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Topoi Research Project A-4-2

Archaeozoological analysis of domestic sheep in the area between South-West Asia and South-East Europe (7th-2nd millennium BC)

The use of wool-bearing sheep provided the basis for new and rapidly growing textile production, which without exaggeration can be seen as a technological revolution. Therefore, the multidisciplinary Topoi research group A-4 "The Textile Revolution" investigated pictorial, written, artefactual, archaeozoological and geo-archaeological evidence attributing the innovation to the spread of sheep husbandry and wool processing between the 5th and 3rd millennium BC in the Near East and, somewhat later, in Europe as well. The objectives were:

- To form a more precise notion of the innovation of wool production and processing by determining when and where it first emerged, and how it later spread.
- To comparatively analyse economic and social consequences (handcraft specializations, a broader range of textile techniques, materials and garments – and hence new possibilities for clothing-based differentiation and depicting identity and status through textiles) in regions where early high cultures in the Near East and the prehistoric cultures of Europe developed.
- To form a more precise view of the introduction of fleece-bearing sheep through indirect, archaeozoological methods (metrics, herd demographics).
- To quantitatively determine (model) anthropogenic environmental changes to selected regions and micro-regions as accurately as possible, which, at the very least, most likely involved the question of the grazing pressure of sheep.

Within the research group A-4 the research project A-4-2 was devoted to the process of the major economic shift in sheep husbandry that involved the change of the exploitation focus of sheep from meat and milk towards fibre production and the transformation of sheep with a hairy coat to those with a woolly fleece. Central to the research was the development of a database into which the results of a comprehensive literature research in archaeozoological publications and unpublished raw data of sites in Southeast Europe and Southwest Asia spanning a time frame from 7000 BC to 1500 BC have been recorded (fig. 1). The content of the database is published here. The data have been collected from 548 publications published between 1952 and 2015. Data collection was conducted between March 2013 and July 2019.

Database • general description, metadata and field descriptions

In order to become recorded the sites had to confirm to a set of pre-defined criteria. Only data from settlement sites were recorded, necropoles and sites with religious or cultic contexts were not taken into account. The time frame was defined at 7000-1500 BC. To avoid statistical biases, sites with a NISP below a defined threshold were not recorded. For SE-Europe this threshold was set at a minimum of 500 mammal remains identified at least to taxonomic family level, for SW-Asia the threshold was elevated to a minimum of 1.000 identified mammal remains.

The present state of the database (29.7.2019) combines data of 401 sites from 18 countries, 296 of which are located in SE-Europe and 105 in SW-Asia (see tab. 1 and fig. 2). If given in the publications, chronological, stratigraphical or archaeological sub-divisions within a site were recorded separately, allowing intra-site comparisons. Combined, sites with and without sub-units add up to 565 separate archaeozoological datasets (Site Bone Data). To allow for diachronic studies, each site or sub-unit was assigned to one or multiple time slices of 500 years.

The amount of sites monitored for the research is thus much higher than the number of recorded sites. For instance, in SW-Asia 396 Neolithic and Bronze Age sites were monitored, 132 of which did not fit the criteria for site category or time range, further 158 yielded less than 1.000 identified mammal bones (fig. 3).

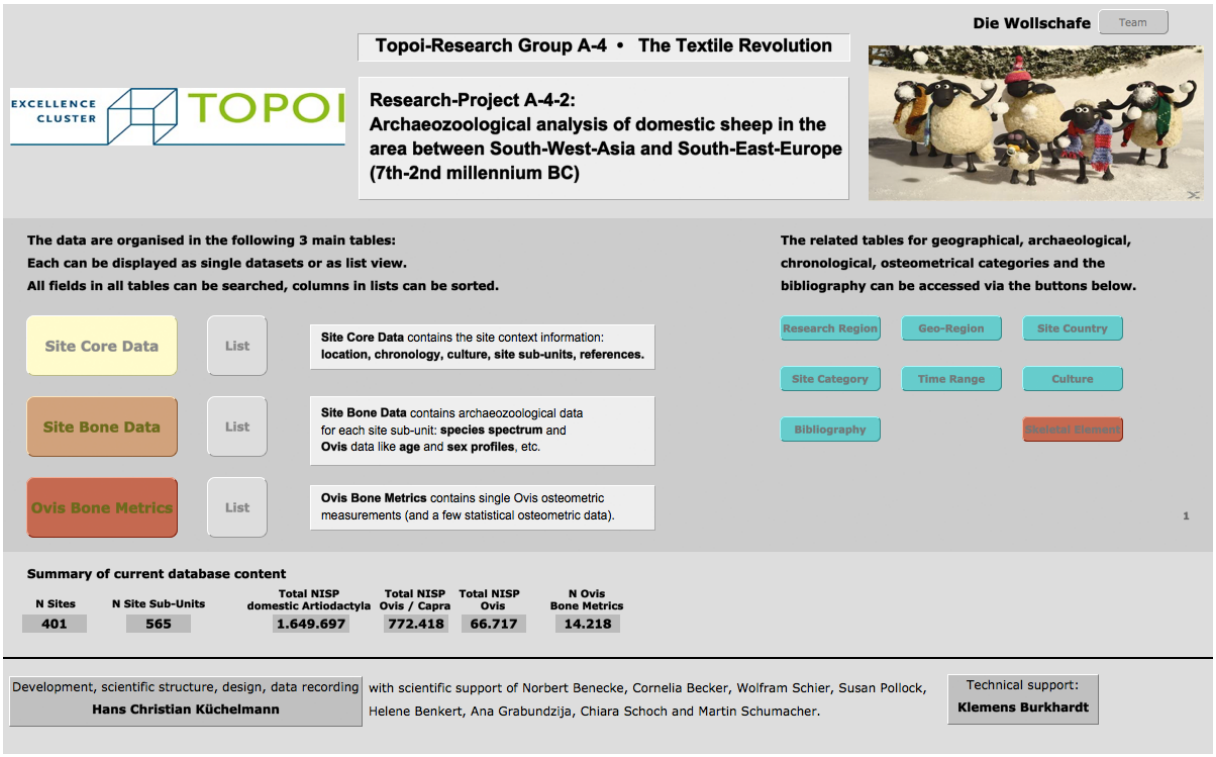

Fig. 1: Start page of database.

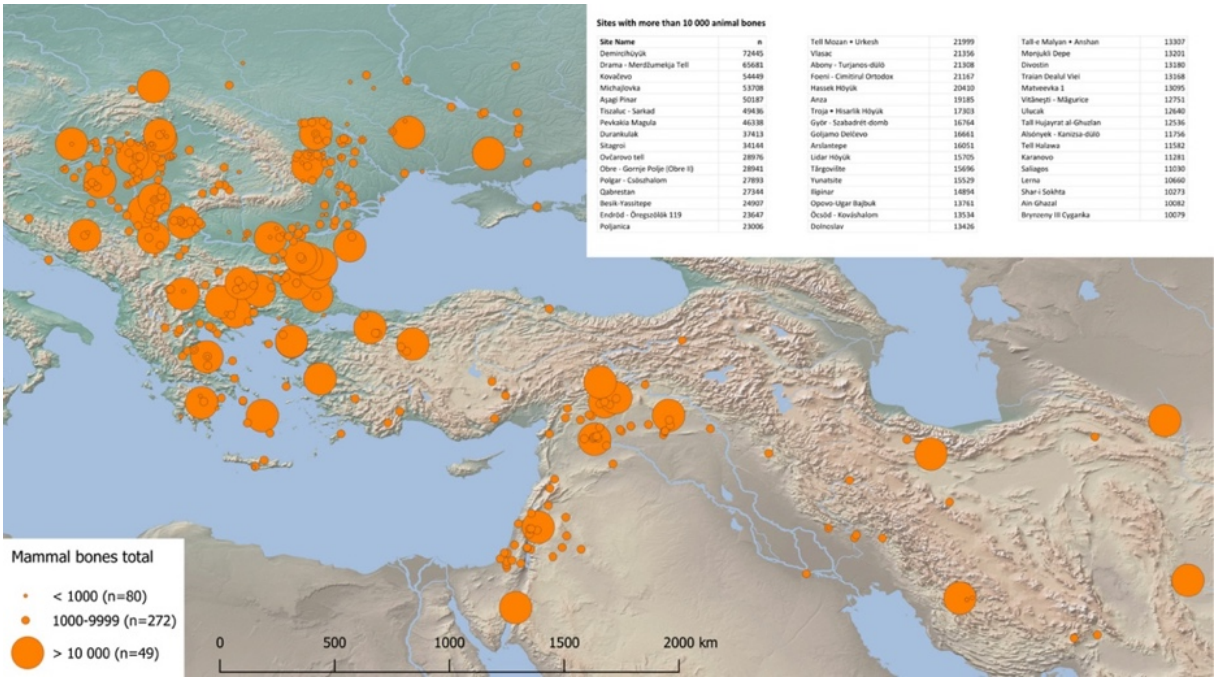

Fig. 2: Map of recorded sites and assemblage sizes (map: Stefan Suhrbier 2017).

Despite the high amount of data, there are some biases, which need to be addressed before using the data for future analysis. First of all, the geographical distribution of the sites is uneven. This is partially due to landscape conditions (e.g. mountains, deserts) and is thus a result (see tab. 2, fig. 2, 5), but it also illustrates a research artefact. While in some countries a vivid scientific community is engaged in archaeozoological research since the 1950s (e.g. in Hungary, Romania, Greece, Israel, Syria and Turkey), for some other countries I did not find any published archaeozoological research fitting the recording criteria, like Albania, Montenegro and Slovenia (tab. 1, fig. 2, 3, 5). The chronological distribution of the data is also uneven. A large amount of data is available for the 6th and 5th millennium BC, whereas for the 4th and 3rd millennium the amount of available sites is much lower (see Becker et al. 2014, 136, 154-155, fig. 4-5), which reflects the archaeological status quo.

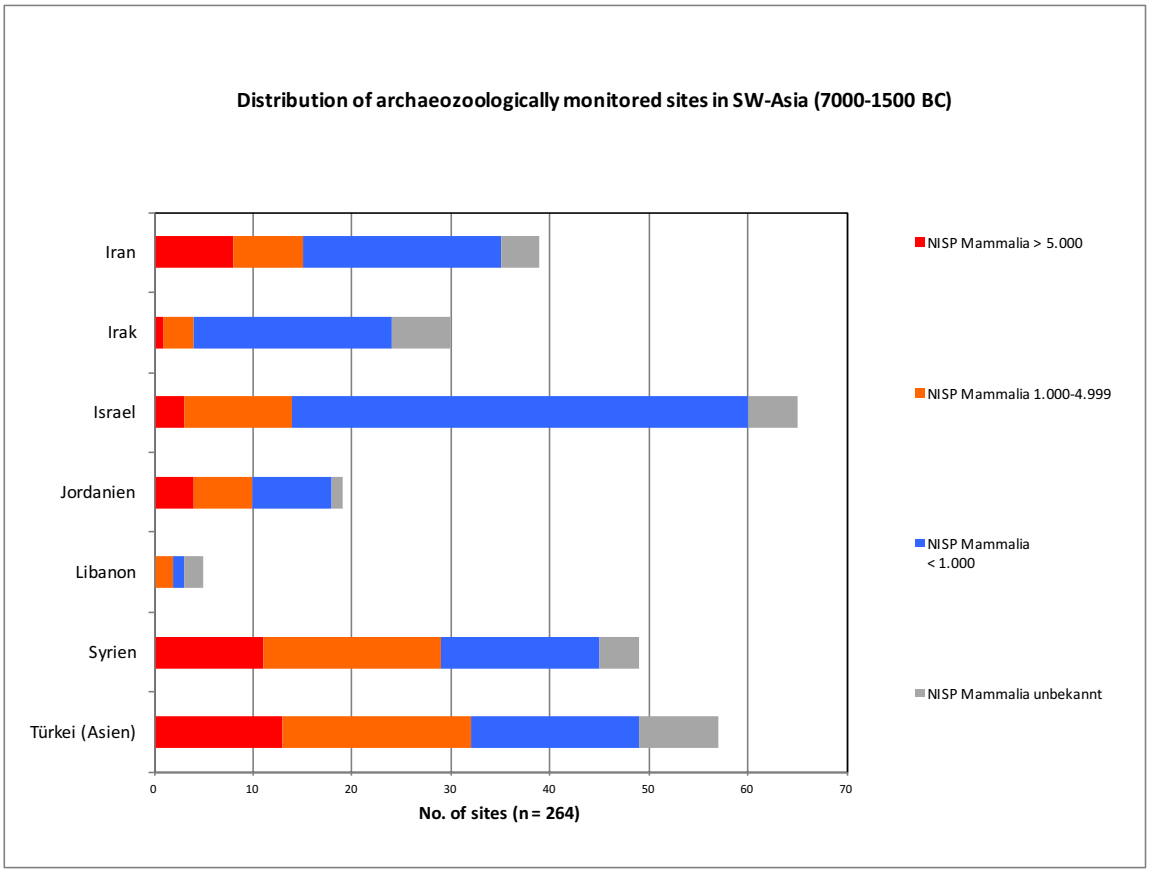

Fig. 3: Distribution of sites in SW-Asia monitored for the research per country. Only sites with a number of identified mammalian specimens (NISP) higher than 1000 were recorded (graphic: Hans Christian Küchelmann 2017).

Tab. 1: Site distribution per country.

Country	Code	No. of sites
Bosnien-Herzegowina	BA	4
Bulgarien	BG	30
Griechenland	GR	42
Mazedonien	MK	4
Moldowa	MD	19
Serbien	RS	24
Kroatien	HR	3
Rumänien	RO	70
Türkei Europa	TR-E	5
Ukraine	UA	29
Ungarn	HU	66
Irak	IQ	3
Iran	IR	19
Syrien	SY	27
Jordanien	JO	9
Israel	IL	15
Libanon	LB	1
Türkei Asien	TR	31
Sum		**401**

The original relational database was programmed in FileMaker Pro (Version 11) consisting of eleven relational tables (fig. 1). The site data have been collected in three hierarchical main tables (level 1-3, fig. 4). Due to technical and financial issues the original plan to publish the whole relational database online has been cancelled. The data are presented here in form of separate Excel-files. The original FileMaker Pro database is available on request from the author at info@knochenarbeit.de (the database will be a run-time version, working on most standard computer operating systems without requirement to install the program).

Level 1: Site Core Data
Archaeological context data like site name, location, geo-region, dating, excavation years, archaeological periods and cultures, site sub-divisions (if applicable) and the number of identified mammal bone specimens (NISP) of the whole archaeozoological assemblage (fig. 4a).

Level 2: Site Bone Data
The archaeozoological data of the site or site sub-unit including the species spectrum and frequencies of domestic ungulates and game animals as well as age spectra of sheep/goat bones and sex data, pathologies and horn shapes of sheep bones. This table also contains a statistical summary of the osteometric data per site or sub-unit (fig. 4b).

Level 3: Ovis Bone Metrics
Measurement data of single sheep bones (fig. 4c).

The number of identified (bone) specimens (NISP) was chosen as basic figure for comparison of the archaeozoological data, because it is the quantification method most widely applied throughout the published assemblages. To avoid statistical biases, sites with a NISP below a defined threshold were not recorded. For SE-Europe this threshold was set at a minimum of 500 mammal remains identified at least to taxonomic family level, for SW-Asia the threshold was elevated to 1.000 identified mammal remains.
The database at present includes archaeozoological data of 2.114.791 identified mammal bones. Of those, 1.649.697 bones belong to the economically important domestic ungulates (cattle, *Bos taurus*; pig, *Sus domesticus*; sheep *Ovis aries* and goat, *Capra hircus*). Within these the number of sheep and goat bones add up to 772.418, including 66.717 bones identified as *Ovis aries* and 32.942 identified as *Capra hircus* in the publications. The amount of game animal bones is 271.037. The database contains the published data extracted from the publications plus calculations relevant to assess the significance of sheep within the assemblage like sums, species, age and sex percentages, ratios, withers height and logarithmic size indices (LSI).

Age data of sheep/goat bones are separated in data for dentition development and wear (n = 14.206), epiphyseal fusion data (n = 40.635) and general age classes (n = 27.510) depending on the data available in the publications. Sex data were available for 3.506 *Ovis aries* bones.

The osteometrical part of the collection includes 14.218 osteometric datasets of individual *Ovis aries* bones, of which 1.152 contain data for calculated withers height and 13.771 contain data for calculated LSI-values. In 257 cases only statistical data of specific osteometric measurements (minimum, maximum, mean and standard deviation) are given in the publications and could only be recorded as such. The latter data are not included in the statistical summaries of the osteometric data per site or sub-unit.

Level 1: Site Core Data

Research Region • Country • Country Code
Geographical location of the site. To facilitate statistical meta-analysis, the present day political country of the site has been recorded as well as the continent (research region SE-Europe or SW-Asia). Country codes are given according to the International Organization for Standardization (ISO 3166).

Site Name
Site name according to publication(s).

Latitude and Longitude
Digital geographical coordinates.

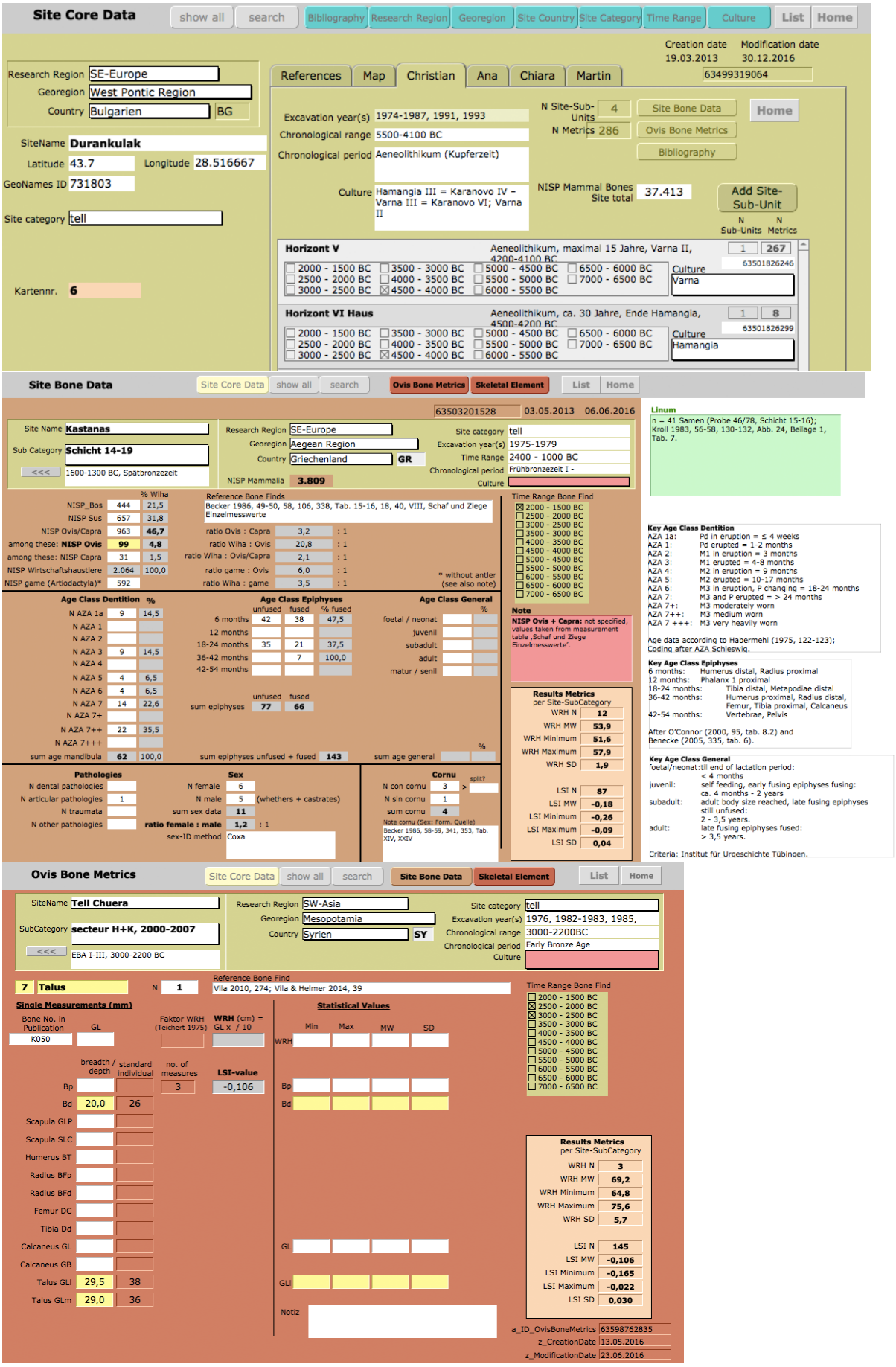

Fig. 4: Screenshots of recording masks of the hierarchical main tables in the database:
a) level 1: Site Core Data, b) level 2: Site Bone Data, c) level 3: Ovis Bone Metrics.

Geo-Region

Since prehistoric settlement patterns do not necessarily follow modern day political divisions, we thought it to be useful to assign the site locations also to natural landscape divisions in order to be able to compare these with each other (fig. 5, tab. 2). Geo-regions in SE-Europe have been defined by Ana Grabundžija with modifications by Wolfram Schier, Hans Christian Küchelmann and Martin Schumacher. Geo-regions in SW-Asia follow the geographical classification of natural landscapes (naturräumliche Gliederung) of Abdulsalam (1988, map A 7).

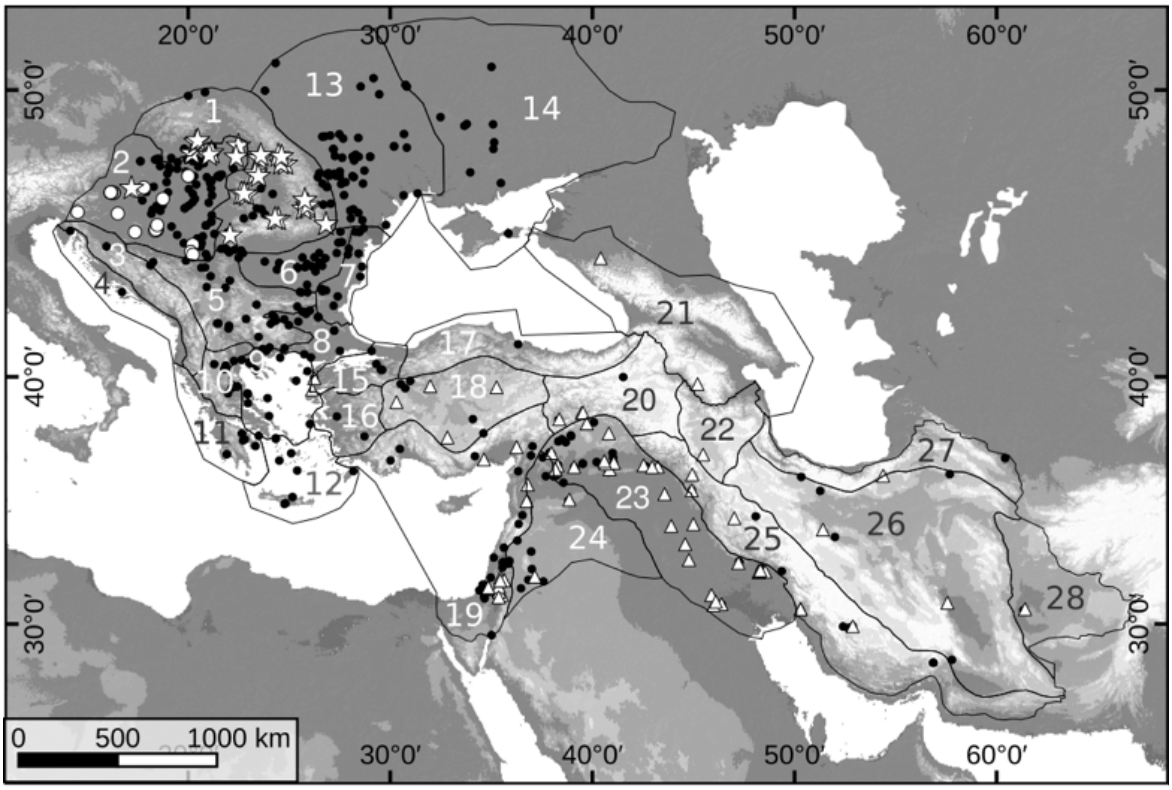

Fig. 5: Boundaries of defined geo-regions (map: Martin Schumacher 2019).

Tab. 2: Geo-Regions and site distribution per geo-region.

No. on map	SE-Europe	No. of sites	No. on map	SW-Asia	No. of sites
1	Carpathian Region	27	15	Marmara Region = Maramararaum (note: sites in Turkish Thrace have been assigned to the Thrace Region)	6
2	Pannonian Region	83	16	East Aegean Coast Region = Ägaisraum	2
3	Dinaric Alps Region	3	17	South Pontic Region = Pontusraum	1
4	East Adriatic Coastal Region	2	18	Central Anatolia = Inneranatolien	5
5	Central Balkan Mountain Region	21	19	Mediterranean Region = Mittelmeerraum	27
6	Lower Danube Region	28	20	East Anatolia = Ostanatolien	2
7	West Pontic Region	15	21	Caucasian mountains	/
8	Thrace Region	17	22	Azerbaijan	/
9	Aegean Region	17	23	Mesopotamia = Mesopotamien	34
10	Central Greece Region	9	24	Syrian Desert = Syrische Wüste	12
11	Ionian Coast Region	5	25	Zagros = Zagros-System	9
12	Crete Region	9	26	Central Iranian Highland = Zentraliranisches Hochland	5
13	Northwest Pontic Region	48	27	North Iranian Mountains = Nordiranisches Gebirgsland	1
14	North Pontic Region	12	28	Southwest Afghanistan = Südwestliches Afghanistan	1
	Sum	**296**			**105**

Site Category
Within the Topoi research group A-4 eight site categories have been defined (settlement, tell, cave, necropolis, sanctuary, survey, sedimentological archive, other). For the archaeozoological study only data from settlements (n = 267), tells (n = 127) and caves (n = 7) have been recorded.

Chronological Range • Culture Group • Period
These fields show the chronological range, archaeological period and culture of the site as given in the publication(s). As I am not familiar with all archaeological cultures, phases, etc. and their corresponding chronology and particularly since many chronological and cultural assignments changed after publication, most of these data were checked and if necessary changed by Wolfram Schier, which is noted in case in the respective field. However, in case of some sites recorded at the end of the project, the chronology has not been checked and there maybe inaccuracies. In case of doubt, there is a remark "Datierung prüfen" in the chronological range field.

Excavation Year
The year(s) of the excavation campaign(s) as given in the publication(s).

Site Sub-Units
Overview about chronological, stratigraphical or archaeological sub-divisions within the site as given in the publication(s). If there are no separately recorded sub-units, the value "total" is displayed.

No. of Site Sub-Units
The number of sub-divisions within the site for which separate data were available and recorded.

NISP Mammalia
The total number of identified mammal specimens of of the site. The threshold for the recording of a site in this database was a minimum value of 500 mammal bones identified to at least family level.

Ovis Osteometric Data
If osteometric data were available for a site, this field displays the amount of individual sheep bone osteometric datasets.

Level 2: Site Bone Data

Site Name • Research Region • Geo-Region • Country
Like in table Site Core Data.

Site Sub-Unit
Name of chronological, stratigraphical or archaeological sub-division within the site as given in the publication(s). If there are no sub-units, the value "total" is displayed.

Time Slice(s)
500 years time slice assigned to the site or sub-unit. These can be one or multiple slices according to the data given in the publication(s).

NISP Bos, Sus, OC, Ovis, Capra, WiHa, JaWi and **NISP Bos, Sus, OC, Ovis, Capra, WiHa %**
The number of identified specimen of *Bos taurus*, *Sus domesticus*, *Ovis/Capra*, *Ovis aries*, *Capra hircus*, domestic ungulates (WiHa = Wirtschaftshaustiere) and ungulate game (JaWi = Jagdwild).
In the %-columns give the percentages of the total NISP of domestic ungulates (field NISP WiHa) for each species is calculated. The column NISP WiHa % thus always displays 100 % and is left as control for correct calculation. All fields displaying calculated values instead of raw data are filled light grey in the tables.
The column NISP JaWi gives the summarized NISP of all large and medium ungulate game species (wild Artiodactyla) found within the site. These are commonly bones of aurochs (*Bos primigenius*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*). In a few cases less common ungulate species occur in assemblages and are included in this count. In particular, these are European bison (*Bison bonasus*), water buffalo (*Bubalus arnee*), wild goat (*Capra aegagrus*), Nubian ibex (*Capra nubiana*), chamois (*Rupicapra rupicapra*), elk (*Alces alces*), fallow deer (*Dama dama*), hartebeest (*Alcelaphus buselaphus*), gazelle (*Gazella* sp.), saiga (*Saiga tatarica*) and camels (*Camelus dromedarius*,

Camelus sp.). In these cases, the species and their NISP are noted in the field "note SBD".
As has been often discussed in archaeozoological reports, deer antler, being frequently used as raw material for artefact production, can appear in higher quantities in bone material and can thus cause a bias towards deer species within the game animals giving incorrect impressions of the ratio of domestic to wild ungulates. Therefore, antler has been regularly subtracted from the NISP of wild ungulates, if possible. However, in a lot of reports the number of antler pieces is not given. In such cases a remark "n antler not specified" is noted in the field "note SBD".

Ratios Ovis : Capra, WiHa : Ovis, WiHa : OC, JaWi : Ovis, WiHa : JaWi
Calculation of the ratios of the specified species fields.
E. g. ratio Ovis : Capra = NISP Ovis divided by NISP Capra = x : 1.

AgeMan 1 - 7+++, AgeMan 1 % - 7+++ %, AgeMan Sum, AgeMan Sum %
These fields give the number of mandibles with tooth eruption data or wear stages available for the site or sub-unit. The values are given for combined *Ovis* and *Capra* Mandibulae since in the majority of the publications sheep/goat age data were not separated for the two species. The age stages are given according to the system developed by the Archäologisch-Zoologische Arbeitsgruppe (AZA) Schleswig (Reichstein 1991, 21, 116, tab. 41) with stage codes from 1 - 7+++. The field "AgeMan Sum" calculates the total amount of available mandible age data per site or sub-unit. The %-fields calculate the percentage of the total number of mandible age data (field AgeMan Sum) for each stage.
Depending on the archaeozoological school, different ageing stage systems are used in the publications, but these are relatively easy convertible from one to each other. See tab. 3 for a concordance between the different systems, which has been applied throughout all sites.

AgeEpi 6m to 42-54m Unfused and Fused, AgeEpi 6m % to 42-54m Unfused and Fused %, AgeEpi sum Unfused and Fused, AgeEpi Sum Total
The AgeEpi fields show the number of *Ovis*/*Capra* bones providing epiphyseal fusion data according to the epiphyseal fusion groups defined by O'Connor (2000, 95, tab. 8.2) and Benecke (2005, 335, tab. 6) (tab. 4). The sum fields calculate the sums of unfused and fused epiphyses as well as the total amount of available epiphyseal fusion data per site or sub-unit. The %-fields calculate the percentage of fused epiphyses within the specific fusion age group according to the method of O'Connor (2000, 94-95, tab. 8.2). The formula applied for this field is

% fused epiphyses = n fused epiphyses x 100 / (n unfused epiphyses + n fused epiphyses).

AgeGen FoetalNeonat to MaturSenil • AgeGen FoetalNeonat to MaturSenil % • AgeGen Sum
In some publications only general age classes for *Ovis*/*Capra* bones are given. Although not directly comparable to dentition and epiphyseal fusion age data, these give an approximate impression of the age spectrum and were thus recorded in the specified fields. The definitions of the age classes follow an internal paper of the Institut für Urgeschichte Tübingen (Tab. 5). The %-fields calculate the percentage of the total number of general age data (field AgeGen Sum) for each stage.

Sex Female • Sex Male • Sex Sum • Ratio Female : Male • Sex ID-source
The number of securely identified *Ovis aries* bones with sex identification criteria. The field Sex ID-Source explains the method applied for sex identification, e.g. horn core or pelvis shape.

Path Dental, Articular, Trauma, Other
The number of different types of pathologies recorded on *Ovis aries* bones.

Cornu behörnt / unbehörnt, Cornu Sum, Cornu Notiz
The number of hornless and horned sheep (*Ovis aries* skulls and horncores) and the sum of bones that gave horn data. In the "Notiz" field descriptions of horn shapes and other additional information given in the publication(s) are quoted together with the reference.

Notiz SBD
Any kind of additional data that was assumed to be relevant for the research question, but did not fit into any of the data fields.

Tab. 3: Concordance table for different systems of sheep / goat (*Ovis aries* / *Capra hircus*) tooth eruption and mandible wear stages (MWS) and approximate lifetime estimates based on Greenfield (2005, 22, tab. 1) amended by the author.

MWS Grant (1982, 96, tab. 1)	MWS and approximate age according to Payne (1973, 293, 299, tab. 1)			MWS and approximate age according to Reichstein (1991, 21, 116, tab. 41) and Habermehl (1975, 122-123)			General age stages
MWS	MWS	definition	age	MWS	definition	age	
				1a	Milk premolars erupting	< 1 month	neonate
1-2	**A**	Pd4 unworn	0-2 months	**1**	Milk premolars erupted	1-2 months	
				2	M1 erupting	3 months	
3-7	**B**	Pd4 in wear, M1 unworn	2-6 months	**3**	M1 erupted	4-8 months	juvenile
8-18	**C**	M1 in wear, M2 unworn	6-12 months	**4**	M2 erupting	9 months	
19-28	**D**	M2 in wear, M3 unworn	1-2 years	**5**	M2 erupted	10-17 months	
				6	M3 erupting; P2-P4 changing	18-24 months	
29-33	**E**	M3 in wear, posterior cusp unworn	2-3 years	**7**	M3 and P2-P4 erupted	> 24 months	subadult
34-37	**F**	M3: Posterior cusp in wear, dentine pattern of anterior cusps not closed	3-4 years	**7+**	M3 moderately worn		
38-41	**G**	M2 and M3: Dentine pattern closed with enamel islands in the center	4-6 years	**7++**	M3 heavily worn		adult
42-44	**H**	M3: Dentine pattern closed with enamel islands in the center; M2: enamel islands disappearing	6-8 years	**7+++**	M3 very heavily worn		mature
45+	**I**	M3: enamel islands disappearing	8-10 years	**7+++**	M3 very heavily worn		senile

Tab. 4: Epiphyseal fusion groups for *Ovis/Capra* bones according to O'Connor (2000, 95, tab. 8.2) and Benecke (2005, 335, tab. 6).

Age Class	**Epiphyses fusing**
6 months	Humerus distal, Radius proximal
12 months	Phalanx 1 proximal
18-24 months	Tibia distal, Metapodiae distal
36-42 months	Humerus proximal, Radius distal, Femur, Tibia proximal, Calcaneus
42-54 months	Vertebrae, Pelvis

Tab. 4: General age classes and approximate age of *Ovis/Capra* at the specific age class. Definition of age classes according to Institut für Urgeschichte Tübingen, age data according to Reichstein (1991, 22, fig. 6).

Age Class	**Definition**	**Approximate Age**
foetal/neonat	until end of lactation period	< 4 months
juvenil	self feeding, early fusing epiphyses fusing	ca. 4 months - 2 years
subadult	adult body size reached, late fusing epiphyses still unfused	2 - 3,5 years
adult	late fusing epiphyses fused	> 3,5 years

Reference Bone Data
The literature reference given as abbreviation (author(s), year, page(s), table, fig.). The full reference is given in the bibliography table.

Linum
In the initial stage of the project it was thought to be useful to record evidence for linum (*Linum usitatissimum*) within the monitored sites to compare this possible indicator for plant fibre production with evidence for sheep. However, the evidence for *Linum* in the monitored publications was very scarce and it would have required a thorough archaeobotanical literature research to get a full picture of comparative data here. Nevertheless, if evidence for Linum was published in a report it is recorded in this field together with the reference.

ID Site Bone Data
The unique identification number of the bone dataset. The number is a time stamp automatically generated by the database at time of recording.

WRH N, Mw, Min, Max, SD
Statistical descriptive data of withers height values (WRH = Widerristhöhe) for the site or sub-unit calculated from the sum of single values in the table Ovis Bone Metrics.
N = quantity; Mw = Mittelwert = arithmetic mean; Min = minimum value; Max = maximum value, SD = standard deviation).

LSI N, Mw, Min, Max, SD
Statistical descriptive data of logarithmic size index values per site or sub-unit calculated from the sum of single values in the table Ovis Bone Metrics.

Level 3: Ovis Bone Metrics

Site Name • Site Sub-Unit
Like in tables Site Core Data and Site Bone Data.

Reference Bone Metrics
Exact reference of the measurement given as abbreviation. The full reference is given in the bibliography table.

Bone No. in Publication
In some publications an identifier for the single bone is given, which is noted in this field.

Skeletal Element
The skeletal element from which the measurements were taken.

N
Quantity of bones from which the measurements were taken. Generally, measurements from single bones were recorded, in which case N = 1. Only in case of datasets with statistical values for measurements given in a publication N is > 1.

GL • WRH
Field “GL” contains measurements of the greatest length of *Ovis aries* long bones (Humerus, Radius, Femur, Tibia, Metacarpus, Metatarsus). The field “WRH” calculates the withers height (Widerristhöhe = WRH) from the greatest length values according to Teichert (1975, 63, Tab. 4, column “ur- und frühgeschichtliche Schafe”). See tab. 5 for the multipliers applied. No withers height has been calculated from Tali and Calcanei because of the large range of variation and subsequent inaccuracies in the resulting values calculated from these small bones as discussed by von den Driesch & Boessneck (1974, 339-340).

Bp • Bd • GLP • KLC/SLC • BT • BFp • BFd • TC/DC • Calcaneus GL and GB • Talus GLl and GLm
20 osteometric breadth and depth measurements and three length measurements of Calcaneus and Talus have been chosen for recording because of good preservation abilities and expectations of a high amount

of published measurement data. These were therefore mainly early fusing epiphyses or small compact bones like Talus and Calcaneus. All measurement distances and measurement codes follow von den Driesch (1976a; 1976b). See fig. 6 and tab. 5 for details.

LSI

The breadth and depth measurements are calculated to logarithmic size indices (LSI) using the method published by Meadow (1999) applying the formula

Log measurement bone find – log measurement standard individual = LSI.

The standard individual is an *Ovis aries* individual of the Staatssammlung für Anthropologie und Paläoanatomie München (inventory no. SAPM-MA-02718) published by Manhart (1998, 61-62, 333, Tab. 104). If multiple breadth and depth measurements of a single bone were provided in a publication, the database calculates the arithmetic mean out of all LSI-values per bone.

Notiz OBM

Additional information concerning individual measurements are noted here, e.g. approximate GL measurements in case of broken edges, sex identifications, implausibility, etc.

StatMed WRH, Min, Max, MW, SD • StatMed LSI Min, Max, MW, SD

Some publications provide only tables with statistical summaries of specific osteometric measurements. In those cases, the quantity minimum and maximum value, arithmetic mean and standard deviation are recorded, if available.

Tab. 5: Measurements of sheep (*Ovis aries*) standard individual for LSI calculations. The 23 measurements chosen for recording are highlighted yellow. The column "factor WRH" shows the multipliers used for the calculation of the withers height according to Teichert (1975).

		Measurements standard indivdual (mm)														
Name	Factor WRH	Bp	Bd	GLP	SLC (KLC)	BT	BFp	BFd	DC (TC)	Dd (Td)	GL	GB	GLl	GLm	N measurements	a_ID_SkeletalElement
Scapula				41	26										933	1
Humerus	4,28		41			40									3275	2
Radius	4,02	42	40				38	32,5							2937	3
Femur	3,53	54	48						26						447	4
Tibia	3,01	53,5	35							27					2303	5
Calcaneus											73	23,5			1107	6
Talus			26										38	36	2558	7
Metacarpus	4,89	32	33												3504	8
Metatarsus	4,54	27,5	31,5												2707	9

- Standard indivdual from Manhart (1998, 61-62, 333, Tab. 104; inventory no. SAPM-MA-02718, old inv.-Nr. 6).
- Measurement definitions after von den Driesch (1976a; 1976b).
- Withers height calculation factors after Teichert (1975, 63, Tab. 4, ur- und frühgeschichtliche Schafe).

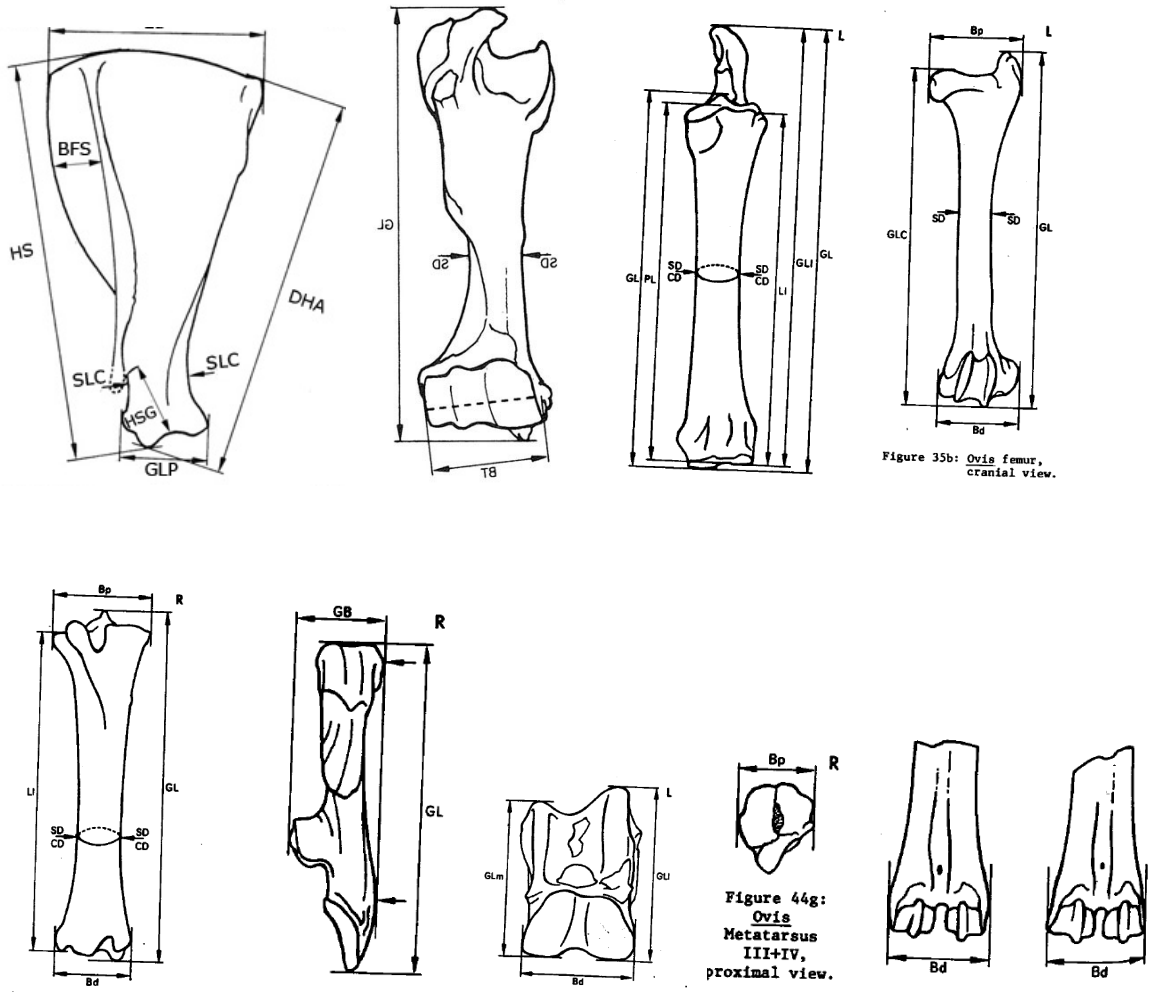

Fig. 6: Measurement distance definitions from von den Driesch (1976b), from top left to bottom right: Scapula, Humerus, Radius, Femur, Tibia, Calcaneus, Talus, Metatarsus.

References

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A-4-2: Archaeozoology

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A-4: Textile Revolution

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