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Mid-Holocene pastoralism in North-Western Sudan: cattle bone finds from Wadi Hariq and their cultural implications

Introduction

The palaeodrainage system named Wadi Hariq is located in the south-eastern part of the Sahara (northwestern Sudan) about 400 km west of the River Nile (Fig. 1). Within the valley system a total of 104 sites have been discovered during survey. Between 1997 and 2001 seven of the most promising sites were selected for excavation. In this report the faunal remains from site Wadi Hariq S 01/1 will be discussed. Based on the ceramics, the occupation of Wadi Hariq S 01/1 dates to the Handessi horizon B, i.e. ca. 1800 BC to the second half of the second millennium BC (Jesse et al. 2004; Jesse this vol.; Lange this vol.). The faunal assemblage of this site yields some cattle bone measurements, which prompted us to review the metrical data of cattle from all sites in the Wadi Howar region.

Archaeofaunas of Wadi Hariq S 01/1

At Wadi Hariq S 01/1 more than 4,400 faunal remains have been collected (Fig. 2). Due to the poor state of preservation - especially of the surface finds - the identification rate did not surpass 25%. The sample mainly consists of bovid bones, i.e. cattle, sheep, goat, scimitar-horned oryx, dama gazelle, and dorcas gazelle. Bone finds of giraffe were only found during the detailed mapping program carried out near the site.

Considering the number of identified specimen (NISP) and their weight, game was not important in the subsistence of the Wadi Hariq inhabitants. Meat supply was secured almost exclusively by livestock. The herds consisted mainly of cattle and goats with only a few sheep. Since we know that the ratio skeleton

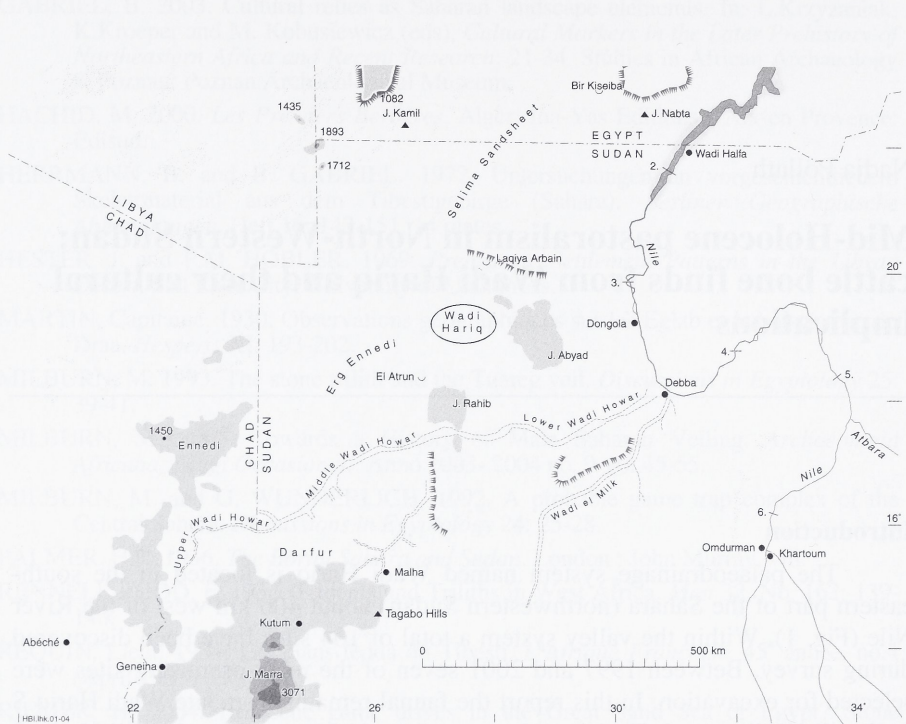


Fig. 1. Map of northeastern Sudan with the location of Wadi Hariq.

weight to body mass is similar in most of the larger mammals, bone weight is a suitable parameter to estimate the dietary importance of a species (Kubasiwicz 1956). In this regard cattle was the most important animal, more than 70 percent of the meat consumed being beef.

The spectrum of wild taxa evidences different habitats within the site catchment (Fig. 3). On the one hand there are species that inhabit the true desert or semi-desert landscapes like dama gazelle and dorcas gazelle. These artiodactyl species will mainly obtain water from their food plants. Due to particular adaptations, these bovids are capable of going without water for long periods, possibly even their entire life. Hare also can obtain moisture from its food and this explains why the species occurs all over North Africa, even in the desert (Dorst and Dandelot 1972). Scimitar-horned oryx and giraffe, on the other hand, have somewhat higher ecological demands. The scimitar-horned oryx frequents the sub-desert steppes and arid grasslands but may also be found in the Sahel during

	NISP		Weight	
	n	%	g	%
Cattle	268	28,3	1913,2	71,1
Sheep	2	} 20,9	5,4	} 11,1
Goat	25		54,9	
Sheep/goat	171		238,9	
Total domesticated animals	466	49,3	2212,4	82,2
Scimitar-horned oryx, <i>Oryx dammah</i>	1	0,1	1,2	0,0
Dorcas gazelle, <i>Gazella dorcas</i>	3	} 1,0	32,6	1,4
Gazelle, small	6			
Dama gazelle, <i>Gazella dama</i>	1	} 0,8	9,4	0,4
Gazelle, medium-sized	7			
Rodentia indet.	1	0,1	0,1	0,0
Horned sand viper, <i>Cerastes cerastes</i>	1	0,1	0,1	0,0
Bovid, large	152	16,1	183,0	6,8
Bovid, medium size	14	1,5	52,7	2,0
Bovid, small	295	31,2	200,5	7,4
Total identified bones	946	100,0	2692,0	100,0
Mammalia indet.	3417		1530,5	
Ostrich, <i>Struthio camelus</i>	24 (egg shell)			
Zootecus insularis	14			
Giraffe, <i>Giraffa camelopardalis</i> (not from the excavated area)	1			

Fig. 2. Composition of the faunal assemblages from site Wadi Hariq S 01/1. NISP and bone weight.

the dry season and occasionally even in the true desert after the rains (Dorst & Dandelot 1972; Kingdon 1997). Among the taxa recorded at Wadi Hariq the requirements of giraffe are the highest. Although they can refrain from drinking for weeks if they obtain enough moisture from their food, giraffes cannot survive too long without drinking (Dorst & Dandelot 1972). The presence of giraffe and oryx, however, shows that the Wadi Hariq palaeodrainage must have offered good pastures at least during part of the year. After the rainy season, the run-off

from the wadi slopes may have caused relatively favourable conditions within the wadi system, which allowed for a population of giraffes to survive. The foregoing suggests that the landscape resembled a mixture of (semi-) desert and northern Sahel.

	Dorcas gazelle, <i>Gazella dorcas</i>	Dama gazelle, <i>Gazella dama</i>	Scimitar oryx, <i>Oryx dammah</i>	Giraffe, <i>Giraffa camelopardalis</i>
Desert	+	+	+	
N-Sahel	+	+	+	
S-Sahel			+	+
Sudan Savanna				+

Fig. 3. Wadi Hariq S 01/1. The wildlife and their preferred habitats.

Water requirements of livestock are different. Cattle of present-day nomadic pastoralists in the West African Sahel, such as the Kel Temasheq (Tuareg), usually tolerate intervals of two or three days without water depending on season and quality of pasture. Goats can go without water for 15 days during the cool season, whereas in the hot season they need water every third day. In the dry season sheep accept up to five days intervals without water even if they have to cover distances of about 20 km. For the Kel Temasheq's sheep, for example, a 30 days period in the cool season and a one to two days interval in the hot season without drinking has been recorded (Smith 1980).

All domestic species mentioned tolerate arid conditions to a certain extent. In contrast to their wild counterparts, however, domestic animals cannot obtain enough water from their food plants. Thus livestock would not survive long without water. Although the wadi probably provided favourable conditions during the wet season, we doubt whether livestock would have found adequate pasture towards the end of the dry season, even if the herders had dug wells to guarantee a sufficient water supply.

In most bone samples from Saharan sites there is insufficient data concerning the age at death of the animals. This is, however, not the case in this assemblage, which produced a surprisingly high amount of bones of very young cattle and small livestock, in particular of perinate animals. In some cases we might be even dealing with the remains of unborn calves and kids. From our experience with faunal assemblages in arid regions, the likelihood that these

fragile bones are preserved through time is extremely low, suggesting that these animals were buried.

Principally, cattle and goat are polyoestrous, which means that they can conceive throughout the year (Rüsse & Sinowatz 1991). Modern stock-farming profits therefrom and is able to secure milk supply throughout the year by a staggered gestation of cows and small ruminants (e.g., Pingel 1986). As the extreme climatic and environmental conditions of (semi-)arid regions cause water and fodder shortage towards the end of the dry season, offspring born in the dry season has fewer survival chances since their mothers do not produce enough milk to feed them. In arid regions livestock-keepers will counteract by adjusting the reproductive cycles, so that births will take place during the rainy season when cows, goat and ewes find enough pasture and water. Thus the peak of births in modern West African N'Dama cattle and in different African goat breeds is in the middle of the rainy season (Smith 1980; Smith 1992; Felius 1995). Moreover, even today herders will try to avoid off-season births by preventing copulations or killing the off-season pregnant female at an early stage of gravidity (Wilson 1986; Muffarih 1991). Such a rational approach can also be assumed for prehistoric pastoralist societies.

Considering the environmental conditions at Wadi Hariq and its surroundings as suggested by the spectrum of wild fauna and the mortality profiles in livestock, this raises the question about the annual cycle of the pastoralists frequenting Wadi Hariq. While livestock-keeping may have been possible during the rainy season, it can be doubted whether the Wadi Hariq region did offer enough pasture and water during the dry season. Conceivably, pastoralists and their flocks spent this time of the year near permanent water bodies, e.g., the Nile valley. For sure, while the high relative frequency of fetal and perinate and/or neonate individuals in the faunal assemblage provides ample evidence for the presence of man and his flocks at Wadi Hariq during the rainy season, we cannot entirely exclude the possibility of a dry season presence, but have considerable doubts whether this was the case.

On the type and stature of cattle in North Eastern Africa

As said, the Wadi Hariq assemblage provided a number of cattle bones, the morphometrics of which might provide clues as to their geographic origin if compared with contemporaneous and older cattle. Following a modern definition, a (modern) breed is a group of animals that are related by a descent from a common ancestor. All individuals of a breed will produce an offspring with the same characteristics of the population when reproducing with other members of that population. These characteristics comprise size, shape of the body and horns, colour of the coat, weight, and performance (beef, milk, labour, reproduction),

among others. However, when dealing with domestic animals from prehistoric or early historic times, the definition of breed is not as narrow as today, since there did not exist tight breeding programs with defined breeding objectives. But there were distinct types of cattle that developed in different regions as a result of human selection towards certain features with landscape characteristics and pasture productivity acting as limiting factors moulding the phenotype. Roman authors, for example, distinguish between different types of cattle in different parts of the Roman Empire (Peters 1998: 32ff.). The cattle of Campania are described as white-coloured, of slender built and suitable for work. Umbrian cattle were tall and robust with bright or reddish coat. They were considered good draught animals. The Ligurian breed, however, was small and therefore not suitable for work, but fertile and very well adapted to the mountainous landscape characterising the Ligurian region.

Further back in prehistory we lack written information of this kind. To a certain extent depictions in rock art could fill this gap. From the colourful and detailed paintings in the mountains of the eastern Sahara we know a lot about the appearance, horn shape and coat colouring of cattle. But their dating remains a problem. Moreover, rock paintings do not occur in the Wadi Howar region. The rock engravings, which also depict cattle, however, show only few details, are rather stylised and therefore less useful to distinguish cattle types. Apart from this the dating of these engravings is also difficult (Jesse 2005, 36). In dynastic Egypt, however, detailed wall paintings show at least two different types of cattle: a tall and slenderly built, long-horned one Egyptian breed, and another one and a smaller, more robust short-horned type, likely introduced from the southern Levant (Boessneck 1988: 70; Laudien 2000: 30 ff.).

The archaeozoological analysis of bone material cannot provide, e.g., information about milk and beef performance or about the coat colouring. The only evidence revealed by the bones concern stature and size, and the shape of horn cores. Though horn cores may be of special interest when dealing with Nile valley archaeofaunas, they are generally rare in most faunal collections from the Eastern Sahara, including those from the Western Desert of Egypt, making stature an important feature when discussing prehistoric ruminant breeds (Laudien 2000). An animal's stature, however, is reflected by the relation of the length to the breadth of its bones. Differences in bone proportions therefore imply different breeds and this can be evidenced using scatter diagrams comparing length with breadth measurements. Usually a single skeletal element is chosen and specimens from different sites are plotted in one diagram (cf. Chaix 1994: 3; Peters 1998: fig. 19-21; Laudien 2000: 95 ff.). This requires a relatively large data set for each assemblage. In Saharan sites, however, complete bones are scarce and a straight-forward comparison of measurements cannot be

carried out. To deal with similar samples, several scholars developed methods to group different measurements into a single analysis. Among these Richard Meadow's Logarithmic Size Index method (LSI) is the most widely used scaling technique (Meadow 1999). Thereby the difference between the logarithmised breadth measurement of a particular bone and the logarithmised measurement of the corresponding bone of a standard skeleton is calculated (formula: $LSI = \log x - \log \text{standard}$; with 'x' being the measurement of the archaeological specimen and 'standard' the corresponding measurement of the standard skeleton). Results are displayed either in vertical-bar graphs (e.g., Linseele 2004: fig. 10 ff.) or in box-plots (e.g., Jesse et al.: 2004: fig. 24). Up to now, LSI was essentially applied to compare breadth measurements. In a recent study a modified application of the LSI method was proposed (Pöllath and Peters, in press), whereby the length and the breadth measurements of completely preserved bones have been calculated using the formula given above (for standard animal measurements see Manhart 1998: Tab. 103). The result are pairs of variables which can be displayed in a scatter plot as with the examples given above.

In this respect, the data from Sudanese desert sites have been compared to data from the Sudanese and the Egyptian Nile valleys to find out whether different cattle populations can be linked from a morphometrical point of view. The only bones from which there are length and breadth measurements available and which are therefore suitable for this kind of analysis are astragali and the first and second phalanges. LSI values have been calculated for materials from the Sudanese Nile Valley, which are dated between the 5th millennium and the 4th millennium BC (Kadada: Gautier 1986; Kadero: Gautier, pers. comm.; Esh Shaheinab: Tigani El-Mahi 1982, Peters 1986). The Egyptian data set comprises data from three sites: Abydos, Elephantine and Karnak. The Abydos bone sample comes from the tomb of Qa'a, dated c. 2780 BC (von den Driesch & Peters 1996). The bones from Elephantine date to the second half of the 3rd millennium BC (Boessneck & von den Driesch 1982), and those from Karnak North to the late 2nd millennium BC (von den Driesch & Boessneck, unpubl.). The Wadi Howar and Wadi Hariq materials date to the 3rd and 2nd millennium BC (Wadi Hariq: Jesse et al. 2004; Wadi Howar: measurements unpublished, in general Keding 1997, Van Neer & Uerpmann 1989).

In Fig. 4 the data sets from the different sites are combined. The values from Wadi Howar and Wadi Hariq cattle (light grey signs) group at the lower left corner of the diagram. The cattle from the Sudanese Nile valley (white grey signs) can be found at the upper left side, finally, the black signs refer to the values of the Egyptian sites and concentrate at the upper right side. The ranges covered by cattle from Egyptian and Sudanese Nile valley sites assume the shape of ellipses with principal axes inclined to the right side. Obviously, there is

almost no overlapping between these two ellipses. In contrast to this, the finds of the Eastern Saharan sites form a much broader ellipse with a more or less horizontal axis. Moreover, one observes an overlapping of the Eastern Saharan ellipse with the lower values obtained from the Sudanese Nile valley as well as the Egyptian Nile valley sites. From this the following working hypotheses can be deduced:

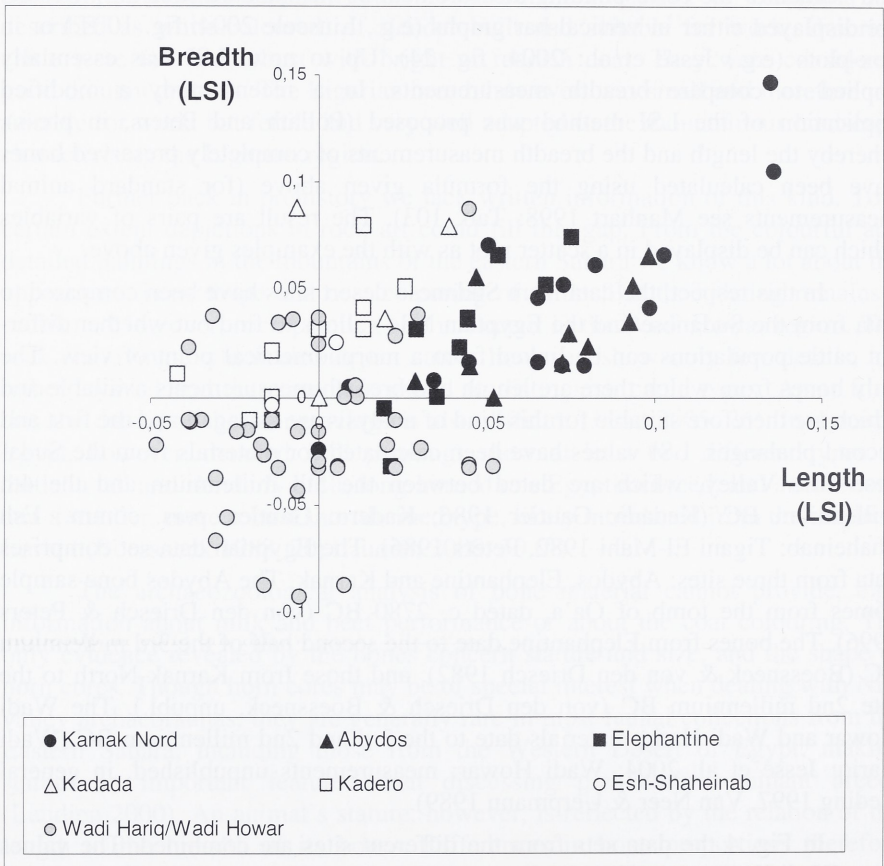


Fig. 4. Cattle in the Wadi Howar Region (light grey), the Sudanese Nile valley (white), and the Egyptian Nile valley (black). Scatter diagram of the LSI values of length and breadth measurements taken from complete bones.

- 1) The Sudanese and the Egyptian cattle have a different stature and therefore represent separate breeds and
- 2) The cattle population from the Eastern Sahara relates osteomorphologically to both the Sudanese and the Egyptian breeds.

To validate these hypotheses a divariate analysis has been carried out, in which bone allometry are compared. Allometry describes the relationship between dimensions of organisms and changes in the relative proportions of these dimensions with changes of absolute size. The skeleton of a vertebrate has to support the body. Its ability for this is proportional to the area of the bone's cross-section. While the volume and therefore the weight of a body increases as the cube of the size, the surface or the cross section of a bone increases only as the square of its size. If an animal doubles its size, the limbs have to bear eight times the weight. Thus bones of larger animals are not only relatively but also absolutely broader. Therefore the growth of bones scales allometric. This allometric relationship can be expressed by the formula $y = b \cdot x^a$. Logarithmised, we get the formula for the line of regression $\log(y) = \log(b) + a \cdot \log(x)$, where $\log(b)$ is a constant giving the intersection point of the line of regression with the y axis at $\log(x) = 0$ (Reichstein 1991: 20). The allometric exponent a defines the slope of the line of regression and is calculated using the formula for the principal axis of the scatter ellipse, which circumscribes the dispersion of the data points.

The divariate analysis compares two sets of pairs of variables. To conduct this analysis a skeletal element with a statistically sufficient amount of measurements has to be chosen. Since the Saharan sites do not provide enough data that fulfil this condition, we decided to compare with data sets from Nile valley sites in Sudan and Egypt to be able to confirm or reject the first hypothesis (lit. see above). The astragalus is a relatively abundant bone within the sites in question and was therefore chosen. The divariate analysis is carried out using DIVA, a software developed for metrical analyses of this kind. The program calculates the regression line that fits each data set. If there is no significant difference between the two sets of data, then they will have a common regression line. If the difference is significant, each set will produce its own regression line. If the latter applies, we are dealing with morphologically different populations. The validity of the data sets and the statistical significance of the results are checked by t- and F-tests (Cann 2003).

Fig. 5 shows the result of the divariate analysis of cattle astragali. The differences between cattle from the Sudanese Nile valley and from the Egyptian Nile valley are statistically significant (t-, F1/F2-Test). This corroborates the interpretation given earlier, that we are dealing with two morphologically different breeds. One could, of course, argue that this difference relates to the fact that

the samples analysed pertain to populations separated by millennia, since the specimens analysed from the Sudanese Nile valley date to the 5th to 4th millennia and those from the Egyptian Nile valley to the 3rd to 2nd millennia. To underline the validity of the foregoing assumption we compared a 5th millennium BC cattle population from Merimde, Lower Egypt, (von den Driesch & Boessneck 1985) with the one inhabiting the Sudanese Nile valley (Fig. 6). Again we observe a significant difference between the two data sets, indicating that even at that time there must have existed different breeds in Lower Egypt and

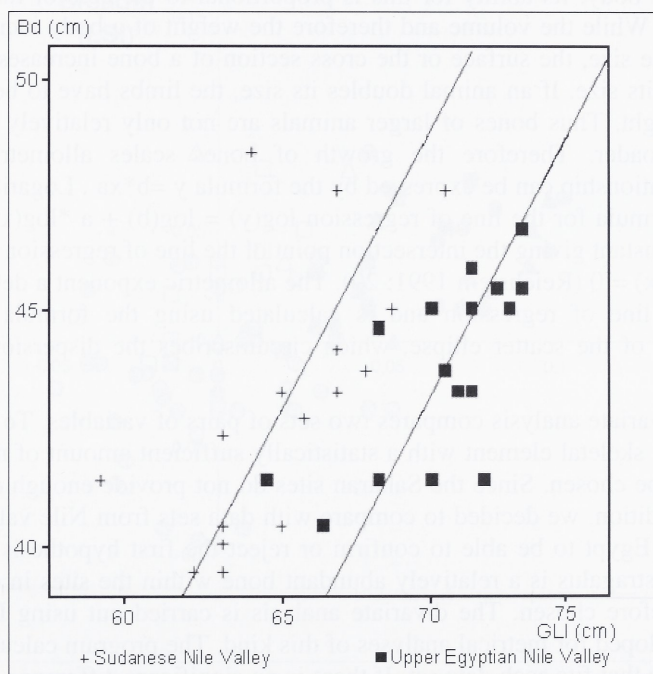


Fig. 5. Cattle. Astragali. Correlation of GLI (greatest length lateral) and Bd (breadth distal).

the Sudanese Nile valley. But the graphs shown here can only serve as a first approach, which has to be substantiated by an enhanced database. In the future it will be necessary to test the hypothesis with data sets of shorter time segments for each region.

With respect to the second hypothesis, the lack of sufficient data does not allow for testing. From figure 4, however, it can be seen that the Eastern Saharan

cattle on the whole were very slender compared to the two Nile valley breeds. The unusual distribution in a broad horizontal ellipse strongly suggests that we are not dealing with a homogeneous type of cattle. Since the Eastern Saharan cattle bone measurements show a considerable overlap with the measurements from Egyptian and Sudanese Nilotic cattle in their respective lower values size ranges indicates that they were linked genetically to both at a certain point. Both, the more robust type and the more slender type of the Eastern Sahara cattle population may have had bone proportions similar to their relatives inhabiting the Sudanese or Egyptian Nile valley, but the animals did not reach the same shoulder

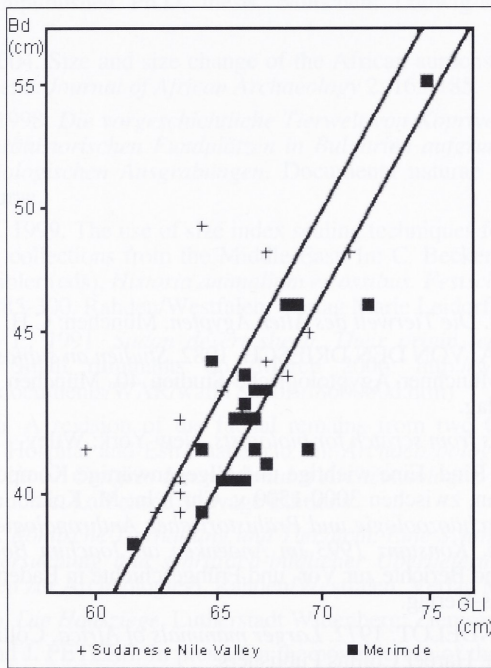


Fig. 6. Cattel. Astragali. Correlation of GLI (greatest length lateral) and Bd (breadth distal).

height, likely due to the poor pasture conditions. Thus from an osteological point of view, the cattle raised by the pastoralists of the Eastern Sahara do not represent a single type or breed, but a heterogeneous population with different geographic origin.

No doubt, the interpretation of the measurement data presented here depends on the representativeness of the respective data sets. For the moment the

results can only be considered preliminary and will have to be verified if additional data from new sites become available. This kind of analyses is also hampered by the fact that we do not have enough contemporaneous sites in each region. Therefore the results of this study can only serve as a basis for further research. In addition stable isotope analyses will be carried out to characterise chronologically and/or geographically separated cattle populations in order to trace back transhumant cycles, and to be able to discuss in more detail the subsistence strategies and decision making of prehistoric human groups inhabiting Northeastern Africa.

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