Norbert Benecke – Cornelia Becker – Hans Christian Küchelmann

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FINDING THE WOOLLY SHEEP

Meta-analyses of archaeozoological data from Southwest-Asia and Southeast-Europe

Working report 2014 to 2016

Department of Natural Sciences at the German Archaeological Institute
by Norbert Benecke, Cornelia Becker (Free University Berlin) and Hans Christian Küchelmann (University of Groningen)

e-FORSCHUNGSBERICHTE DES DAI **2017** · Faszikel 1

Archaeozoological data from 401 sites in Southwest-Asia and Southeast-Europe dating to the time span 7000–1500 BC were recorded and analysed for the question when and where the economic shift from a milk- and meat-oriented sheep husbandry to one with a focus on wool production occurred. This research report offers some preliminary results of meta-analyses of the corresponding database. Among the parameters studied, fluctuations in the demographic composition of herds as well as osteometric data indicating changes in animal size and body shape have yielded some indirect evidence for incipient and/or increasing importance of wool exploitation in sheep. In Southwest-Asia, this development started around 4000 BC while in Southeast-Europe it began thousand years later.

Co-operation: Free University Berlin, University of Groningen.
Head of project: N. Benecke, C. Becker.
Team: N. Benecke, C. Becker, H. C. Küchelmann, St. Suhrbier.

Today, hundreds of different breeds of sheep are known which are kept for mutton, milk or wool and sheep husbandry still occupies an important place in the culture of many peoples around the globe (fig. 1). The wild sheep

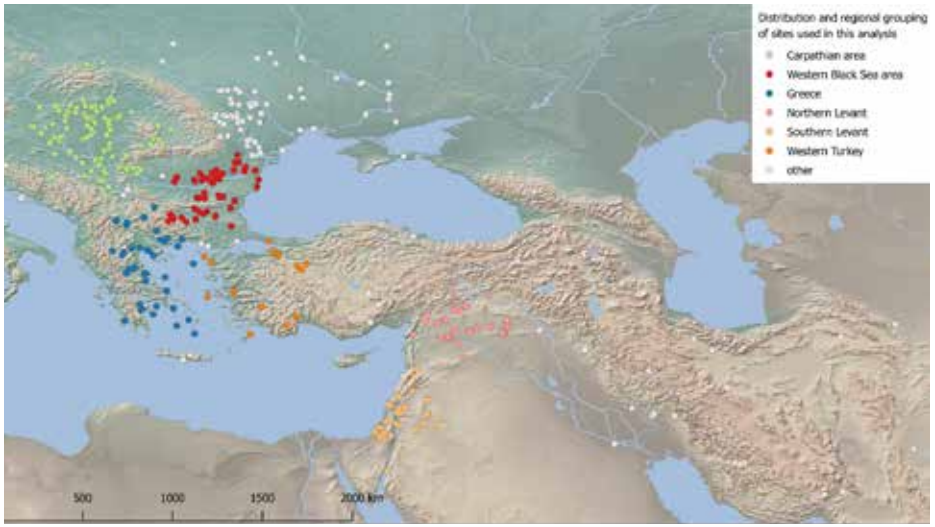
1 Large herd of sheep and goats in the Wadi Araba (Jordan) (photo: N. Benecke).

(*Ovis orientalis*) was one of the earliest ungulate species to be domesticated for agricultural purposes. Its domestication took place in the Fertile Crescent, most probably in multiple areas, during the 9th millennium BC. The coat of the early domestic sheep resembled that of its wild ancestor, representing a hairy coat. The agents and events that subsequently led to the development of the woolly sheep are still only rudimentarily understood. Probably, a series of genetic mutations have occurred resulting in different coat qualities and finally in real wool. Once the usefulness of wool was recognised, stock-breeders might have fostered and accelerated the development by selective breeding. The substitution of the woolly sheep for the archaic hairy form may be considered one of the major innovations in prehistory, providing people with the raw material for a greater variety of textile products.

Given the fact that wool, like any other animal fibres, from the Neolithic, Chalcolithic or Bronze Age are preserved only in rare occasions under special archaeological conditions and even the genetics of the coat qualities are not yet known, research on the origin of the woolly sheep needs to rely primarily on indirect evidence. Only in this way is it actually possible to narrow down the beginning of wool production geographically and chronologically. The TOPOI-research group "Textile Revolution" ↗ has chosen a multi-proxy approach that draws on archaeological artefacts linked to textile production, written sources, archaeozoological data and geoarchaeological evidence to tackle the question of early wool exploitation (cf. Becker et al. 2016). In this report, selected archaeozoological data from Southwest-Asia and Southeast-Europe is presented pursuing two basis questions: (1) when and where did the economic shift from a milk- and meat-oriented sheep husbandry to one with a pronounced focus on wool production occur and (2) when and how did these changes arrive in Southeast-Europe.

The archaeozoological database

In recent years, the number of sites with faunal remains relevant to the emergence of sheep with woolly fleece or wool production has grown immensely. The amount of osteological collections actually available in Southwest-Asia and Southeast-Europe counts to several hundreds, however,

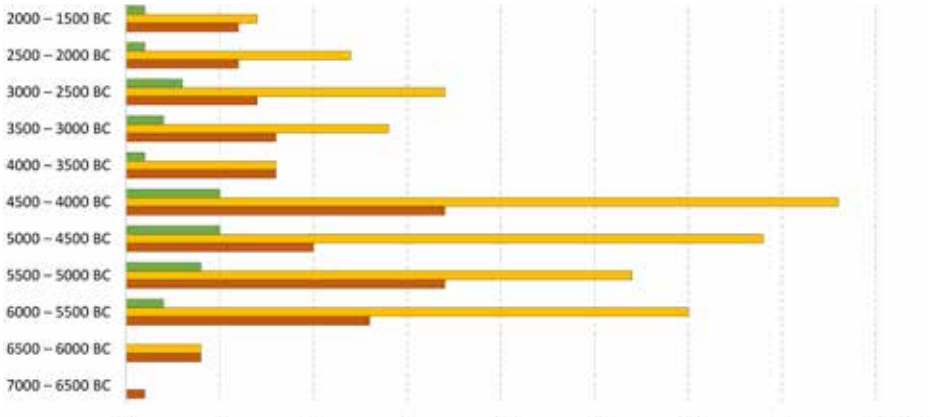


2 Distribution and regional grouping of sites considered in this project (graphic: St. Suhrbier, Free University Berlin).

they are of different validity. For the present study, only data from those settlements that provide a faunal assemblage with more than 500 identified mammal remains were considered. The underlying database was developed by H.-C. Küchelmann who also documented the data over the last four years. During data acquisition no selection was made with regard to representativeness of the faunal samples (small versus large scale excavation, hand collected versus sieved materials) and quality of publication (single table versus monograph, reliability of the species identification). The collecting and recording of data was focused on those sites which date to the time span between 7000 and 1500 BC, putting most emphasis on the 5th to the 3rd millennia BC when woolly sheep most probably made its appearance. To allow diachronic studies, each site or phase of a site (sub-unit) was assigned, whenever possible, to a time slice of 500 years.

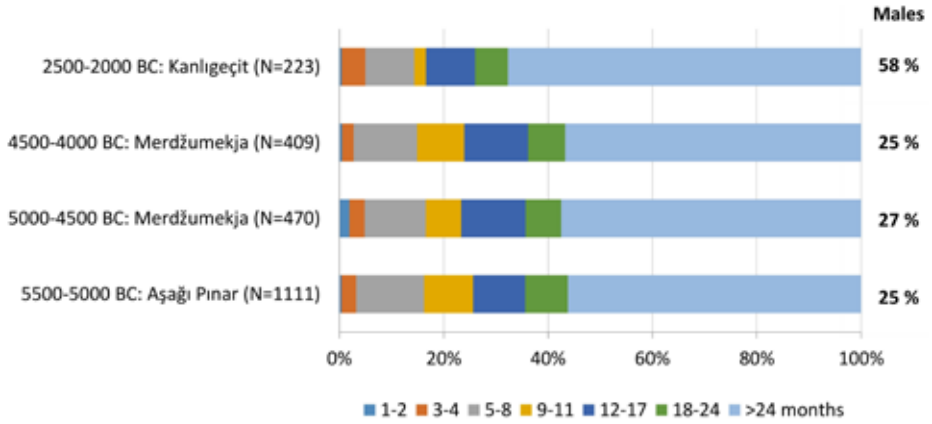
A defined set of data was recorded which consists of three interrelated levels. Level 1 (“site core data”) includes the general identification data of each site, comprising site name, location (latitude and longitude), site category, country, year(s) of excavation, chronological information and references. Level 2 (“site bone data”) consists of data related to the specific faunal assemblage. These are frequencies (NISP – number of identified specimens) of the major livestock species, frequency of game, age data for sheep/goat (on mandibles and epiphyses of postcranial elements), sex data for sheep (on horn cores and pelvic bones) and pathologies. Level 3 (“Ovis bone metrics”) consists of selected measurements of single sheep bones.

Over the past four years, a total of 401 sites or 568 sub-units were registered in the database. These sites produced more than two million identified mammal bones, among them ca. 67,000 identified sheep remains. The osteometrical data record consists of 1,152 values (greatest length of complete long bones) for withers height calculations and 13,769 values for the calculation of Logarithmic Size Indices (LSI). It is planned to publish an online version of the complete database in the near future. Subsequently, first results of the analysis of archaeozoological data available in the database will be presented and discussed.



	7000 – 6500 BC	6500 – 6000 BC	6000 – 5500 BC	5500 – 5000 BC	5000 – 4500 BC	4500 – 4000 BC	4000 – 3500 BC	3500 – 3000 BC	3000 – 2500 BC	2500 – 2000 BC	2000 – 1500 BC
> 10,000			2	4	5	5	1	2	3	1	1
1,000 – 10,000		4	30	27	34	38	8	14	17	12	7
< 1,000	1	4	13	17	10	17	8	8	7	6	6

3 Chronological distribution of sites and sub-units which could be assigned to time slices of 500 years (graphic: St. Suhrbier, Free University Berlin).



4 Age structure of sheep/goat (on mandibles) and percentage of males in sheep (on pelvic bones) for selected sites in Thrace (analysed by N. Benecke) (graphic: N. Benecke).

Results

The 401 sites considered here, are distributed over a huge area stretching from the Carpathian Basin in the west to the Iranian highlands in the east (Fig. 2). The geographical distribution of the sites is quite uneven mainly reflecting the state of archaeological research in the two regions. Concerning sample size there are 49 sites with more than 10,000, 272 sites with 10,000 to 1,000 and 80 sites with less than 1,000 identified mammal remains. For comparative purposes the sites were grouped into six sub-regions: Carpathian area, western Black Sea area, Greece, western Turkey, northern Levant and southern Levant.

The chronological resolution of the available data is illustrated in Figure 3. Numerous faunal assemblages have been analysed and presented only as bulk samples without further precise dating according to contexts or intra-sites phases. However, there are still 312 sites or sub-units left which could be assigned to time slices of 500 years. Over the time periods (from 7000 to 1500 BC) they show an uneven distribution. A large amount of data is available for the 6th and 5th millennium BC, whereas for the 4th and 3rd millennia BC the number decreases dramatically. This is an unfavourable situation, because in particular these two millennia were most important for the questions raised here. Taking also into account the uneven distribution of sites, it turns out that there is any region neither in Southeast-Europe nor Southwest-Asia for which we might pursue very detailed questions over a long time sequence on a broad basis of bone material.

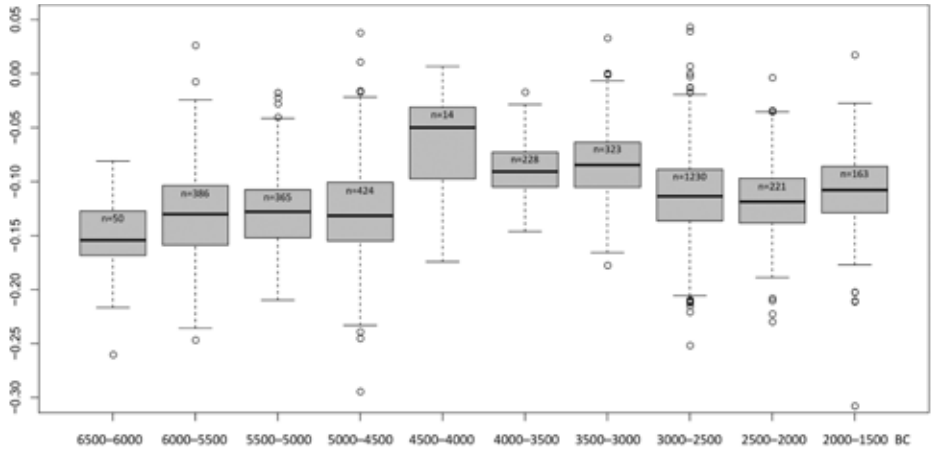
In Southwest-Asia and Southeast-Europe, sheep along with goat, cattle and pig formed the basis of stockbreeding between 7000 and 1500 BC. Comparing both regions, the extent of sheep husbandry exhibits a great regional variability mainly reflecting different environmental conditions. At sites in Southwest-Asia, sheep and goats were generally of great economic importance in all periods considered here. In Southeast-Europe, the keeping of sheep and goats gradually declined after an initial phase when animal husbandry became established in the course of neolithization. This can be

5 Early Bonze Age site Kırklareli-Kanlıgeçit (Thrace, Excavation 2008) where archaeozoological data point to a focus on wool production in sheep husbandry (photo: M. Hochmuth).

interpreted as an adaption of the stock breeding of Near Eastern origin to new regions with different vegetation and climate. Overall, data concerning species composition do not indicate an expansion of sheep farming at the expense of the other species which could be linked to the beginning of wool production. Obviously, the emergence of wool as a newly exploitable secondary product was not accompanied by greater changes in the composition of livestock.

The way sheep and other domestic animals were primarily exploited in the past is reflected in the age structure and sex ratio of the corresponding bone collections. Models have been outlined for the types of kill-patterns one might expect from meat-, milk-, and wool/hair-producing flocks of sheep and goats. When these species are kept primarily for meat, most of the animals will be killed by approximately 2–3 years of age. It is at this age that the sheep and goats approach bodily maturity, and continuing to feed them beyond this will not substantially increase meat output. A relatively small number of adults will be kept for breeding purposes. Shepherds emphasizing milk production will eliminate excess lambs and kids, especially males, early in the first year of life. Wool-production strategies in sheep lead to very different age distributions, since adult animals, and especially castrates, are primary wool-producers. One might therefore expect to find a high proportion of adult male animals in the kill-off from a wool-producing flock.

The sites in Southwest-Asia exhibit a great variability in the age structure of sheep/goat. In most of the assemblages animals being older than two years of age when slaughtered form the largest group. A diachronic view does not show clear trends in the development of the age structure. Concerning sex ratio, female sheep clearly prevail among the subadult and adult animals in the collections of the oldest periods (6000–5500 and 5500–5000 BC). This pattern points towards a mode of exploitation where meat and milk were the main products. From 4000 BC the proportion of male sheep increases significantly. In general, rams and castrates now represent more than one third of the animals. Very high percentages of male sheep (>50 %) have been observed at Tall Hujayrat al-Ghuzlan (Jordan) and Troy (Turkey). Because



6 Development of size and shape in sheep in Southwest-Asia presented as Box-plots of LSI-values. Box = distance 25th–75th quartile with mean, whiskers = distance 10th–90th percentile, small circles = outliers (graphic: St. Suhrbier, Free University Berlin).

male sheep, and in particular castrates, produce more wool and a wool of better quality than females, this change in sex ratio could be an indication of an economic shift from a milk- and meat-oriented sheep husbandry to one with a pronounced focus on wool production.

Similar to Southwest-Asia, the sites in Southeast-Europe show a great variability in the age profile of sheep/goat. Most of the assemblages are characterized by high proportion of animals being older than 24 months of age. Again, no trend in the development of the age structure is visible pointing to the fact that sheep and goats were always kept for a broad spectrum of products with varying importance from site to site. Even within the same culture a high variability of exploitation strategies can be detected. Females are dominating among the subadult and adult sheep in most of the assemblages of the older periods. In contrast to Southwest-Asia, higher percentages of males occur only from the second half of the 3rd millennium BC. This is the period (Early Bronze Age) during which the keeping of woolly sheep and the exploitation of wool is generally expected in Southeast-Europe (figs. 4, 5).

The last aspect to be discussed here is the development of size and body shape in sheep using the logarithm size index (LSI) method. According to this method, for selected dimensions (bone measurements) the differences between the logarithmic value of a prehistoric bone and the corresponding logarithmic value of a standard individual are calculated. The resulting LSI-values can then be treated statistically, e.g. for the calculation of parameters like mean, median and standard deviation for specific groups of bones (subunits, time periods).

In Southwest-Asia, the sheep of the early periods (6500–4500 BC) are quite uniform in size and body shape, i.e. the mean values and ranges (minimum, maximum) are similar (Fig. 6). In the following periods (4500–3000 BC), a rising mean value and a shrinking of the variability, in particular for the minima, can be seen. This indicates the presence of larger or more robust built sheep at that time. From 3000 BC onwards, again a larger variability

and a slight decrease of the mean values become apparent. In Southeast-Europe, the development of size and shape in sheep shows a somewhat different picture. For a long period of time, i.e. from 6500 to 3500 BC, the osteometric data show a slight but steady decline in the mean values, while the variability remains almost unchanged. After 3500 BC, and especially in the period 3000–2500 BC, a clear increase in the mean values can be seen and at the same time higher lower and upper ranges (minimum, maximum) in the LSI-distribution. Similar to Southwest-Asia, the presence of larger or more robust built sheep can be assumed at that time. In the subsequent periods (2500–2000 BC), size and shape in sheep remain more or less the same followed by a period (2000–1500 BC) where we see again a larger variability and a marked decline of the mean value.

Both in Southwest-Asia and Southeast-Europe, small-sized sheep were typical for the Neolithic period. From 4500 BC onwards, sheep of larger size and more robust body shape occur at first at sites in Southwest-Asia. Whether they represent a complete new breed of sheep introduced from an unknown region or sheep that resulted from selective breeding of local sheep remains an open question. Possibly, this new type of sheep is characterized by a woolly fleece. In Southeast-Europe, especially on the Balkan Peninsula, a similar development is visible, but with a considerable delay of time. Here, sheep of larger size and more robust body shape occur from 3000 BC onwards. It has still to be demonstrated, probably via genetic studies, whether these larger sheep represent imported animals from the Near East or the outcome of local breeding.

Assuming that the striking changes in the sex ratio of sheep towards the occurrence of significantly more male animals in the younger periods and the corresponding changes in phenotype are markers of a sheep husbandry where wool was exploited, the archaeozoological evidence in fact could point to the beginning of wool production in Southwest-Asia in the centuries around 4000 BC. From here this new form of sheep management probably found its way to Southeast-Europe at the turn from the 4th to the 3rd millennium BC.

Outlook

In April this year, Demars et al. (2017) published a report in which they describe the hitherto unknown genetic mutations causing the transition from a hairy to a woolly fleece in modern sheep. This breakthrough in the understanding of the genetics of fleece variation in sheep opens a new window for research on prehistoric sheep bones (ancient DNA studies) concerning the question when and where woolly sheep made its first appearance in the Old World.

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