 (79.3)	119.0-134.0 (131.5)	55.0-70.0 (62.5)
astragalus	77.0-97.0 (87.0)		51.0-69.0 (60.0)		43.0-56.0 (49.5)
metatarsus	255.0-300.0 (277.5)	55.0-71.0 (63.0)	62.5-80.0 (71.3)	32.0-68.5 (50.25)	36.0-44.5 (40.3)
Wild pig					
M$_3$ tooth	40.0-55.0 (47.5)				
M$_1$-M$_3$ tooth	76.0-118.0 (97.0)				
axis	60.0-63.0 (61.5)				
scapula			28.5-41.0 (34.8)		43.0-59.0 (51.0)
radius		35.0-43.0 (39.0)	40.5-48.0 (44.3)	25-30.5 (27.8)	30.0-38.0 (34.0)
tibia			35.5-42.0 (38.8)		30.0-37.0 (33.5)
astragalus	49.0-57.0 (53.0)		27.0-33.0 (30.0)		35.5-42.5 (38.0)

Having reviewed a number of analytical possibilities, bone measurements from Schela Cladovei were plotted against Bökönyi's extreme values by calculating individual scores within standardized ranges (R=1). Standard range scores (SRS) for each measurement were obtained as follows:

$$SRS = (individual\ measurement{-}median)∕(maximum{-}minimum)$$

The logic of this calculation follows that of Uerpmann's size index method (*Uerpmann H-P., 1979*, appendix 2) based on mean values and standard deviations, but it looks undeniably simpler and more robust, given the absence of a series of re-measurable reference skeletons. It is aimed at maximizing the use of meagre individual measurements by comparing them to the standardized parameters of that measurement in a base 'population', understood in a purely empirical sense. Thanks to this procedure, however, the configuration of all measurements can be studied within the same histogram, thereby adding up the number of measurable bone specimens. Using the SRS method, a measurement identical to a minimum recorded by Bökönyi gives an SRS = -0.5; one identical to a median gives an SRS = 0, and one identical to a maximum gives an SRS = +0.5.

Results

Prior to the metric evaluation of our data, it was worth considering whether it was possible that bones from wild animals might be more likely to be measurable than domestic ones. Diachronic comparisons between archaeozoological assemblages suggest wild animals are often treated in a different way with regard to butchery, i.e. bones of wild animals are far less intensively butchered than those of domesticates. Wild animals also often tend to be represented by more easily recognizable older individuals, thereby increasing their relative contribution to the measurable set. Tables 4 and 5 outline this difference for the animals under discussion here. In these tables, no *a priori* distinctions were made between the measurable bones from wild *vs* domestic animals.

Table 4, a summary of bovine bones, shows that a major portion of domestic-looking, relatively small cattle bone fragments also occurred in Mesolithic contexts, although none of them were preserved in a measurable state. On the other hand, a dozen measurable bones with no precise chronological affiliation beyond "early prehistoric" (i. e. unknown) were also included in the analysis.

Table 4. The numbers of all refuse bones and measurable specimens from Bovines (aurochs and possibly domestic cattle).

	NISP from Table 1			Numbers of measurement data from Table 2	
	Wild	Domestic	Total	Measurements	Measurable bones
Mesolithic	12 (14%)	75 (86%)	87	0	0
Neolithic	53 (12%)	400 (88%)	453	28	13
(Unknown)				*32*	*12*
Total	**65**	**475**	**540**	**60**	**25**

It is clear that the number of measurable bones is very small both in absolute and relative terms (25/540 = 4%). Given the overwhelming dominance of "domestic" size cattle fragments among the refuse material, one may hypothesize that, in the case of comparable carcass treatment, the majority of remains will fall within the size range of domestic cattle. This is especially the case for the large Early Neolithic assemblage.

Table 5, a summary of pig bones shows that bones of domestic-looking, relatively small pigs were also found in Mesolithic contexts. In this

case two measurable bones with no precise chronological affiliation beyond "early prehistoric" (i.e. unknown) were included in the calculations.

Table 5: The numbers of all refuse bones and measurable specimens from Suids (wild boar and possibly domestic pig).

	NISP from Table 1			Numbers of measurement data from Table 2	
	Wild	Domestic	Total	Measurements	Measurable bones
Mesolithic	48 (42%)	67 (58%)	115	10	5
Neolithic	39 (37%)	66 (63%)	105	4	4
(Unknown)				*6*	*2*
Total	**87**	**133**	**220**	**20**	**11**

In this case, the proportion of measurable bones is similarly small: 11 out of 220 bones (i.e. 5%), while differences between the fragments possibly originating from wild or domestic pig are smaller in the overall refuse bone material. Should different NISP proportions be reflected in the distribution of SRS values for both Bovines and Suids, the idea of different carcass manipulation for wild animals will gain support.

SRS values calculated using all relevant Bovine bone measurements from Schela Cladovei are shown in the histogram of Figure 3. Although, in principle, growing bone tends to attain full length before it reaches its final breadth and depth (*Davis S., J., M., 1996*, 599), measurements taken on the same individual specimen tended to yield comparable SRS values, regardless of their geometrical dimension.

The more-or-less trimodal configuration of cases is largely concentrated around the SRS=-0.5 limit, that is, the minimum of aurochs measurements using Bökönyi's criteria, spread between 0 and -1. Only the greatest length of a large astragalus is greater than the median value of aurochs. It seems that although some of the larger bones may originate from aurochs, individuals reaching the size of wild bulls are not represented in the material. Thus, most animals in the group of cases left of the aurochs minimum (-1.0<SRS<-0.5) appear to originate from adult domestic cattle which, given the Neolithic or at least unknown (Table 2) origins of Bovine bones does not contradict Bökönyi's criteria. Since almost 90% of all Bovine bones were considered domestic in the Neolithic assemblage, the hypothesis concerning differential carcass treatment for aurochs is not manifested in this small sample. A separate group (SRS<-

1.0) is formed mostly by various measurements of small cattle astragali from young individuals. This age cohort of cattle would not be represented by measurements of long bones among the data owing to incomplete epiphyseal fusion.
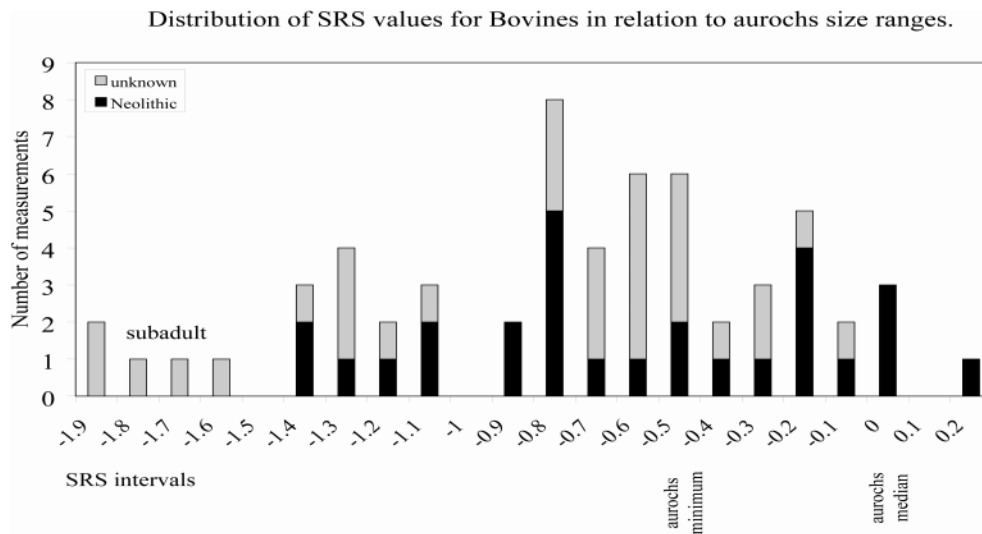
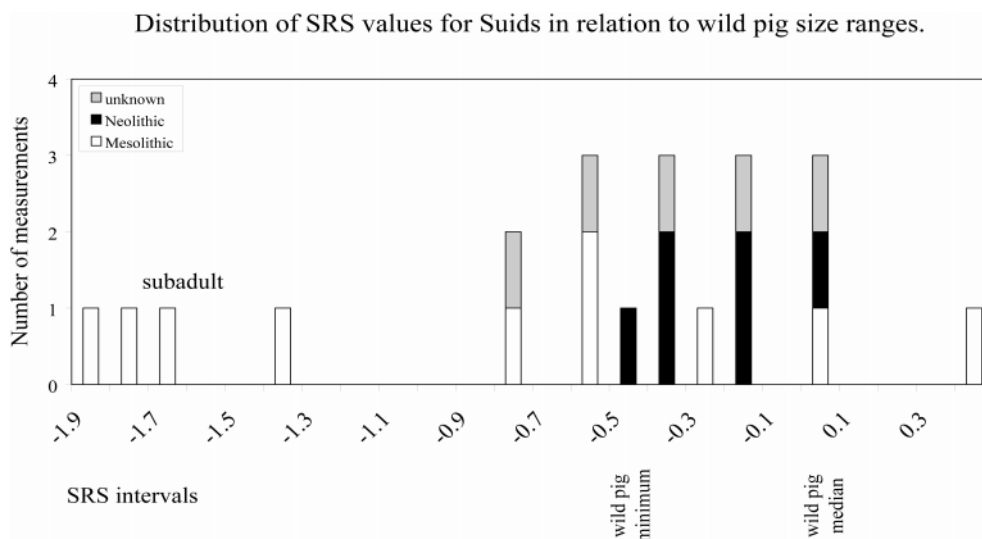Distribution of SRS values for Bovines in relation to aurochs size ranges.

Fig 3: Distribution of SRS values for Bovines in relation to aurochs size ranges

Distribution of SRS values for Suids in relation to wild pig size ranges.

Fig 4: Distribution of SRS values for Suids in relation to wild pig size ranges

With a Nobis (*1954*) index reaching only 28.1% (100*SD/GL), and an estimated withers height of 1289.3 mm (*Calkin V.I., 1962*), the only Bovine metacarpus preserved in full length seems to have originated from a relatively tall cow; this stature corresponds to the average withers height of some unimproved modern breeds such as Belarus Red cattle. Therefore, even in the absence of reliable stratigraphic information, this bone is likely to have belonged to Neolithic domestic cattle; most authors agree that even female aurochs reached a withers height of at least 1500 mm in central Europe (*Guintard C., 1994*, 180).

SRS values for the smaller set of Suid measurements are shown in Figure 4. The overall pattern of this group is very similar to that displayed by the Bovine measurements. The only major difference is the apparently greater contribution of wild pig to the sample, although very few cases fell above the SRS=0 median value of Bökönyi's size range. This trend reflects a possible difference between the chronological compositions of the Bovine and Suid set of measurements; the majority of pig bones originated from verified Mesolithic contexts and thus may be hypothetically assigned to the wild ancestor. Nevertheless, there is a sufficiently large number of Neolithic bone measurements to attribute some specimens, falling below Bökönyi's wild pig threshold, to domestic animals. The group of small cases in this histogram is made up by transversal measurements of Mesolithic pig bones which, however, originate from subadult individuals and may thus also represent wild pig. There is a clear overlap between the size-ranges of the pig bones from Mesolithic and Neolithic contexts, which does not contradict the idea of interbreeding between wild and domestic populations as suggested in previous studies based on archaeozoological (e.g. *Bolomey A., 1973*) and genetic (*Larson G., et al. 2005*) evidence. The withers heights estimated from a Mesolithic astragalus and an adult radius using coefficients by Teichert (*1969*) are 850.2 mm and 1051.4 mm respectively, both corresponding to the stature of modern wild pig in Hungary (sows 700–970 mm, boars 770–1080 mm at 3 years of age; *Faragó S., 2002*, 367), although prehistoric wild pigs are known to have been larger than their modern counterparts.

Discussion

The graphic representation of Mesolithic/Neolithic cattle and pig bone measurements from Schela Cladovei does not contradict the size

ranges established in Bökönyi's 1995 article. Even the sketchy, informal parameters based on his empirical work are of help in analyzing the small data-set available for study. In addition, the size distributions of pooled bone measurements show a major component of domesticates, a trend congruent with the picture gained from NISP values.

The interpretation of SRS diagrams, however, is open to discussion. For one thing, this form of presentation clearly shows a disadvantage shared with the calculation of traditional size indices: the final configuration of data is dependent on the growth characteristics of both the skeletal element and its measurable dimensions. Ageing based on the epiphyseal fusion of long bones, an important method (*Habermehl K., H., 1961*), often only provides a *terminus ante quem age* at slaughter if unfused bones are encountered in the faunal material. Fragments of early fully fused epiphyses may sometimes originate from younger animals which have not yet reached adult size, especially in terms of robusticity (transversal bone measurements). The inclusion of such bones into more sophisticated calculations may be a source of considerable bias. It may be worth citing here the fusion ages of long bones discussed in this study (Table 6).

Table 6: Ages of epiphyseal fusion for the bones used in calculating SRS values in this study (*Schmid 1972, 75*).

Cattle	Proximal epiphysis	Distal epiphysis
radius	1.0-1.5 years	3.5-4.0 years
metacarpus	fused by birth	2.0-2.5 years
tibia	3.5-4.0 years	2.0-2.5 years
metatarsus	fused by birth	2.0-2.5 years
Pig		
radius	1.0 year	3.5 years
tibia	3.5 years	2.0 years

There may be minor inherited differences in the age of epiphyseal fusion in modern domesticates. Moreover, growth and development are directly influenced by environment/nutrition as well. Nevertheless, it is evident from these data that the animals are not fully mature at the ages listed. This, however, is expressed mostly in the transversal dimensions of bones under discussion here. Post fusional growth, e.g. in bones of the hock joint, may also be dependent on the mobility of the animal species in

question (*Davis S., J., M., 1996*, 599) which may explain the high contribution of astragali to the group of outliers in both graphs.

Given these intricacies, measurements taken on fragmented bone may not always be a reliable predictor of an animal's domesticated status. In the case of the Schela Cladovei data, it may be accepted that several of the Neolithic small Bovine bones originate from domestic cattle, although even this reasoning is somewhat circular, being rooted in the general rule that domestic cattle and pig tend to be smaller than their wild ancestors.

While very large prehistoric bones may undoubtedly originate from aurochs and wild pig respectively, recently Rowley-Conwy (*1995*, 125) has called for extreme prudence when interpreting small bones as those of domestic cattle and pig in Mesolithic contexts in Europe. The problem of animals representing transitional size groups, to a great extent, is a product of sexual dimorphism that creates a size overlap between large domestic males and small wild females which coincides with the size of transitional phenotypes possibly produced by the interbreeding between wild and domestic stocks (*Benecke N., 1994*, 101). This trend is characteristic of Late Neolithic Bovines in the Carpathian Basin when aurochs was still abundant in the area. According to both historical and ethnographic sources, back crossing has been a well known form of upgrading domestic pig stocks until the present day.

Omnivorous wild pigs may have been attracted to human habitations early on, and during the Neolithic they may also have crossed with the domestic population and again been difficult to recognize on a purely osteological basis. This possibility is worth considering for two reasons. Evaluating the prehistoric fauna of Icoana, Bolomey (*1973*, 51) "rejects the term of 'domestic' for the pig population at the Iron Gates, but agrees that to some extent it suffered human control". Moreover, in addition to their small percentage in the Mesolithic assemblage of Schela Cladovei, pigs in general seem to have played a negligible role in the apparently mobile pastoral animal husbandry of the Starčevo-Criş culture. Therefore uncertainties in stratigraphic and zoological identification interfere with the observation of their aforementioned 'control' by humans.

Conclusions

Evidence from Britain, Ireland, southern Scandinavia (*Bonsall C., et al.* 2002*a, b*; *Rowley-Conwy P., 2004*) as well as Hungary (*Bartosiewicz L., 2005*),

suggests that contrary to post-processual theories mentioned in the introduction, Mesolithic foragers did not seem keen on intensifying their economy, while Neolithic populations were engaged in food production (cultivating plants and raising domestic animals) and tended to be sedentary.

The prehistoric occurrence of sheep bones at the site of Schela Cladovei is indicative of the Early Neolithic eastern Mediterranean influence in the Iron Gates region. The extreme size differences between domestic animals and their wild counterparts at Schela Cladovei suggest that the transition to agriculture took place at a rapid pace, which further implies that the likelihood of local domestication is slight. Domestic cattle too were very probably imported. Of the major domestic animals, pig (and dog) are the most likely to have been mixed with local wild stock. Furthermore, with the appearance of domestic livestock there seems to have been a decreasing emphasis on the relative contribution by fishing (Table 7).

Table 7. Summary of domestic, wild and aquatic resources (NISP excluding deer antler fragments).

	Domestic mammals	Wild mammals	Tortoise/Anura	Fish	Totals
Mesolithic	263 (15%)	283 (16%)	66 (4%)	1191 (66%)	1803
Neolithic	822 (42%)	381 (19%)	33 (2%)	734 (37%)	1970

The osteometric differentiation between cattle and pig and their wild ancestors therefore should be of fundamental importance at this site as well. The problem, however, is that its manifestation is burdened by the consonance between numerous phenomena (sexual dimorphism, differential epiphyseal fusion, regional size differences in the wild populations), which make singling out the quantitative effects of domestication difficult.

It is this complexity that makes it necessary to explore all possible means of improving our understanding of the effects of domestication on size. The study of a small data set from Schela Cladovei using a special method (standardized range scores) developed on empirical observations by Bökönyi (*1995*) has shown that the inhabitants of this site in the Iron Gates exploited both wild and domestic cattle during the Neolithic. It was

more difficult to identify the Mesolithic Suid remains from this site as those of domestic pig.

As with Uerpmann's size index, SRS values are dependent on both the reference material (in this case Bökönyi's size ranges) and skeletal parts studied. However, when these potential sources of bias are identified and kept in mind, this method contributes interesting details to the emerging picture of animal exploitation in the Iron Gates Gorge. The evaluation of future data along the same lines is expected to produce an increasingly coherent body of information.

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