Archaeozoological Study on the Bronze Age Alpine Settlement Savognin-Padnal in the Canton of Grisons, Switzerland

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1. INTRODUCTION

1.1. Aim of the study

The most important economic strategy for the self-sufficiency of farmers involves the cultivation of plants and stock-farming of domestic animals (Jacomet, 1999). To date, few archaeozoological studies have focused on the Bronze Age in the Swiss Alpine region in comparison to those in the Swiss Central Plateau region (hereafter referred to as Plateau) by pioneers, such as Kuhn (1935), Revilliod and Reverdin (1927), Steinmann (1923, 1925), and Wettstein (1924), and later by other researchers (e.g. Hüster Plogmann and Schibler, 1997).

One of the initial studies of the Swiss Alpine east region (hereafter referred to as Alpine east) involved the Early Bronze Age (EBA; 2200–1600 BC) (Rychner, 1998) settlement Schellenberg-Borscht (currently Principality of Liechtenstein) described by Kuhn (1937). The Middle Bronze Age (MBA; 1600–1300 BC) settlement Lumbrein-Surin Crestaulta was investigated by Rüeger (1942), who indicated that the Bronze Age settlers hunted far fewer wild animals. The two Late Bronze Age (LBA; 1300–800 BC) Alpine east settlements Ramosch-Mottata and Oberriet-Montlingerberg were described by Würgler (1962). These previous studies indicated that the faunal economy of the Bronze Age Alpine east was almost completely dependent on domestic animals. However, few archaeozoological studies have been conducted (Kaufmann, 1983; Schibler, 1998b) compared to the dramatically advanced archaeological studies of the area (e.g. Carrer *et al.*, 2016; Della Casa, 1998, 1999, 2000, 2002, 2003, 2005, 2007; Della Casa *et al.*, 1999; 2016; Jecker, 2015; Primas, 1985, 1999; Rageth, 1974, 1976-1986; Reitmaier, 2010, 2012, 2013, 2017; Reitmaier and Della Casa, 2010; Reitmaier *et al*., 2017).

Recently, archaeozoological studies have focused on the large Alpine east settlements that existed between the EBA and LBA, i.e. Cazis-Cresta (hereafter referred to as Cazis) (Plüss, 2007; 2011) and Savognin-Padnal (hereafter referred to as Padnal) (Bopp-Ito, 2012; Bopp-Ito *et al.*, 2018a, 2018b). The enormous data obtained from Padnal makes it possible to explore the subsistency of the Alpine east settlement, the relationship between animals and humans, and the changes that occurred during the Bronze Age.

Therefore, the aim of this study was to elucidate the animal husbandry practices at Padnal, and the economic relationship between Padnal and other human communities, i.e. local Swiss communities and the communities of neighbouring countries.

The core questions of this study are as follows:

1) What types of domestic animals were commonly possessed by the Padnal community?
2) At what age were domestic animals most commonly slaughtered?
3) Was there any gender selection in the slaughtering of animals?
4) What kind of animal exploitations can be assumed/presumed?
5) What were the hunting activities of the Padnal community?

6) What was the economic relationship between Padnal and other communities?

The three highlighted themes of this study are as follows:

(i) Animal husbandry at Padnal (Chapter 4.1)
(ii) Size diversity in Swiss Bronze Age cattle (Chapter 4.2)
(iii) Phenotypic diversity in Swiss Bronze Age pigs (Chapter 4.3)

1.2. Archaeological context: The settlement Savognin-Padnal

1.2.1. Historical background of Padnal

The transalpine colonization of the Swiss Alpine region over 2000 m above sea level (a.s.l.) was found during the Mesolithic (Cornelissen and Reitmaier, 2016), and the temporal settlements, which were based on the soil economy with the use of high alpine pastures, expanded during the Late Neolithic/Copper Age (Della Casa, 2003; Jecker, 2015; Primas, 1998; Rageth, 1987; Reitmaier, 2012; Walser and Lambers, 2012). The EBA immigrants from the north and south who brought livestock (Bopp-Ito *et al*., 2018a, 2018b; Grupe *et al*., 2017; Trixl *et al*., 2017) built "high settlements" on hills, approximately 700-2400 m a.s.l., for firming, pasturing, and mining activities (Della Casa *et al*., 2016; Murbach-Wende, 2016; Primas, 1999; Rageth, 2000; Reitmaier, 2010, 2012, 2013, 2017; Reitmaier *et al*., 2017). Seasonal transhumance of sheep, goats, and cattle grazing between settlements and meadows over the timber line might have intensified during the LBA (Reitmaier *et al*., 2017) (for details, see paper 2 and 3).

The settlement Padnal was discovered in 1938 by Bonifaci Plaz and Walo Burkart when collecting gravel samples (Rageth, 1998-2009 in the HLS). Thereafter, Padnal was further described by a prospecting excavation between 1953 and 1956 by Benedikt Frei and Bonifaci Plaz and a systematic excavation by Jürg Rageth from the Archaeological Service of the Canton of Grisons (ASG) in Switzerland between 1971 and 1983, and has now been identified as an agro-pastoral Bronze Age settlement with bronze production (Della Casa *et al*., 2016; Fasnacht, 1999; Rageth, 1974, 1976-1987, 1998a, 2000, 2002). An abundance of archaeological remains, such as ceramics, stone implements, bone tools, moulds, bronze objects, metal slags, bronze smelting materials, animal bones (*ca*. three tones), carbonized seeds, and beads of amber (Rageth, 1986) were found in the more than 2.5 m high deposits of the cultural sequence layers.

1.2.2. Geographical and topographical location

Padnal is located in the south of the present-day village Savognin, in the district of Oberhalbstein, in the Canton of Grisons, eastern Switzerland (Fig. 1.1). Most of the Alpine Bronze Age sites were located along the pass-routes (Della Casa, 2007; Rageth, 2000) (Fig. 1.2). Main pass-routes remained in use until the Roman period, but minor pass-routes may

have been used in the prehistoric times, especially transalpine passages, which were used for the transportation of exotic raw materials, such as copper and tin ore, bronze artefacts, or ornaments, during the Bronze Age (Jennings, 2015; 2016). The presumed north-south transalpine routes may have included the "San Bemardino", "St. Gotthard", "Diesrut", "Greina", and "Flüela" passes (Della Casa, 1998, 2000, 2007; Primas, 1998). The "Muretto", "Ofen", and "Reschen" passes were probably used from the MBA onwards (Cornelissen *et al*., 2013; Primas, 1998; Rageth, 2000). It is presumed that most of the settlers entered the Alps together with their domestic animals through one of the pass-routes (Grupe *et al*., 2017), although some of the passes were difficult for the cattle to cross (Hafner, 2012).

The Padnal settlement was built 1223 m a.s.l. alongside the road that crosses over the "Julier pass" towards northern Italy (Primas, 1998; Rageth, 1986, p. 64) (Fig. 1.3). The settlers may have intentionally selected this location for trading purposes with the southern (southern part of the Alps, Tyrol, and the northern Po plain) and the northern (Plateau, south Germany, and northern Europe) communities and for copper mining (Della Casa *et al*., 2016; Jecker, 2015; Jennings, 2015; Rageth, 1986, p. 64, 2000). The first Padnal settlers built the settlement on a natural hill-top in a hollow; a similar positioning to other Bronze Age Alpine settlements, e.g. Cazis, which is expected to be favourable in escaping attacks by wild animals or other human tribes (Rageth, 1986, p. 64, 2000) and in terms of the climatic conditions (Della Casa, 1998), despite the basin having bad drainage. The "Brook Julia" (Gelgia in Roman), a tributary of the River Rhine, flows under the south slope of the settlement (Fig. 1.4–1.7) (for details, see paper 1).

1.2.3. Plan and dating of the excavation

Six fields were excavated (Rageth, 1985, p. 65) (Fig. 1.8) and it is estimated that this excavation area only covered one third to one half of the area of the original settlement (Rageth, 1986, p. 70). Two living zones with houses, warehouses, stalls, and smithy were identified in the north (Field 1, 1/2, 2, 4) and in the south (Field 3, 5, 5/6, 6) zones, and these structures were presumed to have been rebuilt at least six times due to conflagrations (Rageth, 1986, p. 64, 67, 70, 2000). The architectural style of the house rows was similar to that seen in other Alpine east settlements, such as Cazis and Lumbrein Surin-Crestaulta (Rageth, 2000).

The settlement was occupied for approximately 1150 years between the EBA and LBA (*ca*. 1950–800 BC based on C14 analysis). Rageth (1984, p. 64) divided the settlement into five layers (synonymous Horizont in German): Horizonts E, D, C, B, and A, and four phases: EBA, from the end of EBA to the beginning of MBA (E-MBA), MBA, and LBA (Fig. 1.9). The analysis of C14 dating was undertaken at "the laboratory of the Institute of Physics, University of Bern" and "Swiss C14 commission" (Rageth, 1986, pp. 95-96; Jürg Rageth at ASG personal communication). The demography was calculated as four to five people having lived in a house, 40 to 50 people having lived in the EBA, and it expanded up to 120 people in the LBA (Rageth, 1986, 2000, 1998-2009 in the HLS). There were approximately 20-60 cm narrow

paths between houses except in Layer C and A. These paths were possibly made for the drainage of water to flow from the north to the south slope, for walking, and as garbage grooves because many of the animal bones, in particular from the LBA, were found in these grooves (Rageth, 1986, p. 73). The change in structures of the village is briefly described based on Rageth (1986, pp. 65-75) as follows (Fig. 1.10) (for details, see paper 1):

EBA (Bz, A1/A2): Layer E, 1950/1900–1550 BC. Settlers burnt wood for clearing and to build their first settlement (Rageth, 1986, p. 64). Layer E was separated into two layers (the older and the younger) in the south zone (E-I and E-II) but was separated into three layers in the north zone (E-c, E-b, and E-a). The "E-a" layer was further separated into five layers (E1-E5). Five to six houses with fire places were aligned in a row. The south edge house (named House 1 by Bopp-Ito) was identified as a smithy because Rageth found large quantities of copper ore, slag, and mould fragments (Rageth, 1986, p. 67).

E-MBA (Bz B1/B2): Layer D, 1550–1450 BC. There were eight to nine houses in three rows. Two houses (named House 1 and House 2 by Bopp-Ito) were presumed to be smithy (Rageth, 1986, pp. 67-68). There was an uncommon construction; a cistern (4.8 m width × 3.0 m depth × 2.0 m height) made of larch (*Larix spp.*) in Field 5, presumably to reserve water (Rageth, 1985, Rageth, 1986, p. 69) for extinguishing fires or as drinking water for animals (Rageth, 1986, p. 64, 69; Rageth, 2000).

MBA (Bz C): Layer C, 1450–1350/1300 BC. There were only four houses: two in Field 1, one in Field 3, and one that was extended over Field 2 and Field 2/3 (Rageth, 1986, pp. 70-71).

LBA (Early period; Bz D, Ha A): Layer B, 1350/1300–900/800 BC. Six houses were maintained in the traditional three-row style. The central house (20 × 6 m, named House 2 by Bopp-Ito) may have been the house of the chief of the village or the house of more than one family. The two houses (named as House 1 and 3 by Bopp-Ito) beside the central House 2 were probably sheds for domestic animals (Rageth, 1986, p. 72, Rageth, 1998a). The peak of prosperity for the Padnal community occurred during the early LBA (Rageth, 1986, 2000, 1998-2009 in the HLS).

LBA (Late period, Ha B): Layer A, 1350/1300–900/800 BC. Layer A is little known. The traditional style of the north to south row of houses could no longer be found and there was a house without a fire place in the south living zone. The final Bronze Age settlement was built within 100 years after a partial burning of the Layer B settlement; however, the Layer A settlement was abandoned and degraded without evidence of conflagration (Rageth, 1986, p. 74). Materials newly excavated from the east edge of Padnal were dated to between the

final period of the Bronze Age and the beginning of the Iron Age and it was unclear whether Padnal continued to the Iron Age or whether the community shifted to a completely new settlement (Rageth, 2002).

1.2.4. Culture

Padnal belonged to the "Inner-Alpine Bronze Age" culture (hereafter referred to as Inner-Alpine culture). This culture was named by Rageth (1986, p. 91, 2000; Rychner *et al*., 1998) based on the typology of ceramics, bronze objects, stone implements, and bone artefacts (Fig. 1.11–1.12). The first advocate of this culture was Burkart (1946) in the report of the Crestaulta settlement (*cf.* Rageth *et al*., 1998) near Lumbrein-Surin, and then reiterated by Stauffer-Isenring (1983) when ceramics (with attributes of this culture) were identified in the northern part of the Canton of Grisons, the district Engadin, north and south Tyrol, and their vicinities. Rageth (1986, p. 91; 2000, p. 37) presumed that Inner-Alpine culture emerged from the strong influence of the northern culture ("Hügelgräber- und Urnenfelderkultur" in the north Alpine foreland) and the southern culture ("Poladakultur" in the southern part of the Alps) and spread across the Canton of Grisons to Lugnez, Churer Rheintal, Schanfigg, Domleschg, Heinzenberg, Oberhalbstein, and Engadin. The culture may have also spread to Schams, and a part of Rhein valley in the Canton of St. Gallen, Vinschgau, and south and north Tyrol but not to Misox, Bergell, and the Puschlav areas (Rageth, 1986).

The culture at Padnal changed during the LBA to "the Rhine-Swiss-East France Urnfield culture" ("Rhein-Schweiz-Ostfrankreich culture" "Rhin-Suisse-France orientale"; abbreviated RSFO in French, which spread to the Rhine valleys in northern Switzerland and eastern France), "Main-Schwaben culture" (which spread to the north side of the Lake Constance in Germany), and "Laugen-Melaun culture" (which spread to other parts of the Canton of Grisons in Switzerland and south-east Tyrol in Austria and Italy) (Caduff, 2007; Jecker, 2015; Jennings, 2016; Rageth, 1986, pp. 92-93, 2000; Reitmaier, 2012, 2017; Reitmaier *et al*., 2017; Rychner *et al*., 1998). For example, ceramics at Padnal still maintained the traditional style of the MBA but some foreign ceramics appeared that had an element of "Urnfield culture" that emerged in the far north German areas and "Laugen-Melaun culture", which was originally from Trentino and south Tyrol (Rageth, 1986, p. 92). The LBA artefacts had a strong influence from outside the Canton of Grisons and the traditional attributes of Inner-Alpine culture had been replaced with a new style that united these three cultures (Jecker, 2015) (Fig. 1.11–1.12). The "Laugen-Melaun culture" was introduced in the Lower Engadine (Unterengadin) area (e.g. Scuol-Munt, Ramosch-Mottata) in 1200/1100 BC from the southern part of the Alps, probably through the Ofen or Reschen passes (Rageth, 2000, p. 37) (for details, see paper 1 and 2).

1.2.5. Plant and timber macro remains: on-site of Padnal

More than 40,000 macrobotanical remains, such as seeds and fruits (EBA >20,000; MBA >10,000; LBA >10,000), were found in Padnal as "on-site" data excavated from the

settlement (Jacomet and Kreuz, 1999). Most of these macrobotanical remains were from cultivated plants and were found in carbonised stocks in the burnt layers determined by M. Villaret-von Rochow in Musée Botanique Cantonal de Lausanne. This study was continued by Maria Hopf from Römisch-Germanischen Zentralmuseum, Mainz after the death of Villaret. Hopf then offered Padnal samples, found mainly from D and C layers at Field 3 during an excavation in 1973 (Rageth, 1977, p. 98), to Stefanie Jacomet at the Integrative Prehistory and Archaeological Science (IPAS), University of Basel (Jacomet, 1999; Jacomet and Rachoud-Schneider, 1998a). The most important cultivated cereals were (in order of importance): barley (*Hordeum vulgare*) (Jacomet, 1998a, 1999), spelt wheat (*Triticum spelta*), einkorn (*Triticum monococcum*), emmer wheat (*Triticum dicoccum*), and oats (*Avena spp.*). There were large amounts of pulses, such as peas (*Pisum sativum*), broad beans (*Vicia faba*), and flax seeds (*Linum usitatissimum*) (Jacomet, 1998b, 1999; Rageth, 1986, p. 84). Barley and pulse were the most important cultivated plants for Padnal settlers (Jacomet, 1998a, 1998c). There were some wild plants, such as hazelnut (*Corylus avellana*) and rose hip (*Rosa spp.*) (Jacomet, 1998b). Interestingly, rose hip was more popular to the Padnal settlers than to the lake shore settlements in the Plateau region (Jacomet and Rachoud-Schneider, 1998b). Leaf litter and leaf fodder of rose hip and hazelnuts in Padnal may have been fed to domestic animals (Zoller, 1998b).

Most of the carbonised timber and bark at Padnal were from larches (*Larix spp.*) and spruces (Picea *spp.*) (Rageth, 1977, p. 98; Rageth, 1986, pp. 96-98), which were the most common trees in the Bronze Age Alpine east forests based on a pollen analysis (Zoller, 1998a). Other species included alder (*Alnus spp.*, except *Alnus viridis*), birch (*Betula spp.*), pine (*Pinus spp.*), Swiss stone pine (*Pinus cembra*), silver fir (*Abies spp.*), grains trees, willow (*Salix spp.*), ash (*Fraxinus spp.*), mountain ash, and hazel (*Corylus spp.*). Larch was commonly used for constructs (including a cistern) and poles. Spruce was presumed to be used as fire wood but also for flooring (Rageth, 1977, p. 98; Rageth, 1986, pp. 96-98). The Padnal settlement was surrounded by a dense conifer forest (Rageth, 1986, p. 64). However, larch and spruce can be found only from the subalpine zone (1600-2250 m a.s.l.; *cf.* Wegmüller, 1977). Perhaps Padnal settlers climbed up to near the timber line for obtaining larch and spruce lumber to construct their settlement.

1.2.6. Alpine palaeoenvironment: off-site of Padnal

The Holocene epoch is divided into three periods; the early Holocene (*ca*. 9000–6300 cal. BP; i.e. calendar or calibrated years before present (before 1950), the middle Holocene (*ca.* 6300–3500 cal. BP), and the late Holocene (*ca*. 3500–1000 cal. BP) (Bell and Walker, 2005; Heiri and Lotter, 2003; Heiri *et al*., 2003). A pollen profile from the northern Tyrol showed that pasture management began before the Bronze Age and that the Alpine vegetation has not changed since the late-glacial period (8000 cal. BP), thereby indicating that the climate was presumably similar to that of the present (Bortenschlager, 1993). However, the Central Alps area was different from the northern Tyrol based on the combination of pollen and macrofossil analyses. The highest level of the upper forest (larch, Swiss stone pine, birch,

spruce, and alder trees) was 2300–2400 m a.s.l. between 8000 and 5000 cal. BP (early to middle Holocene), but from 5000–3000 cal. BP (middle to late Holocene) onwards, the timber line shifted downwards until *ca*. 2000 m a.s.l., and the increase in alders and decrease in spruce, fir, and Swiss stone pine trees indicated deforestation by humans (Lang, 1993; Magny *et al*., 1998). The forest limit was reduced by 200–300 m by 3700 cal. BP (the end of EBA) (Dietre *et al*., 2016; Wick *et al*., 2003). The EBA was the last period of the maximum density of forest, as well as the maximum elevation of the timber-line. Primas (1998) found the Alpine timber line became lower between 3300 and 3150 cal. BP, and that the montane-subalpine transition zone (1100–1500 m a.s.l.) experienced lower climatic temperatures (Rey *et al*., 2013, p. 1415). However, the change in climate did not influence the subsistence of the Alpine settlements because the settlements increased and continued throughout the Bronze Age (Oeggl and Nicolussi, 2009; Walser, 2012). The prehistoric human activity over 1000 m a.s.l., especially, over 2000 m a.s.l., was only possible if the climate was favourable (Della Casa, 2007, 2013; Reitmaier, 2010, 2012). The climate during the Bronze Age was affected by the increase in human activities, such as the occurrence of fire and cattle grazing (Bell and Walker, 2005, p. 91; Jacomet, 1998d, p. 141; Rey *et al*., 2013, p. 1415, 1425) but the relationship between the timber line and environmental temperature is not always parallel. The timber line in the subalpine-alpine zone in the Alpine west region was 300 m higher (2400 ± 100 m a.s.l.) than the Alpine east region during the early and middle Holocene; however, conditions were warmer than the present-day (Carnelli *et al*., 2004; Grosjean *et al*., 2007; Schoch, 1999).

Climatic changes can have a great impact on the landscape, vegetation, and land use for animals (Röpke *et al.,* 2011). The main two ecotones (ecological areas): (i) subalpine coniferous forests, and (ii) Alpine meadows, are sensitive to climatic changes and influence the Alpine vegetation (Wick *et al*., 2003). Presently, the Alpine east region has short summers and long winters (Netting, 1981), but little is known about the conditions before the Medieval period, especially over 1200 m a.s.l. (Zoller, 1998b) and it is difficult to reconstruct the local conditions (Holzhauser *et al*., 2005; Lang, 1993). The prehistoric summer air temperature in the northern Swiss Alpine zone during the late Holocene (3500–1000 cal. BP), *ca.* during the MBA, was estimated to be *ca.* 11.5–12.0 °C (present temperature *ca.* 11 °C, at 1500 m a.s.l.) based on the presence of the subfossils of chironomid (Heiri and Lotter, 2003; Heiri *et al*., 2003). According to Heiri *et al*. (2003) and Blant *et al*. (2010), the summer temperature in the subboreal chronozone during the MBA was lower (*ca*. 11.5 °C) than the EBA (*ca*. 12 °C) and LBA (*ca*. <12 °C). Although the conditions in the subalpine zone in the northern Alps changed from subcontinental to oceanic conditions before the Bronze Age (Rey *et al*., 2013), the presumed cool and wet climate based on the summer temperature and mean annual precipitation was stable from 5500 cal. BP (middle Holocene) onwards (Wick *et al*., 2003). The climatic amelioration and deterioration at the lake dwellings during the MBA were reconstructed based on the dendrochronology (Magny, 2015) that the Alpine region does not have (Schibler, 2017). The

lack of dendrochronological dating makes it difficult to reconstruct the climatic change in the Alpine region (Schibler, 2017; Schibler and Jacomet, 2005; Walser and Lambers, 2012).

The first evidence of an Alpine pasture was found in the EBA (Wick *et al*., 2003) and the incidence of them increased after 1500 BC (MBA) (Dietre *et al*., 2012). The predominant vegetation was similar to that of today (Zoller, 1998c). The increase of open land after the clearing of spruce forests indicated a warm and dry climate during 1300–1000 BC (LBA) based on the palynology in the Alpine east region (Röpke *et al*., 2011, p. 493). During the early Iron Age, the climate changed to cool and moist, and land use decreased. Nevertheless, the settlers who lived in the high-altitude settlements were well adapted to the harsh environment. Iron Age settlers clearly managed to survive short harvest periods and long winters because there were no complete abandonments of settlements after the onset of the Metal Ages (Röpke *et al*., 2011, p. 496).

The change in glacier length is an indirect signal of the climatic fluctuation which coincided with radiocarbon peaks, namely stronger or weaker solar activities (Holzhauser *et al*., 2005, p. 797). For example, the Little Ice Age coincided with cooler winters and wetter summers; thus, it increased the length of glaciers and raised the levels of lakes (Holzhauser *et al.,* 2005, p. 799). Glaciers in the Alpine east region formed again between *ca.* 4000 and 3500 cal. BP and persisted throughout the remainder of the Holocene, although the summer air temperature did change (Leemann and Niessen, 1994). Glacial advancement indicates the occurrence of a cooling episode between 4400 and 4200 cal. BP (between the Late Neolithic and EBA) in the Alpine regions and in the Swiss Plateau (*cf.* Figure 3-C in Grosjean *et al*., 2007, p. 206). The climate in the Alpine west region became cooler and moister during the EBA, warmer and dryer between the MBA and LBA, and became cooler and moister again in the final period of the LBA. The glacier was permanently covered for 5,000 years since 3,000 BC onwards until a hot summer in 2003 (Grosjean *et al*., 2007; Holzhauser *et al*., 2005, p. 798).

In conclusion, the Bronze Age palaeoenvironment in the Alpine east region barely changed except during the final LBA when conditions became cooler than before. However, it remains unknown whether the disappearance of the layer A settlement in Padnal was due to this climatic change.

2. Materials and Methods

2.1. Materials

Since materials were excavated and collected by hand, it is possible that remnants of small animals, such as small mammals, birds, reptiles, amphibians, fish, or insects could be absent in the faunal composition. Materials in this study were acquired from Field 1 (northern part) and Field 3 (southern part) of the settlement (*cf*. Fig. 1.8). Jürg Rageth particularly selected Field 3 because it was the central excavated field and because of an interest in the large central house (named as House 2 by Bopp-Ito) from the LBA. Field 3 included materials from all five layers (E, D, C, B, A) between the EBA (Horizont E) and LBA (Horizont A). However, Rageth excluded materials from layer A due to their poor preservation. Hence, the materials in this study were from the layer E, D, C, B. Materials from the layer D (E-MBA) were randomly sampled up to 10,000 specimens by Jörg Schibler and Miki Bopp-Ito (of the present study) due to the enormous number of specimens available. Materials from layer C (MBA) and B (LBA) in Field 1 had already been reported by Anna Gassler and Philippe Morel during the preliminary study (Rageth, 1986, pp. 93-94) but unfortunately, their database was lost after the death of Philippe Morel. Thus, I re-examined their materials and created a new database (for details, see paper 1). All materials from Fields 1 (15,136 specimens; 84,467.3 g; mean 5.6 g) and 3 (24,895 specimens; 148,679.0 g; mean 6.0 g) were used in this study (total 40,031 specimens; 233 kg 146.3 g; mean 5.8 g).

Human (*Homo sapiens*) bones, less than 0.1% of the total number of examined materials, were included only for taphonomic analyses (Chapter 3.1), but were completely excluded from all other analyses. Human bones were separately observed and are described in chapter 3.2.4: Humans (*Homo sapiens*).

Animal bone artefacts were completely excluded from all analyses and are separately described in Chapter 3.3.5: Artefacts.

2.2. Methods

2.2.1. Species identification

Species identification is the principle method for archaeozoology (Davis, 1987, p. 32). The frequency of animal species provides archaeological clues to reconstruct animal husbandry related to the economy, sociology, culture, geography, topography, climate, and environment of the past (e.g. Bopp-Ito *et al*., 2018a, 2018b; Davis, 1987; Deschler-Erb and Marti-Grädel, 2004; Schibler, 2017; Jacomet and Schibler, 2010). Each individual bone specimen was classified with reference to collections at the institute of IPAS, University of Basel, the Natural Historical Museum in Basel, and the Natural Historical Museum in Bern, and with reference to previous studies (e.g. Bacher, 1967; Baumann *et al*., 2005; Boessneck *et al*., 1964; Clutton-Brock *et al*., 1990; Cohen and Serjeantson, 1986; Fernandez, 2001; Fick, 1974; Niethammer and Krapp, 1978, 1982; Payne, 1985; Pucher, 1996a; Pucher and Engl, 1997; Schmid, 1972) (for details, see paper 1).

Bones were classified into three categories:

1) **Species level**
2) **Big groups**
3) **Indeterminate bones (indet.)**

"Big groups" refers to bone specimens that could not be identified to the species level but could be identified to the family, subfamily, or genus levels, such as "domestic pig or wild boar", "dog or wolf", "a large ruminant" (the size of cattle or red deer), "a small ruminant" (the size of sheep), etc. Only specimens in the "species level" category were identified as "identified specimens". Specimens in the "big groups" and "indeterminate bones" categories were regarded as "unidentified specimens".

Sheep and goats were divided into five categories:

1) Sheep
2) Probably sheep
3) Goat
4) Probably goat
5) Sheep or goat (referred to as **sheep/goat)**

These five categories were re-grouped into three categories for some analyses:

1) Sheep or probably sheep
2) Goat or probably goat
3) Sheep or goat (referred to as **sheep/goat**)

Finally, all categories were integrated into one large category "**sheep/goat**" to assess the frequency of these species in comparison with other species (Appx. Tab. 1–11).

The number of identified specimens (NISP) was used for the quantification of bone specimens and reported as “n”. Weights were reported with the unit “g”.

Overall bone data were recorded using the database system OSSOBOOK (autumn 2005) (Schibler, 1998a) and transported to EXCEL for analysis. Most of diagrams were created using EXCEL and SPSS v 21.0 (SPSS, 2012). All data are stored in the archaeozoological databank on the server at the institute of IPAS, University of Basel.

The quantity of species from each house in Field 3 throughout the Bronze Age, as well as between Field 1 and 3 during the MBA and LBA was observed to find out whether there was the social difference, such as in the Neolithic settlement Arbon 3 (Deschler-Erb and Marti-Grädel, 2004), or there was the different eating habit between houses (Bopp-Ito, 2012).

Thanks to Rageth, who put a label in each vinyl bag on which the grid numbers were written, I could reconstruct the archaeological information from each house and path in Field 3. However, there were no labels in the bags of Field 1. They might have been lost during the 1970s.

2.2.2. Slaughter age

Mortality profiles are the most important resource in the reconstruction of economies and animal husbandry practices (Davis, 1987, p. 39). Mortality profiles indicate the kind of livestock products that were used and, hence, were the most significant in the economy, e.g. meat, hide, milk, wool, fibre, dung, or muscular power as in the case of draught animals (e.g. Davis, 1987, p. 155; Greenfield, 2010; Halstead and Isaakidou, 2011). In addition, mortality profiles imply social disparities in food consumption, e.g. higher quality or specific food types consumed by the upper social class (e.g. Bopp-Ito and Deschler-Erb, 2007; Deschler-Erb *et al.*, 2007).

The slaughter ages of the three main domestic animals: cattle, sheep/goats, and pigs were determined using the age lists from the Archaeozoology Laboratory at the institute of IPAS (Appx. Tab. 12-14). These ages were based on the condition of the epiphyseal fusion as well as on tooth eruption and wear traces, and were determined with reference to several previous studies (Becker, 1981; Becker and Johansson, 1981; Bull and Payne, 1982; Bullock and Rackham, 1982; Ducos, 1968; Grant, 1982; Habermehl, 1975, 1985) (for details, see paper 1). The ages of dogs were determined in accordance with the methodologies described by Horard-Herbin (2000).

Determined ages based on epiphyseal fusion were divided into four categories:

1) Foetus (Fetus)

2) Younger than subadult

3) Not adult

4) Adult

Determined ages based on dental traits were divided into six categories:

1) Foetus (Fetus)

2) Infant (Infantile)

3) Juvenile

4) Subadult

5) Young adult

6) Senile adult

2.2.3. Sex determination

The sex ratio reflects the sexual selection of animals for economic exploitation; however, sex determination is difficult in young individuals (Zeder, 2006a, 2006b). With the exception of hares, the males of most mammals display larger than the females. However, long bones of castrated males would have been longer and slender (Davis, 1987, pp. 44-45). Sex ratios were determined from cattle, sheep/goats, pigs, and wild boars and were classed according to the different categories available in OSSOBOOK, such as male, perhaps male, female, and perhaps female, etc., but for purposes of this study, they were integrated into two large groups:

1) Males and castrated males

2) Females

Sexual dimorphism of the horn core and Pelvis from cattle and sheep/goats was distinguished based on the reference collections at the institute of IPAS, University of Basel, and according to previous studies (Armitage, 1982; Boessneck *et al.*, 1964; Grigson, 1982). The sex ratio of pigs and wild boars were determined from the Canines and the alviore (Hillson, 1992) based on the reference collections at the institute of IPAS (for details, see paper 1).

The female cattle probability was verified by fitting a *finite mixture model* (McLachlan and Peel, 2000) based on the measurement of the Metacarpus Bd (greatest breadth of distal end) (Davis, 1987, p. 44, 2012; Fock, 1966; Hüster, 1990; Hüster Plogmann and Schibler, 1997). The variance of the true female probabilities was estimated using a *meta-analytic technique* (Russo, 2007). The estimations of the variance in female probabilities and the *p*-

value of a test of the hypothesis of variance equal to zero were estimated by Werner Vach using STATA version 13.1 (StataCorp., 2013) (For details, see paper 2).

2.2.4. Osteometry

In osteometry, it is important to consider the allometry and sexual dimorphism to body size (Davis, 1987; Teichert, 1993; Zeder, 2006a, 2006b). Osteometric data in Padnal was obtained from adults (including subadults) only, based on the eruption and wear of teeth and on bones with completely fused epiphyses, following the defined metrical method of von den Driesch (1976). Bones were accurately measured to the 0.01 mm decimal (see Appendix Tables 21–26). Body size was reconstructed using wither height and logarithmic size index (LSI).

Wither height

Wither height was calculated using factors based on Matolcsi (1970) for cattle (*Bos taurus*) (Appx. Tab. 15), Teichert (1975) for sheep (*Ovis aries*) (Appx. Tab. 16), Teichert (1969) for pigs (*Sus domesticus*) (Appx. Tab. 17), and Harcourt (1974) for dogs (*Canis familiaris*) (Appx Tab. 18).

Additionally, the entire body size of human (*Homo sapiens*) foetuses and neonates were calculated using the factor from Fazekas and Kosa (1978) (Appx. Tab. 19).

Logarithmic size index

The LSI can be used to convert estimated body size measurements into logarithms and is calculated using the equation LSI = (log x – log m) = log (x/m) where x is the measurement to be assessed and m is the measurement at the standard reference (Meadow, 1999; Simpson *et al*., 1960). If the specimen was larger than the standard, it has a positive value and the specimen is smaller than the standard it has a negative value (Meadow, 1999, p. 288). The method used followed the standard protocols described by Breuer *et al*. (1999) and Schibler and Steppan (1999). The standard values of cattle (Fig. 2.1–3) were determined by Renate Ebersbach (unpublished data) and Guido Breuer, and other species were determined by Guido Breuer (Breuer *et al*., 1999, 2001) (Fig. 2.4–5). Only the value of "Humerus the greatest breadth of proximal (Bp)" from *Ovis musimon* (reference no. Z-2266, adult, male) was measured by Miki Bopp-Ito (dexter Humerus Bp 51.86 mm, sinister Humerus Bp 51.67 mm, mean 51.77 mm).

The LSI values of cattle, sheep, sheep/goats, and pigs from Padnal were chronologically compared with box plots using Wessa software version 1.2.1 (Wessa, 2017) and with statistical analyses of non-parametric Krusal-Wallis and non-parametric post-hoc Mann-

Whitney *U* tests in a one-way analysis of variance (ANOVA). Differences were considered significant if the *p* value was lower than the significance level (α) 0.05. Statistical tests for LSI were performed using PAST software version 3.04 (Hammer *et al*., 2001) (For details, see paper 2).

2.2.5. Pathological and anatomical alteration

Pathological alteration of animal skeletons can provide evidence of the animal use for the secondary production as well as management practices (Deschler-Erb and Marti-Grädel, 2004; Hüster Plogmann and Schibler, 1997). Animal skeletal alterations can occur as a result of aging, injury, and intensive exploitation by humans (Schibler, 1996a). Pathological skeletal alterations were identified based on the reference collections of pathological samples at IPAS, University of Basel, and previous studies (Bartosiewicz *et al*., 1997; Deschler-Erb and Marti-Grädel, 2004, 2006; Johansson, 1982; von den Driesch, 1975; Wäsle, 1976). According to OSSOBOOK, there are several aspects that can be used to identify symptoms, such as dental anomalies (misplaced tooth, irregular abrasion, polyodonty or oligodonty, alveolar pylaria), wound inflammation by trauma (bone fracture or crack), over exhaustion and overstress (neoplasm, arthritis, or malnutrition), etc.

2.2.6. Taphonomic analysis

The results of taphonomy can offer key information that can be used to reconstruct the historical subsistence of humans and the environment of the past. The concept of taphonomy is "the study of the environmental phenomena and processes that affect organic remains after death" (Davis, 1987, p. 17) and is biased by the archaeozoological records "if some non-human-related processes have affected the condition or frequencies of biological remains" (Lyman, 1994, p. 1). It is important to consider if animal remains were ecologically deposited (e.g. wild mice, snails, insects) or intentionally deposited by humans (e.g. domestic and almost all wild animals) in archaeozoological study sites (Lyman, 1994, p. 7). Taphonomic information indicates the processes of preservation of organic materials as well as the historical events and processes that led to their existence and eventual inclusion in our records (Davis, 1987, p. 22; Lyman, 1994, pp. 12-40).

Preservation

The condition of preservation directly influences the proportion of identifiable animal species and, thereby the overall results of other analyses. The better the preservation of a specimen, the higher the chance that it can be identified to the species level as well as provide age, sex, and mensural information (Davis, 1987, p. 35). Only teeth remained in the worst cases of preservation (Schibler, 2001).

Each specimen was classed according to three different weathering stages of preservation of the bone surface following Lyman's five stages (*cf.* Lyman, 1994, pp. 354-358);

1) **Good:** smooth and moist surface, similar to original tissues (Lyman's stage 0).

2) **Bad**: cracking and flaking of outer surface (Lyman's stage 1–2).

3) **Very bad:** rough and coarse surface, dry, very fragile, completely worn-out (Lyman's stage 3–5).

The rate of remained single tooth from Padnal and other Bronze Age settlements was examined to determine whether materials were sufficiently well preserved for further analyses (Deschler-Erb, 2005; Hüster Plogmann and Schibler, 1997; Schibler, 1996b, 2001; Schibler and Studer, 1998).

Fragmentation

The mechanics of bone fracture are very complicated owing to various taphonomical reasons (Lyman, 1994, pp. 315-338), such as trampling of settlers, breaking during the excavation or transport, and by intentional human activities, such as butchering (Davis, 1987, p. 17; Lyman, 1994, pp. 294-315; Plüss, 2011, pp. 83-98). The degree of fragmentation directly influences the NISP.

There were three preconditions for the bone quantification to be counted as a single specimen:

1) Intact bone

2) Fragment with old edges

3) Fragment mended by more than two fragments with new broken edges from the same skeletal element of an animal from the same assemblage

Fragments with new broken edges but for which no other matching pieces were counted as a single specimen.

The fragmented division of flat and long bones from cattle, sheep/goats, and pigs were observed following the methodology described by Hüster Plogmann and Schibler (1997) using the OSSOBOOK codes. Flat bones, such as the Cranium (three parts), Mandibula (seven parts), Scapula (six parts) and Pelvis (five parts) were selected to determine which of these bones most commonly remained (Appx. Fig. 1–3). Long bones were divided into five parts for length; **1) proximal epiphysis**, **2) upper part of the shaft**, **3) middle part of the shaft**, **4) lower part of the shaft**, and **5) distal epiphysis**, as well as divided into four parts for circumference; **1) completed (4/4)**, **2) three quarters (3/4)**, **3) half (1/2)**, and **4) one quarter**

(1/4) (Appx. Fig. 4). Fragments classed according to their length and circumference, were divided into four categories: **1) smallest, 2) small, 3) big**, and **4) biggest**.

Flat bones (Appx. Fig. 1–3) were divided as follows, (the number in parentheses indicates the OSSOBOOK code):

1) Cranium: 1. Front (Praemaxillare, Maxilla, Palatinum, Nasale, Orbita, Jugale) (10)
   2. Rear (Frontale without Orbita, Temporale, Parietale, Occipitale (without Condylen) (20)
   3. Base (Base included Condylen, Petrosum, Styloid) (30)
2) Mandibula: 1. Ramus (1)
   2. Corpus (Corpus base, Corpus alveolar) (2)
   3. Diastema (3)
   4. Corpus and Diastema (4)
   5. Corpus and Ramus (5)
   6. Intact Mandibula (6)
3) Scapula: 1. Articular (1)
   2. Margo thoracalis (2, 10)
   3. Margo cervicalis (3, 11)
   4. Margo caudalis (4)
   5. Spina (5)
   6. More than two-thirds of an articular and intact Scapula (7, 8)
4) Pelvis: 1. Acetabulum (1)
   2. Ilium (2)
   3. Ischium (3)
   4. Pubis (4)
   5. Big fragment and intact Pelvis (5, 6, 7)

Long bones (Fig. 3.3.8, Appx. Fig. 4);

1. Smallest: 1/5-2/5sC (short length and small circumference)
2. Small: 1/5-2/5bC (short length and big circumference)
3. Big: > 3/5sC (long length and small circumference)
4. Biggest: > 3/5bC (long length and big circumference)

Results from other species, as well as from other skeletal elements, such as Costae, Vertebrae, phalanx, Carpalia, Tarsalia, etc., can be found in the archaeozoological databank on the server of IPAS, University of Basel.

The results of fragmentation that were induced by the taphonomical affects and human activities are separately described in Chapter 3.1 and 3.3, respectively.

Other traces (gnawing, digestion, burning, change of colour)

Traces of gnawing are identified by bite marks. Most bones were marked by carnivores, omnivores, or rodents, such as dogs, pigs, humans, or mice (Lyman, 1994, p. 306, 325). Bite marks from dogs or pigs are identifiable as punctures on the hard and dense bone surface; however, it is difficult to distinguish whether the bite marks were made by dogs or pigs. Bitten off old bones or broken edges of bones due to biting by dogs or pigs suggested that the rest of the bone may have been eaten. Digested bone fragments were identifiable due to their distorted or "melted" appearance.

Burn traces were roughly separated into three groups based on the different burning temperatures:

1) burned (lower than 600 °C)

2) carbonized (*ca.* 600–1,000 °C)

3) calcinated (over 1,000 °C)

Specimens were furthermore divided into seven different degrees of the burning conditions (Hüster Plogmann *et al*., 2011; Lyman 1994, pp. 385-388).

Bones were found to have changed colours, i.e. to green, red, yellow, and dark brown, and some displayed black spots. The number of bone fragments that had changed to green colour due to the touching with bronze objects excavated from smithy in Field 3 (Rageth, 1986, p. 67, 2000) was explored.

Distribution of skeletal elements

Archaeozoologists take great interest to identify any evidence of deliberate selection of specific skeletal parts of animals in relation to the economic or ritual activities of humans (Lyman, 1994, p. 223).

The distribution of skeletal elements from cattle, sheep/goats, and pigs were evaluated based on their weight because the weight of each skeletal element is not affected by the number of fragments (Becker, 1986, p. 254). Skeletal elements were separated into five main categories and 16 sub-categories.

1) Cranium part

1. (Cranium, horn core, Maxilla, and upper teeth), 2. (Mandibula, lower teeth, and Os hyoideum)

2) Rumpf (= trunk) part

3. (Vertebrae; cervicalis, thoracalis, lumbalis, sacrum, and caudalis) 4. Costae, 5. Sternum

3) Stylopodium

6. Scapula, 7. Humerus, 8. Pelvis, 9. (Femur and Patella)

4) Zygopodium

10. (Radius and Ulna), 11. (Tibia and Fibula)

5) Autopodium

12. Carpalia, 13. Tarsalia, 14. Metacarpus, 15. Metatarsus, 16. Phalanx

The skeletal spectrum from cattle, sheep/goats, and pigs were analysed based on the standard reference values (log value = 0) which were measured by Guido Breuer (personal communication) from the reference collections (Z-2426 cattle, mean of Z-1449 goat and Z-2266 sheep, mean of Z-1446 and Z-2268 wild boars) at IPAS, University of Basel.

Traces of decomposition (butchering)

The evidence of butchering can be identified as cut and chop marks. Animals were presumably butchered for consumption as well as for bone tools. In general, butchered bones were more intensely fragmented than bones which had no butchering marks (Lyman, 1994, p. 351). Cut and chop marks indicated whether there was a rule of decomposition or a professional animal decomposition group with special techniques in the settlement. Butchering traces were classified according to the following groups:

1) Cut marks

2) Chop marks

3) Cut and chop marks

The details and conditions of butchered fragments were observed, e.g. halved lengthwise or horizontally, prepared for meat, divided into small pieces, opened marrow, chopped Scapula joint or spina, portioned Costae, and spiral fractured long bones. This study did not investigate and clarify what materials the butchering implements were made of, e.g. stone (silex) or bronze, because it is difficult to distinguish the tool material based on a cross-sectional view of cut or chop marks without a specific microscope.

2.2.7. Pig dental phenotypes using geometric morphometrics

The phenotypic diversity in size and shape of the lower second (M_2) and third (M_3) molar tooth of domestic pigs from Padnal and other Bronze Age sites in Switzerland (total n = 248) were measured using geometric morphometrics (e.g. Bookstein, 1991; Zelditch *et al.*, 2004)

following standardised protocols described by Cucchi *et al.* (2011, 2016) and Evin *et al.* (2013). Two-dimensional digital images were processed using tpsDig2 version 2.16 (Rohlf, 2010a), tpsUtil version 1.53 (Rohlf, 2012), and tpsRelw version 1.49 (Rohlf, 2010b) using the landmarks (M_2 = 7, M_3 = 8) and sliding semi landmarks (both M_2 and M_3 = 70) methods during the generalised Procrustes analysis and using the Procrustes distances approach to obtain the centroid size (CS) (*cf.* Fig. 2 in Cucchi *et al.*, 2011, p. 14) and shape variables (Procrustes coordinates).

The heterogeneity of log-transformed CS between pig groups in relation to time and space was tested with a Kruskal-Wallis rank sum test and visualised using box plots. Multiple Wilcoxon rank tests were used for pairwise comparisons.

The shape data were assessed using a principal component analysis following Baylac and Friess (2005). Differences in shape were tested using a multivariate analysis of variance (MANOVA) quantified by leave-one-out cross validation (95% confidence interval) with 100 iterations (Evin *et al.*, 2013) for canonical variate analysis and displayed by neighbour-joining networks based on Mahalanobis distances. The multi-test comparisons followed those of Benjamini and Hochberg (1995) and the differences were considered to be significant if the *p*-value was smaller than the significance level (α = 0.05). Statistical analyses were performed using R version 2.13.1 (R development Core Team, 2012) (for details, see paper 3).

The teeth of the Padnal pigs are separately reported in Chapter 3.3.4 and the reports are based on the results analysed by Miki Bopp-Ito under the instruction of Thomas Cucchi and Allowen Evin at the Muséum National d'Histoire Naturelle in Paris and with the support BioArch in 2010. The difference in CS was tested using the Welch F test of ANOVA of variance and the difference in shape was tested using the Wilks' lambda test of MANOVA following the methodology of Cucchi *et al.* (2011) and using the software PAST version 3.04 (Hammer *et al.*, 2001).

2.2.8. Regional grouping of main domestic animals

The frequency of domestic and wild animals from Padnal were compared with those found in the other Bronze Age sites from Switzerland, Lichtenstein, and south Germany to establish whether there was any difference between frequencies divided by regions and periods, and especially, to assess whether there was a difference in diversity between dryland and wetland settlements (Schibler, 2017), mainly in the Alpine and Plateau regions. Comparable settlements were chosen because of vast differences in their historical, economic, cultural, geographical, topographical, and environmental backgrounds (Menotti, 2015a, 2015b; Reitmaier, 2010; Schibler, 2017). Settlements in the Plateau region had already begun during the Early Neolithic (frühes "Jungneolithikum") with the agro-pastoral subsistence. Inhabitants of the Plateau settlements had been exploiting secondary products from domestic animals since the middle of Neolithic, and had expanded their settlements; however, the occasional unfavourable climate of this region did influence animal husbandry practices (Schibler, 1996b, 2017). The cultural diversity between east and west regions

persisted until the LBA, influencing the trade and exchange (Jennings, 2015, 2016; Rychner *et al*., 1998). Increase in human activities was noted in the Alpine region between the Mesolithic and Late Neolithic/Copper Age, and the permanent settlements rapidly expanded during the EBA (Della Casa, 2003). The Alpine settlers may have been imigrants from outside of the Swiss Alps in search for copper mines for bronze production (Della Casa *et al.*, 2016; Rageth, 1986) and pastoralism (Reitmaier *et al*., 2017), and who brought domestic animals with them (Bopp-Ito *et al.*, 2018a, 2018b; Grupe *et al.*, 2017). The cultures of the Alpine and east and west Plateau regions greatly differed, despite the increase in active trade during the LBA (Jecker, 2015; Jennings, 2015). Especially, the Laugen-Melaun culture from northern Italy strongly influenced the Alpine pastoralism (Jecker, 2015; Reitmaier, 2017) (for details, see Paper 2 and 3).

The Padnal data was separately displayed but it was included in the Alpine east data. The Swiss data was compared with the additional data from north Italy and Austria. The regional grouping was as follows:

Seven groups from the Swiss Alps, Plateau, and Jura Mountains

1) **Alpine east** (the east part of Swiss Alps including Lichtenstein)
2) **Alpine west** (the west part of Swiss Alps)
3) **East Midland wetland** (the lake dwellings in the east Plateau including south Germany)
4) **East Midland dryland** (the terrestrial settlement in the east Plateau)
5) **West Midland wetland** (the lake dwellings in the west Plateau)
6) **West Midland dryland** (the terrestrial settlement in the west Plateau)
7) **Jura Mountains** (Swiss part of the Jura Mountains)

Five groups from the south-Tyrol and the north lowland in Italy, the east-Tyrol and the north-east lowland in Austria

1) **South Tyrol** (the southern part of the Alps in north Italy)
2) **South lowland dryland** (the terrestrial settlement in the northern lowland in Italy)
3) **South lowland wetland** (the lake dwellings in the northern lowland in Italy)
4) **East Tyrol** (the east part of the Alps in Austria)
5) **East lowland** (lowland in the north-east part of Austria)

The osteometric data of Swiss cattle, sheep, sheep/goat, and pigs was recorded and the chronological change between the Late Neolithic and Iron Age was assessed by using the LSI. Furthermore, only Bronze Age groups were compared with the groups from neighbouring countries. The regional groups in Switzerland are re-arranged as follows:

Swiss Alps, Plateau, and Jura Mountains

1) **Alpine (the east and west of the Alps)**
2) **Wetland (only the wetland sites in the east and west Plateau)**

3) Jura Mountains (Swiss part of the Jura Mountains)

3. RESULTS and DISCUSSION

3.1. Taphonomy

3.1.1. Identification

Altogether 40,031 specimens, and 233,146.3 g (*ca.* 230 kg) of bones were recorded in the database, of which 26,408 specimens and 213,691.4 g (*ca.* 210 kg) of bones were identified to the species level (included humans) (Fig. 3.1.1). Only 39,992 specimens, 233,057.7 g (*ca.* 230 kg) of animal bones were recorded, of which 26,369 specimens and 213,602.8 g (*ca.* 210 kg) bones were identified.

The proportion of total NISP was 66%, and the weight was 92% (Fig. 3.1.2). Unidentified specimens were small, light, and highly fragmented bones (see Appx.Tab. 1–11). The highest ratio of the determinable NISP was found in the EBA (Fig. 3.1.3) despite it producing the fewest excavated bones (Fig. 3.1.4). This suggests that the EBA bones were well preserved. The determinable NISP gradually decreased from MBA onwards, and the NISP ratio was the lowest in the LBA.

Most of the bone fragments were excavated from outside rather than inside the houses (Fig. 3.1.5) and the proportion of bones excavated outside of the houses increased after the MBA onwards (Fig. 3.1.6), indicating that it became a common practice for people to discard bone remains outside their houses. However, we were not sure whether all the bones lay at their original place when they were excavated.

The distribution of bones from the different structures in the settlement was unequal. House 2 in Field 3 during the EBA contained the most number of bone fragments (Fig. 3.1.7). The smithy (Rageth, 1986, p. 67) named House 1 in Field 3 during the E-MBA contained many animal bones (Fig. 3.1.8). Animal bones were excavated more from outside during the MBA (Fig.3.1.9). During the LBA, the central House 2 in Field 3, which may have been the house of the clan chief (Rageth, 1986, p. 72), had most of the animal bones (Fig. 3.1.10). Notably, there was always a specific house in Field 3, which contained many bone fragments, except during the MBA. In contrast, bones in Field 1 were mostly excavated from paths between houses (Fig. 3.1.11). These different ways of discarding refuse implies that there were different disposal habits between people living in Field 1 and Field 3. These details are discussed further in Chapter 3.2.5.

The bones excavated from within houses were more identifiable than those collected from outside the houses (Fig. 3.1.12), especially during the LBA (Fig. 3.1.13). This suggests that factors other than preservation influenced the ratio of identification. The mean bone weight was, therefore, assessed to determine whether there was any difference between the phases.

The mean weight of the total bones (5.8g) showed that the identified specimens were 8.1g and unidentified specimens were merely 1.4 g (Fig. 3.1.14). The EBA bones had the heaviest mean weight of identified specimens (Fig. 3.1.15). The identification of E-MBA bones was higher than those from MBA and LBA despite E-MBA bones having the lightest mean weight (*cf*. Fig. 3.1.3). If the mean weight was heavier, the ratio of identification would presumably increase, as in the case of the EBA; however, if the mean weight was lower but the ratio of identification was higher, as in the case of E-MBA, specimens would presumably be better preserved or have more identifiable features, such as epiphyses, teeth, horn core, or other characteristic skeletal elements. There was no difference in the mean weight of bones inside and outside the houses (Fig. 3.1.16–17). As a result, the higher ratio of identified bones from the houses may be more strongly related to the preservation than the mean weight. However, specimens that were less than 2 g were difficult to identify unless belonging to small mammals, birds, or fish, etc. Although more specimens were excavated from Field 1, identification was effective than in Field 3 (Fig. 3.1.18). However, the mean weight of specimens was almost the same (Fig. 3.1.19).

3.1.2. Preservation

The bone surface showed that more than half of the bones were in excellent condition (Fig. 3.1.20); however, the other half of the specimens were dried, cracked, crumbling, and frayed, probably caused by heavy wind or water erosion by rain and snow. Environmental factors, such as quantity of precipitation, temperature changes, or desiccation greatly impact the preservation of bone specimens (Lyman, 1994, p. 354).

Identification is highly dependent on the preservation of the specimens. The relationship between preservation and identification showed that the likelihood of identifying well preserved bones was two fold that of poorly preserved bones (Fig. 3.1.21). The condition of preservation at Padnal changed during the LBA (Fig. 3.1.22) which may be due to the close proximity of specimens to the ground surface. LBA layers (layer A and layer B) were more greatly influenced by natural erosion and they experienced disturbance as a result of cultivation activities after the Middle Age and onwards (Rageth, 1986, p. 74). Notably, the EBA maintained the highest identification ratio (*cf.* Fig. 3.1.3), despite it producing many poorly preserved materials. Meanwhile, preservation of the EBA remains, from the aspect of single tooth remains, was the highest among all phases (For details, see Chapter 3.4). Heavy mean weight was seen to be the most influential factor (*cf.* Fig. 3.1.15). Heavy, well preserved specimens may result in the highest identification of bone remains (Fig. 3.1.23). There was no difference in preservation between inside and outside the houses (Fig. 3.1.24). The number of well-preserved bones was related to the high identification regardless whether specimens were found inside or outside the houses (Fig. 3.1.25). Specimens from the EBA had the highest ratio of identification due to them being both well preserved and having the heaviest mean weight. In contrast, specimens from the LBA had the lowest ratio

of identification owing to their poor preservation, despite the bones not having the lowest mean weight. This indicates that preservation was the primary factor that influenced the identification ratio, and that mean weight was the secondary influential factor, in the Padnal specimens. The factor of positioning, i.e. inside or outside the house did not affect the ratio of identification. The mean weight of the bones could be affected by several factors, such as the intensity of human activities and the preservation quality of the bones.

The preservation of specimens found at Field 3 was better than those found at Field 1 (Fig. 3.1.26). Since many bones in Field 1 were deposited in paths (*cf.* Fig. 3.1.11), they were exposed to weathering by water, wind, and snow; were trampling by humans and animals; and damaged by much stronger abrasion, attributed to the different sediments occurring in Field 1 than in Field 3 (*cf.* Fig. 3.1.11). The flow of the drainage system was one of the important concerns of Padnal people (Rageth, 1986, p. 64). Water drainage flowed from the north to south direction and into the river Julia (Rageth, 1986, p. 73). The northern area (Field 1) was, therefore, generally drier than the southern area (Field 3). Field 3 could overflow and could retain moisture longer than Field 1. Since moist ground protects organic materials from microbial attack better than dry ground (Hedges, 2002, p. 321), the bones in Field 3 were likely to be less affected by such weathering.

The condition of preservation can be shown by the skeletal spectrum (*cf.* Chapter 2.2.6. Taphonomic analysis). If the ratio of the skeletal spectrum was higher than the reference value, it indicated the selection of specific body parts for consumption, rituals, or for use as bone tools. However, if the ratio of skeletal spectrum was lower than the reference value, it could be due to various taphonomical reasons; for example, the bones may have been thrown away or moved by dogs from the inhabiting zone to areas outside of the excavated area, consumed by dogs or pigs, and washed away by rains. Furthermore, the chemical composition of soil affects the preservation of bones. Although alkaline or chalky soil effectively preserves bones by reacting with calcium phosphate, strongly acidic soil dissolves bones. In addition, some skeletal parts may still be hidden outside the excavated areas because less than one half of the entire Padnal settlement was excavated.

3.1.3. Broken edges

Sharp and round edges

There were very few intact bones and most of the fragments had sharp edges which showed that they had not been moved since they were deposited (Fig. 3.1.27). The round edge fragments showed heavy erosion and movement from the original deposited point. The occurrence of these latter fragments increased during the LBA. There was no difference in the broken edges of bones excavated from inside and outside the houses, except in the case of bones that were discarded into the paths [used as footpaths and for drainage (Rageth, 1986, p. 84)] between houses during the LBA (Fig. 3.1.28). More specimens with round edges

were found from Field 1 (Fig. 3.1.29). As previously mentioned, specimens in the northern Field 1 experienced more weathering than those in the southern Field 3.

Old and new edges

The occurrence of new edged bones increased during the LBA (Fig. 3.1.30). These newly broken edges were caused by humans during the excavation, in transport to the institute, or while transferring stored specimens to a surface for identification (Davis, 1987, p. 22). A higher number of bones with new edges were found from excavations of outside (than inside) the houses during the LBA (Fig. 3.1.31) and obviously from Field 1 (Fig. 3.1.32). It could be happened because materials from Field 1 had the history of twists and turns. After the excavation and subsequent storage of specimens at the office of ASG, Switzerland, specimens were transported to the Natural History Museum in Geneva for the initial investigation (no data, Louis Chaix personal communication). Specimens were returned to the office of ASG and then transported to the University of Basel for the second investigation in 1970 (Rageth, 1986). After a few decades, the specimens were transported to a new building in the institute of IPAS, University of Basel, for the third investigation by Miki Bopp-Ito. Therefore, materials from Field 1 had more opportunities to be damaged than specimens from Field 3, which were directly transported from the office of Archaeological Service of the Canton of Grisons to our institute. It is uncertain whether the materials from Field 1 would have had a higher number of old edges such as seen in the bones from Field 3 if the specimens were directly transported to the institute and not subjected to long distance transportation.

3.1.4. Bite marks

The proportion of bones with bite marks was 2.2%, and the bones were presumably marked by dogs or pigs. Bite marks by humans or rodents were not found. The bones excavated from outside the houses during the MBA had the highest frequency of bite marks (Fig. 3.1.33–34). This is expectedly due to the MBA Padnal inhabitants having changed their disposal habits to discard their waste outside the house (*cf.* Fig 3.1.6), providing freely loitering dogs and perhaps free-ranging pigs access to these discarded bones. After the E-MBA, dogs and pigs may no longer have been fed by inhabitants and may have had to seek their own food (for details, see Chapter 3.2.2.4. Dog, and paper 1 and 3) (Appx. Photo. 1-4).

There were fewer bite marks on sheep/goat bones than on cattle and pig bones (Fig. 3.1.35). The smaller and more fragile sheep/goat bones were much easier for dogs and pigs to chew and swallow than the large and hard cattle bones. The distribution of bite marks on the skeletal elements differed greatly between the main three domestic animals. Bite marks on sheep/goat and pig bones were concentrated on the limbs. In contrast, bite marks were distributed over all the cattle skeletal elements, especially on the Vertebrae and Costae (Fig.

3.1.36). Perhaps these flat bones of cattle were too large to consume but those from sheep/goats and pigs may have been easier for dogs and pigs to eat. Therefore, bite marks on the flat bones of sheep/goats and pigs were absent from the record (Appx. Fig. 5-7). Interestingly, specimens found from inside the houses in Field 3 had a very high occurrence of bite marks (Fig. 3.1.37–38). It is unknown whether the inhabitants in Field 3 still fed their dogs inside the houses.

3.1.5. Digestion traces

Only two fragments (Astragalus and Calcaneus) from sheep/goats from Field 3 during the LBA showed traces of digestion. Both fragments had old broken edges and the bone surface had been severely corroded by the digestive juices of the stomach and intestine. It is more likely that the predator that consumed the fragments may have been a small carnivore like a dog rather than an owl or raptorial bird because Calcaneus had bite marks in addition to the heavy corrosion. If bones were digested by owls or raptorial birds, they would show less corrosion due to the shorter digestion time in the stomach (Lyman, 1994, p. 204). Anyway, there is no evidence that owls or raptorial birds occurred in Padnal.

3.1.6. Burning traces

Traces of burning were observed in 2.7% of the total bone fragments. The highest number of burnt bones was concentrated in the thickest burnt layer of the E-MBA following a great conflagration disaster (Rageth, 1986, p. 70, 84) (Fig. 3.1.39).

Most of the burnt bones were completely or partially carbonised (Fig. 3.1.40). Bones with light or dark brown scorches were burnt at temperatures lower than 600 °C (Hüster Plogmann *et al*., 2011; Lyman, 1994, pp. 385-388). There were many carbonized and calcinated bones, but some bones had changed to a pure white colour which indicated that they had been burnt at temperatures that exceeded 1,000 °C (Lyman, 1994, pp. 385-388). Since fires used in the production of bronze needed to be higher than 1,200-1,300 °C (Fasnacht, 1998, p. 235), these pure white bones might have been burnt during the smelting activities. Many calcinated bones were found in House 1 and 2 in the EBA (*cf*. Fig. 3.1.7) and House 1 and 2 in the E-MBA (*cf*. Fig. 3.1.8), despite House 2 in the EBA having not been a smithy (Rageth, 1986, p. 67-68) (Fig. 3.1.41). Burnt bones from houses (Fig. 3.1.42) might have been burnt as kitchen refuse, for disposal, or fuel for the fire place (Lyman, 1994, p. 388).

It was difficult to identify species from burnt bones because of the modification of the bone surface and the breaking of the bones into very tiny fragments (Fig. 1.3.43) (Appx. Photo. 5-6). Almost only cattle bones were found amongst the burnt bones and those that were, were predominantly from the head (Fig. 3.1.44). A black carbonized neonate human

bone was found (for details, see Chapter 3.2.4.), and it is unlikely that the bone was burnt for cremation purposes (i.e. at a higher temperature) which would have otherwise resulted in the bone being a grey-white colour (Lyman, 1994, p. 386). However, it is unknown if cremation occurred at Padnal.

Field 3 had more burnt bones (Fig. 3.1.45) and they were burnt at the higher temperature (Fig. 3.1.46), probably due to the metallurgical activities in Field 3

3.1.7. Colour changes

In total, 1.9% of bones had traces of colour change. Most of these coloured bones also had black dots and some of were coloured dark brown or yellow. Bone colouration is naturally influenced by the composition of the soil that it is preserved in. A total of 0.1% of the animal bones had changed to green colour (Fig. 3.1.47). Green-coloured bones were found in abundance from the E-MBA House 1 in Field 3 which was a smithy with smelting activities (Rageth, 1986) (for details of houses, see Chapter 3.2.2.1., and paper 1). Green colouration may also indicate that bones were preserved in close proximity to bronze (alloy of copper and tin) objects and which would have changed to green colour in the presence of oxygen, carbon dioxide, water, or salt.

3.1.8. Conclusion of taphonomy

Approximately 60% of the total number of animal bone fragments was identified to the species level. This low ratio may be due to the poor preservation and heavy fragmentation of specimens. However, there was a sufficient amount of NISP data to use in analyses to further insights into the relationship between animals and humans in the Padnal settlement.

3.2. Species

3.2.1. Preliminary note

The proportion of domestic animals (cattle, sheep/goat, pig, dog, and horse) showed 99.6% of the NISP and 99.3% of the weight (for details, see tables in Chapter 8.3). The most dominant animal was cattle, followed by sheep/goats. The NISP of wild animals was 0.4% and 0.7% of the weight (Fig. 3.2.1–3.2.2). Almost no specimens from small animals, such as small mammals, birds, reptiles, fish, or insects were found due to the excavation and collection by hand (Appx. Tab. 1-11, 27-38).

3.2.2. Domestic animals

3.2.2.1. Cattle (*Bos primigenius f. taurus*)

Proportion of cattle frequency

Cattle were the most important animal in Padnal. A total of 54% of the NISP (n = 14,151), and 79% of the weight *ca.* 168 kg (167,872 g, mean weight = 11.9 g) of specimens were cattle (*cf.* Fig. 3.2.1–3.2.2). The NISP and weight of cattle specimens increased up to 60% and 80%, respectively, during the LBA (Fig. 3.2.3–3.2.4). This suggested that the economic needs of cattle increased at Padnal (for details, see paper 1 and 2).

Mortality profile

The obvious change in the cattle mortality profile was found during the LBA with the rapid increase in the number of senile cattle (Fig. 3.2.5) (for details, see paper 1). These findings indicate an intensification of secondary products (e.g. Greenfield, 2010; Halstead and Isaakidou, 2011). Most of the cattle in the previous phases were killed at a younger age (i.e. young adult) for the primary product; meat. The LBA senile cattle may have served as working animals, and perhaps, for milk production; however, the later proposed idea requires further investigation, such as a lipid analysis (e.g. Carrer *et al*., 2016). Exploitation of cattle as drought animals was principally needed for the expansion of cultivation fields to meet the increasing food demand during the LBA (Rageth, 1986, p. 73) and for bronze production and mining (Rageth, 1986; Stopp, 2015).

Little is known about the mining activities in Switzerland (Della Casa, 2003; Della Casa *et al*., 2016; Doonan, 1999; Fasnacht, 1998, 1999; Primas, 1999; Rageth, 1986; Rychner, 1995; Rychner and Fasnacht, 1998). Although many Iron Age mining spots were located in the

vicinity of Padnal, the one in the Bronze Age had not been found until recently (Della Casa *et al.*, 2016). Regardless, the district Oberhalbstein where Padnal was located was the biggest area for copper production; however, Bronze Age roasting pit, smelting or refining furnace, or raw copper near Padnal have not yet been found (Della Casa *et al*., 2016; Fasnacht, 1999; Rageth, 1986, 2000, p. 37; Schaer, 2003). However, the Canton of Grisons contributed to the only precise traces of the prehistoric copper exploitation in Switzerland (Rychner, 1995). Since the EBA, the Padnal settlement may have been primarily located for bronze production (Della Casa *et al.*, 2016). A large quantity of cattle meat could have been utilised by the miners at the mining spots in the vicinity of the settlement in response to a surplus of meat production, and because cattle may have been exploited to deliver food to the miners and return heavy copper ore to the settlement, especially the LBA cattle.

The neighbouring settlement "Cazis" showed the same pattern of mortality profiles (Plüss, 2011). It is suggested that the change in cattle exploitation during the LBA was in the accordance with the intensification of bronze production and which occurred in the entire Alpine east region. This sudden economic change might be attributed to the new immigrants from the southern part of the Alps who introduced the Laugen-Melaun culture to the area (Jecker, 2015; Reitmaier *et al*., 2017). The development of milk production at Padnal may have been possible due to the expansion of the pasture ground, especially after the MBA (Nicolussi, 2012; Röpke, *et al*., 2011). The exploitation of milk production of Padnal senile female cattle will be confirmed in the near future.

Sex ratio

The sex ratio based on horn cores and Pelvis exhibited a cattle population of roughly half females (n = 44) and half males/castrated males (n = 56) (Fig. 3.2.6). There was no change in the sex ratio except in the MBA where there were few female cattle; however, this may be due to the extremely small sample size of this age (total n = 14) (Fig. 3.2.7). Female cattle were consistently slaughtered when they were adults; however, male/castrated male cattle were killed at various stages of age (Fig. 3.2.8). Female cattle were used for meat and possibly for milk; however, no senile adult female cattle were identified. On the other hand, male/castrated male cattle were slaughtered from young to senile ages, indicating their exploitation for meat and as draught animals (Deschler-Erb and Marti-Grädel, 2004; Hüster Plogmann and Schibler, 1997) (for details, see paper 1 and 2).

The probability of LBA female cattle was estimated to be 70% by fitting a *finite mixture model* (McLachlan and Peel, 2000) based on Metacarpus Bd (greatest breadth of distal end), and estimated using *meta-analytic techniques* (Russo, 2007) (for details, see paper 2). Despite the high proportion of female cattle, there was no significant difference between the cattle population of Padnal and other Swiss Late Neolithic and Bronze Age settlements (tau = 0.0, p = 0.551). Since there were no data for the probabilities of female cattle between the EBA and MBA owing to the scarcity of samples, it was not possible to calculate the change in sex ratio.

Body size

It was not possible to calculate the Wither height of cattle due to the lack of intact long bones, since cattle bones at Padnal were highly fragmented (*cf.* Chapter 3.1.3, broken edges). However, cattle provided the largest amount of osteometric data among the species.

The distribution of size from each skeletal element showed that a few large and very large cattle existed in each phase, especially during the E-MBA and MBA (Fig. 3.2.9a–3.2.9b). Male or castrated male cattle were presumably exploited as draught animals and for breeding purposes. There were two remarkably large horn cores (House 2 (52): excavated point 78 (b) and 176) in the EBA (Horizont E, Field 3) and one Ulna (House 1 (411): excavated point 82 (b)) fragment in the E-MBA (Horizont D, Field 3) from bovines. The two horn cores were genetically identical (Ulna was not reproducible) and belonged to the mitochondrial d-loop haplogroup T2 of cattle (*Bos taurus*) (Harmath *et al*., 2017; Angela Schlumbaum at IPAS personal communication) (for details, see paper 1 and 2). However, the LSI showed that there was no difference in the size of adult cattle between phases but that the EBA subadult to adult cattle group was the smallest among all cattle groups (Fig. 3.2.10–3.2.11). The first immigrants into Padnal presumably brought small-sized cattle with them perhaps from the southern parts of the Alps (for details, see paper 2).

Pathological and anatomical changes

Only 0.2% of the total bone samples showed traces of pathology in cattle specimens and this proportion gradually increased by the LBA (Fig. 3.2.12). The main pathological symptoms were arthritis of joints, exostoses, lipping, modification of epiphyses, or bone multiplication after injury of fractures (Fig. 3.2.13). The pathological symptoms were found mainly in adult and senile adult cattle.

The relationship between the size and pathological stage was observed using Phalanx 1 and 2 according to the protocol of Bartosiewicz *et al*. (1997) (Fig. 3.2.14–16). The pathological bones obviously belonged to a large cattle species. It is probable that they belonged to a bull or ox that was exploited as a draught animal for carrying heavy loads, such as bronze products (Rageth, 1986), trading items (Jennings, 2015), hay for winter fodder (Thomas Reitmaier at ASG personal communication), or farming produce (Hüster Plogmann, 2002; Hüster Plogmann and Schibler, 1997; Schibler and Studer, 1998). Mostly 1 and 2 degrees of pathological stages were observed in Padnal cattle. The reasons for the absence of heavier pathological stages in these cattle could be the predominant soft earth roads in the Bronze Age (Bartosiewicz *et al*., 1997), and the death of the animals before the occurrence of bone deformation (*cf*. Fig. 3.2.5). Heavy arthritis was found in the Pelvis bones after the MBA and onwards and the occurrence of abnormal figure of dentition and other

diseases also increased during this time (Fig. 3.2.17–22), presumably due to the aging phenomenon.

3.2.2.2. Sheep (*Ovis ammon f. aries*) and Goat (*Capra aegagrus f. hircus*)

Proportion of sheep and goat frequency

Sheep and goats were the second most important animals. Their NISP was 9,878 and the weight was *ca.* 29 kg (29,403 g, mean weight = 3 g). The majority of sheep/goats were kept in the settlement until the MBA. There was a reduction in the amount of sheep and goats during the LBA (Fig. 3.2.23–24) which showed exactly the opposite trend of cattle (*cf.* Fig. 3.2.3–3.2.4). This may be a result of the intensification of cattle meat (Bopp-Ito, 2012) and milk production instead of goat meat and milk (Plüss, 2011). The ratio of sheep and goats was four to one (Fig. 3.2.25). Sheep increased approximately up to 90% during the LBA (Fig. 3.2.26–3.2.27). It may seem possible to infer that this increase was due to a higher production of wool; however, their mortality profile did not indicate this possibility.

Mortality profile

The slaughter pattern of sheep/goats was the opposite of that of cattle. After the MBA onwards, the number of senile sheep/goats declined remarkably (Fig. 3.2.28). In contrast, there were dominant senile sheep/goats during the E-MBA but it appeared to only be a temporal increase. The comparison of sheep and goat mortality profiles showed that both were mostly slaughtered after two years old in the adult stage (Fig. 3.2.29). These animals contributed greatly to the subsistence of Padnal inhabitants by providing vital products, such as meat, wool, and milk. Interestingly, more lambs were slaughtered than kids before they reached one year old. One of plausible exploitations of lambs is for their soft meat; however, it is possible that lambs may have been used as sacrificial animals (Deschler-Erb, 2008) and in some feasts, such as good harvest or spring thanksgiving.

Sex ratio

The ratio of female sheep was one fifth, in contrast to that of female goats which was two-thirds of total goats (Fig. 3.2.30). This difference between sheep and goats indicated a sexual selection of the slaughtered animals; however, there was no chronological change (Fig. 3.2.31). Some male and castrated male sheep were killed when they were very young, but most of the adult sheep and goats, regardless of sex, were perhaps used for wool and milk production (Payne, 1973) (Fig. 3.2.32–3.2.34). Wool production may have been especially important to high altitude settlers, such as in Padnal to create clothing items to

protect from the cold. Dominant adult female goats may have been exploited for milk production (Plüss, 2011).

Body size

Wither heights of sheep at Padnal were between 48 cm (perhaps the smallest female) and 63.5 cm (perhaps the largest male) (Fig. 3.2.35). Padnal sheep were smaller than other Swiss LBA sheep: female 51.5–65.0 cm, mean = 58 cm; male 60.4–69.5 cm, mean = 66 cm, as described by Studer (1991). It was not possible to calculate the Wither height for goats due to the lack of intact long bones. There was no chronological difference in size (Fig. 3.2.36–37b). LSI values of sheep and all sheep/goats did not show any significant difference between phases (Fig. 3.2.38–39); however, notably, the sample sizes used in the statistical analysis, particularly for sheep, were very small.

Pathological and anatomical changes

Pathological changes were found only in 0.04% of the bones of the NISP of sheep/goats. This small proportion may be due to fewer numbers of senile individuals than cattle. Therefore, most of the sheep and goats died or were killed before any significant anatomical changes occurred in the bones. The absence of arthritis or exostosis bones showed that none of sheep and goats was used as draught animals, i.e. for transporting heavy goods or cultivating fields, as was the case for the cattle (Fig. 3.2.40–42). Most of the roots of teeth from adult sheep and goats were shorter and the end points of the roots were heavily ramified; nevertheless, their enamel and crowns were not worn-out. It is not clear whether these observed anatomical changes in the roots of teeth were due to poor preservation of the specimens.

3.2.2.3. Pig (*Sus scrofa f. domesticus*)

Proportion of pig frequency

Pig may have constituted less than 10% of the domestic animals, but were still the third most important animal at Padnal. The NISP of pig was 2,138 and their weight was *ca.* 14 kg (14,210 g, mean = 6.6 g) (Fig. 3.2.43–44). The number of pigs increased during the LBA, possibly due to the increase in the demand for meat production that was linked to an increase in bronze production.

Mortality profile

Most pigs were slaughtered when they were in the young adult stage. The occurrence of senile pigs declined by the LBA; however, in contrast, the occurrence of subadult pigs

increased (Fig. 3.2.45). These results indicate that since LBA Padnal settlers produced a sufficient amount of meat from cattle, they perhaps ate the soft, young pig meat as a luxury food (Bopp-Ito and Deschler-Erb, 2007; Deschler-Erb *et al*., 2007).

Sex ratio

Throughout the Bronze Age, one-fourth of the pigs at Padnal were females (n = 21) and the remainder were males and castrated males (n = 68) (Fig. 3.2.46–47) which is a typical pattern of meat production (Payne, 1973). The correlation between sex ratio and age showed that slaughtered young pigs were only male and castrated males, and that the females were presumably allowed to age and reproduce (Fig. 3.2.48).

Body size

Wither height of pigs using the factor by Teichert (1969) was between 76 and 81 cm (Fig. 3.2.49). Since Central European domestic pigs decreased in size in the Neolithic period to between 60 and 85 cm and retained this size until the Middle Age (Teichert, 1970), Padnal pigs were found to have maintained a relatively larger, stable size throughout the Bronze Age.

There was no chronological difference in the size of skeletal elements (Fig. 3.2.50a–50b). LSI values were not significantly different between phases (Fig. 3.2.51) and the size of pigs at Padnal did not appear to change throughout the Bronze Age. It suggested that there were stable pig husbandry practices at Padnal throughout the Bronze Age.

Pathological and anatomical changes

Only 0.1% of the total pig bone fragments showed pathological changes. Since pigs were only bred for meat production and not for any other exploitation, there was far less evidence of lesions or arthritis. There were three pig teeth that had severely worn-out crowns. These senile adult pigs perhaps suffered from severe periodontitis (Fig. 3.2.52–55). This is a disease that appears to progress with age (Page and Schroeder, 1982; Samuel and Woodall, 1988) and these inflammatory and degenerative diseases of the periodontal tissues are common in domestic mammals (Harvey, 1985). These heavily worn-out pig teeth indicated that Padnal pigs may have been produced with a free-range management in the settlement; however, were they probably fed discarded food from the inhabitants during the long, snowy winters (Hamilton *et al*., 2009).

3.2.2.4. Dog (*Canis lupus f. familiaris*)

The proportion of dog was only 0.5% of the NISP (total n = 93), *ca*. 0.5 kg (506 g, mean = 5.4 g). Dogs were consistently kept in the settlement but their numbers gradually declined (Fig. 3.2.56–57). The deposited dog bones were deliberately buried at the corner of inside of House 2 in the EBA and most of them were intact. Such a burial pattern suggested that these

bones were from one individual dog (Benecke and Lichardus, 1999) (Fig. 3.2.58). This EBA dog (hereafter referred to as dog No. 1) was obviously buried with a great care, presumably by House 2 inhabitants. Missing Phalanx on the one limb may have be eaten by other dogs or pigs, and in addition, the skin and fur was found to have been peeled from the body (Studer, 1991) (for details, see paper 1).

Another dog was excavated from the same corner of the House 2 (hereafter referred to as dog No. 2) but the surface of the Tibia bone of this dog was found to have cut marks and bite marks. This indicates that dog No. 2 may have been slaughtered possibly for consumption by humans and it is possible that the remains were fed to other dogs or pigs (Horard-Herbin, 2000; Schibler and Studer, 1998). It was apparent that there were different ways of managing the dog population at Padnal during the EBA and that in the later phases, many of the dog bone fragments were found to have been discarded outside the houses with the refuse. The role of dogs in the settlement appears to have changed completely after the E-MBA and thereafter (*cf*. Chapter 3.1.4. Bite marks). As a result, dog No. 1 appears to have been the exception and it is likely that it lived as a human companion, while the other dogs appeared to have been systematically exploited for meat consumption and for their fur coats after they had served roles, such as guarding, herding, or hunting (Schibler and Studer, 1998).

The age of the two EBA dogs were over 6 years old (Horard-Herbin, 2000). Tooth wear indicated that dog No. 2 was much older than dog No. 1. Their wither heights, calculated based on the factor by Harcourt (1974), were between 43.7 cm and 46.2 cm, and the mean was 45.2 cm but other phases were unavailable for calculation (Fig. 3.2.59). Bronze Age dogs were between 49 cm and 64 cm, and the mean was 57 cm (Schibler and Studer, 1998), EBA Padnal dogs were much smaller than the average of Bronze Age dogs. Wither heights of EBA Padnal dogs were as small as Late Neolithic Plateau dogs (Arbogast *et al*., 2006; Chaix, 1976b; Hüster Plogmann and Schibler, 1997) or EBA north Italian dogs (Riedel, 1976a, 1976b). Domestic animals at Padnal seemed a deep relationship with north Italian human communities (for details, see paper 2).

Because there were no dog specimens from Cazis from which to calculate their wither height (Plüss, 2011), the mean of osteometric values between Padnal and Cazis dogs from the EBA were compared (Fig. 3.2.60). There was only a slight difference in size between Padnal and Cazis dogs. The Alpine east community appeared to have had smaller dogs, at least during the EBA.

3.2.2.5. Horse (*Equus caballus*)

Only one intact of 6th Vertebra lumbalis, weighing 35.5 g, was excavated from House 23 (named by Miki Bopp-Ito for convenience) in Field 1 in the LBA. The ratio was merely 0.004% of the NISP. The size of Vertebra lumbalis from Padnal was smaller, at least compared to a reference collection of horse bones (z-1605, *Equus caballus* from the modern Holsteiner Wallach breed, IPAS, University of Basel) (for details of osteometric data, see Appendix

Table 26). No bronze objects or harnesses used for riding horses were found from Padnal (Jürg Rageth at ASG personal communication). Only two fragments of horse bones were identified to the family level (Equidae) in Cazis (Plüss, 2011). Bronze Age horses in Switzerland may have been domestic horses (Schibler, 2017; Schibler and Studer, 1998). The frequency of horses in the Alpine east region was apparently very low (*cf*. Chapter 3.4).

3.2.3. Wild animals

The hunting of wild animals appeared to be of low importance for Padnal inhabitants. The proportion of wild animal bone specimens was merely 0.4% of the NISP (n = 108) and the weight was *ca*. 1.6 kg (1,575.9 g, mean = 14.6 g) (for details, see paper 1). The occurrence of wild animal bones was reduced to half by the LBA; however, various wild animals were apparently still hunted. The most commonly hunted wild animals were wild boar, Alpine ibex, and red deer. Roe deer were also regularly hunted; however, there were only a few excavated specimens of the remainder of the wild animals, such as brown bear and birds. The House 23 in Field 1 during the LBA may have belonged to a hunter because numerous and various wild animal bones from red deer, roe deer, brown bear, and wood pigeon, as well as bones from domestic animals (cattle, sheep, goat, pig, dog, and horse) excavated from this site. In addition, human bones were also excavated from this site. It is possible that the Padnal community in the LBA had a specialised structure of people or groups with specific skills or responsibilities, e.g. farmers, hunters, a chief, bronze producers, shepherds, butchers, traders, etc.

The occurrence of wild animals in the archaeozoological record of Padnal provides information and evidence that can be used to reconstruct the ancient environment surrounding the settlement as well as offer insights into the hunting activities of the inhabitants (Fig. 3.2.61). It is possible that inhabitants climbed up over the timber line to hunt ibex. They may have hunted wild boars, brown bears, and wild pigeons or doves in the wide broad leaf forests and, although apparently seldom, they may have hunted red deer or roe deer in the open forests. Greylag geese were probably caught from the river nearby to the settlement.

In general, far fewer wild animals were hunted in the Bronze Age than in the Neolithic period (Schibler, 2017; Schibler and Studer, 1998) and far fewer wild animals were hunted in the Alpine than in the Plateau regions (Plüss, 2011; Schibler, 2017; Stopp, 2015) (for details, see Chapter 3.4). It can be assumed that wild animals at Padnal were not hunted for economic reasons, but perhaps rather for recreational or religious reasons.

3.2.3.1. Red deer (*Cervus elaphus*)

Red deer was the third most important wild animal to the Padnal inhabitants. The NISP was 0.06% (total n = 15; *ca.* 200 g) throughout the Bronze Age but they were regularly caught in each phase, especially during the MBA (Fig. 3.2.62).

Padnal people did not appear to gather shed antlers in March and April (Clutton-Brock and Albon, 1989) because very few antler fragments (2.7 g) were excavated, and only from Field 3 in the EBA. Red deer may, therefore, have only been hunted in autumn (Plüss, 2011) for meat and the Padnal community did not appear to be interested in creating artefacts from the antlers (for details, see Chapter 3.3.5. Artefacts).

3.2.3.2. Roe deer (*Capreolus capreolus*)

Roe deer represented only 0.03% of the NISP (total n = 7; *ca.* 34.2 g) throughout the Bronze Age. There was only one specimen from Field 3 in the E-MBA, and the other six specimens were excavated from Field 1 in the LBA (Fig. 3.2.63).

The habitat of roe deer occurs between the open field and border of the forest zone and they are distributed throughout Switzerland (Blant, 1988). However, despite their high population density, Padnal people did not need to hunt roe deer for meat. Instead, roe deer was possibly only be hunted as luxurious seasonal meat or when the opportunity arose.

3.2.3.3. Ibex (*Capra ibex*)

Ibex was the second most important wild animal to the Padnal community, with a ratio of 0.06% (total n = 17; *ca*. 350 g) throughout the Bronze Age (Fig. 3.2.64). Most of the ibex fragments were of horn cores and long bones.

3.2.3.4. Wild boar (*Sus scrofa*)

Wild boar was the most important wild animal to the Padnal community. The ratio was 0.2% (total n = 59; *ca*. 950 g) throughout the Bronze Age (Fig. 3.2.65). Wild boars accounted for half of the total hunted wild animals; however, their numbers reduced during the LBA. There was no apparent sexual selection of wild boars by the Alpine settlers as female and male wild boars were hunted equally in both the Padnal (Fig. 3.2.66) and Cazis settlements (Plüss, 2007, 2011).

Wild boars often inhabit high density forests that are comprised of beech, oak, and chestnut, or arable lands near to settlements because they are typically omnivorous and probably opportunistic scavengers of discarded food. Wild boars avoid high mountains, especially lingering snow that is more than 60 cm thick, which occurs in the high Alpine valleys (Baettig, 1988). Since Padnal was surrounded by a dense conifer wood (Rageth, 1986), inhabitants would have had to go down to the broad leaf forest to hunt wild boars. The highest ratio of wild boar bones indicated that they probably lived in close proximity to the settlers and that their meat was more popular than that of ibex and red deer. Despite the high occurrence of wild boar in the archaeozoological records of Padnal, the total population of wild boar in the Swiss Alpine and northern Italian regions was very small throughout the Bronze Age (Riedel, 1986d). In general, wild animals in the Alpine region were not hunted out of necessity.

3.2.3.5. Brown bear (*Ursus arctos*)

There was only a single record of a brown bear and the bone ratio was, therefore, only 0.004% (total n = 1; 25.7 g) of the total number of specimens. Only one Ulna fragment was excavated from House 23, possibly the hunter's house, in Field 1 during the LBA. A canine tooth ornament from the EBA was reported by Rageth (1981). This evidence suggests that brown bears may have been regarded as a kind of symbolic animal for Padnal people. Since 1904, there have been no reported sightings of brown bears in the Canton of Grisons (Hainard, 1962) but they may have been hunted in the Alpine region during the Bronze Age (*cf*. Chapter 3.4).

3.2.3.6. Small mammals

Two Muridae bone fragments were found at Padnal. A single, intact Cranium of a yellow-necked field mouse (*Apodemus flavicollis*) was excavated from Field 3 during the E-MBA (total n = 1; 0.4 g). A Mandibula of a kind of field mouse (*Apodemus spp.)* was excavated from Field 3 during the LBA (total n = 1; 0.1 g). Since these species usually live in fields, they might be strayed into the settlement and naturally died there.

3.2.3.7. Birds

Two Pelvis specimens of graylag goose (*Anser anser*) (total n = 2; weight = 1.3 g) were excavated from Field 3 during the E-MBA. Since the graylag goose is a migratory species that moves in a flock, it is possible that they may have flown into the Alps during the summer time (when they were presumably caught) because the river Julia just beside of the southern part of settlement or the river Rhine may have frozen over or have been too cold for them during winter.

A single Ulna from a white stork (*Ciconia ciconia*) (total n = 1; 1.7 g) was excavated from Field 3 during the LBA. White storks are also a migratory species and they fly southwards during winter. The white stork at Padnal was perhaps also caught in summer.

Two columbiforms were identified at Padnal. One Ulna of a stock dove (*Columba oenas*) (total n = 1; 0.4 g) was excavated from Field 3 during the E-MBA. Stock doves were historically widely distributed in the Canton of Grisons (Plüss, 2007, 2011). They have the ability to return to their own nest each breeding season, despite not being migratory birds (Gibbs *et al*., 2001). One Ulna of a common wood pigeon (*Columba palumbus*) (total n = 1; 0.6 g) was found in Field 1 during the LBA. Wood pigeons are migrant species and are widely distributed throughout Europe. The wood pigeon is larger than the stock dove, with a body size of approximately 38.0–44.5 cm and a wingspan range of 68–80 cm (Dunning, 1992). These columbiforms may have lived in the forest near to the Padnal settlements and were perhaps eaten by the hunter in House 23.

3.2.3.8. Others

A single shell of a grapevine snail (*Helix pomatia*) (total n = 1; 1.2 g) was excavated from Field 3 during the EBA.

A single Humerus of a toad (*Bufo spp.*) (total n = 1; 0.3 g) was excavated from Field 3 during the E-MBA.

3.2.4. Humans (*Homo sapiens*)

Some human bone fragments (n = 39, weight = 88.6 g, mean = 2.3 g) were discovered amongst the animal bones. The highest proportion of the NISP was found in the MBA but the highest weight was found in the LBA (Fig. 3.2.67–68). There was no evidence of a cemetery, neither inside nor outside of the settlement (Rageth, 1974, 1976-1986). Two of the human bones found during the E-MBA had burnt traces, although it is not certain if they were burnt during a cremation. There was a possible crematorium for Padnal inhabitants in "Tinizong" near the settlement dated between the EBA and MBA (Rageth, 1993, 1994, 2000).

The mortality profile showed the high number of neonates/foetuses (Fig. 3.2.69). Neonatal/fetal body size was calculated using the factor by Fazekas and Kosa (1978), and was calculated to be between 42 and 56 cm (Fig. 3.2.70). There were at least four neonates or foetuses in Field 3.

An intentional burial pattern was observed because most of the neonates/foetuses were buried at the same excavation point of the house floor (Fig. 3.2.71). Padnal people buried neonates/foetuses under their house floor (or inhabitants would have kept corpses on their house floors instead of burying them) perhaps in memory of the child or in wishing for the child to be reborn. There is archaeological evidence in Japan during the Middle of Jomon Period (5,500–4,500 BC by C14 dating) that inhabitants keep stillborn neonates or new-born babies in earthenware pots and buried them inside the house to encourage their revival (Otsuka and Tozawa, 1996). The same burial style for neonates/foetuses was also found at Cazis (Plüss, 2011). It is likely that a cemetery for Padnal inhabitants existed somewhere outside of the settlement and that only neonates/foetuses were buried inside the settlement. There were some human bone fragments from young, adult, and age-undetermined humans; however, the reasons why they were scattered throughout the settlement is unknown.

Neonate bones were grouped in order of the same excavated points (Fig. 3.2.72–79).

3.2.5. Proportion of species in Padnal

3.2.5.1. Proportion of species between phases

Cattle were the most dominant animals at Padnal and their numbers drastically increased during the LBA. Sheep, goats, and pigs also represented high proportions of the domestic animals and dog, horse, and wild animals were scarcely represented in the excavated bone

specimens (Fig. 3.2.5.1–3.2.5.2). In contrast to the reduction of sheep and goats, the number of cattle suddenly increased during the LBA (Fig. 3.2.5.3–3.2.5.4). There were fewer pigs during the EBA but their numbers doubled after the E-MBA and onwards. The increased in cattle and pigs during the LBA may suggest that a surplus of meat was produced, possibly to support mining labour.

3.2.5.2. Proportion of species between structures

The structures were separated into two categories: houses (inside) and paths (outside) in Field 1 and 3. Interestingly, the main three animals, i.e. cattle, sheep/goats, and pigs were excavated equally from inside and outside the houses, but dog, horse, and wild animal bones were mainly found inside of the houses (Fig. 3.2.5.5).

The difference in consumption patterns of the species in each house between the EBA and LBA was observed in Field 3. EBA House 1 had more sheep/goats with north Italian ceramics (Rageth, 1980, 1986) (Fig. 3.2.5.6). This house was assumed to be the smithy of the village based on the abundance of bronze remains (for details, see paper 1). In contrast, House 2 was found to have more cattle with south German ceramics. Two dogs were buried at the corner of this house (*cf.* 3.2.2.4. Dog). Furthermore, this House 2 had two big horn cores from cattle with a T2 mitochondrial haplogroup (Bopp-Ito, 2012; Bopp-Ito *et al.*, 2018a; determined by Angela Schlumbaum at IPAS). These Near East lineage T2 cattle (Beja-Pereira *et al.*, 2006) may have been brought into Padnal by immigrants from the south Germany region during the EBA, although there were several possible routes between the north and south (Bonfiglio *et al.*, 2010; Cortés *et al.*, 2008; Harmath *et al.*, 2017; Hristov *et al.*, 2015) (for details, see paper 2).

During the E-MBA, House 1, 2, and 3 had far more cattle remains and House 1 and 2 were presumed to be smithies by Rageth (1986) (Fig. 3.2.5.7). There was a higher incidence of sheep/goat remains in House 4 (for details, see paper 1). There was only one house in Field 3 during the MBA and no longer difference in the consumption patterns between house and outside (Fig. 3.2.5.8).

The different consumption patterns until the MBA were probably affected by the different cultural traditions of each immigrant. However, this difference changed during the LBA. House 2 and 3 had more cattle, and House 1 had substantially more sheep and goats (Fig. 3.2.5.9). However, it is noteworthy that there were very few animal bones from House 1 and 3. Rageth (1986) assumed that the large central House 2 may have been the house of the chief of the village or the house of more than one family, and House 1 and 3 were presumably sheds for animals. The low number of animal bones found in House 1 and 3 supports the hypothesis of Rageth that these houses were used as huts for domestic animals during the winter.

The relationship between the mortality profiles of cattle and sheep/goats and the consumption patterns of each structure may indicate the strength of the economic system.

The higher incidence of senile cattle in EBA House 1, a smithy, may indicate that these animals were working animals used in the production of bronze, during which more sheep/goats were consumed when they were subadults. In contrast, there was a higher incidence of slaughtered subadult cattle in EBA House 2, possible for meat production and because they bred dominant cattle (Fig. 3.2.5.10). Therefore, the secondary product of cattle as working animals at the Padnal settlement had already begun during the EBA (Greenfield, 2010; Halstead and Isaakidou, 2011). It is possible that there were different economic roles between the Padnal inhabitants, e.g. one household may have used cattle as working animals for the bronze production and possibly for agricultural activities, and another household may have used cattle to supply meat to the miners. It is expected that the EBA inhabitants co-operated for a common economic purpose.

Similar aspects were seen to have continued during the E-MBA (Fig. 3.2.5.11). The smithy House 1 kept senile cattle but smithy House 2 slaughtered many subadult cattle. Although both houses were assumed to be smithies, the different exploitations of cattle (as previously observed) continued in each house. Senile cattle in House 1 were presumably used as working animals and not for milk production, which is also supported by the scarcity of calves (Payne, 1973). Thus, the secondary product of cattle, i.e. as working power is shown to have begun during the EBA. The production of milk from cattle during the E-MBA could not be clarified due to the lack of co-occurrence of infant and senile cattle.

The combination of infant and senile cattle was observed for the first time during the MBA. It suggested that this is when dairy production of cattle began at Padnal; however, in comparison to practices in north Italy, Padnal dairy production was in its early stages (Riedel and Tecchiati, 1998) (Fig. 3.2.5.12). The expansion of the Alpine meadow during the MBA supported this hypothesis (Nicolussi, 2012). Certain aspects completely changed during the LBA. Senile cattle were dominant in the all structures except House 1 due to the lack of cattle teeth for age identification (Fig. 3.2.5.13). The combination of infant and senile cattle suggested the continuation of dairy production. However, the sex ratio of females did not support this hypothesis (*cf.* 3.2.2.1. Cattle). Therefore, it can only be confidently stated that Padnal cattle during the LBA were exploited for meat and working power, and whether or not Padnal inhabitants used cattle for milk production is still open for debate (for details, see paper 1, 2, and 3).

3.2.5.3. Proportion of species between Field 1 and Field 3

It is only possible to draw comparisons between Field 1 (north) and Field 3 (south) during the MBA and LBA. A greater number of animal bones were excavated from outside of the houses in both fields; however, most of the specimens were found in Field 1 (Fig. 3.2.5.14). In MBA, Field 1 contained double the number of cattle specimens than sheep/goats and Field 3 contained about half of the number of specimens found in Field 1 (Fig. 3.2.5.15). However, in the LBA, the proportion of cattle changed in Field 3 and there was no longer a

difference in the excavated specimens between Field 1 and 3 (Fig. 3.2.5.16) (Appx Tab. 4–10). In addition, there was no difference in the proportion of dogs between fields.

The mortality of cattle showed different profiles between Field 1 and 3 during the MBA. Mostly young adult cattle were slaughtered in Field 1 and mostly calves were slaughtered in Field 3 (Fig. 3.2.5.17). This difference did not continue into the LBA, and instead both fields had a high proportion of senile cattle. However, the mortality profiles of sheep/goats and pigs differ between Field 3 and Field 1, with a higher incidence of senile individuals in the former than in the latter (Fig. 3.2.5.18–19). Interestingly, there was a higher frequency of butchering traces (cut and chop marks) on cattle bones from Field 1 and a higher frequency of butchering traces on sheep/goat bones from Field 3. However, the social difference observed in the Neolithic settlement Arbon 3 (Deschler-Erb and Marti-Grädel, 2004), was not observed between these two fields.

3.2.6. Conclusion of species

Domestic animals were very important for the subsistence of the inhabitants of the Padnal settlement. Wild animals were rarely hunted. The most dominant domestic animal was cattle. Cattle were exploited for the surplus production of meat and for working power, and cattle numbers increased during the LBA. Milk production may date back to the MBA; however, this could not be verified in this study. Sheep and goats were used for meat, milk, and wool. Different eating habits were observed between inhabitants perhaps in accordance with different cultural traditions. The number of pigs increased during the LBA for meat production. The increase in meat production at Padnal may have been related to an increase in bronze production. A noteworthy change occurred in the animal husbandry practices in terms of the exploitation at Padnal during the LBA.

3.3. Evidence of human activity on animal bones

The skeletal spectrum, fragmentation, butchering traces on animal bones, and bone artefacts assist in the reconstruction of historical human activities with animals (*cf.* Chapter 2.2.6: Taphonomic analysis).

3.3.1. Skeletal spectrum

The distribution of the skeletal spectrum was based on the weight of bones from three main domestic animals: cattle, sheep/goats, and pigs, was observed (Becker, 1986, p. 254). Skeletal elements were separated into five groups (*cf.* Chapter 2.2.6).

3.3.1.1. Cattle

There was no difference in the cattle skeletal spectrum between periods. Mandibula fragments increased, whereas long bones decreased during the LBA. Rumpf bones, such as Vertebrae and Costae were missing throughout the Bronze Age (Fig. 3.3.1), possibly owing to the consumption by dogs and/or pigs. Since bite marks on Rumpf bones were extremely scarce, it is likely that these types of bones were otherwise entirely consumed.

Such a distribution of the skeletal spectrum is typical of a meat producing settlement (Marti-Grädel *et al*., 2012; Schibler *et al*., 2011). Padnal inhabitants practiced a self-sufficient way of life by producing cattle meat within the settlement. There was no difference between Field 1 and 3.

3.3.1.2. Sheep/goat

There was no difference in the sheep/goat skeletal spectrum between periods. Compared to the abundance of Mandibula and Tibia, there were very few Vertebrae (Fig. 3.3.2). Since Vertebrae and Costae of sheep/goats are characteristically fragile bones, they may have been completely eaten by dogs or pigs. There was also no difference between Field 1 and 3.

3.3.1.3. Pig

There was a slight difference in the skeletal spectrum of pigs between periods. Compared to the similar distribution in terms of the reference value during the EBA, there were more Mandibula, Scapula, and Humerus bones in the later periods (Fig. 3.3.3). This provides evidence of the development of meat production because the shoulder and upper arm parts produce the biggest quantity of pork meat (Schibler *et al.*, 2011). It suggested that the demand for pig meat increased in the settlement after the E-MBA and onwards. There was difference in the skeletal spectrum between Field 1 and 3. Numerous Mandibulae were found only in Field 1 during the LBA.

3.3.1.4. Conclusion of skeletal spectrum

The skeletal spectrum from three main domestic animals exhibited no chronological change and instead had similar distributions, although the distribution of EBA pigs was slightly different (Fig. 3.3.4–7). People fed and slaughtered animals inside the settlement to self-sufficiently manage the meat requirements of the Padnal inhabitants. Although they were not found in the excavated areas, the Cranium and parts of the Cranium may have been discarded outside of the settlement.

The distribution of the skeletal spectrum of Padnal was found to be very similar to that of Cazis (Plüss, 2011). This indicates that these Bronze Age Alpine settlements had similar economic systems.

3.3.2. Fragmentation of flat and long bones

Bone fragments from three main domestic animals; cattle, sheep/goats, pigs, were grouped in the several parts of skeletal elements (Fig. 3.3.8) (*cf.* Chapter 2.2.6).

3.3.2.1. Cattle

Cranium

There was no chronological change in the fragmentation pattern of the Cranium in cattle. The rear part of the Cranium was most commonly found, but rarely with horn cores (Fig. 3.3.9). All of bones from Cranium were fragmented into small pieces perhaps due to extract the marrow. There was no difference between Field 1 and 3.

Mandibula

The fragmentation of Mandibula changed during the LBA. The Corpus alveolar part was found more commonly than Ramus. People regularly separated Ramus and Corpus perhaps due to the removal of marrow (Fig. 3.3.10). The Diastema part was most commonly found in Field 3 during the MBA.

Scapula

The most commonly found part was Margo cervicalis, especially in Field 3 (Fig. 3.3.11). The second most commonly found part was Margo thoracalis. The Scapula was more often fragmented lengthways than widthways.

Pelvis

The most commonly found part was the Ilium and no significant change was observed between periods (Fig. 3.3.12). The Acetabulum part was found more frequently in Field 1 during the MBA.

Long bones (Humerus, Femur, Radius, Ulna, Tibia, Metacarpus, Metatarsus)

Most of the long bones, especially the Humerus, Femur, and Tibia, were fragmented into smaller specimens throughout the Bronze Age (Fig. 3.3.13–19) perhaps due to the preparation for meat and marrow (Deschler-Erb and Marti-Grädel, 2004; Hüster Plogmann and Schibler, 1997). These specimens offered traces of butchery.

The neighbouring settlement Cazis had the similar pattern (Plüss, 2007, 2011).

3.3.2.2. Sheep/goat

Cranium

Similar to the findings with cattle, the most commonly found fragments were the rear part of the Cranium because they are thicker and therefore are more solid than the other parts of the cranium (Fig. 3.3.20). More front part specimens were found in Field 3 during the MBA.

Mandibula

The most commonly found parts were the Ramus and Corpus alveolar parts (Fig. 3.3.21). It was common practice to separate the Mandibula into three parts, namely, Ramus, Corpus, and Diastema, and then separate the Corpus into alveolar and base parts, perhaps to extract marrow. Such a regular pattern suggests that the existence of the specialists for butchering in the settlement Padnal and the butchers maintained this traditional meat preparation method throughout the Bronze Age (Appx. Photo. 10).

Scapula

Interestingly, the fragmentation of the Scapula in both cases of cattle and sheep/goat changed during the LBA. Although the Margo cervicalis and thoracalis parts were most commonly found until the MBA, the frequency of other parts of Scapula increased during the LBA (Fig. 3.3.22). This phenomenon may be due to poor preservation rather than due to butchering.

Pelvis

The most commonly found part was the Ilium; however, the frequency of the Ischium part increased during the MBA, especially in Field 1 (Fig. 3.3.23).

Long bones (Humerus, Femur, Radius, Ulna, Tibia, Metacarpus, Metatarsus)

Long bones were fragmented into the smallest specimens, especially the bones behind legs, such as Femur, Tibia, and Metatarsus (Fig. 3.3.24–30). Settlers used the same butchering method in cattle, sheep, and goats. The difference in body size between cattle and sheep/goats did not seem to affect the methods used. Field 3 had much smaller fragmented bones than Field 1 but it is not known if this was due to differing habits of butchering or different levels of preservation.

3.3.2.3. Pig

Cranium

Surprisingly, the front part of the pig Cranium was most commonly found (Fig. 3.3.31); however, Field 1 had double the amount of rear part of the Cranium than Field 3.

Mandibula

As in the case of cattle, sheep, and goats, the Corpus alveolar was the most commonly found part (Fig. 3.3.32).

Scapula

The Spina part is the most commonly found specimen of the Scapula. This differs greatly from the most commonly found specimens of cattle and sheep/goat remains (Fig. 3.3.33).

Pelvis

The Ilium was the most commonly found part both in Field 1 and 3 (Fig. 3.3.34), but only during the MBA. This may be due to the preservation of specimens rather than due to the intentional change of butchering techniques.

Long bones (Humerus, Femur, Radius, Ulna, Tibia, Metacarpus, Metatarsus)

Only the Femur was found to have been fragmented into smallest specimens. The other long bones were left more intact and remained as larger specimens (Fig. 3.3.35–41). It seems this was not because of the body size, more owing to differences between hervivores (cattle, sheep, and goats) and omnivores (pigs). One of the greatest differences between the long bones of the other domestic species and those of pigs from Padnal is that there was no evidence of utilisation of pig bones to create bone artefacts. There are some evidences of utilisation of pig Fibula and Canine tooth from male pigs at Cazis (Plüss, 2011). However,

artefacts including ornament made of pig bones were not found from Padnal. The ornament made of canine tooth from brown bear is excavated (Rageth, 1981) (*cf.* Chapter 3.3.5. Artefacts).

3.3.2.4. Conclusion of fragmentation

There was no chronological change in the fragmentation but regular techniques of fragmentation were observed for each species and each skeletal element. It is not known if there was a specific group or individual who prepared the meat and marrow in the settlement; however, it is clear that the same methods were continued across the generations.

3.3.3. Butchering traces (cut and chop marks)

Butchering traces were found on 5.1% (n = 2,022) of the total specimens (n = 40,031), and they were separated into three marks; cut, chop, and cut and chop marks. Chopped bones were most commonly found (Fig. 3.3.42), especially during the E-MBA (Fig. 3.3.43) (Appx. Photo. 7-9).

3.3.3.1. Cut and chop marks on bones of main domestic animals

Cut marks including cut and chop marks

There were at least two types of cut marks: sharp, narrow, and shallow cut marks by a double-edged blade, and dull-sharpened, wide, deep, and jagged cut marks by a single- or double-edged blade. It is unknown what materials, e.g. stone or metal, the implements were made out of.

There was a high frequency of cut marks and cut and chop marks on cattle specimens (Fig. 3.3.44). Cut marks on pig bones increased but those on sheep/goat bones were decreased. The distribution of cut marks on each skeletal element was concentrated to Vertebrae and Pelvis of cattle, Humerus and Scapula of sheep/goat, and Costae, Vertebrae, Scapula, and Tibia of pig (Fig. 3.3.45).

Chop marks including cut and chop marks

Chop marks appeared most frequently on cattle bones during the E-MBA (Fig. 3.3.46). Chop marks were most frequently found on long bones, especially the Tibia in cattle. A single incidence of chop marks in sheep/goats was on the Metacarpus and Metatarsus, and on the Humerus and Femur in a single incidence of chop marks on skeletal elements of pigs (Fig. 3.3.47).

To date, not a single bucranium (a special ornament which was cut from a specific part of a cattle Cranium with horn cores) has been found in the Bronze Age sites in Switzerland, i.e. Padnal as well as other large Bronze Age settlements, such as Cazis (Plüss, 2007, 2011) and

Hauterive-Champréveyres (Studer, 1991). Bucrania are not limited to the Neolithic period, for example Arbon-Bleiche 3 (Deschler-Erb *et al*., 2002), are still traditionally made in the near East, Europe, and Africa (Sabine Deschler-Erb at IPAS personal communication). The Crania of cattle in Padnal were always found to have been fragmented into very small pieces and the mean weight was only 3.45 g. It is possible that the Crania of animals were discarded outside the settlement. Cut and chop marks on the Cranium bone specimens and horn core of cattle may indicate the extraction of the brain for consumption (Lyman, 1994, p.44), because brain matter is highly nutritious (Schibler *et al*., 2011; Sabine Deschler-Erb at IPAS personal communication).

3.3.3.2. Cut and chop marks on bones of other species

Other species included unidentified specimens of "dog or wolf fragments" and "goat or chamois fragments" which had butchering traces on 31 specimens (0.08%) of total bones collected (n = 40,031). Wild animals included red deer, roe deer, ibex, brown bear, and wild boar (Fig. 3.3.48), and it is probable that hunted animals would have been prepared for eating.

The highest frequency of cut marks on the bones of wild animals was found in the EBA (Fig. 3.3.49). It was not possible to identify a specimen of "dog or wolf" (n = 1, weight = 1.1 g) in the MBA to species level due to the age of the individual being too young; however, there was a cut mark on the Radius. It is unclear if this cut was made during the skinning process (possibly to make a fur pelt) or while preparing the meat for consumption. Although EBA dogs were buried with care, bones from dogs in the latter phases were found to have cut and bite marks. This "dog or wolf" may have been eaten or skinned, or both.

Chop marks were found on bones from red deer, wild boar, "goat or chamois", and on undetermined bones (Fig. 3.3.50). Chop marks were found on a Tibia fragment from a "goat or chamois" in the EBA (n = 1, weight = 36.4 g), indicating that these marks were made while preparing the meat for consumption. Unfortunately, it was not possible to determine the species due to the worn-out state of the epiphysis of this fragment. Regardless, it is unlikely that the fragment belonged to an alpine chamois (*Rupicapra rupicapra*) because they were seldomly found in the Alpine east region at the time, although their population recovered during the 20th century (Baumann *et al*., 2005; Kaufmann, 1983; Plüss, 2007, 2011; Rüeger, 1942; Würgler, 1962).

3.3.3.3. Butchering techniques

The most popular butcher techniques used were halving of long bones lengthways, the spiral fracture, and butchering into small pieces (Fig. 3.3.51), especially during the EBA (Fig. 3.3.52). These butchering techniques were mainly performed on cattle and sheep/goat bones (Fig. 3.3.53). The most commonly found long bones that had been halved lengthways were the Radius and Metatarsus of cattle, the Tibia and Metacarpus of sheep/goats, and the Humerus and Femur of pigs (Fig. 3.3.54). However, no long bones were found to have been

divided symmetrically and bilateral from the top to bottom. All the halved bones had been diagonally broken in the middle of the shaft. These remains appear to be discarded biproducts of meat preparation and bone marrow extraction rather than for use in preparing artefacts.

3.3.3.4. Conclusion of butchering

Butchering methods did not change throughout the Bronze Age in Padnal. Although there were butcher specialists in the settlement, the techniques of butchering somehow continued throughout the generations. Unfortunately, I could not analyse the type of cut marks due to the lack of a scanning electron microscope (Greenfield, 1999). It will be of great interest for future investigations to explore the typology of cut marks and the materials of the blades of cutting tools, i.e. stone or metal.

3.3.4. Size and shape of Padnal pig teeth using geometric morphometrics

The size and shape of the lower teeth M_2 (n = 26) and M_3 (n = 47) of pigs from Padnal were chronologically compared between the four chronological groups There was no significant difference in the size of both M_2 and M_3, and the Welch F test of M_2 showed F = 0.738, df = 6.51, P > 0.5, and M_3 showed F = 0.177, df = 8.233, P > 0.9. The sizes of pig teeth were highly homogenised between the four chronological groups (Fig. 3.3.55–56).

There was no significant difference in the shape of both M_2 and M_3 between the four chronoilogical pig groups. The first and second principal components of M_2 (56.4% of the total variance) and M_3 (58.9% of the total variance) were completely overlapped across the four chronological groups (Fig. 3.3.57–58). Wilk's lambda test indicated there was no significant difference in the shape between the four chronological groups of M_2 (F (22, 24) = 0.9823, P > 0.5) and M_3 (F (42, 89.76) = 1.315, P > 0.1), indicating that the shape of teeth of Padnal pigs did not vary throughout the Bronze Age (Fig. 3.3.59–60).

It can be stated that pig husbandry practices at Padnal showed no chronological change. There was no significant difference in the size and shape of M_2 and M_3 pig teeth, indicating genetic homogeneity across individuals (Cucchi *et al.*, 2011). It also suggests that inhabitants only bred pigs within the Padnal pig group and used the same husbandry practices. It is presumed that pigs would have been kept in pens in the settlement during cold winters to avoid snow (Rageth, 1986). However, it is not known whether Padnal pigs were able to roam freely at least within the settlement during other seasons.

3.3.5. Artefacts

Six bone artefacts were found from materials excavated at Padnal (Fig.3.3.61–66). All of them were points (Spitze). Some artefacts were identified by “type”, “side form view”, and “profile view” based on the protocol of the typology of bone artefacts (Schibler, 1981).

Many points (Spitze) have been made with respect to the Ulna of cattle and sheep/goats in Padnal and have already been reported by Rageth (1974, 1976-1986). The ornamental instance of a canine tooth from a brown bear in the EBA was also reported by Rageth (1981).

3.4. Diversity of animal husbandry and body size of main domestic animals between regions in Switzerland and neighbouring countries

3.4.1. Frequency of species

Frequency of the animal specimens in the Swiss Bronze Age

The data were obtained from the Bronze Age assemblages (n = 70) which possessed over 100 the NISP (Fig. 3.4.1–3.4.3). The Alpine, Jura Mountains, and some Plateau (= Midland) settlements were located on dryland which is built on the terrestrial ground, while most of the Plateau settlements were located on wetlands and that were built alongside the lake shore; however, to date, evidence of these latter settlements has not been discovered during the MBA (Menotti, 2001, 2015a, 2015b; Schibler, 2017). There were only a few assemblages that possessed over 1,000 of the NISP (Fig. 3.4.4). The Padnal data were separately displayed in some of the figures but were also included in the Alpine east data. Over 12,000 of the NISP were from the Alpine east groups throughout the Bronze Age, and the east Wetland group followed the next (Fig. 3.4.5). The frequency of lost single tooth which shows the quality of preservation (Deschler-Erb, 2005; Hüster Plogmann and Schibler, 1997; Schibler, 1996b, 2001) was exhibited that the preservation of dryland settlements, except the Cham Oberwil, were better than wetland settlements (Fig. 3.4.6).

The most common species across the entire Swiss Bronze Age assemblages was cattle, then sheep and goats (Fig. 3.4.7). Pigs followed third in importance, and a very few dogs and horses were found. Wild animals were hardly hunted. There were more sheep than goats across all Bronze Age settlements (Fig. 3.4.8). The increase in sheep at Padnal and Cazis during the LBA may have been due to the activation of wool production. However, this is unlikely in Padnal because the mortality profile of sheep suggested that individuals were slaughtered at the young adult stage, and therefore, more likely bred for meat production. The majority of sheep being males and castrated males also supported their exploitation for their primary product. Plüss (2011) suggested that the reduction of goats during the LBA was due to cattle replacing goats in the production of milk.

The size of Bronze Age dogs based on the wither height indicated that EBA dogs, especially Padnal dogs, were smaller than LBA dogs (Fig. 3.4.9). Interestingly, there were three sized dogs during the Bronze Age in Switzerland. Dogs at the LBA settlement Hauterive-Champréveyres reached sizes as large as modern-day German shepherds, dogs at the EBA settlement Zürich-Mozartstrasse, the LBA settlement Zürich-Alpenquai, and the LBA settlement Cortaillod-Est reached sizes as large as modern-day Old English sheepdogs, and dogs at Padnal reached the size as large as modern-day Shetland sheepdogs (Plüss, 2011; Studer, 1991; Hüster Plogmann and Schibler, 1997). These different dog sizes might have been a result of the genetic; however, further investigations are needed to confirm this.

There was a large difference in the hunting activity of the various regions. Wetland inhabitants hunted various wild animals (Fig. 3.4.10–3.4.12). Regardless of wet or drylands, all Plateau communities mostly hunted red deer (Fig. 3.4.13), although much less than during the Neolithic period (Schibler, 2017; Schibler and Chaix, 1995; Schibler and Jacomet, 2005).

Frequency of the animal specimens between regions in the Bronze Age

Distribution of the NISP from Switzerland and neighbouring countries (Fig. 3.4.14–3.4.15) showed that mainly cattle were kept in the eastern Switzerland and Jura Mountains, mainly sheep/goats were kept in the western Switzerland and South Tyrol, and mainly pigs were kept in the Jura Mountains (Schibler, 2017; Stopp, 2015) (Fig. 3.4.16).

The proportion of domestic and wild animals showed a uniquely high number of cattle in the NISP at Padnal and the Alpine east region. Although the proportion of cattle further increased in the Alpine region during the LBA, cattle numbers were seen to have declined in other regions (Fig. 3.4.17). This sudden change in the Alpine east region, especially in Padnal, might have indicated the production of surplus meat for mining people near the settlement (Della Casa *et al*., 2016) and the increase of secondary products, such as milk and draught power, based on the mortality profiles (for details, see paper 1 and 2). The seasonal vertical transhumance of cattle between the settlement and high Alpine pasture for milk production may have begun during the LBA (Carrer *et al*., 2016; Reitmaier, 2010, 2012, 2017; Reitmaier *et al*., 2017); however, such evidence has not yet been found from other Alpine sites (Bopp-Ito, 2012; Bopp-Ito *et al*., 2018a; Plüss, 2011; Stopp, 2015).

The Alpine west communities mostly farmed sheep and goats (Fig. 3.4.18). In particular, the economy of one of the Alpine west EBA settlements Sion-Petit Chasseur (Chaix, 1976a) was completely dependent on sheep. Padnal and the north Italian communities also had a large stock of sheep/goats (e.g. Riedel and Tecchiati, 2001). This indicates that the sheep and goat husbandry practices at Padnal, and perhaps, the Alpine west communities may have been influenced by practices from southern Alpine communities (Schibler, 2017; for details, see paper 2). However, it is unclear if sheep and goats were exploited for their secondary products. Notably, the wool production was introduced to Central Europe in the 4th millennium BC (Teichert, 1993) and that there was an active trade of wool during the Bronze Age (Redding, 1984).

Inhabitants of the Jura Mountains mostly farmed pigs, possibly due to the specific circumstances in this area (Schibler, 2017; Schibler and Studer, 1998; Stopp, 2015) (Fig. 3.4.19). The dominance of pig stock in the east Tyrol region may also be related to mining activities, and it is possible that the pigs were transported to the consumer sites (Marti-Grädel *et al*., 2012; Schibler *et al*., 2009, 2011; Stopp *et al*., 2010). The Jura Mountains and the east Tyrol regions exploited pigs as a “living tinned food” (Schibler and Studer, 1998).

This means that pigs were ready to be consumed anytime. Inhabitants in these regions presumably bred pigs at the sites because pigs have a high fecundity within a relatively short perinatal period.

Dogs were popular and were commonly found at each Bronze Age settlement; however, the number was always very low (Fig. 3.4.20). Although the role of the dogs in these communities is not clear (Schibler and Studer, 1998), they are presumed to have assisted with sheep herding and with hunting in accordance with the farming of sheep/goats and hunting of wild animals, respectively.

The frequent appearance of cut marks on the bones of dogs suggests that dogs were consumed in general (Schibler, 2017). Dogs at the LBA settlement Hauterive-Champréveyres in the west wetland region may have also been consumed and contributed to fur trade (Studer, 1991). However, there was an interesting example of an EBA Padnal dog older than six years (dog No. 1; *cf*. Chapter 3.2.2.4. Dog) that was burried at the corner of House 2. This dog was skinned for fur but perhaps not consumed because there was no cut mark. It shows the different relationships between human and dogs in the Padnal community. However, it is difficult to confirm this based on just one example.

Definite evidence for the domestication of horses, in 4,000 BC, was found from the steppe in Ukraine (Benecke, 1994) and the genetic studies supported that the area was a centre for domestic horses (Cieslak *et al*., 2010; Jansen *et al*., 2002; Lippold *et al*., 2011; Vilà *et al*., 2001). In 2,600 BC, the first prototype of ancient domestic horse appeared in Eastern Switzerland (Schibler and Hüster Plogmann, 1995) and most of the Swiss Bronze Age horses may have been derived from these domestic horses (Schibler, 2017; Schibler and Studer, 1998).

Horses were definitely a more dominant livestock animal in the Plateau than the Alpine regions (Fig. 3.4.21) and were limited in the Alpine and east Wetland regions during the EBA but ultimately spread to other parts of Switzerland during the LBA. However, horses were still most frequently maintained in Eastern Switzerland.

Since horses were symbolic animals of wealth and luxury, they were not eaten but rather exploited for riding and transportation purposes (Deschler-Erb, 2005; Schibler, 1996b, 2017; Schibler and Studer, 1998). The LBA settlement Zürich-Alpenquai (Wettstein, 1924; Wiemann *et al.*, 2012) was the exemplary wealthy settlement which had many horses and snaffles, harnesses, bronze weapons, and many other precious objects (Mäder, 2001a, 2001b; Wagner, 2005). The vastness of their range of trade is noteworthy; extending even to the east European communities (Jennings, 2015; Mäder, 2001a, 2001b). This indicates that Zürich-Alpenquai had a strong connection with the Danube basin communities and this is probably from where they acquired numerous horses and objects. Hence, this lack of a very specific trade association is why so many Bronze Age settlements did not possess horses.

Another settlement that had many horses was the east Wetland Wasserburg Buchau in south Germany (Kokabi, 1990). This was also considered to be a wealthy settlement with many bronze objects. The combination of bronze weapons and horses in these settlements

might have been in preparation of fighting units because the bronze weapons were used only in an emergency (Kimmig, 1992). Horses in these settlements, which were located close to the river Rhine and the LBA settlement Schleitheim Auf den Egg in the east dryland (Rehazek, unpublished data) may have been farmed in preparation for defence to warfare. This suggests that the communities close to the northern border and Jura Mountains would not have had a peaceful existence during the LBA.

More wild animals were hunted in the Plateau than in the Alpine regions (Fig. 3.4.22). Red deer were commonly hunted mainly as a meat source instead of farming and slaughtering cattle, and their products were used to make bone and antler artefacts (e.g. the tine was processed for a grip of the bronze knife; *cf*. Schibler, 1998c) as a traditional craft work of the Swiss wetland people since the Neolithic (Choyke, 1998; Schibler, 1987a, 1987b, 1995a, 1995b, 1997, 1998c, 2007). However, hunting of wild animals and gathering of antlers were less important economic activities for the wetland people during the Bronze Age compared with those during the Neolithic period (Schibler, 1998c, 2017).

There was a chronological change in the frequency of some species but, interestingly, the change mostly occurred during the LBA. The obvious change in species involved cattle and horses (Fig. 3.4.23–25). The incidence of cattle markedly increased in the Alpine east region, implying a change in cattle husbandry practices that was influenced by the economy (Della Casa, 2013; Della Casa *et al*., 2016; Reitmaier *et al*., 2017). Horses rapidly spread in the Plateau regions, and this increase may have led to acquisition of wealth in these settlements through trade activities (Jennings, 2015).

3.4.2. Body size

The osteometric data from main domestic animals were collected from assemblages in Switzerland and the neighbouring countries (Fig. 3.4.26–30) (details of cattle, see paper 2).

Cattle

It is already known that there was no significant difference between the Late Neolithic and Late Bronze Age cattle (Bopp-Ito *et al*., 2018a); however, the Early Iron Age cattle were smaller than the Late Neolithic cattle (Fig. 3.4.31). There were also small-size cattle groups between regions: the Alpine, the south Tyrol, and the south lowland regions (Fig. 3.4.32). Padnal cattle were obviously smaller than other Swiss Alpine cattle (Fig. 3.4.33). However, there was no significant difference between south Tyrol cattle and Padnal cattle, and when south Tyrol cattle became larger, the size of Padnal cattle followed suit (Fig. 3.4.34). In the comparison between other Alpine cattle, the south Tyrol cattle showed a significant difference in the LBA (Fig. 3.4.35). It suggested that south Tyrol cattle perhaps immigrated into Padnal throughout the Bronze Age but no longer immigrated to Cazis during the LBA. This could have occurred due to the different economic relationships between Padnal and

south Tyrol communities, as well as between Cazis and Plateau and south German communities. In addition, the different strengths of the influence of the south and north culture may also have impacted the size diversity (Jecker, 2015; Reitmaier *et al*., 2017; Riedel and Tecchiati, 2001).

There were four different sizes of cattle during the Bronze Age in the vicinity of Switzerland. There were the largest cattle in the Plateau region, the middle-sized Borscht and Cazis cattle, the small-sized Padnal, south Tyrol, and east Tyrol cattle. The north-east Austrian lowland EBA cattle and the south lowland LBA cattle groups were extremely small-sized (Fig. 3.4.36). It indicated that although the cattle exploitation had changed from primary to secondary products during the LBA in the Alpine region, the cattle breeding strategy did not change throughout the Bronze Age in both the Plateau and the Alpine regions. The sudden appearance of smallest LBA cattle in the south lowland region has not yet been investigated. Further, detailed observations are needed to clarify the environmental and cultural influences in that region.

Sheep and goat

There was no significant difference in the size of Swiss sheep in groups between three periods (Late Neolithic, Bronze Age, and Early Iron Age) (Fig. 3.4.37). Only south lowland sheep were seen to be small in comparison to those of other groups (Fig. 3.4.38). These south lowland sheep also became smaller during the LBA, as was the case with the cattle. Meanwhile, east Tyrol sheep were significantly larger. The statistical comparisons showed the same results of sheep/goat groups (Fig. 3.4.39–40). The size of sheep/goats in the Swiss and in the south Tyrol regions was the same; however, east Tyrol EBA sheep/goats were the largest, and the south lowland sheep/goats were the smallest. There were also three different sizes of sheep/goat groups (Fig. 3.4.41), but somehow the immigrants that entered the Swiss Alps (together with their cattle, sheep, and goats) were mainly from the south Tyrol region, with much fewer immigrants derived from the south lowland region, although evidence from material culture is necessary (Jecker, 2015; Jennings, 2015). Furthermore, strontium analysis should be performed to confirm the transalpine and immigration patterns as well as the origin of animal lineages (Grupe *et al*., 2017).

Pig

The size of Early Iron Age pigs was smaller than those in the Bronze Age (Fig. 3.4.42). There was almost no difference in size between pig groups divided by regions and periods (Fig. 3.4.43), although the east Tyrol EBA pig groups was larger than the others. Swiss wetland pigs were only from the east Plateau region but their LSI did not change between the EBA and LBA, although geometric morphometric analysis revealed that the lower molar teeth from the east Plateau pigs became smaller during the LBA (for details, see paper 3). The post cranium skeletal elements from the LBA Zürich-Alpenquai pigs did not change the

body size; however, their smaller molar teeth size was remarkably reduced. This may be attributed to a change in diet, whereby they may have been fed soft food or scraps by settlers, possibly in fenced areas or pens instead of roaming free in the forest or at least in the settlement and consuming naturally occurring food stuff, such as hard fresh acorns in the wood, as was the case with the EBA Plateau pigs. This might have happened due to deforestation (Bleicher *et al*., 2013) (for details, see paper 3). The LSI of the Bronze Age pigs indicated that there was not much difference between the groups in the Swiss regions and in the neighbouring countries (Fig. 3.4.44).

3.4.3. Conclusion of comparisons between regions

There were different frequencies of domestic and wild animals between regions; with cattle having the highest frequency in the Alpine east, sheep/goats in the Alpine west, and pigs in the Jura Mountains. There was also a higher incidence of dogs in the lowland areas, such as the Plateau, south, and east lowland regions, and a higher incidence of horses and wild animals in the Plateau regions. These regional differences were influenced by several factors, such as the cultural traditions, the development and exploitation of secondary products, the deterioration of security, and the instability of the environment (e.g. Della Casa, 2013; Menotti, 2015b; Reitmaier *et al*., 2017). Meanwhile, the size diversity of domestic animals may have been impacted by the different economic relationships between settlements, the mobility and migration of people with the animal packs particularly in the Alpine region, and the change of animal husbandry practices due to a change in the environment, particularly in the east Plateau region (Bopp-Ito *et al*., 2018a, 2018b; Plüss, 2011; Schibler, 2017; Stopp, 2015) (for details, see paper 2 and 3).

The animal husbandry practices of the Bronze Age communities in Switzerland and the neighbouring countries appeared to all change simultaneously during the LBA due to the influence of the various factors that were specific to each settlement. Therefore, to some extent, regional comparisons can clarify the tendency of each region; however, it is important that the different circumstances of each settlement, such as the location, altitude, history, culture, economy, and environment be carefully considered.

4. Research papers

4.1. Bopp-Ito, M., 2012. Animal husbandry in the Bronze Age Alpine settlement "Savognin – Padnal", Switzerland: a preliminary study. In: Christine Lefèvre (ed.) Proceedings of the General Session of the 11th International Council for Archaeozoology Conference (Paris, 23-28 August 2010). British Archaeological Reports International Series 2354. Archaeopress and Publishers of British Archaeological Reports, Oxford, pp. 75–85.

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Animal husbandry in the Bronze Age Alpine settlement "Savognin - Padnal", Switzerland: a preliminary study

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Abstract

The settlement "Savognin - Padnal", in the Swiss central Alpine region, is a Bronze Age site with abundant faunal remains. Although data collection is ongoing, and only a part of the total assemblage has so far been analysed, more than 30,000 fragments have been recorded and about 20,000 fragments identified. More faunal material will be investigated in the near future.
Cattle were the main livestock throughout the Bronze Age, and became even more important during the Late Bronze Age, whereas the proportion of sheep and goat decreased. Hunting was not of prime importance.
Two different dietary habits were detected during the first half of the Bronze Age. Some inhabitants consumed more cattle, while others preferred sheep and goats to cattle.
The cattle mortality profile shows a changing pattern in the Late Bronze Age compared to that of preceding times. Presumably, in the Early and Middle Bronze Ages, meat supply was the primary resource obtained. However, in the Late Bronze Age, it appears that dairy and traction were important resources alongside meat production.
The full results from Padnal will contribute more evidence to reveal the characteristics of Bronze Age Alpine animal husbandry.

Keywords

Husbandry, Alps, Bronze Age, Cattle, Sheep/Goat, Pig, Dairy.

Introduction

The Bronze Age settlement "Savognin-Padnal" (hereafter called Padnal) is situated in the canton Grisons, eastern Switzerland (Figure 1). Padnal lies at an altitude of c. 1210m above sea level on a natural hill top in the basin of a steeply sloping valley. It is located along a modern road ascending to the Julier pass (2200m over sea level, and a watershed of the Rhine and the Danube) which was definitely used since Roman times, but perhaps also since the Bronze Age, as an Alpine crossing towards Italy.

The settlement was found in 1938 during gravel collection. After a period of prospecting (1953 to 1956), the site was excavated systematically by Jürg Rageth, from the Archaeological Service of the canton Grisons, between 1971 and 1983 (Rageth 1976, 1986, 1987; Zürcher 1982).

The settlement was occupied between the Early and Late Bronze Ages. Excavated artefacts from cultural deposits include a large number of faunal remains. However, the excavated area was only between one third and one half of the original settlement surface (Rageth 1986).

The excavated area was divided into six fields. According to the typochronology of the pottery and the bronze objects, the archaeological finds including the animal bones could be divided into four phases (Rageth 1986). This chronology was supported by 14C dating analysis undertaken at Bern University: the Early Bronze Age (EBA) from 1950/1900 - 1550 BC; the end of Early to beginning of Middle Bronze Age (E - MBA) from 1550 - 1450 BC; the Middle Bronze Age (MBA) from 1450 - 1350/1300 BC; the Late Bronze Age (LBA) from 1350/1300 - 900/800 BC (Jürg Rageth, personal communication).

Catastrophic fires destroyed the settlement in each phase. The houses were rebuilt several times but, after the fifth fire, no reconstruction occurred and the inhabitants abandoned the settlement.

This article focuses on the following research questions:

- Which species was the most exploited in each phase?

- Was there any diachronic difference among the phases?

- What kind of dietary habits did people in the settlement have? If there was a difference among people, what was the cause?

- What was the mortality profile of domestic animals? What kind of animal management do they reflect?

Material and method

Materials for this study are from Fields 1 and 3 (Figure 2). Animal bones from Field 1 have already been reported by Anna Gassler and Philippe Morel (in Rageth 1986). Unfortunately, these data could not be directly incorporated in this study, firstly because the original database has been lost, and secondly because the data from two phases were amalgamated, rendering diachronic comparison impracticable. Furthermore, a high level of detailed information from each specimen was essential. Therefore all materials from Field 1 were re-examined. Materials from Field 3 were selected by the archaeologist with consideration of the best district in the plan to investigate faunal remains. At the end of the study, all of the data acquired from Fields 1 and 3 will be integrated.

As data collection is still progressing, only a portion of the material has been analysed. At present, roughly 30,500 fragments and 178kg of animal bones have been examined. This is only 5% of the total weight of faunal assemblages from the excavation. More than 20,000 fragments and 163kg of bones could be identified. The mean weight of the fragments is 8.4g for identified bones and 1.4g for unidentified bones.

Preservation conditions are relatively good, but about half of the bone assemblage has very bad surface preservation, and individual bones are highly fragmented. Faunal remains were excavated by hand-collection; therefore, almost no information concerning small mammals, birds, or fishes is available.

Individual bone fragments were observed and statistically analysed using the special software "OSSOBOOK" (Schibler 1998). The main parameters are number of identified specimens (NISP), fragment weight, skeletal element, fragmentation type, broken condition, mortality age, sex, preservation, bite marks, burn marks, butchery, pathology, and osteological measures.

Because of taphonomic reasons, the minimum number of individuals (MNI) has not been evaluated. Teeth were generally only present as single teeth, while mandibles with teeth rows were seldom present.

In addition to published literature (Bacher 1967; Bossneck *et al.* 1964; Clutton-Brock *et al.* 1990; Cohen and Serjeantson 1986; Fernandez 2001; Fick 1974; Niethammer

FIG. 1 - LOCATION OF SAVOGNIN-PADNAL (COPY RIGHT OF A MAP: HTTP://WWW.WIKIMEDIA.ORG).

and Krapp 1978, 1982; Payne 1985; Pucher 1996; Schmid 1972), the reference collections of IPAS and the Natural Historical Museum Basel were used for the determination of species.

Some species were hard to distinguish, particularly cattle/aurochs and goat/chamois (Baumann *et al.* 2005; Pucher and Engl 1997).

Bones were classified into three categories: 1) "species" level; 2) "large groups", e.g. a large ruminant, a small ruminant, dog or wolf, domestic pig or wild boar, etc; 3) "indeterminate bones".

Slaughter ages were determined following the age list of the laboratory of Archaeozoology at IPAS. This age list is based on tooth eruption and wear traces, and on the condition of the epiphysial fusion, as referenced in several publications (Becker 1981; Becker and Johansson 1981; Bull and Payne 1982; Bullock and Rackham 1982; Ducos 1968; Grant 1982; Habermehl 1975, 1985). In this study only tooth eruption and wear traces were used for the age determination, because of the low number of fragments with epiphyses. Determination of dog age was calculated in accordance with Horard-Herbin (2000).

Sex of cattle and sheep/goat was identified by Pelvis and Horn core (Armitage 1982; Boessneck *et al.* 1964; Grigson 1982), for pigs it was determined by canine teeth and the alveole.

Osteometry was measured only for the adult individuals, by using the metrical method defined by von den Driesch (1976).

Results

Frequency of species

Bone fragments of domestic animals represent about 99.5% of the Padnal bone assemblage throughout the Bronze Age. Cattle were the main livestock (Figure 3). During the first half of the Bronze Age, almost 50% of the

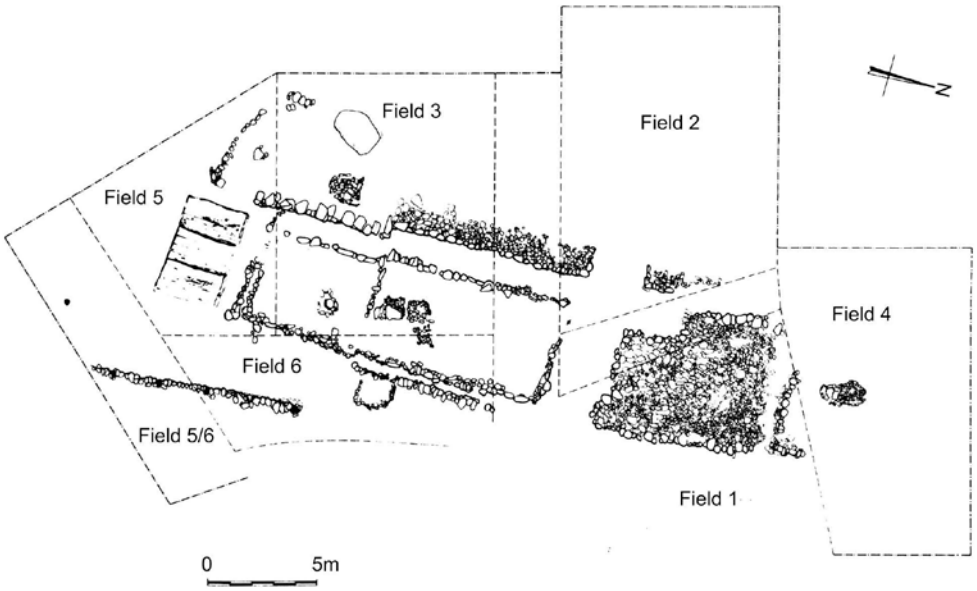

FIG. 2 - EXCAVATION PLAN OF PADNAL;
THE SITUATION OF THE SECOND PHASE - THE END OF EARLY BRONZE AGE TO THE BEGINNING OF MIDDLE BRONZE AGE
(DRAWING BY JÜRG RAGETH 1986, P. 68 : FIG. 6, TRANSLATED NOTES IN ENGLISH BY AUTHOR).

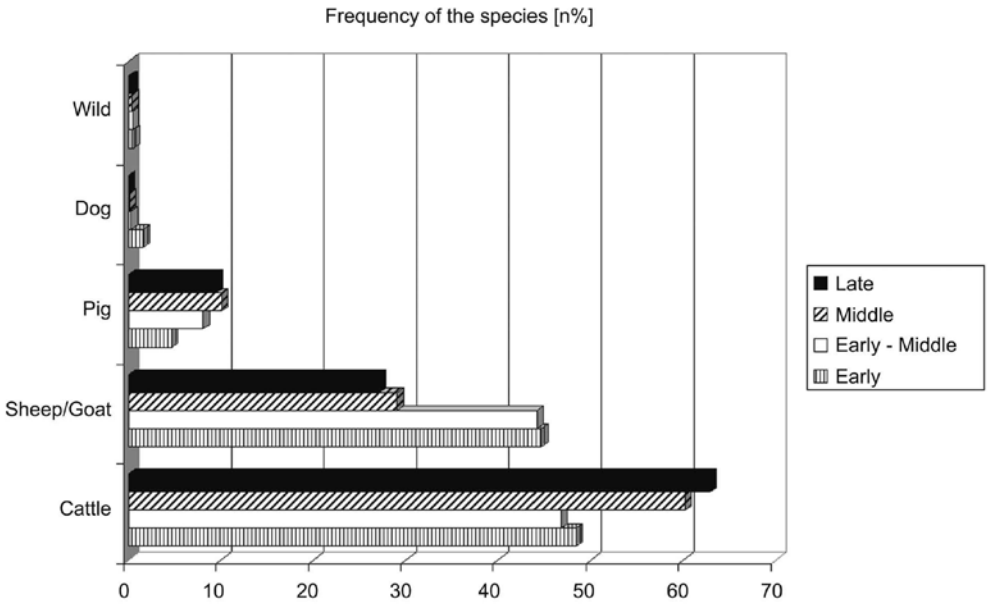

FIG. 3 - PROPORTION OF THE ANIMAL REMAINS BASED ON NUMBER OF FRAGMENTS.
(EARLY = EARLY BRONZE AGE; EARLY-MIDDLE = END OF EARLY BRONZE AGE TO THE BEGINNING OF MIDDLE BRONZE AGE; MIDDLE = MIDDLE BRONZE AGE; LATE = LATE BRONZE AGE).

identified fragments are cattle bones. Later, they became even more important, especially during the LBA.

Genetic species identification was attempted for two horn cores and one proximal ulna fragment from large bovines (by Angela Schlumbaum at IPAS, personal communication). Sequences from the two horn cores were identical and belong to the taurine mitochondrial d-loop haplogroup T2.

T2 is a typical Near Eastern haplogroup, present only in a few recent Eastern European breeds (Beja-Pereira *et al.* 2006) and was earlier identified in a Roman cow from Augusta Raurica in Switzerland (Schlumbaum *et al.* 2006). In Europe, except Italy (Mona *et al.* 2010), the T clade is typical for taurine cattle, whereas aurochs mainly belongs to the P clade (Edwards *et al.* 2007); evidence for aurochs with T clade in northern Europe is inconclusive. Therefore, the best explanation for the Padnal remains is that they are large domestic cattle.

In contrast to the cattle remains, the portion of sheep and goats decreased gradually. During the EBA and E-MBA, the proportion of sheep/goat to cattle was almost equal, but after the MBA, sheep/goat represented less than 30% of the assemblage (Figure 3).

Pigs were not abundant; their representation is always less than 10%, but they were present through all phases of occupation at Padnal.

Dogs were kept by inhabitants of Padnal during the Bronze Age, though their bone frequency was very limited. Almost intact bones, possibly from an individual dog, were buried in an EBA house. This burial is the only example from Padnal, while dog bones from younger phases were scattered in and around houses. It is assumed that during the EBA, dogs were ritually buried, or at least they were not discarded like refuse. After the EBA, the social and ritual meaning of the dog probably changed, as evidenced by the differing deposition practices.

Until now only a single vertebra of horse relating to the LBA has been found.

Wild animals were of little importance to the Padnal inhabitants (Figure 3). Their representation rates are between 0.6% and 0.3% in each phase, and they became less important with successive phases. Nevertheless, the faunal biodiversity was not poor and they represent the ancient environment surrounding the settlement. In each of the phases there is evidence for the hunting of red deer and ibex, while wild boars were also popular animals for the inhabitants. The frequency of brown bear and roe deer was seldom but they were also occasionally hunted. An ornament made from a canine tooth of a brown bear from the Early Bronze Age settlement was reported (Rageth 1981).

Three bird bone fragments were identified. Two pelvis fragments of a graylag goose, and two fragments of ulna, one of a wood pigeon and one of a stock pigeon.

A mollusc was also found. The shell of a grapevine snail (*Helix pomatia*) was excavated from a layer relating to the EBA.

Bones from small mammals and an amphibian were determined (by Heidemarie Hüster Plogmann, IPAS, personal communication). Yellow-necked field mouse is the only small mammal identified at present, and a humerus of toad (*Bufo sp.*) was identified from the E-MBA.

A difference in consumption patterns of houses at Field 3 was recognised. Three houses were built in a row and two of them were involved in the district of Field 3 in the EBA (Figure 4).

People from house 1 consumed more sheep and goats, while the rate of cattle consumption was high at house 2. The rates of cattle and sheep/goats from the path were almost equal. The frequency of pig was the same in each locality.

New houses were built in three rows after the settlement burned down. Four houses with a narrow path between them were constructed in the district of the Field 3 in the phase E-MBA (Figure 5). For convenience the south part is called path 1 and the north part is called path 2. The same consumption phenomenon is observed in this phase. Occupants of houses 1, 2 and 3 consumed more cattle, while people from house 4 consumed more sheep and goats. Interestingly, cattle bones were predominantly discarded on path 1, with sheep and goat bones discarded on path 2. Therefore, it can be asserted that the function of the entire path was not only for walking or drainage, but also to serve as a refuse place for domestic garbage.

Data of houses from the Field 3 in the MBA and LBA is currently being collected.

Mortality profile

Mortality profiles for the three main domestic animals were observed by tooth eruption and wear.

During the EBA and MBA, cattle were generally slaughtered as young adults (Figure 6), but a change of slaughter practice occurred during the LBA, when cattle were allowed to live longer than previously.

Sheep and goats had rather long lives in the first half of the Bronze Age (Figure. 7). During the LBA the mortality rate of lambs and kids was increased, with only a few older individuals kept as breeding stock.

Pig mortality profiles underwent little change (Figure 8). Old individuals had a higher chance to survive in the EBA than in other phases, but after the end of EBA the number of

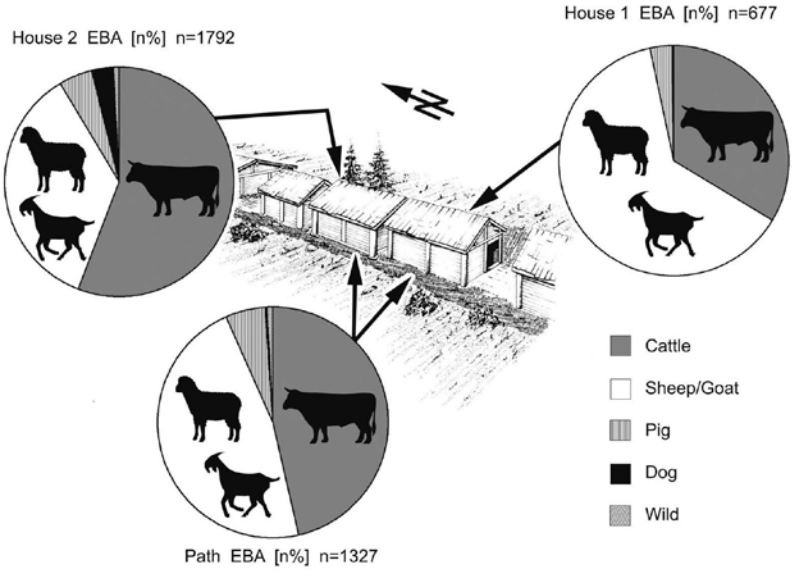

FIG. 4 - PROPORTION (N%) OF THE ANIMAL REMAINS FROM EACH HOUSE AND PATH AROUND HOUSES IN THE EARLY BRONZE AGE (N = NUMBER OF FRAGMENTS).
(RECONSTRUCTED PICTURE : RAGETH 1986, P. 67 : FIG. 5).

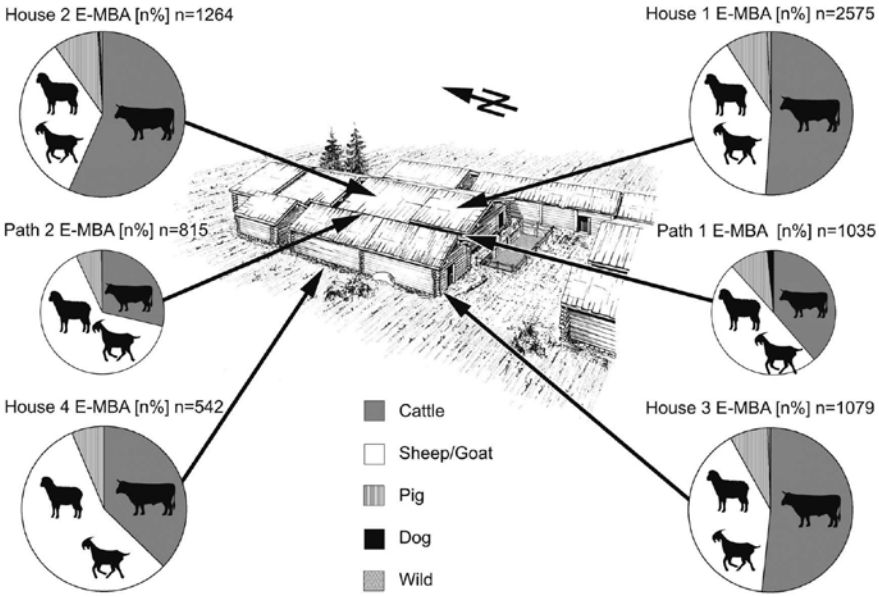

FIG. 5 - PROPORTION (N%) OF THE ANIMAL REMAINS FROM HOUSES AND PATHS DURING THE END OF EARLY BRONZE AGE TO THE BEGINNING OF MIDDLE BRONZE AGE (N = NUMBER OF FRAGMENTS; E-MBA = THE END OF EARLY BRONZE AGE TO THE BEGINNING OF MIDDLE BRONZE AGE).
(RECONSTRUCTED PICTURE : RAGETH 1986, P. 69 : FIG. 8).

slaughtered young adult pigs increased. The MBA is an exceptional situation where no individuals were allowed to reach senior adulthood. Sub-adult individuals were increasingly slaughtered in the LBA and inhabitants again kept a few mature pigs.

Discussion

At Padnal the most exploited animal was cattle. Over time, the number and weight of remains increased, but cattle were not always dominant. In the first half of the Bronze Age, the proportion of sheep and goat remains was nearly the same as cattle, suggesting that the individual numbers of cattle and sheep/goat were equal during the first stage of occupation (Figure 3). These results illustrate that sheep and goat were relatively important animals at the beginning of animal management at Padnal.

Some suppositions were considered as a background to this scenario. The first supposition is that the inhabitants imagined sheep/goats can find food by themselves, while the small land clearance of the EBA, unlike the larger scale clearance of the LBA, created small pastures which were unable to provide sufficient fodder for large numbers of cattle. Therefore, they brought a small herd of cattle, and, possibly, cattle herders were less socially prevalent than shepherds.

The second supposition regards cultural selection. In the western part of Switzerland and the Mediterranean region, sheep and goats were dominant during the Bronze Age (Schibler and Studer 1998), while in the eastern part of Switzerland, small ruminants were less represented than in western Switzerland. It is possible that people from the eastern zone moved into the central Alpine region, and brought with them more cattle than sheep/goats, but due to the western cultural influence they also selected sheep and goats during the early period of their settlement.

The third supposition is simple: almost equal numbers of immigrants from eastern and western parts of Switzerland came to Padnal during the EBA, bringing with them cattle and sheep/goats respectively.

A very similar situation was found at the Bronze Age settlement Cresta-Cazis (Plüss 2007) in the same central Alpine region as Padnal in canton Grisons, Switzerland. The settlement was settled *c.* 700m above sea level in the basin of a neighbouring valley to Padnal. The frequency proportion of species resembles that of Padnal. Cattle frequency increases, with sheep and goat frequency decreasing as the years go by. Cattle were the more important species by the LBA.

A similar phenomenon has also been reported from the settlement Thaur-Kiechlberg/Tyrol near Innsbruck, in the eastern Alpine region of Austria (Deschler-Erb 2010). The settlement was situated between steep hillsides and settled from the late Neolithic (Pollinger culture and Copper Age) to the Early Bronze Age. During the Neolithic, the most important species was sheep/goat, though in the following phases sheep/goat frequency gradually decreases, and by the EBA cattle became the most important species.

Was the dominance of cattle at Padnal influenced by husbandry in the eastern Alpine region? This issue requires more examples for further discussion.

An unexpected result from Padnal was the different dietary habits in the settlement during the two early phases. In particular, as two houses of the EBA were built side by side, the different dietary habits were not at all expected. What was the cause of this difference?

According to the archaeological excavation, house 2 in the EBA (Figure 4) was built earlier than the house 1 (Rageth 1986). Perhaps the inhabitants of house 2, who consumed more cattle than sheep/goat, were among the first colonists. "Soon later" (Rageth 1986, 65), the people from house 1 joined the community. They brought with them more sheep and goats. Quite likely they were welcomed into the community, for their occupation concerned copper working. Indeed, many fragments of moulds, copper based metals, casting slag, fragmented crucibles, and a place resembling a fire place for roasting minerals were found from house 1. Thus, this house is presumed by Rageth to be the smithy of the village.

Some excavated bronze objects are of a very rare type, and some fine ceramics with adornment elements are similar to Straubinger (Bayern, Germany) ceramics. Such bronze objects and ceramics did not have indigenous attributes or parallels in the EBA. These artefacts likely evidence the existence of different cultures at Padnal in the early stage of occupation.

During the E-MBA, houses 1 and 2 are also inferred to be the smithy by Rageth. Although these rebuilt houses followed the same building plan as the earlier houses 1 and 2, the dietary habits of the inhabitants had changed (Figure 5). These houses contained more cattle than sheep/goats fragments, implying that the inhabitants consumed more cattle. It is unknown if the occupants were direct descendants from the smithy in the EBA. During this period, house 4 is an exception, where people consumed more sheep and goats than cattle.

The cause of differing dietary habits in the settlement is still obscure. It is possible to hypothesise that the difference is a result of the economic traditions of each group of immigrants, as for the Neolithic lake-shore settlement Arbon Bleiche 3 (3384 - 3370 BC) at lake Constance, Switzerland, also had such different dietary habits (Marti-Grädel *et al.* 2004). Based upon the distribution of foreign ceramic vessels at Arbon Bleiche, this marked difference is perceived as the presence of immigrants who had different food habits or economic traditions rather than hierarchical differences among the native population.

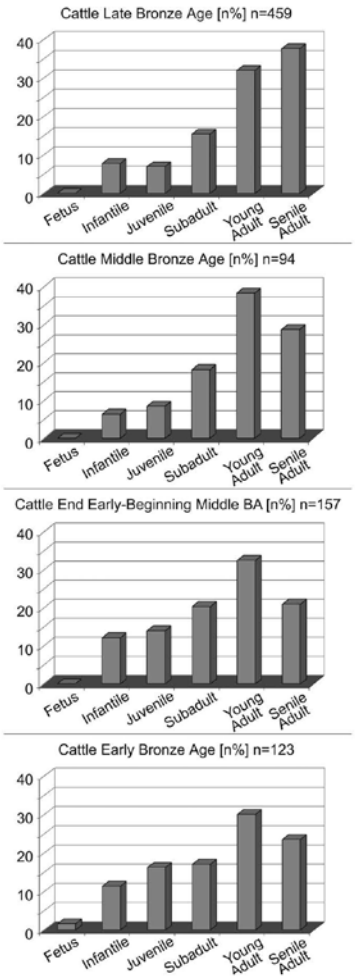

FIG. 6

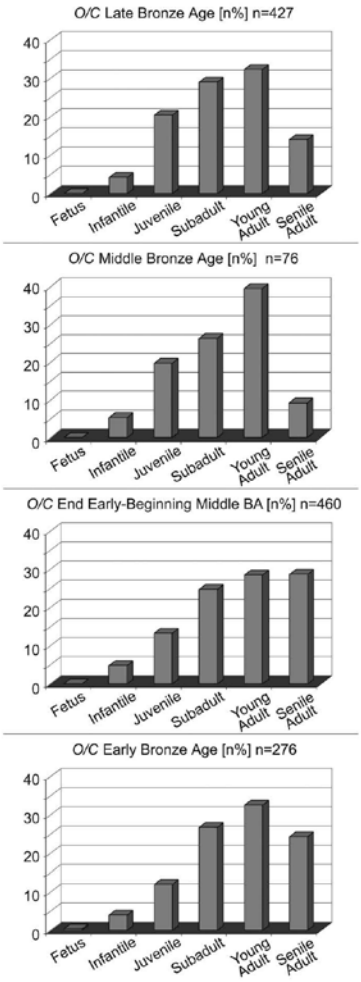

FIG. 7

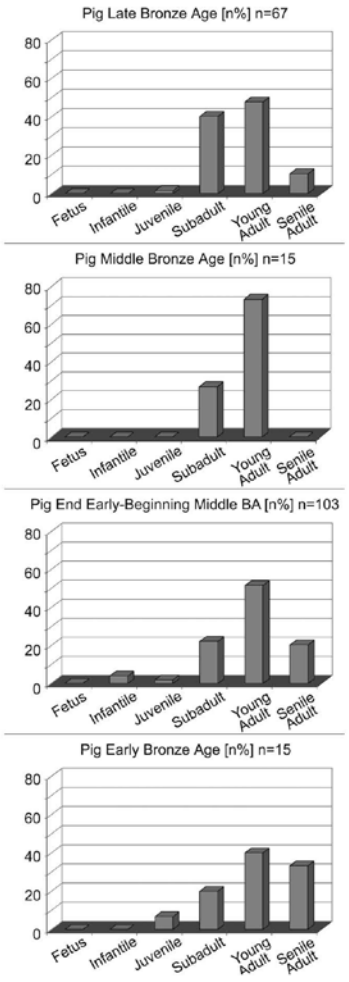

FIG. 8

FIG. 6 - CATTLE MORTALITY PROFILE COVERING FOUR PHASES BASED ON TEETH ERUPTION AND WEAR (N = NUMBER OF TEETH; N% = PERCENTAGE OF ASSEMBLAGE).

FIG. 7 - MORTALITY PROFILE FOR SHEEP AND GOATS COVERING FOUR PHASES BASED ON TEETH ERUPTION AND WEAR (N = NUMBER OF TEETH; N% = PERCENTAGE OF ASSEMBLAGE; O/C = *OVIS* AND *CAPRA*).

FIG. 8 - MORTALITY PROFILE OF PIGS COVERING FOUR PHASES BASED ON TEETH ERUPTION AND WEAR (N = NUMBER OF TEETH; N% = PERCENTAGE OF ASSEMBLAGE).

It is not possible to directly compare the case of Arbon Bleiche 3 to Padnal due to the lack of some information. Padnal does not have the same level information available as there is for Arbon; e. g., dendrochronological data, sieved faunal materials, and interdisciplinary discussions - particularly the correspondence of ceramic typology and faunal remains.

At least it is clear that there is no archaeozoological evidence indicating hierarchical differences among members of the community. Future collaboration with an archaeologist is essential to produce a conclusive hypothesis, and it is hoped that once data collection has been completed the picture for the entire settlement at Padnal will become clearer.

At Padnal the cattle mortality profile shows a distinctly altered pattern in the LBA (Figure 6). Between the EBA and MBA, most cattle seem to have been slaughtered by the age of young adult and it was rare that they were allowed longer lives, but in the LBA significant numbers of cattle were allowed to live until old age. The generally ac-

cepted theory of Bronze Age agricultural economy states that domestic ungulates were exploited not only for meat, but also for milk, wool, and traction (Schibler and Studer 1998). Padnal followed this economic system. Based on horn core and pelvis analysis, sex differentiation profiles of cattle during the LBA show an almost equal proportion of female and male. In addition, a few LBA cattle bones were recognized with arthritis. Therefore, it is suggested that between the EBA and MBA at Padnal meat was the primary product or "final products" (Helmer and Vigne 2007), obtained from cattle. In the LBA dairy and traction became more important secondary or "ante – mortem" products.

A similar example has been reported from the settlement Cazis (Plüss 2007). The mortality pattern at Cazis is exactly the same as Padnal, and also shows an alteration in the LBA. Senile individuals increased overwhelmingly, and what is more, there were hardly any foetal/neonate and very few infantile individuals represented. The author of Cazis interpreted that the old individuals were kept for dairy and a traction purposes. It has been suggested that the economic system at Cazis changed during the late MBA and the beginning of LBA.

For the above mentioned settlement Kiechlberg near Innsbruck, Deschler-Erb (2010) presumed that the economic system had already changed in the EBA based on the cattle mortality profile. The profile was interpreted as milk products, under the "milk model" (Halstead 1998; Payne 1973).

The cattle mortality profile from Padnal traces a very similar pattern to that from Kiechlberg. The only difference is the lack of foetal/neonates at Padnal in the LBA. It is assumed that the highly mortality of neonates from Kiechlberg in the EBA is due to the lower skill of inhabitants in managing a difficult delivery than the LBA inhabitants of Padnal or Cazis. On one hand, the assumption of milk production from three domestic animals (cattle, sheep, goat) is supported by the heavy slaughtering of offspring. On the other hand, it is known that cows have a different lactation physiology from caprines, namely, the presence of a living calf is essential for milking cow (Balasse 2003).

A low infantile mortality rate of cattle in the LBA at Padnal is still obscure, whether the consequence of keeping offspring alive or not. Although the period of occupation of these Alpine settlements were different, they each present the same mortality patterns. Extremely high proportions of senile individuals are demonstrated, suggesting that dairy became very important for their economy.

There is another possibility about missing calves: new born calves were moved together with the mother cows up to higher altitudes in summer time and they were slaughtered and consumed there. Transhumance may already have emerged during the Neolithic at the Alpine foreland lakeshore dwellings of Switzerland (Akeret and Jacomet 1997; Ebersbach 2002), and presumably during the Bronze Age in the central Alpine region (Reitmaier 2010; Reitmaier and Della Casa 2010).

It is currently unknown when milk production from cattle became popular in the central Alpine region. It is known that the procurement of milk from cattle began during the Early Neolithic in Mediterranean Europe, in the mid sixth millennium BC (Helmer and Vigne 2007). In Switzerland, cattle were used as draught animal by *c.* 3400 BC at the latest, and it is likely that even earlier milk was regularly obtained (Schibler and Schlumbaum 2007).

As mentioned above, this new economic system had already diffused to the Neolithic – Bronze Age settlements in the eastern Alpine region by the EBA. Why did it take such a long time to be introduced to the central Alpine region? Were the societies like Cazis or Padnal isolated from surrounding communities?

The existence of dairy farming was proved by fatty acids analysis from Neolithic sites Hornstaad-Hörnle IA and Arbon Bleiche 3 in central Europe (Spangenberg *et al.* 2006, 2008). It was postulated that Arbon settlers produced not only "short life" milk, but also the "long life" milk, by convert milk into natural yogurt, butter, and cheese. Thus, dairying was already present in the north Alpine foreland region in the fourth millennium BC. If so, is it possible that people who immigrated into the central Alpine region knew of the dairy process?

Considering the mortality profile of sheep and goat, it has been observed that milk was obtained from goats at Cazis in the EBA (Plüss 2007). The frequency of goats was low at Padnal, but a lot of sheep/goats in the first two phases suggest the possibility that the inhabitants knew that the management of a sheep/goat dairy farm was based on a number of senile individuals (Figures 3 and 7). During the MBA sheep/goats were not allowed to become old individuals. From these factors it is suggested that sheep/goats were exploited for milk and wool in the first half of the Bronze Age, and in the following phases they were utilised for meat supply. It is evident that sheep and goats replaced cattle as dairy products. Hence, it is postulated that milk production from cattle became popular in the central Alpine region during the Late Bonze Age.

Conclusions

People at Padnal lived as farmers and pastoralists. Some people worked as long distance traders, some were possibly hunters, and some were metal smiths. They immigrated to the central Alpine region along with some domestic animals at the beginning of the Bronze Age. They cleared woods and built a settlement similar to other Bronze Age settlements, as if hiding in a steep basin in the valley of Oberhalbstein in canton Grisons (Rageth 1986). They had a herd of cattle, a flock of sheep and goats, and pigs. From time to time, inhabitants hunted wild animals in the surroundings of the settlement, perhaps with their dogs.

There were coniferous woodlands, grasslands, and a brook within the vicinity of the settlement.

The following results were determined:

- The most exploited animal at Padnal was cattle.

- Some differences among phases were identified. In the first two phases, sheep and goats represented a significant proportion of the animal remains, but gradually decreased over successive phases. In their place the demand for cattle increased and in the LBA they became the most important animal.

On one hand, high representation of cattle is assumed to be a result of a more cattle focused culture. On the other hand, it is assumed to be related to agricultural development. The more open environment could provide more fodder for a larger herd and could offer vast pasture lands for cattle husbandry.

- There were two different dietary habits in the first half of the Bronze Age. It is hypothesised that the different habits were due to the different economic tradition of immigrant groups.

- The noteworthy mortality profile of domestic animals shows the increasing number of senile cattle in the Late Bronze Age. The economic system in the LBA can not be considered without the dairy products and draught labour of cattle. Together with the development of agriculture, animal husbandry changed the strategy for subsistence at Padnal in the LBA.

These results represent the state of research at the time of writing. In a future paper, the results of taphonomical analysis, anthropogenic traces, and osteometry will be discussed. It is hoped that further study will contribute a little to the progenitors' historical study of animal husbandry in the Swiss Alpine Bronze Age and reconstruct greater focus on the lives of nameless inhabitants at Padnal.

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Abbreviation

IPAS = Institute for Prehistory and Archaeological Science

EBA = Early Bronze Age

E-MBA = end of Early Bronze Age to the beginning of Middle Bronze Age

MBA = Middle Bronze Age

LBA = Late Bronze Age

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RESEARCH ARTICLE

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Size diversity in Swiss Bronze Age cattle

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Abstract

To date, osteometric data for Swiss Bronze Age cattle, particularly from Alpine sites, are scarce. In the present study, using a large dataset generated by combining preexisting data with recent data obtained from a large Alpine site, cattle size from the Late Neolithic to the Late Bronze Age (LBA) in populations from different sites and regions was evaluated using the logarithmic size index and other statistical analysis. Additionally, the finite mixture model and a meta-analytic technique were used to observe possible effects of sex ratios on cattle size. Results indicated that sex ratios did not affect size distribution. Cattle populations did not differ over time, but the Alpine cattle were smaller than the Central Plateau cattle. There were two distinct sizes in the Alpine cattle populations. It is suggested that the different economic interrelationships between Alpine and other geographically related communities might have led to the emergence of size diversity in Swiss Bronze Age cattle. Further interdisciplinary studies with larger sample sizes are required to confirm these possibilities.

KEYWORDS

bronze age, cattle husbandry, logarithmic size index, osteometry, sex ratio, zooarchaeology

1 | INTRODUCTION

Specimens identified in archaeological sites suggest that cattle were the main domestic animal (approximately 30%–70% in each site) during the Bronze Age (2200–800 BC) in Switzerland, and it is presumed that they were exploited for meat and milk and as working power (Bopp-Ito, 2012; Plüss, 2011; Schibler, 2017; Schibler & Studer, 1998; Stopp, 2015). Cattle size in the Swiss Bronze Age was smaller than that in the Neolithic and Roman periods (Hüster Plogmann & Schibler, 1997; Schibler & Schlumbaum, 2007). However, little is known about the change in cattle size during the Bronze Age, and the diversity in cattle size distribution across regions, especially across the Central Plateau (hereafter calls Plateau) and the Alpine regions, has not been explored owing to the scarcity of osteometric data from Alpine sites.

The Alpine sites, which underwent colonization related to lithic raw materials during the Late Neolithic (LN) or Copper Age (Della Casa, 2003) and had expanded settlements with unique culture during the Early Bronze Age (EBA), and Plateau sites, which were sequenced since the Early Neolithic with agropastoral subsistence (Schibler, 2017), were located at different economic, geographical, topographical, and environmental crossroads (Jecker, 2015; Jennings, 2015; Reitmaier, 2012; Rychner, 1998a; Stöckli, 1995). Animal husbandry was influenced by these factors: for example, while Plateau settlements exploited cattle for secondary products from the second half of the fourth millennium BC onwards (Deschler-Erb & Marti-Grädel, 2004; Hüster Plogmann & Schibler, 1997), exploitation for secondary products at the Alpine settlements might have been intensified during the LBA (Bopp-Ito, 2012; Plüss, 2011; Stopp, 2015).

Previous studies have proposed plausible factors that could have had an impact on animal morphologies and caused size variations, such as livestock diet (Breuer, Rehazek, & Stopp, 1999), which was linked to climate (Davis, 1981) or altitude (Knockaert et al., 2017), breeding strategies (Duval, Horard-Herbin, & Lepetz, 2013; Trixl, Steidl, & Peters, 2017), idiosyncratic choices of husbandry (Cucchi et al.,

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2016), introduction of new animal forms (Gaastra, 2014; MacKinnon, 2010), transalpine mobility, and migration of humans together with their livestock (Grupe, Hölzl, Mayr, & Söllner, 2017), or selection of specific sex, such as small female cattle (Manning, Timpson, Shennan, & Crema, 2015). Because body size and sex are strongly correlated (Davis et al., 2012) and sex ratio provides a hint of cattle exploitation, computation of sex ratios of cattle populations was considered necessary.

Recently, substantial Bronze Age osteometric data were acquired from an Alpine settlement at Savognin-Padnal (hereafter calls Padnal) (Bopp-Ito, 2012), which might have been near the copper mining site for bronze production (Della Casa, Naef, & Turck, 2016; Rageth, 1986). Thus, the aim of this study was to shed new light on the change and diversity of cattle size linked with husbandry practices across settlements during the Bronze Age. The analyses of cattle size and sex ratios as preconditions may provide evidence on possible influences of sex ratio on size diversity. Samples from the aforementioned different regional sites would address factors that might have had the most influence on cattle size diversity.

2 | MATERIALS AND METHODS

2.1 | Grouping of the studied samples by assemblages, regions, and periods

Combining the data on osteometric samples obtained from four assemblages (Horizont [synonymous with layer] B, C, D, E) in Padnal (Bopp-Ito, unpublished data) with preexisting data of samples obtained from 32 assemblages from LN (ca. 2800–2200 BC), EBA (2200–1600 BC), Middle Bronze Age (MBA; 1600–1300 BC), and LBA (1300–800 BC; Rychner, 1998b), sites of modern-day Switzerland and Liechtenstein, created a large sample size (total assemblages n = 36; Figure 1, Table 1, Table S1, and Appendices S1 and S2). Although cattle specimens were decreased at the Plateau sites, the ones at the Alpine sites were increased (Schibler, 2017; Figure S1); in particular, the senile adult cattle at the Alpine sites increased during the LBA (Bopp-Ito, 2012; Plüss, 2011; Stopp, 2015). In contrast, dominant senile Plateau cattle appeared between the LN and EBA (Hüster Plogmann & Schibler, 1997; Figure S2).

The samples were grouped by (a) assemblage levels (a site that involved several settlements from different layers and a site that involved a single settlement) and (b) regional levels and by periods (Table S2 and Appendix S3). Sites were separated in different altitudes: Padnal (1,200 m), other Alpine sites (700–800 m), and Plateau sites (400 m). The EBA and MBA Alpine samples were pooled into one period because some Alpine samples were from the transitional period between EBA and MBA (Rageth, 1986). Therefore, the Alpine samples were divided into two groups: (a) EBA and MBA and (b) LBA. Alpine LN samples were too scarce for this study due to insufficient number of settlements in this period, but Plateau LN samples were abundantly available. The Plateau samples were divided into three groups: (a) LN, (b) EBA, and (c) LBA. Plateau MBA sites have not been discovered thus far (Menotti, 2015).

2.2 | Osteometric samples obtainment and logarithmic size index

The osteometric samples from Padnal were identified as belonging to cattle (*Bos taurus*) (Bopp-Ito, unpublished data) following cross-referencing with published literature (e.g., Schmid, 1972) and the reference collection of the Institute of Integrative Prehistory and Archaeological Science, University of Basel, Switzerland. Samples from Padnal were obtained using metric methods (von den Driesch, 1976) that considered only the completely fused epiphyseal bones, which indicated that the cattle were adults of over 3 years of age, although some subadult cattle have fused epiphyses at two-and-a-half years of age. This inclusion criterion (i.e., adult or subadult) was based on several previous studies (e.g., Becker, 1981; Becker & Johansson, 1981; Habermehl, 1975). Species identification and measurement of the originally reported data from the 32 assemblages were used following a description by Manning et al. (2015) and the references therein.

Calculation of the logarithmic size index (LSI = [log x − log m] = log (x/m), where x denotes the measurement to be judged and m denotes the measurement at the standard reference) is an effective method for estimating body size from specific osteometric parameters obtained

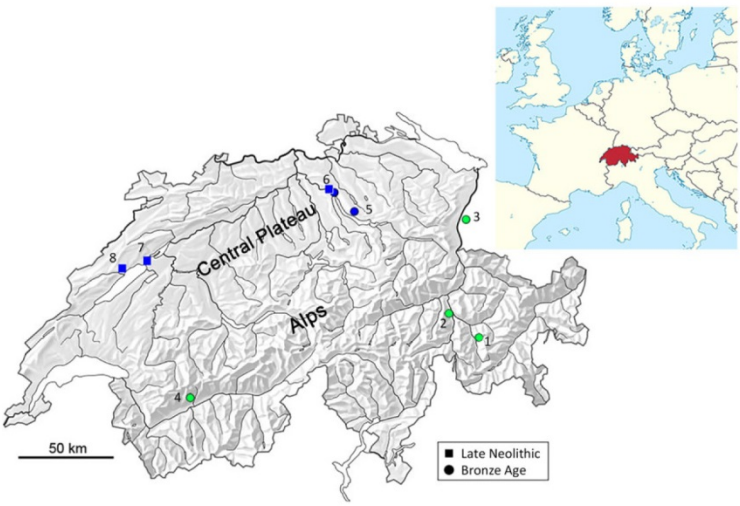

FIGURE 1 Locations of the studied sites between Late Neolithic (square) and Bronze Age (dot) periods in Switzerland and Liechtenstein. Light gray (Green) dots (Nos. 1, 2, 3, and 4) correspond to the Alpine Bronze Age sites, dark gray (blue) dots (Nos. 5 and 6) to the Central Plateau Bronze Age sites, and dark gray (blue) squares (Nos. 6, 7, and 8) to the Central Plateau Late Neolithic sites. Numbers refer to the entries in Table 1: 1 = Savognin-Padnal; 2 = Cresta-Cazis; 3 = Schellenberg-Borscht; 4 = Ayent Le Château; 5 = Meilen-Obermeilen; 6 = Zürich sites; 7 = Pont-de-Thielle; 8 = Auvernier sites [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Sample sources for the Late Neolithic and Bronze Age cattle excavated from four Alpine sites (18 assemblages) and nine Central Plateau sites (18 assemblages) in Switzerland and Liechtenstein. The map number (No.) corresponds to the locations shown in Figure 1. For details, see Appendix S1

Region	Period	No.	Assemblage	Reference	Year	LSI *n*	Mc Bd *n*
Alpine	Late Bronze Age	4	Ayent Le Château	Chaix	1990	1	
		2	Cresta-Cazis, Planum 14	Plüss	2007	10	1
		1	Savognin-Padnal, Horizont B	Bopp-Ito	Unpub.	39	10
	Total					50	11
	Middle Bronze Age	2	Cresta-Cazis, Planum 12	Plüss	2007	22	2
		2	Cresta-Cazis, Planum 11	Plüss	2007	5	1
		2	Cresta-Cazis, Planum 10	Plüss	2007	3	1
		1	Savognin-Padnal, Horizont C	Bopp-Ito	Unpub.	12	2
		1	Savognin-Padnal, Horizont D	Bopp-Ito	Unpub.	13	1
	Total					55	7
	Early Bronze Age	4	Ayent Le Château	Chaix	1990	1	
		2	Cresta-Cazis, Planum 8	Plüss	2007	15	
		2	Cresta-Cazis, Planum 5	Plüss	2007	4	
		2	Cresta-Cazis, Planum 4	Plüss	2007	3	
		2	Cresta-Cazis, Planum 3	Plüss	2007	13	5
		2	Cresta-Cazis, Planum 2	Plüss	2007	6	2
		2	Cresta-Cazis, Planum 1	Plüss	2007	8	
		1	Savognin-Padnal, Horizont E	Bopp-Ito	Unpub.	6	
		3	Schellenberg-Borscht 1965	Hartmann-Frick	1965	14	1
		3	Schellenberg-Borscht 1937	Kuhn	1937	3	
	Total					73	8
Central	Late Bronze Age	6	Zürich-Alpenquai	Wettstein	1924	70	39
Plateau	Total					70	39
	Early Bronze Age	5	Meilen-Obermeilen	Kuhn	1935	26	6
		6	Zürich-Mozartstrasse, 1o	Hüster Plogmann/Schibler	1997	27	8
		6	Zürich-Mozartstrasse, 1u	Hüster Plogmann/Schibler	1997	38	7
	Total					91	21
	Late Neolithic	8	Auvernier La Saunerie	Stampfli	1976	56	18
		8	Auvernier Brise-Lames	Desse	1976	9	
		7	Thielle Wavre, Pont-de-Thielle	Chaix	1977	7	4
		6	Zürich-Mozartstrasse, 2o	Hüster Plogmann/Schibler	1997	44	17
		6	Zürich-Mozartstrasse, 2u	Hüster Plogmann/Schibler	1997	15	3
		6	Zürich-Mythenschloss 2.4	Hüster Plogmann/Schibler	1997	11	
		6	Zürich-Mythenschloss 2.2–3	Hüster Plogmann/Schibler	1997	6	1
		6	Zürich-Mythenschloss 2.1	Hüster Plogmann/Schibler	1997	2	
		6	Zürich-Pressehaus C2	Hüster Plogmann/Schibler	1997	4	3
		6	Zürich Seefeld Kan. San. F	Hüster Plogmann/Schibler	1997	1	
		6	Zürich Seefeld Kan. San. E	Hüster Plogmann/Schibler	1997	13	
		6	Zürich Seefeld Kan. San. D	Hüster Plogmann/Schibler	1997	30	8
		6	Zürich Seefeld Kan. San. C/B	Hüster Plogmann/Schibler	1997	17	2
		6	Zürich Seefeld Kan. San. A	Hüster Plogmann/Schibler	1997	9	1
	Total					224	57
					Total	563	143

Note. LSI = logarithmic size index; LSI n = number of specimens used for LSI determination; Mc Bd = Metacarpus greatest distal breadth; Mc Bd n = number of specimens providing measurements of the Mc Bd used for sex ratio determination as the effective variable to distinguish the sexes; Unpub. = unpublished; Zürich Seefeld Kan. San. = Zürich Seefeld Kanalisationssanierung.

from bone fragments, especially for generating a large sample size, and it is widely used in zooarchaeology to study geographical and chronological diversity of animal morphologies (Meadow, 1999; Simpson, Roe, & Lewontin, 1960). The LSI was applied to the osteometric data from Savognin-Padnal combined with the preexisting data of Swiss LN and Bronze Age cattle following a standardized protocol described by Breuer et al. (1999) and Schibler and Steppan (1999) and the references therein, because most of our samples provided data only on

width due to heavy fragmentation. The marginal measurements were excluded following aforementioned protocols and Duval et al. (2013). In total, 563 osteometric samples from postcranial skeletal elements based on eight measurement positions, which were selected to ensure adult or subadult specimens based on fusion of their epiphyses in later stages of age (e.g., Habermehl, 1975), were considered as parameters for the analysis (von den Driesch, 1976; Table 2). Standard reference values for LSI estimation were based on the bone measurements of a 13-year-old modern Hinterwälder breed female cow (Z-2431, withers height approximately 116.9 cm) from the collection of the Institute of Integrative Prehistory and Archaeological Science, University of Basel, as recorded by R. Ebersbach and G. Breuer (Breuer et al., 1999). LSI expresses the size of a cattle specimen relative to that of a reference specimen, with a specimen larger than the reference specimen (LSI value = 0) securing a positive value, and a specimen smaller than the reference specimen securing a negative value (Meadow, 1999). LSIs for each assemblage with at least over 10 observations were compared through notched box plots created using Wessa net software version 1.2.1 (Wessa, 2017), and histograms for Alpine assemblages were generated after Duval et al. (2013) using PAST software version 3.04 (Hammer, Harper, & Ryan, 2001).

The statistical differences between LSIs were examined according to assemblages and periods, following a standardized protocol described by Colominas, Schlumbaum, and Sana (2013) and Duval et al. (2013) and the references therein. The nonparametric Kruskal–Wallis test with one-way analysis of variance was performed to determine the statistical validity of the differences between the sample medians, followed by a post hoc nonparametric Mann–Whitney *U* test if significant differences were detected. The level of statistical significance was set at $p = .05$. To assess the statistical significance of differences between the all LSIs divided by regions (Alpine and Plateau) and periods, a mixed model (StataCorp, 2013b) with assemblages as random effects was used. Statistical tests for LSI were performed using PAST and STATA software version 13.1 (StataCorp, 2013a).

2.3 | Sex ratio

Differences in sex ratio possibly cause differences in body size distribution, as male cattle tend to be larger than female cattle. Our samples pooled the data on female, male, and castrated male cattle (Armitage, 1982; Grigson, 1982); however, sex information was not available from all the sites described in the references included in the current study. Therefore, to distinguish the sexes, the greatest distal breadth (Bd) of the metacarpus (see von den Driesch, 1976) as one of the most effective osteometric variable (Davis et al., 2012; Hüster, 1990) was extracted from the osteometric data and used for sex ratio determination (Table 1). Raw osteometric variables (not log-transformed) were used and analysed by fitting to a finite mixture model (McLachlan & Peel, 2000). The model assumes a mixture of two normal distributions with sex-specific means and standard deviations. From the model output, the percentage of female cattle can be identified by assuming that the lower mean value corresponds to female cattle. This method provided estimates of the percentage of females (referred to as female probability) and of the sex-specific means and standard deviations together with 95% confidence intervals. This model is fitted separately for each assemblage with at least six observations.

The variance in the true female probabilities based on the estimated female probabilities was estimated by using a meta-analytic technique (Russo, 2007). The estimated tau of this variance and the *p* value of a test of the hypothesis that the variance equalled zero are reported. Additionally, a metaregression to evaluate whether female probabilities were associated with the mean LSI in eight assemblages was performed, and $p < .05$ indicated significance. Statistical analyses for sex ratio and its association with the mean LSI were performed using the STATA software version 13.1 (StataCorp, 2013a).

TABLE 2 Measurements used to obtain osteometric data from cattle bones for subsequent logarithmic size index analysis (for details see von den Driesch, 1976) and the standard value (Breuer et al., 1999, pp. 227–228)

Skeletal element	Position and standard value (mm)
Humerus	Bp (Greatest proximal breadth), 87.50
Radius	Bd (Greatest distal breadth), 70.60
Ulna	DPA (Depth across the processus anconaeus), 59.24
Femur	DC (Greatest depth of the caput femoris), 45.61
Tibia	Bp (Greatest proximal breadth), 96.71
Metacarpus	Bd (Greatest distal breadth), 55.29
Metatarsus	Bd (Greatest distal breadth), 51.94
Calcaneus	GL (Greatest length), 125.50

3 | RESULTS

3.1 | Sex ratio diversity of cattle between assemblages and periods

The distribution of metacarpus Bd measurements of cattle bones from assemblages, with at least six observations, revealed a clear bimodal sex distribution (Figure 2). Hence, it is possible to fit a finite mixture model successfully for each settlement. All estimates are reported in Table S3. No evidence for a variation in true sex ratios over time or within regions was found (tau = 0.0; $p = .55$), and the average female probability across assemblages was 60% (Figure 3). Furthermore, no evidence for an association between the mean LSI and female probability was found ($p > .05$).

3.2 | Size diversity of cattle between assemblages

The LSI values with over 10 observations revealed a highly significant difference in size between the cattle populations divided by assemblages and periods ($\chi^2 = 82.7$, $p < .0001$). The size of Plateau cattle, except Zürich-Mythenschloss cattle, was homogenized. However, the Schellenberg-Borscht and Cresta-Cazis (hereafter calls Borscht and Cazis) Alpine cattle were larger than those at Padnal, which were the smallest (Figure 4). Pairwise comparisons confirmed that Padnal cattle were significantly smaller (Table 3). However, the histograms of all LSIs from Alpine assemblages showed that there was hardly any size reduction in Alpine cattle inside the settlements, that is, in Cazis and Padnal (Figure 5). The distribution of mean LSI (Figure 6) roughly grouped cattle

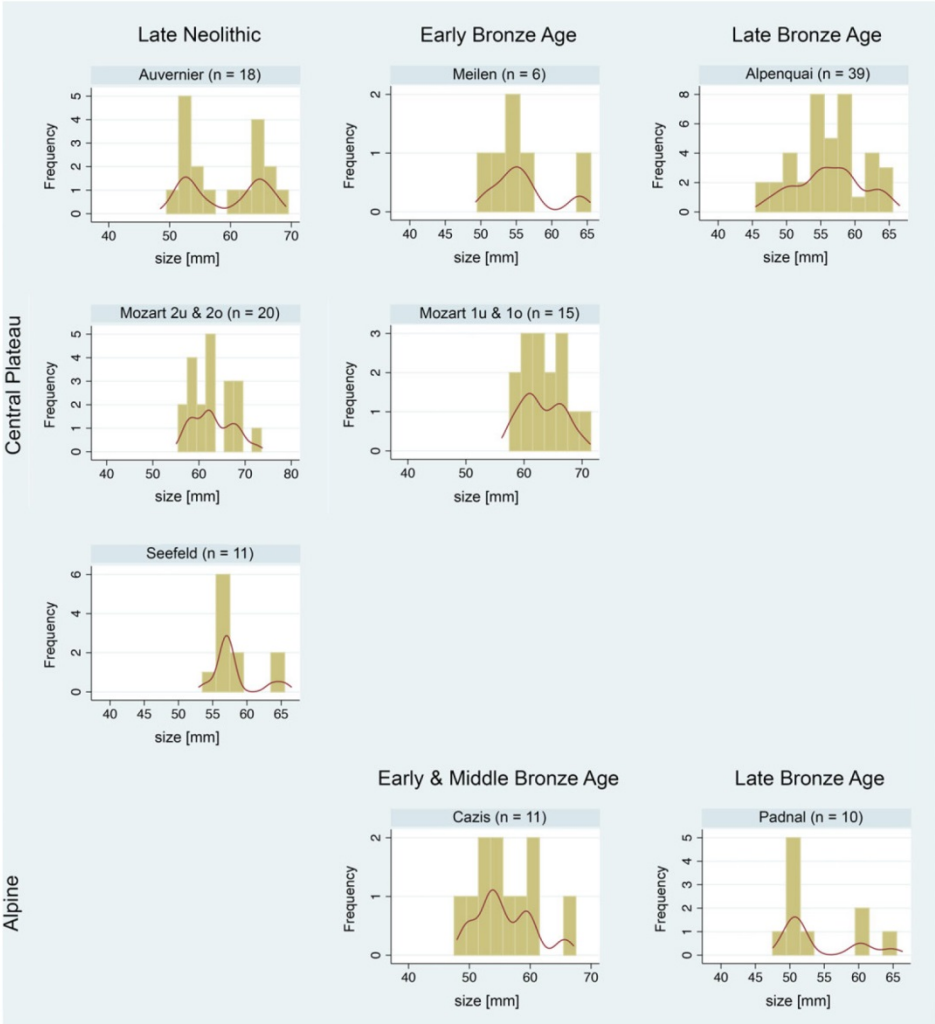

FIGURE 2 Histograms with Kernel density curves showing the distribution of the greatest distal breadth (Bd) measurements of cattle metacarpus from the Late Neolithic and Bronze Age assemblages. These data were used in a finite mixture model. For site names and details, see Table 1 [Colour figure can be viewed at wileyonlinelibrary.com]

populations into three sizes: Plateau, Borscht/Cazis, and Padnal cattle. Statistical parameters are summarised in Table S4.

3.3 | Size diversity of cattle between regions

All pooled LSI data divided by regions and periods showed that size distributions varied widely among the Alpine and Plateau cattle populations (Figure 7). Alpine cattle showed a marked decrease in the median LSI value with time, in contrast to no changes in Plateau cattle LSI values. However, this may have been due to the slight contribution of the Cazis LBA cattle, owing to the small sample size, as indicated in Figure 4. A mixed model analysis revealed that even after taking into account the settlements as factors of their own, the difference in size between the Alpine and Plateau cattle was significant (p = .033). Evidence for a time trend was not found (p = .610), even inside the settlements, as evident from Figures 5 and 6. Statistical parameters are summarised in Table S5.

4 | DISCUSSION

It is evident that Alpine cattle tended to be smaller than Plateau cattle, but there was no evidence for any time trends. In general, a substantial variation in size distribution across settlements makes the assessment of global trends difficult. However, cattle from Padnal was relatively small throughout the Bronze Age. Our study indicates that comparing samples at the assemblage level is important for a better understanding of cattle size distributions, because it seems necessary to take the archaeological circumstances of each individual site, including its distinct location,

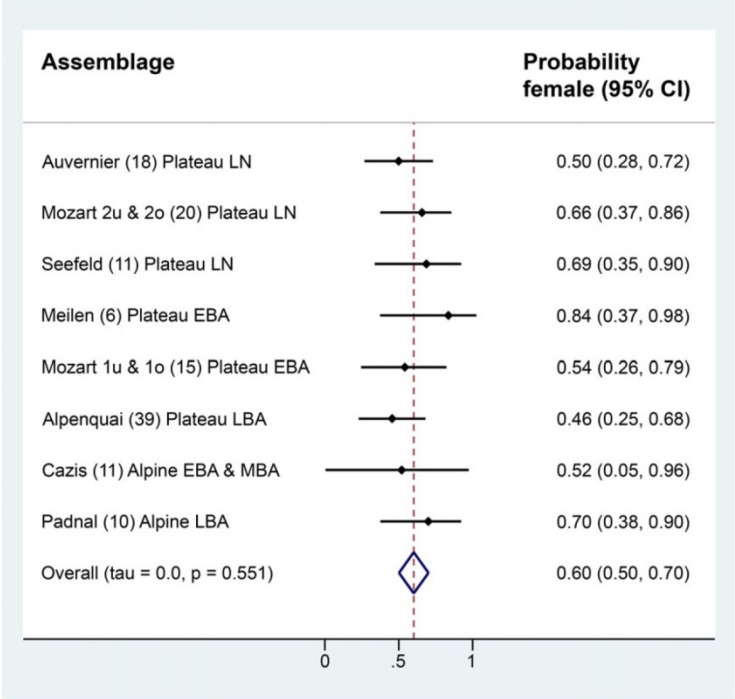

FIGURE 3 Forest plots of the probable proportions of female cattle in the Alpine and Central Plateau assemblages. Assemblages providing more than six measurements of the greatest distal breadth (Bd) of cattle metacarpus were included. Numbers in parentheses next to the assemblage names indicate the sample sizes. CI = confidence interval; EBA = Early Bronze Age; LBA = Late Bronze Age; LN = Late Neolithic; MBA = Middle Bronze Age; Plateau = Central Plateau. For site names and details, see Table 1 [Colour figure can be viewed at wileyonlinelibrary.com]

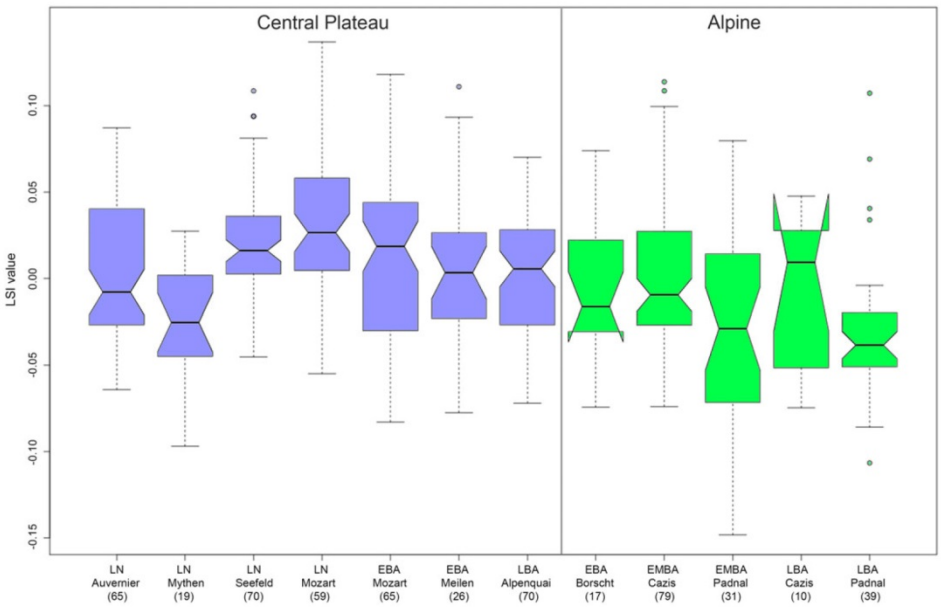

FIGURE 4 The logarithmic size index (LSI) of cattle in the Alpine and Central Plateau assemblages between the Late Neolithic and Bronze Age periods. Numbers in parentheses indicate the sample size used to obtain LSI. EBA = Early Bronze Age; EMBA = Early and Middle Bronze Age; LBA = Late Bronze Age; LN = Late Neolithic. For site names and details, see Table 1 [Colour figure can be viewed at wileyonlinelibrary.com]

environment, economy, and links with cattle husbandry, such as the identified number or the mortality profile, into consideration. Several potential factors may have contributed to the diversity in cattle size distribution, as discussed below.

As there was no evidence for variations in sex ratios between assemblages, this factor can be excluded from the list of potential explanations. The 60% female probability across assemblages might be due to samples belonging to mature individuals. Hence, there was sexual selection of offspring; mostly males were killed for meat and females were retained for secondary products (Halstead & Isaakidou, 2011). The LN Zürich-Mythenschloss small cattle might have been mostly female due to the high mortality profile of offspring calves

TABLE 3 Mann–Whitney *U* test pairwise comparisons of the logarithmic size index (LSI) of cattle in the Alpine and Central Plateau assemblages between the Late Neolithic and Bronze Age periods. Numbers in parentheses indicate the sample size used to obtain LSI. For site names and details, see Table 1

Period	Late Neolithic				Bronze Age							
Region	Central Plateau							Alpine				
	LN	LN	LN	LN	EBA	EBA	LBA	EBA	EMBA	EMBA	LBA	LBA
Assemblage	Auver.	Mythen.	Seefeld	Mozart	Mozart	Meilen	Alpenq.	Borscht	Cazis	Padnal	Cazis	Padnal
Sample n	65	19	70	59	65	26	70	17	79	31	10	39
LN Auvernier		**<.05**	**<.01**	**<.001**	0.4232	0.6477	0.9543	0.4232	0.7254	**<.05**	0.7025	**<.0001**
LN Mythen			**<.0001**	**<.0001**	**<.01**	**<.05**	**<.01**	0.2050	**<.05**	0.7796	0.1033	0.2021
LN Seefeld				0.1187	0.2327	0.0590	**<.05**	**<.01**	**<.001**	**<.0001**	0.1437	**<.0001**
LN Mozart					**<.05**	**<.05**	**<.001**	**<.01**	**<.0001**	**<.0001**	**<.05**	**<.0001**
EBA Mozart						0.6637	0.3326	0.1716	0.1996	**<.01**	0.4088	**<.0001**
EBA Obermeilen							0.8755	0.3646	0.4078	**<.05**	0.7911	**<.001**
LBA Alpenquai								0.3683	0.3340	**<.01**	0.5852	**<.0001**
EBA Borscht									0.6110	0.2274	0.7441	**<.05**
EMBA Cazis										**<.05**	0.9224	**<.0001**
EMBA Padnal											0.2425	0.8039
LBA Cazis												0.0847
LBA Padnal												

Significant p values are in bold. α = .05.

Note. α = significance level; Alpenq. = Alpenquai; Auver. = Auvernier; EBA = Early Bronze Age; EMBA = Early and Middle Bronze Age; LBA = Late Bronze; LN = Late Neolithic; MBA = Middle Bronze Age; Mythen. = Mythenschloss.

(Hüster Plogmann & Schibler, 1997). The correlation of sex ratios with mean LSI from a corresponding metaregression also did not hint at an influence of sex ratios on size distribution. Therefore, our hypothesis that the intensification of dairy production based on the increase in senile cattle at the Alpine sites during the LBA was not supported. The Alpine cattle, especially Padnal cattle, could have been exploited for meat and as working power in agriculture and bronze production (Bopp-Ito, 2012; Plüss, 2011; Stopp, 2015). However, a larger sample size is necessary to draw definite conclusions regarding the role of sex ratios in determining size diversity.

Although there was no time trend, significant trends were found between the two regions and 12 assemblages. Cattle size distributions seemed to be related to the altitude for large Plateau cattle in the flat Plateau, middle Borscht and Cazis cattle in the lower Alps, and small Padnal cattle in the middle of the Alps. These habitats were formed by various types of fodder in soil, temperature, or agropastoral land use (Davis, 1981; Duval et al., 2013; Jacomet, 1998; Knockaert et al., 2017; Reitmaier, 2012), and the quality of diet could also have affected cattle size (Breuer et al., 1999). However, the lack of data based on various proxies, for example, pollen or tree rings, that enable dating and climate reconstruction, makes it difficult to explore the climatic effects on the samples from Alpine sites (Schibler, 2017).

As to the reason why small Padnal cattle suddenly appeared in the Alps, there is a possibility that they could be an introduced allochthonous population (Gaastra, 2014; MacKinnon, 2010), but it is difficult to discuss this due to the lack of the osteometric samples from Neolithic Alpine cattle. There is an alternative possibility that they could be a migrated population accompanied by migrants (Grupe et al., 2017) from areas outside the Swiss Alpine region, such as from the southern parts of the Alps (northern Italy and Tyrolian Austria), because the size of cattle in the southern parts of the Alps over 1,000 m above the sea level (e.g., Riedel & Tecchiati, 1998) is smaller than that in the northern parts (Riedel & Tecchiati, 2001; Stopp, 2015; Trixl et al., 2017), but homogeneous with that of Padnal cattle (Bopp-Ito, unpublished data), indicating a similar environment and close economic relationship between Padnal and the southern communities.

The location of Padnal beside the road that crosses over the Julier pass towards northern Italy, and excavation of outstanding foreign objects, particularly those with attributes of northern Italy (Rageth, 1986), suggest a deep relationship with north Italian communities through traffic and trade networks (Della Casa, 2007; Jecker, 2015; Jennings, 2015). The southern Alpine people who might have had a technology of bronze production (Marti-Grädel, Stopp, Deschler-Erb, Hüster Plogmann, & Schibler, 2012) perhaps migrated into the northern parts of the Alps with their livestock and selected the location at Padnal to build their settlement for bronze production (Della Casa et al., 2016; Rageth, 1986). The lack of change in the size of cattle in each Alpine site might reflect their stable animal management strategies throughout the Bronze Age. Nevertheless, the limited number of sites with animal remains located close to the southern Alpine communities, making it difficult to conclude whether small cattle at Padnal were an exception or occurred commonly. In contrast, the extra-large Near East mitochondrial d-loop haplogroup T2 cattle (Bonfiglio et al., 2010), to date have been found only from the Roman site in Switzerland (Schlumbaum, Turgay, & Schibler, 2006), were excavated from a house with objects with south German attributes in the EBA Padnal settlement (Horizont E) (Bopp-Ito, 2012), which suggests the migration of large cattle from north routes and small cattle from south routes. However, it is difficult to confirm this possibility without genetic (e.g., Schibler & Schlumbaum, 2007), geometric morphometrics (Cucchi et al., 2016), isotopic, or strontium (Grupe et al., 2017;

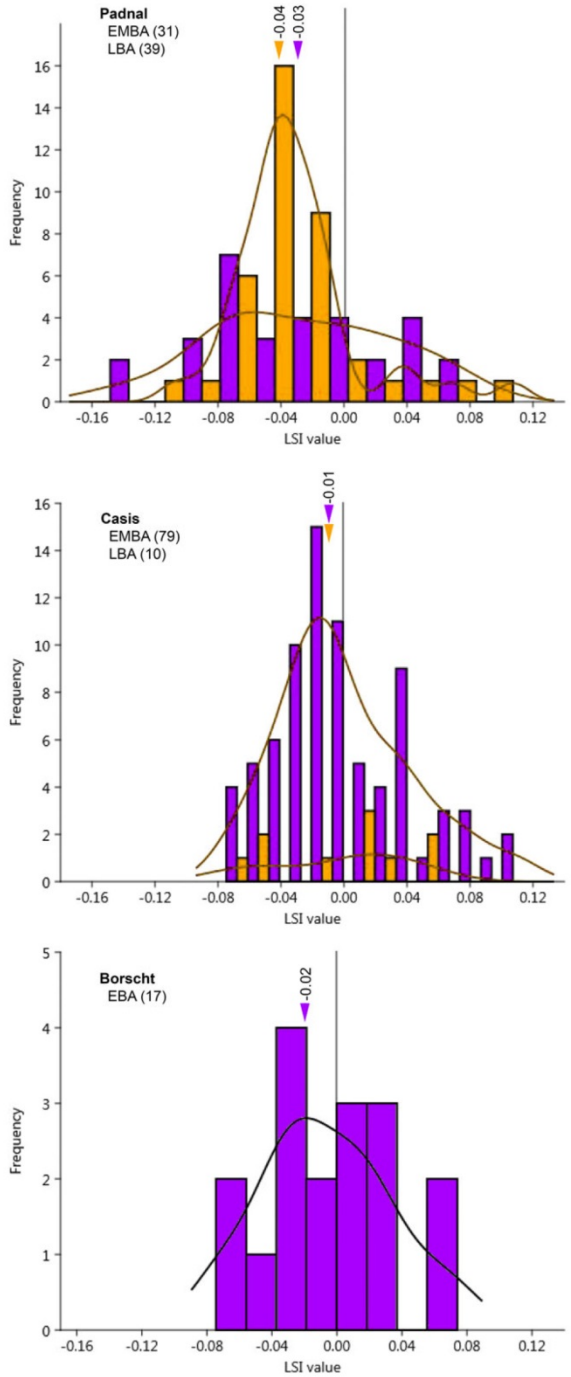

FIGURE 5 Histograms of the logarithmic size index (LSI) with Kernel density curves of cattle from the Alpine Bronze Age assemblages. EBA and EMBA are dark gray (purple) and LBA is light gray (orange) colour. Numbers in parentheses indicate the sample size used to obtain LSI. The arrows indicate the median value for each assemblage (after Duval et al., 2013). EBA = Early Bronze Age; EMBA = Early and Middle Bronze Age; LBA = Late Bronze Age. For site names and details, see Table 1 [Colour figure can be viewed at wileyonlinelibrary.com]

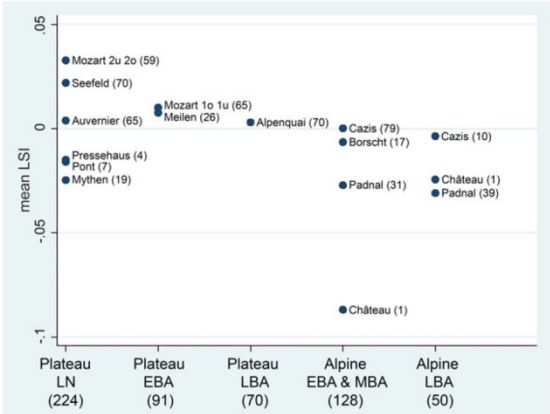

FIGURE 6 Mean of the logarithmic size index (LSI) of cattle in the Alpine and Central Plateau assemblages between the Late Neolithic and Bronze Age periods used to a meta-regression to evaluate whether means were associated with female probabilities. Numbers in parentheses indicate the sample sizes used to obtain LSI. EBA = Early Bronze Age; LBA = Late Bronze Age; LN = Late Neolithic; MBA = Middle Bronze Age; Plateau = Central Plateau. For site names and details, see Table 1 [Colour figure can be viewed at wileyonlinelibrary.com]

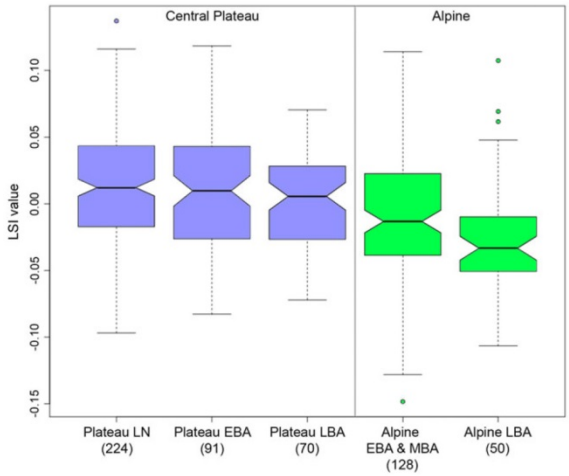

FIGURE 7 The logarithmic size index (LSI) of cattle in the Alpine and Central Plateau regions between the Late Neolithic and Bronze Age periods. Numbers in parentheses indicate the sample sizes used to obtain LSI. EBA = Early Bronze Age; LBA = Late Bronze Age; LN = Late Neolithic; MBA = Middle Bronze Age [Colour figure can be viewed at wileyonlinelibrary.com]

Reitmaier et al., 2017) evidence to reconstruct phylogenetic relationships and places of origin and migration.

The middle-sized Alpine cattle at Borscht and Cazis might have migrated from the southern but more so from the northern communities, such as Plateau or South Germany, and these cattle might have been phylogenetically related because these sites possessed objects with northern attributes much more than Padnal during the EBA (Jecker, 2015). As they were located along the river Rhine (cf. Figure 1), contact with the northern communities through the river and lakes was more probable and frequent than with Padnal, which

was located in the higher mountains. The different strength of economic interrelationships between Alpine and other geographically closed communities might have resulted in three sizes of Swiss Bronze Age cattle. The migrated Alpine cattle were well adapted to the environment at different altitudes, increased their populations, and did not change their size in each settlement, in spite of the change of culture and cattle husbandry practices, such as change of cattle exploitation during the LBA. Further research with large sample sizes and the aforementioned interdisciplinary approaches are necessary for verifying our hypotheses.

5 | CONCLUSION

Osteometric data of Swiss LN and Bronze Age cattle from different regions and assemblages across periods were used to evaluate the differences in the size of cattle using the LSI and to explore the effect of sex ratio on size, based on a finite mixture model and a meta-analytic technique using the measurements of the greatest Bd of the metacarpus. Sex ratio did not correlate with mean LSI. Our hypothesis that the increase in female cattle for dairy production in the LBA Alpine sites was not proved. There was no evidence for time trends but there were differences in size between cattle populations that were presumably caused by varied nutrition in the diet linked to the altitude, but this is open to debate. The smallest Padnal cattle might have been migrated populations accompanying migrants mainly from the southern parts of the Alps, and they could have been exploited for meat and as working power for bronze production, mining, and agriculture. Middle-sized Borscht and Cazis cattle might be more phylogenetically related to large Plateau cattle because these sites might have been economically interrelated more frequently with northern communities. Further investigations with larger sample sizes and interdisciplinary studies, including genetics and geometric morphometrics to show a possible link between cattle populations, isotopic analyses to show diet variations, and strontium analyses to show the cattle and human migration, are required to confirm this possibility.

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CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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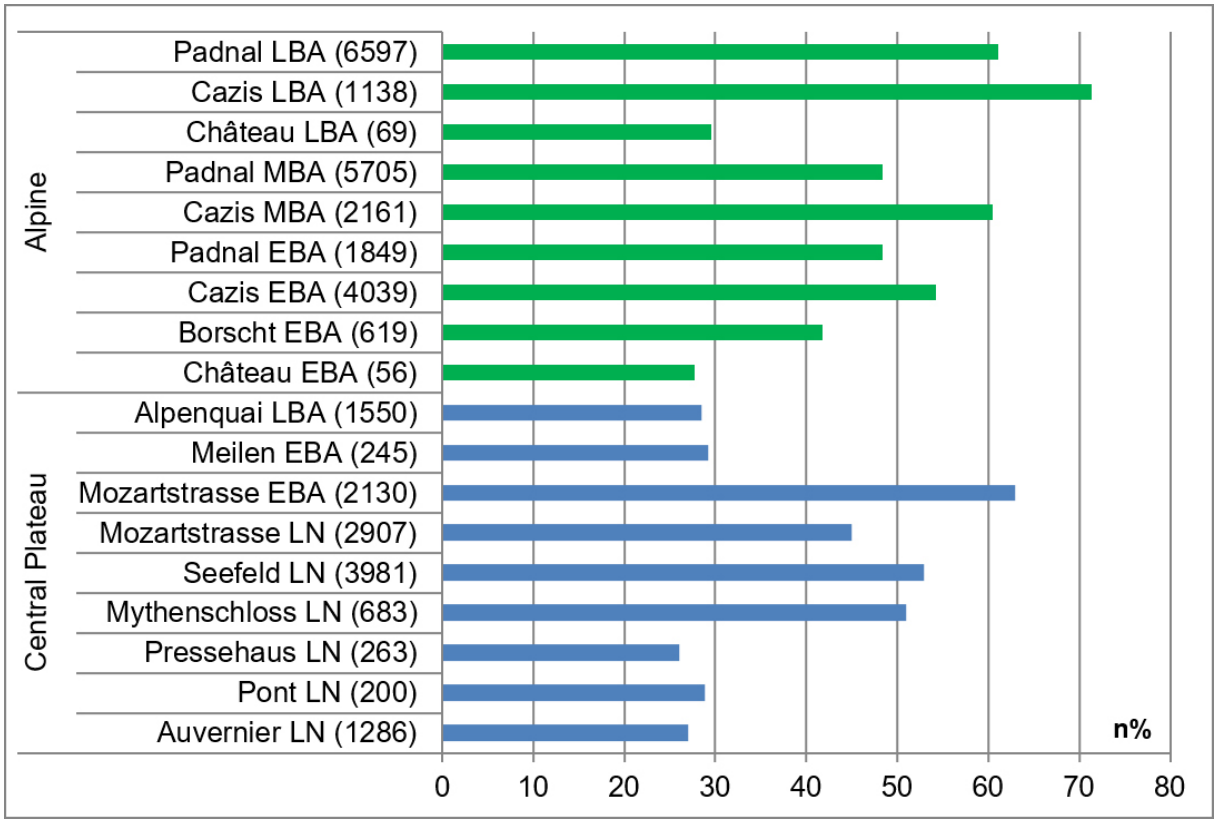
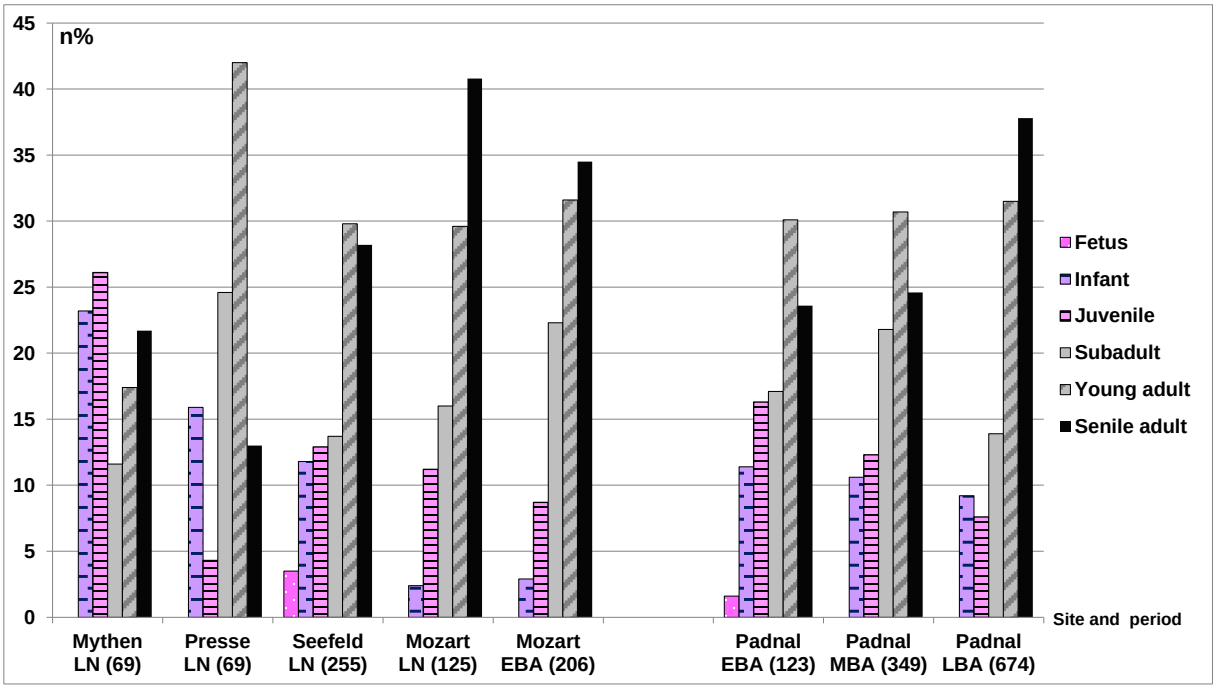
Supplementary materials

Figure S1. Proportion of the number of identified specimens (NISP) of cattle in each assemblage. Numbers in parentheses indicate the NISP of cattle. For site names and details, see Table 1.



LN = Late Neolithic; EBA = Early Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

Figure S2. Cattle mortality profile based on tooth eruption and wear from the settlements in Zurich area and Savognin-Padnal. Numbers in parentheses indicate the number of teeth used to obtain the mortality profile. For site names and details, see Table 1.



LN = Late Neolithic; EBA = Early Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age; Mythen = Mythenschloss; Presse. = Pressehaus; Seefeld Kan. San. = Seefeld Kanalisationssanierung; Mozart = Mozartstrasse; Padnal = Savognin-Padnal.

Table S1. Dating of the assemblages listed in Table 1 corresponding to the locations shown in Figure 1.

Region	Period	Map No.	Assemblage	Method	Dating BC	Dating Reference
Alpine	**LBA**	4	Ayent Le Château	C14	1210-906	David-El Biali M, 1990
		2	Cresta-Cazis, N-Planum 14	C14	1350-1100/800	Wyss R, 2002
				Typology	LBA-Iron Age 1300-400	Murbach-Wende I, 2016
		1	Savognin-Padnal, Horizont B	C14	1350/1300-900/800	Rageth J, 1986 & pers. Com.
	MBA	2	Cresta-Cazis, N-Planum 10-12	C14	1800-1550	Wyss R, 2002
				C14	1750-1300	Murbach-Wende I, 2016
		1	Savognin-Padnal, Horizont C	C14	1450-1350/1300	Rageth J, 1986 & pers. Com.
		1	Savognin-Padnal, Horizont D	C14	1550-1450	Rageth J, 1986 & pers. Com.
	EBA	4	Ayent Le Château	Typology	BzA3-BzA4	David-El Biali M, 1990
			Cresta-Cazis, N-Planum 1-5, 8	C14	2400-1800	Wyss R, 2002
		2	Cresta-Cazis, N-Planum 8	C14	1850-1700	Murbach-Wende I, 2016
			Cresta-Cazis, N-Planum 1-5	C14	2000-1850	Murbach-Wende I, 2016
		1	Savognin-Padnal, Horizont E	C14	1950/1900-1550	Rageth J, 1986 & pers. Com.
		3	Schellenberg-Borscht 1937, 1965	Typology	Early Bronze Age 2000	Hild A, 1935, 1936
Plateau	**LBA**	6	Zürich-Alpenquai	Typology	Late Bronze Age	Hochuli S et al., 1998 (SPM III)
	EBA	5	Meilen-Obermeilen	Typology	Early Bronze Age	Kuhn M, 1935, Keller F, 1870, Hochuli S et al., 1998 (SPM III)
		6	Zürich-Mozartstrasse, 1u, 1o	Typology	Early Bronze Age	Bleicher N, 2011
	LN	8	Auvernier La Saunerie	Den.	2800-2450	Stöckli E et al., 1995 (SPM II)
		8	Auvernier Brise-Lames	Den.	2800-2450	Stöckli E et al., 1995 (SPM II)
		7	Thielle Wavre, Pont-de-Thielle	Den.	2701	Stöckli E et al., 1995 (SPM II)
		6	Zürich-Mozartstrasse, 2o	Den.	2605-2568	Gross-Klee E, 1997
		6	Zürich-Mozartstrasse, 2u	Den.	2625-2605	Gross-Klee E, 1997
		6	Zürich-Mythenschloss 2.1	Den.	2548	Stöckli E et al., 1995 (SPM II)
		6	Zürich-Mythenschloss 2.2, 2.3, 2.4	Den.	2680	Stöckli E et al., 1995 (SPM II)
		6	Zürich-Pressehaus C2	Den.	2719-2713, 2690-2683	Stöckli E et al., 1995 (SPM II)
		6	Zürich Seefeld Kan. San. A, C/B, D, E, F	Den.	2718-2675	Gross-Klee E, 1997

Den. = Dendrochronology. Pers. com. = Personal communication; Bz = Bronzezeit (Bronze Age); LN = Late Neolithic; EBA = Early Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age; Zürich Seefeld Kan. San. = Zürich Seefeld Kanalisationssanierung.

Table S2. Detailed list of the studied sites. The map number (Map No.) corresponds to the locations shown in Figure 1. For details of site names and references, see Table 1.

Map No.	Site	Grouping	Topography	Altitude (*ca.* m)	Location near (by)	Culture LN	EBA	MBA	LBA
1	Padnal	Alpine EMBA, LBA	Middle Alps	1223	Julier pass		Inneralpine	Inneralpine	Mix of RSFO, Main-Schwaben, Laugen-Melaun
2	Cazis	Alpine EMBA, LBA	Lower Alps	765	River Rhine		Inneralpine	Inneralpine	Mix of RSFO, Main-Schwaben, Laugen-Melaun
3	Borscht	Alpine EMBA	Lower Alps	690	River Rhine		Inneralpine	Inneralpine	Mix of RSFO, Main-Schwaben, Laugen-Melaun
4	Château	Alpine EMBA, LBA	Lower Alps	840	River Rhone		Rhone		RSFO
6	Alpenquai	Plateau LBA	East Plateau	400	Lake Zurich				RSFO
5	Meilen	Plateau EBA	East Plateau	404	Lake Zurich		Arbon		
6	Mozartstrasse	Plateau LN, EBA	East Plateau	404	Lake Zurich	Schnurkeramik, Glockenbecher	Arbon		
6	Mythenschloss	Plateau LN	East Plateau	404	Lake Zurich	Schnurkeramik, Glockenbecher			
6	Pressehaus	Plateau LN	East Plateau	404	Lake Zurich	Schnurkeramik, Glockenbecher			
6	Seefeld	Plateau LN	East Plateau	404	Lake Zurich	Schnurkeramik, Glockenbecher			
7	Pont	Plateau LN	West Plateau	430	Lake Neuchâtel	Schnurkeramik, Glockenbecher			
8	Auvernier	Plateau LN	West Plateau	430	Lake Neuchâtel	Schnurkeramik, Glockenbecher			

LN = Late Neolithic; EBA = Early Bronze Age; EMBA = Early and Middle Bronze Age; LBA = Late Bronze Age; RSFO = Rhein-Schweiz-Ostfrankreich-Kultur.

Table S3. Results of a *finite mixture mode*l analysis in Figure 2 and 3. The greatest distal breadth (Bd) measurements of cattle metacarpus were used in the models.

Region	Period	Assemblage	Data (n)	Probability female (95% CI)	Mean [mm] female (95% CI)	Mean [mm] male & cast. (95% CI)	SD female (95% CI)	SD male & cast. (95% CI)
Alpine	LBA	Savognin-Padnal, Horizont B	10	0.700 (0.376, 0.900)	50.7 (50.0, 51.3)	61.8 (59.3, 64.3)	0.83 (0.49, 1.40)	2.20 (0.99, 4.89)
	EBA & MBA	Cresta-Cazis, Planum 1-5, 8, 10-12	11	0.520 (0.051, 0.957)	52.6 (50.0, 55.2)	59.3 (50.6, 68.0)	2.21 (1.00, 4.91)	3.88 (1.12, 13.43)
Central Plateau	LBA	Zürich-Alpenquai	39	0.455 (0.252, 0.675)	52.6 (51.0, 54.2)	59.3 (57.7, 60.9)	3.48 (2.12, 5.71)	3.51 (2.23, 5.54)
	EBA	Meilen-Obermeilen	6	0.836 (0.370, 0.978)	53.6 (53.6, 53.6)	63.9 (63.9, 63.9)	2.19 (1.18, 4.06)	0.00 (0.00, 0.00)
	EBA	Zürich-Mozartstrasse, 1u, 1o	15	0.541 (0.264, 0.794)	60.2 (58.7, 61.7)	66.5 (64.6, 68.3)	1.69 (0.85, 3.35)	1.92 (0.93, 3.96)
	LN	Auvernier La Saunerie	18	0.500 (0.284, 0.716)	53.1 (51.9, 54.4)	64.7 (63.5, 66.0)	1.91 (1.20, 3.05)	1.93 (1.21, 3.09)
	LN	Zürich-Mozartstrasse, 2u, 2o	20	0.657 (0.374, 0.860)	60.4 (58.7, 62.1)	68.0 (65.6, 70.4)	2.44 (1.43, 4.16)	2.21 (0.96, 5.13)
	LN	Zürich Seefeld Kan San. A, C/B, D, E, F	11	0.687 (0.347, 0.900)	57.0 (56.7, 57.4)	60.5 (55.1, 65.9)	0.46 (0.28, 0.77)	4.91 (2.31, 10.44)

LN = Late Neolithic; EBA = Early Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age; Zürich Seefeld Kan. San. = Zürich Seefeld Kanalisationssanierung; CI = confidence interval; SD = standard deviation; Male & cast. = male and castrated male cattle.

Table S4. Summary of the descriptive statistics of the osteometric data used in Figure 4.

Period	**Late Neolithic**						**Bronze Age**							
Region	**Central Plateau**									**Alpine**				
Settlement	LN Auver.	LN Pont	LN Mythen	LN Presse	LN Seefeld	LN Mozart	EBA Mozart	EBA Meilen	LBA Alpenq.	EBA Borscht	EMBA Cazis	EMBA Padnal	LBA Cazis	LBA Padnal
N	65	7	19	4	70	59	65	26	70	17	79	31	10	39
Min.	-0.064	-0.052	-0.097	-0.086	-0.045	-0.055	-0.083	-0.077	-0.072	-0.074	-0.074	-0.148	-0.075	-0.107
Max.	0.087	0.040	0.027	0.017	0.109	0.137	0.118	0.111	0.070	0.074	0.114	0.080	0.048	0.107
Mean	0.004	-0.016	-0.025	-0.015	0.022	0.033	0.010	0.008	0.003	-0.006	0.000	-0.027	-0.004	-0.031
Std. error	0.005	0.012	0.007	0.024	0.004	0.006	0.006	0.009	0.005	0.010	0.005	0.010	0.014	0.006
Std. dev.	0.042	0.033	0.032	0.049	0.032	0.043	0.049	0.047	0.038	0.040	0.043	0.058	0.043	0.040
Median	-0.008	-0.034	-0.025	0.005	0.016	0.026	0.019	0.003	0.006	-0.016	-0.010	-0.029	0.009	-0.038

N = number of osteometric samples; Min. = Minimum; Max. = Maximum; Std. error = Standard error; Std. dev. = Standard deviation. LN = Late Neolithic; EBA = Early Bronze Age; EMBA = Early and Middle Bronze Age; LBA = Late Bronze Age. Auver. = Auvernier sites; Pont = Pont-de-Thielle; Mythen. = Mythenschloss; Presse. = Pressehaus; Mozart = Mozartstrasse; Meilen = Obermeilen; Alpenq. = Alpenquai. For settlement names and details, see Table 1.

Table S5. Summary of the descriptive statistics of the osteometric data used in Figure 7.

	Plateau LN	Plateau EBA	Plateau LBA	Alpine EMBA	Alpine LBA
N	224	91	70	128	50
Min.	-0.097	-0.083	-0.072	-0.148	-0.107
Max.	0.137	0.118	0.070	0.114	0.107
Mean	0.014	0.009	0.003	-0.008	-0.025
Std. error	0.003	0.005	0.005	0.004	0.006
Std. dev.	0.042	0.048	0.038	0.048	0.041
Median	0.012	0.010	0.006	-0.013	-0.033

N = number of osteometric samples; Min. = Minimum; Max. = Maximum; Std. error = Standard error; Std. dev. = Standard deviation. Plateau = Central Plateau; LN = Late Neolithic; EBA = Early Bronze Age; EMBA = Early and Middle Bronze Age; LBA = Late Bronze Age.

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4.3. Bopp-Ito, M., Cucchi, T., Evin, A., Stopp, B., Schibler, J., 2018b. Phenotypic diversity in Bronze Age pigs from the Alpine and Central Plateau regions of Switzerland. Journal of Archaeological Science: Reports 21, 38–46. https://doi.org/10.1016/j.jasrep.2018.07.002

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Phenotypic diversity in Bronze Age pigs from the Alpine and Central Plateau regions of Switzerland

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ABSTRACT

Pig husbandry was one of the key components of Swiss Bronze Age communities. However, the extent of diversity within husbandry practices across these communities remains unclear, particularly for the Alpine and Swiss Central Plateau regions. Differences in tooth size and shape provide valuable proxies for exploring the history of pig populations and inferring changes to cultural and socio-economic behaviours. Thus, to explore geographical and chronological changes in pig husbandry in Bronze Age Switzerland, we tracked the phenotypic diversification of pig populations using the geometric morphometrics of the second and third lower molars as proxies. Our results confirmed the phenotypic homogeneity of Alpine pig populations during the Bronze Age, both in size and shape. Thus, strong homogeneity appeared to exist in the genetic make-up of pig herds in this area, which can probably be attributed to interactions among the local communities. Conversely, pig populations from the Swiss Central Plateau exhibited a greater diversification in shape between the eastern and western populations, indicating a lack of genetic interaction. In parallel, we observed a significant decline in the size of the east Central Plateau pig population during the Late Bronze Age, possibly due to shifts in husbandry practices induced by changes in forest management. Based on our findings, we hypothesise that geographical, topographical, environmental, and cultural factors influenced local pig husbandry practices and the phenotypic diversity of pig molars between regions in Bronze Age Switzerland. However, further investigations comparing Bronze Age pig populations over a broader scale are required, using genetic and isotopic markers to further test changes in husbandry practices and the genetic diversity.

1. Introduction

Pigs played an important role in the economy of the Swiss Bronze Age (Bopp-Ito, 2012; Plüss, 2011; Schibler, 2017; Schibler and Studer, 1998; Stopp, 2015). Based on the number of identified specimens, we know that pigs were the main domestic animals along with cattle, sheep, and goats. While the latter were exploited for meat, milk, and wool, or were used as working animals, most pigs were being slaughtered for meat at a young age (Hüster Plogmann and Schibler, 1997; Schibler, 2017); however, little is known about their husbandry practices. Furthermore, the phenotypic diversity of Swiss Bronze Age pigs over time and space, especially across the east and west parts of the Swiss Central Plateau (hereafter called Plateau) and Alpine regions, has not previously been explored because osteometric data are limited due to heavy fragmentation and few adult individuals being available (Duval et al., 2015). Since the three regions previously mentioned are geographically, topographically, environmentally, and culturally divergent (Della Casa, 2013; Menotti, 2015a; Schibler, 2017; Reitmaier, 2012), they may also have required different husbandry practices (Schibler, 2017).

The earliest human presence in the Swiss Alpine region, up to over 2000 m above sea level (a.s.l.), was recorded during the Mesolithic (Cornelissen and Reitmaier, 2016; Hess et al., 2010). Human activity increased from the middle of the 4th millennium BC, the so called Copper Age (Late Neolithic), onwards (Della Casa, 2003). The number of settlements relevant to bronze production, copper mining activity,

Abbreviations: GMM, geometric morphometrics; CS, centroid size; GPA, Generalized Procrustes Approach; Plateau, Swiss Central Plateau; EBA, Early Bronze Age; MBA, Middle Bronze Age; LBA, Late Bronze Age; a.s.l., above sea level; RSFO, Rhine-Swiss-East France Urnfield culture (Rhin-Suisse-France orientale); IPAS, Integrative Prehistory and Archaeological Science

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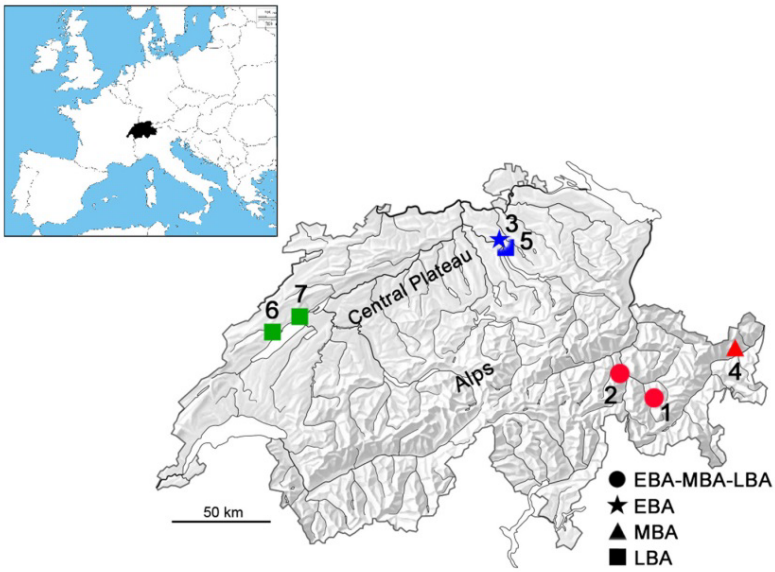

Fig. 1. Location of studied sites: numbers refer to the archaeological sites listed in Table 1. Red symbols (Nos. 1, 2, and 4) indicate Alpine sites, blue symbols (Nos. 3 and 5) indicate sites from the east Plateau, and green symbols (Nos. 6 and 7) indicate sites from the west Plateau. EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 1
Archaeological samples used in the present study.

Region	Period	Map	Settlement	Sample size		Archaeozoological
		No.		M2	M3	References
Alpine	LBA	1	Savognin-Padnal, Horizont B	7	16	Bopp-Ito, unpubl.
	LBA	2	Cresta-Cazis, Planum 14	1	2	Plüss, 2007
	MBA	1	Savognin-Padnal, Horizont C	3	7	Bopp-Ito, unpubl.
	MBA	1	Savognin-Padnal, Horizont D	15	21	Bopp-Ito, unpubl.
	MBA	2	Cresta-Cazis, Planum 10–12	9	15	Plüss, 2007
	MBA	4	Scuol-Avant Muglins	12	26	Rehazek, unpubl.
	EBA	1	Savognin-Padnal, Horizont E	1	3	Bopp-Ito, unpubl.
	EBA	2	Cresta-Cazis, Planum 1–5, 8	14	11	Plüss, 2007
			Total	**62**	**101**	
West Plateau	LBA	6	Cortaillod-Est	4	8	Chaix, 1986
	LBA	7	Hauterive-Champréveyres C 3	8	3	Studer, 1991
			Total	**12**	**11**	
East Plateau	LBA	5	Zürich-Alpenquai	9	10	Wettstein, 1924
	EBA	3	Zürich-Mozartstrasse, 1u & 1o	26	17	Hüster Plogmann and Schibler, 1997
			Total	**35**	**27**	
			Total	**109**	**139**	

"Map no." corresponds to locations in Fig. 1. unpubl. = unpublished reference, Plateau = Central Plateau, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

farming, and pasturing were expanded during the Early Bronze Age (EBA) due to the influx of immigrants from the north and south (Della Casa et al., 2016; Dietre et al., 2016; Jecker, 2015; Murbach-Wende, 2016; Rageth, 1986; Reitmaier, 2010, 2012; Schaer, 2003), immigrants who might have brought livestock with them (Bopp-Ito et al., 2018). This, so called, Inner Alpine Bronze Age culture continued until the Middle Bronze Age (MBA) (Rychner et al., 1998). The increase in human activity above the tree line induced the expansion of grasslands (Nicolussi, 2012) and the culture changed to the Rhine-Swiss-East France Urnfield (Rhin-Suisse-France orientale) (RSFO), Main-Schwaben, and Laugen-Melaun cultures during the Late Bronze Age (LBA) (Jennings, 2016; Rychner et al., 1998). The Alpine economy was developed by the intensification of supra-regional trading and traffic, bronze production, and dairy based pastoralism using vertical transhumance (Della Casa, 2007; Jecker, 2015; Jennings, 2015a; Rageth, 1986; Reitmaier, 2010, 2012; Reitmaier et al., 2013, 2017). Vertical transhumance played an especially important role in the economic system of the Alpine region (Della Casa, 2013; Reitmaier et al., 2017) and deforestation for pastoralism was intensified (Dietre et al., 2016). Due to this, cattle became an even more important source of meat and the demand for cattle as working animals and for milk production increased (Bopp-Ito, 2012; Bopp-Ito et al., 2018; Plüss, 2011; Stopp, 2015); however, dairy activity has not been confirmed by lipid analysis (Carrer et al., 2016) at the Alpine sites discussed in this paper. Recent studies have provided new insights into cattle husbandry practices in the Alpine region (Bopp-Ito et al., 2018; Harmath et al., 2017; Reitmaier et al., 2017), although knowledge remains limited about pig husbandry practices.

In comparison, the lake shore settlements in the east and west Plateau regions were inhabited from approximately 4300 BC onwards, and the exploitation of cattle for dairy production, or for use as working power, began from the Middle Neolithic onwards (Ebersbach et al., 2012; Schibler, 2017). Some sites continued to be inhabited until the Bronze Age, even though major climatic crises arose (Arbogast et al.,

Table 2
Grouping of settlements and cultural background.

Map	Settlement	Dating		Dating	Group	Altitude	Culture
No.		BC		References		(ca. m)	
1	Padnal H-B	1350/1300–900/800	C14	Rageth, 1986 & pers. com.	Alpine LBA	1223	RSFO, Main-Schwaben, Laugen-Melaun
2	Cazis P14	1350–1100/800	C14	Wyss, 2002	Alpine LBA	765	RSFO, Main-Schwaben, Laugen-Melaun
2	Cazis P14	1300–400	Typo.	Murbach-Wende, 2016	Alpine LBA		RSFO, Main-Schwaben, Laugen-Melaun
1	Padnal H-C	1450–1350/1300	C14	Rageth, 1986 & pers. com.	Alpine MBA		Inneralpine
1	Padnal H-D	1550–1450	C14	Rageth, 1986 & pers. com.	Alpine MBA		Inneralpine
2	Cazis P10–12	1800–1550	C14	Wyss, 2002	Alpine MBA		Inneralpine
2	Cazis P10–12	1750–1300	C14	Murbach-Wende, 2016	Alpine MBA		Inneralpine
4	Scuol	1400	C14	Seifert, M., pers. com.	Alpine MBA	1200	Inneralpine
1	Padnal H-E	1950/1900–1550	C14	Rageth, 1986 & pers. com.	Alpine EBA		Inneralpine
2	Cazis P1–5, 8	2400–1800	C14	Wyss, 2002	Alpine EBA		Inneralpine
2	Cazis P8	1850–1700	C14	Murbach-Wende, 2016	Alpine EBA		Inneralpine
2	Cazis P1–5	2000–1850	C14	Murbach-Wende, 2016	Alpine EBA		Inneralpine
6	Cortaillod	1010–955	Den.	Hochuli et al., 1998	W. P. LBA	400	RSFO (West Swiss group)
7	Champ.	1054–1037	Den.	Hochuli et al., 1998	W. P. LBA	400	RSFO (West Swiss group)
5	Alpenquai	LBA	Typo.	Hochuli et al., 1998	E. P. LBA	400	RSFO (Central and East Swiss group)
3	Mozart.	EBA	Typo.	Bleicher, 2011	E. P. EBA	404	Arbon

EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age, Typo. = Typology, Den. = Dendrochronology, pers. com. = personal communication, RSFO = Rhine-Swiss-East France Urnfield culture (Rhin-Suisse-France orientale), E. P. = East Plateau, W. P. = West Plateau, Cazis P = Planum, Padnal H = Horizont, Mozart = Zürich-Mozartstrasse, Alpenquai = Zürich Alpenquai, Champ. = Hauterive-Champréveyres, Cortaillod = Cortaillod-Est, Cazis = Cresta-Cazis, Padnal = Savognin-Padnal, Scuol = Scuol-Avant Muglins.

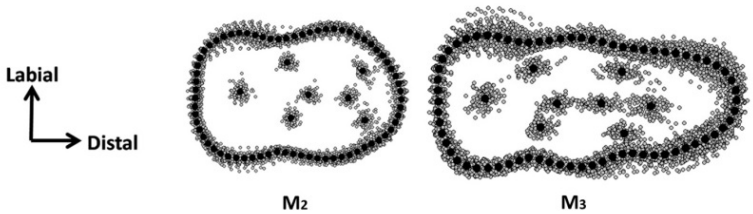

Fig. 2. Visualisation of the second (left image; M_2) and third (right image; M_3) lower molar coordinates of all specimens after superimposition.

2006; Schibler and Jacomet, 2010). Animal husbandry in the east and west Plateau regions was influenced by the different cultures and climatic conditions throughout the Neolithic and Bronze Age (Schibler, 2017; Stopp, 2015). The culture in the east and west Plateau regions changed to the RSFO culture during the LBA; however, the RSFO culture was still separated into the east and west Swiss groups (Jennings, 2016; Rychner et al., 1998), influencing the trade and exchange of both portable objects and immoveable features (Jennings, 2015a). Environmental change occurred in the east Plateau region because of greater deforestation from the Late Neolithic onwards (Doppler et al., 2017), with deforestation intensifying during the LBA (Bleicher et al., 2013). Unfortunately, knowledge about deforestation in the west Plateau region is lacking due to an absence of studies. In parallel, agricultural technology improved with the production of new cereals such as spelt (Jacomet, 1998) and, as a consequence, the hunting of wild animals declined in comparison to the Neolithic period (Schibler, 2017).

Recent studies in the Alpine region have provided us with a large amount of zooarchaeological data from two sites with stratigraphic sequences from the EBA to the LBA: Cresta-Cazis (hereafter called Cazis) (Plüss, 2007, 2011), and Savognin-Padnal (hereafter called Padnal) (Bopp-Ito, 2012; Bopp-Ito et al., 2018), and a MBA site, Scuol-Avant Muglins (hereafter called Scuol) (Rehazek, unpublished). Thus, data from the Plateau sites could be supplemented with data from the Alpine sites, facilitating in-depth investigations of the chronological and regional diversification in pig phenotypes.

To investigate diversity in Swiss Bronze Age pigs, we used dental morphological diversity quantified with geometric morphometrics (GMM) (Bookstein, 1991, 1997; Gunz et al., 2005; Rohlf, 2000; Strauss and Bookstein, 1982; Zelditch et al., 2004). This approach has proven to be effective at differentiating pig populations (Cucchi et al., 2009, 2011, 2016; Duval et al., 2015; Evin et al., 2013, 2014, 2015a, 2015b, 2017; Ottoni et al., 2013). Although, it can be difficult to distinguish wild boars, the size of which was influenced by environmental factors (Albarella et al., 2009; Davis, 1981; Payne and Bull, 1989; Rowley-Conwy et al., 2012), from free-range domestic pigs because they regularly mated when moving freely through the forests (Frantz et al., 2015; Larson et al., 2007). However, these previous GMM studies on pigs revealed the phenotypic diversity within and between domestic, wild (including subspecies), captive wild, hybrid, and insular *Suidae*. Furthermore, teeth preserve well (e.g. Hüster Plogmann and Schibler, 1997) and are less affected by environmental variables than other body parts (Kassai et al., 2005; Laurikkala et al., 2003; Thesleff, 2006). Indeed, the cheek teeth of horses have recently been proven to carry a phylogenetic signal (Cucchi et al., 2017). The size and shape of pig teeth were influenced by the idiosyncratic cultural choices of local husbandry practices (Cucchi et al., 2016; Duval et al., 2015; Duval et al., unpublished). This study, therefore, aimed to assess the chronological and regional phenotypic differentiation in pig populations from Alpine and Plateau sites during the Bronze Age. The results were then applied to detect changes and differences in human–pig relationships relative to husbandry practices, and to analyse the economic and cultural interactions among human communities.

2. Materials and methods

The Bronze Age covers three successive chronological periods: EBA (2200–1600 BC), MBA (1600–1300 BC), and LBA (1300–800 BC) (Rychner, 1998). We divided the pig populations into three geographic regions; (1) the Alpine population, (2) the east Plateau population, and (3) the west Plateau population in what is now Switzerland (Fig. 1,

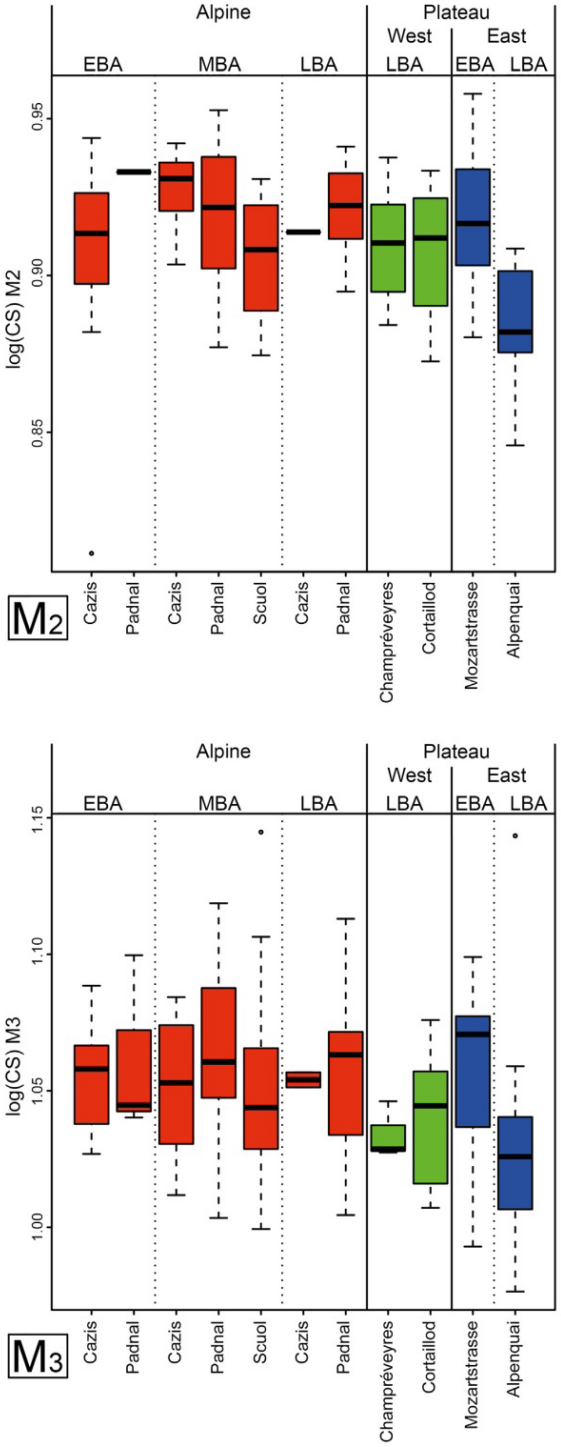

Fig. 3. Boxplots of the second (upper slide; M_2) and third (lower slide; M_3) lower molar centroid size variation. Plateau = Central Plateau, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age, Cazis = Cresta-Cazis, Padnal = Savognin-Padnal, Scuol = Scuol-Avant Muglins, Champréveyres = Hauterive-Champréveyres, Cortaillod = Cortaillod-Est, Mozartstrasse = Zürich-Mozartstrasse, Alpenquai = Zürich-Alpenquai.

Table 1). The Alpine sites are located in the Alpine valleys approximately 750–1200 m a.s.l. (Table 2). Cazis and Padnal were inhabited throughout the Bronze Age and Scuol was inhabited during the MBA (Murbach-Wende, 2016; Rageth, 1986; Wyss, 2002; Seifert, Personal communication). The climatic influence on the Alpine samples used in this study is not known due to the lack of dendrochronology (Schibler, 2017).

The Plateau sites in this study were lake dwellings located at approximately 400 m a.s.l. (Table 2). Zürich-Mozartstrasse (hereafter called Mozartstrasse) at Lake Zurich in the east Plateau region was inhabited from the Early Neolithic to the EBA (Bleicher, 2011; Hüster Plogmann and Schibler, 1997). However, there is no dendrochronological dating for the EBA samples from Mozartstrasse used in this study (Hüster Plogmann and Schibler, 1997). Zürich-Alpenquai (hereafter called Alpenquai) (Wettstein, 1924) was one of the central trading sites in the east Plateau region during the LBA (Jennings, 2015a). Alpenquai was occupied throughout the Hallstatt B period (from ca. 1050 to 800 BC) and several layers were dated based on dendrochronology (Jennings, 2015b; Künzler Wagner, 2005; Mäder, 2001a, 2001b; Wiemann et al., 2012). However, since our samples came from a very early excavation by dredger (Jennings, 2015b) only typological dating was available. Cortaillod-Est (Chaix, 1986), and especially Hauterive-Champréveyres (hereafter called Champréveyres) (Studer, 1991) at Lake Neuchâtel, were one of the largest trading sites in the west Plateau region (Jennings, 2015a). From both the east and west Plateau sites, only EBA and LBA data were available because the lake shores were abandoned due to climatic deterioration during the MBA (Della Casa, 2013; Menotti, 2015a, 2015b).

The permanent second (M_2) and third (M_3) lower molar teeth were used as phenotypic markers. Archaeological specimens were identified as domestic pigs using traditional biometry data (Albarella et al., 2009; Boessneck et al., 1963; Rowley-Conwy and Dobney, 2007; Rowley-Conwy et al., 2012) and the reference collection of the Institute of Integrative Prehistory and Archaeological Science (IPAS), University of Basel, Switzerland. However, a few specimens were difficult to identify as either domestic pigs or wild boars (or hybrids) because of an overlap in size (Evin et al., 2013, 2014); therefore, we could not completely exclude the possibility that our samples include a few wild boar (or hybrid) specimens. Only specimens from animals older than one year, based on teeth eruption and wear patterns (Habermehl, 1975; Horard-Herbin, 1997), were analysed in the present study. Detailed information about the samples is provided in Supplementary Table 1.

This study used GMM methods and statistical analyses following a standardized protocol described by Cucchi et al. (2011, 2016), Evin et al. (2013, 2015b), and references therein. Images were obtained with a 2D digital camera (Nikon D90 and D300S with a 60 mm Micro lens; Nikon Corporation, Tokyo, Japan). We acquired seven and eight landmarks on the occlusal surfaces of 109 M_2 and 139 M_3 respectively, and 70 semi-landmarks (both M_2 and M_3) according to Cucchi et al. (2011) and Evin et al. (2013) using tpsDig2 version 2.16 (Rohlf, 2010a) and tpsUtil version 1.53 (Rohlf, 2012). Generalized Procrustes analysis (GPA) was performed using the Procrustes distances approach to slide the semi-landmarks (Fig. 2) using tpsRelw version 1.49 (Rohlf, 2010b). The centroid size (CS) and shape variables (Procrustes coordinates) were obtained after the GPA.

We tested the heterogeneity of log-transformed CS between pig populations with a Kruskal-Wallis rank sum test and visualized the variation in size using boxplots. Pairwise comparisons of the populations were performed using multiple Wilcoxon rank tests by pooling the specimens by region and chronological phase.

Differences in shape were tested using multivariate analyses of variance (MANOVA), quantified by leave-one-out cross validation of discriminant analyses (canonical variate analysis), and were visualized by neighbour-joining networks based on Mahalanobis distances. Before multivariate analyses, the dimensionality of the shape data was reduced following Baylac and Friess (2005) by selecting the N first components

Table 3
Multi-test comparisons (p values) of the second (upper table; M_2) and third (lower table; M_3) lower molar centroid size between pig populations (pairwise Wilcoxon rank tests after Benjamini and Hochberg correction).

M_2	Alpine EBA	Alpine MBA	Alpine LBA	East P EBA	East P LBA	West P LBA
Alpine EBA		0.479	0.428	0.289	**< 0.01**	0.719
Alpine MBA			0.792	0.847	**< 0.001**	0.230
Alpine LBA				0.984	**< 0.01**	0.305
East P EBA					**< 0.001**	0.155
East P LBA						**< 0.05**
West P LBA						

M_3	Alpine EBA	Alpine MBA	Alpine LBA	East P EBA	East P LBA	West P LBA
Alpine EBA		0.831	1.000	0.681	**< 0.05**	**< 0.05**
Alpine MBA			0.912	0.573	**< 0.05**	**< 0.05**
Alpine LBA				0.503	**< 0.05**	0.092
East P EBA					0.059	0.066
East P LBA						0.387
West P LBA						

Significant p values are bold and highlighted. $\alpha = 0.05$.
P = Central Plateau, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age, α = significant level.

of a principal component analysis that maximizes variability between the groups. Cross-validation percentages corresponded to the maximum value of the 95% confidence interval obtained for a balanced sample size between groups (100 iterations), as per Evin et al. (2013).

Differences were considered significant if $p < 0.05$ (significance level $\alpha = 0.05$), where the significance of the p values was examined after adjustment for multi-test comparisons following the methods described by Benjamini and Hochberg (1995).

Statistical analyses were performed using R v 2.13.1 (R Development Core Team, 2011), with the packages 'ape' (Paradis et al., 2004), 'geomorph' (Adams and Otarola-Castillo, 2013), and 'Rmorph' (Baylac, 2012).

3. Results

3.1. Diversity in the molar size of pig populations

When the specimens were analysed by site and period (Fig. 3), only the M_2 size differed between populations (for M_2: $X^2 = 24.2, p = 0.007$, for M_3: $X^2 = 15.9$, $p = 0.1$). However, when specimens were divided into six populations by region and period, both the M_2 ($X^2 = 16.5$, $p = 0.006$) and M_3 ($X^2 = 11.2$, $p = 0.048$) showed significant differences. Pairwise comparisons (Table 3) revealed that the M_2 size of the east Plateau LBA population was significantly smaller than that of all other populations (Fig. 3). These findings also show that the molar size of the Alpine populations did not change throughout the Bronze Age, but that molar size in the east Plateau populations declined from the EBA to the LBA.

3.2. Diversity in the molar shape of pig populations

Regional and chronological populations (specimens divided by region and period) differed with respect to both their M_2 (F [60, 480] = 2.62, p = 7e-9) and M_3 (F [70, 620] = 2.1, p = 9e-07) shapes. Discriminant analyses a posteriori classified only 45.8% of the M_2 and 41.75% of the M_3 to the correct group. These low percentages are the result of a notable overlap of all Alpine and east Plateau LBA populations.

Unrooted neighbour-joining networks based on Mahalanobis distances showed a structuration of the variation in molar shape for both M_2 and M_3 (Fig. 4). The east Plateau and Alpine populations exhibited an important phenotypic distance for M_2 during the EBA. However, the distance between these populations decreased during the LBA. Compared to the significant distance between the east Plateau EBA and the east Plateau LBA populations, no significant difference was observed between the Alpine populations. M_3, on the other hand, displays a strong geographic signal, which clearly separates the three regional pig populations.

4. Discussion

Our analyses revealed an overall size homogeneity of the teeth of Bronze Age pigs from Switzerland. However, we did observe one pig population with smaller molars in the east Plateau region during the LBA at the site of Alpenquai, for which there are several possible explanations.

Natural factors influence the size of wild boars (Albarella et al., 2009; Rowley-Conwy et al., 2012), including climate (Davis, 1981; Payne and Bull, 1989). Therefore, domestic Alpenquai pigs would also have been influenced by these environmental factors if they were kept in the forest. Major climate deterioration around lake settlements in both the east and west Plateau regions occurred during the final stage of the LBA (Menotti, 2015a, 2015b). Since the west Plateau settlements were occupied before the final stage of the LBA (cf. Table 2), the molar size of the pig populations at those sites was probably not yet influenced by the climate deterioration. However, it is not known if the Alpenquai samples used in this study (Wettstein, 1924) belong to the older or younger Hallstatt B period during the LBA (e.g. Mäder, 2001a, 2001b), due to the lack of dendrochronological dating when they were excavated in the early 20th century. Consequently, we cannot completely exclude the possibility of climatic effects on the Alpenquai samples. However, the climate during the LBA in the east and west Plateau regions might have been favourable for the duration of the lake side settlements (Menotti, 2015b). Therefore, the smaller molar size of the Alpenquai pigs may be due to other factors.

Changes in husbandry practices, such as the reduction of nutrient supply (Tonge and McCance, 1965) or confinement during an animal's growth, could act as environmental perturbations that affect the developmental process, causing a decline in the size of animals (Cucchi et al., 2016). Such changes in husbandry practices could have been induced by the decline of the forest cover close to the Lake Zurich settlements. The intensification of wood management during the LBA (Bleicher et al., 2013) might have forced pig herders from Alpenquai to

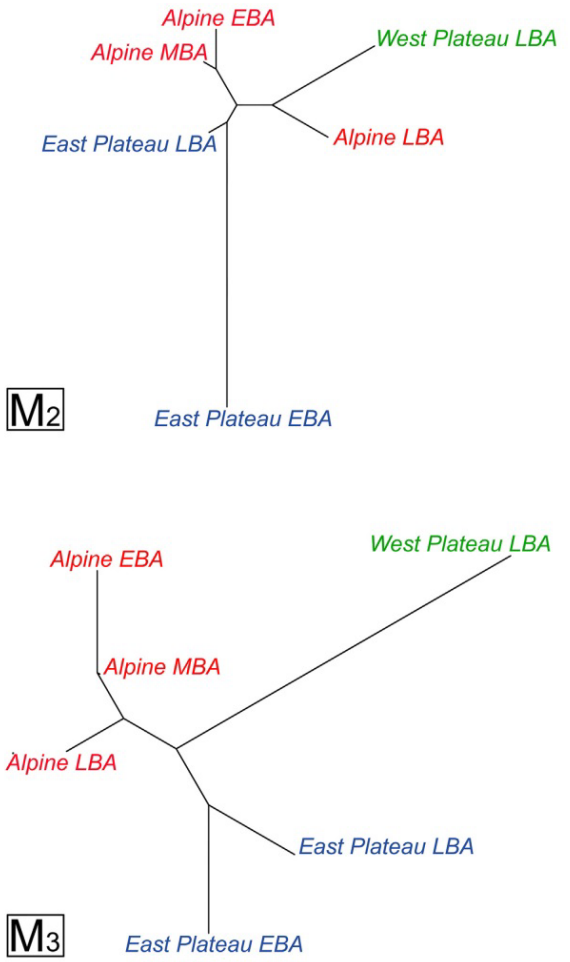

Fig. 4. Unrooted neighbour-joining networks based on Mahalanobis distances of the second (upper slide; M_2) and third (lower slide; M_3) lower molar divided by region and period. Plateau = Central Plateau, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

change from forest to farmyard husbandry. In fact, small ruminants at Alpenquai are postulated to have been kept indoors at times (Kühn and Heitz-Weniger, 2015). The lack of size reduction in LBA Alpenquai cattle (Bopp-Ito et al., 2018) showed that Alpenquai people did not change their husbandry practices or the environment for cattle, but they might have changed pig husbandry practices, and perhaps sheep and goat husbandry practices, in order to keep them on the settlement as farmyard animals. However, further studies exploring pig diet are necessary. In addition, the use of biochemical indicators, such as isotopic analyses (Doppler et al., 2017; Balasse et al., 2016; Cucchi et al., 2016; Frémondeau et al., 2012; Reitmaier et al., 2017) would be helpful to refine our hypothesis.

The M_2 results revealed no significant changes in shape over time among the Alpine populations. However, the M_2 results indicated a divergence in shape between the EBA and LBA for the east Plateau pig populations. The history of the west Plateau population is not known, due to the lack of zooarchaeological material from the EBA. Considering that variation in M_2 shape reflects changes in the history of pig populations (Cucchi et al., 2011, 2016), several plausible explanations for the change in shape of M_2 between the east Plateau EBA and LBA populations are available. Different choices, such as free-ranging forest or farmyard husbandry could have influenced molar size and shape (Cucchi et al., 2016). Alternatively, pigs from the east Plateau EBA might have been genetically different from all other populations. However, our hypotheses are again based on limited information from the east Plateau region, and further evidence from genetic (Evin et al., 2015a; Meiri et al., 2013; Ottoni et al., 2013) approaches are necessary to support this hypothesis.

Contrary to the results observed for M_2, M_3 shows a clear geographic signal clustering the pig populations into three regions. In particular, the lack of change in molar size and shape of Alpine pigs indicates that the Alpine community relied on stable populations of pigs, suggesting the retention of the same breeding strategy through time. Two plausible explanations exist for the unchanged phenotype of Alpine pig teeth. One explanation is that continuous immigrants into the Alpine region (Jecker, 2015; Reitmaier et al., 2017) brought the same phenotypic pig populations with them. Alternatively, the MBA and LBA immigrants continued to use EBA pigs as the original prototype for breeding, as, unlike the EBA immigrants, they brought little or no animals with them. This autonomy in pig husbandry at the Alpine sites was also documented for cattle husbandry, which showed no size reduction of the animals (Bopp-Ito et al., 2018). Furthermore, the decline of mitochondrial DNA haplotypes of cattle at the Alpine site of Padnal (Harmath et al., 2017) suggests that breeding occurred within the limited cattle population of the Alpine region. The same might have happened to the pig population. However, further studies are required to confirm this hypothesis.

The phenotype in the west Plateau LBA pig population is noticeably different to that of the east Plateau and the Alpine populations. A lack of genetic interaction among these three regional pig populations might have occurred due to the topographical, geographical, and environmental divergence, and different cultural traditions between the Alpine and Plateau regions, as well as between east and west Plateau regions (e.g. Della Casa, 2013; Jennings, 2015a; Menotti, 2015a, 2015b; Reitmaier, 2012). These regional differences influenced to animal husbandry practices (e.g. Bopp-Ito et al., 2018; Cucchi et al., 2016; Duval et al., 2015; Plüss, 2011; Schibler, 2017; Schibler and Studer, 1998; Stopp, 2015). We hypothesise that geographical, topographical, environmental, and cultural factors probably influenced local pig husbandry practices and the phenotypic diversity of pig molars between regions (Cucchi et al., 2016; Duval et al., 2015).

5. Conclusions

Analysis of the phenotypic diversification of molar size and shape proxies revealed changes in pig husbandry in Bronze Age Switzerland, demonstrating that husbandry choices were influenced by different geographical, topographical, environmental, and cultural situations between three regions. Chronological continuity within the Alpine region suggests the stability of pig husbandry practices and the close interrelationship of human communities in this region. Conversely, the Plateau region showed the greater phenotypic diversity over time and space, possibly due to the more open topographical situation than the Alpine region and different cultural traditions between east and west Plateau human communities. The small molars of LBA east Plateau pig population might be due to the strong impact of deforestation on pig husbandry practices. However, a broader study using comparative materials, primarily from eastern and western Switzerland is required, alongside genetic and isotopic information, in order to explore these trends further.

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Supplementary Table 1

List of archaeological specimens sources used in the present study:
ASG = Archaeological Service of the Canton of Grisons
UZI = Campus of the University of Zurich Irchel
ZAD = Kanton Zürich Baudirektion Amt für Raumentwicklung Kantonsarchäologie, Archäologie & Denkmalpflege
MHN = Musée d'Histoire Naturelle de Neuchâtel
Plateau = Central Plateau,
EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age, Cazis = Cresta-Cazis, Padnal = Savognin-Padnal, Scuol = Scuol-Avant Muglins, Champréveyres = Hauterive-Champréveyres, Cortaillod = Cortaillod-Est, Mozartstrasse = Zürich-Mozartstrasse, Alpenquai = Zürich-Alpenquai.

Curation	ID	Site	Region	Period	Tooth
ASG	CZS-110-R-3	Cazis	Alpine	MBA	M_2
ASG	CZS-111-R-3	Cazis	Alpine	MBA	M_2
ASG	CZS-112-R-3	Cazis	Alpine	MBA	M_2
ASG	CZS-113-R-3	Cazis	Alpine	MBA	M_2
ASG	CZS-114-R-3	Cazis	Alpine	MBA	M_2
ASG	CZS-115-R-3	Cazis	Alpine	MBA	M_2
ASG	CZS-116-L-3	Cazis	Alpine	MBA	M_2
ASG	CZS-120-R-3	Cazis	Alpine	MBA	M_2
ASG	CZS-122-L-3	Cazis	Alpine	MBA	M_2
ASG	CZS-134-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-140-R-3	Cazis	Alpine	LBA	M_2
ASG	CZS-81-R-3	Cazis	Alpine	EBA	M_2
ASG	CZS-82-R-3	Cazis	Alpine	EBA	M_2
ASG	CZS-83-R-3	Cazis	Alpine	EBA	M_2
ASG	CZS-84-R-3	Cazis	Alpine	EBA	M_2
ASG	CZS-85-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-86-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-87-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-88-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-89-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-91-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-92-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-93-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-94-L-3	Cazis	Alpine	EBA	M_2
ASG	CZS-100-R-4	Cazis	Alpine	EBA	M_3
ASG	CZS-101-R-4	Cazis	Alpine	EBA	M_3

ASG	CZS-102-R-4	Cazis	Alpine	EBA	M_3
ASG	CZS-103-R-4	Cazis	Alpine	EBA	M_3
ASG	CZS-104-R-4	Cazis	Alpine	EBA	M_3
ASG	CZS-105-R-4	Cazis	Alpine	EBA	M_3
ASG	CZS-106-R-4	Cazis	Alpine	EBA	M_3
ASG	CZS-107-L-4	Cazis	Alpine	EBA	M_3
ASG	CZS-108-L-4	Cazis	Alpine	EBA	M_3
ASG	CZS-109-L-4	Cazis	Alpine	EBA	M_3
ASG	CZS-119-R-4	Cazis	Alpine	MBA	M_3
ASG	CZS-121-R-4	Cazis	Alpine	MBA	M_3
ASG	CZS-123-L-4	Cazis	Alpine	MBA	M_3
ASG	CZS-125-L-4	Cazis	Alpine	MBA	M_3
ASG	CZS-126-R-4	Cazis	Alpine	MBA	M_3
ASG	CZS-127-R-4	Cazis	Alpine	MBA	M_3
ASG	CZS-128-R-4	Cazis	Alpine	MBA	M_3
ASG	CZS-129-R-4	Cazis	Alpine	MBA	M_3
ASG	CZS-130-L-4	Cazis	Alpine	MBA	M_3
ASG	CZS-131-L-4	Cazis	Alpine	MBA	M_3
ASG	CZS-132-L-4	Cazis	Alpine	MBA	M_3
ASG	CZS-133-L-4	Cazis	Alpine	MBA	M_3
ASG	CZS-135-L-4	Cazis	Alpine	MBA	M_3
ASG	CZS-137-R-4	Cazis	Alpine	MBA	M_3
ASG	CZS-139-R-4	Cazis	Alpine	MBA	M_3
ASG	CZS-141-L-4	Cazis	Alpine	LBA	M_3
ASG	CZS-143-R-4	Cazis	Alpine	LBA	M_3
ASG	CZS-98-R-4	Cazis	Alpine	EBA	M_3
ASG	PDL-11-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-12-R-3	Padnal	Alpine	MBA	M_2
ASG	PDL-13-R-3	Padnal	Alpine	MBA	M_2
ASG	PDL-15-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-16-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-17-R-3	Padnal	Alpine	MBA	M_2
ASG	PDL-32-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-36-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-38-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-4-R-3	Padnal	Alpine	EBA	M_2
ASG	PDL-40-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-42-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-46-R-3	Padnal	Alpine	MBA	M_2
ASG	PDL-47-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-52-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-56-R-3	Padnal	Alpine	LBA	M_2
ASG	PDL-57-L-3	Padnal	Alpine	LBA	M_2
ASG	PDL-58-L-3	Padnal	Alpine	LBA	M_2
ASG	PDL-59-L-3	Padnal	Alpine	LBA	M_2
ASG	PDL-6-R-3	Padnal	Alpine	MBA	M_2
ASG	PDL-7-R-3	Padnal	Alpine	MBA	M_2
ASG	PDL-70-R-3	Padnal	Alpine	LBA	M_2
ASG	PDL-71-L-3	Padnal	Alpine	LBA	M_2
ASG	PDL-72-R-3	Padnal	Alpine	LBA	M_2
ASG	PDL-8-R-3	Padnal	Alpine	MBA	M_2
ASG	PDL-9-L-3	Padnal	Alpine	MBA	M_2
ASG	PDL-1-L-4	Padnal	Alpine	EBA	M_3
ASG	PDL-18-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-19-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-2-L-4	Padnal	Alpine	EBA	M_3

ASG	PDL-20-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-21-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-22-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-23-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-24-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-25-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-26-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-27-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-28-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-29-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-3-L-4	Padnal	Alpine	EBA	M_3
ASG	PDL-30-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-31-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-33-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-35-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-37-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-39-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-41-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-43-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-45-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-48-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-49-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-50-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-51-L-4	Padnal	Alpine	MBA	M_3
ASG	PDL-53-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-54-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-55-R-4	Padnal	Alpine	MBA	M_3
ASG	PDL-60-R-4	Padnal	Alpine	LBA	M_3
ASG	PDL-61-R-4	Padnal	Alpine	LBA	M_3
ASG	PDL-62-R-4	Padnal	Alpine	LBA	M_3
ASG	PDL-63-L-4	Padnal	Alpine	LBA	M_3
ASG	PDL-64-L-4	Padnal	Alpine	LBA	M_3
ASG	PDL-65-L-4	Padnal	Alpine	LBA	M_3
ASG	PDL-66-L-4	Padnal	Alpine	LBA	M_3
ASG	PDL-68-R-4	Padnal	Alpine	LBA	M_3
ASG	PDL-69-L-4	Padnal	Alpine	LBA	M_3
ASG	PDL-74-L-4	Padnal	Alpine	LBA	M_3
ASG	PDL-75-R-4	Padnal	Alpine	LBA	M_3
ASG	PDL-76-R-4	Padnal	Alpine	LBA	M_3
ASG	PDL-77-R-4	Padnal	Alpine	LBA	M_3
ASG	PDL-78-R-4	Padnal	Alpine	LBA	M_3
ASG	PDL-79-L-4	Padnal	Alpine	LBA	M_3
ASG	PDL-80-L-4	Padnal	Alpine	LBA	M_3
ASG	SCL-144-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-145-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-146-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-147-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-148-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-149-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-150-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-151-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-152-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-153-R-3	Scuol	Alpine	MBA	M_2
ASG	SCL-154-L-3	Scuol	Alpine	MBA	M_2
ASG	SCL-155-L-3	Scuol	Alpine	MBA	M_2
ASG	SCL-156-L-4	Scuol	Alpine	MBA	M_3

ASG	SCL-157-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-158-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-159-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-160-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-161-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-162-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-163-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-164-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-165-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-166-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-167-R-4	Scuol	Alpine	MBA	M_3
ASG	SCL-168-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-169-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-170-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-171-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-172-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-173-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-174-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-175-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-176-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-177-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-178-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-179-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-180-L-4	Scuol	Alpine	MBA	M_3
ASG	SCL-181-L-4	Scuol	Alpine	MBA	M_3
UZI	APQ-1-R-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-10-L-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-2-L-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-3-R-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-4-R-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-5-L-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-6-L-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-7-L-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-8-R-3	Alpenquai	East Plateau	LBA	M_2
UZI	APQ-11-L-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-12-R-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-13-R-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-14-R-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-15-L-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-16-L-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-17-L-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-18-L-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-19-L-4	Alpenquai	East Plateau	LBA	M_3
UZI	APQ-9-R-4	Alpenquai	East Plateau	LBA	M_3
ZAD	MZT-1-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-10-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-11-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-13-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-15-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-17-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-19-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-2-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-26-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-29-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-3-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-32-L-3	Mozartstrasse	East Plateau	EBA	M_2

ZAD	MZT-34-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-35-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-36-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-37-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-38-R-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-41-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-42-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-43-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-45-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-5-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-6-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-7-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-8-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-9-L-3	Mozartstrasse	East Plateau	EBA	M_2
ZAD	MZT-12-L-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-14-L-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-16-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-18-L-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-20-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-21-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-22-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-23-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-24-L-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-25-L-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-30-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-31-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-33-L-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-39-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-40-R-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-44-L-4	Mozartstrasse	East Plateau	EBA	M_3
ZAD	MZT-46-L-4	Mozartstrasse	East Plateau	EBA	M_3
MHN	CTL-12-L-3	Cortaillod	West Plateau	LBA	M_2
MHN	CTL-13-R-3	Cortaillod	West Plateau	LBA	M_2
MHN	CTL-14-R-3	Cortaillod	West Plateau	LBA	M_2
MHN	CTL-15-R-3	Cortaillod	West Plateau	LBA	M_2
MHN	CTL-16-R-4	Cortaillod	West Plateau	LBA	M_3
MHN	CTL-17-R-4	Cortaillod	West Plateau	LBA	M_3
MHN	CTL-18-R-4	Cortaillod	West Plateau	LBA	M_3
MHN	CTL-19-L-4	Cortaillod	West Plateau	LBA	M_3
MHN	CTL-20-L-4	Cortaillod	West Plateau	LBA	M_3
MHN	CTL-21-L-4	Cortaillod	West Plateau	LBA	M_3
MHN	CTL-22-L-4	Cortaillod	West Plateau	LBA	M_3
MHN	CTL-23-L-4	Cortaillod	West Plateau	LBA	M_3
MHN	HRV-1-R-3	Champréveyres	West Plateau	LBA	M_2
MHN	HRV-2-R-3	Champréveyres	West Plateau	LBA	M_2
MHN	HRV-3-L-3	Champréveyres	West Plateau	LBA	M_2
MHN	HRV-4-L-3	Champréveyres	West Plateau	LBA	M_2
MHN	HRV-5-L-3	Champréveyres	West Plateau	LBA	M_2
MHN	HRV-6-L-3	Champréveyres	West Plateau	LBA	M_2
MHN	HRV-7-L-3	Champréveyres	West Plateau	LBA	M_2
MHN	HRV-8-L-3	Champréveyres	West Plateau	LBA	M_2
MHN	HRV-10-L-4	Champréveyres	West Plateau	LBA	M_3
MHN	HRV-11-L-4	Champréveyres	West Plateau	LBA	M_3
MHN	HRV-9-R-4	Champréveyres	West Plateau	LBA	M_3

5. SYNTHESIS of the MAIN RESULTS

Cattle were the most important animals for the subsistence of the Padnal settlement throughout the Bronze Age. The rapid increase in senile cattle during the LBA indicated a change in cattle husbandry practices from the primary (meat production) to the secondary (milk, draught power, and other) products (Bopp-Ito, 2012). However, a small-scale use of cattle as draught animals for transportation or cultivation was already evident during the EBA, i.e. from specimens at the smithy House 1 and the surplus meat supply from cattle at House 2 (*cf.* Chapter 3.2.5). The division of the roles of cattle in each house continued until the E-MBA period. The authentic use of cattle for their working power (i.e. a secondary product of cattle use) began during the LBA as evidenced by the increase of pathological traces on cattle bones. In addition, the size of these pathological bone fragments was larger than those with no pathological traces. Consequently, our findings indicate that Padnal inhabitants used large senile castrated male cattle as working animals for transporting and cultivating, and that these LBA working cattle were being used to carry heavy loads, such as copper ores, woods, bronze objects, and perhaps hay as winter fodder for cattle, sheep, and goats (Thomas Reitmaier at ASG personal communication). This further suggests that there was a rapid development in the bronze production and the mining activities at Padnal.

Meanwhile, the secondary product of milk production of cattle during the MBA was only slightly supported by the mortality profile which showed a majority of infant and senile cattle from a house in Field 3. The mortality profiles in the LBA also suggested that large scale milk production had begun; however, the sex ratio did not support this possibility. The sex ratio based on horn cores and Pelvis did not show any increase in the number of female cattle during the LBA, and the estimated probability of LBA female cattle based on Metacarpus Bd was 70%. However, such probabilities and ratios in the earlier periods were not able to be determined due to the lack of Metacarpus Bd specimens (for details, see Paper 2). Settlements in the southern part of the Alps had been already begun producing milk during the MBA (Riedel and Tecchiati, 2001; Stopp, 2015). Since the Padnal culture and economy was strongly influenced by the south Alpine communities owing to the continuous immigration into the inner-Alpine areas (Jecker, 2015; Reitmaier *et al.*, 2017), it is highly probable that cattle milk production would have begun in Padnal. Furthermore, the grasslands in the Alpine east region expanded after the MBA (Nicolussi, 2012), and therefore, the environment surrounding the Padnal settlement would have been suitable as cattle pasture lands to support the production of milk. Further analyses, specifically lipid analyses, are needed to assess and possibly provide evidence in support of this hypothesis (Carrer *et al.*, 2016).

There were three general sizes of cattle between Late Neolithic and Bronze Age in Switzerland: the largest Plateau cattle (400 m a.s.l.), the middle-sized lower Alpine cattle

(700–800 m a.s.l.), and the smallest Padnal cattle in the high Alpine valley (1,200 m a.s.l.) (Bopp-Ito *et al.*, 2018a). Since there was no affection of the sex ratio for the cattle size across settlements, this size diversity may have resulted from other factors, such as the environment, economy, or culture. The diverse food supply produced at the different altitudes would also be expected to influence the cattle size, especially during their growth process periods. Because large arable fields in the Plateau region had already been managed for agriculture and pasturage since the Early Neolithic (Schibler, 2017), it is possible that cattle farmed in this area were able to obtain higher nutritional foods compared with high Alpine valleys. Although it is difficult to accurately reconstruct climatic changes in the Alpine settlements due to the lack of dendrochronology (Schibler, 2017), the climate in the Alpine east region was presumed to be favourable for humans and animals throughout the Bronze Age (Nicolussi, 2012; Oeggl and Nicolussi, 2009; Reitmaier *et al.*, 2017). Therefore, it is expected that the high altitude pastureland would have been able to produce sufficiently rich nutritional food for the Padnal cattle. Not only grasses but also the evergreen conifer trees, such as spruce, pine, and fir, which surrounded the Padnal settlement, could have been used as fodder for cattle, particularly, during snowy winter (Stefanie Jacomet at IPAS personal communication).

The strongest factor which influenced the size diversity was presumably the different economic relationships between neighbouring human communities. The diverse locations of each settlement at the different latitudes: north Plateau, south Schellenberg-Borscht and Cazis, and rather more south Padnal, resulted in them having more frequent interactions with their closer communities. Lower Alpine sites were able to easily access the Plateau and south German sites through the River Rhine and the Lake Constance. In contrast, Padnal was much closer to the south Alpine communities, which were accessible by crossing the Julier pass. Padnal cattle were as small as south Alpine cattle. This may be due to the settlers at Padnal having presumably immigrated from the north and south, with the south immigrants having contributed more domestic animals to the settlement (Della Casa *et al.*, 2016; Grupe *et al.*, 2017; Jecker, 2015; Rageth, 1986). These immigrants were farmers, pastoralists, and miners who introduced the knowledge of bronze production and the methods for copper mining to the inhabitants of the Padnal settlement. Immigrants at the EBA House 2 were perhaps immigrants from south Germany (Rageth, 1986) and who brought large cattle which belonged to the T2 haplogroup. These findings suggest that the large cattle lineages were derived from the north and the small cattle lineages were from the south. The study of ancient DNA from Padnal cattle revealed that a bottle-neck phenomenon occurred between the MBA and LBA (Harmath *et al.*, 2017). Furthermore, there was the lack of change in size of Padnal cattle during the Bronze Age (Bopp-Ito *et al.*, 2018a). These evidences indicated the continuous breeding of EBA cattle from the first generation and implies that only a few new cattle may have immigrated into the area after the E-MBA and onwards, or that only similar sized cattle that belonged to the same haplogroup were brought into Padnal.

The EBA immigrants from the north (House 2) preferred to consume cattle and immigrants from the south (House 1) preferred to consume sheep and goats. This difference

in consumption was retained during the E-MBA but completely disappeared by the LBA. However, the inhabitants of the LBA central House 2 in Field 3 still consumed many sheep/goats, and this house was inferred to belong to a chief. Despite cattle being the most important animal for their economy, the inhabitants of the central House 2 preferred eating sheep/goats. This habit was retained possibly due to it being a cultural tradition of inhabitants who may have lineages with the south clan. Alternatively, a chief of Padnal may have possessed more sheep and goats because they are generally used as sacrificial animals (Deschler-Erb, 2008) in ritual performances and for some feasts, such as good harvest or spring thanksgiving; however, no evidence was found to support this idea. Interestingly, few animal bones were found in both LBA houses (House 1 and 3) next to central House 2 or chief house in Field 3. House 1 and 3 may have served as pens for domestic animals during the snowy winter, as suggested by Rageth (1986).

The division of work in the village became more obvious during the LBA, with the evidence of a blacksmith, a butcher, a hunter, bone and stone artisans, farmers, traders, and miners. The surplus production of cattle meat was excessive to support only the inhabitants of the settlements and it is presumed that this production increased to meet the nutritional needs of miners near the settlement (Della Casa *et al*., 2016; Schibler *et al.*, 2011). The vertical transhumance economic strategy would aid in further improving cattle breeding efforts to increase the production of meat and possibly milk to sufficiently support the mining activities during the LBA (Reitmaier *et al*., 2017) It is plausible that Padnal cattle and sheep/goats were brought to the higher Alpine meadow during summer. However, evidence of these movements, such as a stone foundation which could be a hut used for cattle, sheep, and goats in the high grasslands (Reitmaier *et al*., 2017) in the vicinity of Padnal, has not yet been found, and isotopic and strontium analyses (Doppler *et al*., 2017; Reitmaier *et al*., 2017) should be performed to confirm the transhumance and immigration patterns and to determine the origin of the animals.

The second most important animals in the Padnal economy were sheep and goats, and there were more sheep than goats. In contrast to the observed increase in cattle, the number of sheep/goats decreased during the LBA. This may be due to husbandry efforts and resources being focused on breeding cattle rather than sheep/goats due to the increase in demand for meat (and draught animals), presumably for a growing population of inhabitants and the increased activity of miners in bronze production (Rageth, 1986). In addition, cattle would have been more useful than sheep/goats in terms of the secondary products they offer. Inhabitants would also have needed to expand agriculture practices to produce a larger quantity of cereals and beans (Jacomet, 1998a, 1998b, 1998c, 1998d), which would have required assistance, e.g. from draught cattle.

In general, both sexes of sheep were slaughtered at the young adult stage; however, some female goats survived until the senile adult stage. It is suggested that most of the sheep/goats were used for meat, and some for wool and milk. There was, however, an exception during the E-MBA, when nearly 40% of the sheep/goats were seen to have been kept until the senile adult age. It suggested that wool production and a self-sufficiency scale

of milk production would have taken place during this time. Since the south Alpine communities were seen to have more sheep/goats, it is possible that Padnal inhabitants who kept a higher proportion of sheep/goats may have been immigrants from the south.

The third most important animal at Padnal was the pig. The gradual increase in the number of pigs by the LBA suggested that there was a higher demand for meat supply for the Padnal inhabitants and for miners. Geometric morphometrics shed new light on Bronze Age pig husbandry practices in Switzerland (Bopp-Ito *et al*., 2018b). The lack of change in size and shape of lower molars M_2 and M_3 of Padnal and other Alpine pigs showed that there was no change in the pig husbandry practices in the Alpine region throughout the Bronze Age. It also indicated that Padnal and Alpine pigs were probably allowed to roam freely in the settlements. In contrast, the east Plateau pigs showed a reduction in size during the LBA, which may have been due to changes in husbandry practices from the free-range management during the EBA to the constrained management during the LBA due to the intensification of deforestation (Bleicher *et al*., 2013). Meanwhile the molar shape comparison, especially the signal of M_3, showed that there was the large difference between three regional pig populations. In particular, the west Plateau pig group was apparently far from those of Alpine and east Plateau. The comparisons revealed that there was no phylogenetic relation among these three regional pig groups during the Bronze Age (for details, see Paper 3).

The lack of genetic changes of Padnal pigs implied that the ancient lineage of pigs may have been continued throughout the generations, which may also have been the case in the Padnal cattle breeding. Human immigration into Padnal is presumed to have continued throughout the Bronze Age, but it is probable that not all immigrants brought their livestock with them. It is expected that the first immigrants at Padnal would have been a mixture of people, such as farmers, pastoralists, or miners from the south and north, and that most of the new immigrants in the LBA would have been miners mainly from the Laugen-Melaun cultural zone (Jecker, 2015; Reitmaier *et al*., 2017). Even though the culture and economy drastically changed during the LBA, the animal breeding strategy at Padnal did not appear to change throughout the Bronze Age.

There were a few dogs in the EBA settlement but dog numbers were gradually reduced. One of EBA dogs (dog No. 1) was the smallest among Swiss Bronze Age dogs and was buried with care in House 2 by inhabitants who possibly immigrated from south Germany. This old dog was likely to have been a companion animal because there was no evidence that it was eaten. Only the missing Phalanx inferred that the dog was skinned for its fur coat (for details, see Paper 1). The remains of another dog (dog No. 2), were excavated from the same House 2 and had both cut and bite marks on them. It suggested that this dog was eaten and that the bones were discarded. After the E-MBA onwards, all of dogs might have been exploited for their fur coats and eaten. Their bones were fragmented into small pieces and scattered on the outside of the houses (i.e. discarded and not carefully buried). The friendly companionship between the owner and dog No. 1 seems to have been the exception and it is possible that the owner (who was potentially an immigrant from south Germany) did not

eat dog meat. It is unknown whether the habit of eating dog meat was influenced by cultures from the southern part of the Alps. Further investigations are needed to clarify these aspects regarding dogs in the Bronze Age and should ideally be conducted with a larger sample size and over a wider geographical range.

Finally, a single horse appeared in Padnal during the LBA. It was much smaller than modern-day domestic horses. The Padnal horse may have been a gift from a larger base settlement, such as the LBA settlement Zürich-Alpenquai in the east Plateau which also possessed plenty of precious harnesses from the far communities in Eastern Europe (Mäder, 2001a, 2001b; Wagner, 2005). The Padnal horse may have been a reward, an offering or a trading of the bronze objects; however, bronze objects which were confirmed made in Padnal were not found at the Zürich-Alpenquai settlement (Jennings, 2016). A horse bone was excavated from House 23 in Field 1 which was presumed to belong to a huntsman and not from House 2 in Field 3 that was presumed to belong to a chief, despite it being a symbolic and, therefore, precious animal. It is not known if the huntsman from House 23 in Field 1 was a trainer of the horse.

Wild animals at Padnal were no longer required for the subsistence of the settlement and the hunting of them had greatly decreased by the LBA. Although not required, some Padnal inhabitants did probably climbed up to the higher Alps over tree lines to hunt ibexes. Wild boars, red deer, roe deer, and a brown bear were seen to have been hunted, although rarely. A pigeon, a dove, a graylag goose, and a white stork were also caught perhaps opportunistically. The hunting of wild animals was only a passive activity for Padnal inhabitants.

Animal husbandry at Padnal offered many insights into the subsistence farming of a high altitude Alpine settlement during the Bronze Age. However, there are still many unsolved and newly emerged questions:

1) From where did the domestic animals at Padnal originate, i.e. from the south and north, or also from the east and west?

2) Did human with/without domestic animal immigration continue into Padnal after the EBA? If not with animals, when was there a reduction and why?

3) Had small scale milk production of cattle already begun in Padnal during the MBA?

4) Was seasonal vertical transhumance used in Padnal cattle, sheep, and goat livestock management during the LBA or the earlier periods?

5) What are the size and shape of north Italian pig teeth? Are they similar to those of Alpine pigs?

Future studies with a larger sample size and with additional interdisciplinary studies, such as ancient DNA analyses, isotopic (e.g., strontium) analyses, geometric morphometrics, and lipid analyses, are needed to answer these questions.

Animal husbandry practices at Padnal were seen to have changed greatly during the LBA in terms of the balance of NISP of cattle and sheep/goats and cattle exploitation from primary to secondary products probably as a result of the cultural and economic changes that occurred in the Alpine region at the time. However, the most important finding of the present study is that the Padnal husbandry practices for domestic animals, especially, cattle and pigs, in terms of the management of breeding strategies did not change throughout the Bronze Age. It is probable that the stable environment surrounding Padnal made it possible to continue using the same strategy of animal husbandry. From the first generation of settlers to the subsequent generations of inhabitants, the Padnal community continued using traditional animal management practices for the subsistence of their settlement in the high Alpine valley.

6. SUMMARY/要旨

Summary

A large amount of bone specimens was excavated from the Bronze Age Alpine hill-top settlement Savognin-Padnal, located between the EBA and LBA in the Canton of Grisons, Switzerland. More than 40,000 bone specimens (233 kg weight) were examined, of which approximately 26,400 (214 kg weight) were identified until the species level.

The number of identified specimen (NISP) showed that 99.6% of the specimens were from domestic animals. The most economically important animal was cattle, and their numbers further increased during the LBA. During this time, the number of senile cattle was also seen to have markedly increased. This change in frequency and age stages indicated a change the exploitation of cattle from primary to secondary products. A small scale use of the cattle as draught animals was already observed during the EBA; however, this only progressed to a large scale during the LBA. The increase in pathological traces on the cattle bone surfaces suggested that the cattle were intensively used in copper mining activity, the bronze production, cultivation, and trading. The small scale production of milk could only be found during the MBA but may have increased during the LBA. However, the cattle sex ratio did not support this possibility and further interdisciplinary studies are needed to clarify this aspect of Alpine Bronze Age settlements. It is possible to confidently presume that Padnal cattle were bred for the surplus meat supply probably to support mining activities near to the settlement. Padnal cattle were found to be the smallest in comparison to other Swiss Bronze Age cattle groups. Since their body size was homogenised with cattle from the southern part of the Alps, the majority of Padnal cattle may have been brought into the settlement by transalpine immigrants, especially during the EBA, although strontium analyses are required to confirm this possibility. Strontium analysis will also offer insights into the possibility of seasonal vertical transhumance for cattle, sheep, and goats.

In contrast, the NISP of sheep and goats decreased during the LBA. Sheep were found to be more dominant than goats at Padnal. Sheep and goats were mostly slaughtered when they were young adults, presumably for their meat. The exception, however, was during the E-MBA when the majority of sheep and goats were senile individuals and were perhaps used for wool and milk production. Although senile female goats were probably used for milk production in earlier periods, dairy production may have been replaced by cattle during the LBA. The diversity of traditional eating habits was retained until the LBA. After the MBA and onwards, cattle were the most commonly consumed animal by all settlers; however, there were some settlers who still consumed a relatively large amount of sheep and goat meat.

Pigs were the third most important animal in the subsistence of the Padnal settlement. The number of pigs gradually increased until the LBA, possibly in response to the increase in demand for meat production. Most of the pigs were found to have been slaughtered at a

young adult age. The size and shape of lower second and third molars from Padnal pigs showed no change throughout the Bronze Age. There were very few specimens of dogs and only one specimen of a horse. Few wild animals were hunted and hunting activities were further reduced during the LBA. The most hunted wild animals were wild bores, ibex, and red deer.

Animal husbandry practices in the terms of NISP and cattle exploitation from primary to secondary products at Padnal changed greatly during the LBA and were probably influenced by the cultural and economic changes that took place in the Alpine east region at the time. However, the change of the breeding management for domestic animals was not observed throughout the Bronze Age. The inhabitants during the EBA were possibly farmers, shepherds, miners or were involved in pastoral and bronze production activities, and immigrated from the south and north into Padnal together with their animal herds. Inhabitants from the second generation onwards continued the same animal husbandry practices and breeding strategies; using cattle for meat, to plough fields for crops, as draught animals to transport heavy copper ores, and for milk, and keeping sheep and goats as a source of meat as well as producers of wool for weaving clothing to protect against cold winters. It is assumed that pigs were brought back to the pens only during winter and were allowed to roam freely in the settlement to find food during other seasons. The seasonal transhumance for domestic animals could be performed using forests and grasslands. However, it is needed the isotopic analysis to confirm this possibility. Padnal inhabitants lived with their domestic animals on the hill-top settlement in the high Alpine valley for over 1,000 years.

要旨

青銅器時代初期から後期まで続いたアルプスの小山の上に造られた遺跡サボニン・パドナル集落は、スイス連邦、グリソン州に所在し、たくさんの骨の破片が発掘された。４０００００個以上（重さ２３３ｋｇ）の骨片が審査され、そのうちの約２６４００個（重さ２１４ｋｇ）の骨片が種のレベルまで判明した。

判明した骨片数（ＮＩＳＰ）のうち、99.6%は家畜であった。経済的に一番重要なのはウシであり、その数は青銅器時代後期にはさらに増加した。また同じ時期、高齢のウシの数が大幅に増えた。このウシの増加、それも高齢ウシの増加という変化は、ウシの一次的利用から二次的利用への変化を示している。牽引動物としてのウシの小規模な利用は、すでに青銅器時代初期から観察されていたが、大規模な利用への進展は、青銅器時代後期になってからである。ウシの骨の表面に残る病理変の増加は、銅の採掘活動、青銅器生産、農耕作、交易のためにウシが集中的に使われたことを表している。小規模な搾乳は青銅器中期になってようやくみられたが、その増加は青銅器時代後期になってである。しかしながら、ウシの性別比からはその増加を証明することはできなかった。ゆえに、アルプスの青銅器時代の乳製品製造の様相の解明には、異なる分野間の学際的研究が必要である。パドナルのウシは、遺跡周辺で行われた採掘活動を支援するため、また肉の余剰生産のために飼育されていたといっても過言ではないであろう。パドナルのウシはスイスの青銅器時代のウシの中で一番小さかった。しかし、アルプスの南側のウシとは似たサイズだったので、ほとんどのパドナルのウシは、アルプスを越えて南からやってきた特に青銅器時代初期の移民たちが、パドナルに持ちこんだと考えられる。しかし、この推測はストロンチウム分析によって確かめられなければならない。ストロンチウム分析はウシ、ヒツジ、ヤギの季節によって山の上の草原に移動させる季節的垂直移動牧畜を考察する手がかりにもなる。

ウシと反対に、ヒツジとヤギの数は青銅器時代後期に減少した。パドナルにおいては、ヒツジのほうがヤギより多数を占めている。ほとんどのヒツジとヤギは恐らく肉のために、若い成獣の年齢で殺された。しかし例外として、青銅器時代初期から中期にかけての時代には、たくさんのヒツジとヤギが高齢になってから殺されている。これは恐らくウールや乳製品の生産のためであろう。高齢のメスヤギは、青銅器時代初期と中期においては搾乳のために使われたが、青銅器時代後期になると、乳製品生産はウシに取って代わられた。伝統的な食生活習慣の違いは青銅器時代後期まで続いた。青銅器時代中期以降は、ウシが全ての住民から最も多く消費された。しかしながら、ウシの次にではあるが、比較的たくさんのヒツジやヤギの肉を消費する住民もまだ残っていた。

ブタはパドナル集落の生活にとって、三番目に重要な動物であった。ブタは青銅器時代後期までに、だんだんと増加した。これは恐らく食肉生産の要求の高まりに答えるためだったであろう。ほとんどのブタは若い成獣の年齢で殺されている。パドナルのブタの下顎第２、および第３大臼歯のサイズと形は、青銅器時代を通して変化していなかった。かなり少数のイヌの骨片と、たったひとつのウマの骨が判定された。ほんのわずかの野生動物が捕らえられていたが、それも青銅器時代後期にはさらに減少した。最も多く捕らえられたのは、イノシシ、アイベックス、アカシカであった。

パドナルの動物飼育法のなかでも、ウシの数とウシの一次的から二次的生産への利用は、青銅器時代後期に大きく変わった。それは、その当時のアルプス東部地方における文化や経済の変化の影響を受けたためであろう。しかし、家畜の繁殖のための管理の仕方は青銅器時代を通して変化は見られなかった。青銅器時代初期の住民は、酪農業と青銅器生産活動を兼ねた農夫であり、ウシ飼いやヒツジ飼いであり、鉱山労働者であったであろう。彼らは動物の群れを連れて、南や北からパドナルに入植した。二世以降の住民たちは、前世代と同じ動物飼育法と繁殖法を継承した。すなわち、ウシを肉のため、穀物畑の耕作のため、重い銅の鉱石を運ぶため、または搾乳のために使い、ヒツジとヤギを肉の供給源として、また寒い冬から身を守る織物のために必要なウールの生産者として飼っていた。ブタは冬の間だけは家畜小屋に連れ戻されたが、その他の季節では自分で餌を得るために、集落内で放し飼いにされていたであろう。家畜の季節的移動は森や草原を利用して行われたであろう。しかしながら、その可能性を証明するためには、同位体分析が必要である。パドナルの住民たちは彼らの家畜と共に、高いアルプスの谷間にあった小山の集落で、千年以上暮らしていた。

(Translated by Miki Bopp-Ito)

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8. Figures (including Tables and Photographs)

Fig. 1.1. Location of Savognin-Padnal in Switzerland.

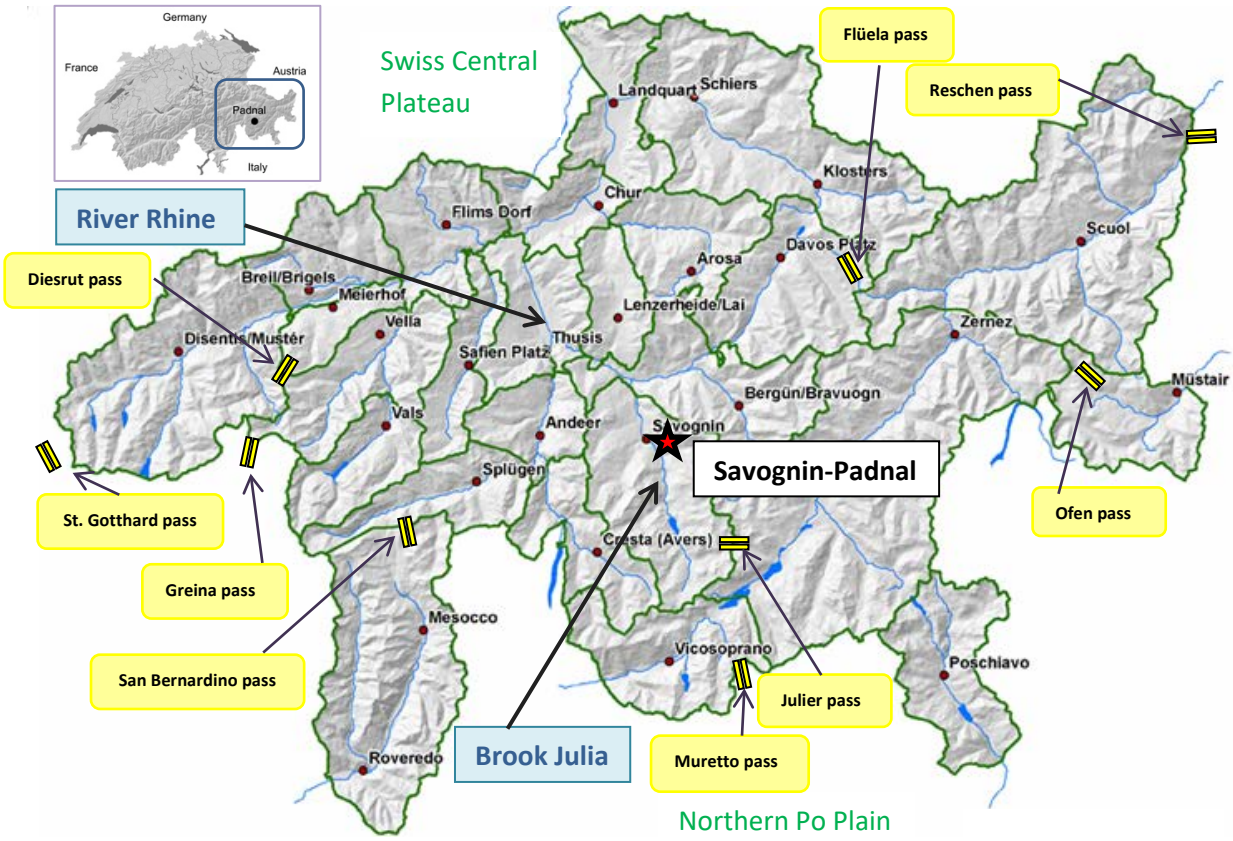


Fig. 1.2. Location of Savognin-Padnal, Brook Julia, and the main passes in Canton Grisons. (Copy right of a map: http://www.baukultur.gr.ch).

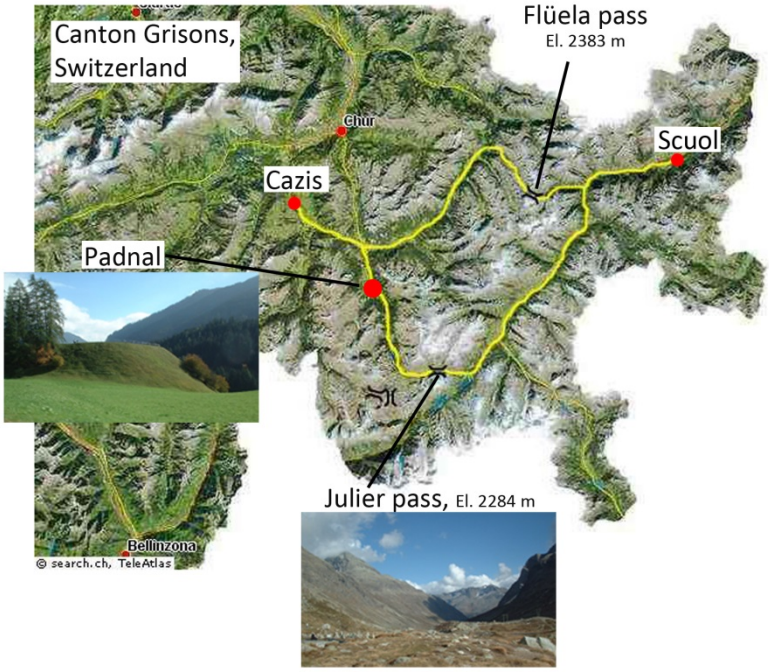


Fig. 1.3. Location of Savognin-Padnal (Photograph by Miki Bopp-Ito) and the vicinity.

Fig. 1.4. Savognin-Padnal and a surrounding landscape of Oberhalbstein from the south-east view (Photograph by Miki Bopp-Ito).

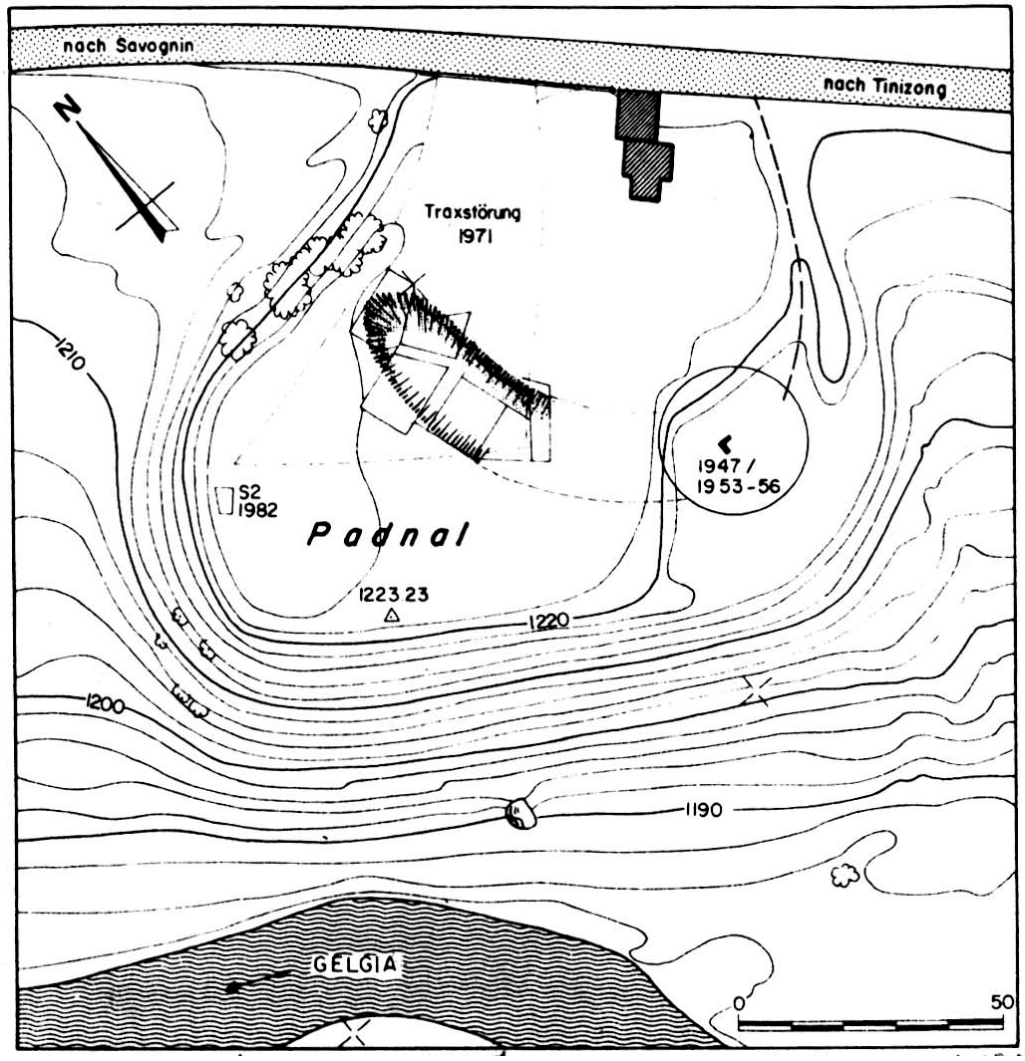


Fig. 1.5. Topographical overview of Savognin-Padnal. (Rageth 1986, p. 64, Fig. 2).

Fig. 1.6. Hill-top settlement Savognin-Padnal near the village Savognin. View from north-west (Photograph by Miki Bopp-Ito).

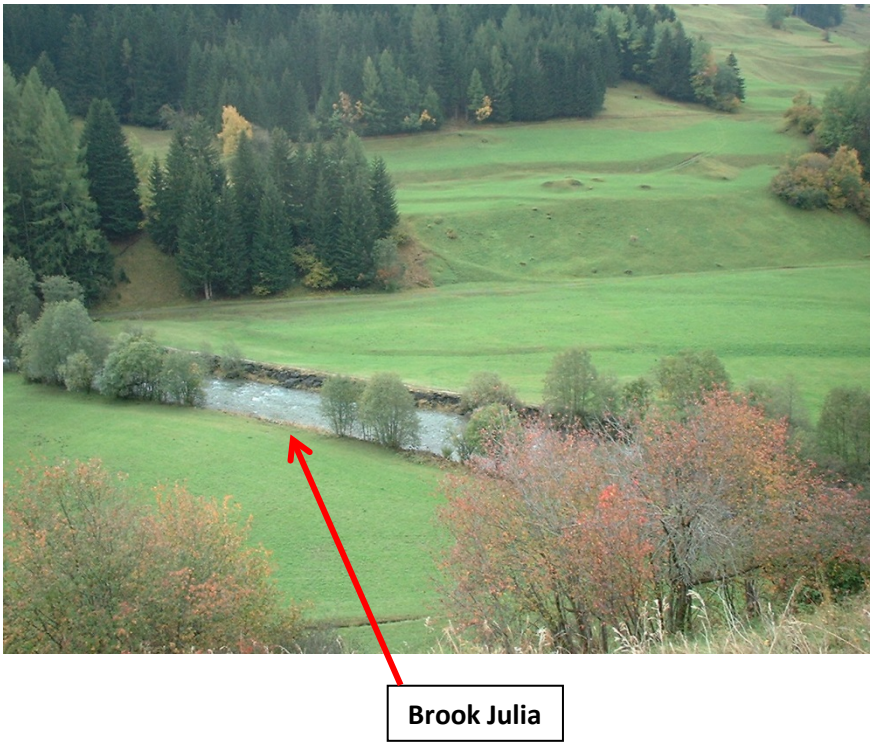


Fig. 1.7. Brook Julia. From the view of the south slope (Photograph by Miki Bopp-Ito).

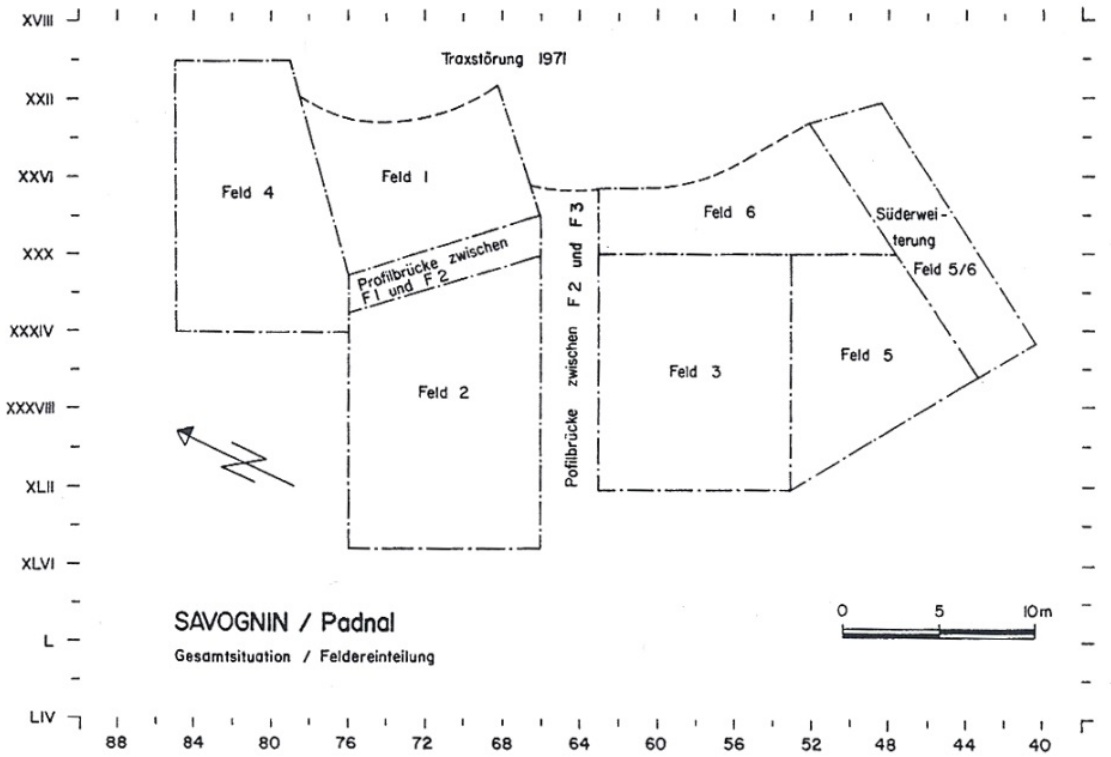


Fig. 1.8. Excavation plan of Savognin-Padnal with divided fields (Drawing by Jürg Rageth, 1985, p. 65, Fig. 1).

PHASE	LAYER	DATING	YEARS
Late BA	Horizont A	ca. 1000-900/800 BC	200
	Horizont B	ca. 1350/1300-1050 BC	300
Middle Bronze Age	Horizont C	ca. 1450-1350/1300 BC	150
End of Early BA Beginning of Middle BA	Horizont D	ca. 1550-1450 BC	100
Early BA	Horizont E	ca. 1950/1900-1550 BC	400

Fig. 1.9. Chronological sequenced phase and C14 dating of Savognin-Padnal and the Bronze Age (BA) phases.

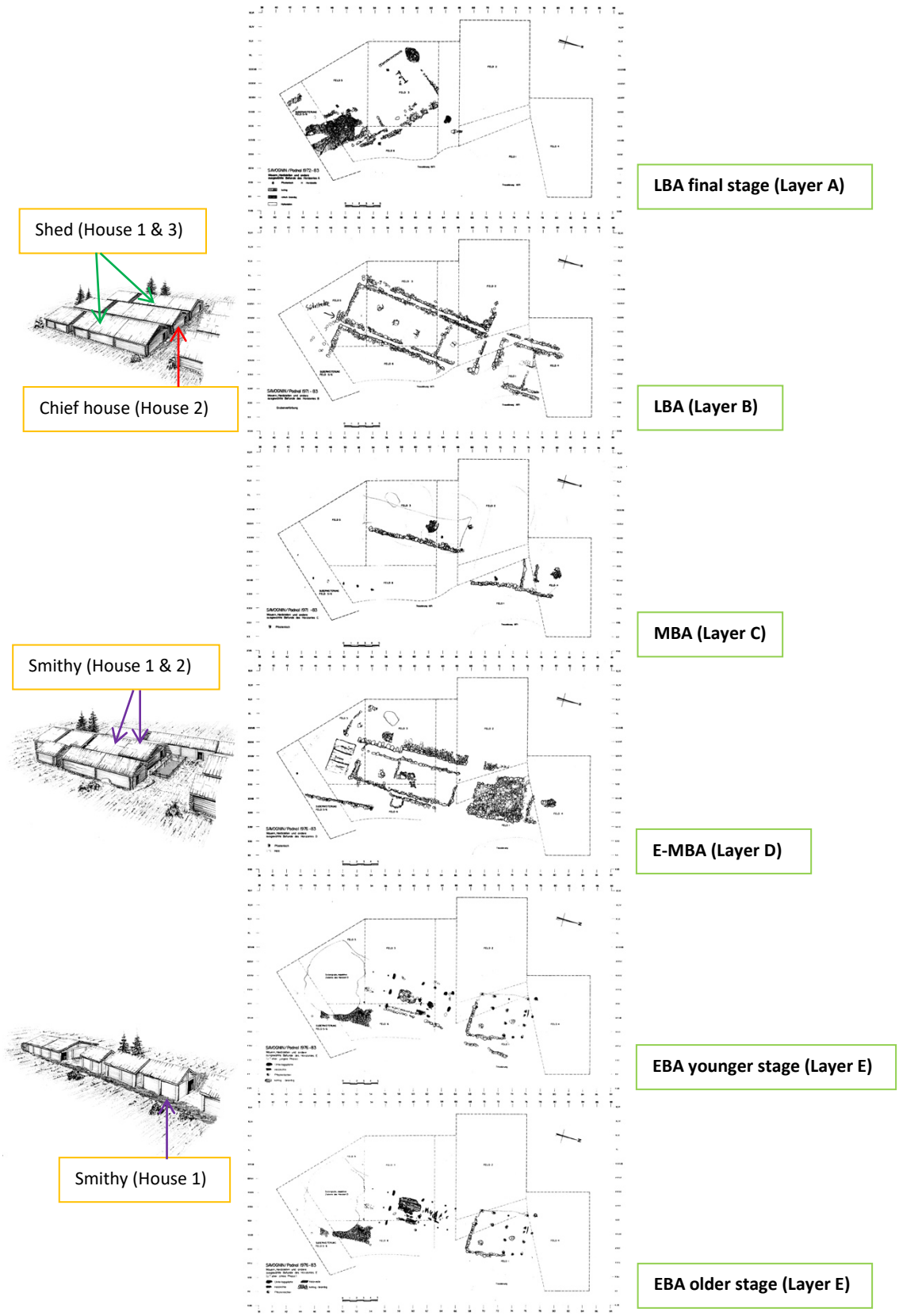


Fig. 1.10. Savognin-Padnal settlement plans on six layers relating to the Bronze Age phases. EBA = Early Bronze Age, E-MBA = Early-Middle Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age. (Drawing by Jürg Rageth, 1986, pp. 66–69, 71–74, Fig. 3–6, 8–12).

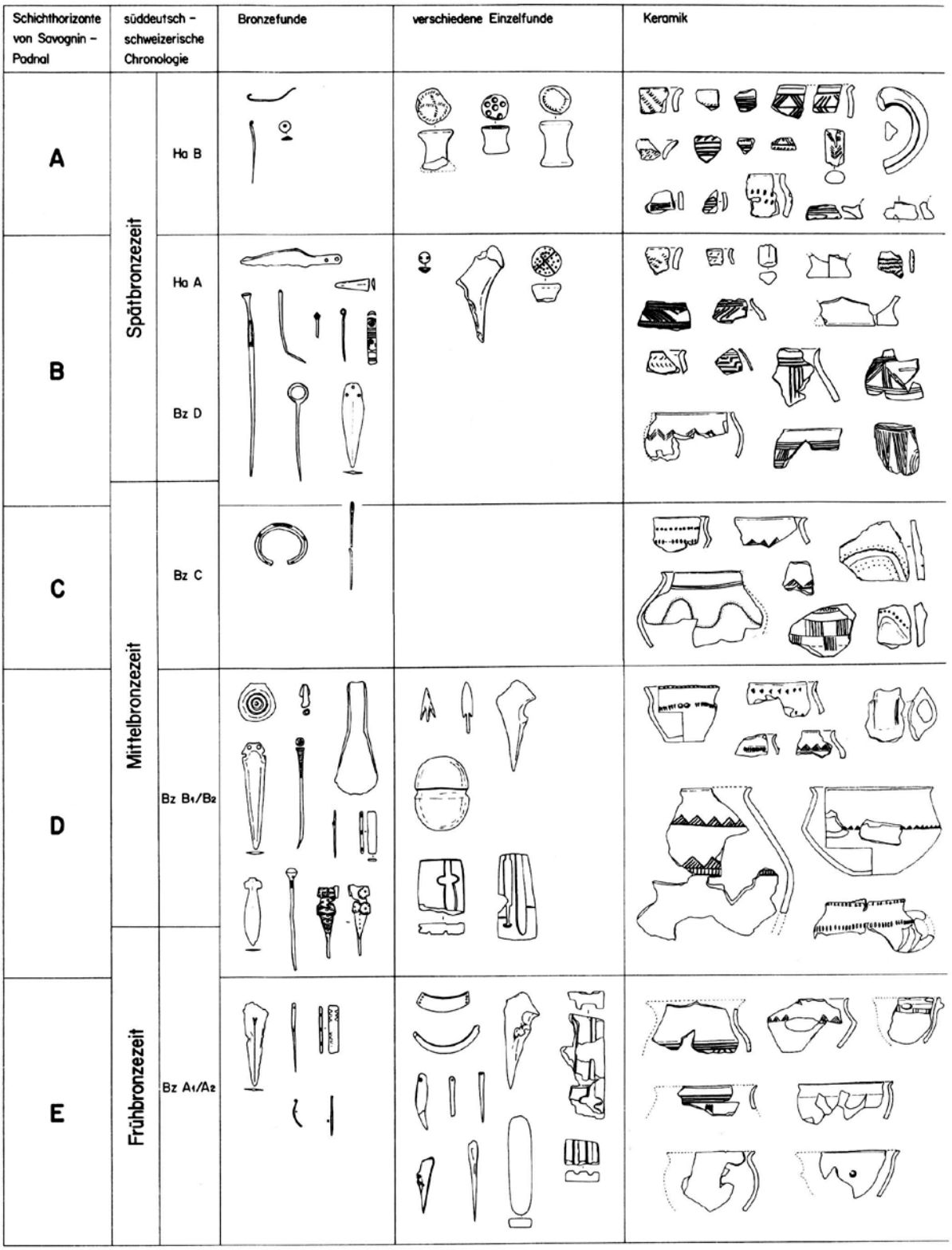


Fig. 1.11. Chronological schema of the settlement Savognin-Padnal, part 1. (Drawing by Jürg Rageth, 1986, pp. 76–77, Fig. 13).

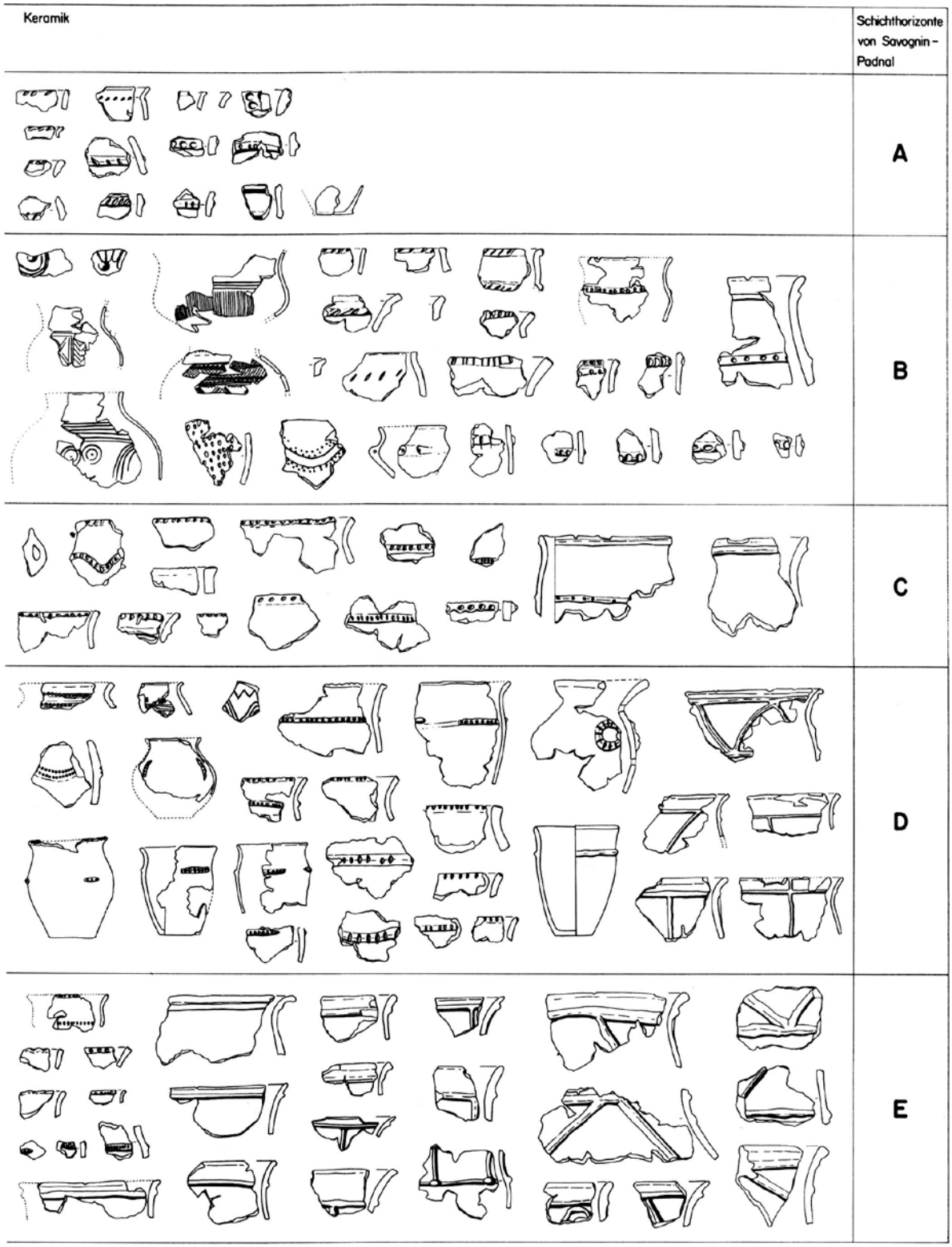


Fig. 1.12. Chronological schema of the settlement Savognin-Padnal, part 2. (Drawing by Jürg Rageth, 1986, pp. 76–77, Fig. 13).

Species		Standard individuals				
		No.	Age (years old)	Sex	Shoulder height	Weight
Bos taurus	Hinterwälderkuh	2431	13	female	116.9 cm	?
Ovis musimon	Moufflon	2266	adult	male	73.0 cm	?
Capra hircus	Goat	1597	adult	male	?	?
Sus scrofa	Wild boar	1446	3	male	?	120 kg

Fig. 2.1. Reference collections at IPAS, University of Basel used as the standard value of Logarithmic size index.

Cattle adult

LSI 1. OSSOBOOK Adult group (No. 27, 28, 29)

Skeletal element	Mass	Standard (mm)
Humerus	Bp	87.50
Radius	Bd	70.60
Ulna	DPA	59.24
Femur	DC	45.61
Tibia	Bp	96.71

5 points
Only Adult
Fused Epiphyses

Fig. 2.2. The standard value of Logarithmic size index (LSI) based on the reference collection (cattle Z-2431, at IPAS, University of Basel) for the adult cattle group.

Cattle subadult-adult

LSI 2. OSSOBOOK Subadult and Adult groups (No. 26, 27,28,29)

Skeletal element	Mass	Standard (mm)
Humerus	Bp	87.50
Radius	Bd	70.60
Ulna	DPA	59.24
Femur	DC	45.61
Tibia	Bp	96.71
Metacarpus	Bd	55.29
Metatarsus	Bd	51.94
Calcaneus	GL	125.50

8 points
Over Subadult
Fused Epiphyses

Fig. 2.3. The standard value of Logarithmic size index (LSI) based on the reference collection (cattle Z-2431, at IPAS, University of Basel) for the subadult-adult cattle group.

Sheep, sheep/goat subadult-adult

LSI. OSSOBOOK Subadult and Adult groups (No. 26, 27,28,29)

Skeletal element	Mass	Standard
Humerus	Bp	51.77
Radius	Bd	32.05
Ulna	DPA	28.80
Metacarpus	Bd	27.20
Femur	DC	22.90
Tibia	Bd	27.90
Metatarsus	Bd	25.80
Calcaneus	GL	65.05

8 points
Over Subadult
Fused Epiphyses

Fig. 2.4. The standard value of Logarithmic size index (LSI) based on the reference collection (sheep Z-2266, at IPAS, University of Basel) for the subadult-adult sheep and sheep/goat groups.

Domestic pig subadult-adult

LSI. OSSOBOOK Subadult and Adult groups (No. 26, 27,28,29)

Skeletal element	Mass	Standard
Humerus	Bp	58.50
Radius	Bd	39.00
Ulna	DPA	48.15
Metacarpus 2	Bd	11.85
Metacarpus 3	Bp	22.75
Metacarpus 4	Bp	19.40
Metacarpus 5	Bd	13.50
Femur	DC	28.40
Tibia	Bd	36.00
Metatarsus 2	Bd	10.25
Metatarsus 3	Bp	16.40
Metatarsus 4	Bp	17.30
Metatarsus 5	Bd	11.30
Calcaneus	GL	91.25
Phalanx 1	Bp	18.66

15 points
Over Subadult
Fused Epiphyses

Fig. 2.5. The standard value of Logarithmic size index (LSI) based on the reference collection (wild boar Z-1446, at IPAS, University of Basel) for the subadult-adult pig.

PHASE	TOTAL FRAGMENT (n)	TOTAL IDENTIFIED (n)	TOTAL WEIGHT (g)	TOTAL IDENTIFIED (g)
	40031 (39992)	26408 (26369)	233146.3 (233057.7)	213691.4 (213602.8)
Late	17401 (17393)	10801 (10793)	97569.2 (97527.9)	88030.0 (87988.7)
Middle	7153 (7135)	4420 (4402)	41727.8 (41703.0)	37037.4 (37012.6)
Early-Middle	10476 (10464)	7368 (7356)	57998.1 (57979.6)	54291.6 (54273.1)
Early	5001 (5000)	3819 (3818)	35851.2 (35847.2)	34332.4 (34328.4)

Fig. 3.1.1. Numbers and weights of total examined fragments and identified specimens including *Homo sapiens* from Savognin-Padnal in Switzerland, in each Bronze Age phase. Values in parentheses indicate the number of animal specimens.

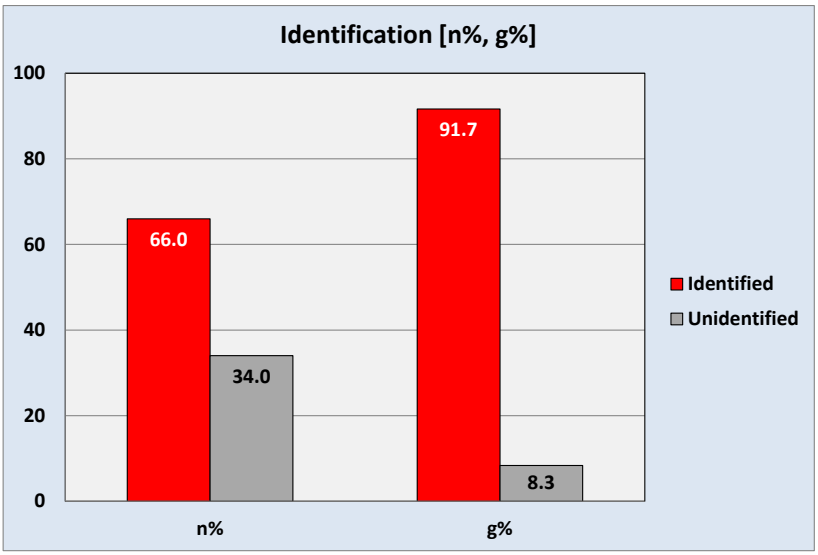


Fig. 3.1.2. Proportion of the animal bones identification from fragments that were excavated from the settlement Savognin-Padnal in Switzerland.

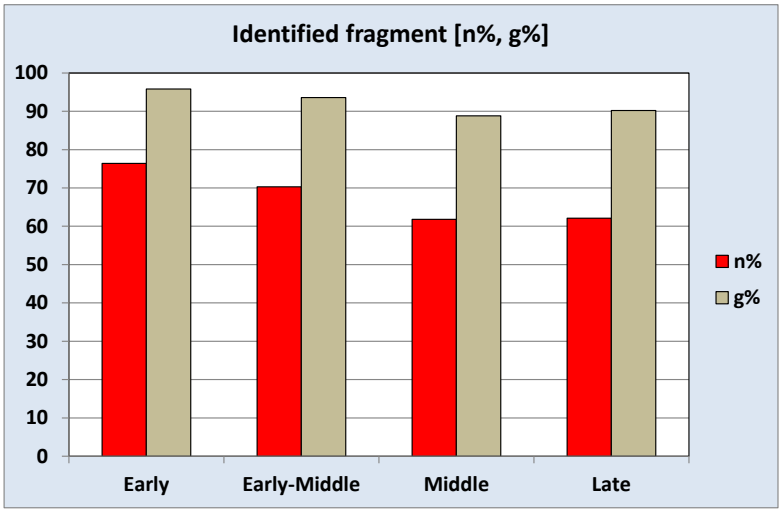
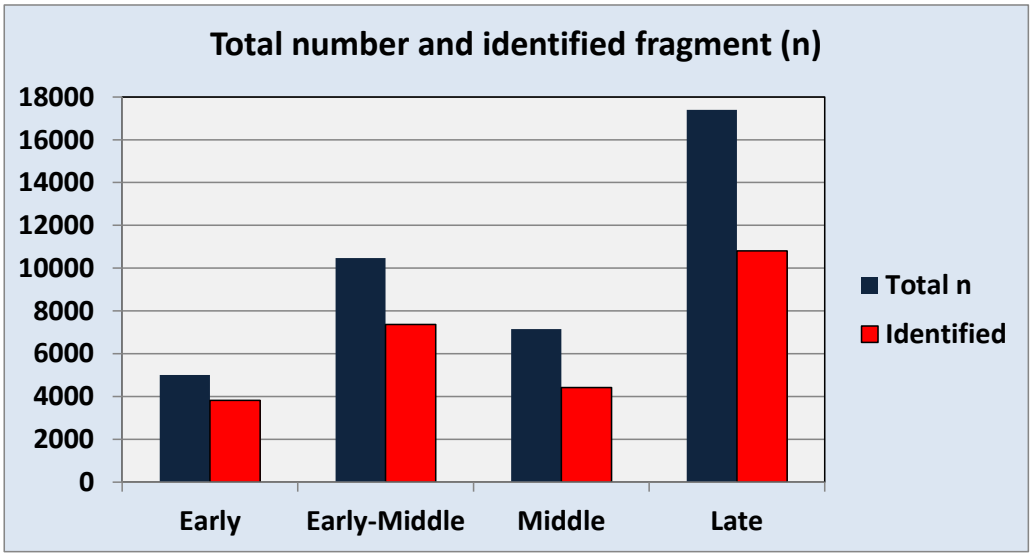


Fig. 3.1.3. Number and weight of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.



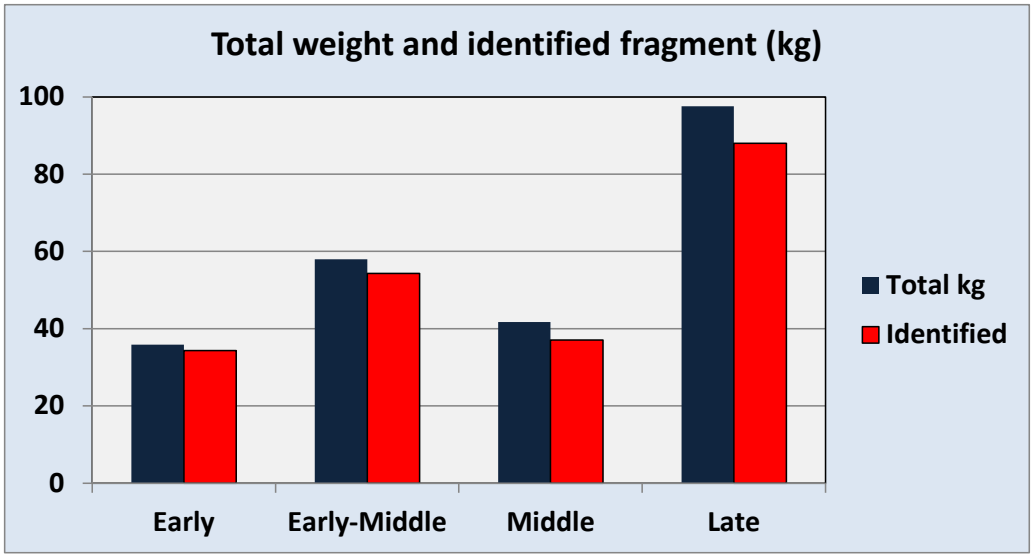


Fig. 3.1.4. Total number and weight of animal bones and identified specimens that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

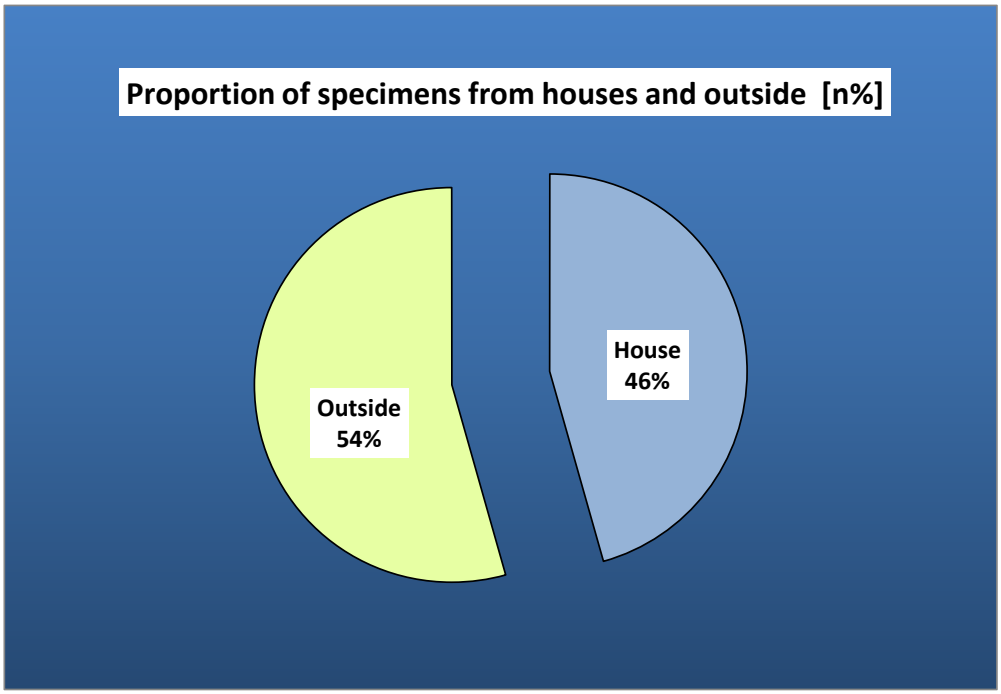


Fig. 3.1.5. Proportion of excavated specimens from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland.

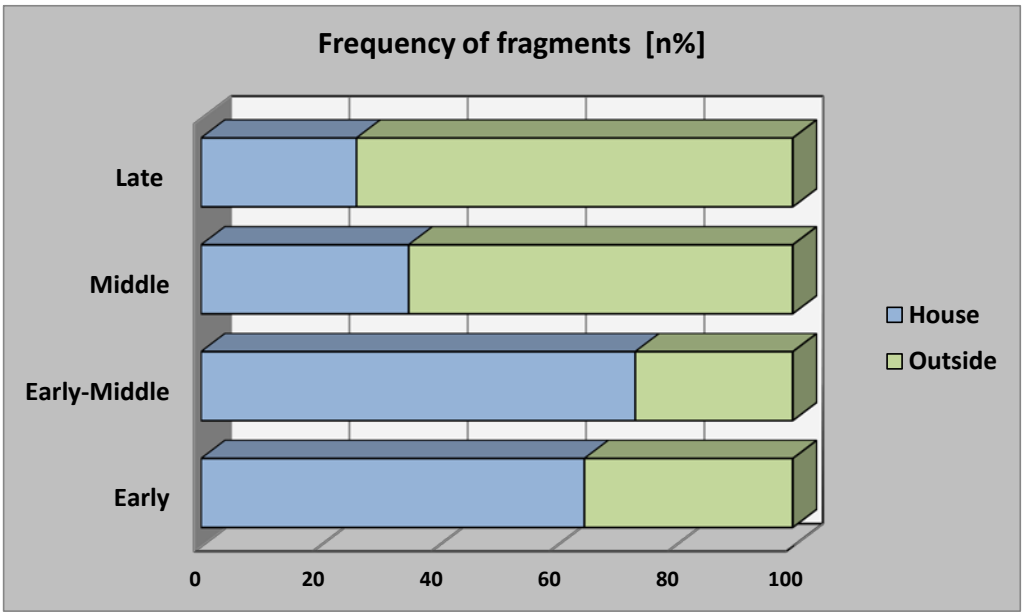
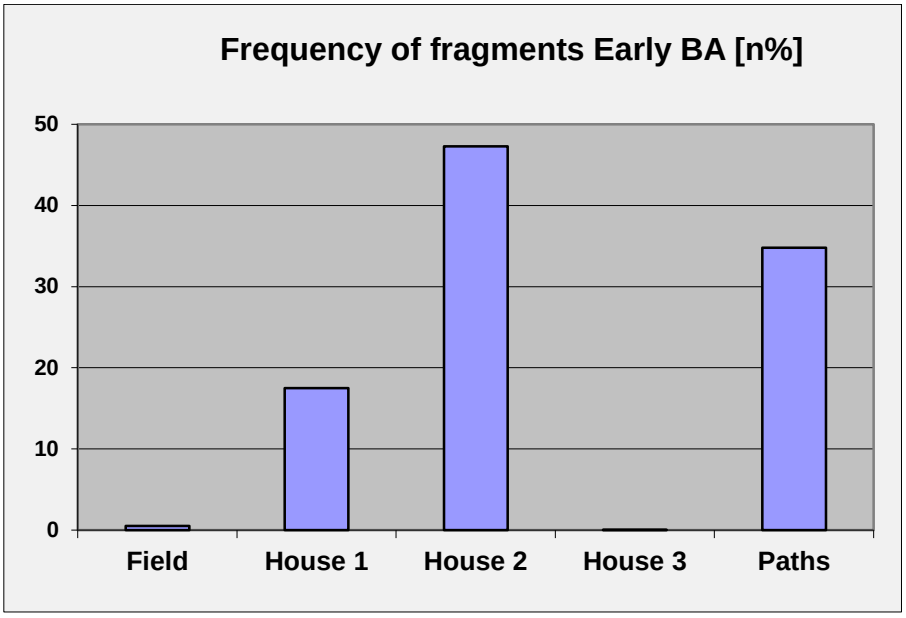
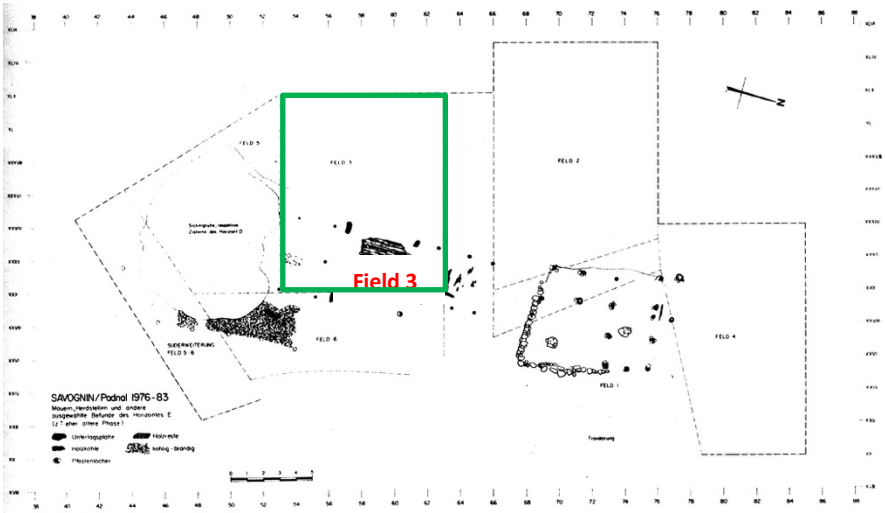


Fig. 3.1.6. Frequency of excavated specimens from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.





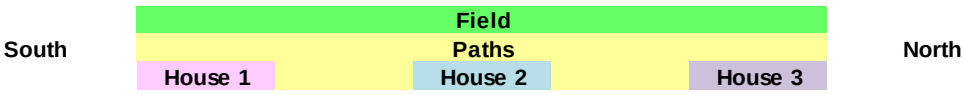
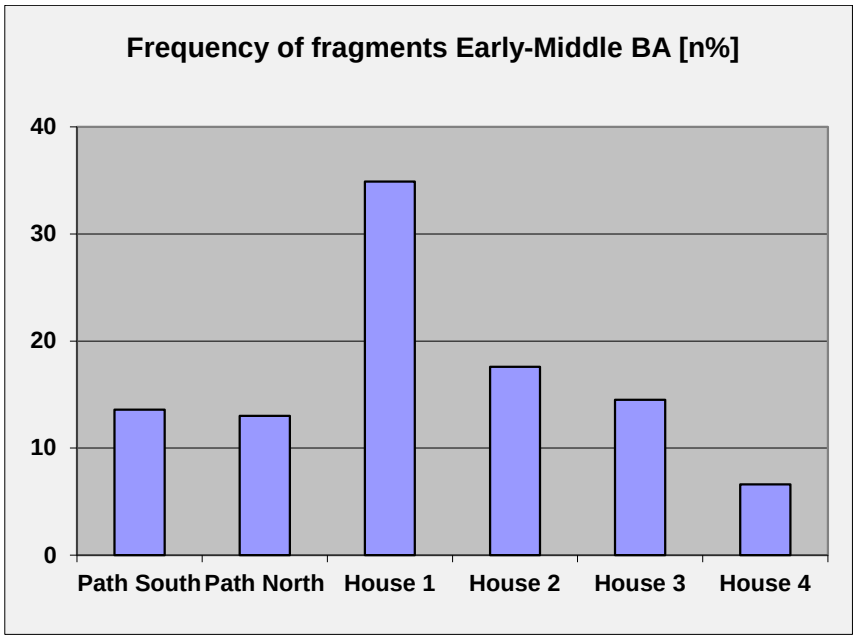
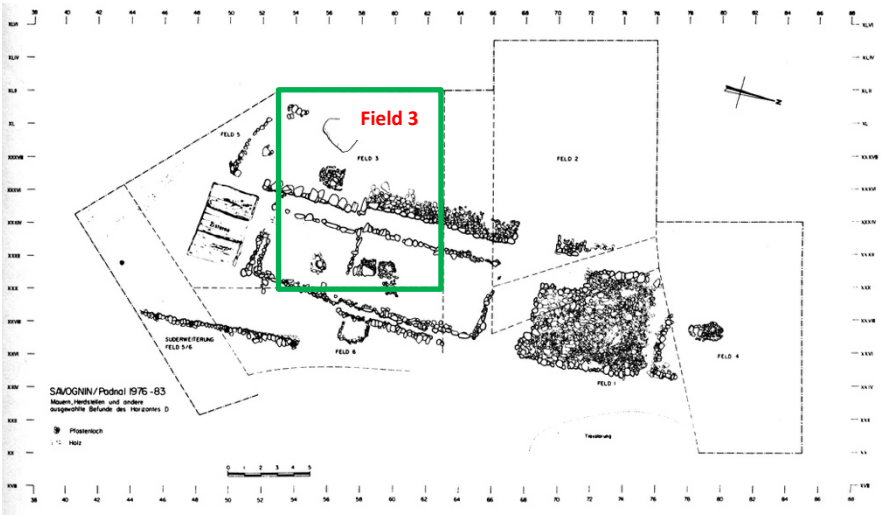


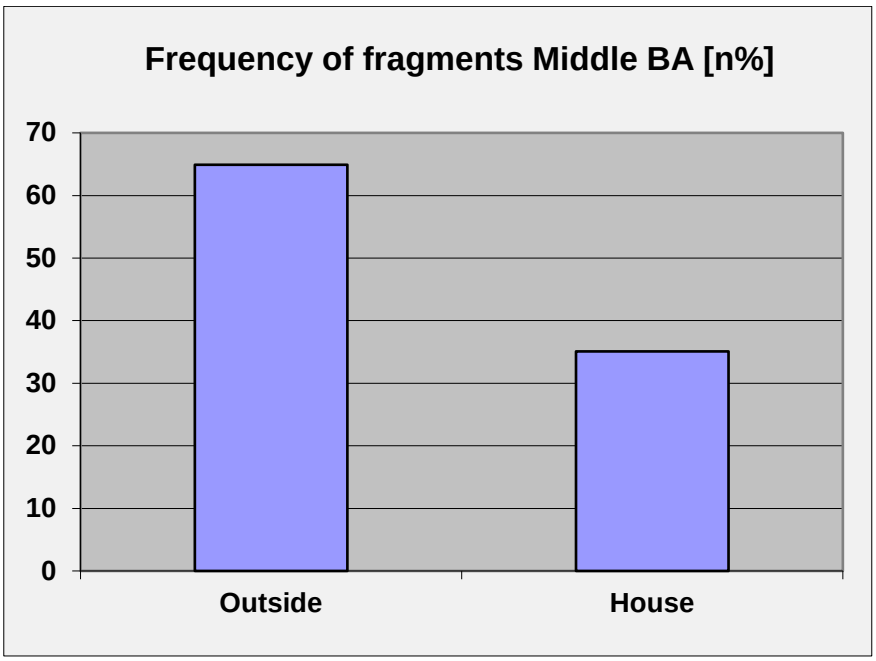
Fig. 3.1.7. Distribution of animal bones excavated from different structures in Field 3 in the settlement Savognin-Padnal from the Early Bronze Age (BA).





	House 3	House 4	
South	Path 1	Path 2	North
	House 1	House 2	

Fig. 3.1.8. Distribution of animal bones excavated from different structures in Field 3 in the settlement Savognin-Padnal from the Early-Middle Bronze Age (BA).



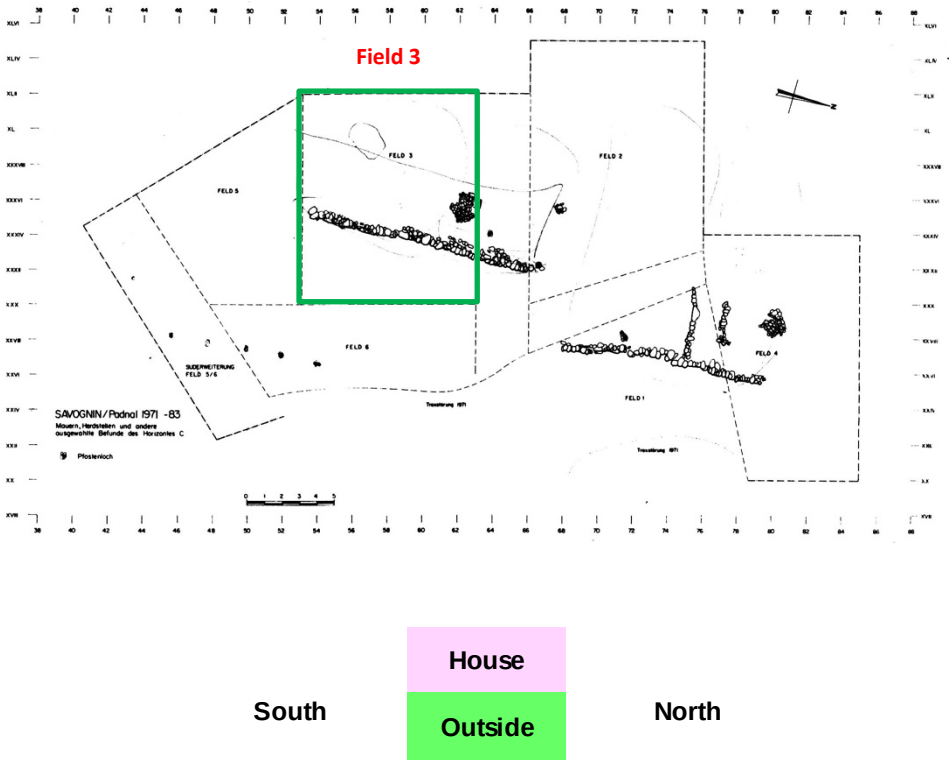
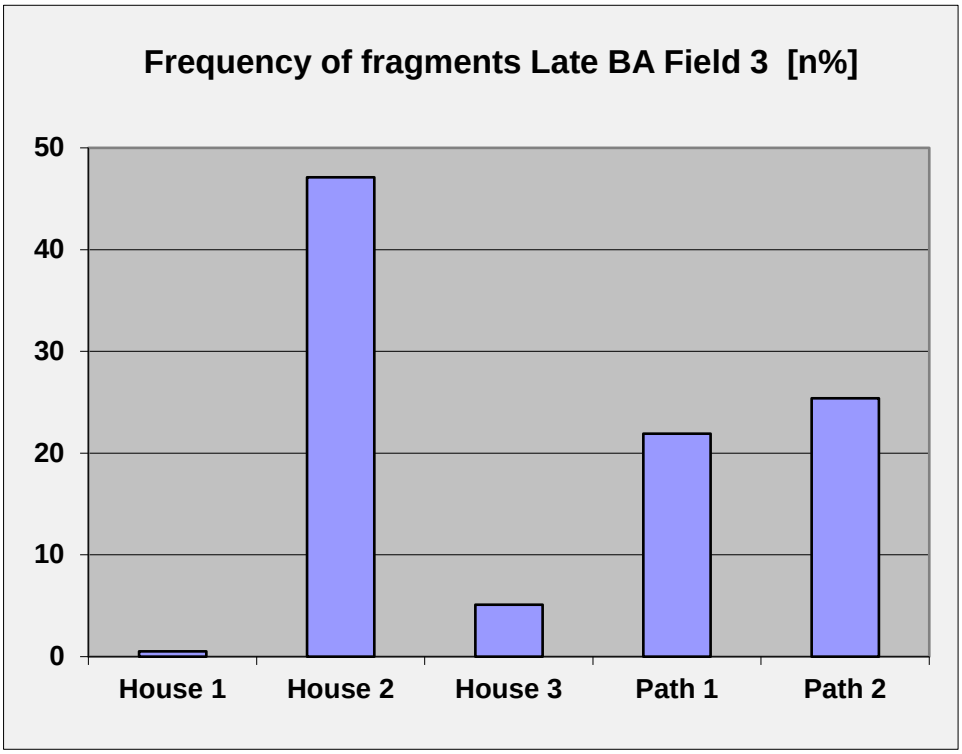


Fig. 3.1.9. Distribution of animal bones excavated from inside and outside of the houses in Field 3 in the settlement Savognin-Padnal from the Middle Bronze Age (BA).



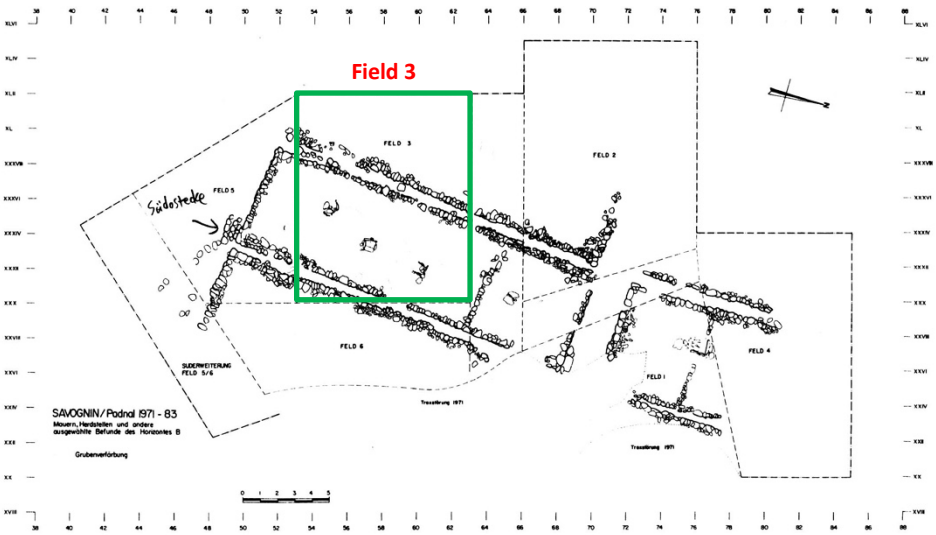
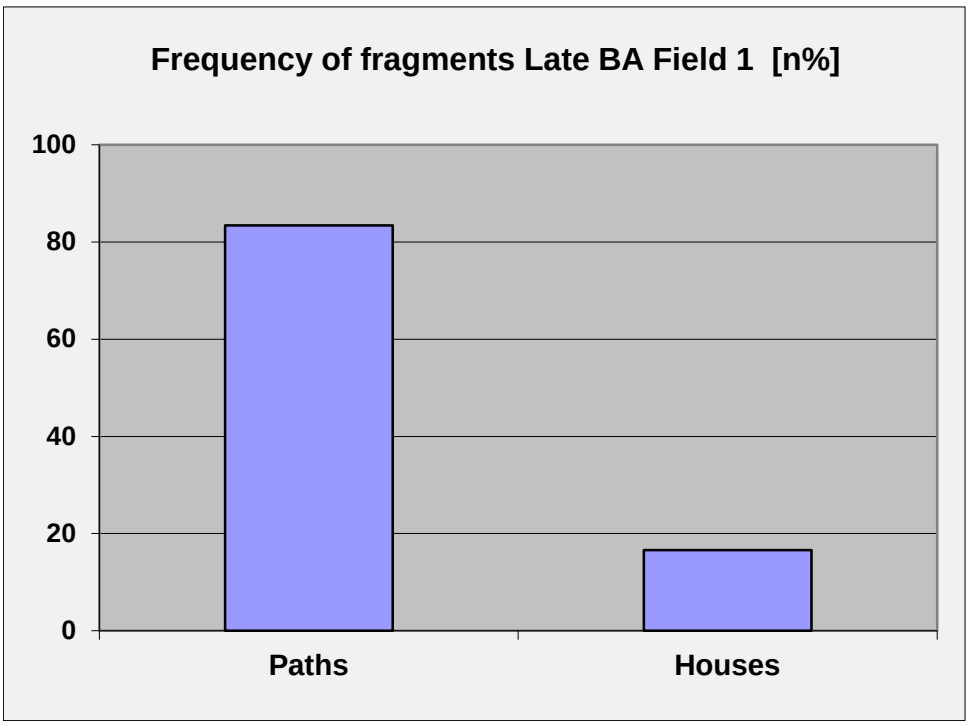


Fig. 3.1.10. Distribution of animal bones excavated from different structures in Field 3 in the settlement Savognin-Padnal from the Late Bronze Age.



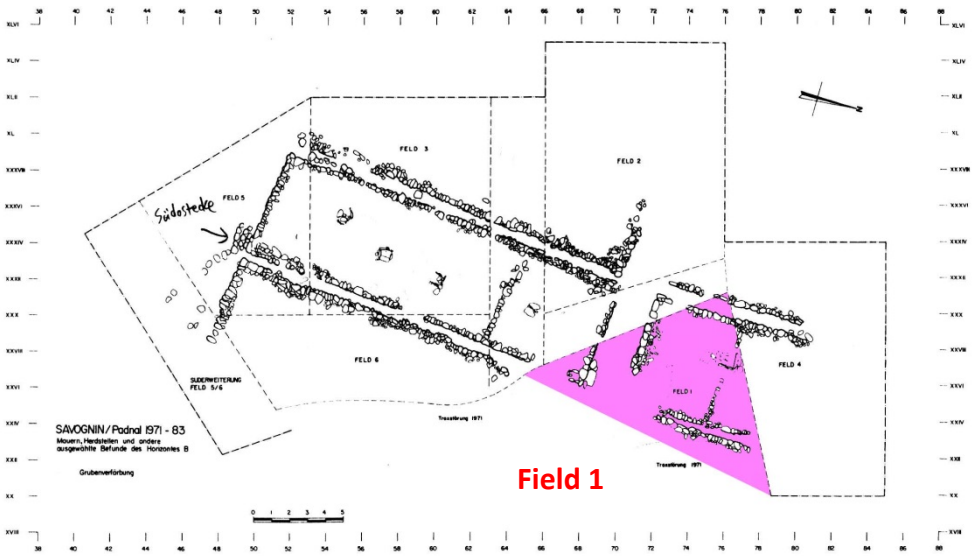


Fig. 3.1.11. Distribution of animal bones excavated from inside and outside (on the paths) of the houses in Field 1 in the settlement Savognin-Padnal from the Late Bronze Age.

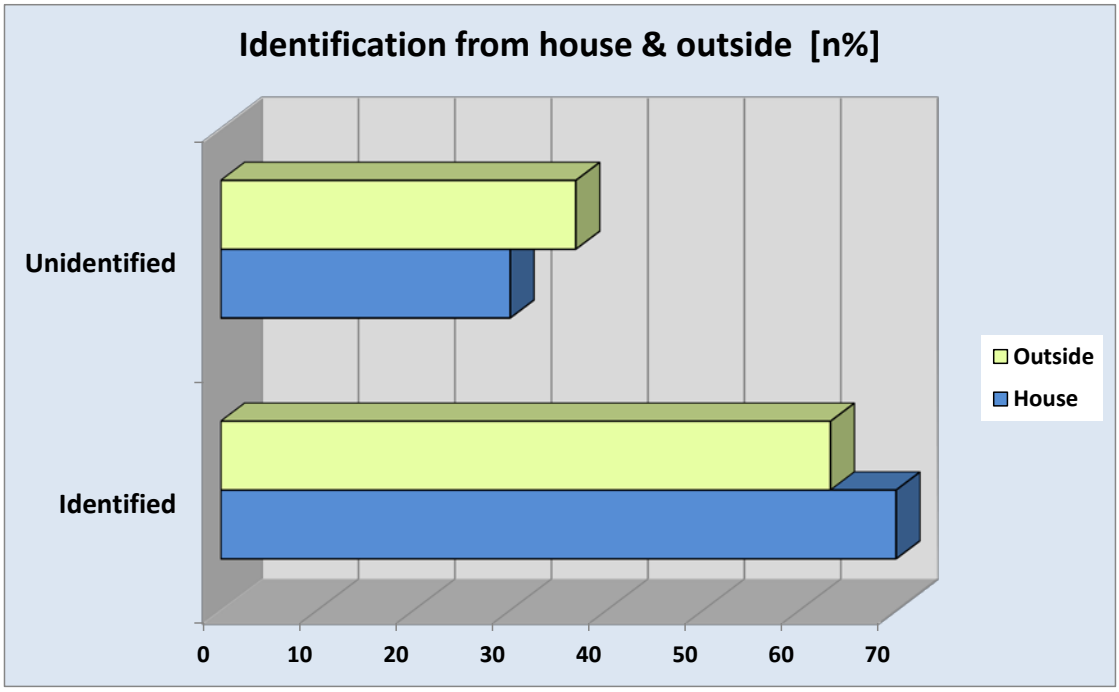


Fig. 3.1.12. Identified specimens that were excavated from inside and outside of the houses in the settlement Savognin-Padnal.

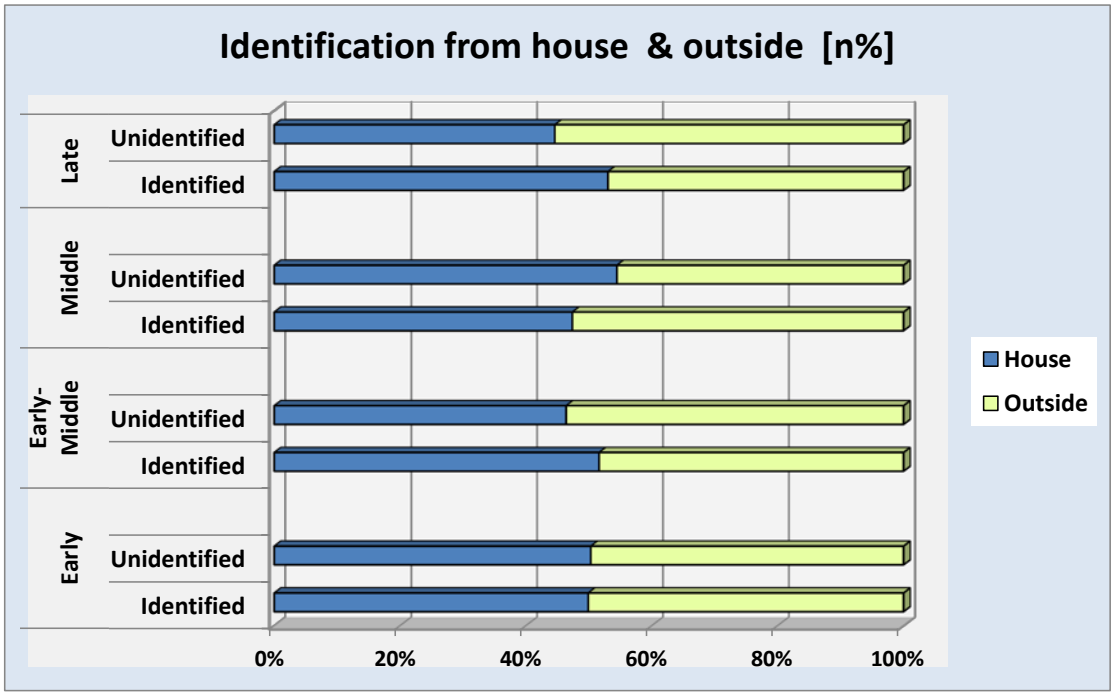


Fig. 3.1.13. Identified specimens that were excavated from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

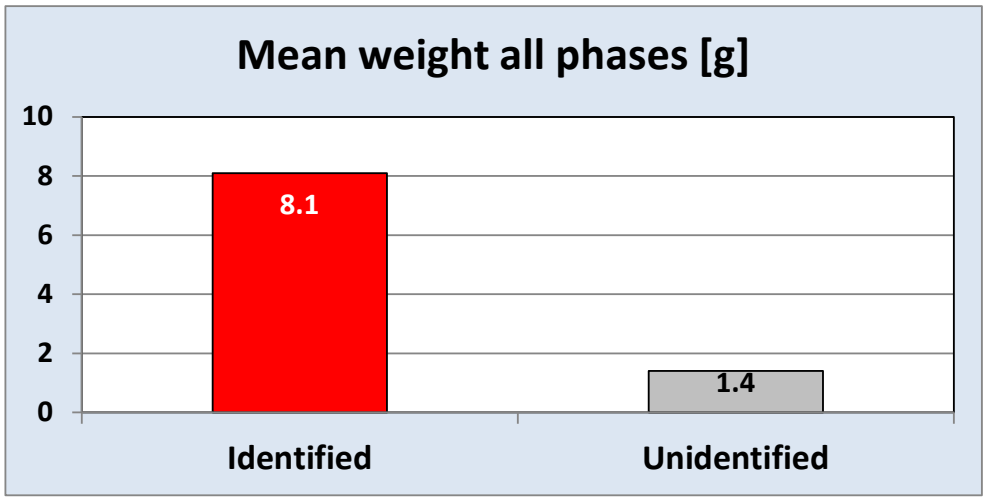


Fig. 3.1.14. Mean weight of identified and unidentified animal bone fragments that were excavated from the settlement Savognin-Padnal.

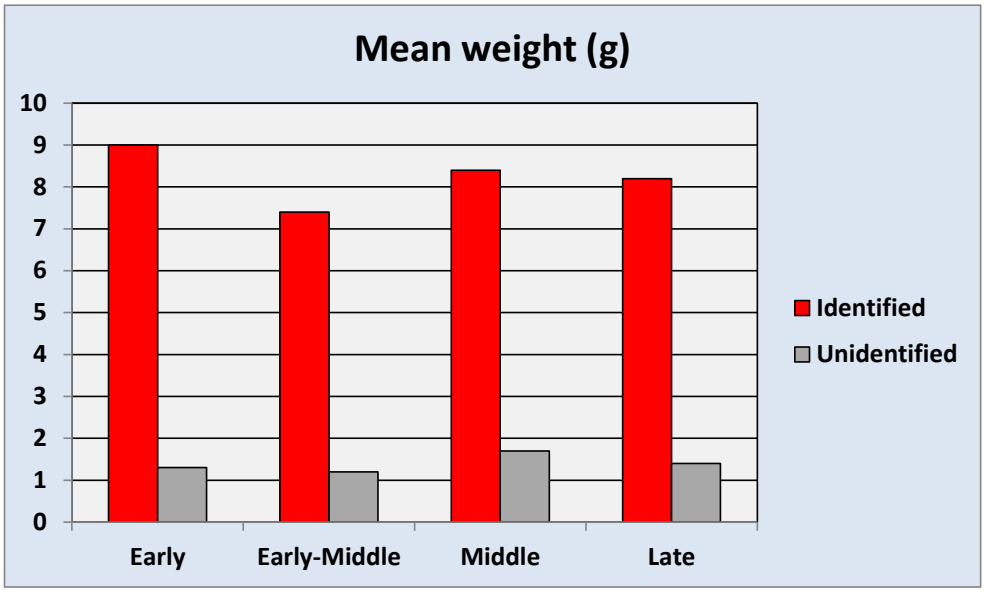


Fig. 3.1.15. Mean weight of identified and unidentified animal bone fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

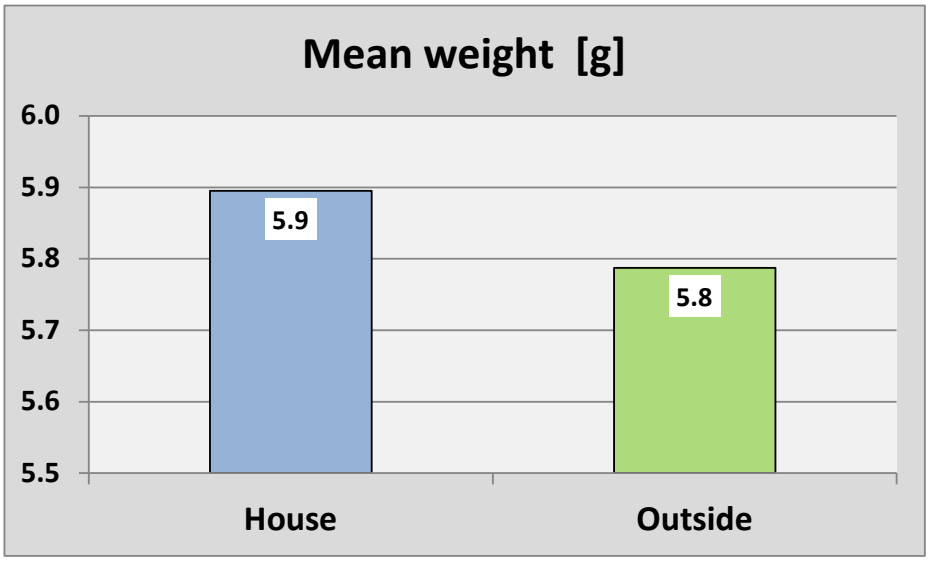


Fig. 3.1.16. Mean weight of total animal bone fragments that were excavated from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland.

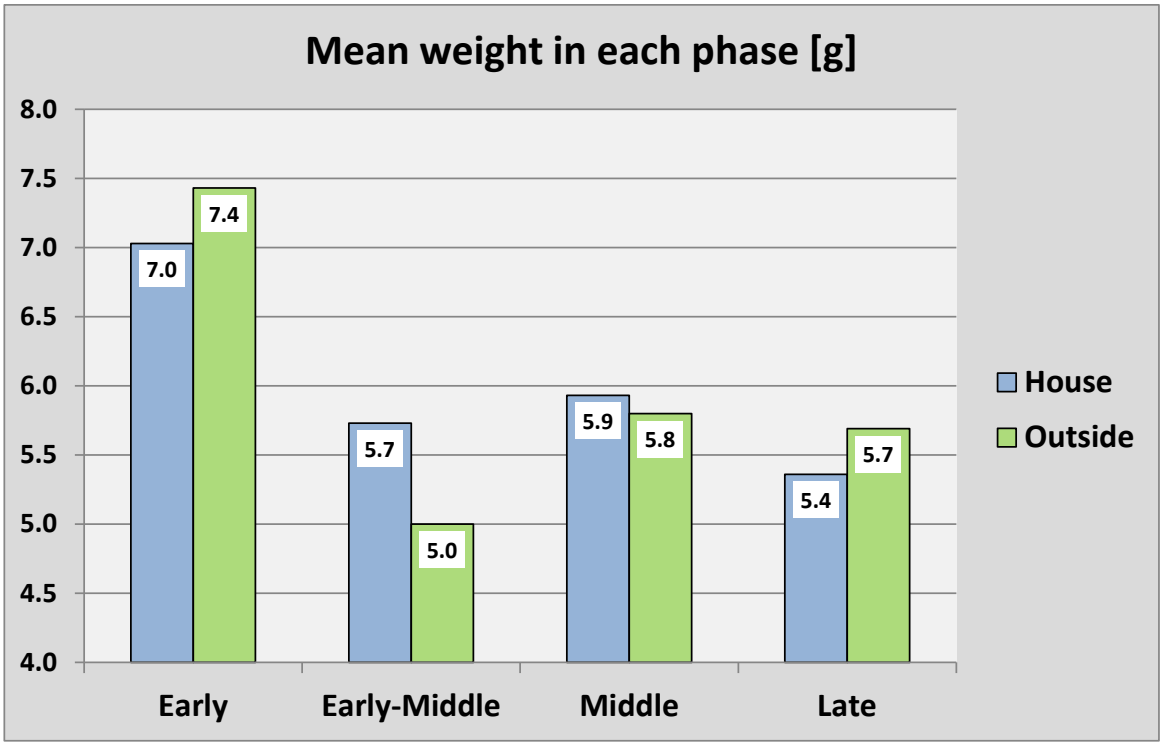
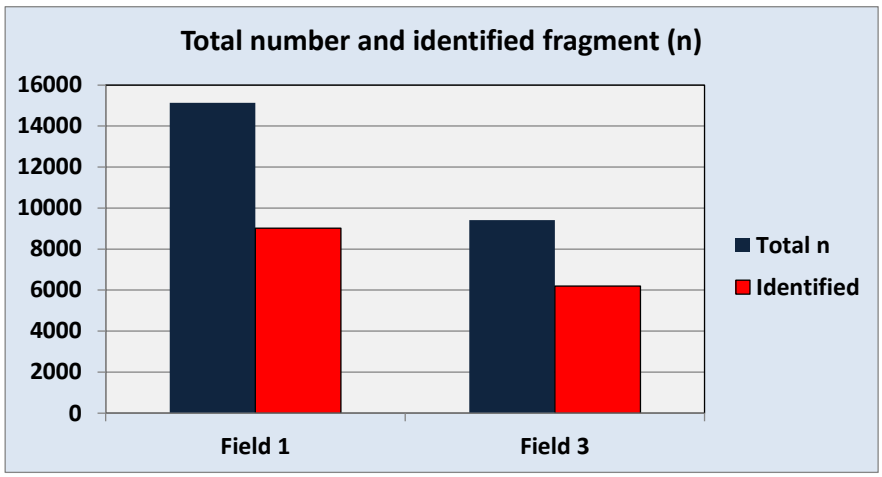
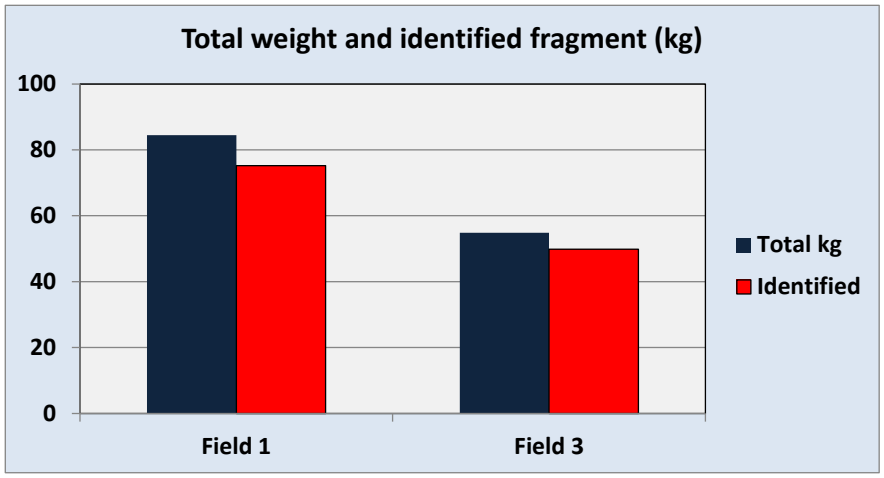


Fig. 3.1.17. Mean weight of animal bone fragments that were excavated from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.





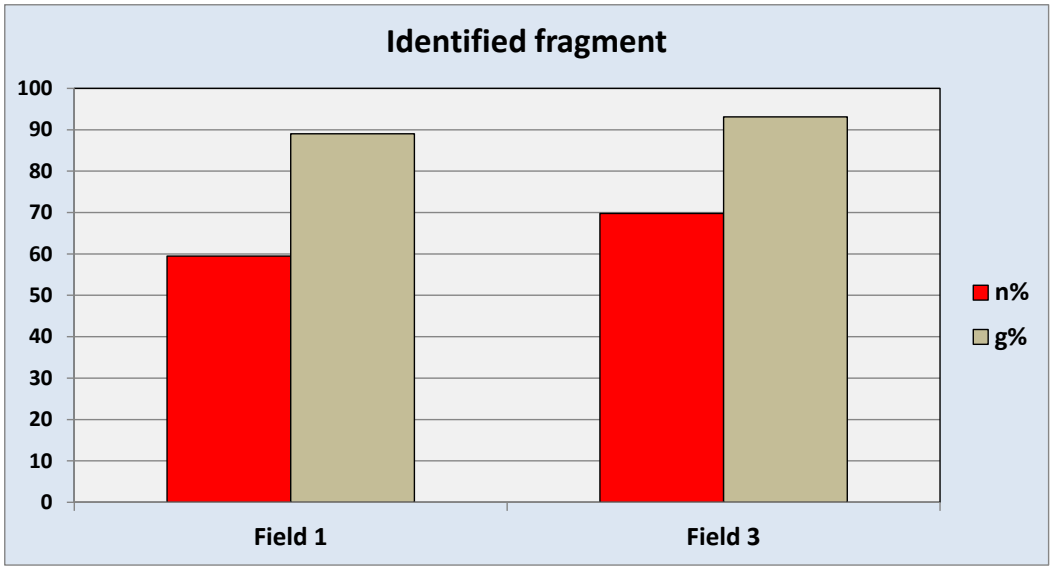


Fig. 3.1.18. The total and specific number and weight of identified specimens (fragments) excavated from Field 1 and Field 3 in the settlement Savognin-Padnal.

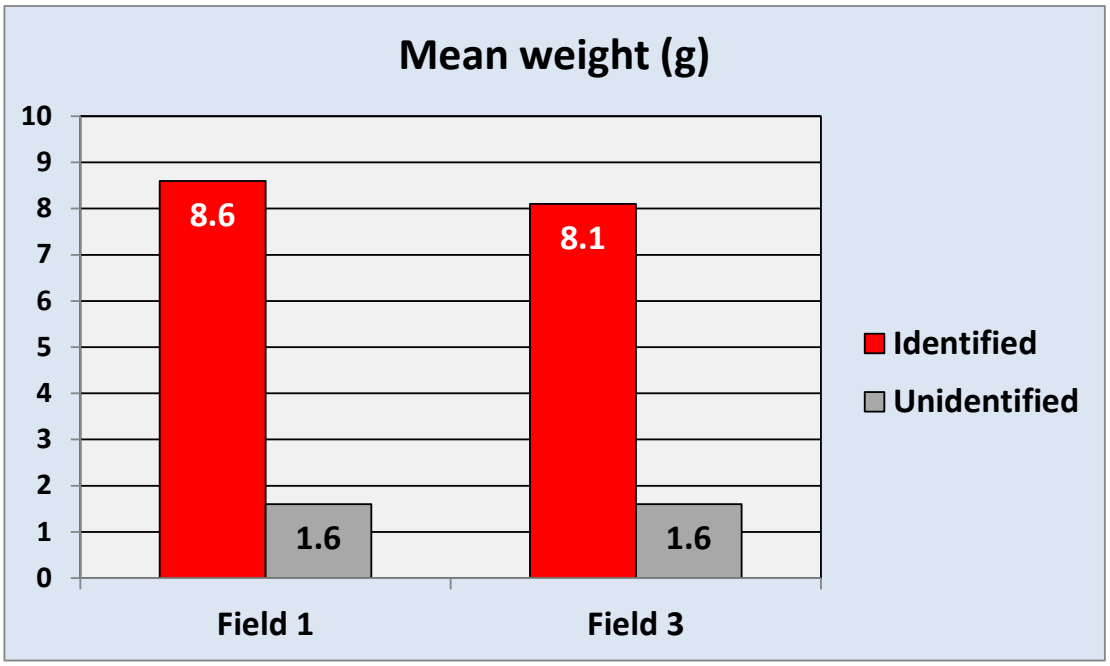


Fig. 3.1.19. Chronological and horizontal comparisons of the mean weight of identified animal bone fragments that were excavated from Field 1 and 3 in the settlement Savognin-Padnal in the Middle and Late Bronze Age.

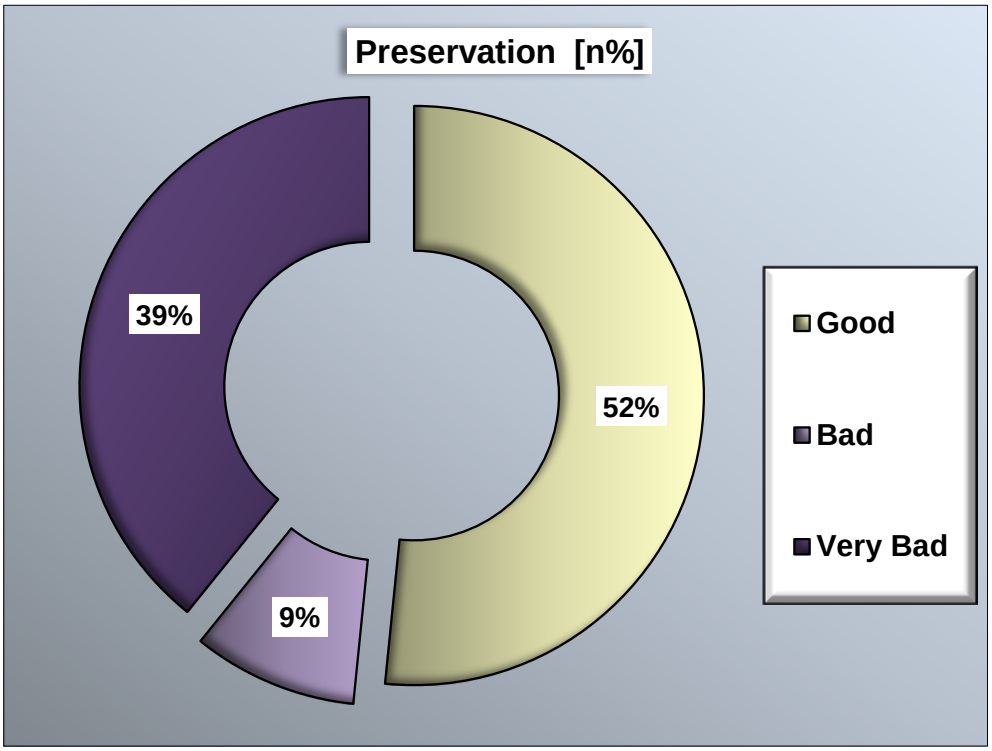


Fig. 3.1.20. The proportion of the preservation based on the bone surface condition of fragments that were excavated from the settlement Savognin-Padnal.

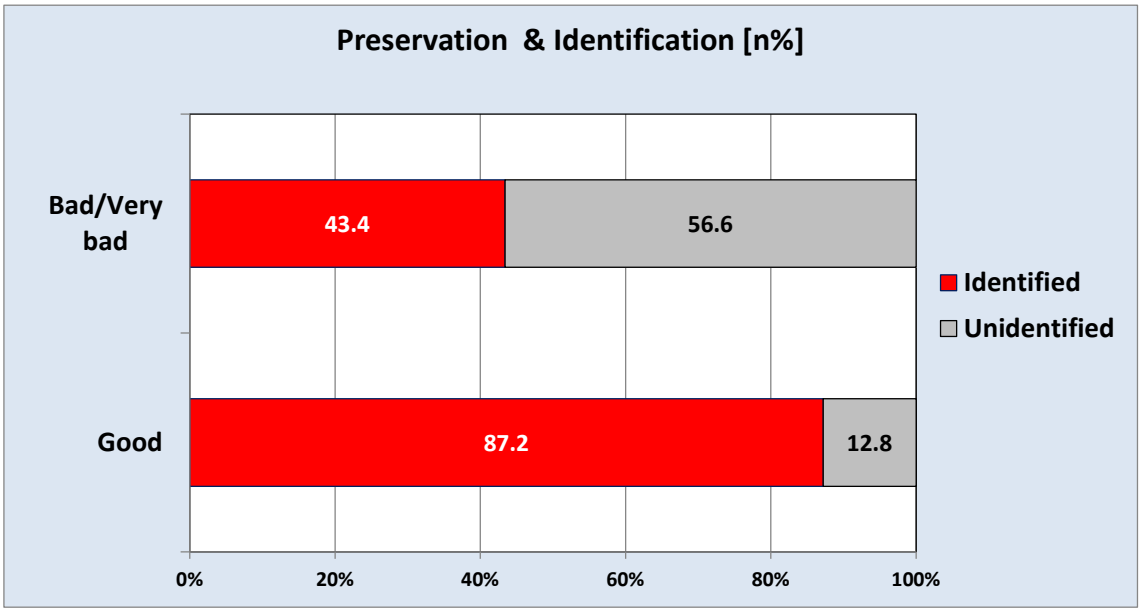


Fig. 3.1.21. Relationship between preservation and identification in the fragments that were excavated from the settlement Savognin-Padnal.

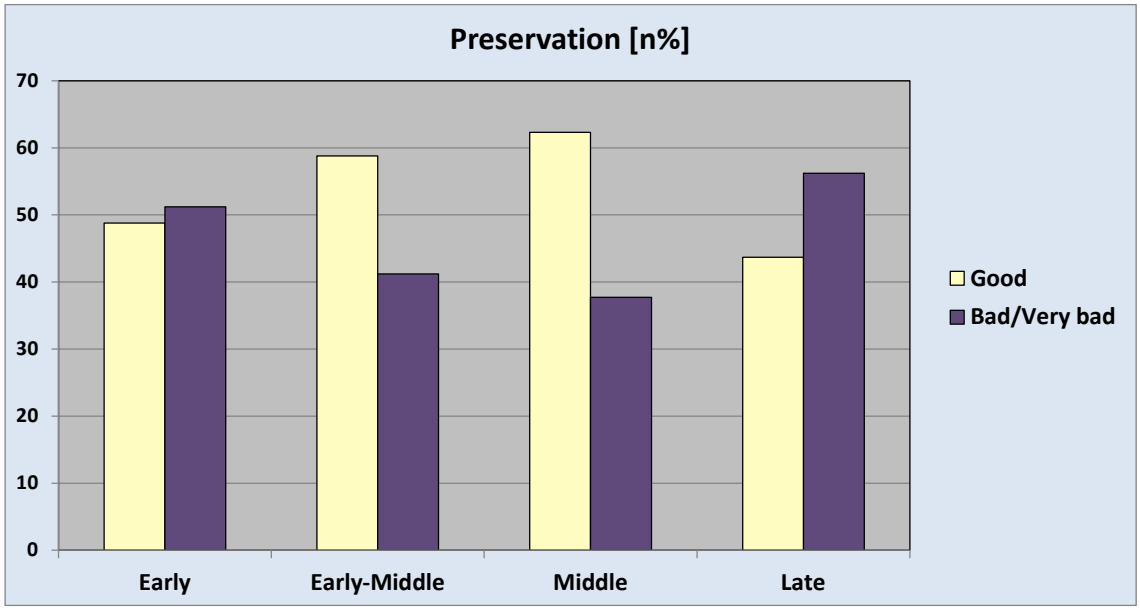


Fig. 3.1.22. Chronological comparison of excavated fragment preservation in each Bronze Age phase.

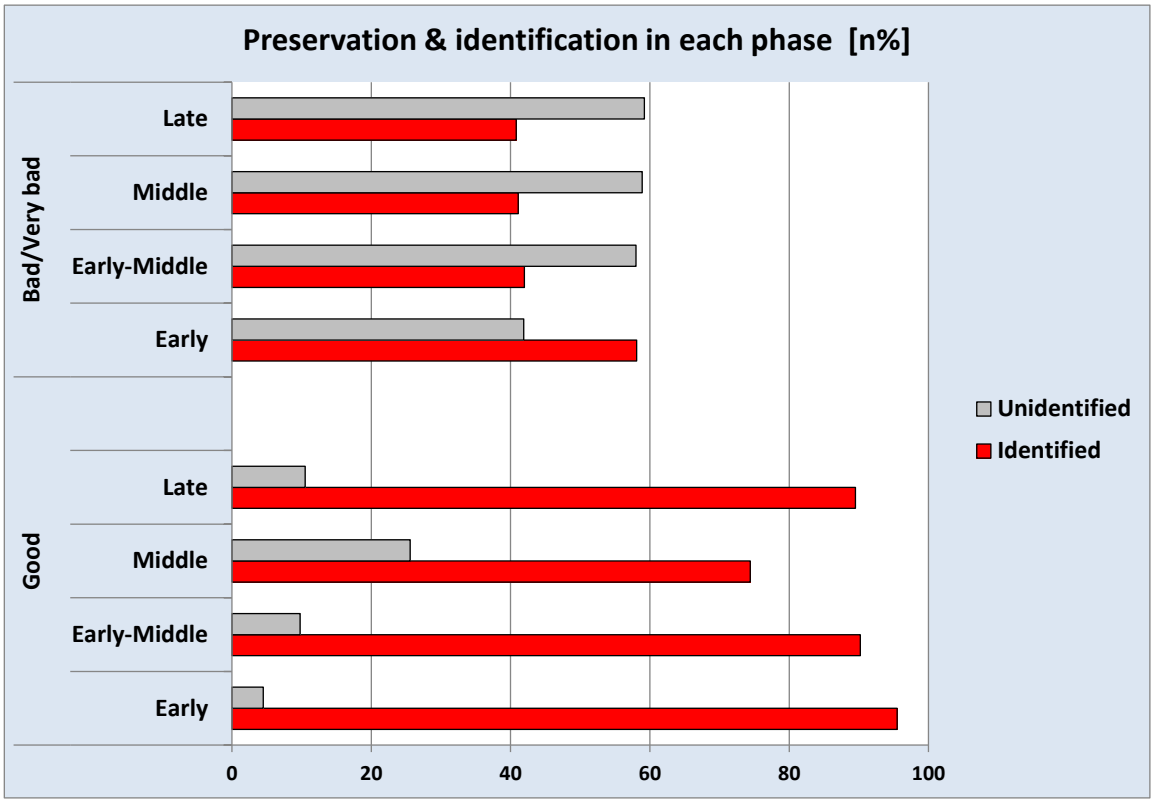


Fig. 3.1.23. Relationship between preservation and identification of fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

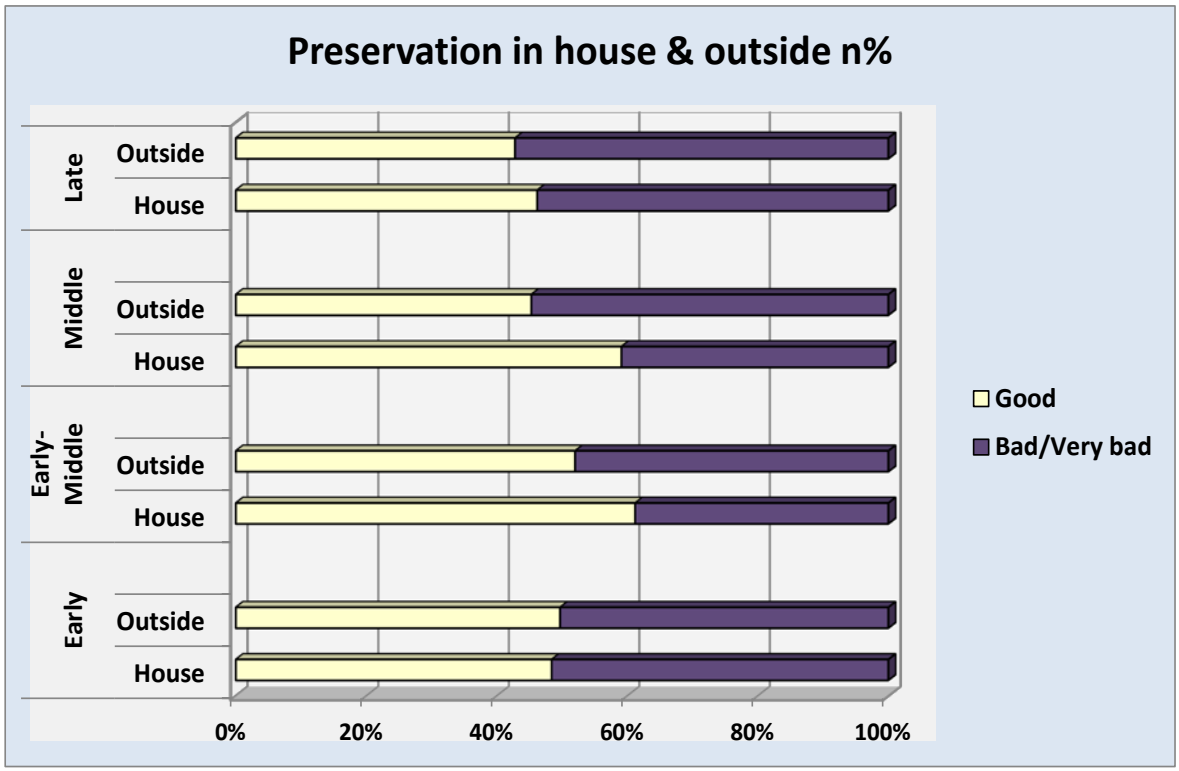


Fig. 3.1.24. Preservation of fragments that were excavated from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

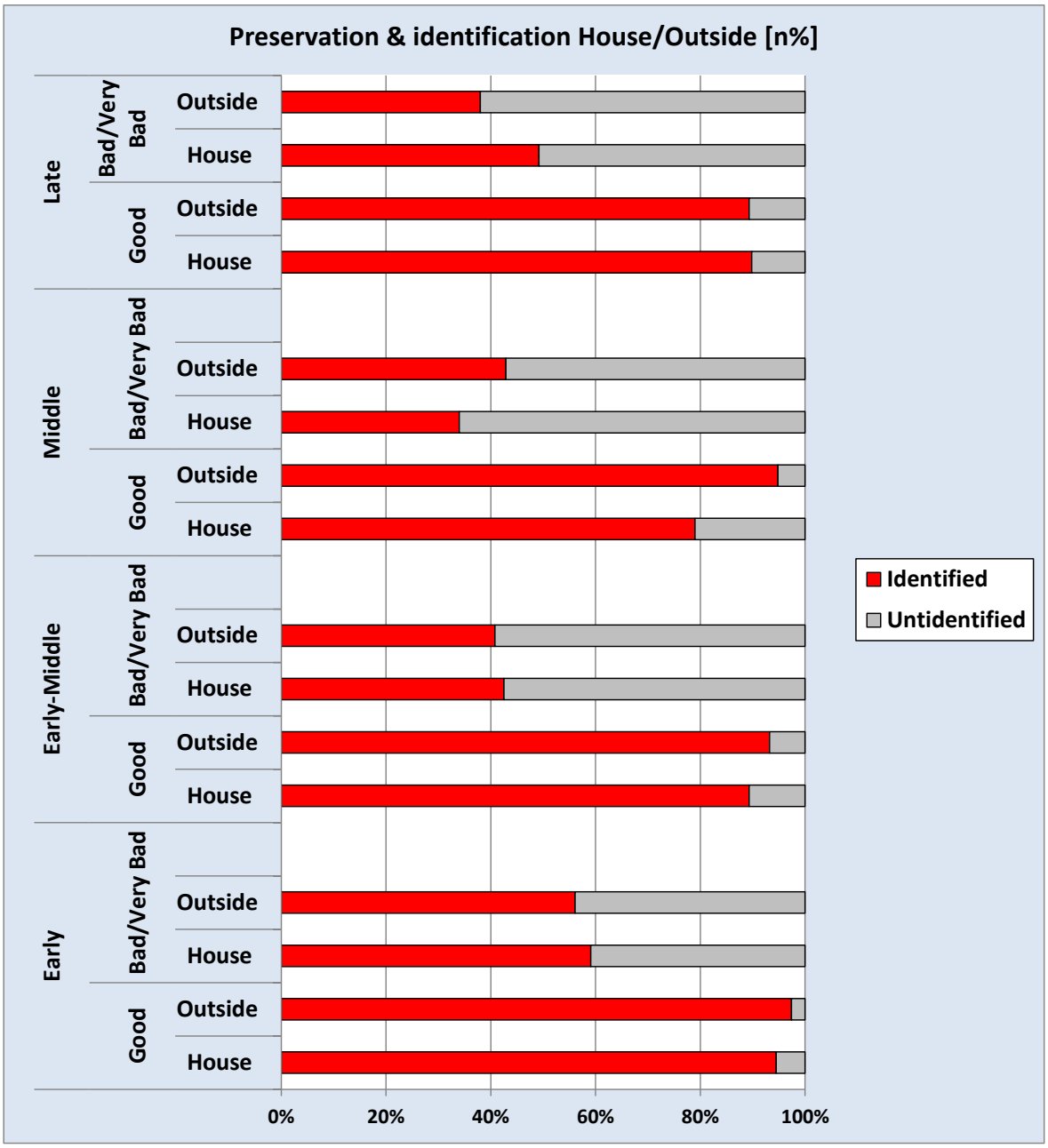


Fig. 3.1.25. Relationship between preservation and identification of the fragments that were excavated from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

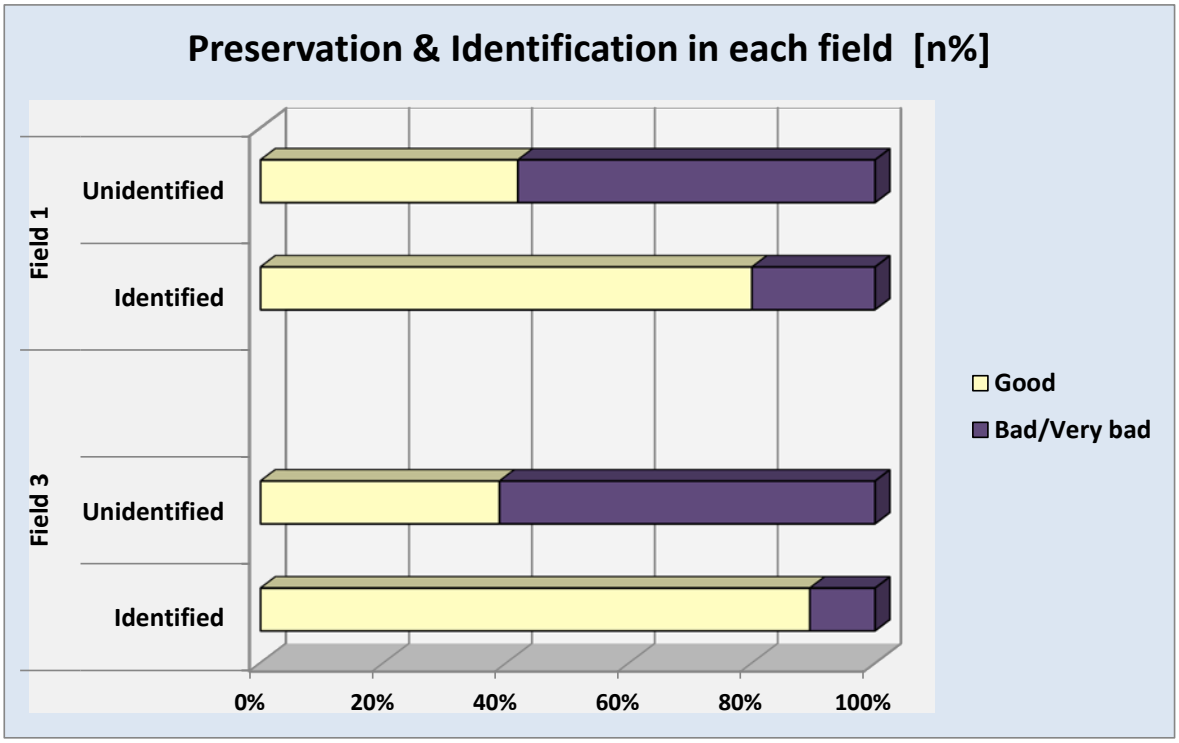


Fig. 3.1.26. Relationship between preservation and identification of the fragments that were excavated from Field 1 and 3 in the settlement Savognin-Padnal.

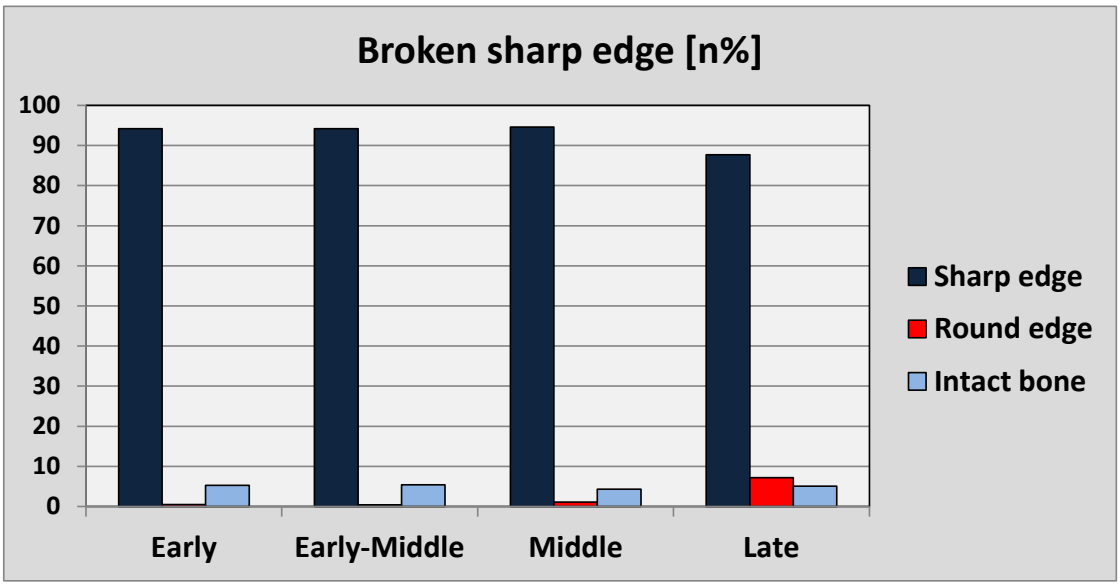


Fig. 3.1.27. The proportion of the broken edge conditions of bone fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

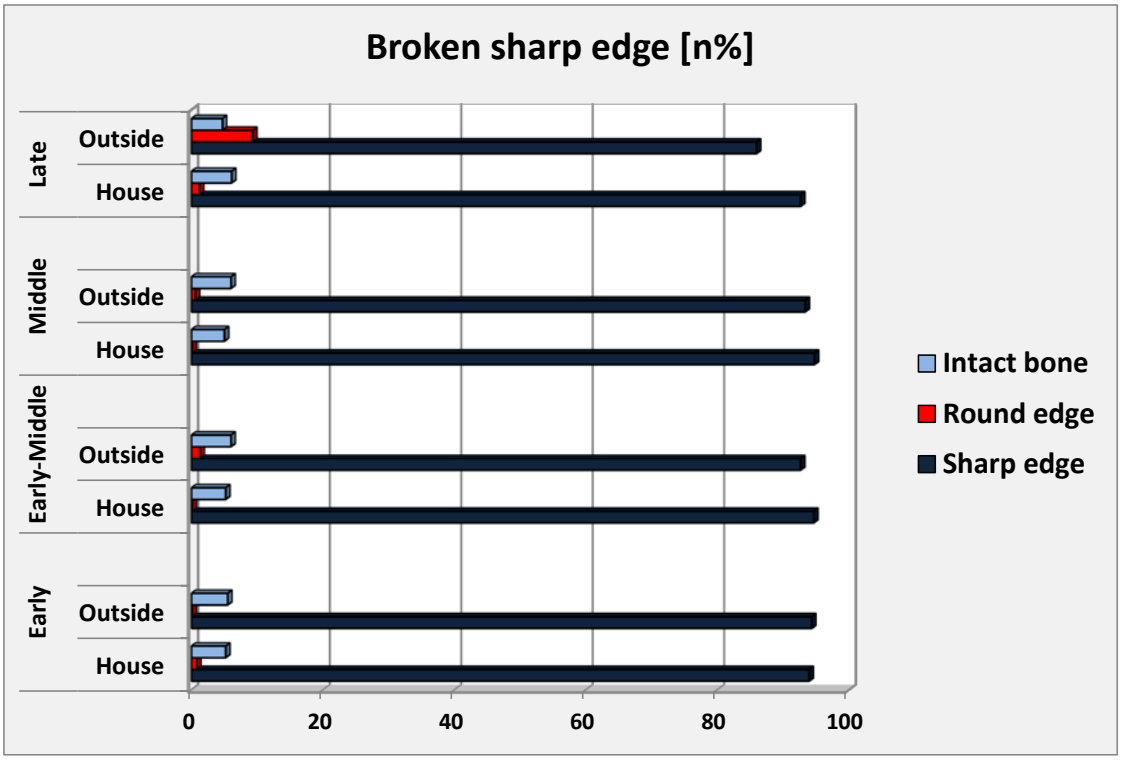


Fig. 3.1.28. The proportion of broken edge conditions of bone fragments that were excavated from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

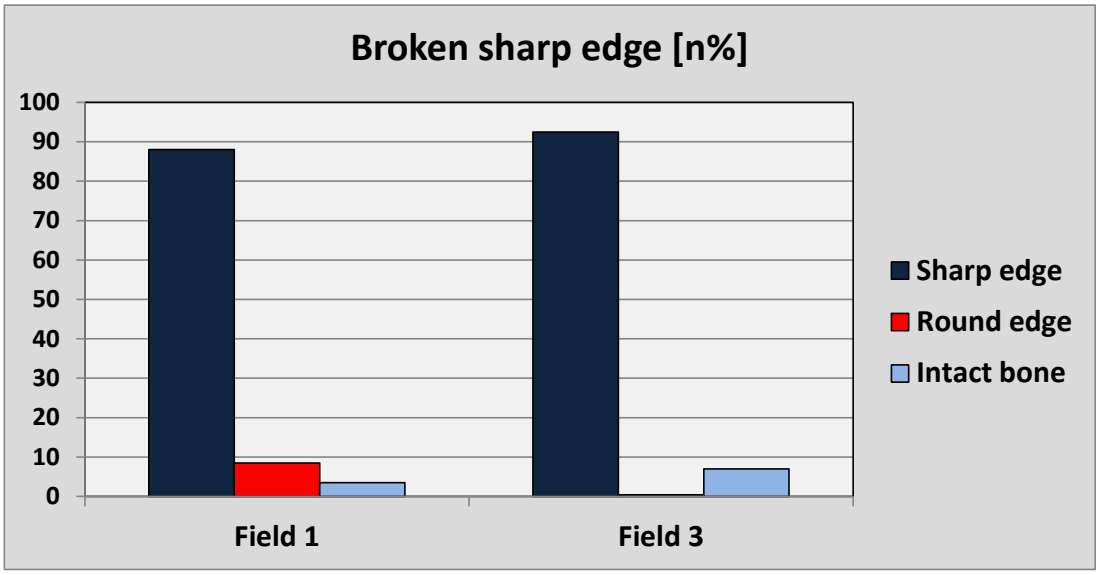


Fig. 3.1.29. The proportion of broken edge conditions of bone fragments that were excavated from Field 1 and 3 in the settlement Savognin-Padnal.

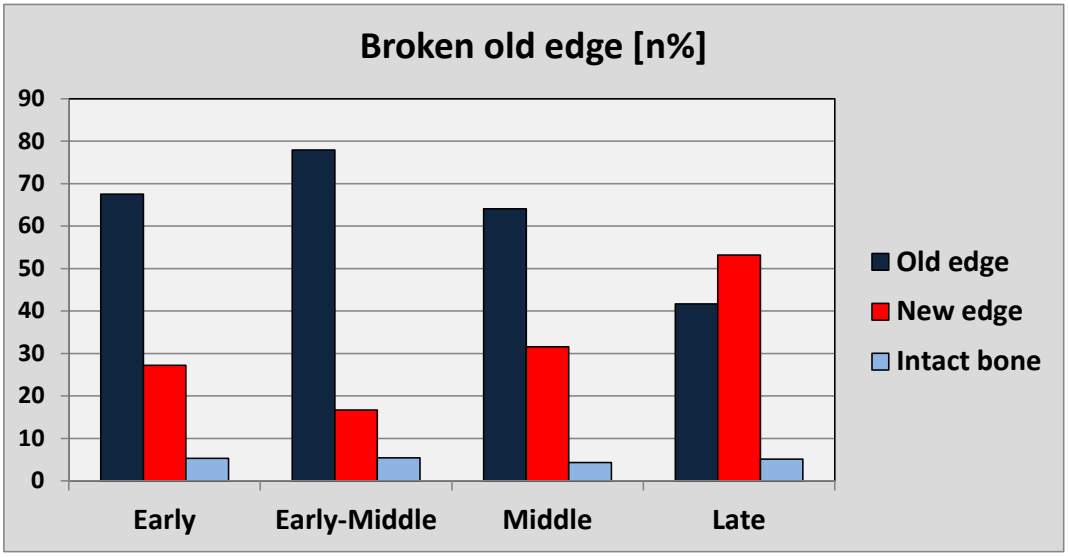


Fig. 3.1.30. The proportion of broken edge conditions of bone fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

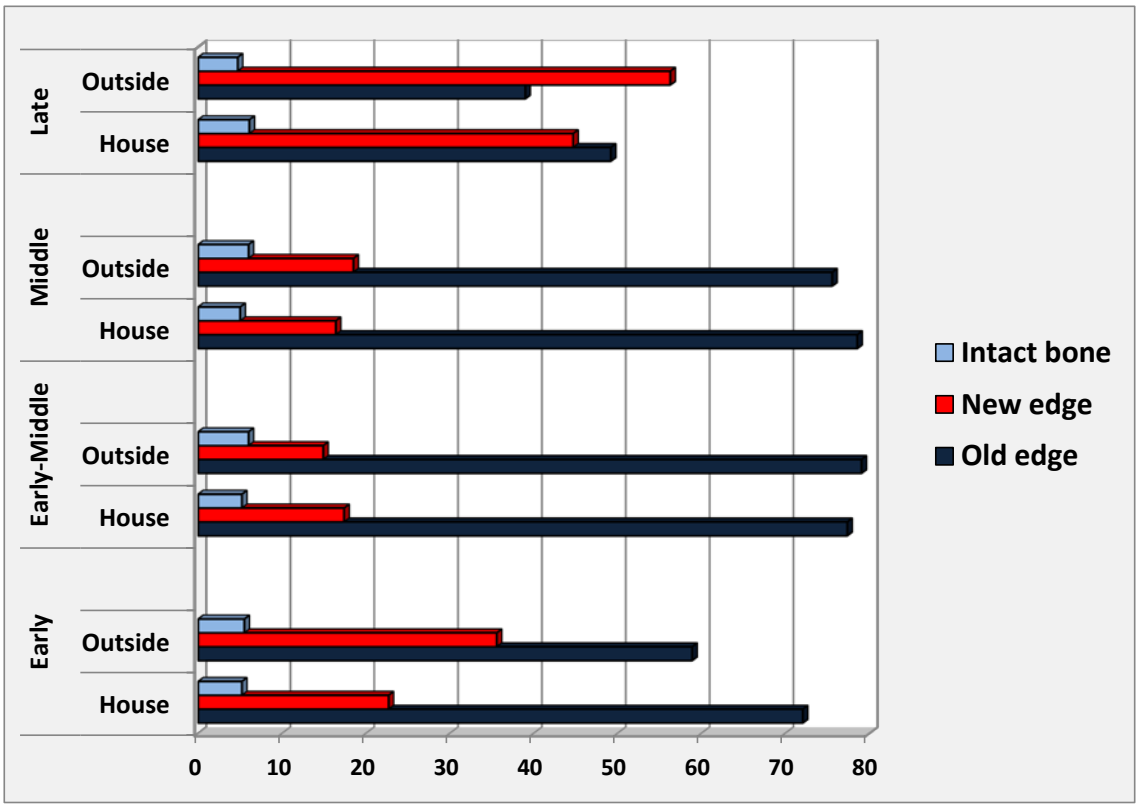


Fig. 3.1.31. The proportion of broken edge conditions of bone fragments that were excavated from inside and outside of the houses in the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

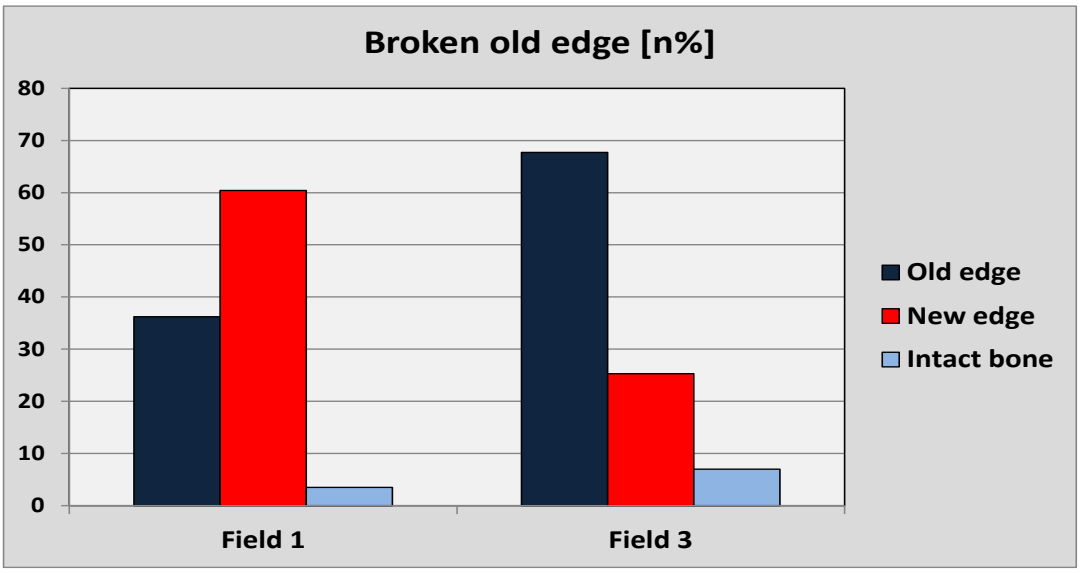


Fig. 3.1.32. The proportion of broken edge condition of bone fragments that were excavated from Field 1 and 3 in the settlement Savognin-Padnal.

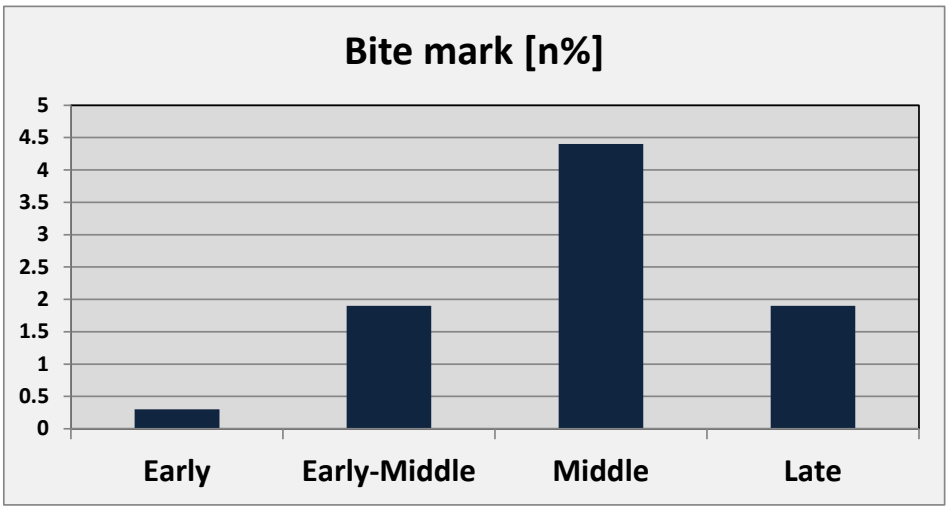


Fig. 3.1.33. Frequency of bite marks on fragments that were excavated in the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

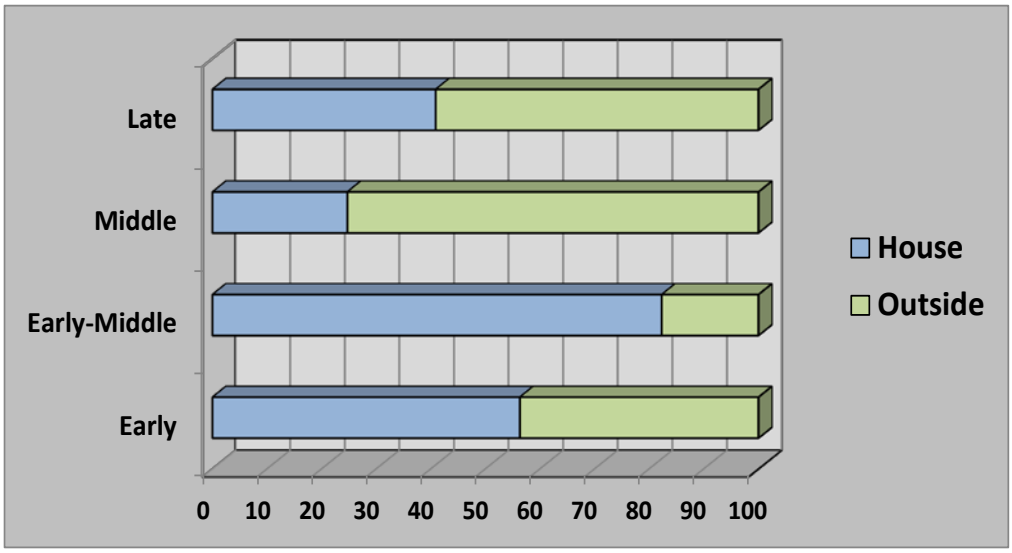


Fig. 3.1.34. Comparison of the distribution area of bite marks on bones that were excavated from inside and outside the houses in the settlement Savognin-Padnal, in each Bronze Age phase.

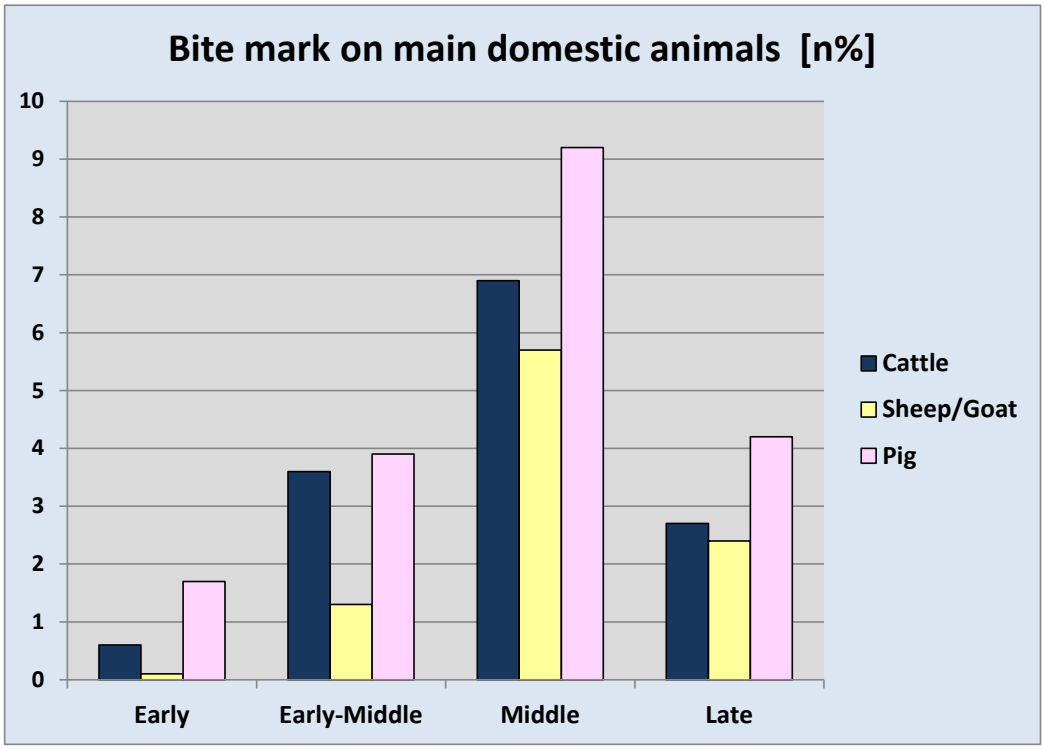


Fig. 3.1.35. Bite mark on bones of the three main domestic animals in Savognin-Padnal in each Bronze Age phase.

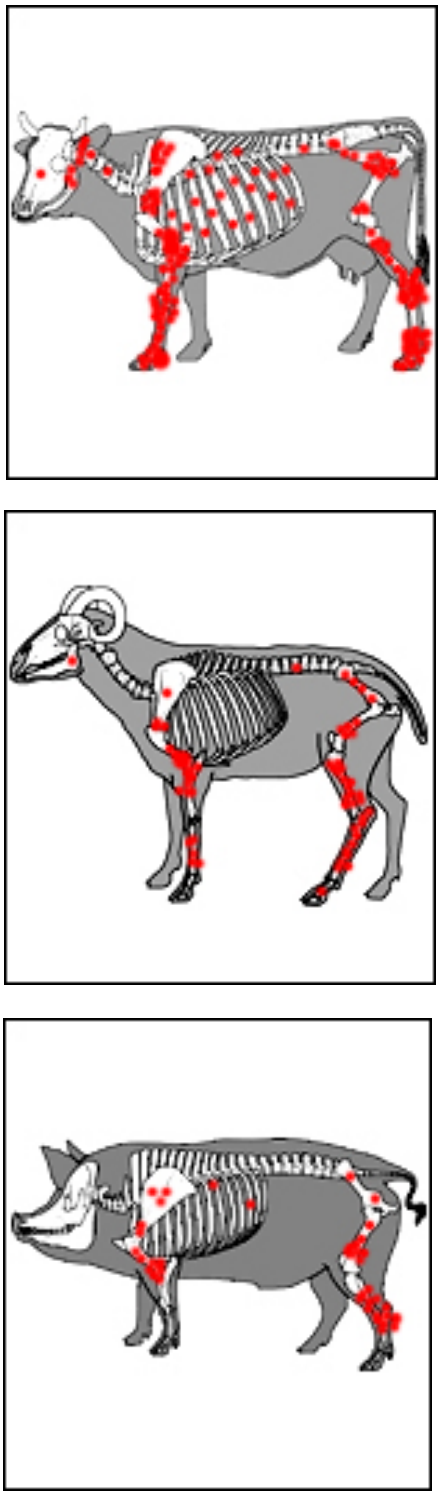


Fig. 3.1.36. Distribution of bite marks on skeletal elements of cattle, sheep/goats, and pigs in the Bronze Age.

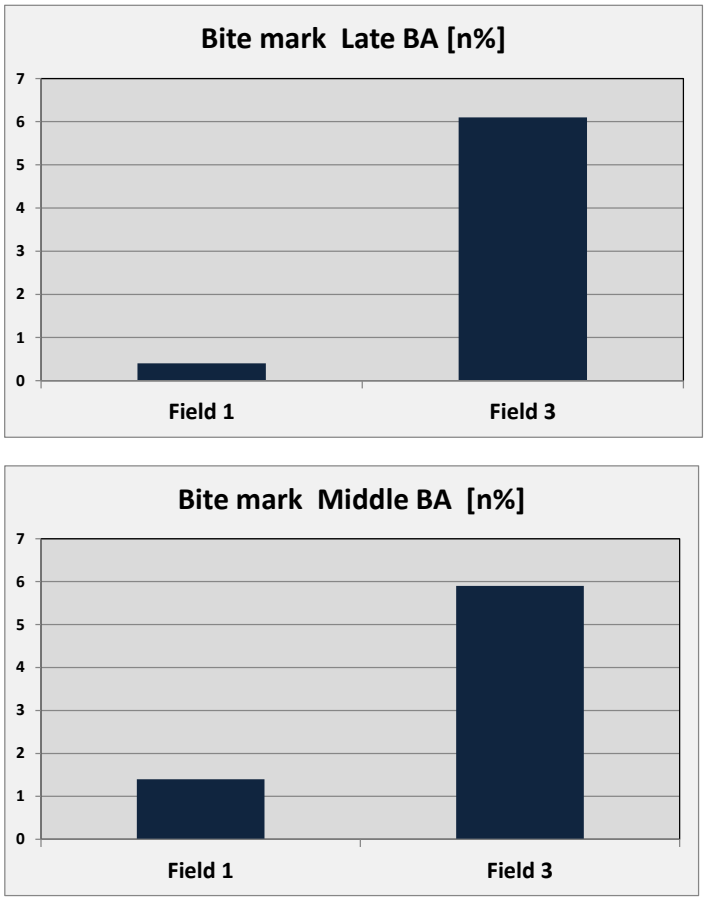


Fig. 3.1.37. The number of bite marks on fragments that were excavated from Field 1 and 3 in the Bronze Age (BA) settlement Savognin-Padnal in Switzerland in the Late and Middle BA.

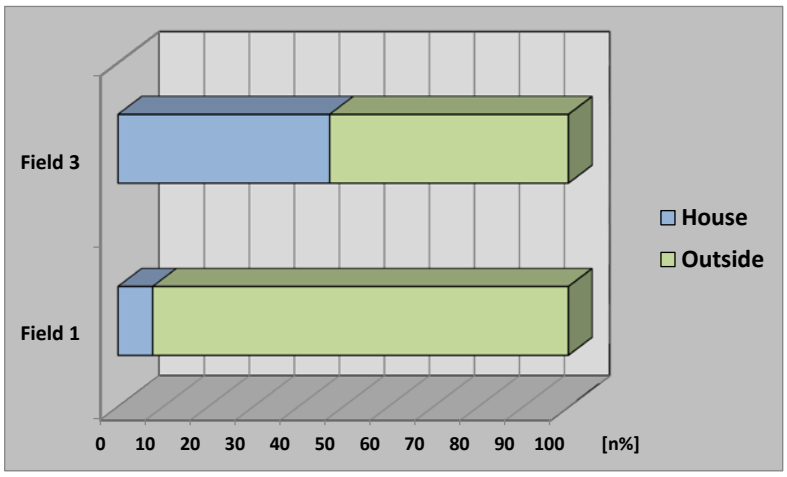


Fig. 3.1.38. Comparison of the distribution area of bite marks on bones that were excavated from inside and outside the houses in Field 1 and 3 in the settlement Savognin-Padnal.

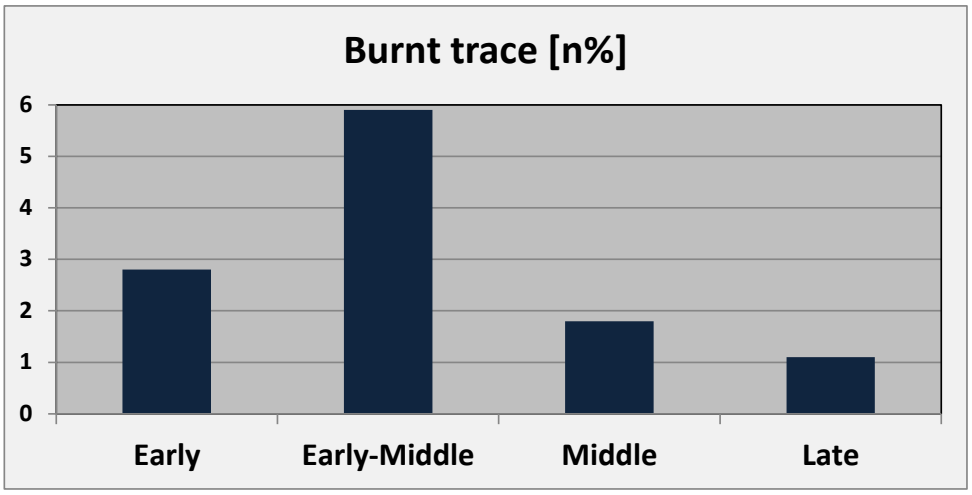


Fig. 3.1.39. The proportion of burnt bone fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

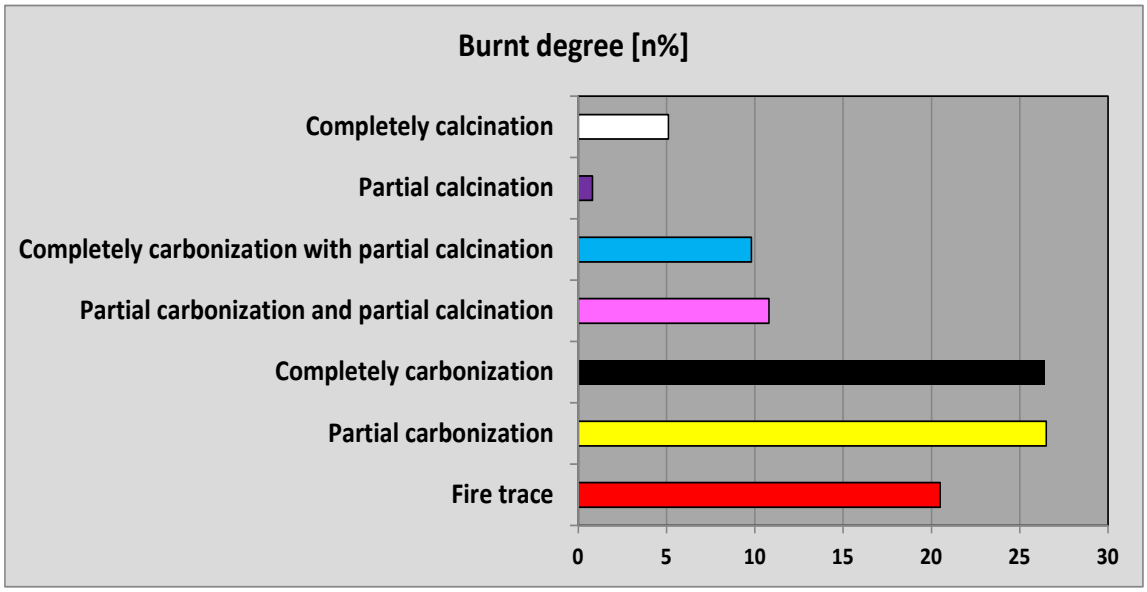


Fig. 3.1.40. The proportion of burnt degrees of bone fragments that were excavated from the Bronze Age settlement Savognin-Padnal.

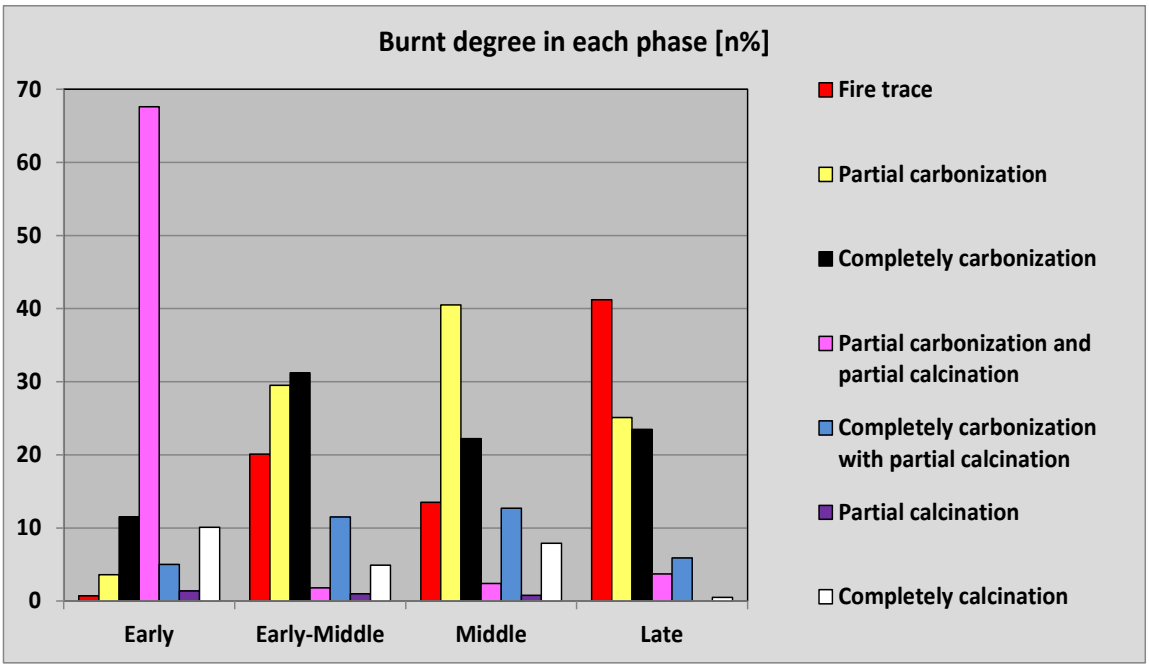


Fig. 3.1.41. The proportion of burnt degrees of bone fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

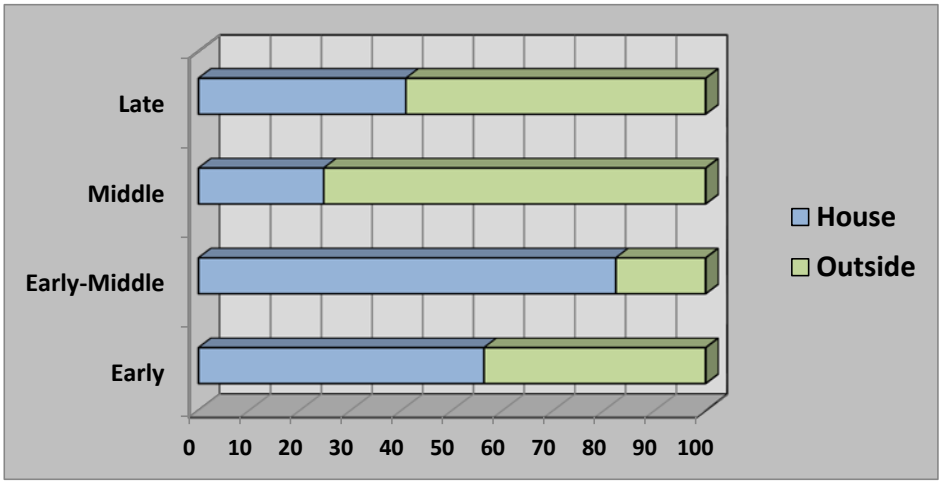


Fig. 3.1.42. The proportion of burnt bone fragments that were collected from inside and outside the houses from the settlement Savognin-Padnal in each Bronze Age phase.

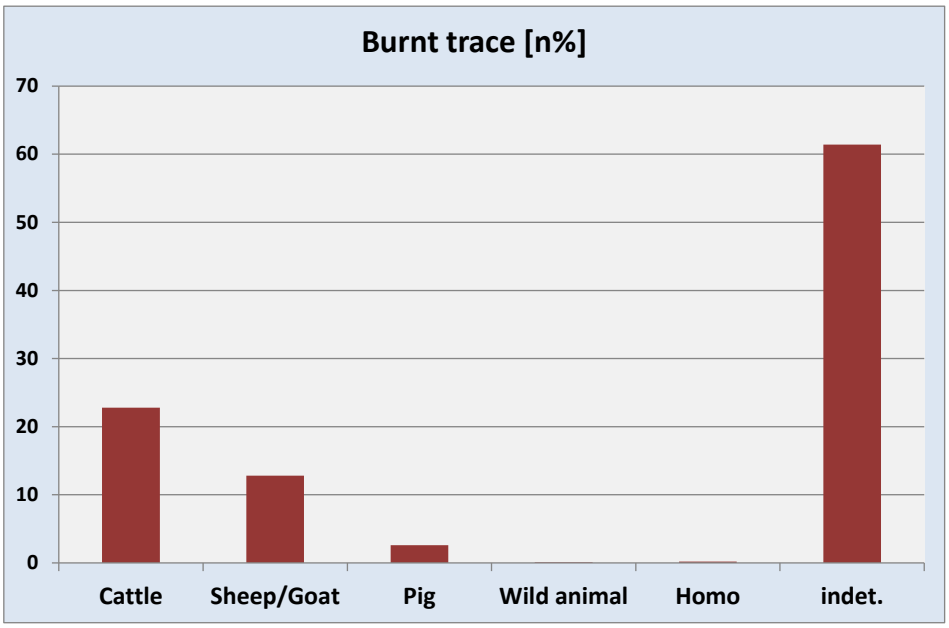


Fig. 3.1.43. The proportion of burnt animal bone fragments that were excavated from the Bronze Age settlement Savognin-Padnal in Switzerland.

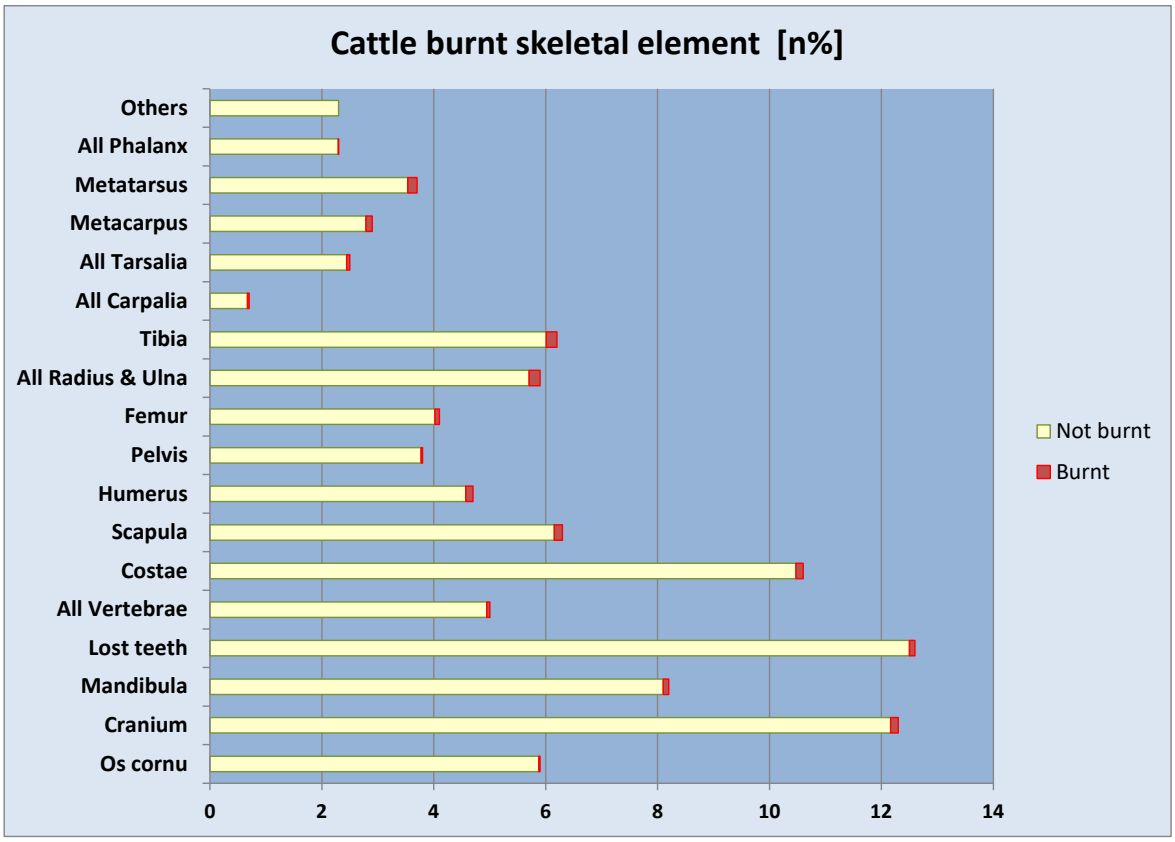
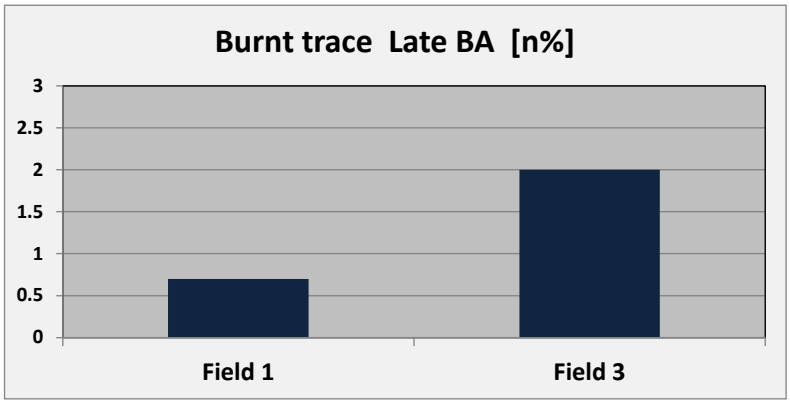


Fig. 3.1.44. The proportion of burnt cattle bone fragments that were excavated from all Bronze Age phases of the settlement Savognin-Padnal.



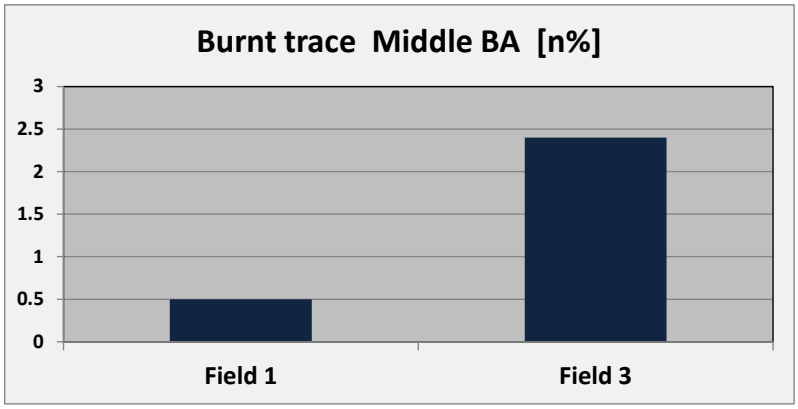
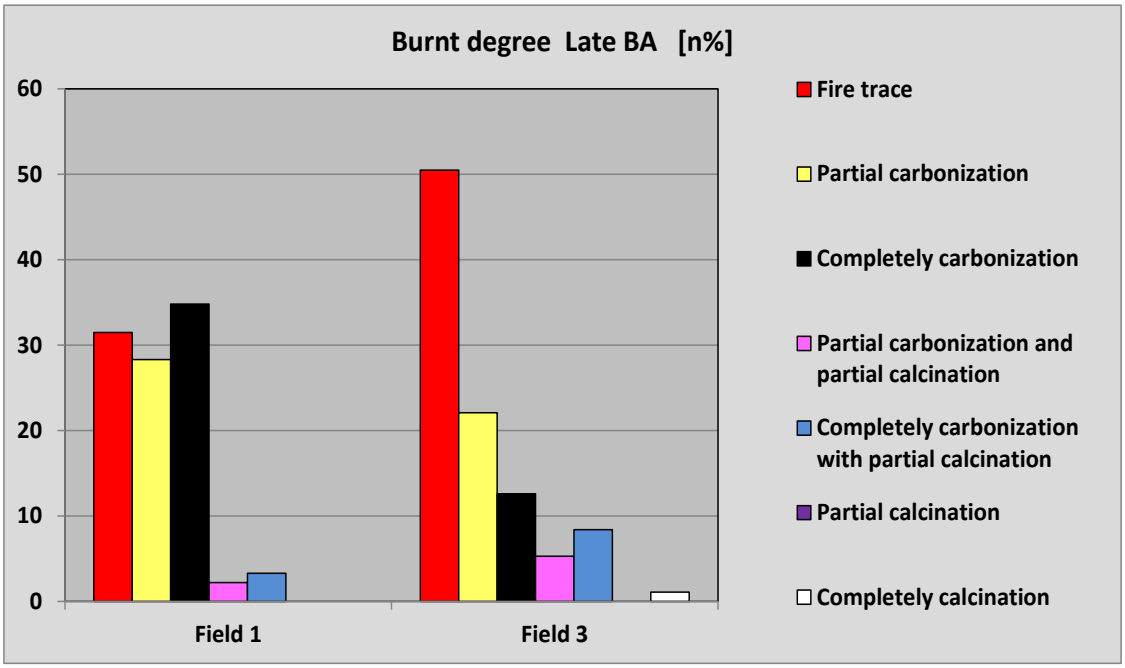


Fig. 3.1.45. The proportion of burnt bone fragments that were excavated from Field 1 and 3 in the settlement Savognin-Padnal in Switzerland, in the Middle and Late Bronze Age (BA).



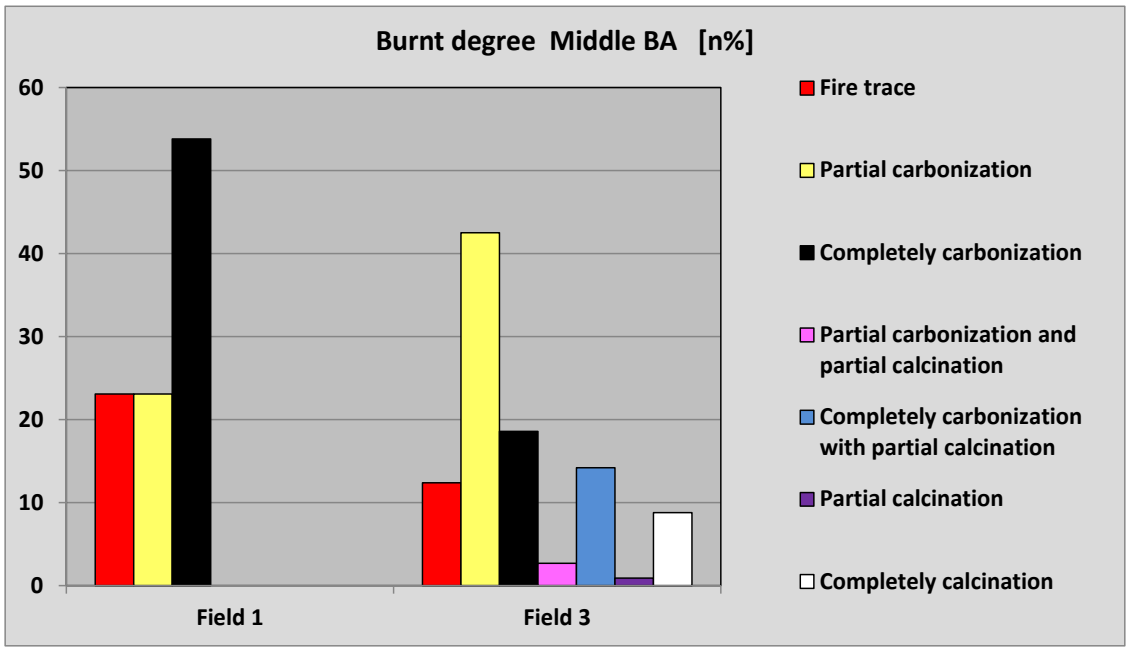


Fig. 3.1.46. The proportion of burnt degrees of bone fragments that were excavated from Field 1 and 3 in the settlement Savognin-Padnal in Switzerland, in the Middle and Late Bronze Age (BA).

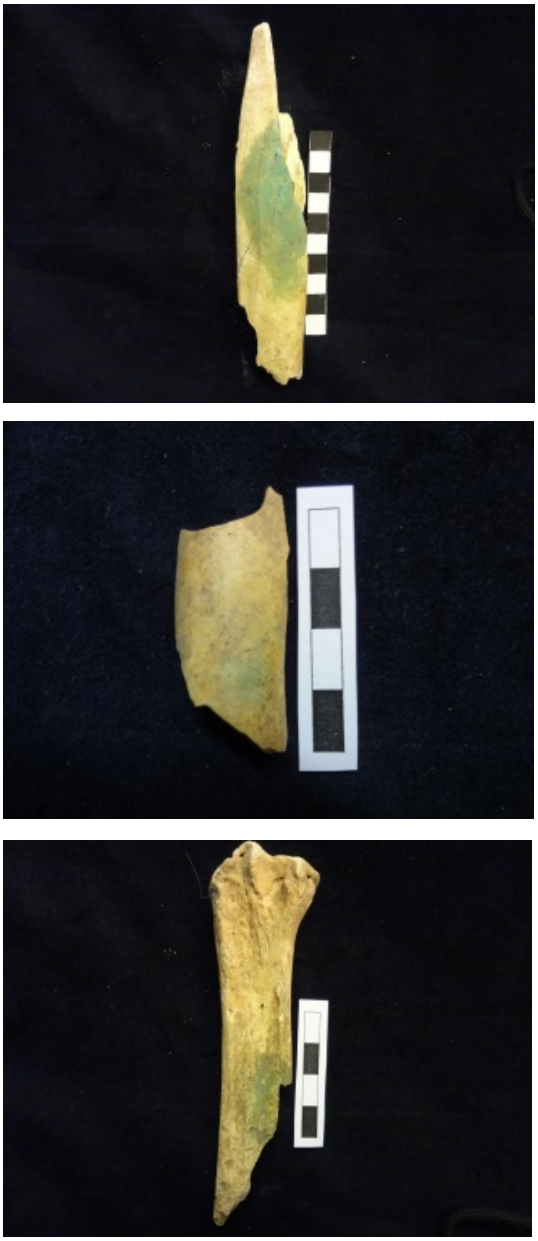


Fig. 3.1.47. Discolouration of bone fragments by bronze from “House 1” in Field 3 in the Early-Middle Bronze Age. Top; cattle Tibia, middle; sheep/goat Femur, bottom; pig Radius

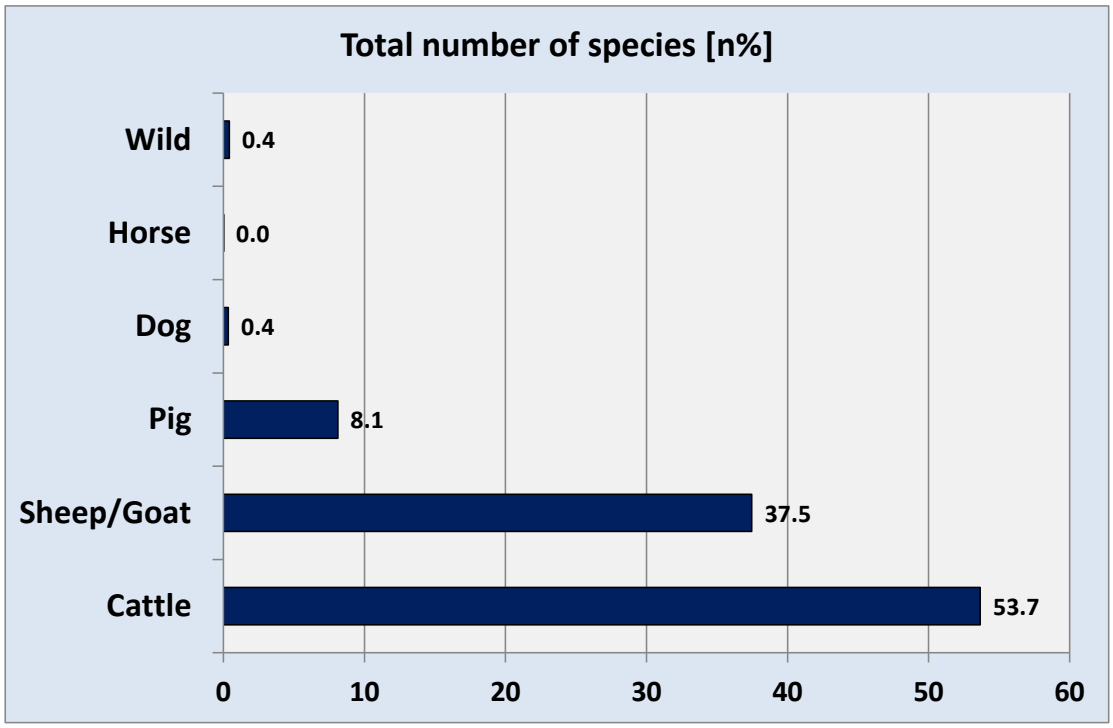


Fig. 3.2.1. The proportion of the number of identified specimens that were excavated from the Bronze Age settlement Savognin-Padnal in Switzerland.

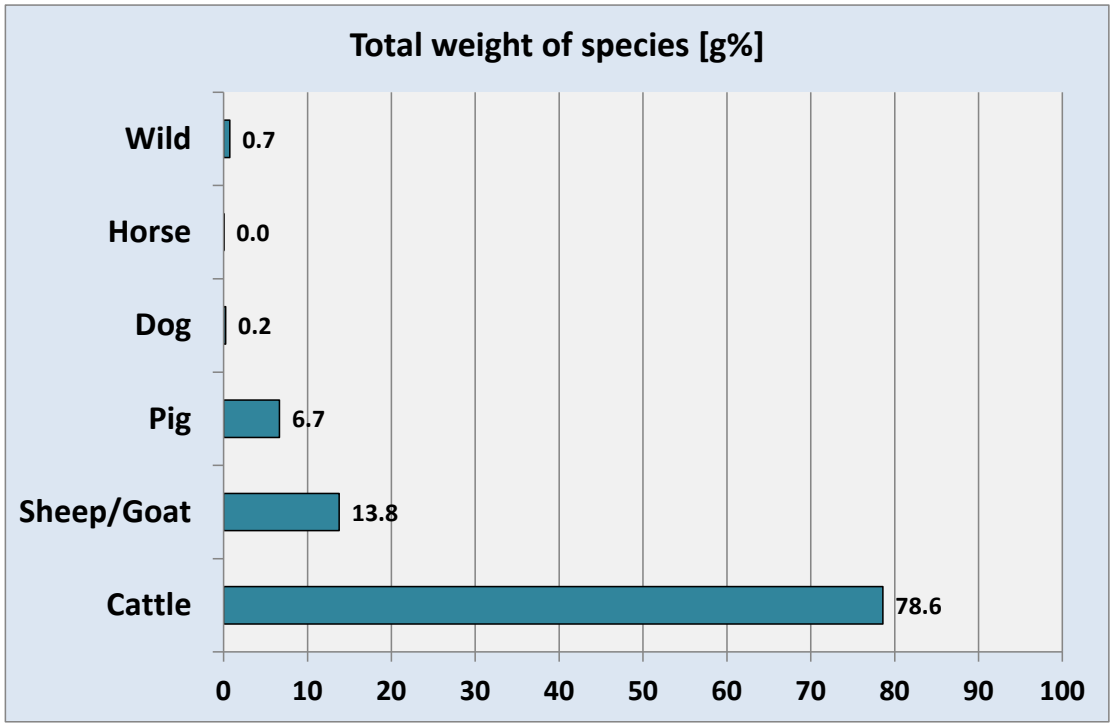


Fig. 3.2.2. The proportion of weight of identified specimens that were excavated from the Bronze Age settlement Savognin-Padnal in Switzerland.

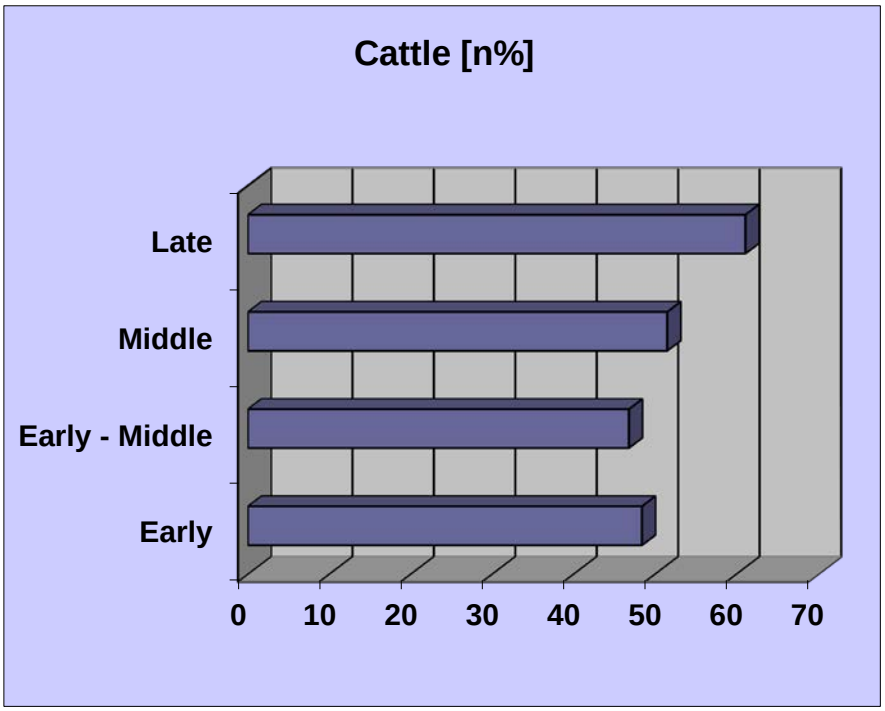


Fig. 3.2.3. The proportion of cattle based on the number of fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

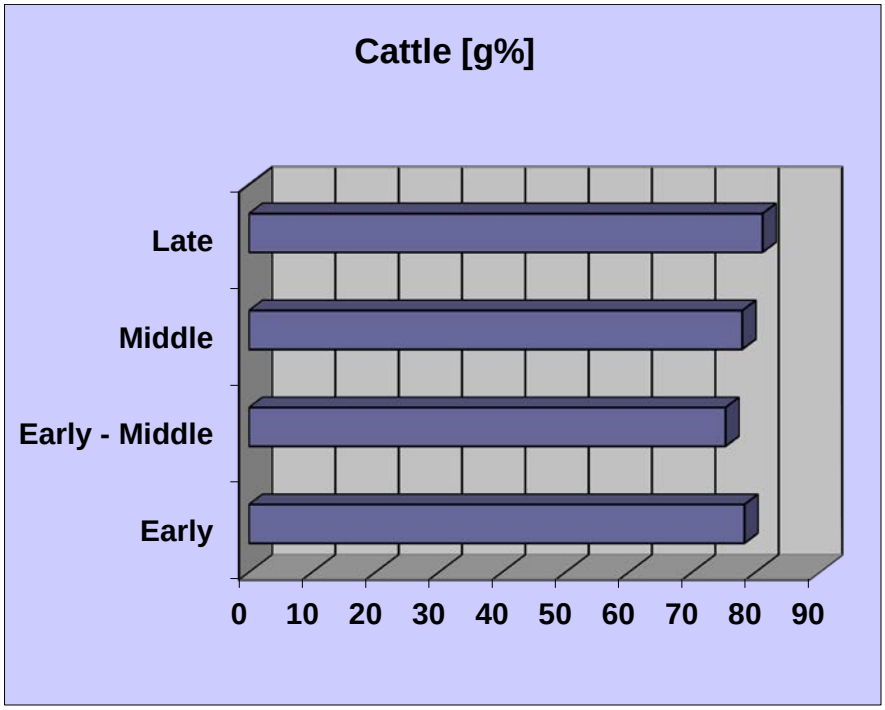


Fig. 3.2.4. The proportion of cattle based on the weight of fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase.

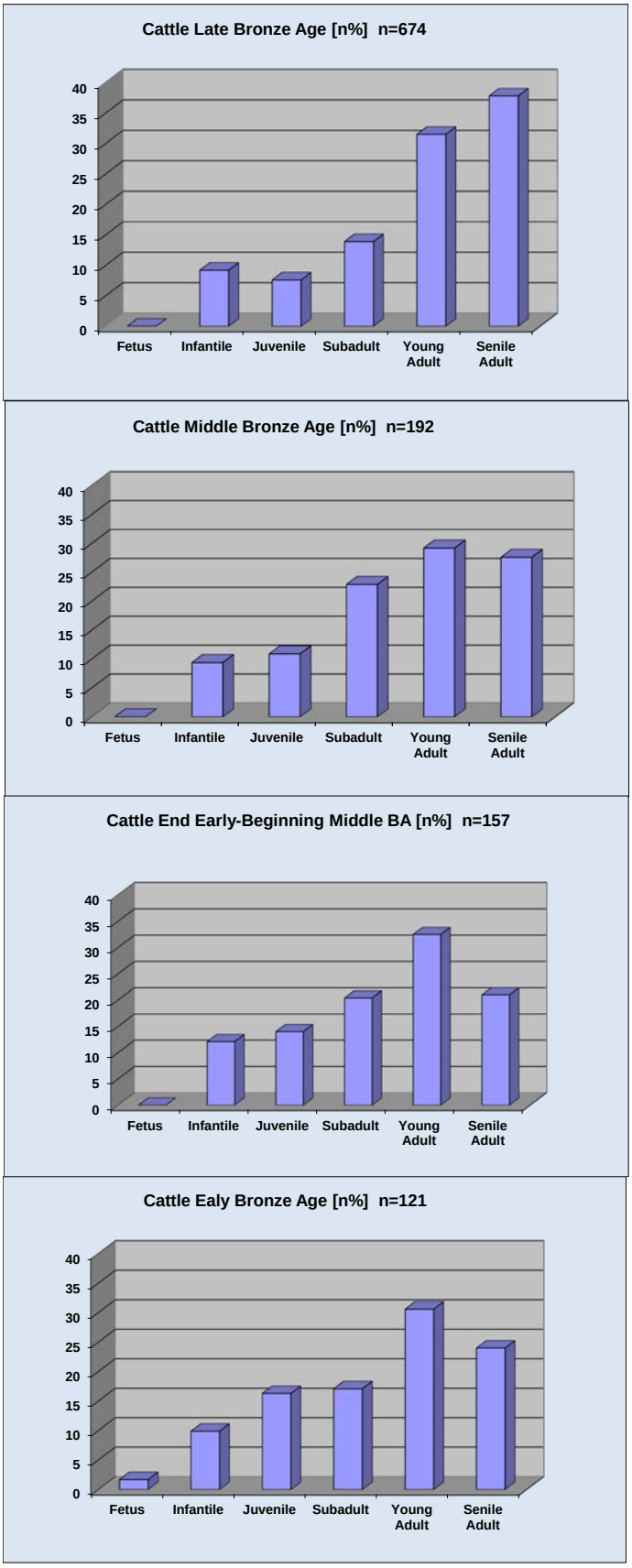


Fig. 3.2.5. Savognin-Padnal cattle mortality profile covering four Bronze Age phases based on teeth eruption and wear.

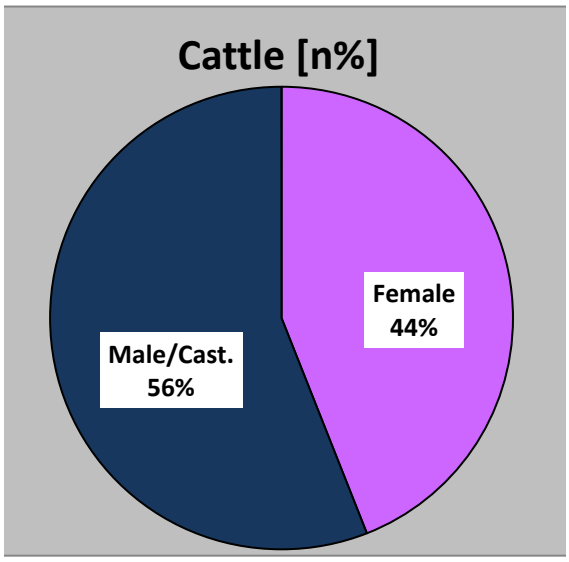


Fig. 3.2.6. Cattle sex ratio at Savognin-Padnal in the Bronze Age. Male/Cast. = male and castrated male cattle.

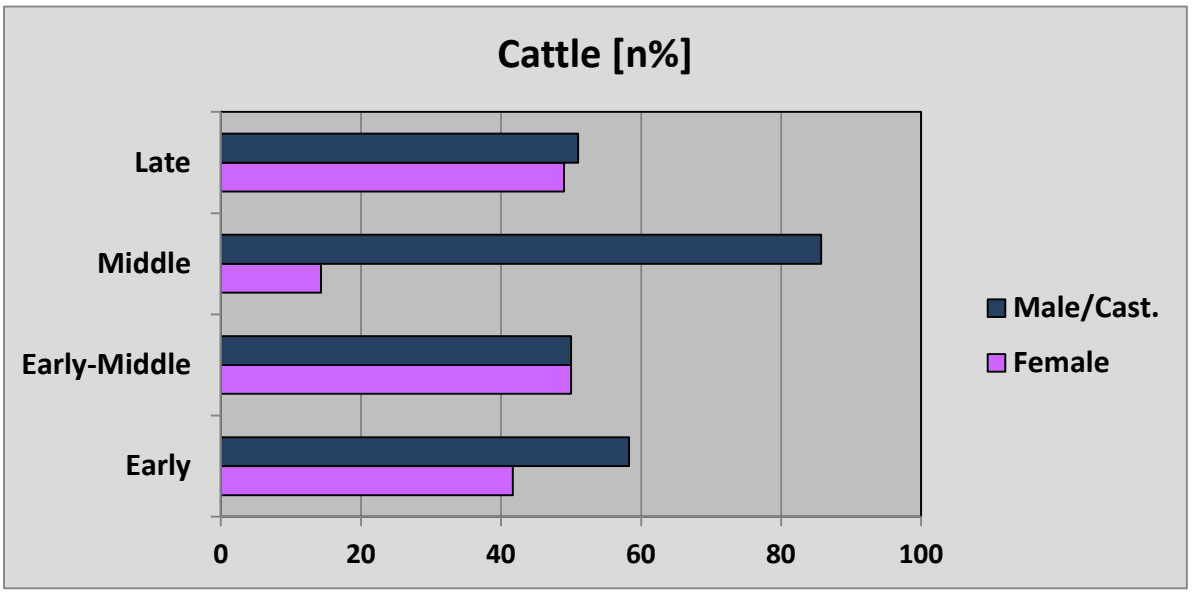


Fig. 3.2.7. The cattle sex ratio at Savognin-Padnal in each Bronze Age phase. Male/Cast. = male and castrated male cattle.

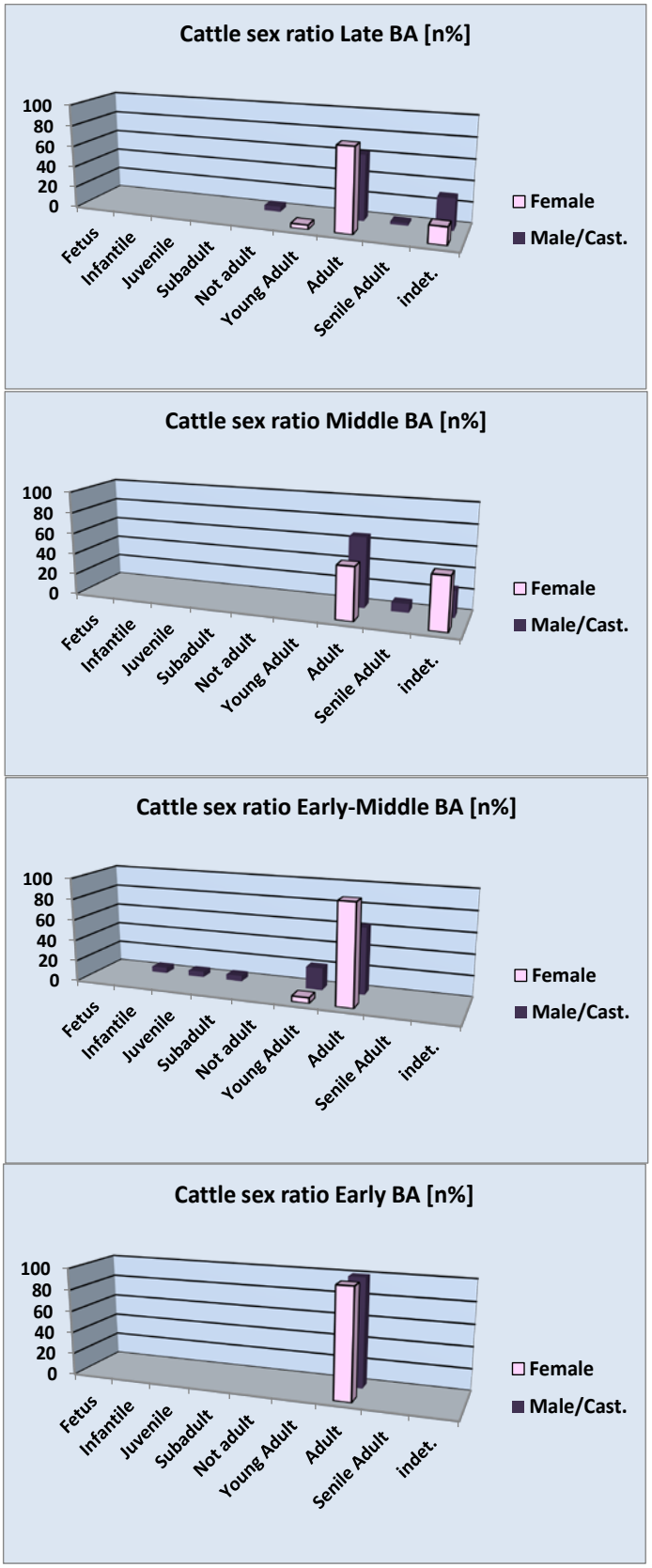
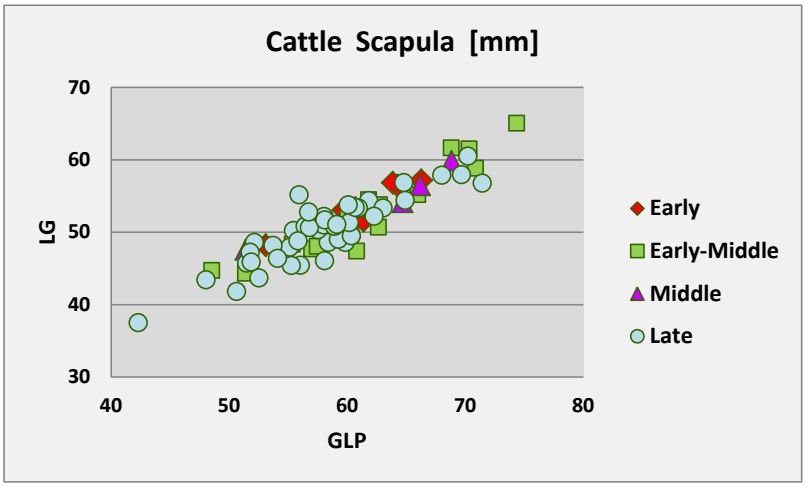
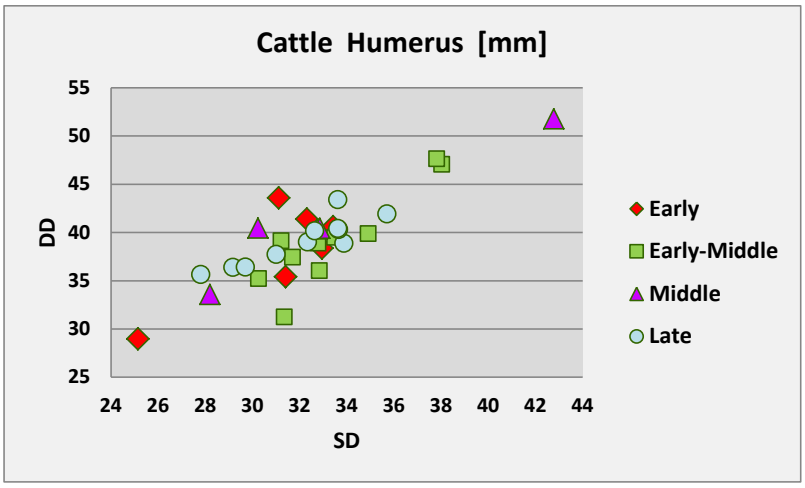


Fig. 3.2.8. The cattle sex ratio and the mortality profile at Savognin-Padnal in each Bronze Age (BA) phase. Male/Cast. = male and castrated male cattle.





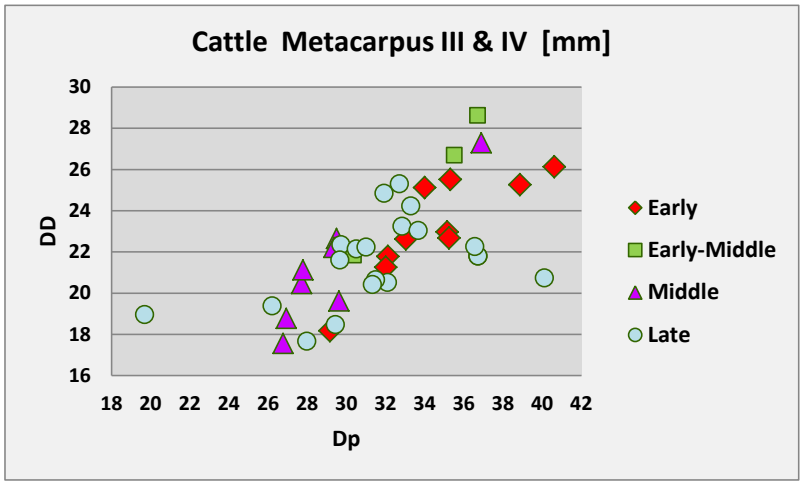


Fig. 3.2.9a. Chronological comparison of osteometric data from Savognin-Padnal cattle in each Bronze Age phase (part 1). (for details see Driesch von den, 1976). GLP = Greatest length of the Processus articulatis; LG = Length of the glenoid cavity; SD = Smallest breadth of the diaphysis; DD = Depth of the diaphysis; Dp = Depth of the proximal end (for details see von den Driesch, 1976).

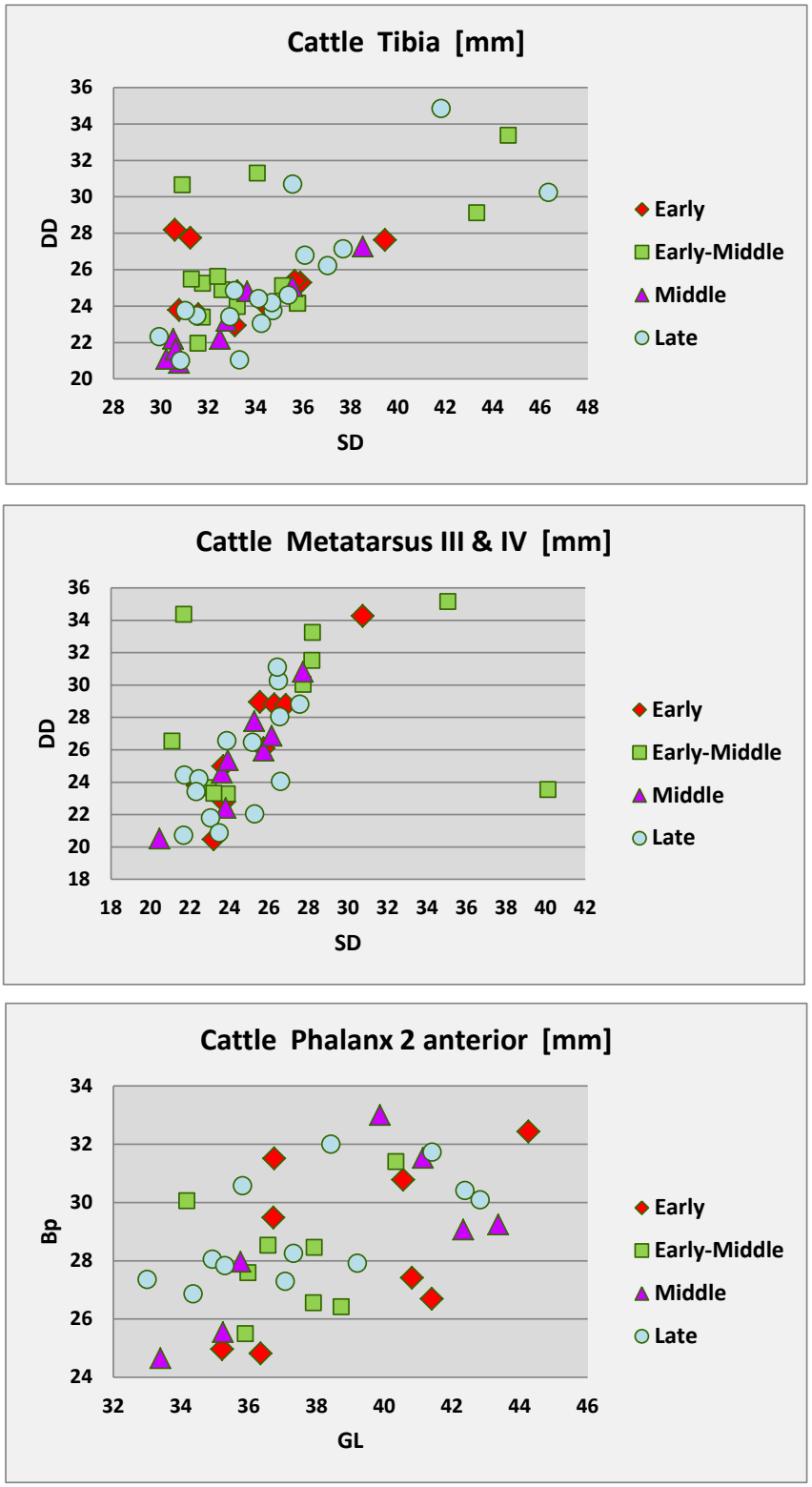
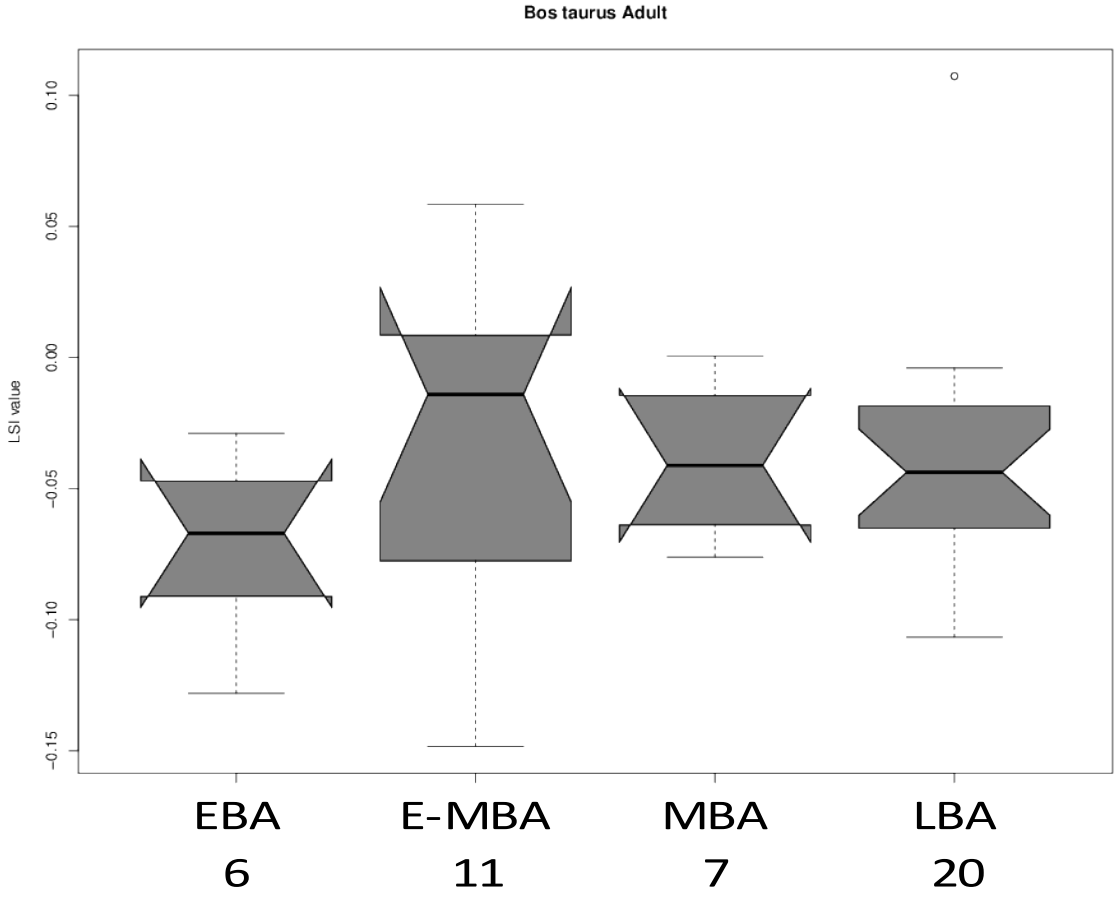


Fig. 3.2.9b. Chronological comparison of osteometric data from Savognin-Padnal cattle in each Bronze Age phase (part 2). SD = Smallest breadth of the diaphysis; DD = Depth of the diaphysis; GL = Greatest length; Bp = Breadth of the proximal end (for details see von den Driesch, 1976).

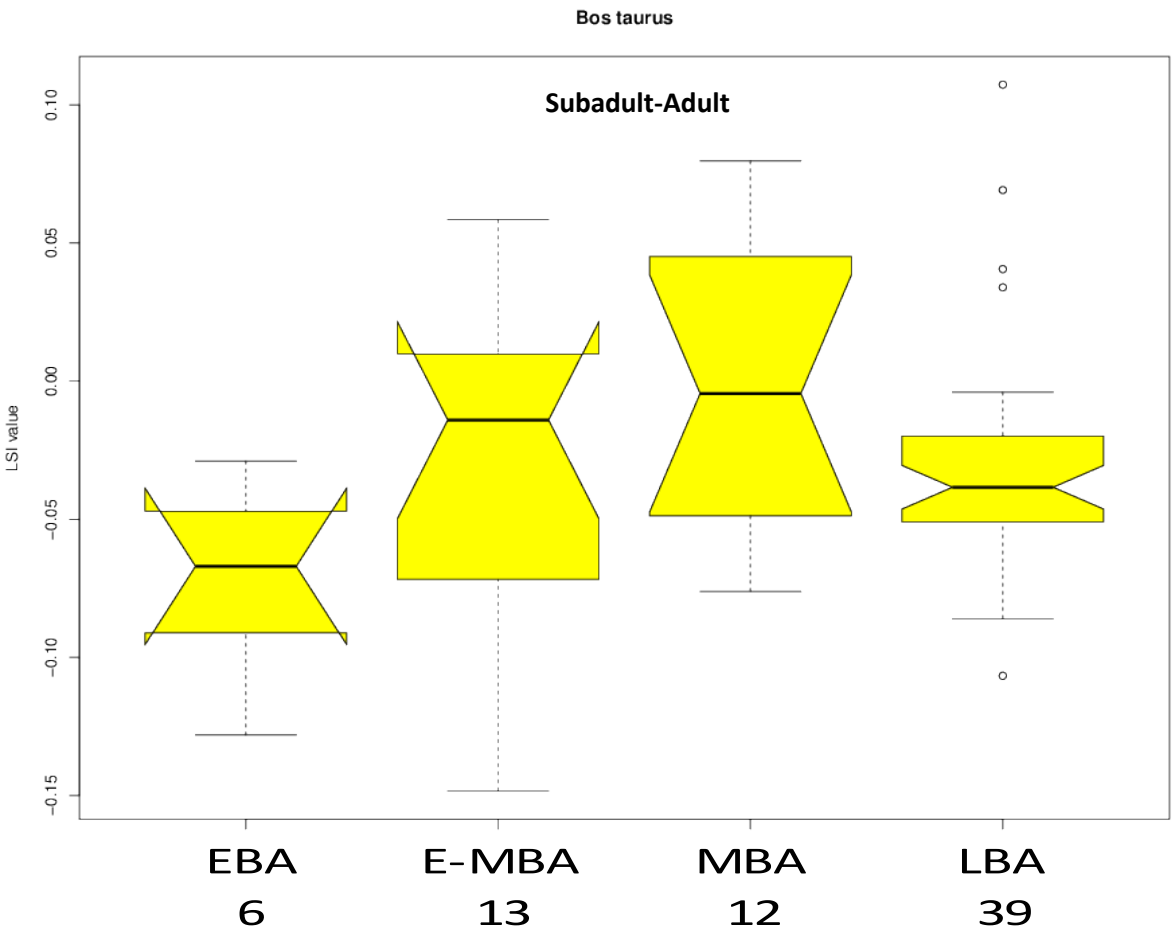


Kruskal-Wallis test for equal medians

H (chi2):	3.509
Hc (tie cor	3.509
p (same):	0.3196

There is no significant difference between sample medians

Fig. 3.2.10. Logarithmic size index (LSI) and Kruskal-Wallis tests of Adult cattle at Savognin-Padnal. Numbers indicate the sample size used to obtain LSI. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.



Kruskal-Wallis test for equal medians

H (chi2):	8.236
Hc (tie cor	8.236
p (same):	0.04138

There is a significant difference between sample medians

Mann-Whitney *U* test

	EBA	E-MBA	MBA	LBA
EBA		0.1479	**0.0169**	**0.0203**
E-MBA			0.2648	0.7513
MBA				0.0936
LBA				

Fig. 3.2.11. Logarithmic size index (LSI), Kruskal-Wallis test, and Mann-Whitney U test of subadult-adult cattle at Savognin-Padnal. Numbers indicate the sample size used to obtain LSI. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

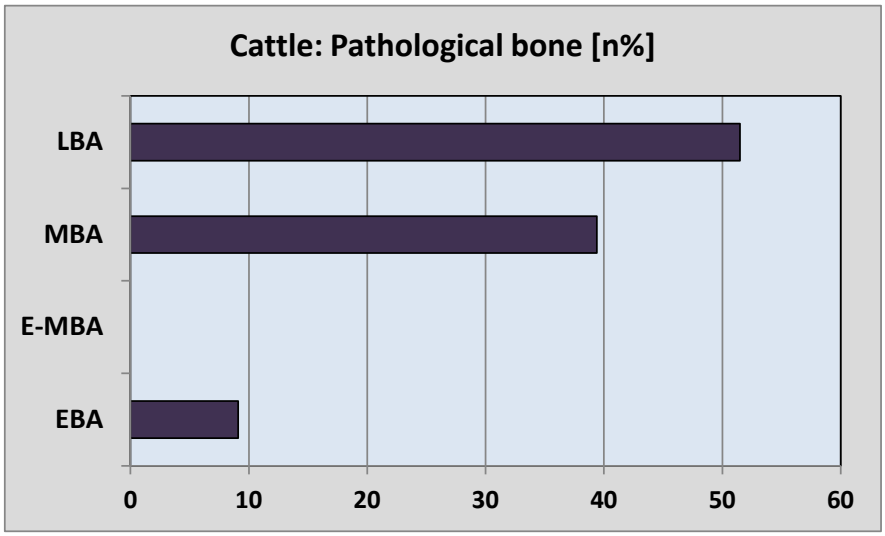


Fig. 3.2.12. Proportion of pathological cattle bones that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase (100% = total number of pathological cattle bones). EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

Phase	Zone	Species	Skeleton	Pathology	Age	Note
EBA	Field 3	Bos taurus	Radius	Arthritis	Adult	The depth of the proximal end is very pressed down. Dp = 35.00 mm, Bp = 70.21 mm Reference collection: Dp = 36.12 mm, Bp = 73.89 mm From House 1.
EBA	Field 3	Bos taurus	Phalanx 2 posterior	Anomaly hole on the distal bottom	Adult	Ca. 2 mm diameter and 5 mm depth of natural round hole. Inside is blank. No work trace for artefact. From path.
EBA	Field 3	Bos taurus	Lost lower tooth	Lipping of M2	Young adult	Lipping sharp pleats on root grew toward M3 side. From path.
MBA	Field 3	Bos taurus	Astragalus	Osteoporosis?	Adult	There is countless number of various size of deep natural holes. From house.
MBA	Field 3	Bos taurus	Pelvis	Coxarthrosis	Adult	There are various sizes of holes and shining surface on the Acetabulum. From House.
MBA	Field 3	Bos taurus	Pelvis	Coxarthrosis	Adult	There are various sizes of holes and shining surface on the Acetabulum. From house.
MBA	Field 3	Bos taurus	Pelvis	Coxarthrosis	Adult	There are various sizes of holes and shining surface on the Acetabulum. From House.
MBA	Field 3	Bos taurus	Vertebra lumbalis	Anomaly figure	Adult	There is unusual natural cavity at the Arcus of proximal side. From outside.
MBA	Field 3	Bos taurus	Phalanx 1 anterior	Exostosis	Adult	Near proximal and distal articulation on the dorsal side of the diaphysis. Very intensive friction on the proximal end. Stage 1. From outside.
MBA	Field 3	Bos taurus	Phalanx 1 anterior	Exostosis & depression	Adult	Depression near the distal end. Stage 1. From house.
MBA	Field 3	Bos taurus	Phalanx 1 anterior	Lipping	Adult	Lipping at the proximal end. Stage 1. From outside.
MBA	Field 3	Bos taurus	Phalanx 1 posterior	Lipping	Adult	Lipping at the proximal end. Stage 1. From outside.
MBA	Field 3	Bos taurus	Phalanx 2 anterior	Lipping & depression	Adult	Deformed the proximal end abnormally developed toward to the dorsal direction. There is unusual natural cavity at the distal end. Stage 1. From outside.
MBA	Field 3	Bos taurus	Phalanx 2 anterior	Lipping	Adult	Lipping at the proximal end. Stage 1. From house.
MBA	Field 3	Bos taurus	Phalanx 2 anterior	Exostosis & depression	Adult	Strong depression at the diaphysis near the distal end. Stage 1. From outside.
MBA	Field 3	Bos taurus	Lost lower tooth	Periodontitis of M3	Very senile adult	Enamel and cement are completely disappeared. The base for crown is as if melted down. From house.
LBA	Field 3	Bos taurus	Pelvis	Coxarthrosis	indet.	Shining surface on the Acetabulum. From Path 2.
LBA	Field 3	Bos taurus	Pelvis	Coxarthrosis & exostosis	Adult	Shining surface on the Acetabulum. Bone multiplication. Stage 3. From House 2.
LBA	Field 3	Bos taurus	Lost above tooth	Anomaly figure of M1	Subadult	Whole crown is extremely deformed to the crescent-shaped figure. From Path 2.
LBA	Field 3	Bos taurus	Phalanx 1 anterior	Depression	Adult	Stage 2. House 2.
LBA	Field 3	Bos taurus	Phalanx 1 anterior	Depression	Adult	Stage 1. House 3.
LBA	Field 3	Bos taurus	Phalanx 2 anterior	Exostosis	Adult	Stage 1. Path 2 (between House 2 & 3).
LBA	Field 1	Bos taurus	Lost above tooth	Anomaly of M1 root	Senile adult	The root is pressed toward to behind by P4.
LBA	Field 1	Bos taurus	Lost lower tooth	Anomaly figure of M3	Very senile adult	Tooth figure is deformed like melted. Additionally influenced by bad preservation. L = 35.03 mm, B = 17.06 mm.
LBA	Field 1	Bos taurus	Radius	Arthritis	Adult	The depth of the proximal end is very pressed down. Dp = 27.82 mm, Bp = 83.34 mm. (Reference collection Dp = 36.12 mm, Bp = 73.89 mm).
LBA	Field 1	Bos taurus	Meta-carpus	Proximal is pressed down	Adult	The depth of the proximal end is very pressed down. Dp = 17.96 mm. (Reference collection Dp = 31 mm).
LBA	Field 1	Bos taurus	Costa	Fraction & bone multiplication	indet.	The middle of Costa is fractured and multiplicated to the double size with a lot of fine Spongioza.
LBA	Field 1	Bos taurus	Costa	Fraction & bone multiplication	indet.	The middle of Costa is fractured and multiplicated to the double size with a lot of fine Spongioza.
LBA	Field 1	Bos taurus	Phalanx 1 anterior	Depression	Adult	Stage 1. Outside.
LBA	Field 1	Bos taurus	Phalanx 1 posterior	Depression	Adult	Stage 1. Outside.
LBA	Field 1	Bos taurus	Phalanx 2 anterior	Exostosis	Adult	Stage 1. Outside.
LBA	Field 1	Bos taurus	Phalanx 2 anterior	Exostosis	Adult	Stage 2. Outside.
LBA	Field 1	Bos taurus	Phalanx 3 ant/post	Flat in front	Adult	The toe is very flat.

Fig. 3.2.13. Pathological symptoms of cattle remains from the settlement Savognin-Padnal in Switzerland, in the Bronze Age. EBA = Early Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

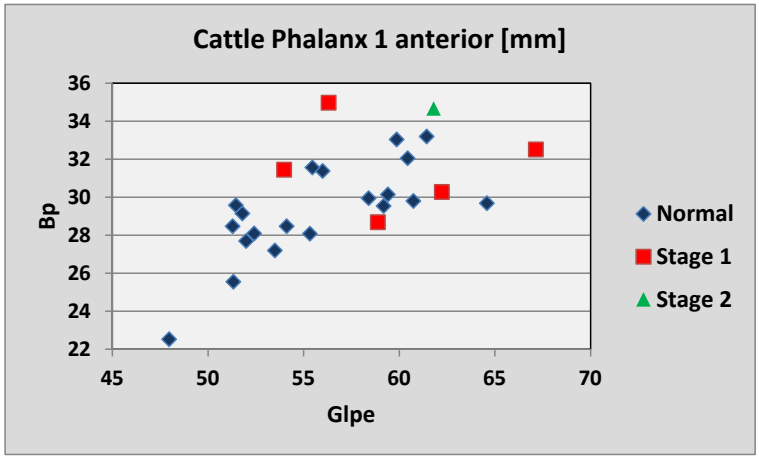


Fig. 3.2.14. Size comparison between normal and pathological Phalanx 1 anterior of cattle from overall materials excavated from the settlement Savognin-Padnal. Glpe = Greatest length of the peripheral half; Bp = Breadth of the proximal end (for details see von den Driesch, 1976).

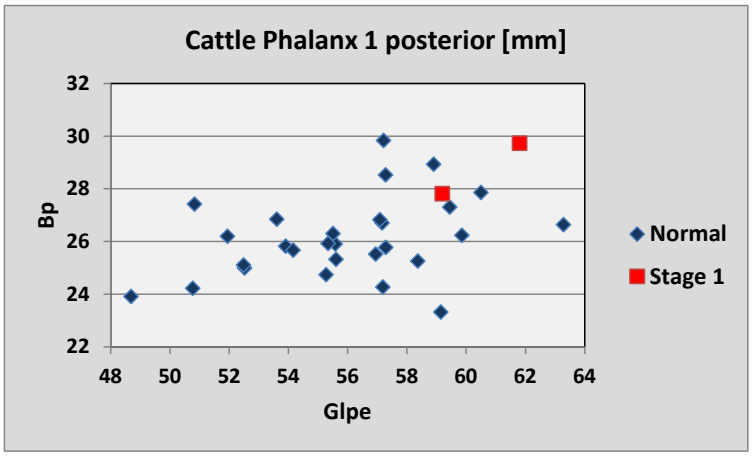


Fig. 3.2.15. Size comparison between normal and pathological Phalanx 1 posterior of cattle from overall materials in Savognin-Padnal. Glpe = Greatest length of the peripheral half; Bp = Breadth of the proximal end (for details see von den Driesch, 1976).

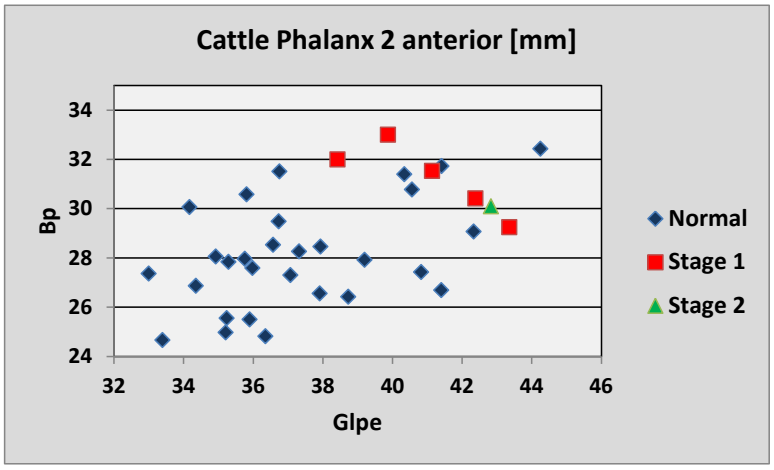


Fig. 3.2.16. Size comparison between normal and pathological Phalanx 2 anterior of cattle from overall materials that were excavated from the settlement Savognin-Padnal. Glpe = Greatest length of the peripheral half; Bp = Breadth of the proximal end (for details see von den Driesch, 1976).

Fig. 3.2.17. Right: cattle Phalnx 1, anterior, left lateral toe. Stage 1 of exostosis. Extension of the articulation on the dorsal side of the diaphysis near the proximal and distal end (Field 3, Middle Bronze Age). Left: reference collection Z-2431 (IPAS).

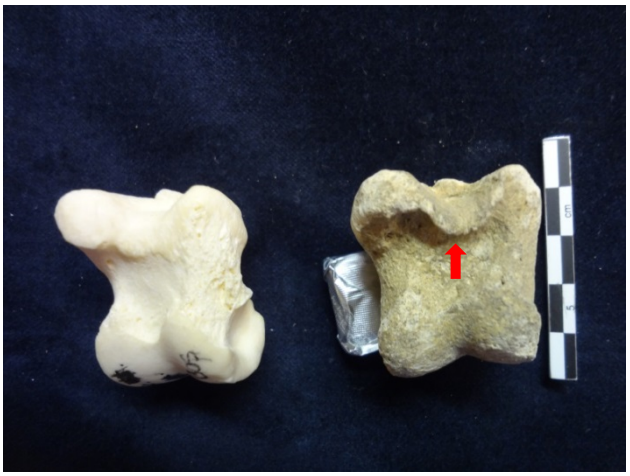


Fig. 3.2.18. Right: cattle Phalnx 2, anterior, right toe. Stage 1 of exostosis and depression near the proximal end (Field 3, Middle Bronze Age). Left: reference collection Z-2431 (IPAS).

Fig. 3.2.19. Cattle upper tooth, right Molar 1, anomaly root and crown (Field 1, Late Bronze Age).

Fig. 3.2.20. Above: cattle lower tooth, right Molar 3, anomaly root and modified occlusal surface (Field 1, Late Bronze Age). Below: reference collection Z-2431 (IPAS).

Fig. 3.2.21. Cattle Radius left, proximal end. Arthritis and very thin epiphysis (Field 3, Early Bronze Age).

Fig. 3.2.22. Right: cattle Pelvis, right. Stage 3 of cox arthritis and exostosis (Field 3, Late Bronze Age). Left: Reference collection Z-2431 (IPAS).

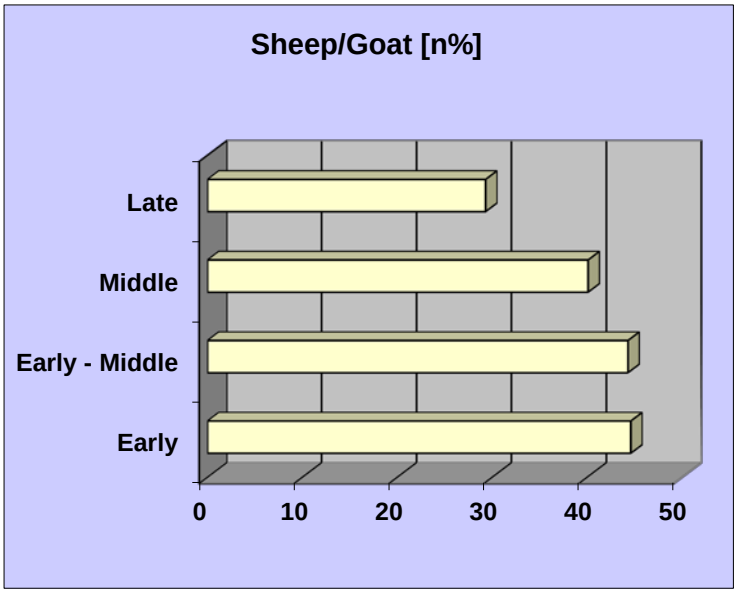


Fig. 3.2.23. The proportion of sheep/goat based on the number of fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. Sheep/Goat = sheep, goats, and sheep or goats.

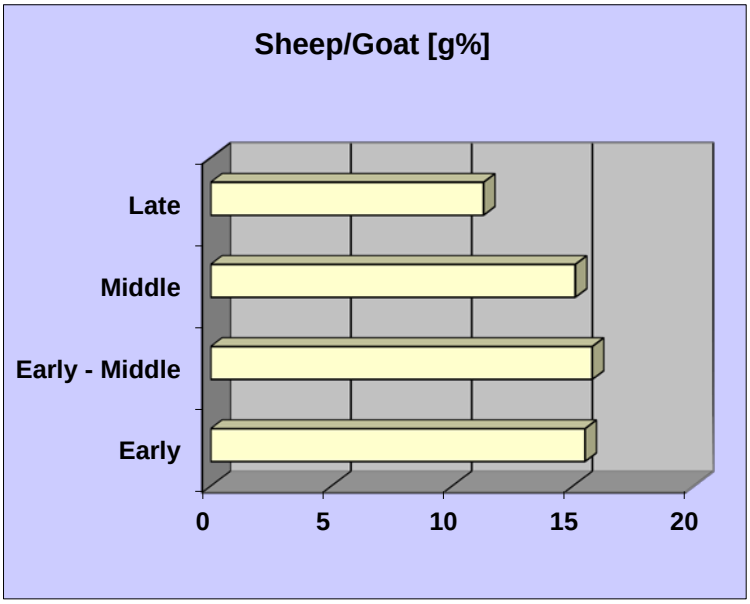


Fig. 3.2.24. The proportion of sheep/goat based on the weight of fragments that were excavated from the settlement Savognin-Padnal, in each Bronze Age phase. Sheep/Goat = sheep. goats, and sheep or goats.

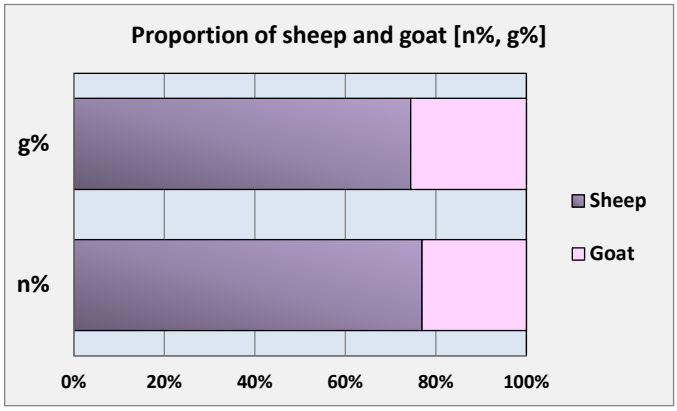


Fig. 3.2.25. The proportion of sheep and goats based on number of identified fragments and weights from the settlement Savognin-Padnal.

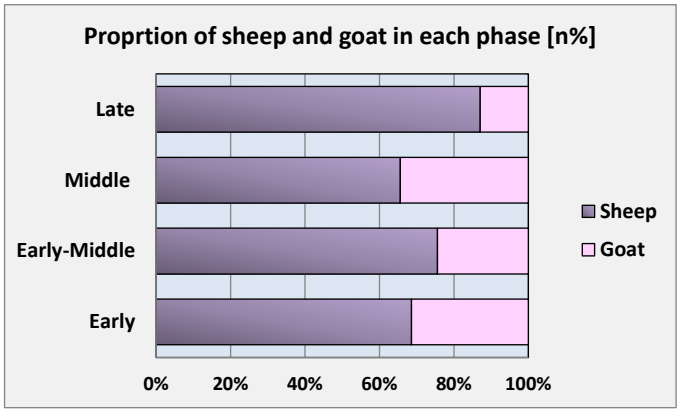


Fig. 3.2.26. The proportion of sheep and goats based on number of identified fragments that were excavated from the settlement Savognin-Padnal, in each Bronze Age phase.

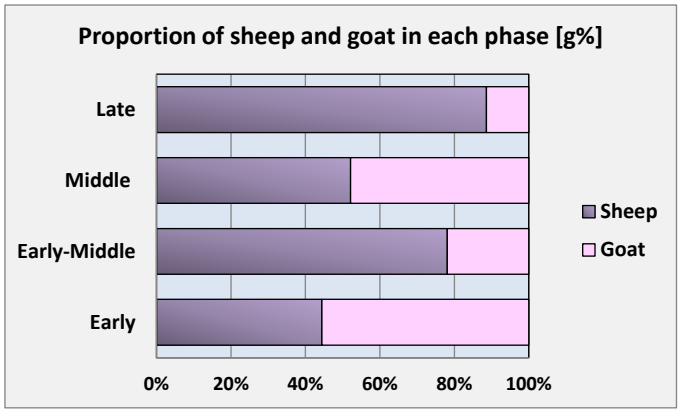


Fig. 3.2.27. The proportion of sheep and goats based on their weights from fragments that were excavated from the settlement Savognin-Padnal, in each Bronze Age phase.

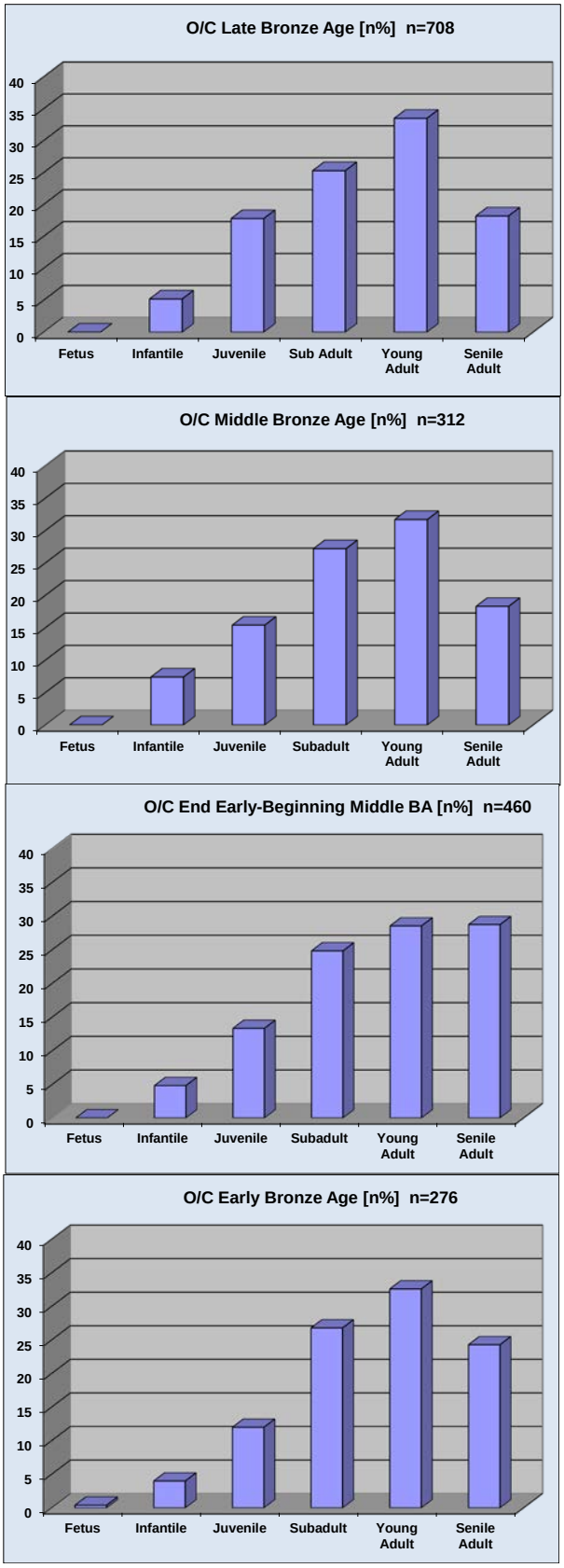


Fig. 3.2.28. Sheep and goats mortality profile based on teeth eruption and wear from fragments that were excavated from the settlement Savognin-Padnal, in each Bronze Age (BA) phase. O/C = Ovis/Capra (sheep, goats, and sheep or goats).

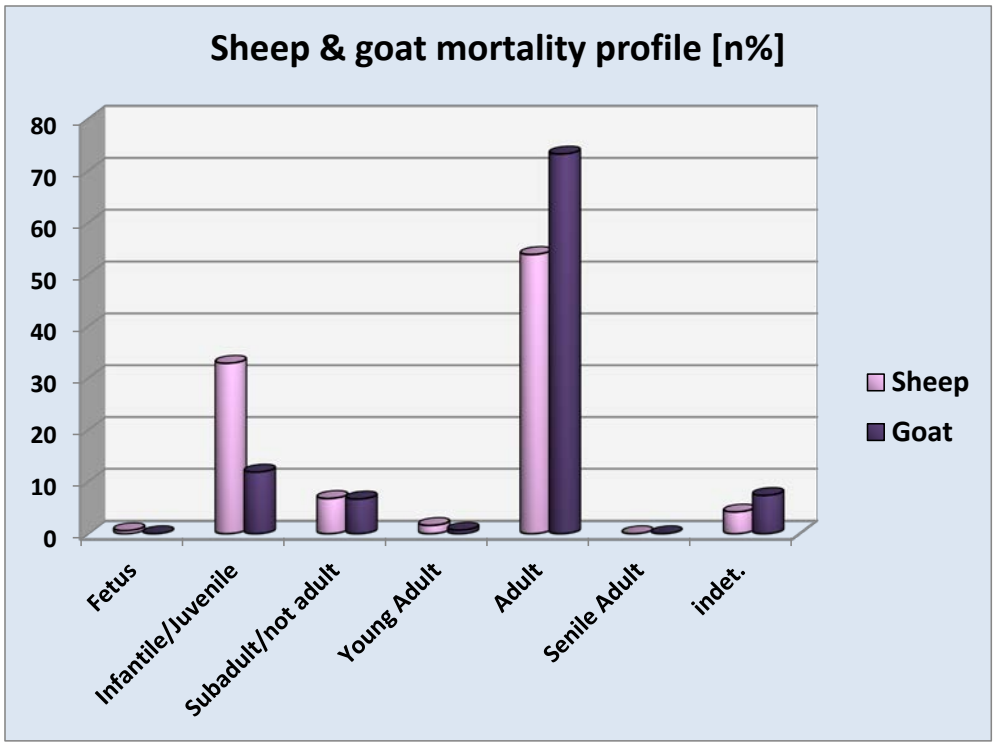


Fig. 3.2.29. Sheep and goat mortality profile based on teeth eruption and wear and fusion of epiphyses from fragments that were excavated from the settlement Savognin-Padnal, in the Bronze Age.

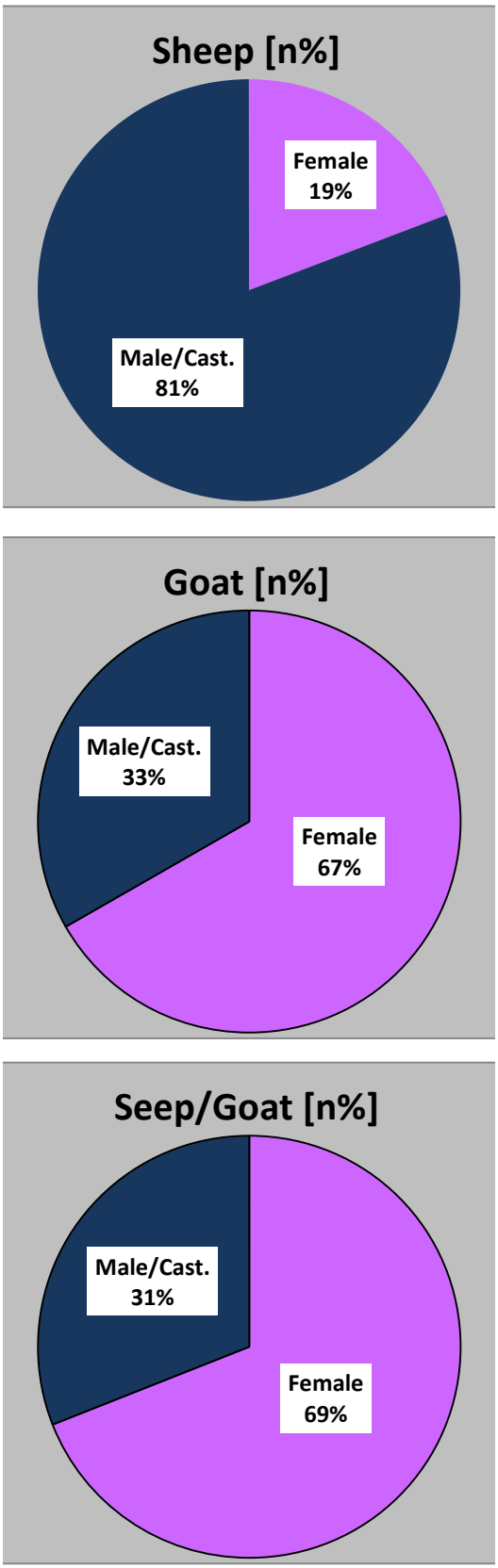


Fig. 3.2.30. The sex ratio of sheep (above), goat (middle), and all sheep/goat (below) in Savognin-Padnal. All Sheep/goat = sheep, goats, and sheep or goats; Male/Cast. = male and castrated male sheep and goats.

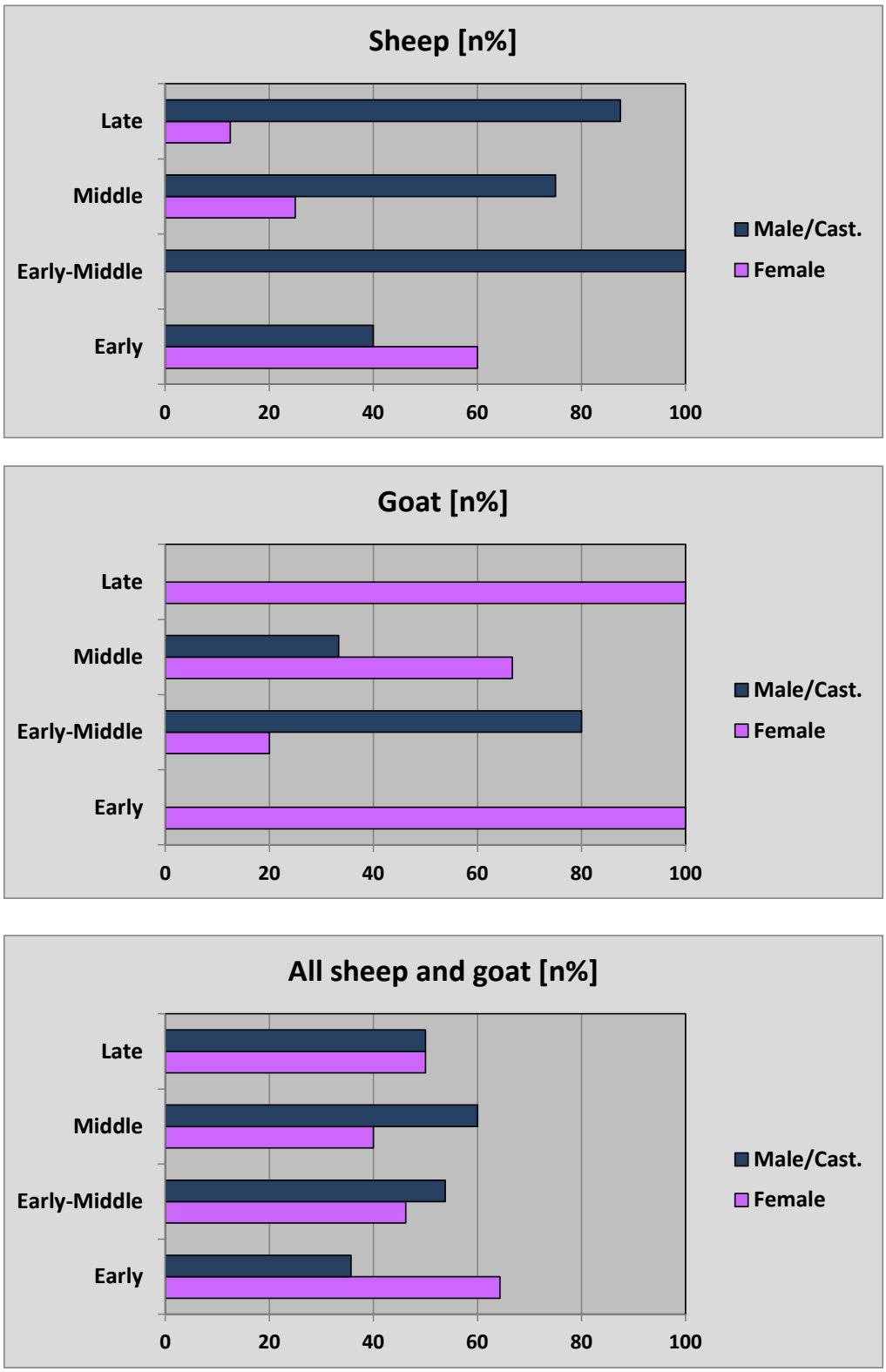


Fig. 3.2.31. The sex ratio of sheep/goat in Savognin-Padnal in each Bronze Age phase: sheep (above), goat (middle), all sheep/goat (below). Male/Cast. = male and castrated male sheep and goats. All sheep/goat = sheep, goats, and sheep or goats.

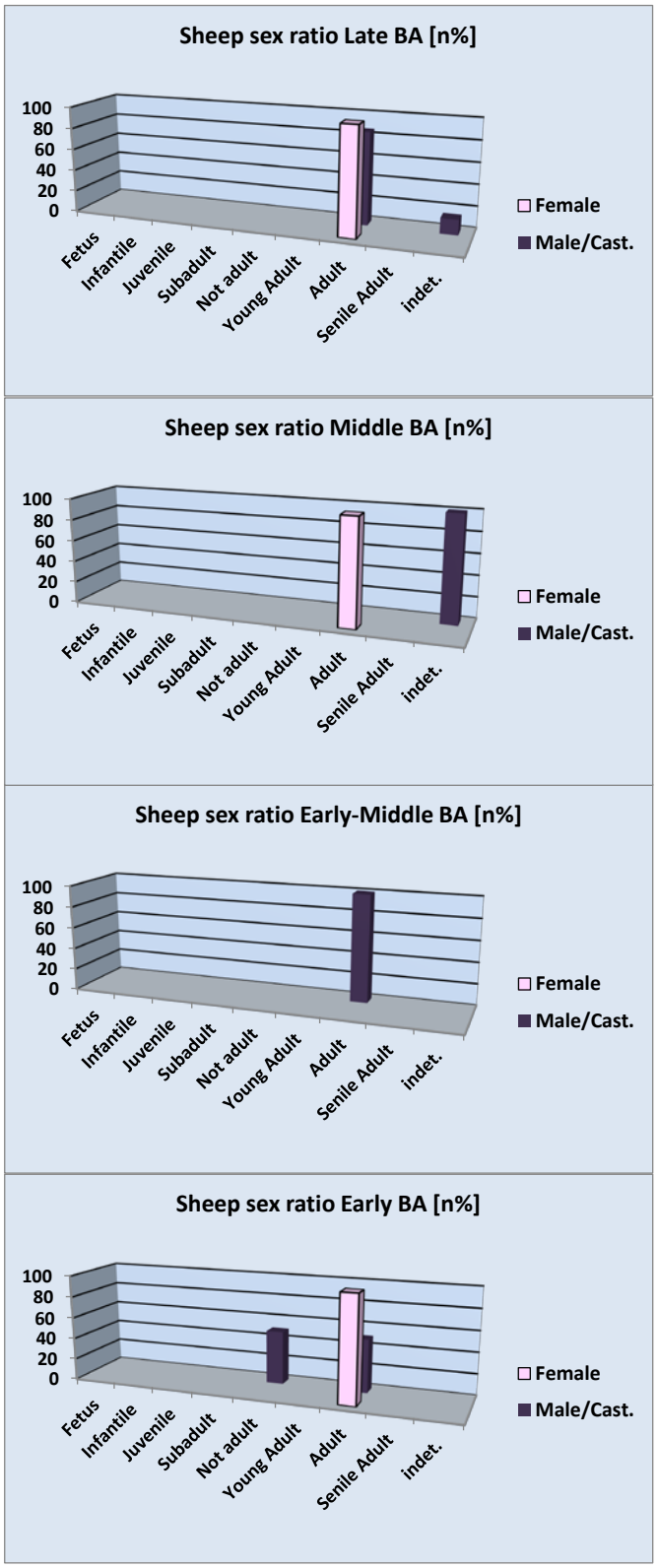


Fig. 3.2.32. Sex ratio and the mortality profile of sheep from the settlement Savognin-Padnal, in each Bronze Age (BA) phase. Male/Cast. = male and castrated male sheep.

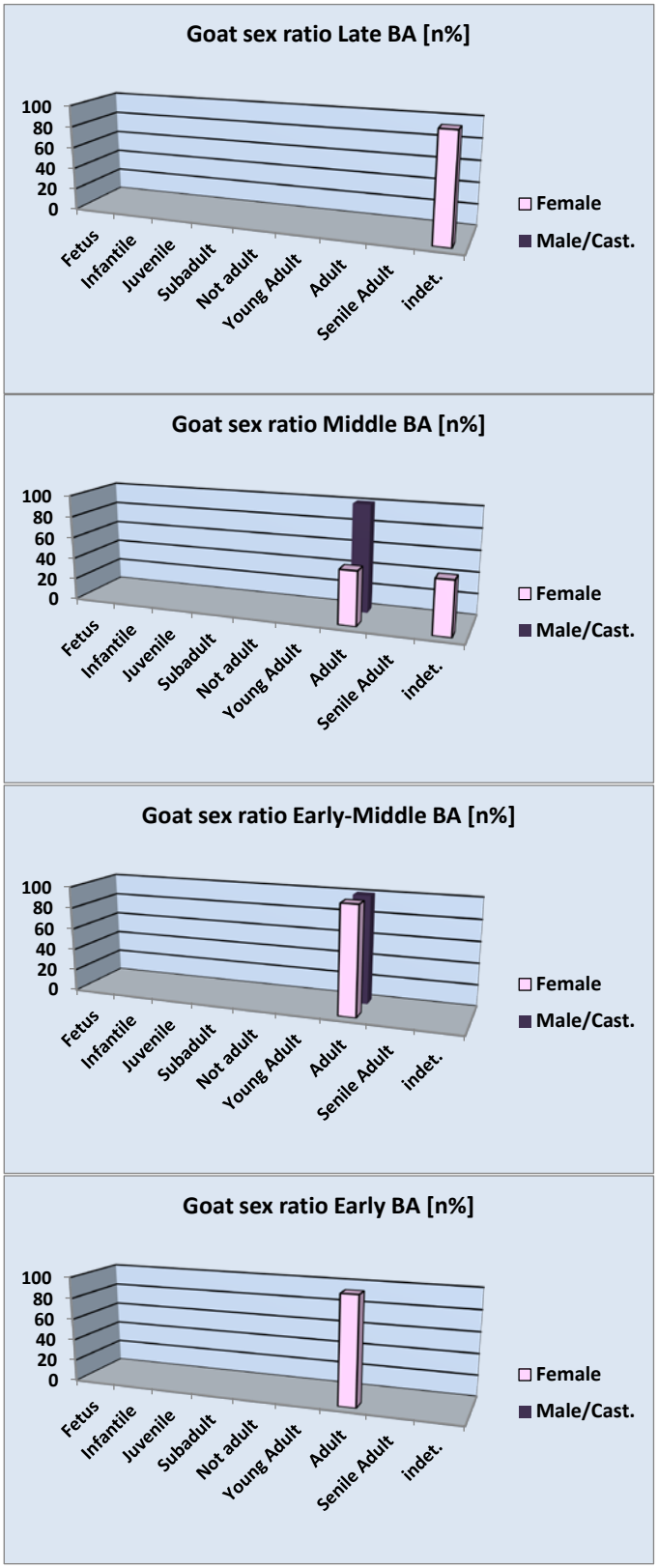


Fig. 3.2.33. Sex ratio and the mortality profile of goats from the settlement Savognin-Padnal, in each Bronze Age (BA) phase. Male/Cast. = male and castrated goats.

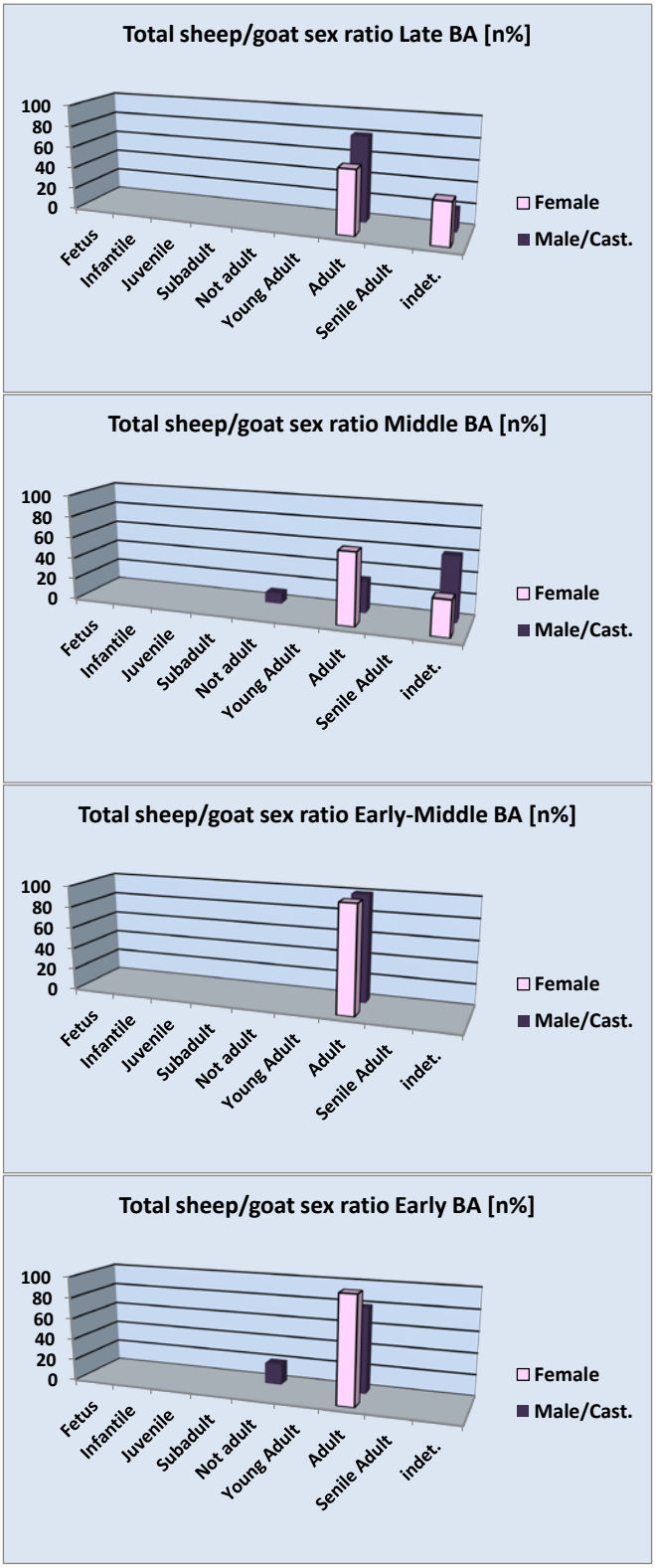
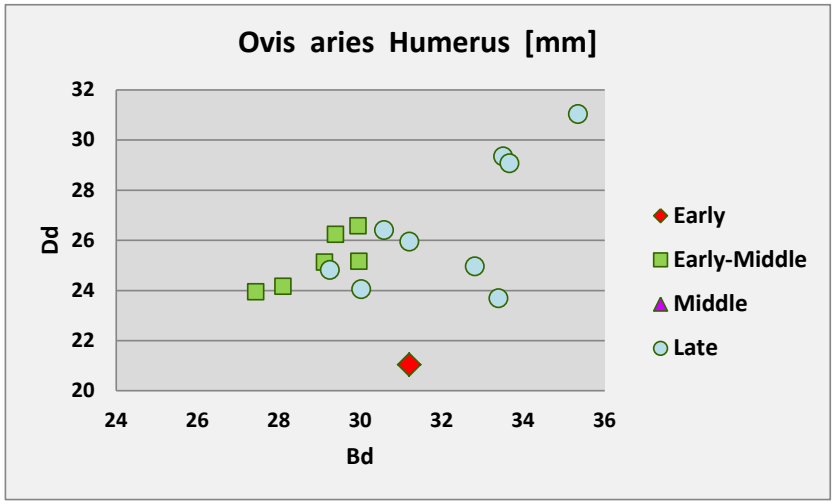


Fig. 3.2.34. The total sex ratio and the mortality profile sheep/goat from the settlement Savognin-Padnal, in each Bronze Age (BA) phase. Sheep/goat = sheep or goats; Male/Cast. = male and castrated male sheep and goats.

Phase	Skeletal element	n	GL (mm)	Factor	Withers height (cm)	W.-h. Mean (cm)
Late BA	Calcaneus	2	51.8-61.45	11.4	59.0 -70.0	63.5
Middle BA	Metatarsus	1	105.67	4.5	48.0	48.0
Early-Middle BA	Calcaneus	2	51.38-51.64	11.4	58.6 - 58.9	58.8
Early BA	no data	0			not available	

Fig. 3.2.35. Sheep Withers height (cm) at Savognin-Padnal using the factor from Teichert, 1975). W. h. mean = Withers height mean; GL = Greatest length (for details see von den Driesch, 1976); BA = Bronze Age.



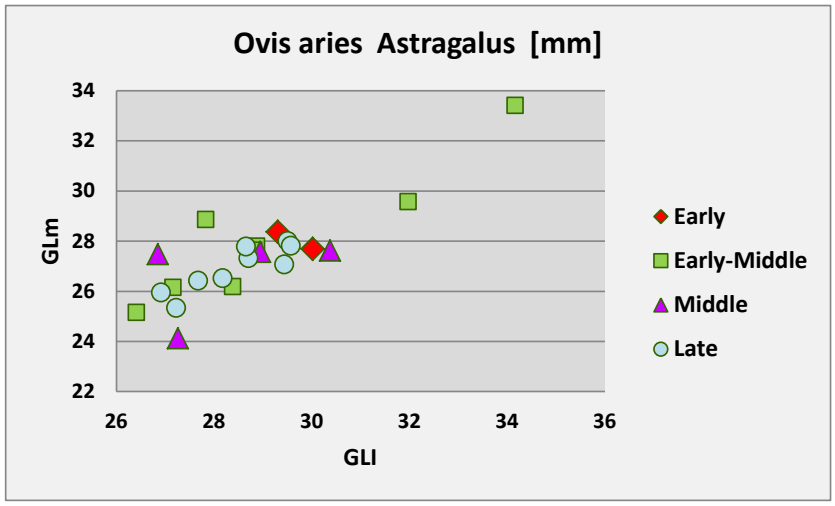
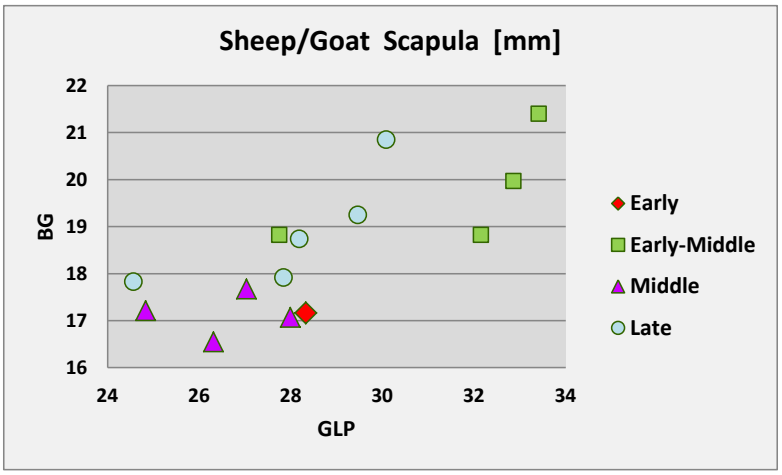
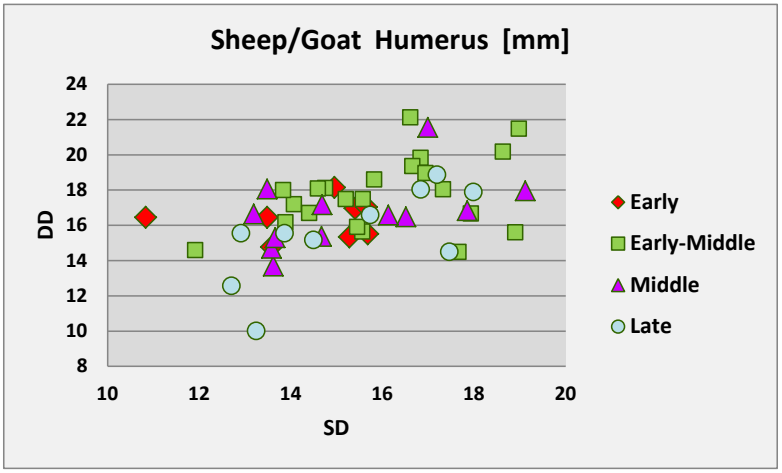


Fig. 3.2.36. Chronological comparison of osteometric data from Savognin-Padnal sheep in each Bronze Age phase. Bd = Greatest distal breadth; Dd = Depth of the distal end; GLl = Greatest length of the lateral half; GLm = Greatest length of the medial half (for details see von den Driesch, 1976).





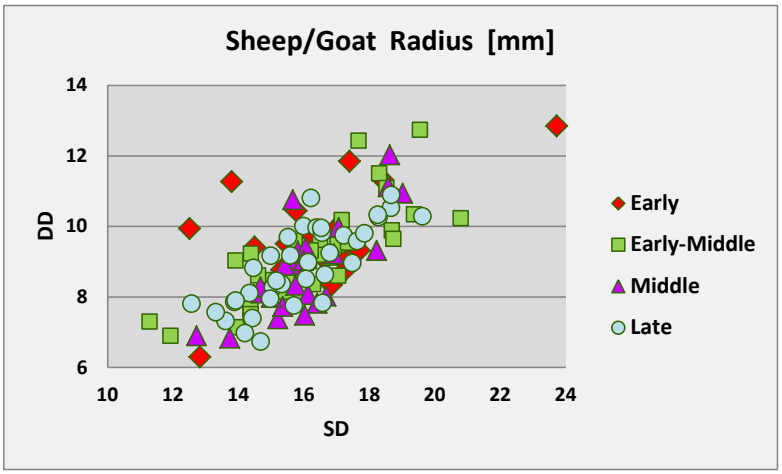
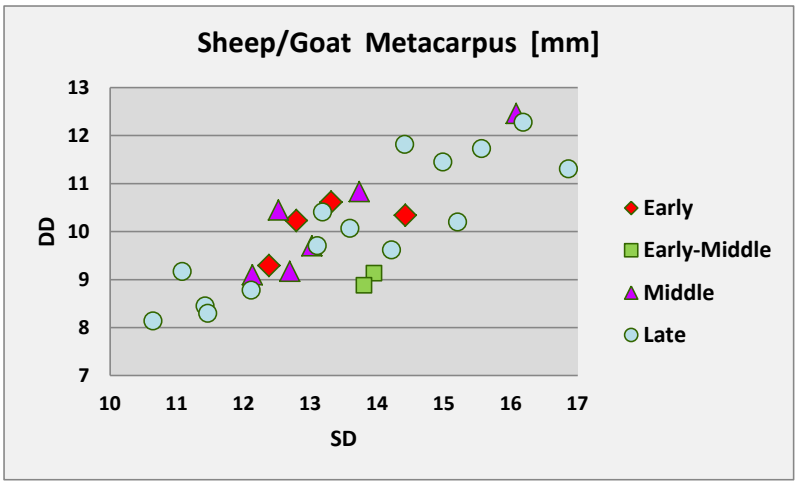
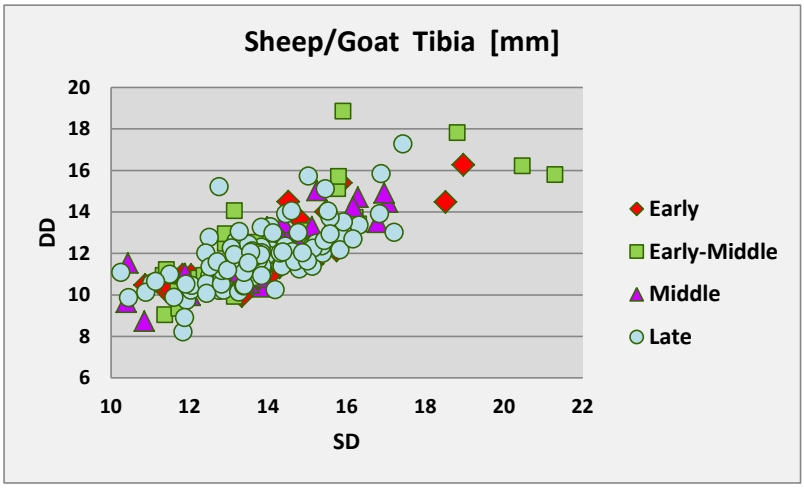


Fig. 3.2.37a. Chronological comparison of osteometric data from Savognin-Padnal sheep/goats in each Bronze Age phase (part 1). GLP = Greatest length of the Processus articulatis; BG = Breadth of the glenoid cavity; SD = Smallest breadth of the diaphysis; DD = Depth of diaphysis (for details see von den Driesch, 1976).





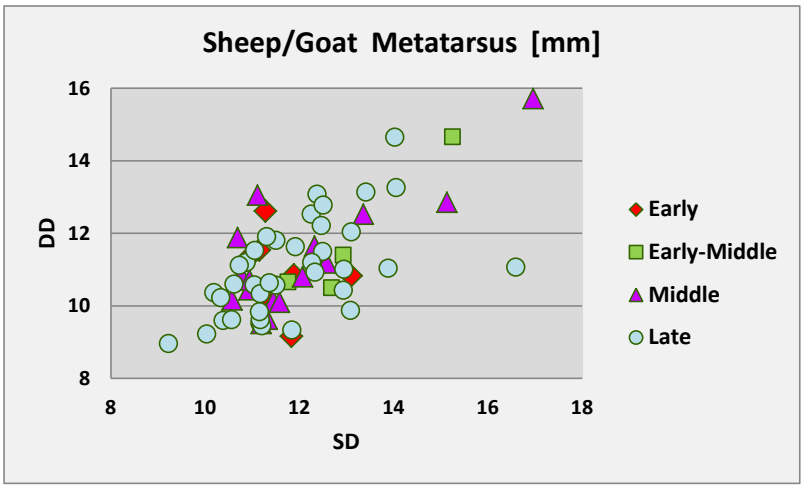
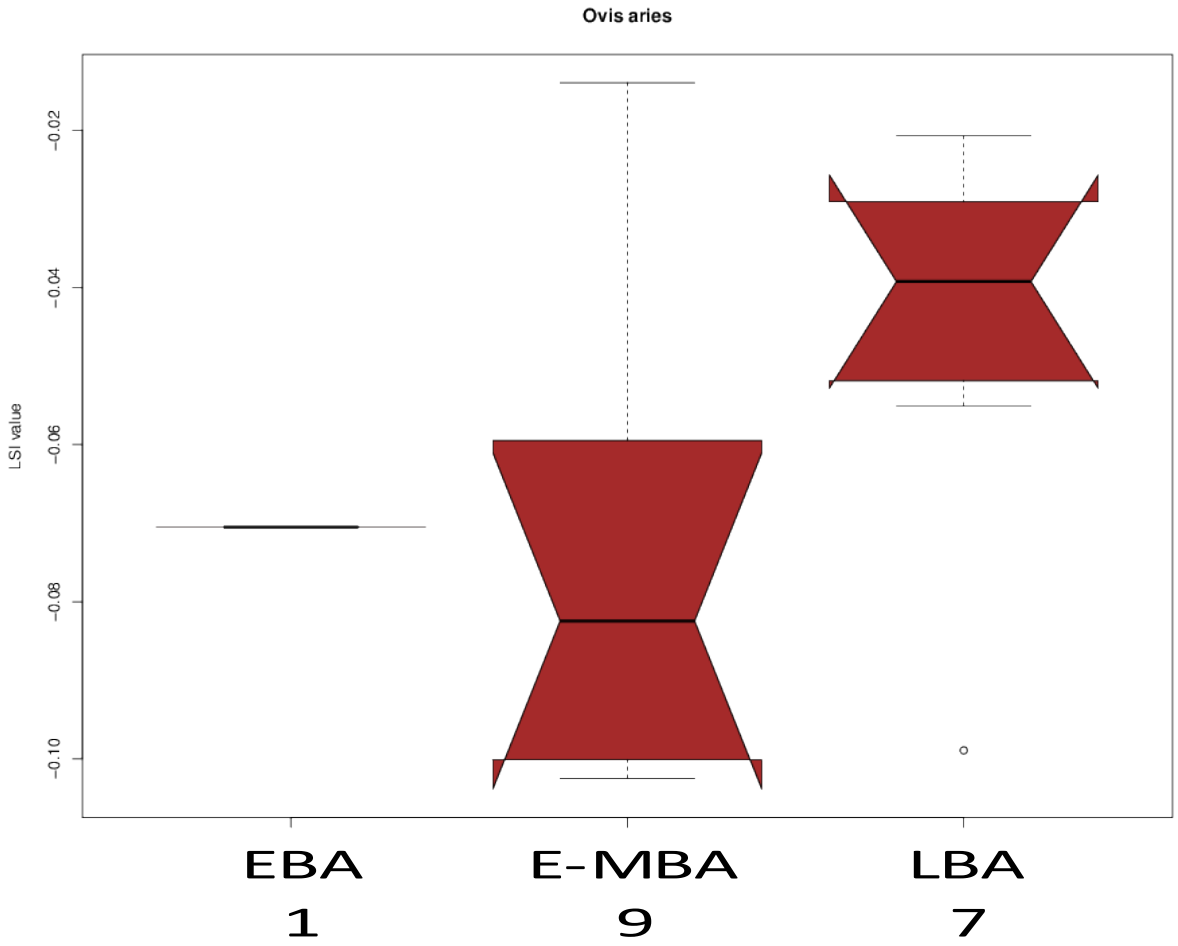


Fig. 3.2.37b. Chronological comparison of osteometric data from Savognin-Padnal sheep/goats in each Bronze Age phase (part 2). SD = Smallest breadth of the diaphysis; DD = Depth of diaphysis (for details see von den Driesch, 1976).

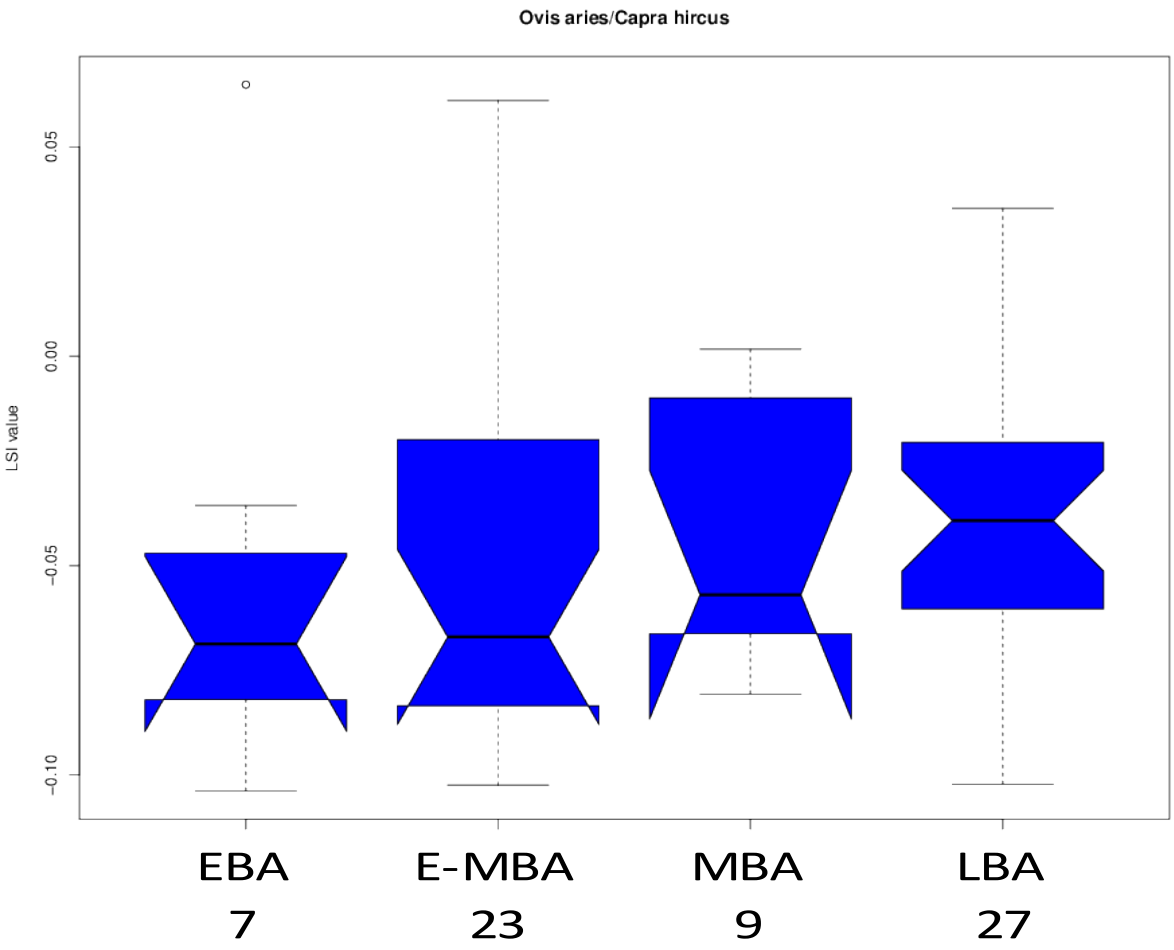


Kruskal-Wallis test for equal medians

H (chi2): 3.431
Hc (tie cor 3.431
p (same): 0.06397

There is no significant difference between sample medians

Fig. 3.2.38. Logarithmic size index (LSI) and Kruskal-Wallis tests of Adult sheep and goats at Padnal. Numbers in parentheses indicate the sample size used to obtain LSI. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; LBA = Late Bronze Age.



Kruskal-Wallis test for equal medians

H (chi2):	2.707
Hc (tie cor	2.707
p (same):	0.439

There is no significant difference between sample medians

Fig. 3.2.39. Logarithmic size index (LSI) and Kruskal-Wallis tests of subadult-adult sheep and goats at Savognin-Padnal. Numbers in parentheses indicate the sample size used to obtain LSI. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

Phase	Zone	Species	Skeleton	Pathology	Age	Note
MBA	Field 3	Ovis aries	Phalanx 1 posterior	Anomaly figure	Adult	The distal end has a round protuberance.
MBA	Field 1	Ovis / Capra	Mandibula with molars	Anomaly figure of roots of M1, M2, and M3	Very senile adult	Roots are twisted, Shrank and wrinkled.
LBA	Field 1	Ovis / Capra	Mandibula with molars	Anomaly Mandibula	Young adult	Praemolar alveolen are all closed.
LBA	Field 1	Ovis / Capra	Metacarpus	Traumatic injury & bone multiplication	Adult	The diaphysis of MC is injured traumatically. Bone multiplication was happened after healed.

Fig. 3.2.40. Pathological symptoms of sheep and all sheep and goats from fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in the Bronze Age. *Ovis aries* = sheep; *Ovis/Capra* = sheep and goats; M = Molar; MC = Metacarpus; MBA = Middle Bronze Age; LBA = Late Bronze Age.

Fig. 3.2.41. Above: sheep or goat right Mandible. Alveoli of premolars are closed. Below: reference collection Z-2437 *Ovis aries* (IPAS).

Fig. 3.2.42. Right side: sheep or goat left Metacarpus. The diaphysis had bone multiplication. Left side: reference collection Z-2437 *Ovis aries* (IPAS).

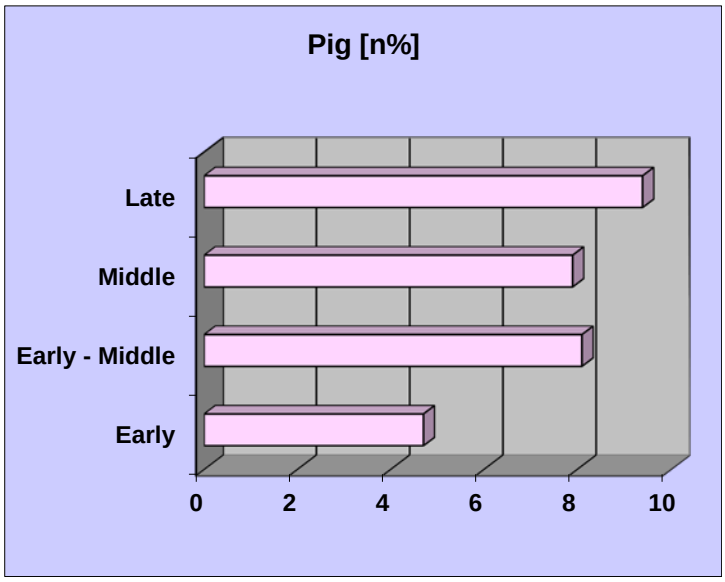


Fig. 3.2.43. The proportion of pig based on the number of fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

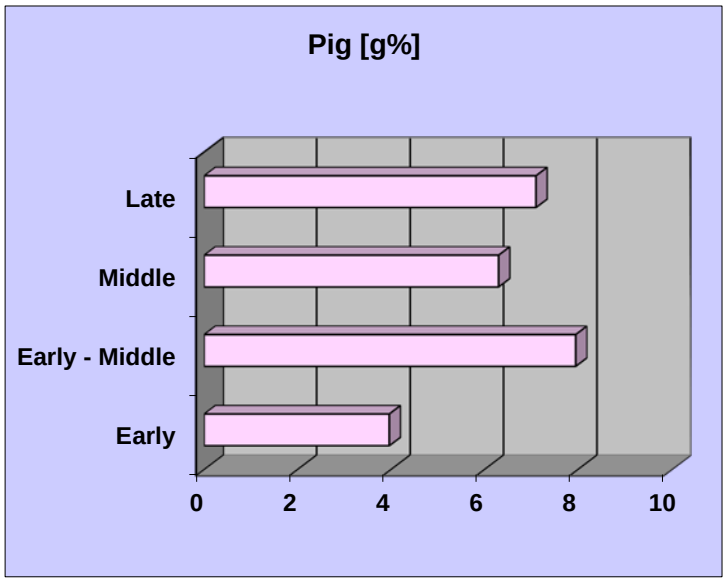


Fig. 3.2.44. The proportion of pig based on weight of fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

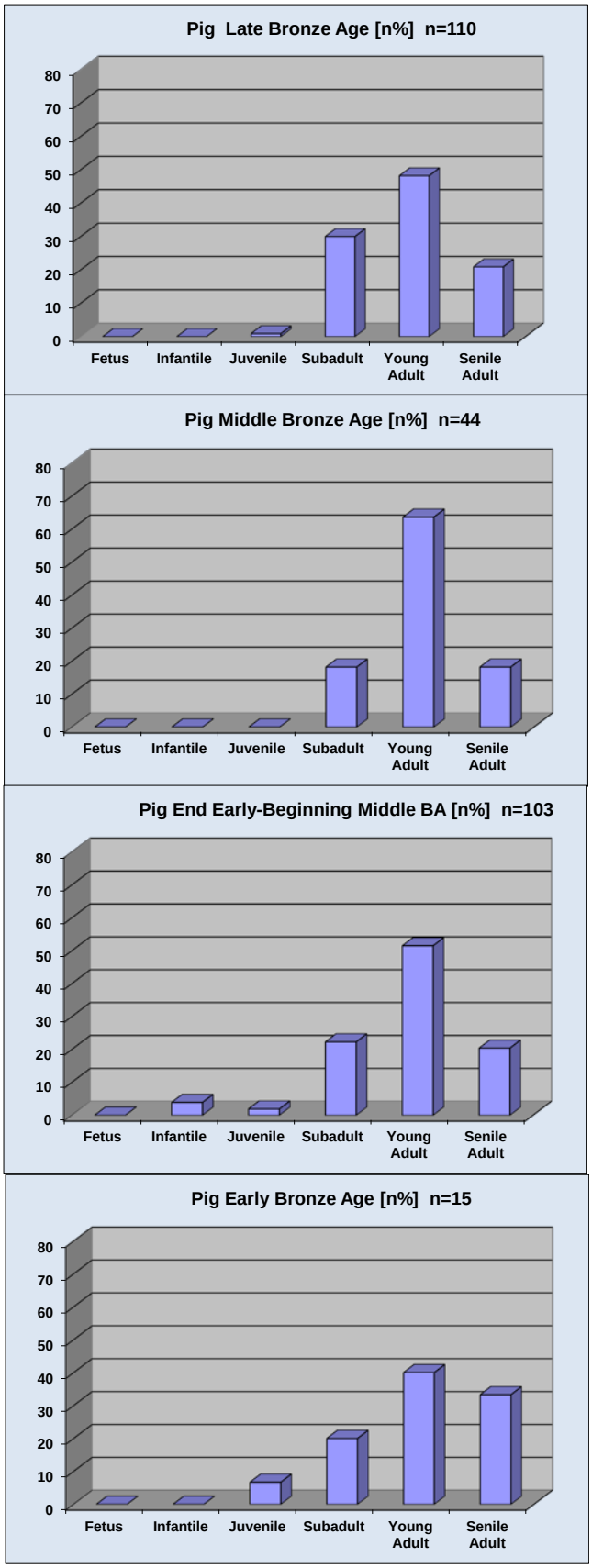


Fig. 3.2.45. Savognin-Padnal pig mortality profile covering four the Bronze Age (BA) phases based on teeth eruption and wear.

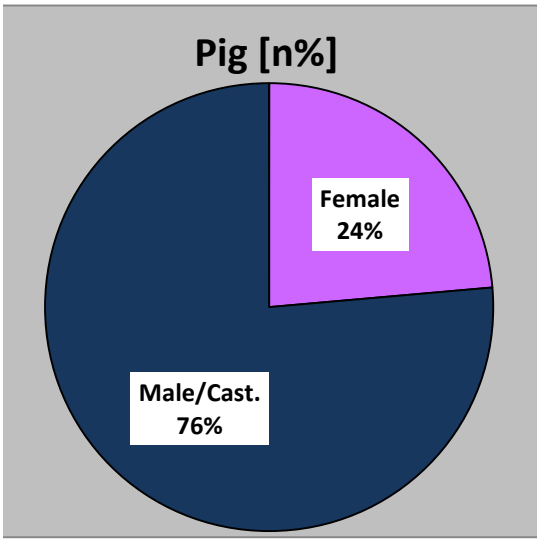


Fig. 3.2.46. Savognin-Padnal pig sex ratio in the Bronze Age. Male/Cast. = male and castrated male pigs.

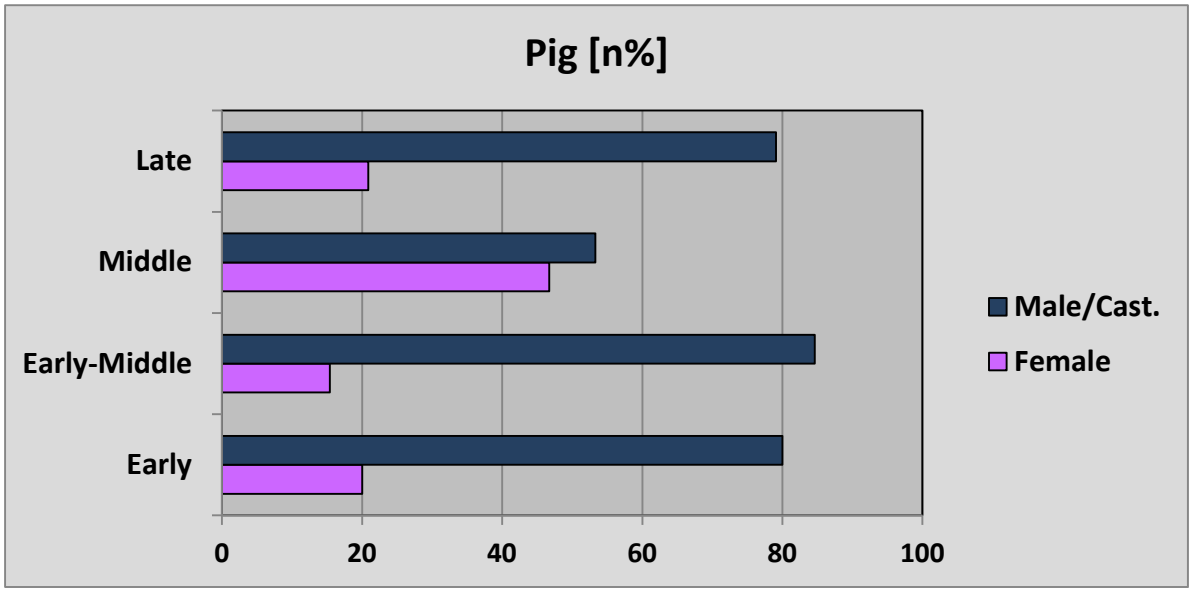


Fig. 3.2.47. Savognin-Padnal pig sex ratio in each Bronze Age phase. Male/Cast. = male and castrated male pigs.

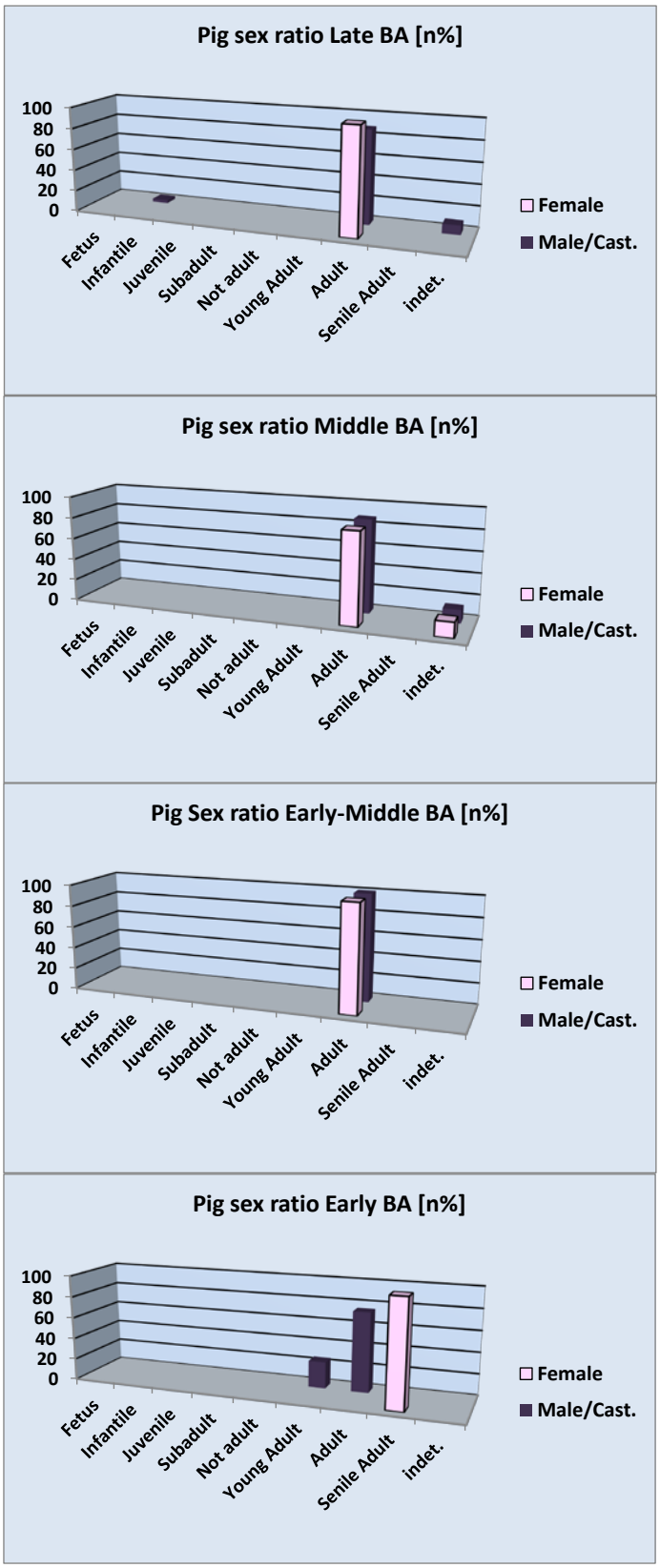
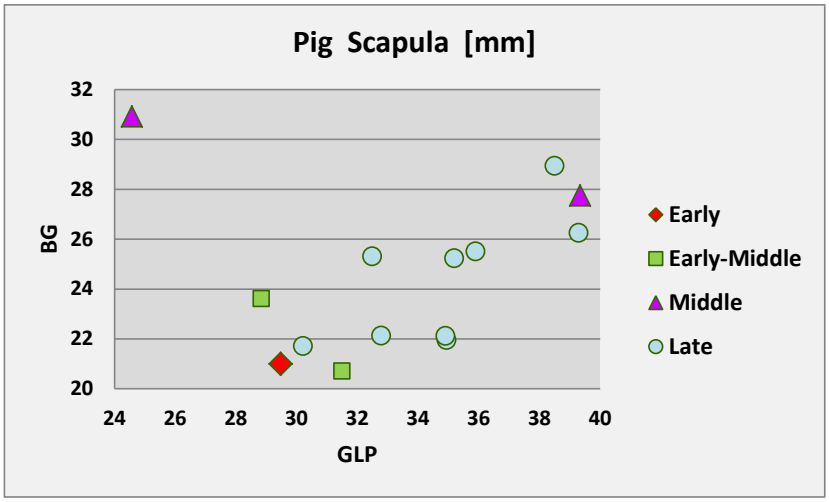
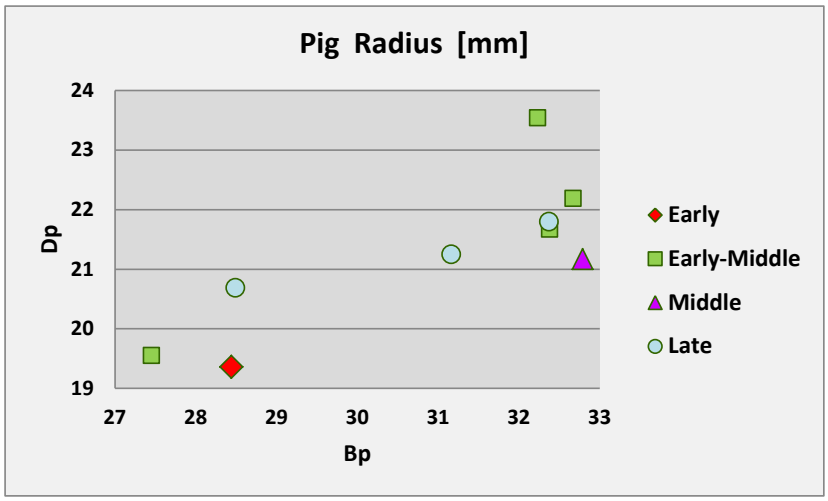


Fig. 3.2.48. Savognin-Padnal pig sex ratio and the mortality profile in each Bronze Age (BA) phase. Male/Cast. = male and castrated male pigs.

Phase	Skeletal element	n	GL (mm)	Factor	Withers height (cm)	W.-h. Mean (cm)	Phase Mean (cm)
Late BA	Astragalus	6	40.65-43.48	17.9	72.76-77.83	75.0	76.2
	Calcaneus	2	72.42-81.01	9.34	67.64-75.66	71.7	
	Metatarsus IV	1	92.57	8.84	81.80	81.8	
Middle BA	Astragalus	2	43.50-43.72	17.9	77.87-78.26	78.1	76.8
	Calcaneus	1	82.26	9.34	76.80	76.8	
Early-Middle BA	Astragalus	3	42.82-44.06	17.9	76.60-78.80	78.0	78.0
Early BA	Matacarpus III	1	75.88	10.72	81.30	81.3	81.3

Fig. 3.2.49. Pig Withers height (cm) at Savognin-Padnal. W. h. mean = Withers height mean. BA = Bronze Age. GL = Greatest length (for details see von den Driesch, 1976).





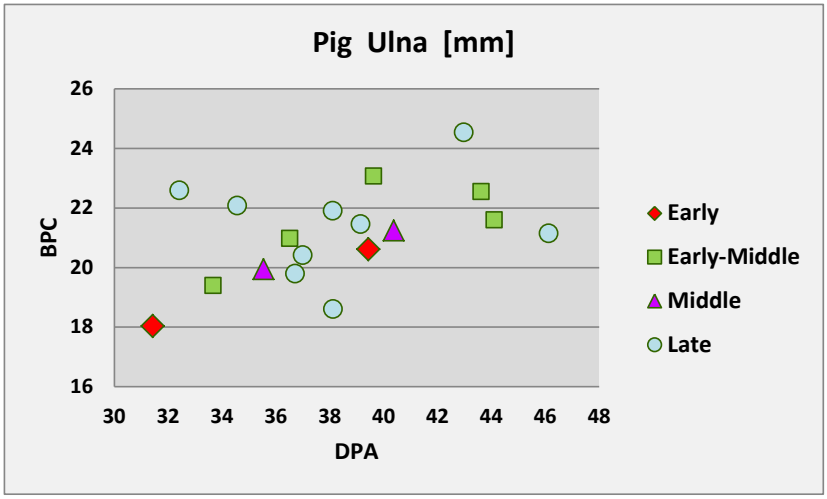
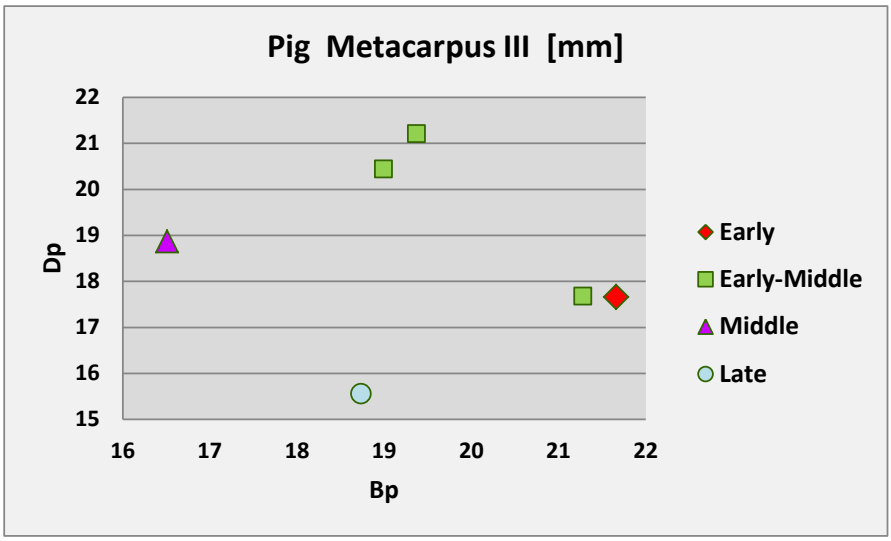


Fig. 3.2.50a. Chronological comparison of osteometric data from Savognin-Padnal pigs in each Bronze Age phase (part 1). GLP = Greatest length of the Processus articulatis; BG = Breadth of the glenoid cavity; Bp = Breadth of the proximal end; Dp = Depth of the proximal end; DPA = Depth across the Processus anconaeus; BPC = Breadth across the coronoid process (for details see von den Driesch, 1976).



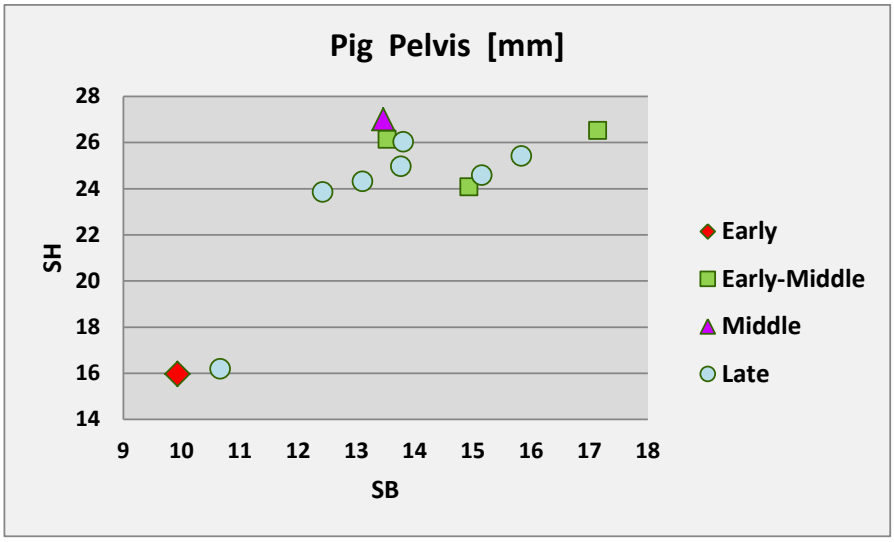
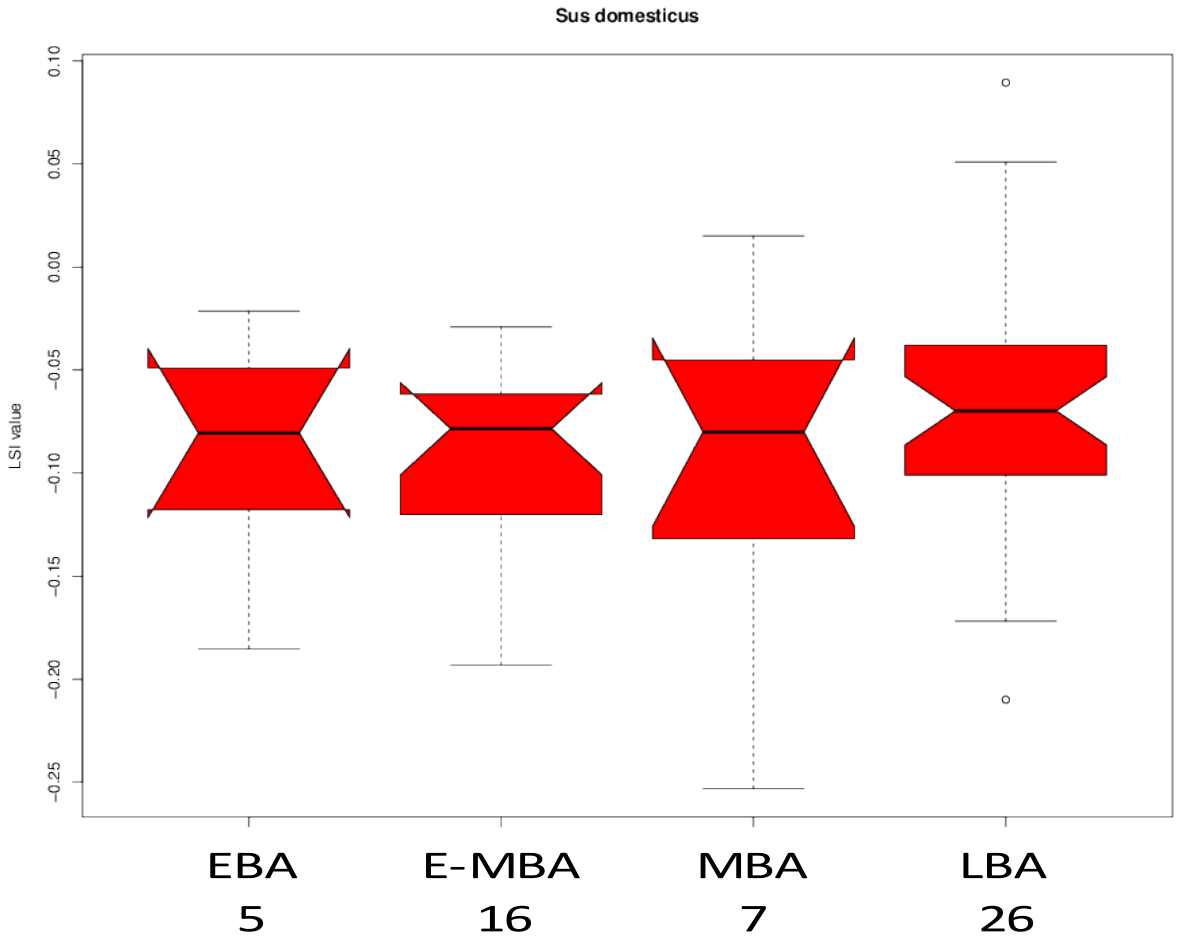


Fig. 3.2.50b. Chronological comparison of osteometric data from Savognin-Padnal pigs in each Bronze Age phase (part 2). Bp = Breadth of the proximal end; Dp = Depth of the proximal end; SB = Smallest breadth of the shaft of ilium; SH = Smallest height of the shaft of ilium (for details see von den Driesch, 1976).



Kruskal-Wallis test for equal medians

H (chi2):	1.719
Hc (tie cor	1.719
p (same):	0.6327

There is no significant difference between sample medians

Fig. 3.2.51. Logarithmic size index (LSI) and Kruskal-Wallis tests of subadult-adult pigs at Savognin-Padnal. Numbers indicate the sample size used to obtain LSI. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

Phase	Zone	Species	Skeleton	Pathology	Age	Note
EBA	Field 3	Sus dom.	Lost upper tooth	Periodontitis of M1	Very senile adult	Enamel and cement were completely disappeared. Roots became very thin. House 2
E-MBA	Field 3	Sus dom.	Lost upper tooth	Periodontitis of M1	Very senile adult	Enamel and cement were completely disappeared. Roots became very thin. House 1
MBA	Field 3	Sus dom.	Lost lower tooth	Periodontitis of M3	Very senile adult	Enamel and cement were completely disappeared. The base for crown was melted. House

Fig. 3.2.52. Pathological symptoms of pig. Sus dom. = *Sus domesticus* (pig) from fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. M1 = First Molar; M3 = Third Molar; EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age.

Fig. 3.2.53. Pig upper right molar tooth M1 in the Early Bronze Age (occlusal surface).

Fig. 3.2.54. Pig upper left molar tooth M1 in the end of Early to beginning of Middle Bronze Age (occlusal surface).

Fig. 3.2.55. Pig lower left molar tooth M3 in the Middle Bronze Age (occlusal surface).

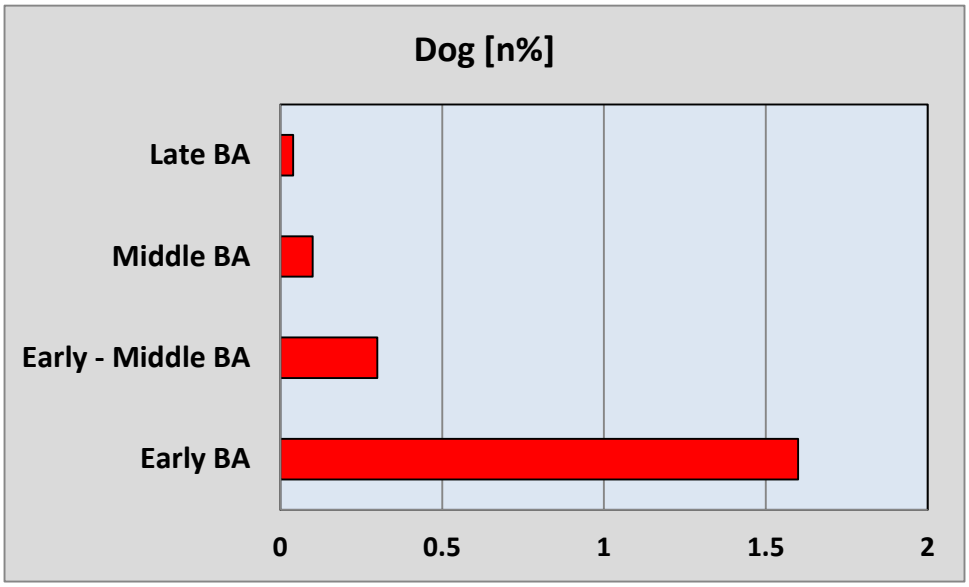


Fig. 3.2.56. The proportion of dog based on the number of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age (BA) phase.

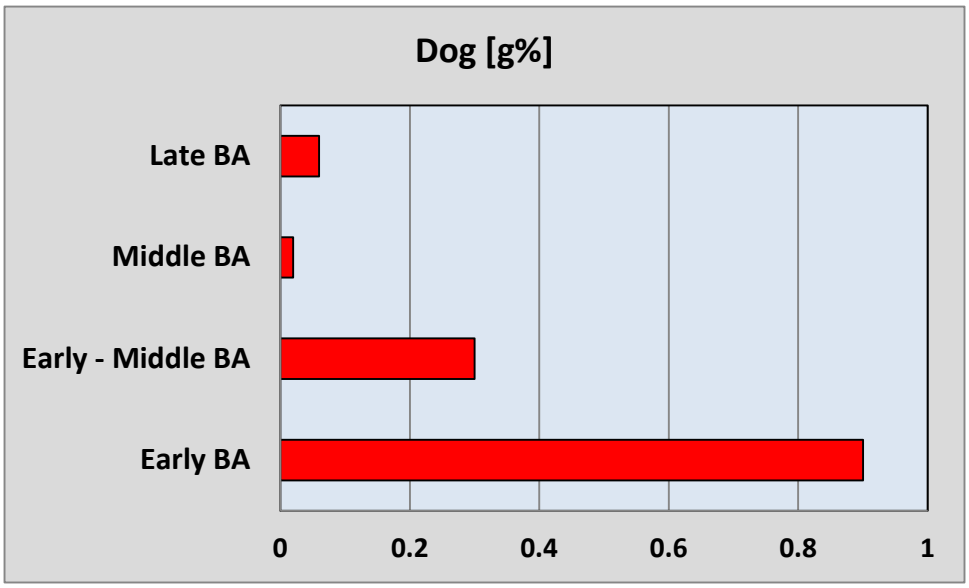


Fig. 3.2.57. The proportion of dog based on weight of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age (BA) phase.

Fig. 3.2.58. Dog (no. 1) skeletal elements excavated from the House 2 in the settlement Savognin-Padnal from the Early Bronze Age.

Phase	Skeletal element	n	GL (mm)	Factor	Withers height (cm)	W. h. mean (cm)	Phase Mean (cm)
Late BA	none	0			not available		
Middle BA	none	0			not available		
Early-Middle BA	none	0			not available		
Early BA	Radius	1	131.35	(3.18Xtl)+19.51	43.7	43.7	45.2
	Femur	1	151.35	(3.14Xtl)-12.96	46.2	46.2	
	Tibia	2	152.75-154.41	(2.92Xtl)+9.41	45.5-46	45.8	

Fig. 3.2.59. Dog Withers height (cm) at Savognin-Padnal in each Bronze Age (BA) phase. W. h. mean = Withers height mean, GL = Greatest length (for details see von den Driesch, 1976).

Measured position	**Early Bronze Age**	
Mean (mm)	**Savognin-Padnal**	**Cresta-Cazis**
Upper M1 Length	12.8(1)	12.9 (1)
Upper M1 Breadth	15.7(1)	14.6 (1)
Lower M1 Length	18.4 (3)	20.6 (4)
Lower M1 Breadth	8 (3)	8.4 (4)
Lower M3-C Length	70.3 (3)	73.3 (1)
Humerus Bd	27.9 (1)	34.3 (1)
Total	153.1	164.1
Mean of total	25.5	27.4

Fig. 3.2.60. Osteometric comparison between Savognin-Padnal and Cresta-Cazis in the Early Bronze Age dogs. Numbers in parentheses indicate the sample size. M1 = First Molar; M2 = Second Molar; M3 = Third Molar; C = Caninus; Bd = Greatest distal breadth; M3-C Length = Length between the aboral border of the alveolus of lower third molar and aboral border of the canine alveolus. (for details of osteometric data see Appendix for Savognin-Padnal and Plüss, (2011) for Cresta-Cazis.

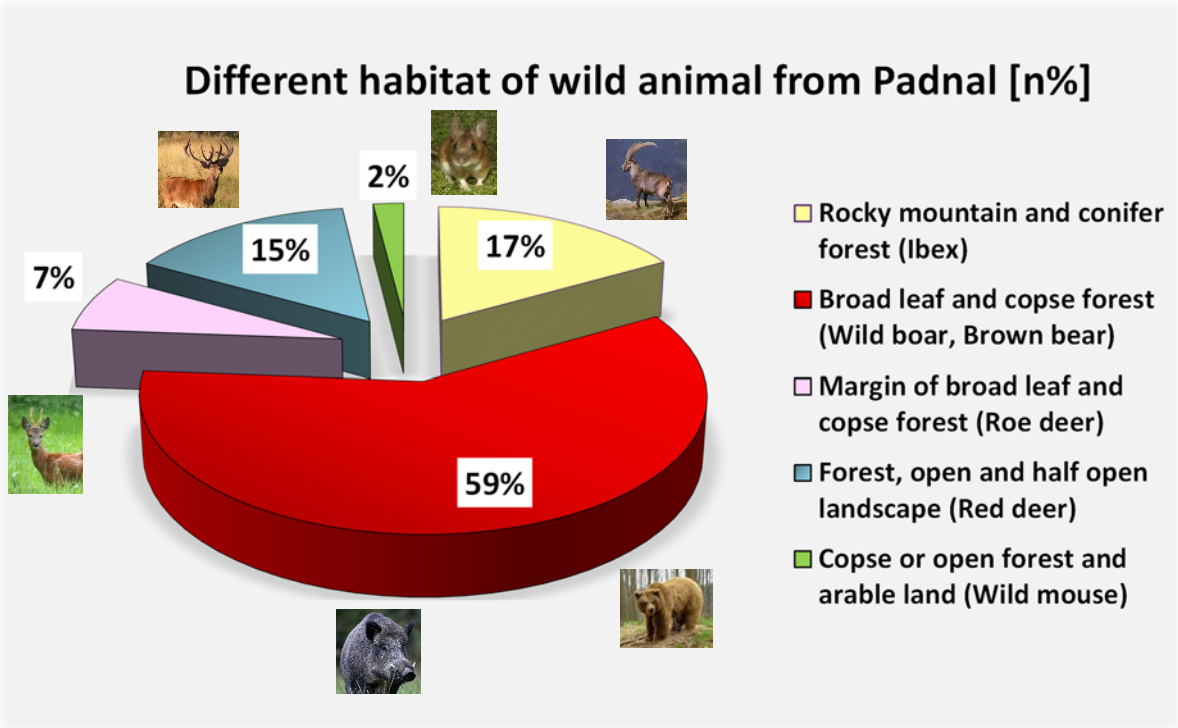


Fig. 3.2.61. The proportion of the different habitats of wild animals (only mammals) from Savognin-Padnal based on the number of identified specimens. (After Marguerita Schäfer (2017): Dissertation manuscript in 2010, Tab. 7.2.5: Vaihingen/Enz. Habitatsansprüche der Wildsäuger).

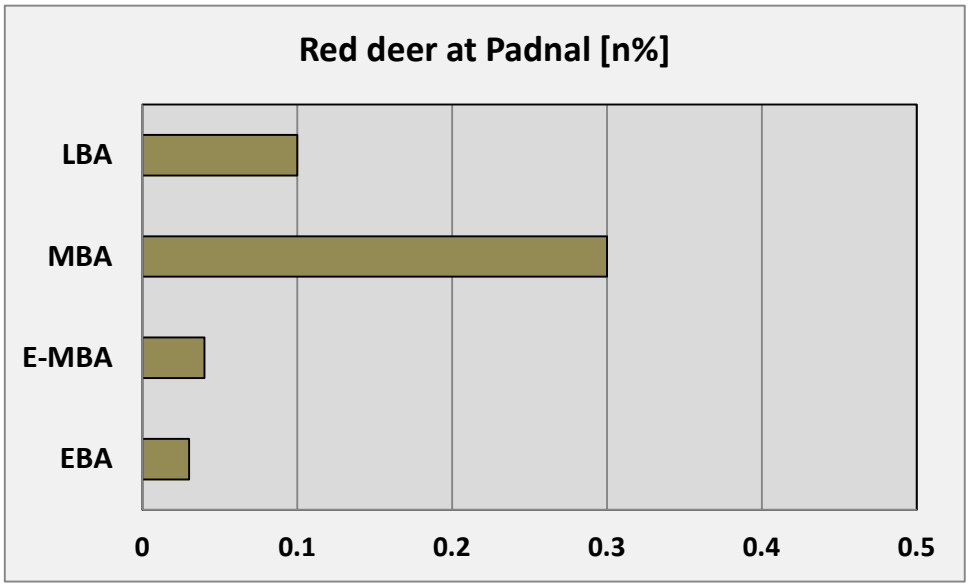


Fig. 3.2.62. The proportion of red deer based on the number of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

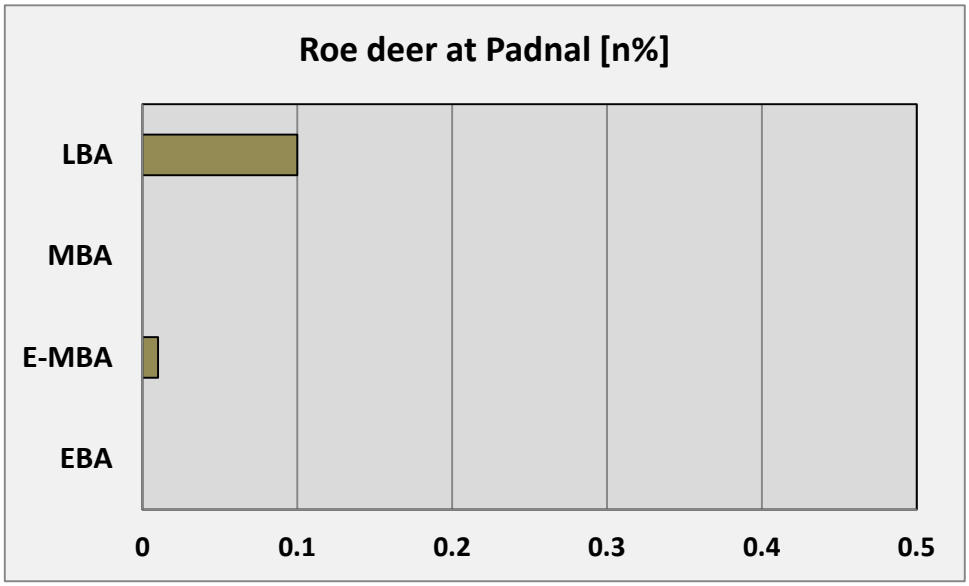


Fig. 3.2.63. The proportion of roe deer based on the number of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

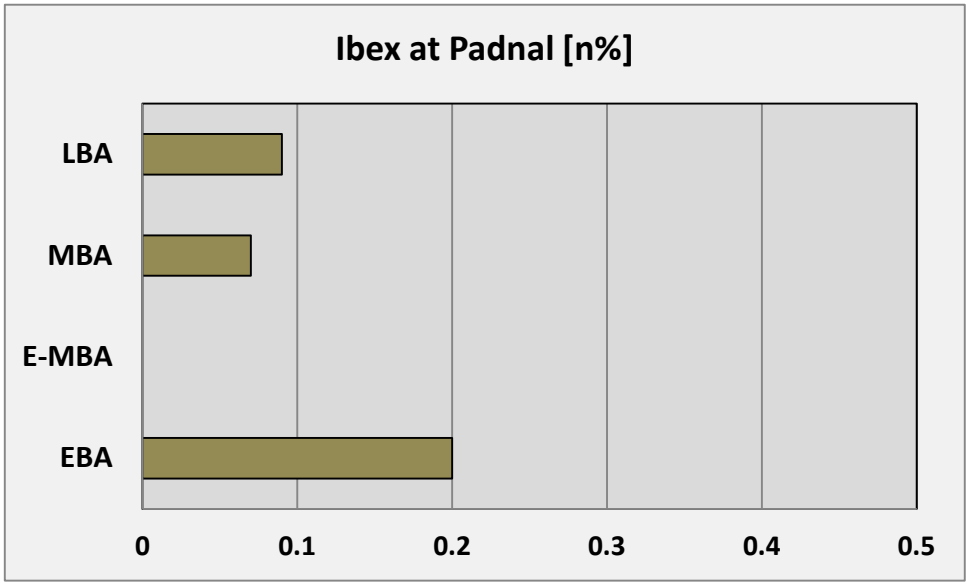


Fig. 3.2.64. The proportion of ibex based on number of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

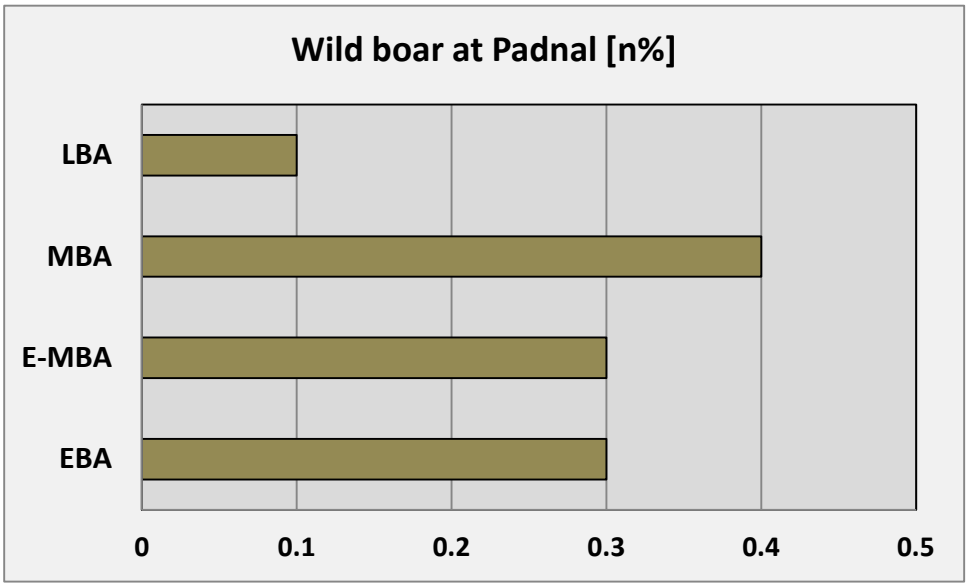


Fig. 3.2.65. The proportion of wild boar based on number of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

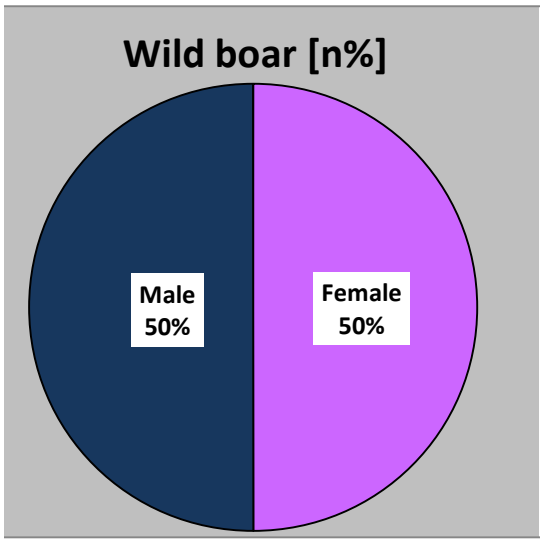


Fig. 3.2.66. Wild boar sex ratio at Savognin-Padnal in the Bronze Age.

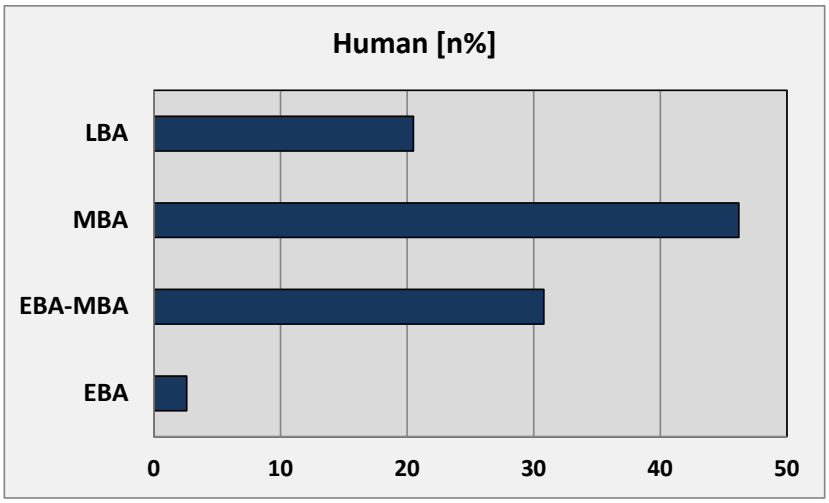


Fig. 3.2.67. The proportion of humans based on the number of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

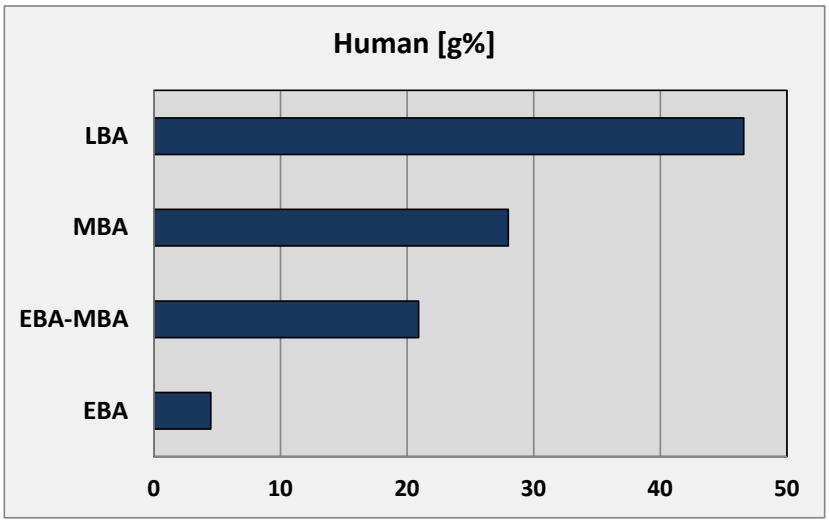


Fig. 3.2.68. The proportion of humans based on weight of identified fragments that were excavated from the settlement Savognin-Padnal in Switzerland, in each Bronze Age phase. EBA = Early Bronze Age; E-MBA = Early to Middle Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

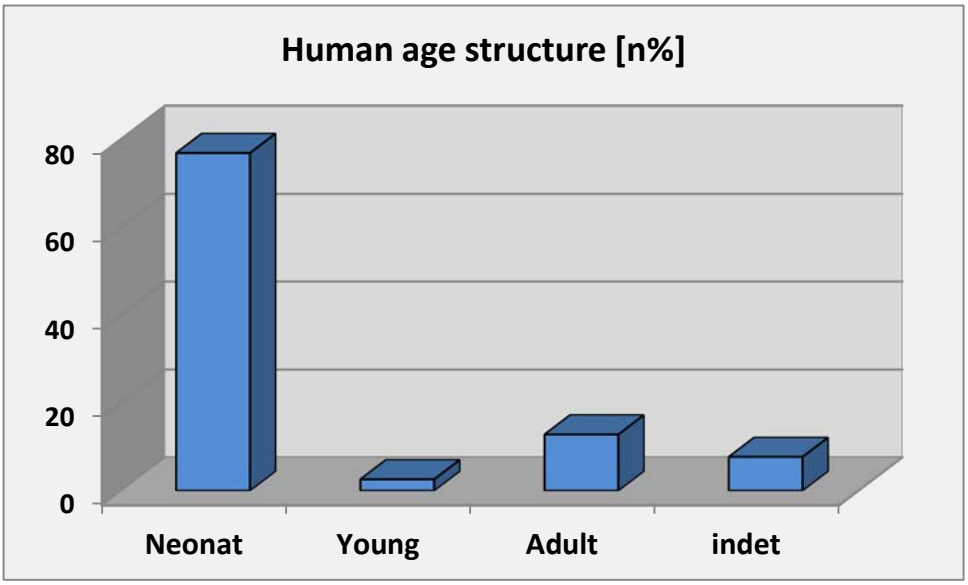


Fig. 3.2.69. Human mortality profile from the settlement Savognin-Padnal based on teeth eruption and wear, and fused epiphyses.

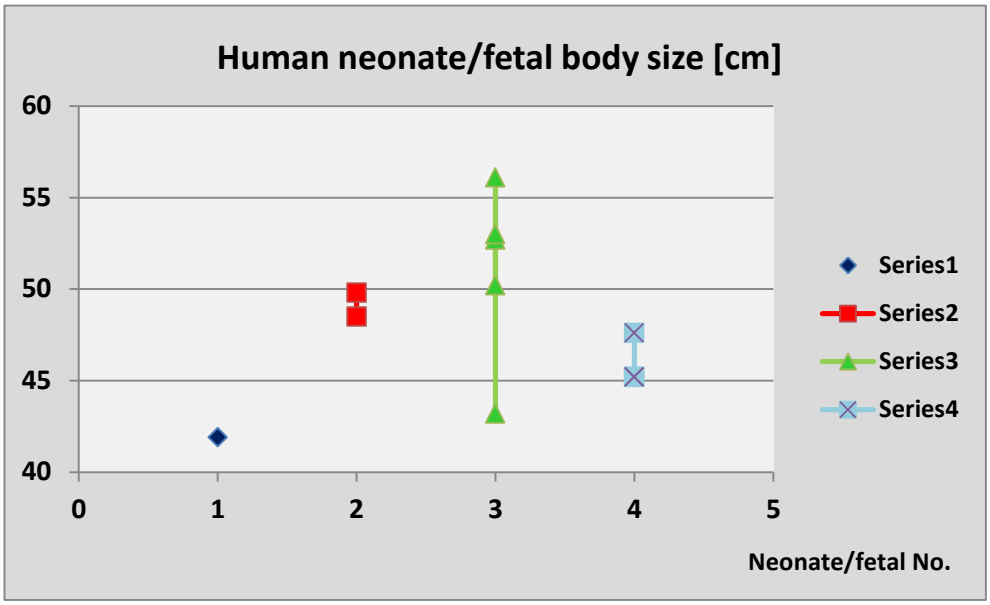


Fig. 3.2.70. Body size of four human neonates/fetuses from the settlement Savognin-Padnal, based on the factor from Fazekas and Kosa 1978). Series = Individual.

No.	Phase	Field	Excavated year	Excavated point	Structure No.	Structure	Skeletal element	Skeletal part	Epiphyse	Body side	Age	Weight (g)	n	Measurement (mm)	Used Measurement (cm) for culculation		Factor (cm) Fazekas/Kosa 1978	Body length (cm)
1	EBA	3	1976	18 (b)	54	Path	Cranium	Petrosum big fragment		dext.	Neonate till <1year old	4	1	remained GL=28.98	GL=>2.898	a	11.71 + 8.00	>41.9
2	E-MBA	3	1974	35	421	House 3	Femur	distal half	distal open	dext.	Neonate	1.7	1	SD=6.43, DD=5.67				
3	E-MBA	3	1973	173	422	House 4	Clavicula	Fragment		sin.	Neonate	0.3	1					
4	E-MBA	3	1973	173	422	House 4	Humerus	Proximal half	prox. open	indet.	Fetal	0.5	1	SD=4.37, DD=4.83				
5	E-MBA	3	1973	173	422	House 4	Humerus	Whole skelet	prox. dis. open	dext.	Neonate	1.8	1	GL=61.21, SD=4.79 DD=5.10	GL=6.121	a	7.52 + 2.47	48.5
6	E-MBA	3	1973	173	422	House 4	Femur	Whole skelet	prox. dis. open	dext.	Neonate	3.2	1	GL=70.31, SD=5.79 DD=6.65	GL=7.031	a	6.44 + 4.51	49.8
7	E-MBA	3	1973	173	422	House 4	Femur	Proximal half	prox. open	sin.	Neonate	1.4	1	SD=5.23, DD=6.27				
8	E-MBA	3	1973	173	422	House 4	Tibia	Diaphyse		dext.	Neonate	1.4	1	SD=5.67, DD=6.29				
9	E-MBA	3	1975	26 (d)	411	House 1	Clavicula	Whole skelet		sin.	Neonate	0.5	1	a: Length=45.93	a: Length=4.593	a	11.94 - 1.22	56.1
10	E-MBA	3	1975	26 (d)	411	House 1	Costa	Whole skelet		sin.	Neonate	0.6	1	a: Length=54.40	a: Length=5.440	a	7.67 + 1.43	>43.2
11	E-MBA	3	1975	26 (d)	411	House 1	Radius	Whole skelet	prox. dis. open	sin.	Neonate	0.9	1	GL=51.98, SD=3.87 DD=3.49	GL=5.198	a	10.61 - 2.11	53
12	E-MBA	3	1975	26 (d)	411	House 1	Femur	Whole skelet	prox. dis. open	sin.	Neonate	4.2	1	GL=74.77, SD=5.59 DD=6.22	GL=7.477	a	6.44 + 4.51	52.7
13	E-MBA	3	1975	26 (d)	411	House 1	Tibia	Whole skelet	prox. dis. open	sin.	Neonate	2	1	GL=62.59, SD=5.08 DD=5.36	GL=6.259	a	7.24 + 4.90	50.2
14	MBA	3	1973	110	31	House	Scapula	Whole skelet		dext.	Neonate	0.9	1	GLP=12.11, BG=5.33 SLC=13.00 DHA=29.07 HS=25.74, Ld=29.75 a: Length=29.73 b: Width=25.36 c: Length spine=27.05	b: Width=2.536	b	16.66 + 2.96	45.2
15	MBA	3	1973	110	31	House	Costa	Whole skelet		sin.	Neonate	0.7	1	a: Length=57.02	a: Length=5.702	a	7.67 + 1.43	>45.2
16	MBA	3	1973	110	31	House	Costa	Big fragment		dext.	Neonate	1.1	2					
17	MBA	3	1973	110	31	House	Costa	Joint half		dext.	Neonate	1.6	5					
18	MBA	3	1973	110	31	House	Costa	Corpus fragment		indet.	Neonate	0.1	1					
19	MBA	3	1973	110	31	House	Costa	Behind one third		indet.	Neonate	0.6	2					
20	MBA	3	1973	110	31	House	Femur	Whole skelet	prox. dis. open	dext.	Neonate	2.7	1	GL=66.91, SD=5.65 DD=6.18	GL=6.691	a	6.44 + 4.51	47.6
21	MBA	1	1971	73		unknown	Humerus	Distal half	distal open	dext.	Neonate	1	1	SD=5.00, DD=5.24				
22	MBA	1	1971	69		unknown	Humerus	Proximal half	prox. open	indet.	Neonate	0.8	1	SD=4.99, DD=5.73				
23	MBA	1	1971	58		unknown	Ulna	Proximal part	prox. open	sin.	Neonate	0.4	1					
24	MBA	1	1971	58		unknown	Ulna	Distal half	distal open	dext.	Neonate	0.3	1					
25	MBA	1	1971	52		unknown	Cranium	Os parietale			Adult	14.6	1					
26	LBA	1	1971	6		House	Cranium	Os parietale			indet.	7.2	3					
27	LBA	1	1971	6		House	Lost lower tooth	Caninus		sin.	Adult	0.9	1					
28	LBA	1	1971	6		House	Mandibula	Corpus Alveole area		dext.	Adult	2.5	1					
29	LBA	1	1971	70		above layer	Tarsus	Os cuneiforme		indet.	not adult	2.5	1	GB=24.81				
30	LBA	1	1971	49		above layer	Humerus	Near distal		dext.	Adult	13.4	1	SD=15.47, DD=21.59				
31	LBA	1	1971	27		above layer	Fibula	Diaphyse		indet.	Adult	14.8	1	SD=14.23, DD=11.02				

Fig. 3.2.71. Human bone fragments from Savognin-Padnal. Coloured groups were assumed to be one individual.

Fig. 3.2.72. Petrosum fragment (dext.) between neonate and one-year-old human from path of Field 3 in the Early Bronze Age. Dext. = dexter: right side of the body.

Fig. 3.2.73. (From left) Clavicula (sin.), Costa (left side), Radius (sin.), Femur (sin.), and Tibia (sin.) of a human neonate from House 1 of Field 3 in the end of Early Bronze Age to the beginning of Middle Bronze Age. Dext. = dexter: right side of the body, Sin. = sinister: left side of the body.

Fig. 3.2.74. (From left) Clavicula (sin.), Humerus x 2 (dext. and indet.), Femur x 2 (dext. and sin.), and Tibia (dext.) of human neonate from House 4 of Field 3 in the end of Early Bronze Age to the beginning of Middle Bronze Age. Dext. = dexter: right side of the body, Sin. = sinister: left side of the body.

Fig. 3.2.75. Partial carbonized Femur (dext.) of a human neonate from House 3 of Field 3 in the end of Early Bronze Age to the beginning of Middle Bronze Age. Dext. = dexter: right side of the body.

Fig. 3.2.76. (From left) Scapula (dext.), Costae (dext. and sin. mixed), and Femur (dext.) of a human neonate from a house in Field 3, Middle Bronze Age. Dext. = dexter: right side of the body, Sin. = sinister: left side of the body.

Fig. 3.2.77. Cranium fragment of an adult human from Field 1 in the Middle Bronze Age.

Fig. 3.2.78. Cranium fragments of a human from a house in Field 1 in the Late Bronze Age.

Fig. 3.2.79. Mandible (dext.) fragment and Canine (sin.) of an adult human from a house in Field 1 in the Late Bronze Age. Dext. = dexter: right side of the body, Sin. = sinister: left side of the body.

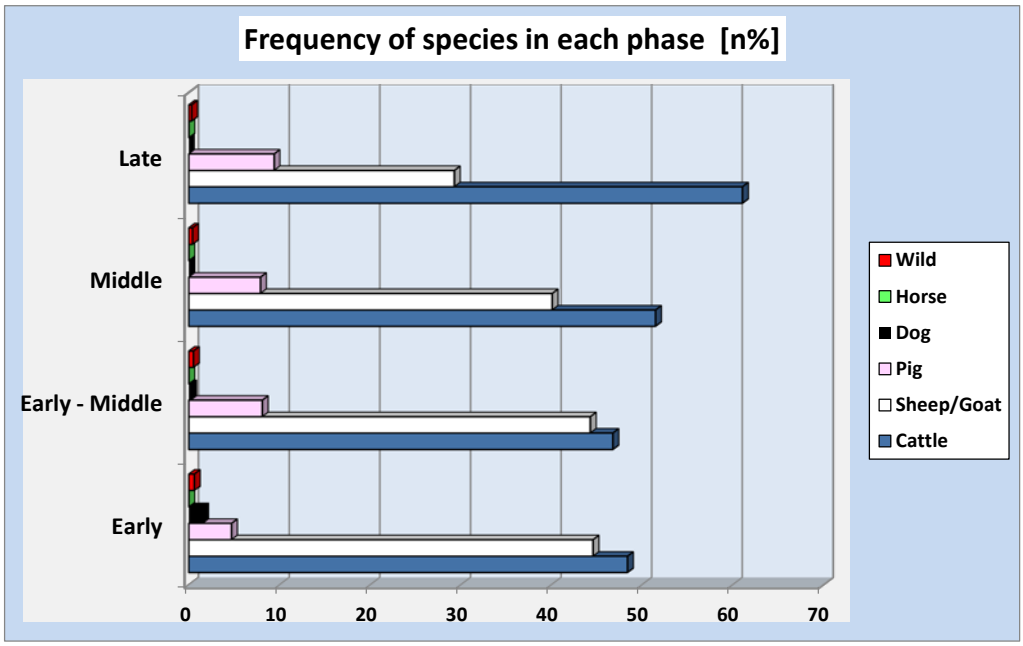


Fig. 3.2.5.1. The proportion of number of identified specimens in each Bronze Age phase in the settlement Savognin-Padnal in Switzerland.

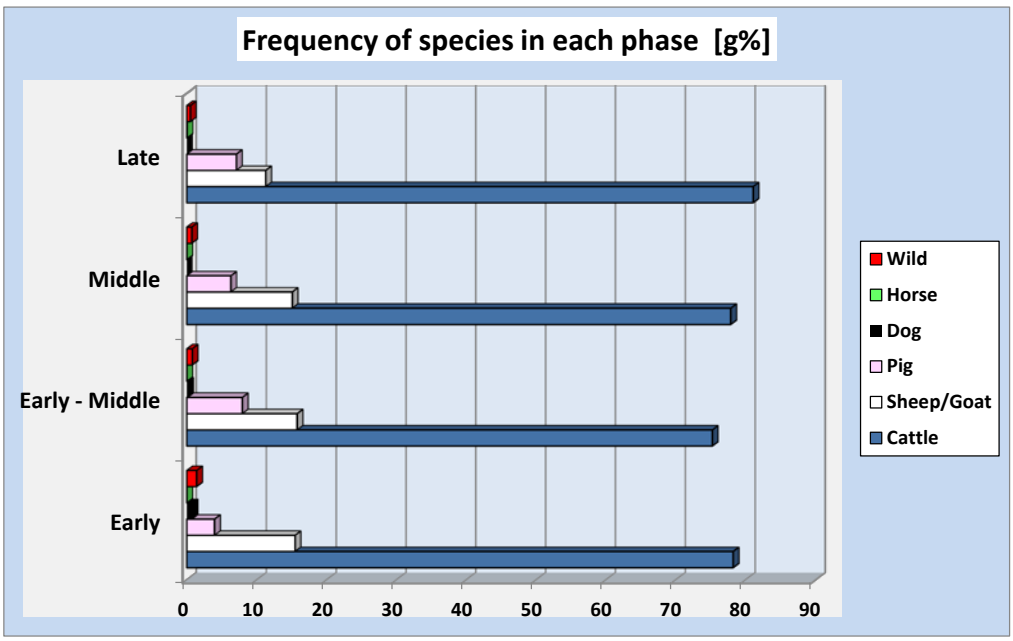
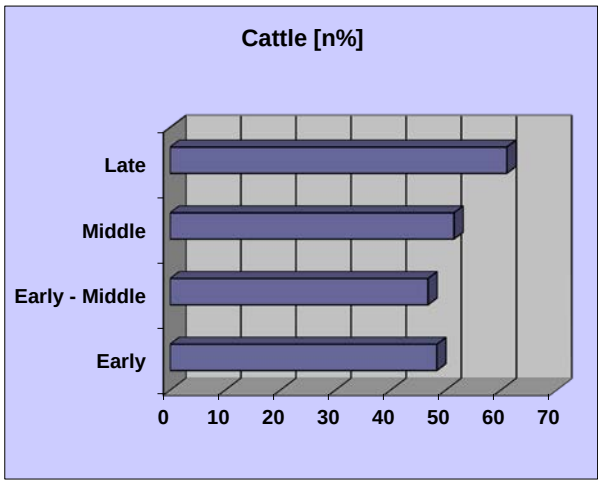
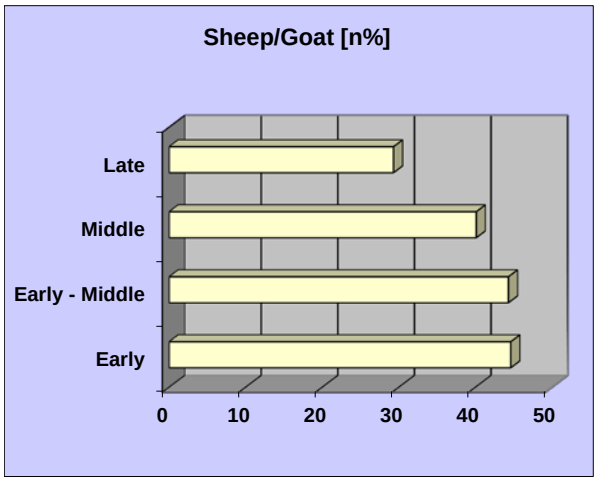


Fig. 3.2.5.2. The proportion of weight of identified specimens in each Bronze Age phase in the settlement Savognin-Padnal in Switzerland.





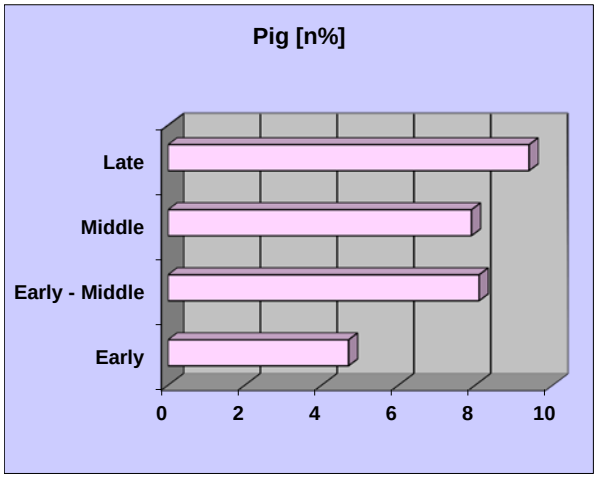
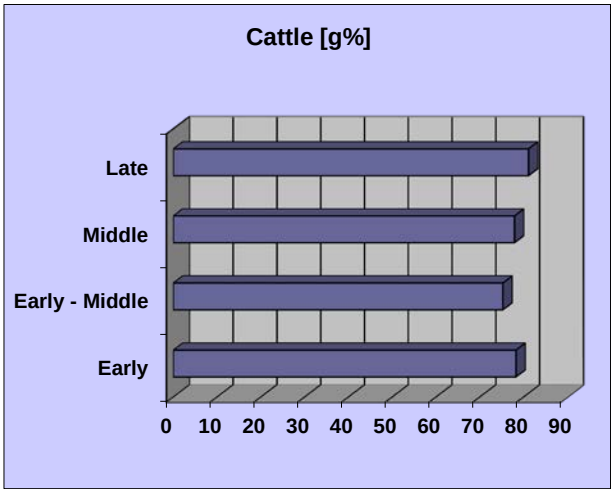
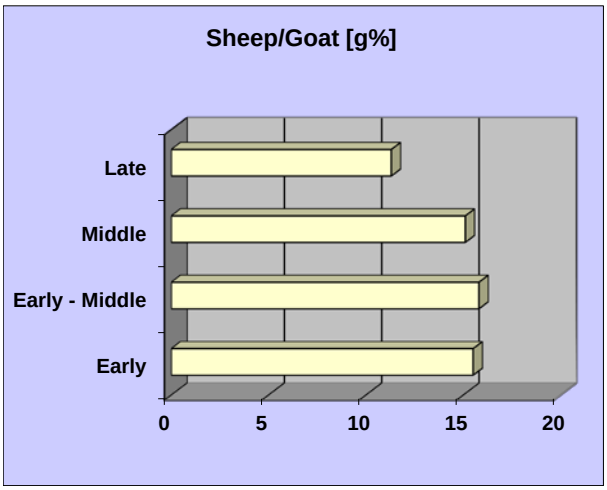


Fig. 3.2.5.3. Comparison of three main domestic animals based on number of excavated specimens in the Bronze Age settlement Savognin-Padnal in Switzerland.





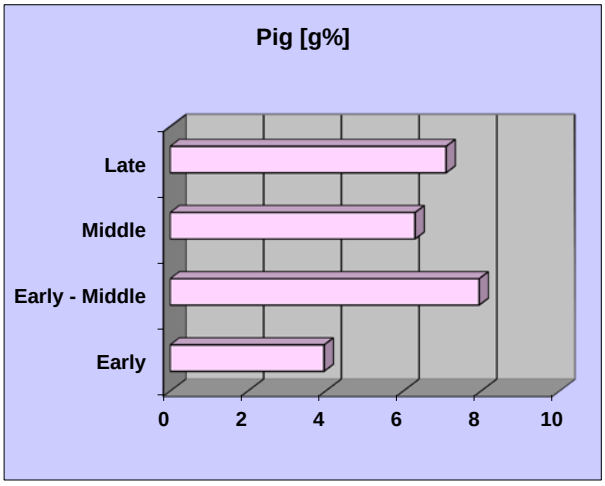


Fig. 3.2.5.4. Comparison of three main domestic animals based on the weight of excavated specimens in the Bronze Age settlement Savognin-Padnal in Switzerland.

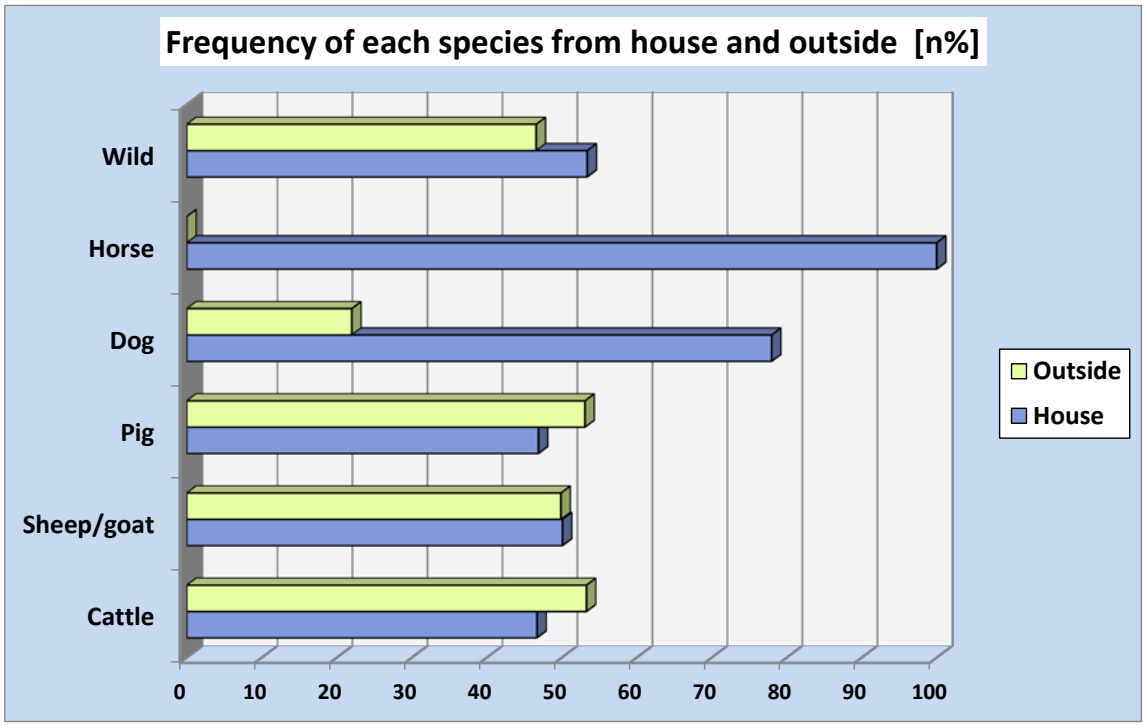


Fig. 3.2.5.5. The proportion of animals based on number of bone fragments excavated from inside and outside the houses in Field 1 and 3 in the settlement Savognin-Padnal in Switzerland.

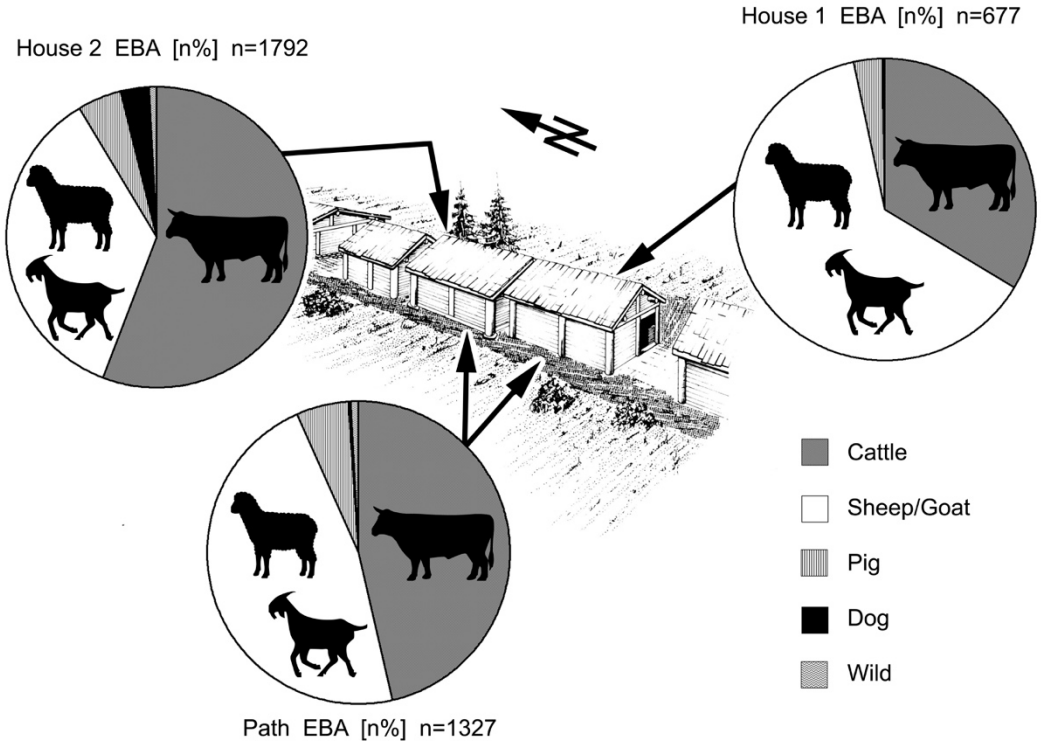


Fig. 3.2.5.6. The proportion of animal remains found from each house and from the path around the houses in the Early Bronze Age (EBA) (n = number of identified fragments) (Reconstructed picture: Rageth 1986, p. 67: Fig. 5).

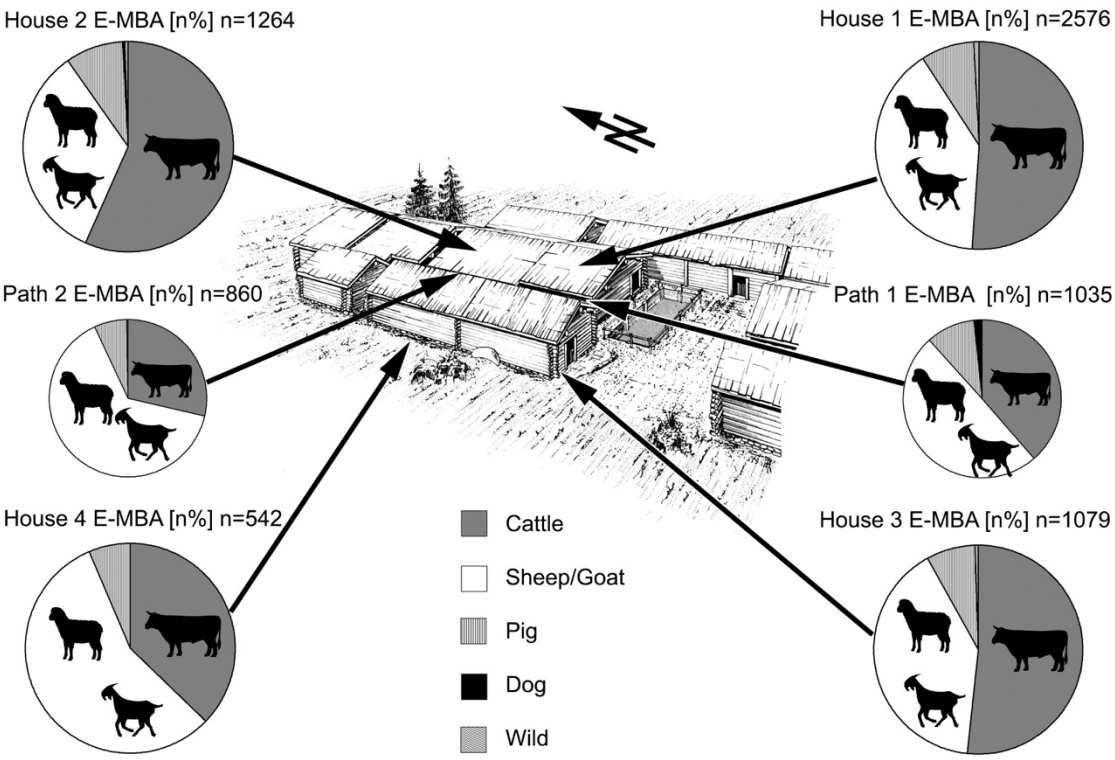
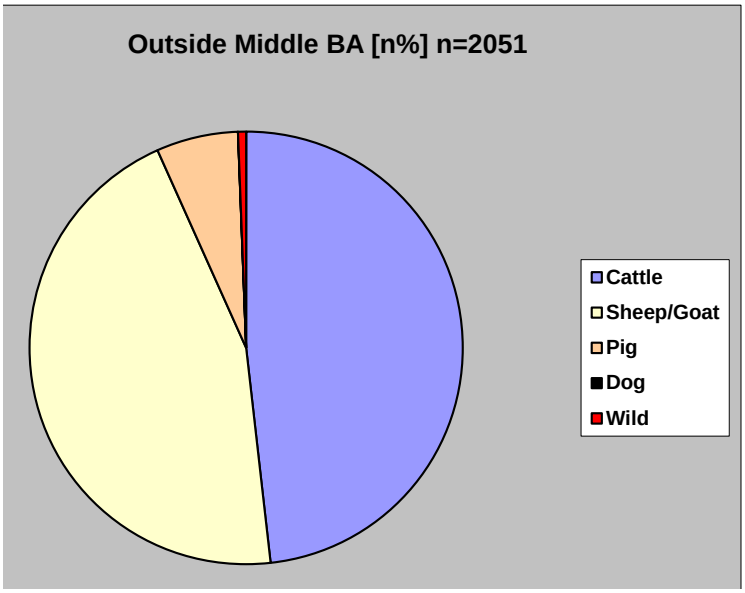


Fig. 3.2.5.7. The proportion of animal remains found from each house and from the path around the houses from the end of the Early Bronze Age to the beginning of the Middle Bronze Age (E-MBA) (n = number of identified fragments) (Reconstructed picture: Rageth 1986, p. 69: Fig. 8).



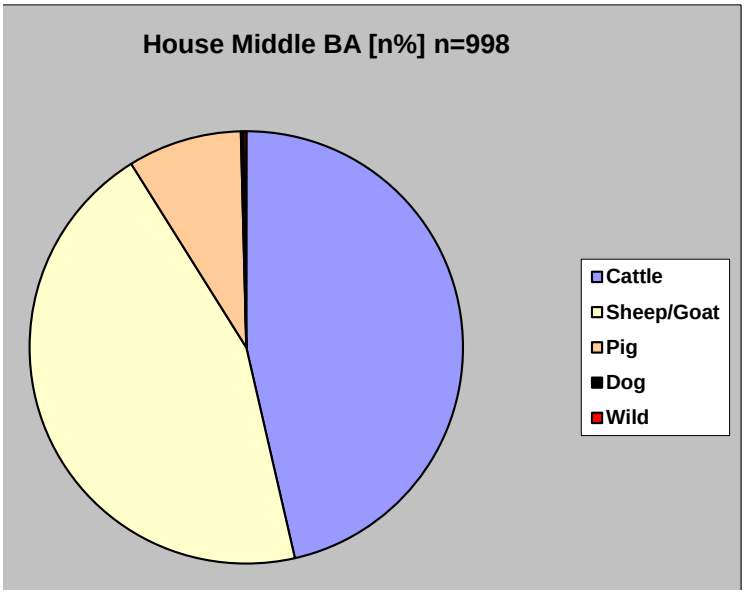


Fig. 3.2.5.8. The proportion of cattle fragments excavated from inside and outside the houses in the settlement Savognin-Padnal in Switzerland, in the Middle Bronze Age (BA) (n = number of identified fragments).

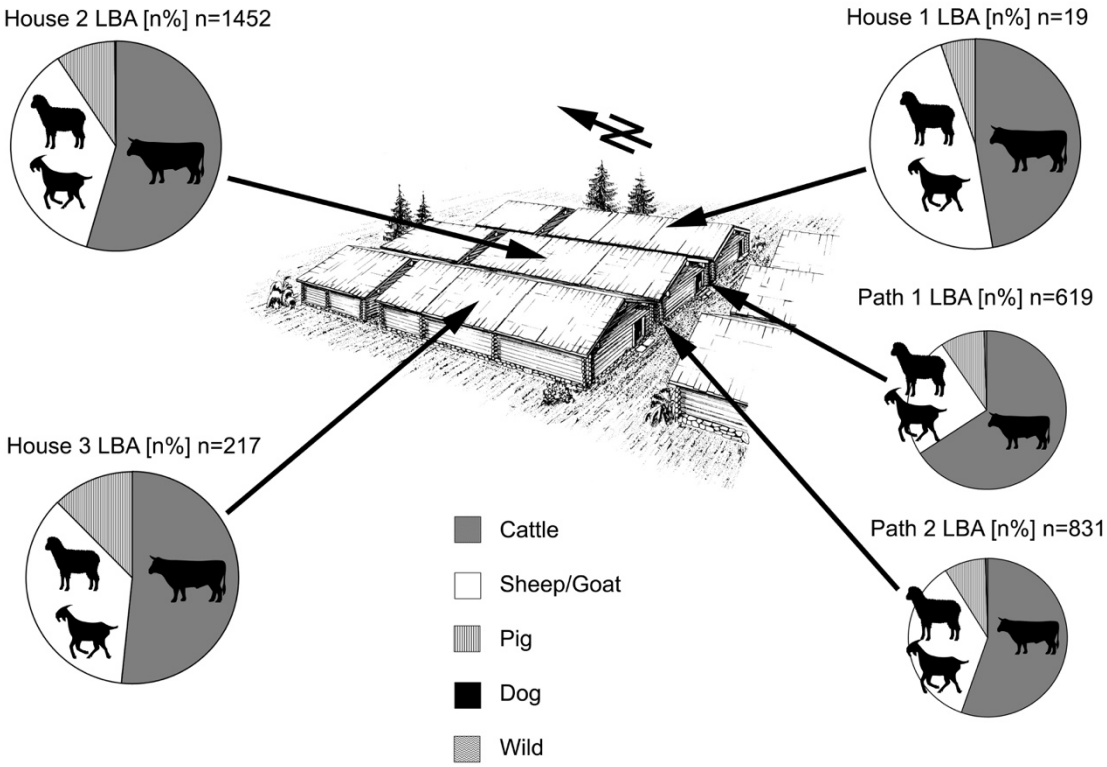


Fig. 3.2.5.9. The proportion of animal remains found from each house and from the path around the houses in the Late Bronze Age (LBA) (n = number of identified fragments) (Reconstructed picture: Rageth 1986, p. 73: Fig. 11).

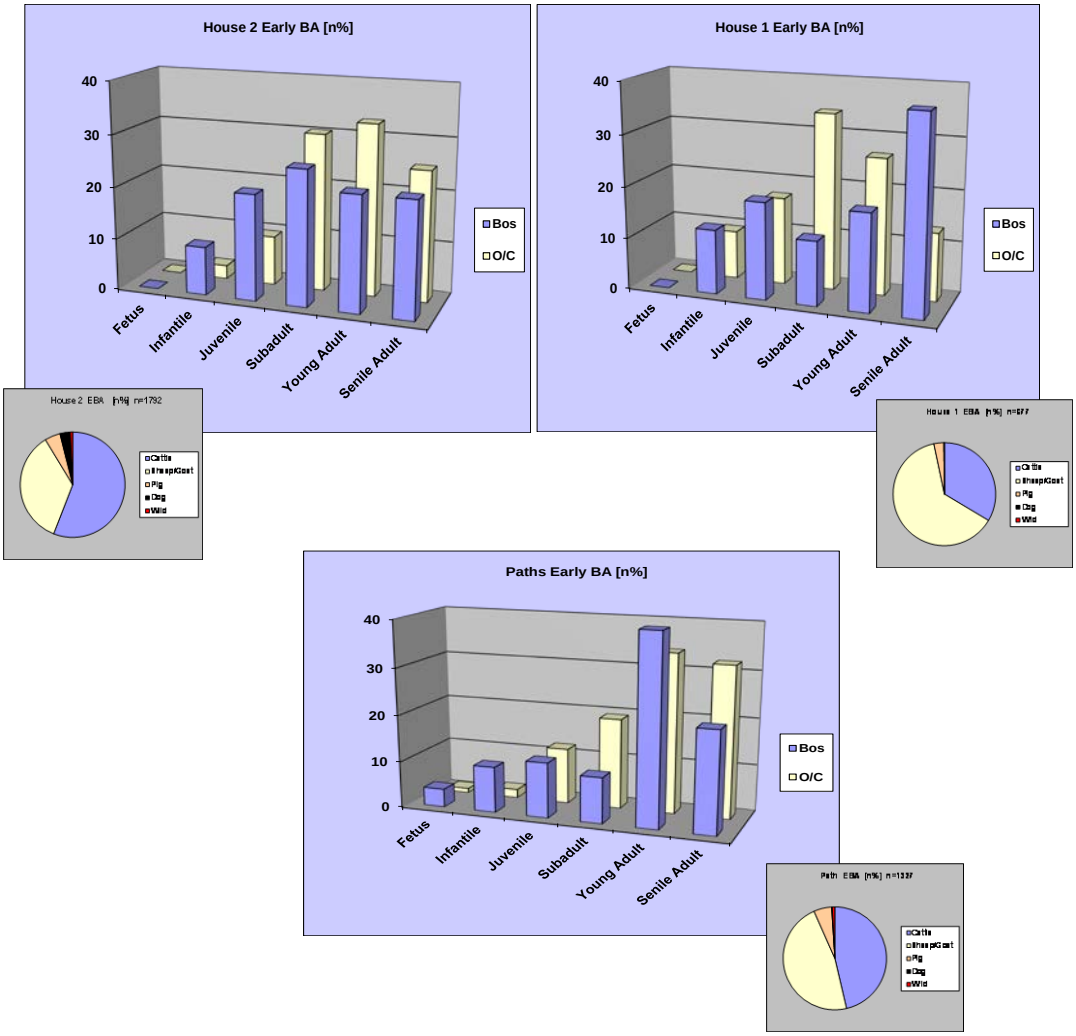


Fig. 3.2.5.10. Cattle (Bos) and sheep/goats (O/C) mortality profiles based on teeth eruption and wear in each structure from Field 3 in the settlement Savognin-Padnal in Switzerland, from the Early Bronze Age (BA).

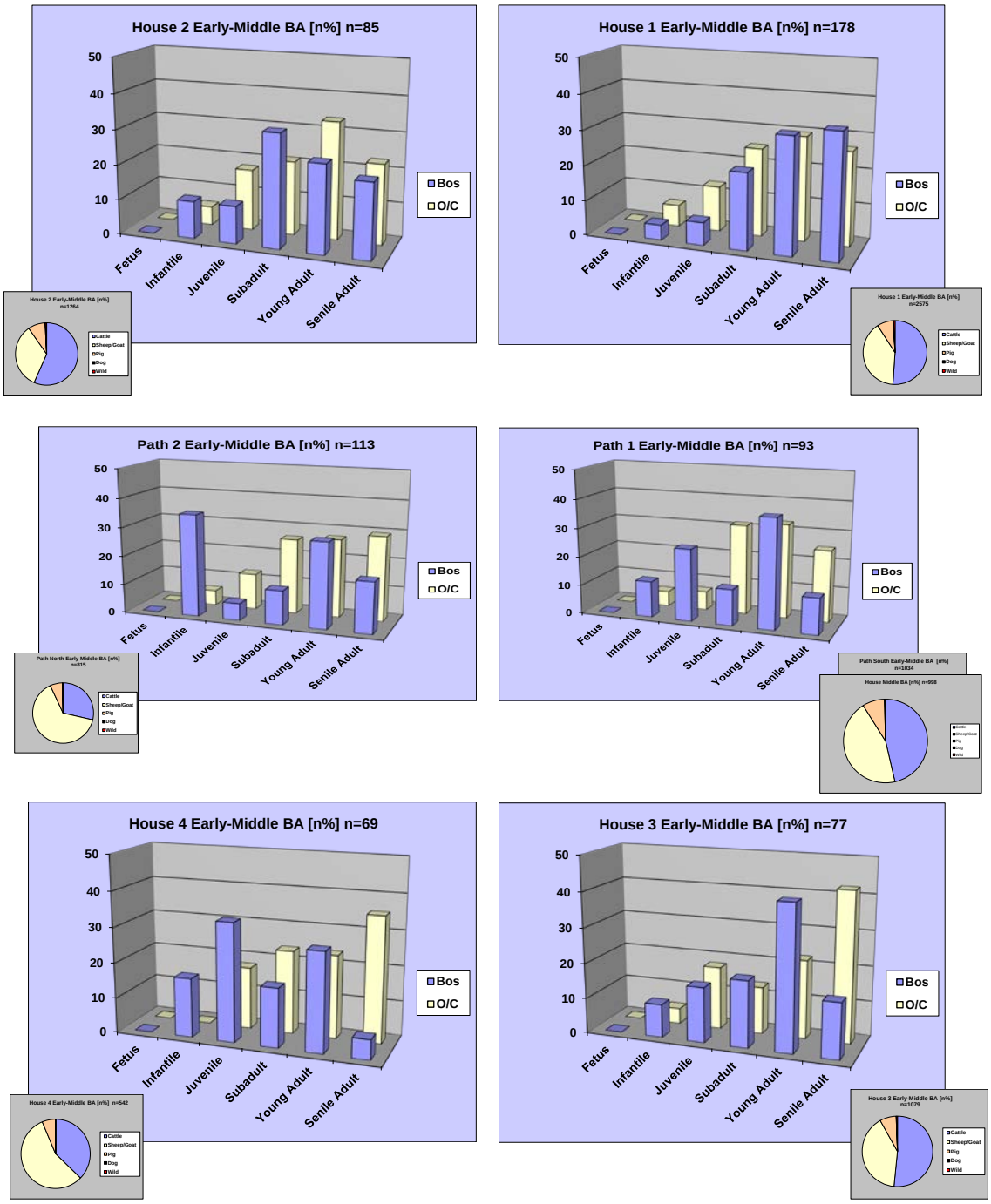
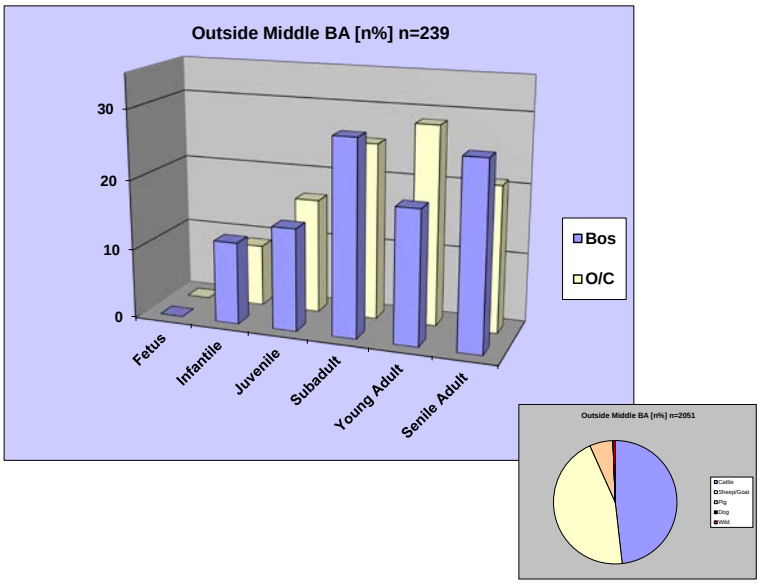


Fig. 3.2.5.11. Cattle (Bos) and sheep/goats (O/C) mortality profiles based on teeth eruption and wear in each structure from Field 3 in the settlement Savognin-Padnal in Switzerland, from the end of the Early to the beginning of the Middle Bronze Age (BA).



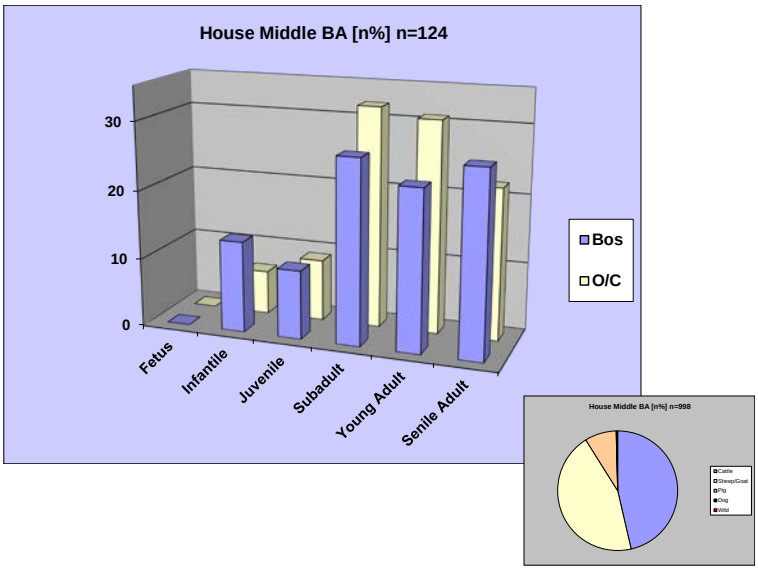


Fig. 3.2.5.12. Cattle (Bos) and sheep/goats (O/C) mortality profiles based on teeth eruption and wear in each structure from Field 3 in the settlement Savognin-Padnal in Switzerland, from the Middle Bronze Age (BA).

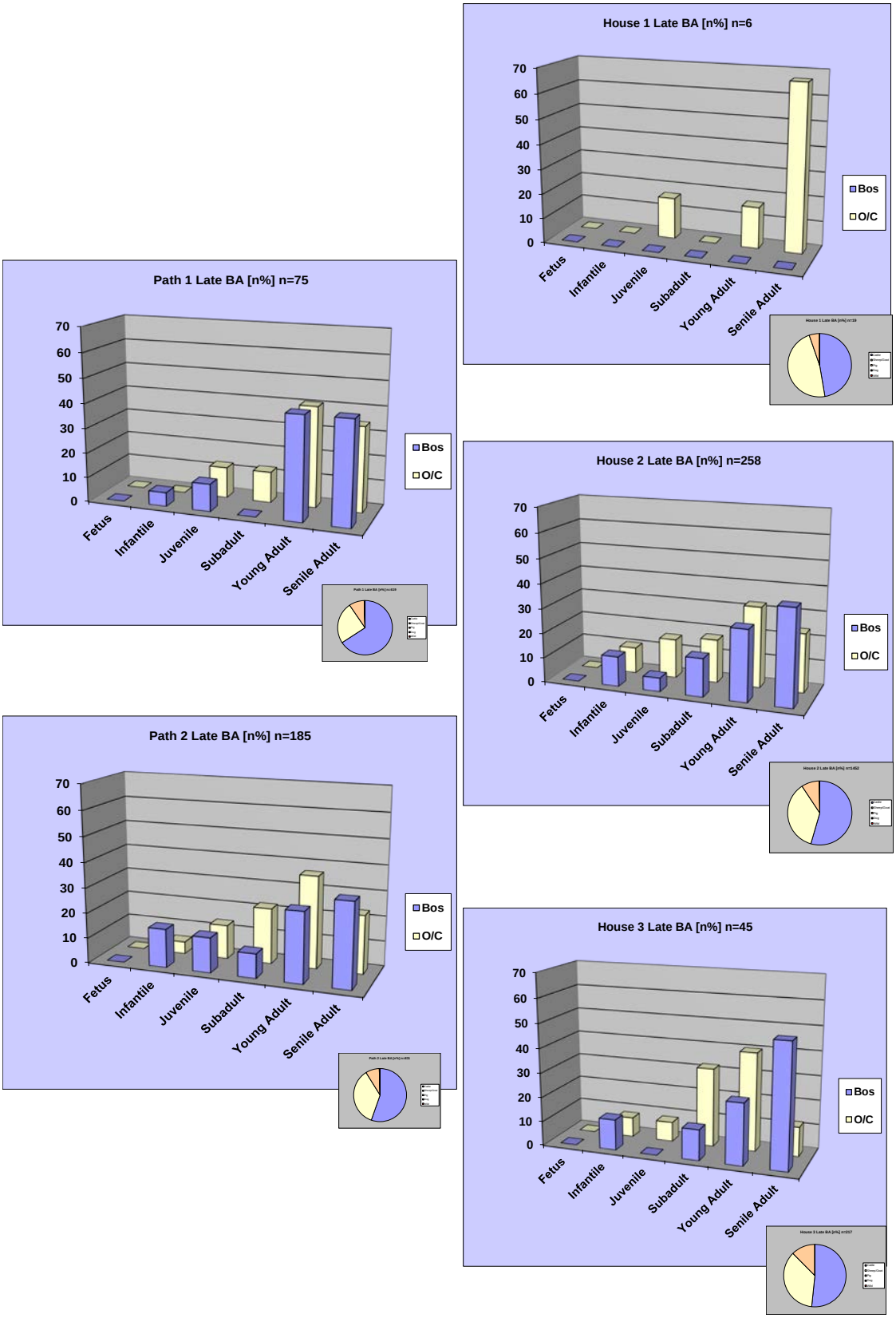


Fig. 3.2.5.13. Cattle (Bos) and sheep/goats (O/C) mortality profiles based on teeth eruption and wear in each structure from Field 3 in the settlement Savognin-Padnal in Switzerland, from the Late Bronze Age (BA).

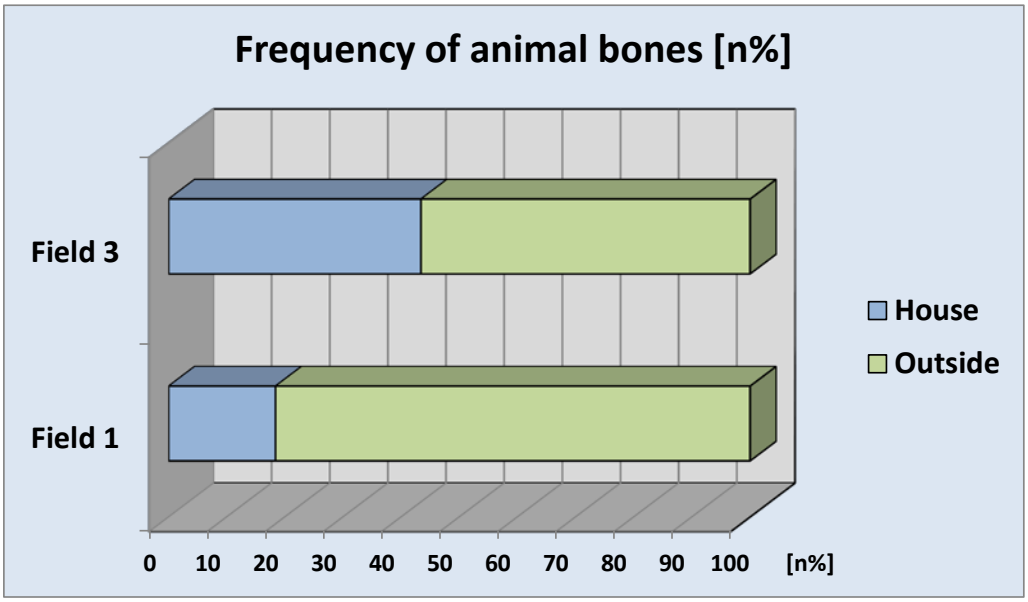


Fig. 3.2.5.14. The proportion of specimens found inside and outside the houses based on number of identified animal specimens in each Field during the Middle and Late Bronze Ages, from the settlement Savognin-Padnal in Switzerland.

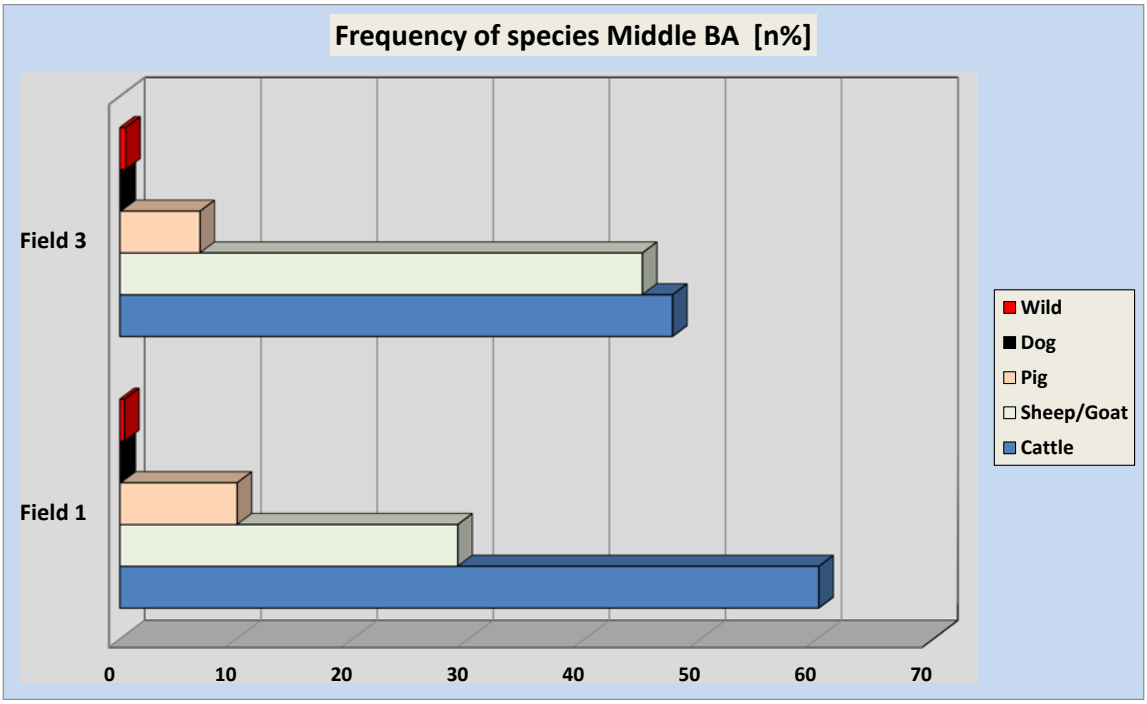


Fig. 3.2.5.15. The proportion of animal species based on number of fragments in each Field in the Middle Bronze Age, from the settlement Savognin-Padnal in Switzerland.

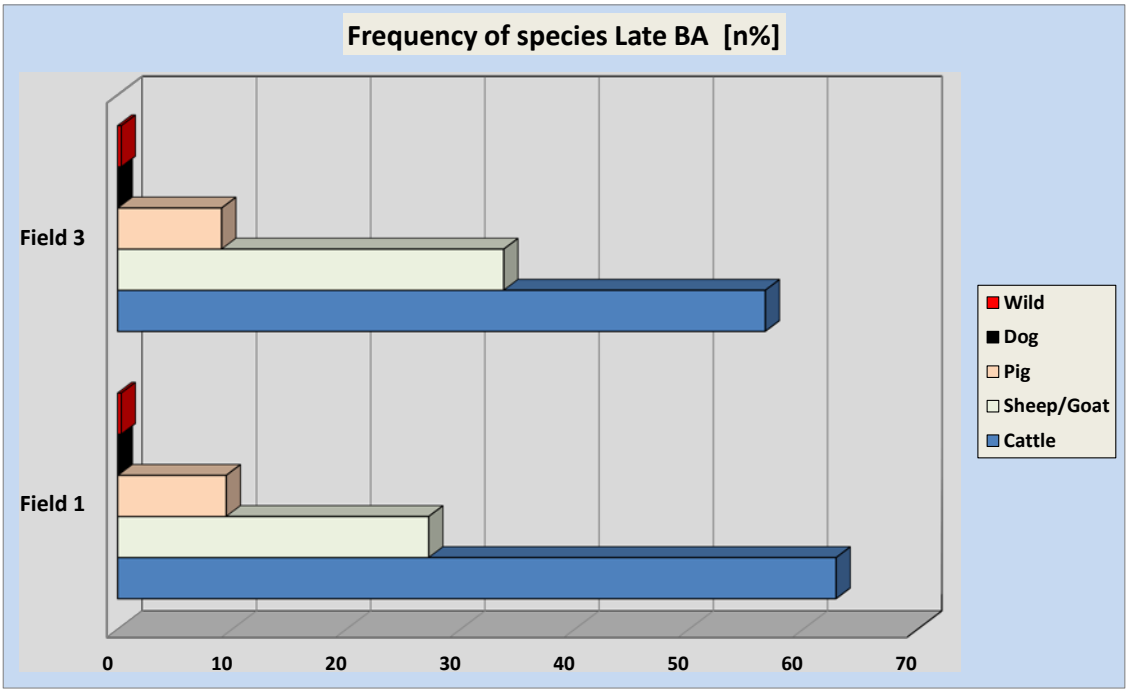
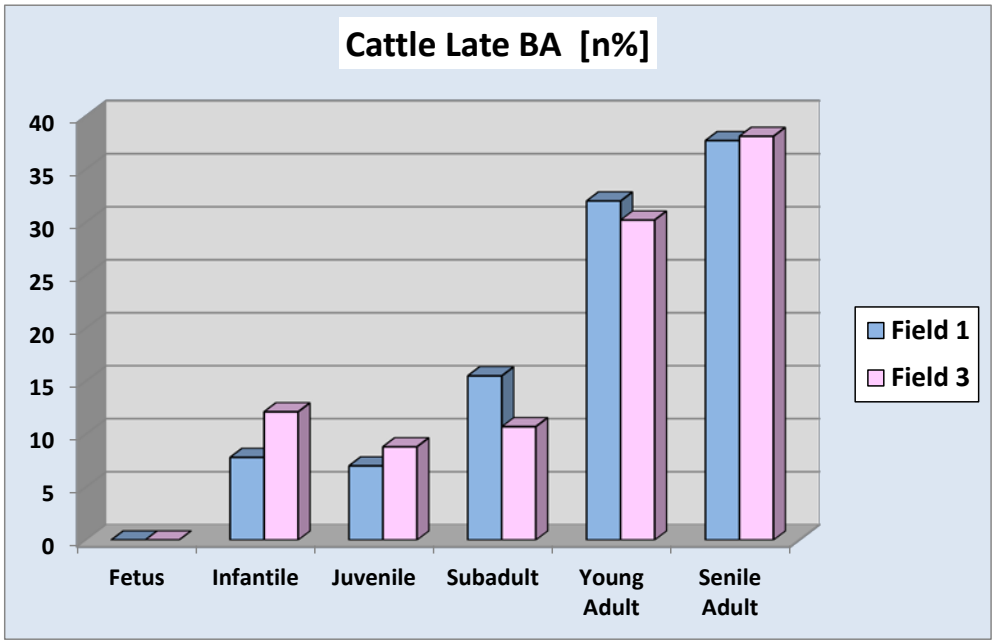


Fig. 3.2.5.16. The proportion of animal species based on number of fragments in each Field in the Late Bronze Age, from the settlement Savognin-Padnal in Switzerland.



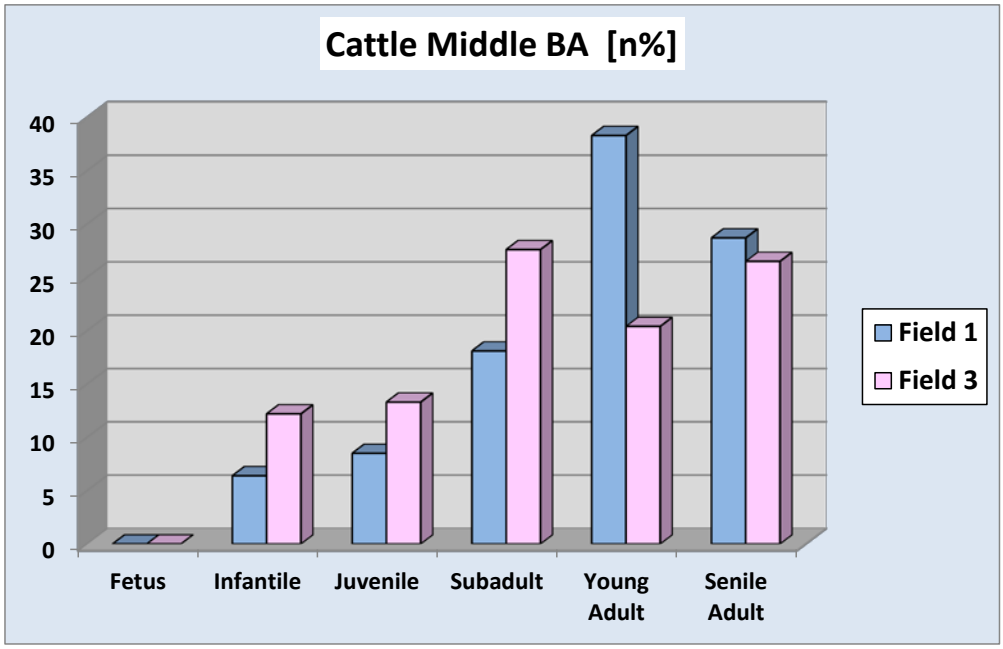
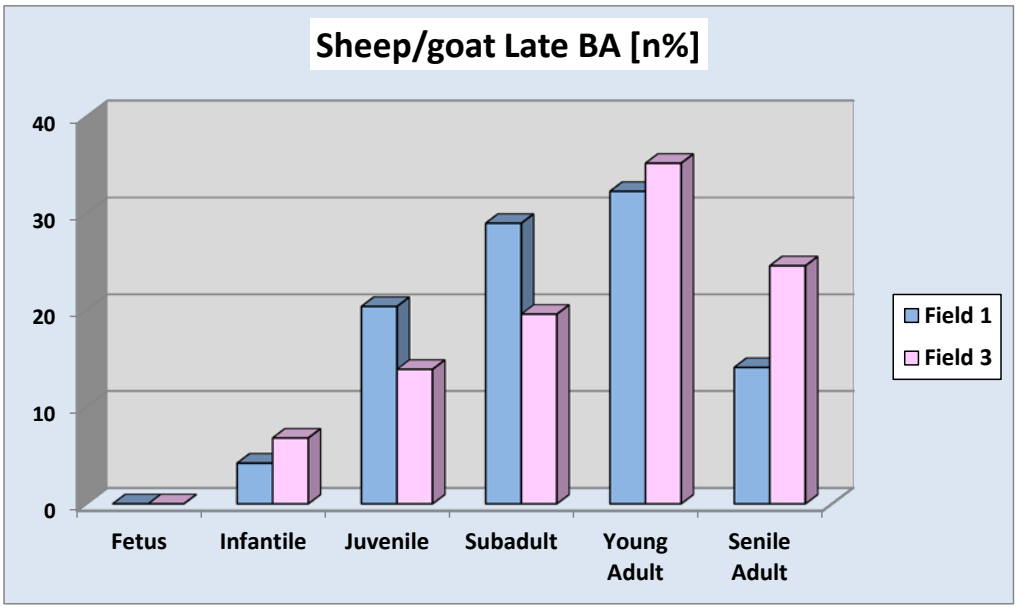


Fig. 3.2.5.17. Cattle mortality profiles from Field 1 and 3 based on teeth eruption and wear. Late Bronze Age (above), Middle Bronze Age (below). BA = Bronze Age.



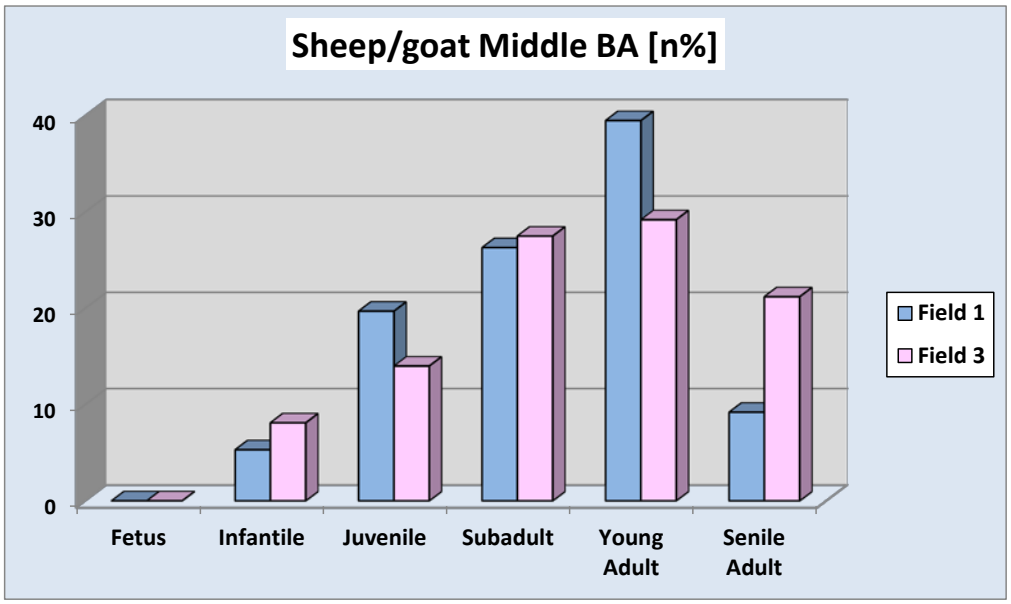
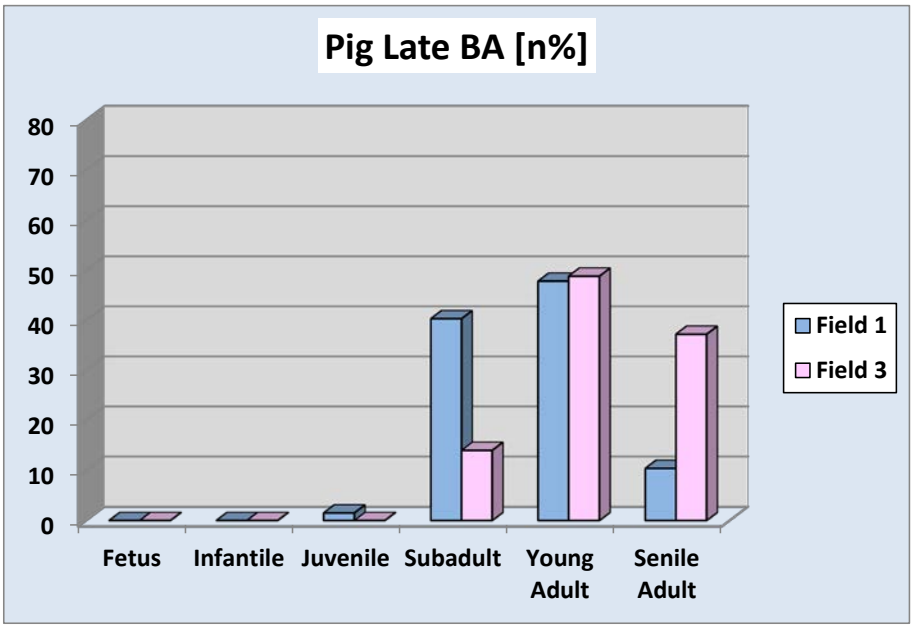


Fig. 3.2.5.18. Sheep/goat mortality profiles from Field 1 and 3 based on teeth eruption and wear. Late Bronze Age (above), Middle Bronze Age (below). BA = Bronze Age.



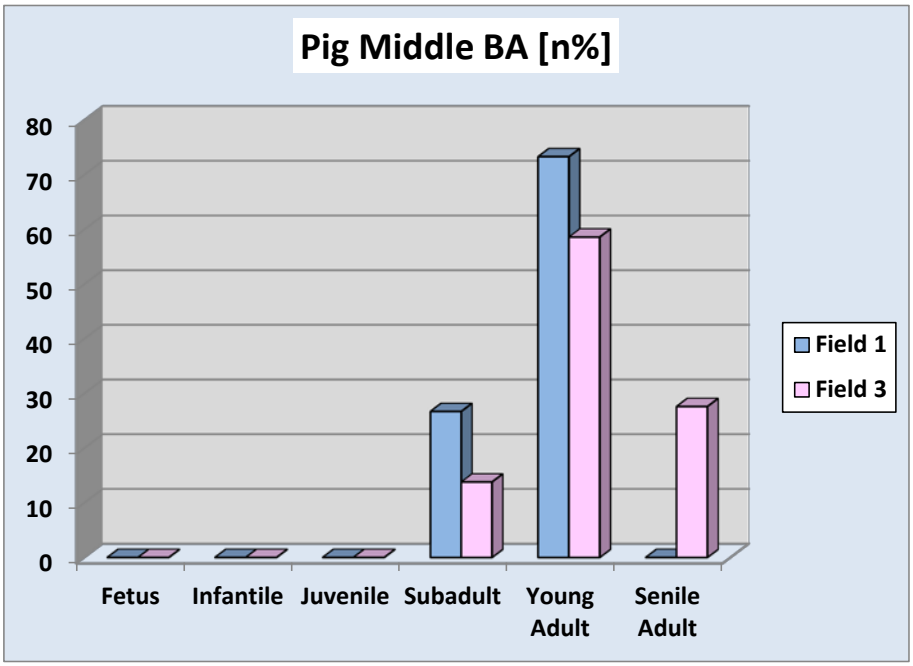


Fig. 3.2.5.19. Pig mortality profiles from Field 1 and 3 based on teeth eruption and wear. Late Bronze Age (above), Middle Bronze Age (below). BA = Bronze Age.

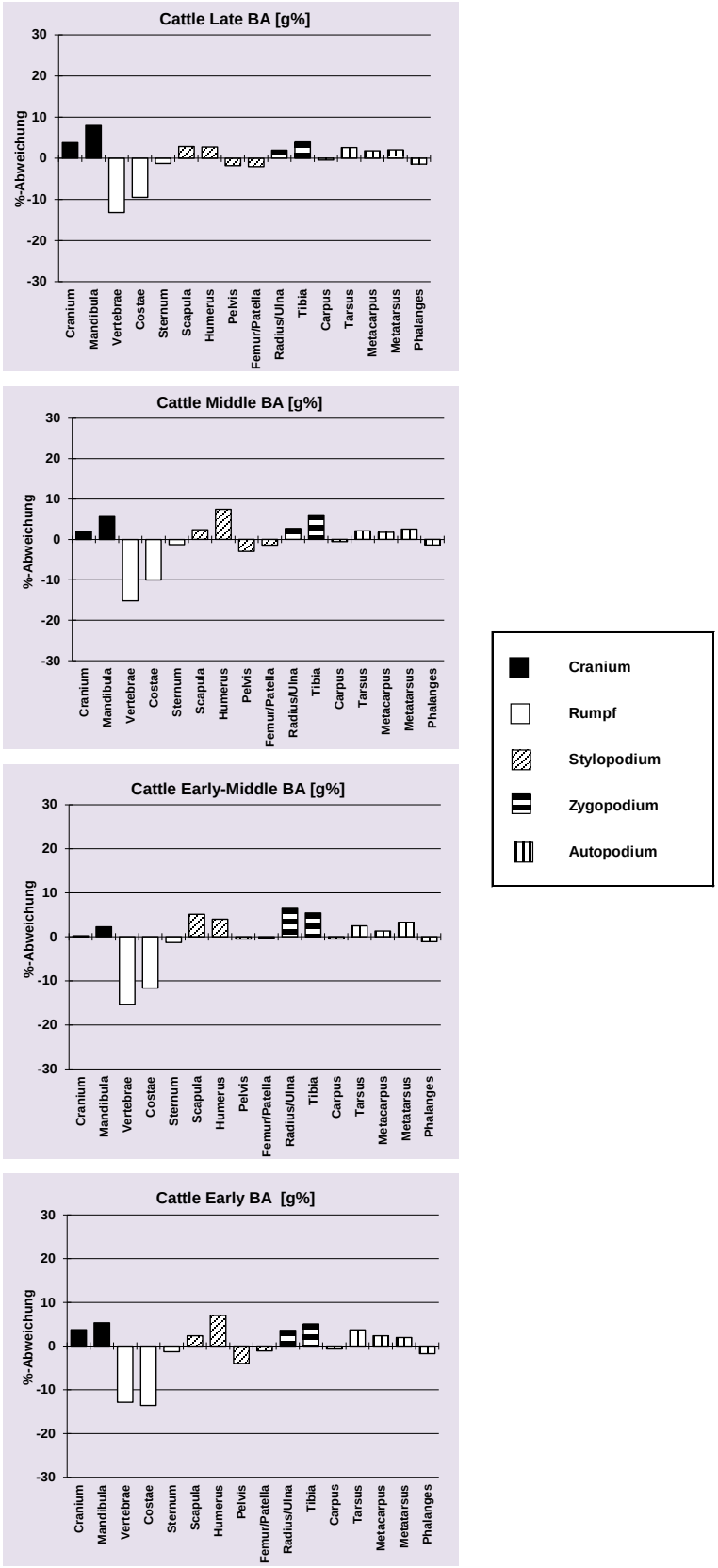


Fig. 3.3.1. Skeletal spectrum of cattle in each Bronze Age (BA) phase based on the weight of identified specimens that were excavated from the settlement Savognin-Padnal in Switzerland.

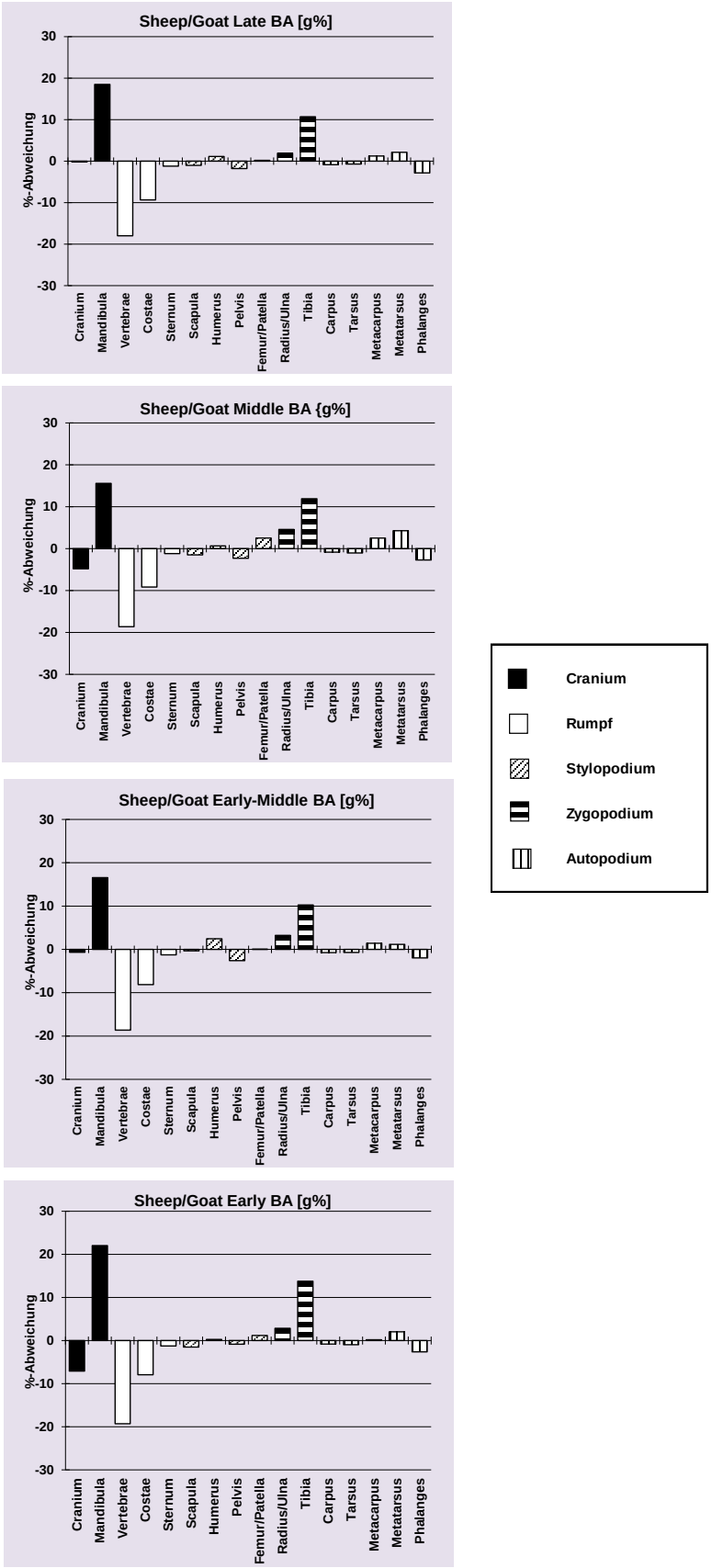


Fig. 3.3.2. Skeletal spectrum of sheep/goat in each Bronze Age (BA) phase based on the weight of identified specimens that were excavated from the settlement Savognin-Padnal in Switzerland.

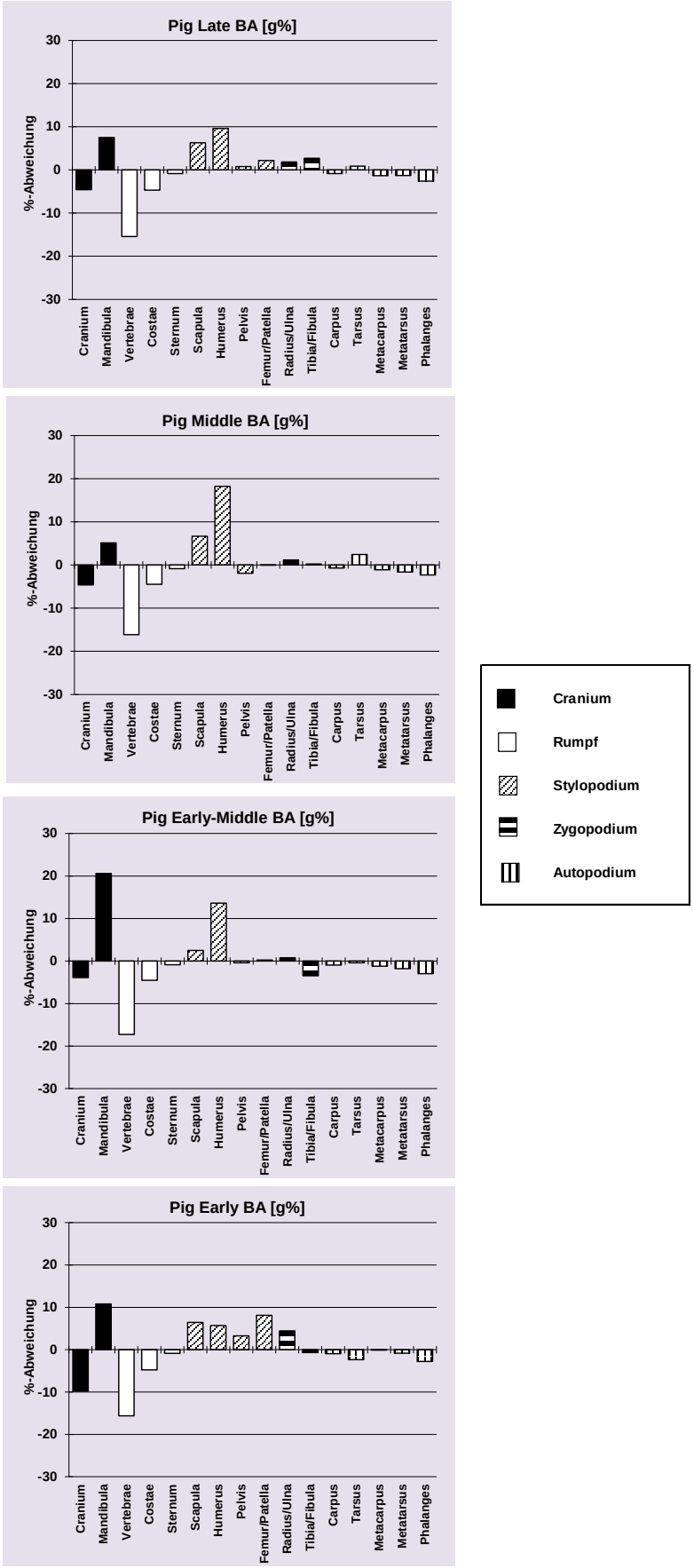


Fig. 3.3.3. Skeletal spectrum of pig in each Bronze Age (BA) phase based on the weight of identified specimens that were excavated from the settlement Savognin-Padnal in Switzerland.

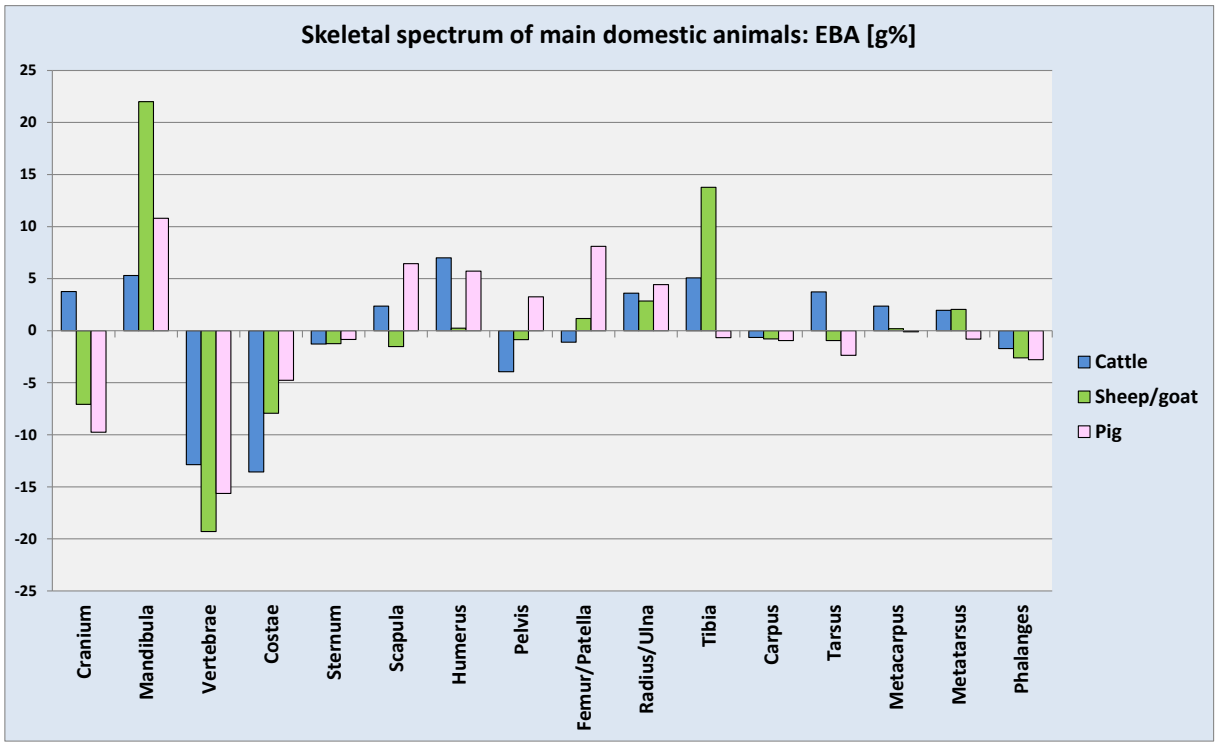


Fig. 3.3.4. Skeletal spectrum of the three main domestic animals in the Early Bronze Age (EBA) phase based on the weight of identified specimens that were excavated from the settlement Savognin-Padnal in Switzerland.

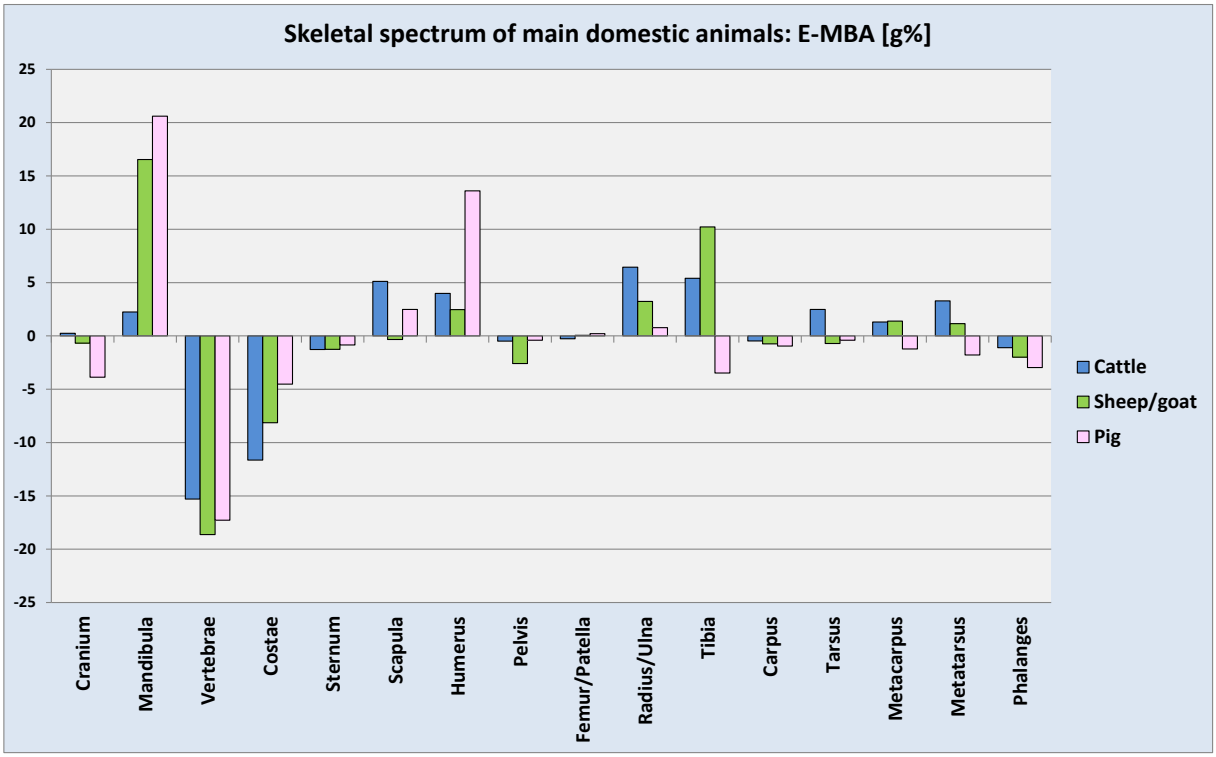


Fig. 3.3.5. Skeletal spectrum of three main domestic animals in the Early-Middle Bronze Age (E-MBA) phase based on the weight of identified specimens that were excavated from the settlement Savognin-Padnal in Switzerland.

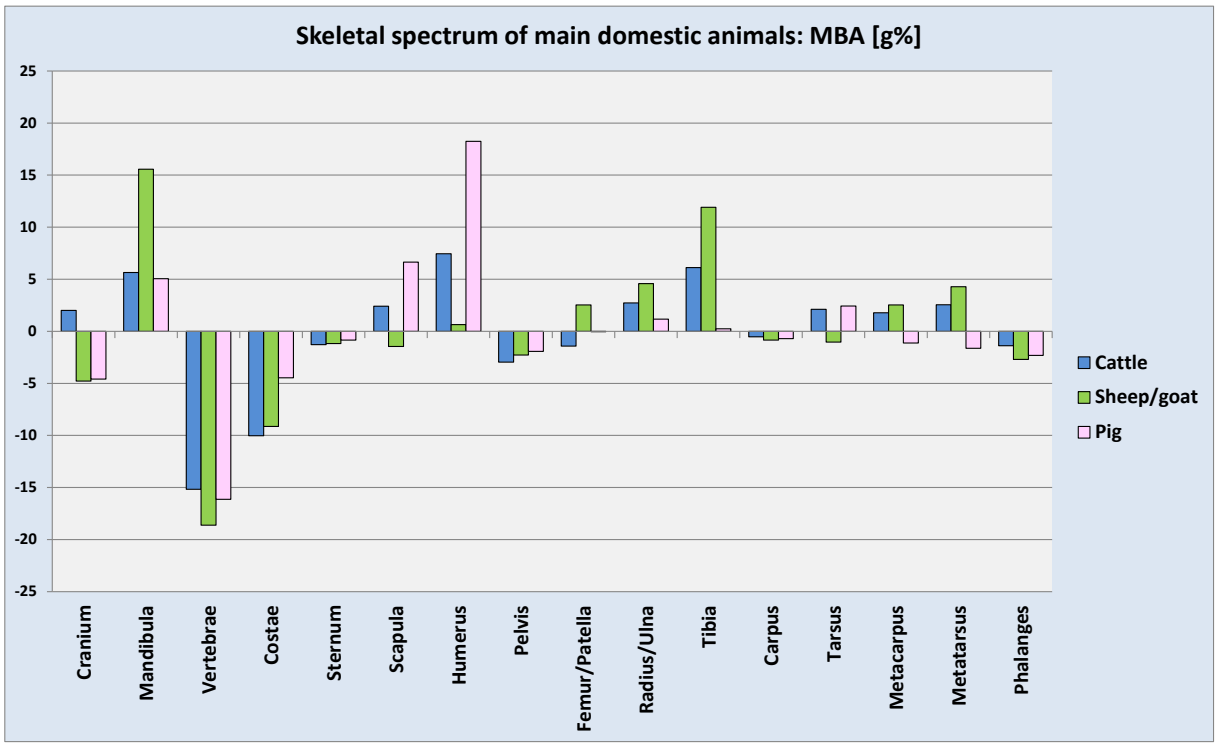


Fig. 3.3.6. Skeletal spectrum of three main domestic animals in the Middle Bronze Age (MBA) phase based on the weight of identified specimens that were excavated from the settlement Savognin-Padnal in Switzerland.

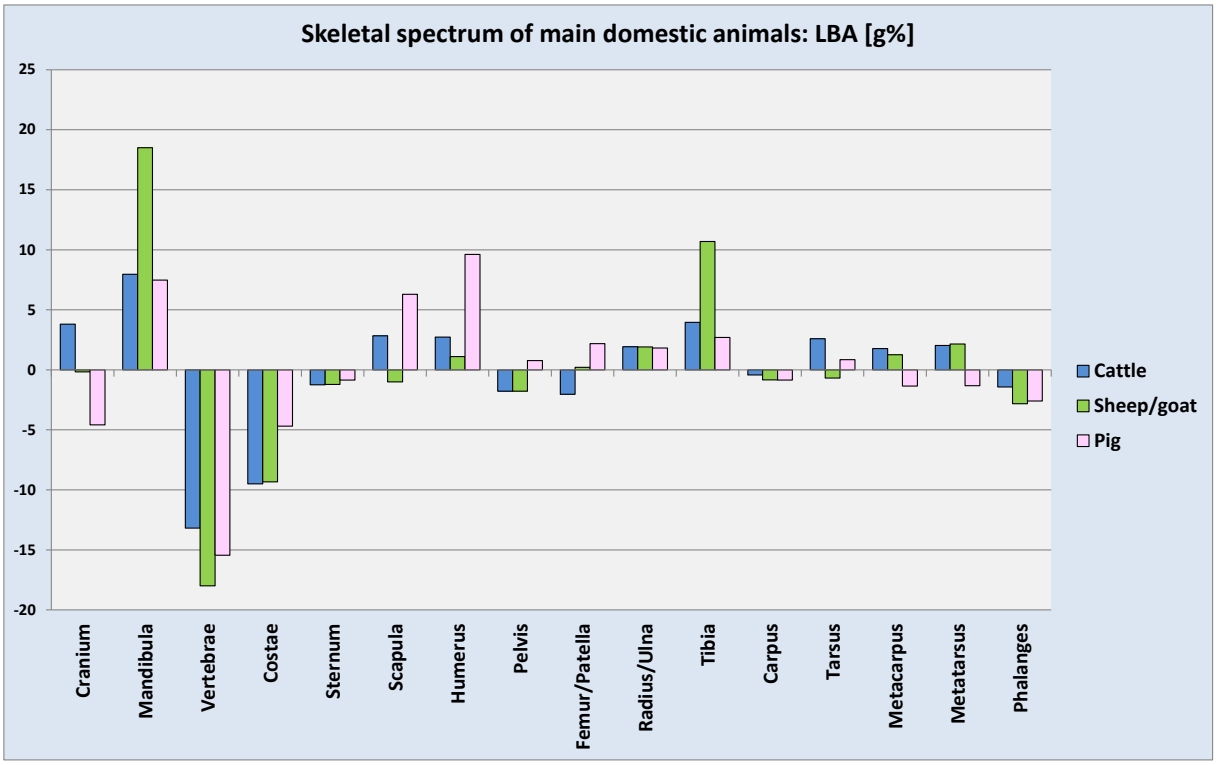


Fig. 3.3.7. Skeletal spectrum of the three main domestic animals in the Late Bronze Age (LBA) phase based on the weight of identified specimens that were excavated from the settlement Savognin-Padnal in Switzerland.

No.	Category	Size	Explanation	Detail explanation
1	Smallest	1/5-2/5sC	Short length & sC (small circumference)	1/5 to 2/5 length and less than half circumference
2	Small	1/5-2/5bC	Short length & bC (big circumference)	1/5 to 2/5 length and more than half circumference
3	Big	>3/5sC	Long length & sC (small circumference)	Over 3/5 length and less than half circumference
4	Biggest	>3/5bC	Long length & bC (big circumference)	Over 3/5 length and more than half circumference

Fig. 3.3.8. Four size categories of long bones.

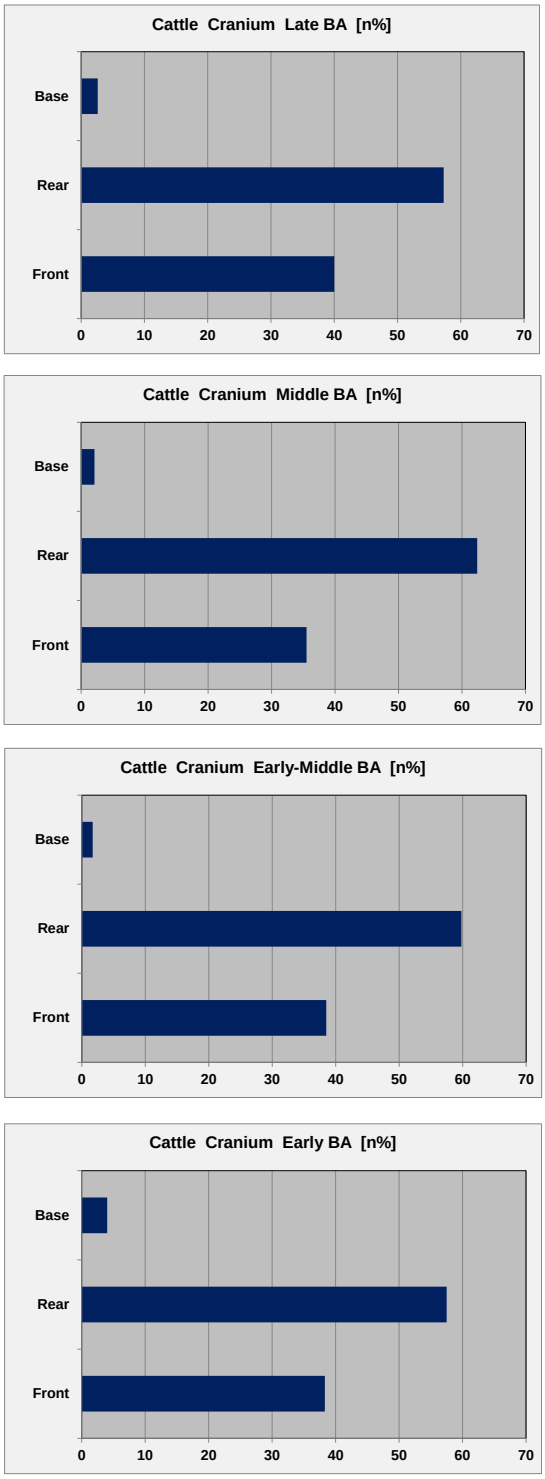


Fig. 3.3.9. Fragmentation of cattle Cranium based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.

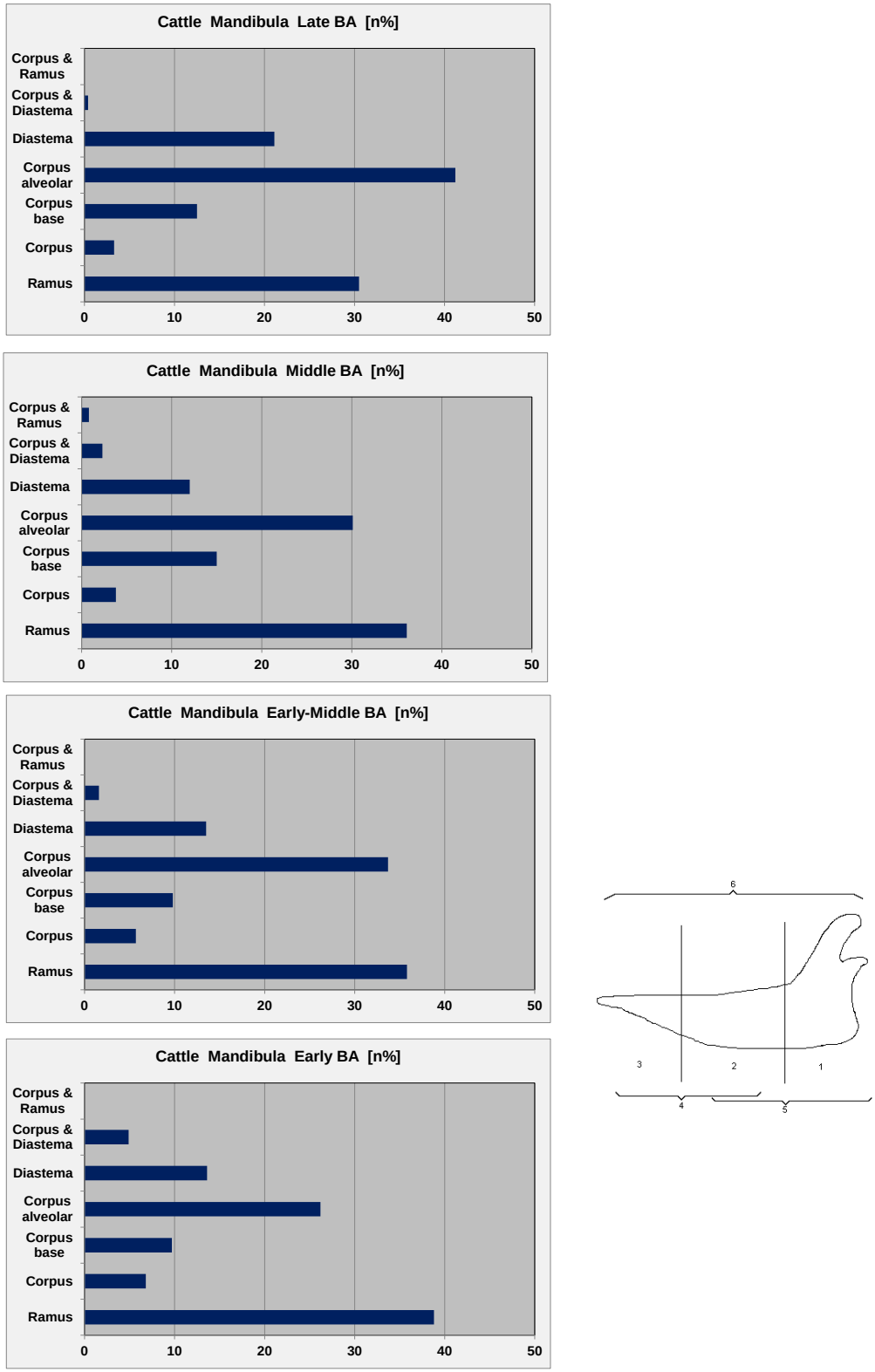
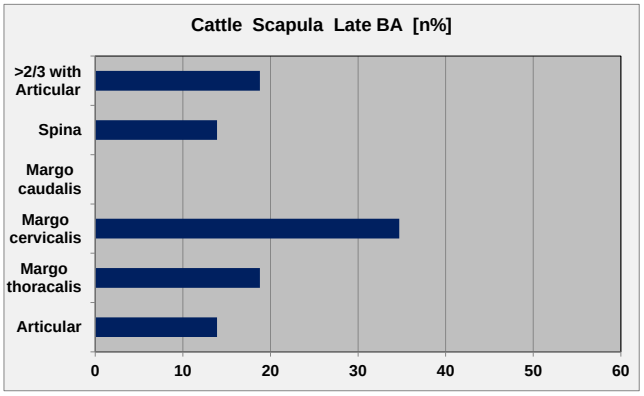
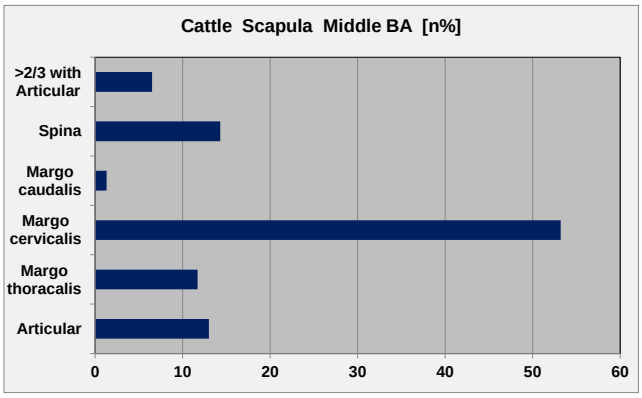
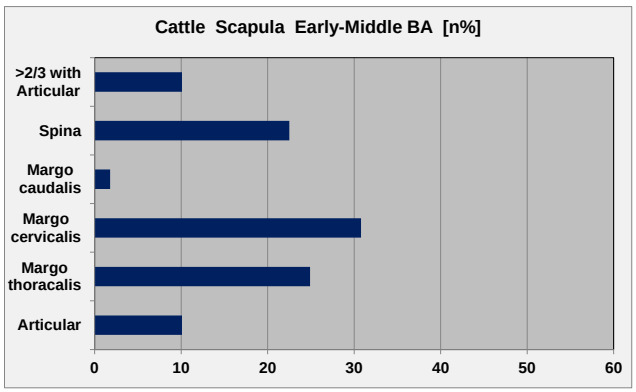
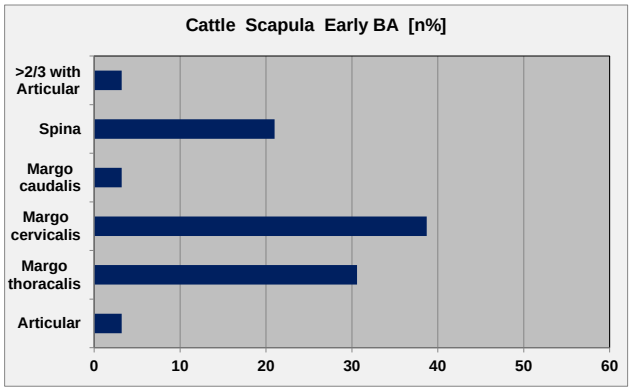


Fig. 3.3.10. Fragmentation of cattle Mandibula based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.









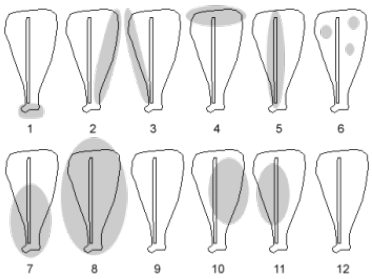


Fig. 3.3.11. Fragmentation of cattle Scapula based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.

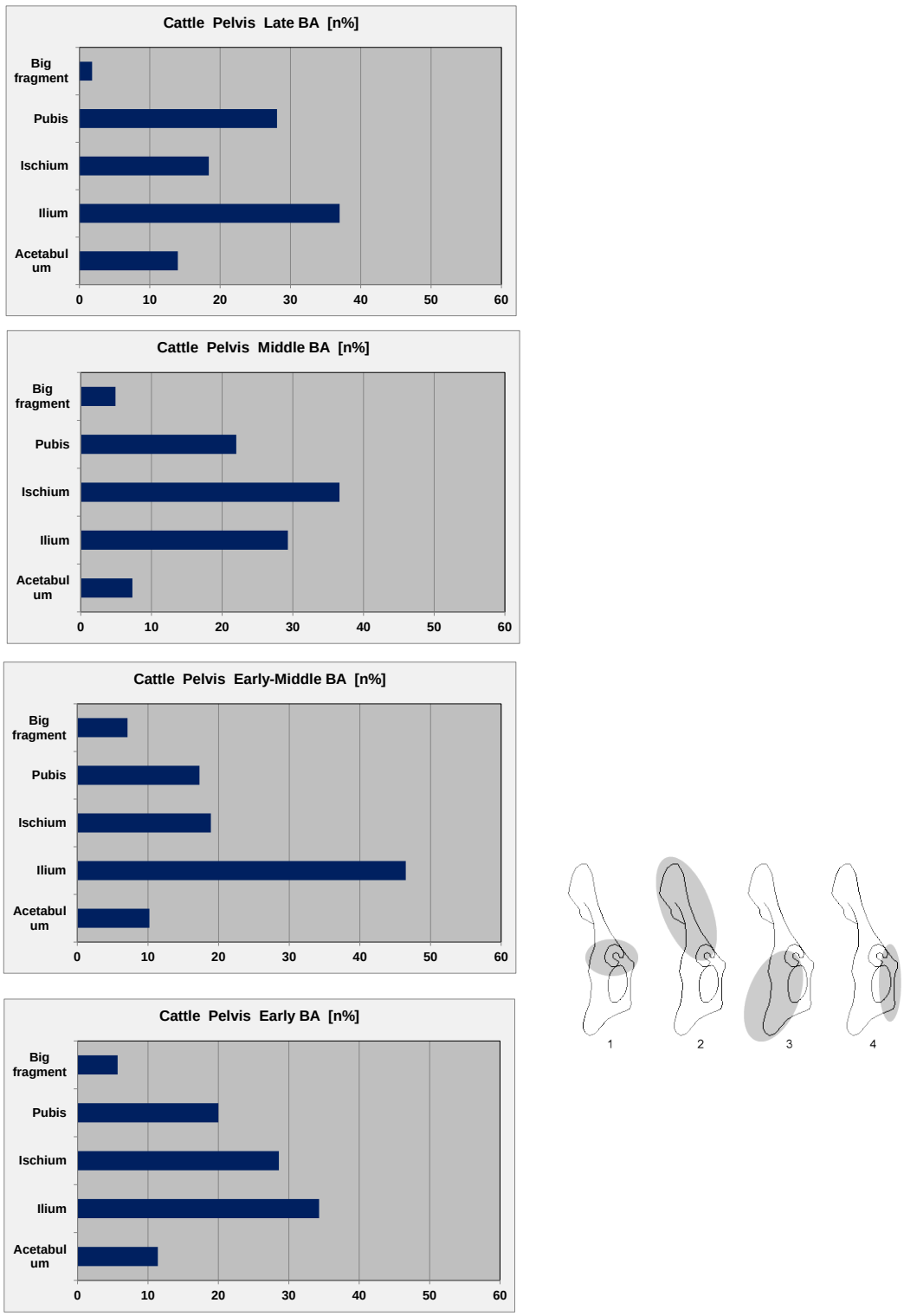
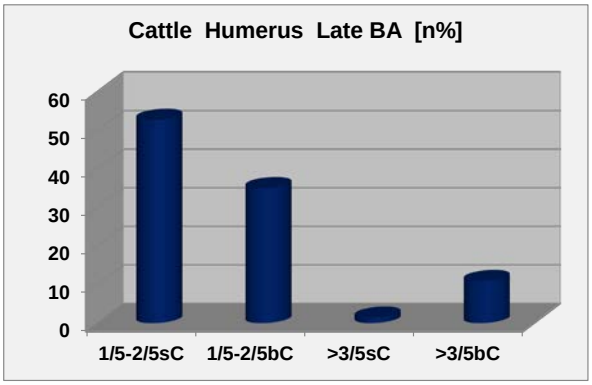
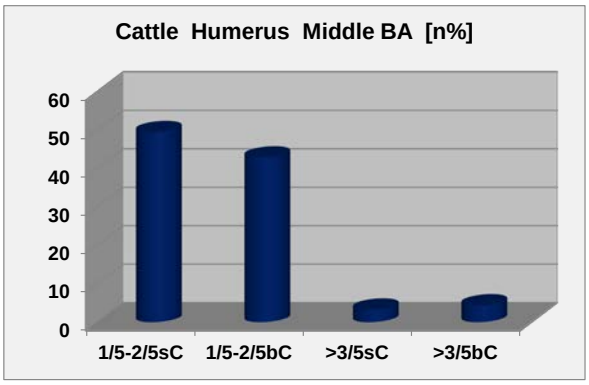
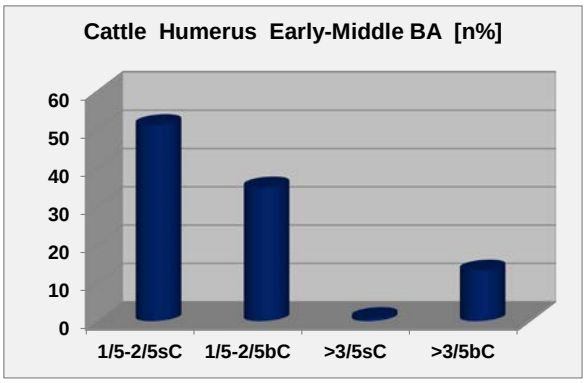


Fig. 3.3.12. Fragmentation of cattle Pelvis based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.







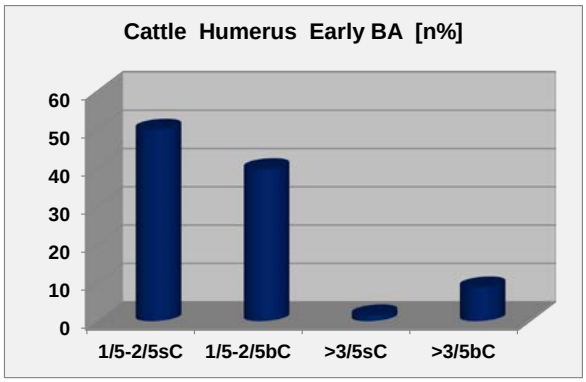
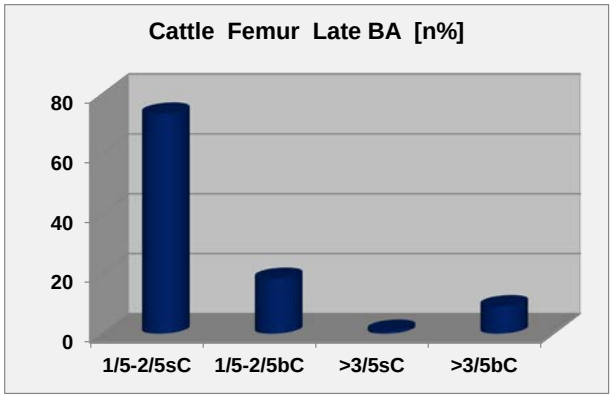
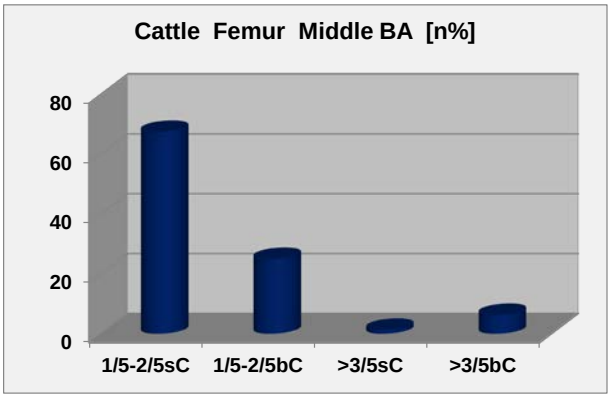
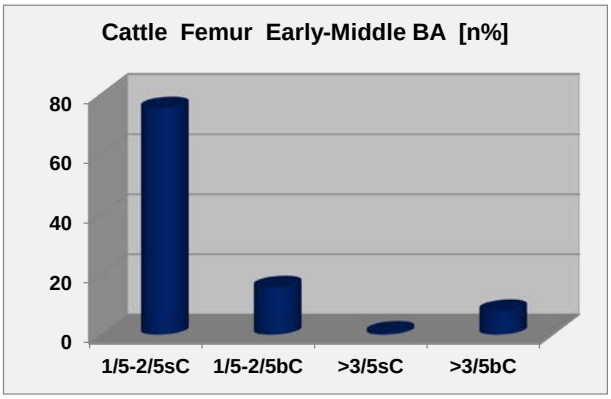


Fig. 3.3.13. Fragmentation of cattle Humerus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







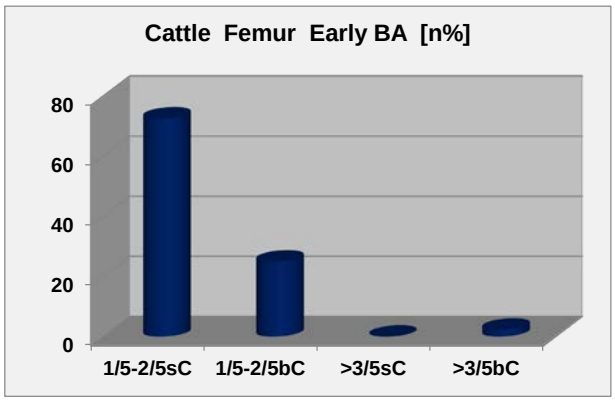


Fig. 3.3.14. Fragmentation of cattle Femur based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

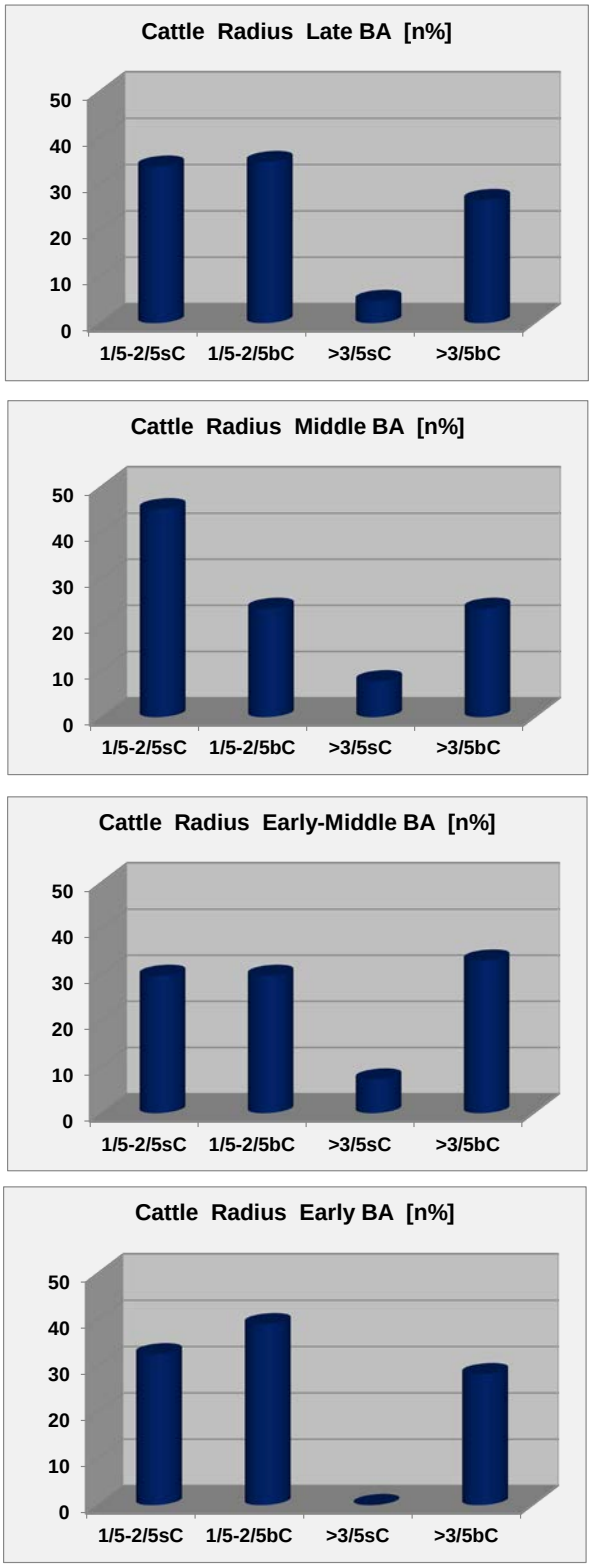
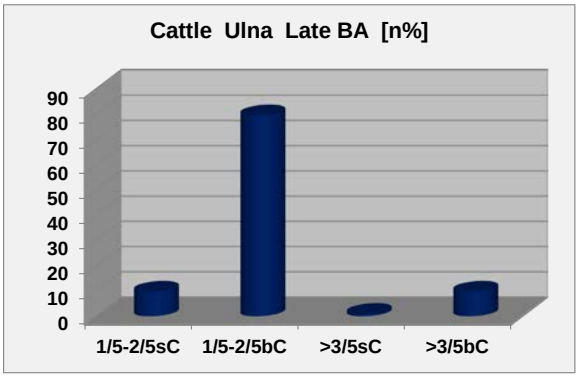
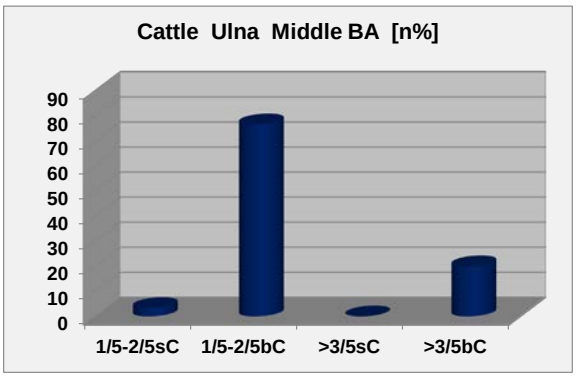
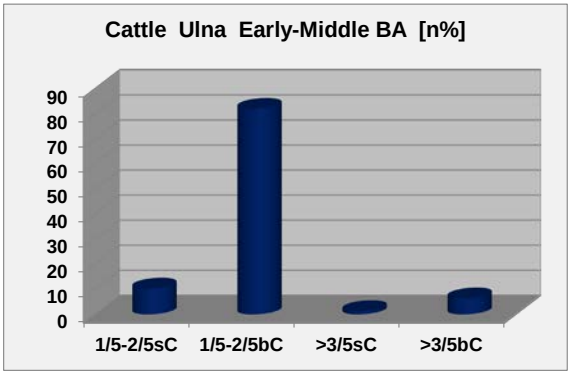


Fig. 3.3.15. Fragmentation of cattle Radius based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







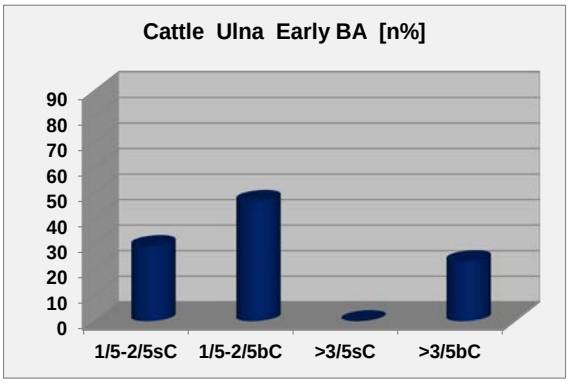


Fig. 3.3.16. Fragmentation of cattle Ulna based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

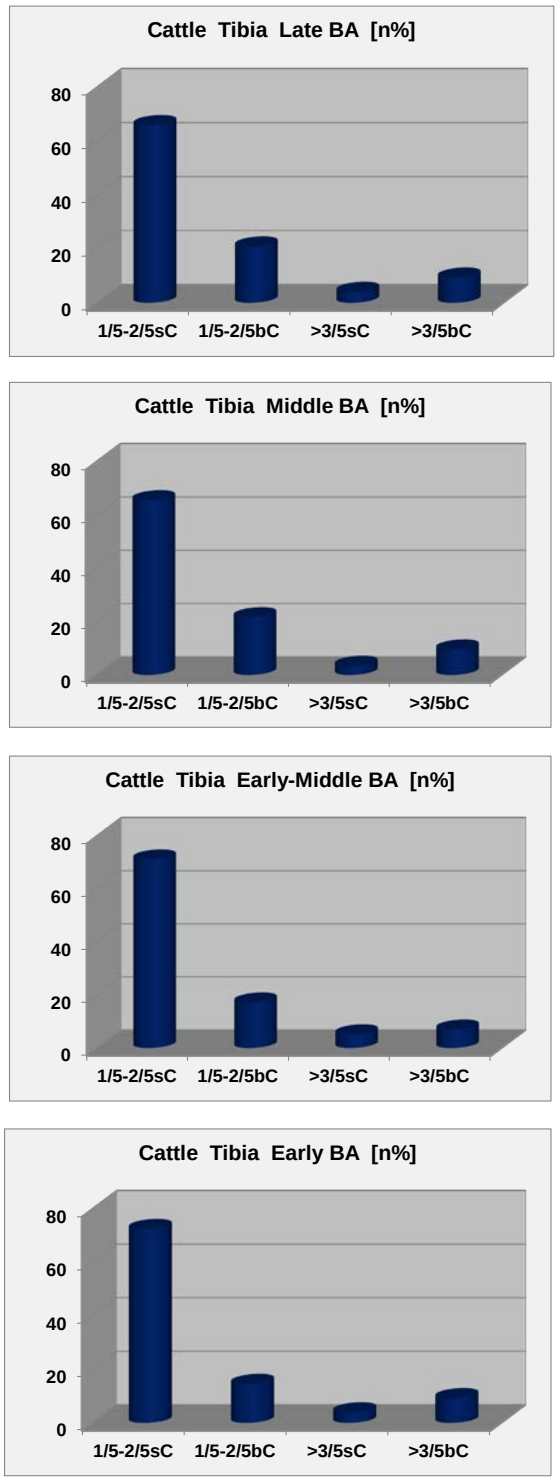


Fig. 3.3.17. Fragmentation of cattle Tibia based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

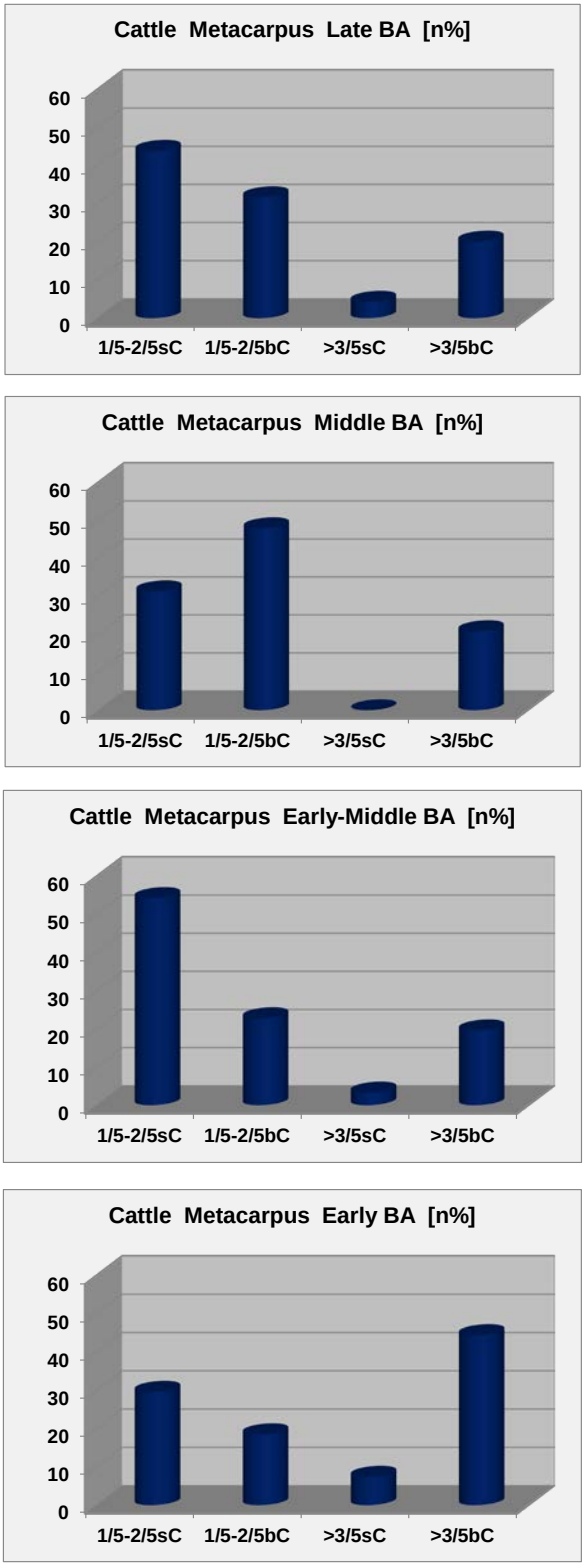
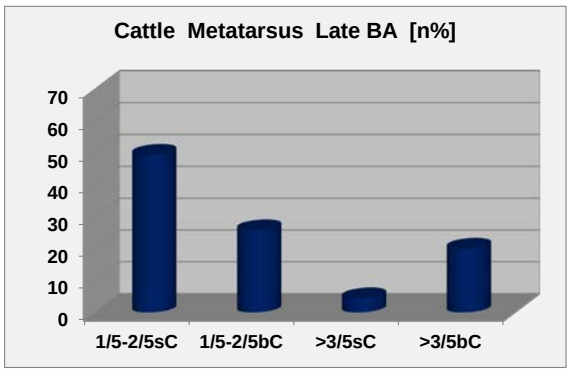
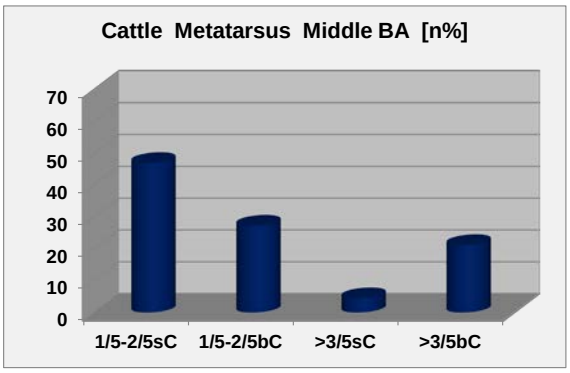
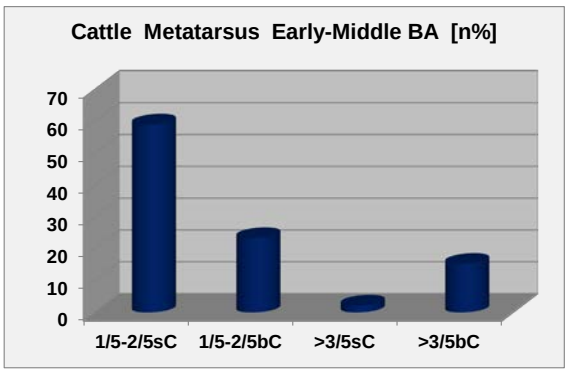


Fig. 3.3.18. Fragmentation of cattle Metacarpus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







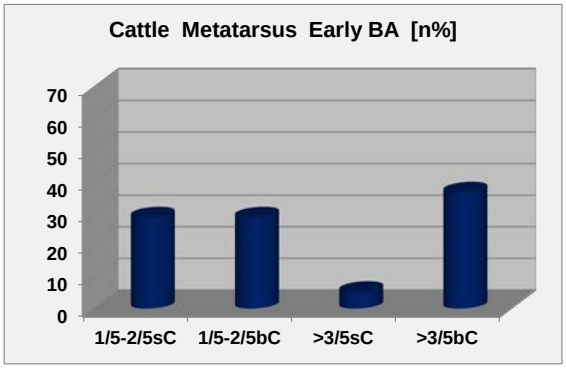


Fig. 3.3.19. Fragmentation of cattle Metatarsus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

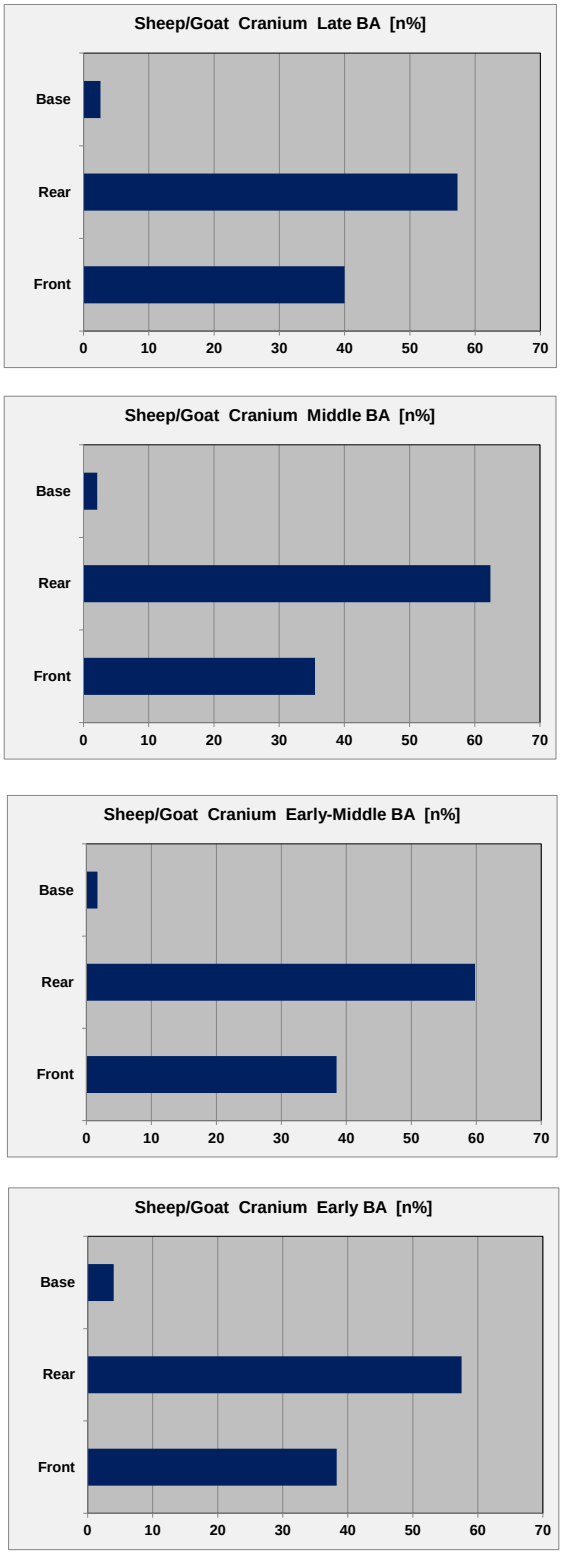
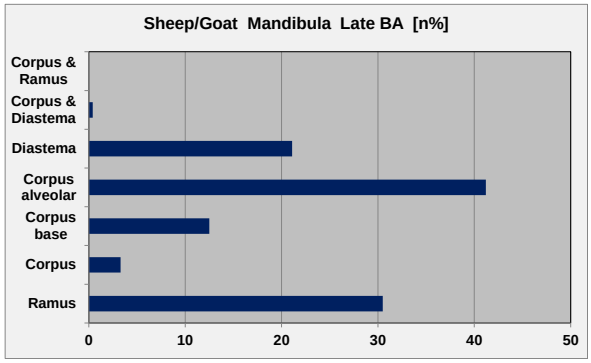
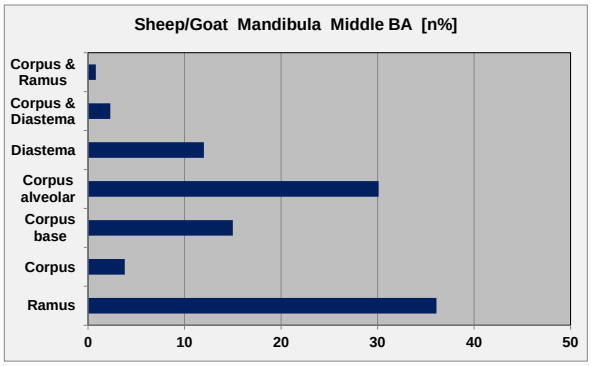
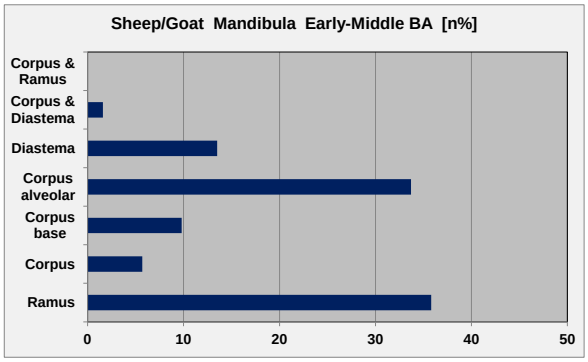
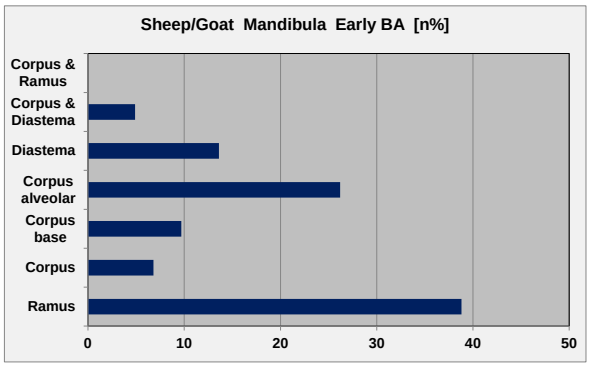


Fig. 3.3.20. Fragmentation of sheep/goat Cranium based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.









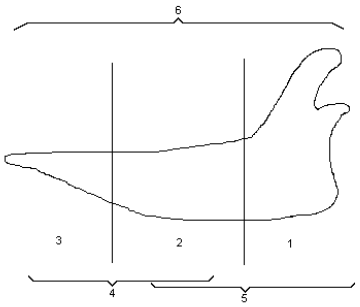
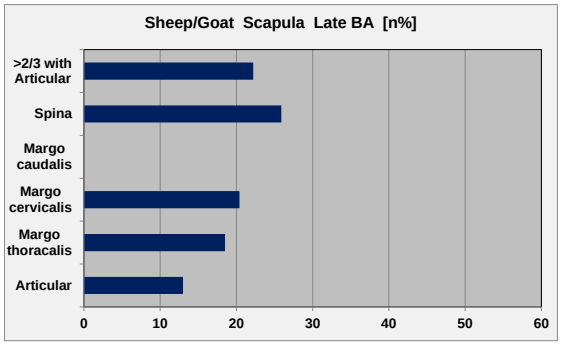
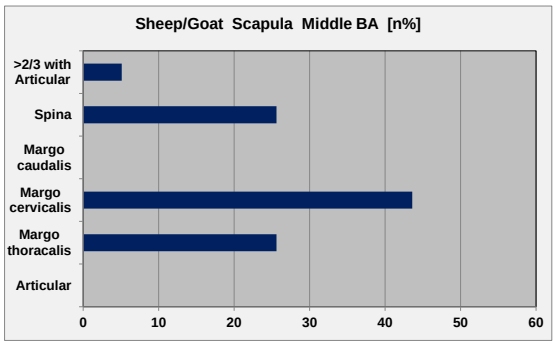
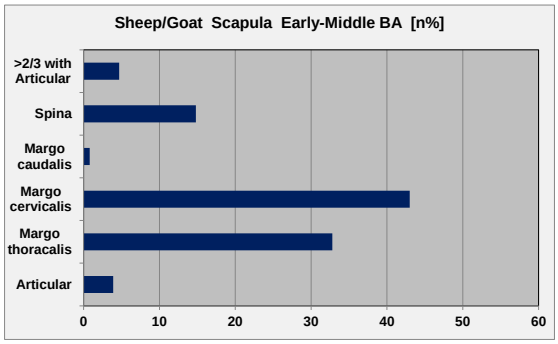
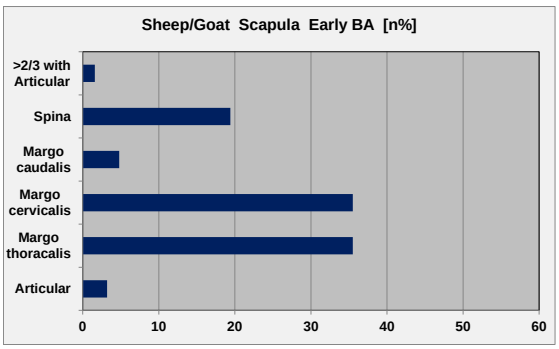


Fig. 3.3.21. Fragmentation of sheep/goat Mandibula based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.









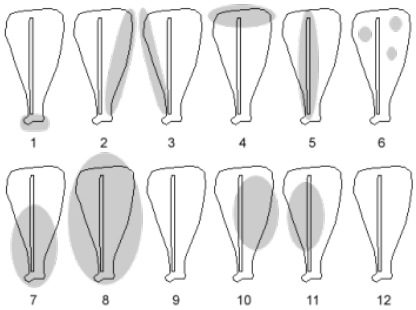


Fig. 3.3.22. Fragmentation of sheep/goat Scapula based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.

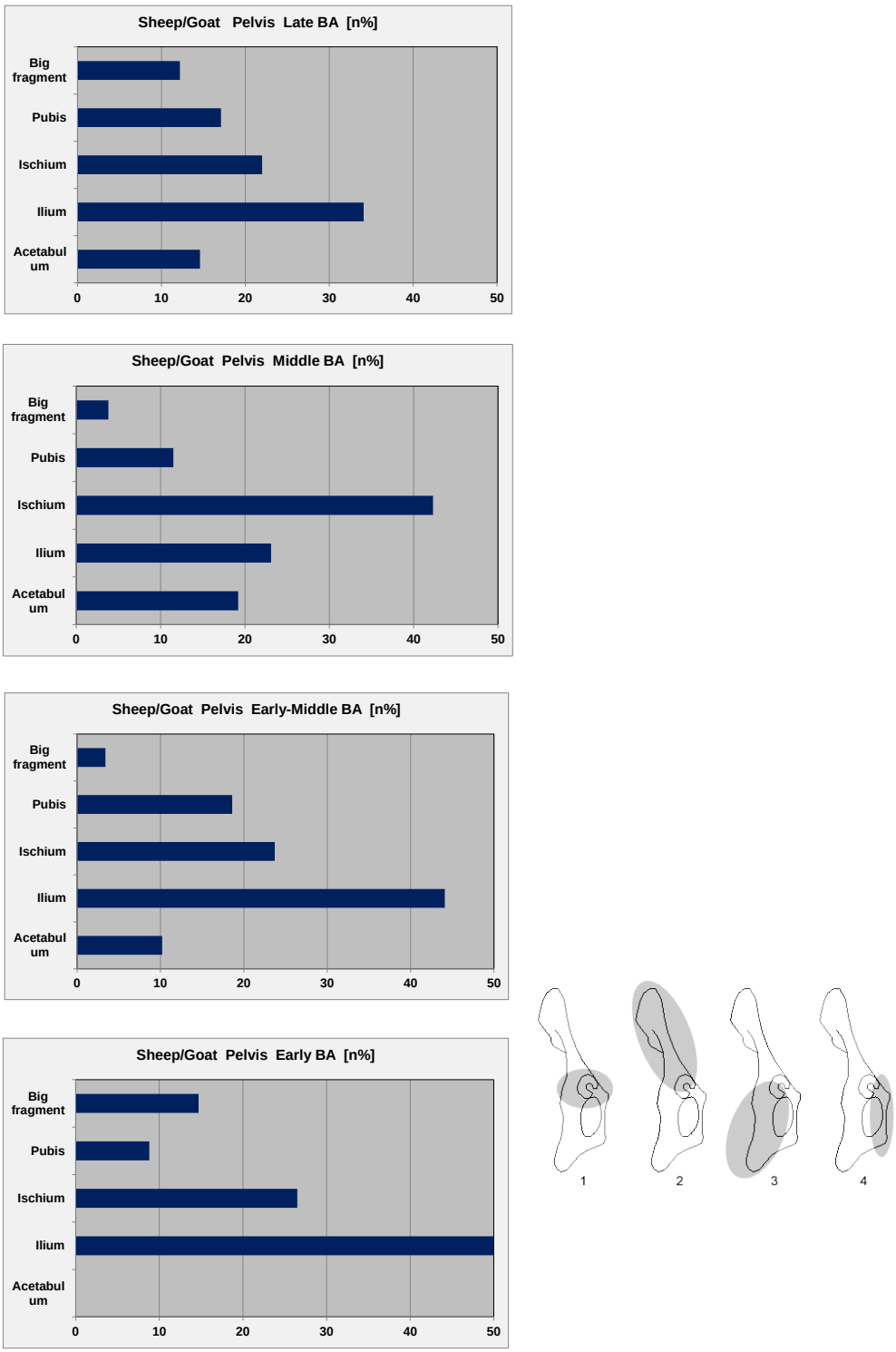


Fig. 3.3.23. Fragmentation of sheep/goat Pelvis based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.

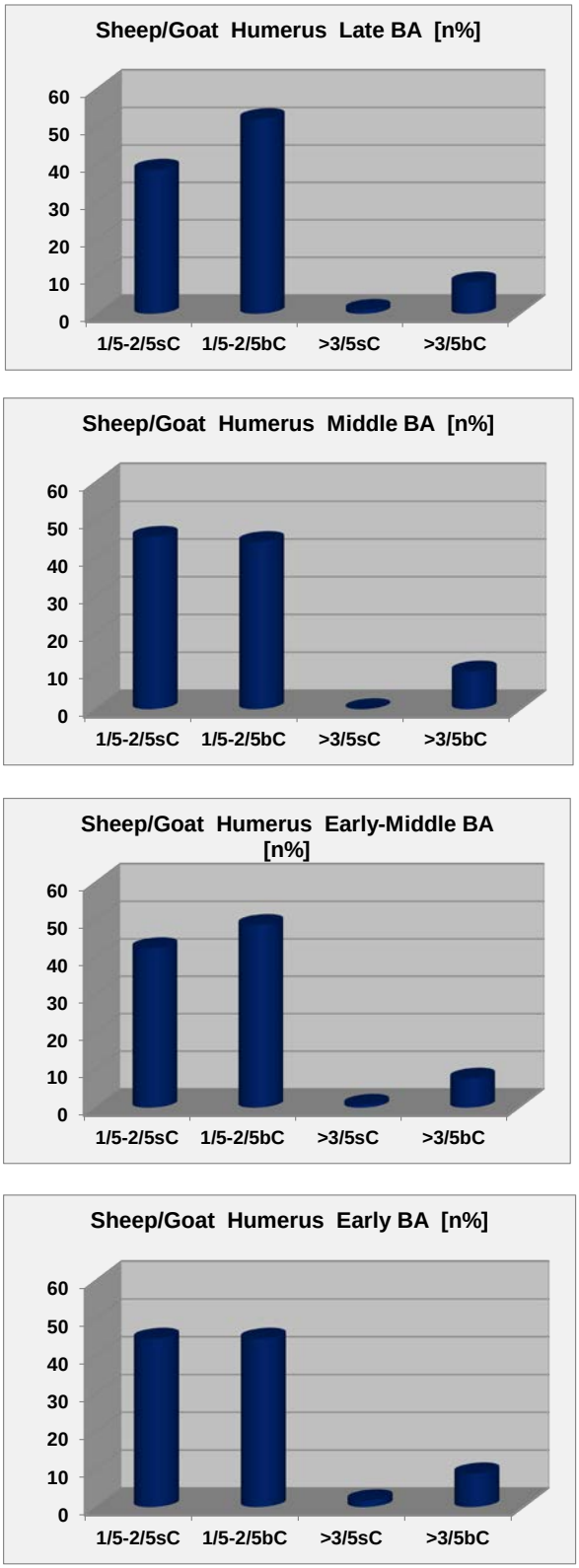
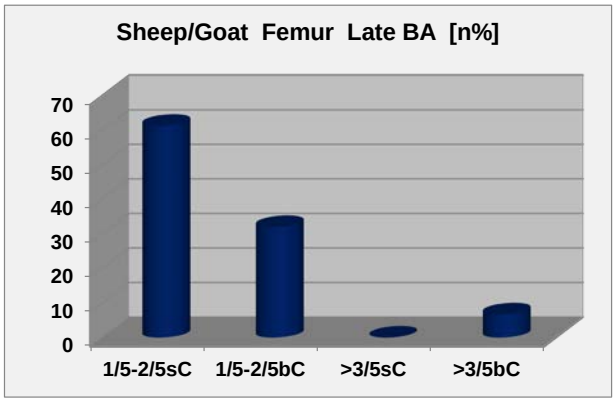
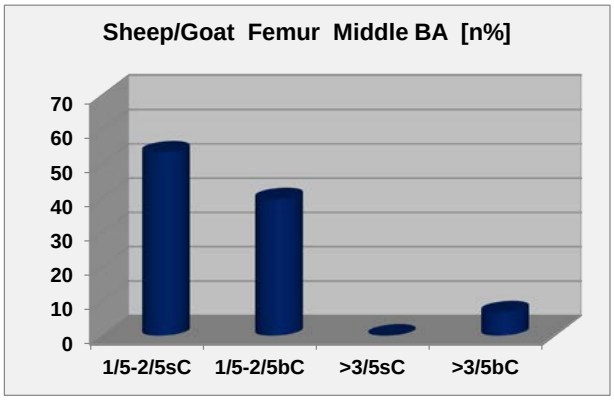
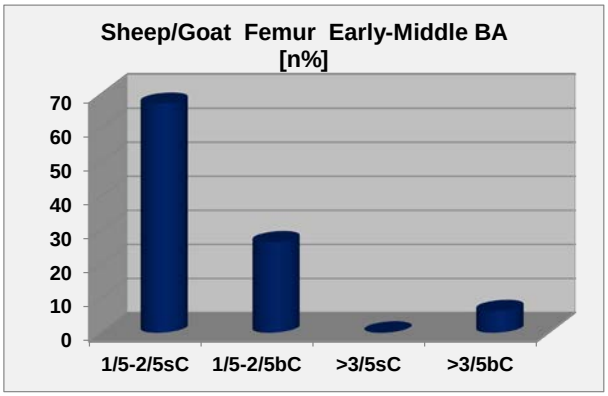


Fig. 3.3.24. Fragmentation of sheep/goat Humerus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







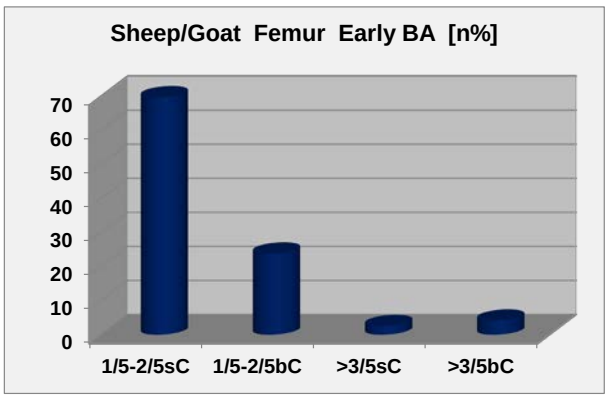
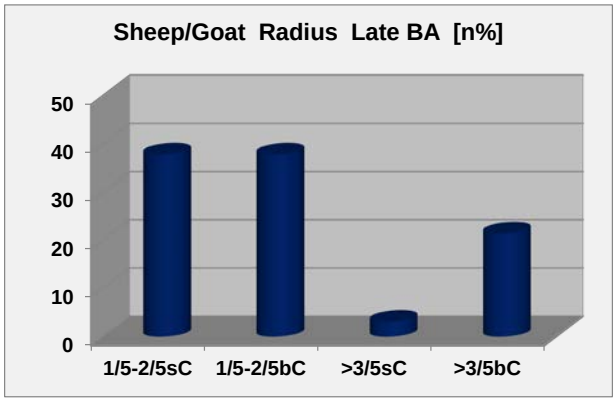
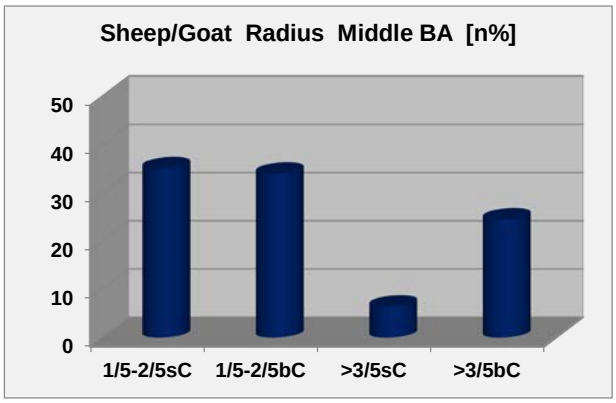
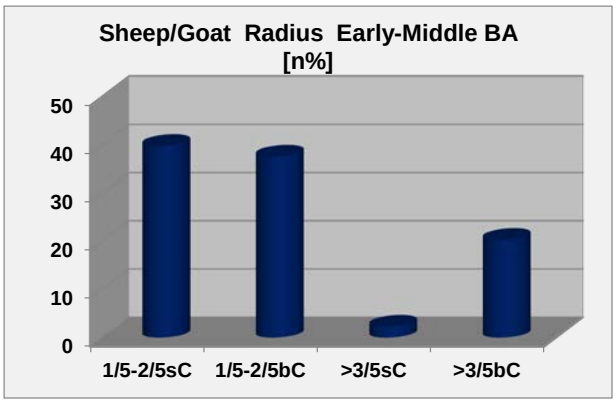


Fig. 3.3.25. Fragmentation of sheep/goat Femur based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







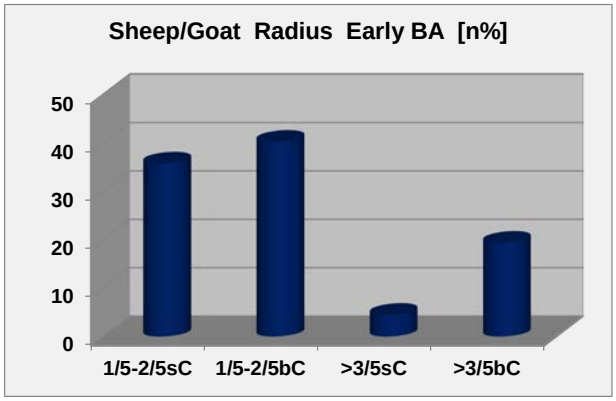
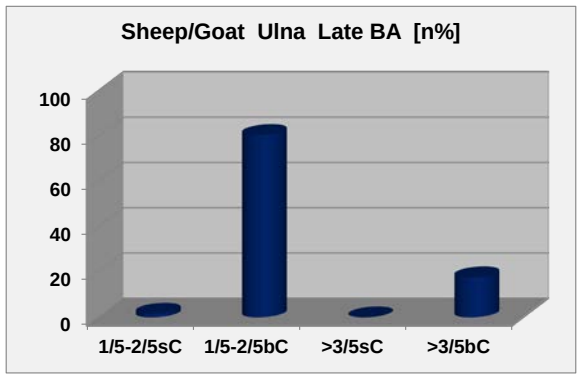
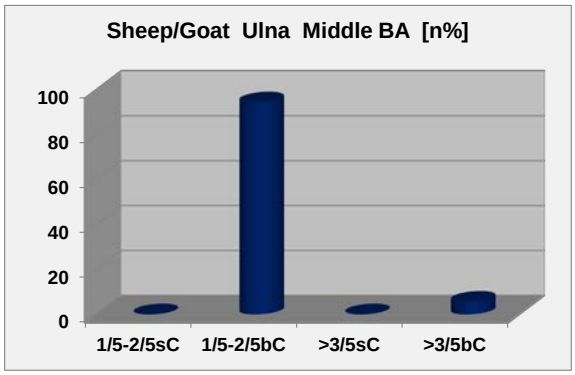
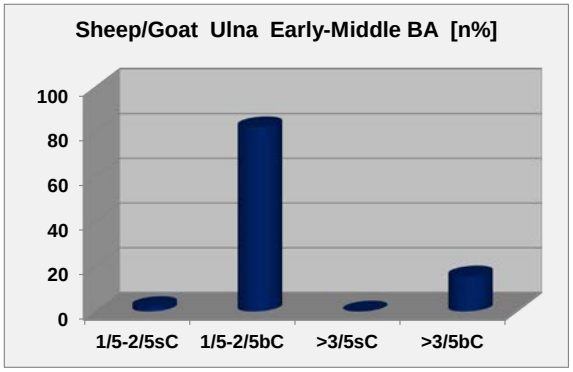


Fig. 3.3.26. Fragmentation of sheep/goat Radius based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







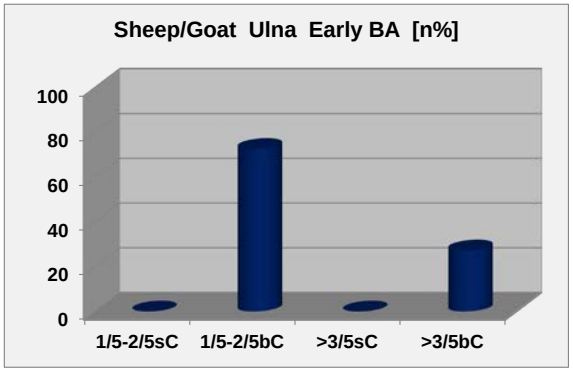
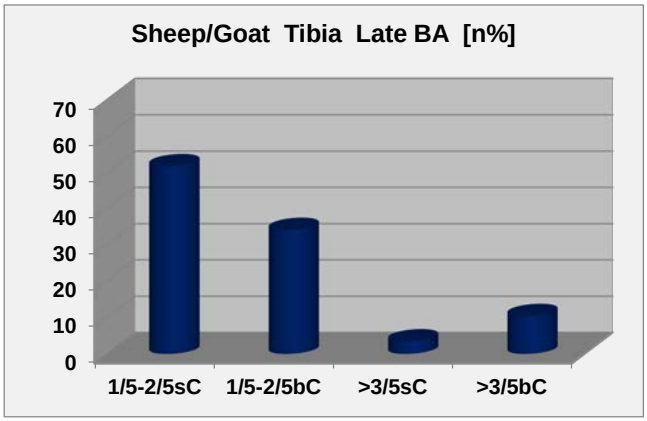
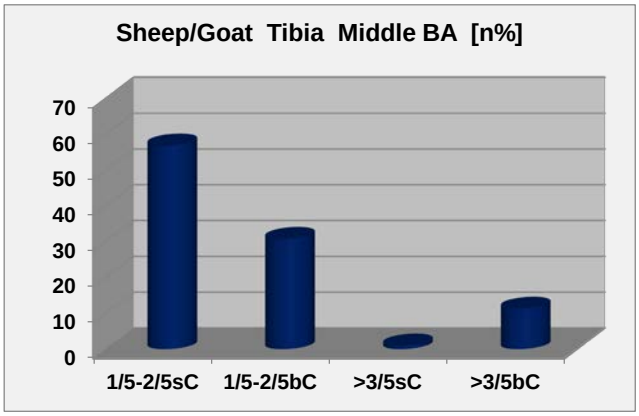
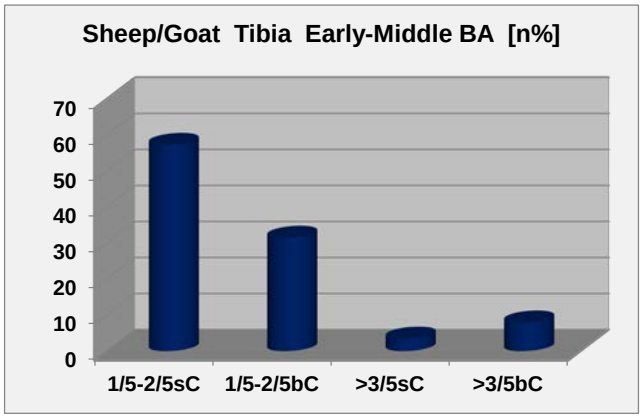


Fig. 3.3.27. Fragmentation of sheep/goat Ulna based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







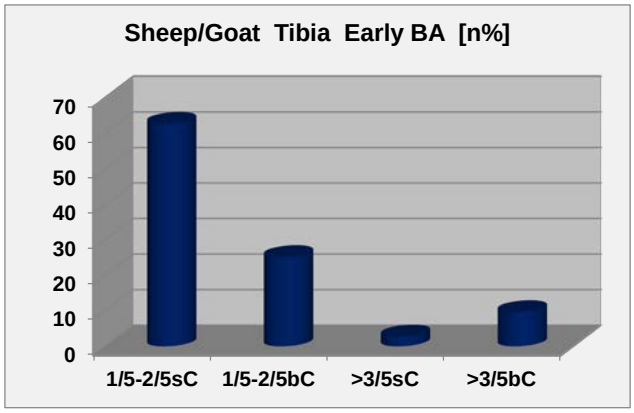


Fig. 3.3.28. Fragmentation of sheep/goat Tibia based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

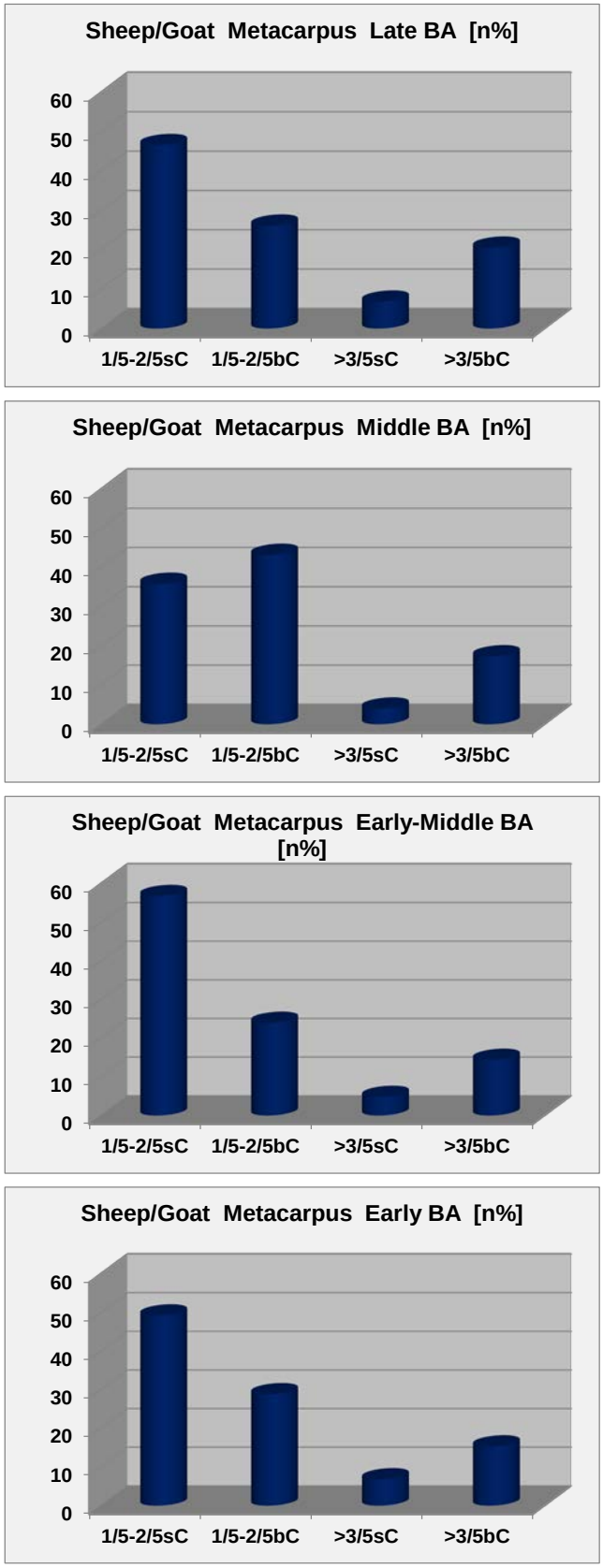


Fig. 3.3.29. Fragmentation of sheep/goat Metacarpus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

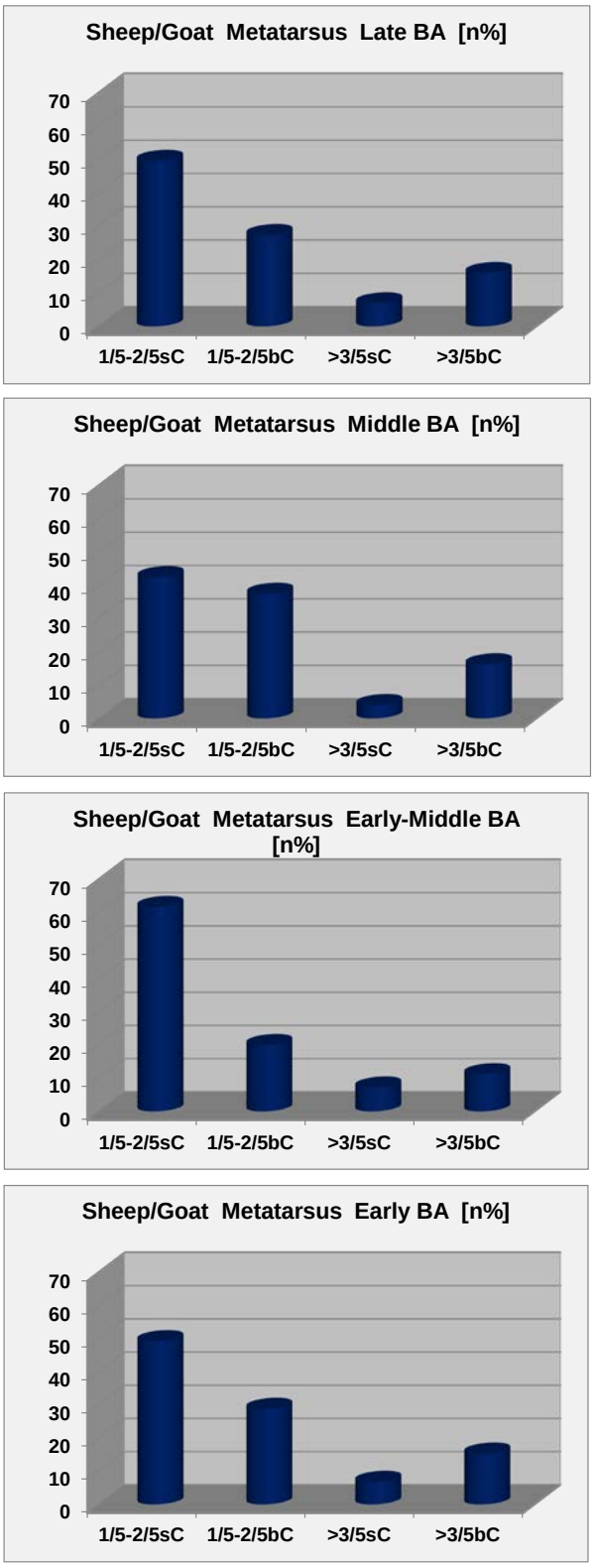


Fig. 3.3.30. Fragmentation of sheep/goat Metatarsus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

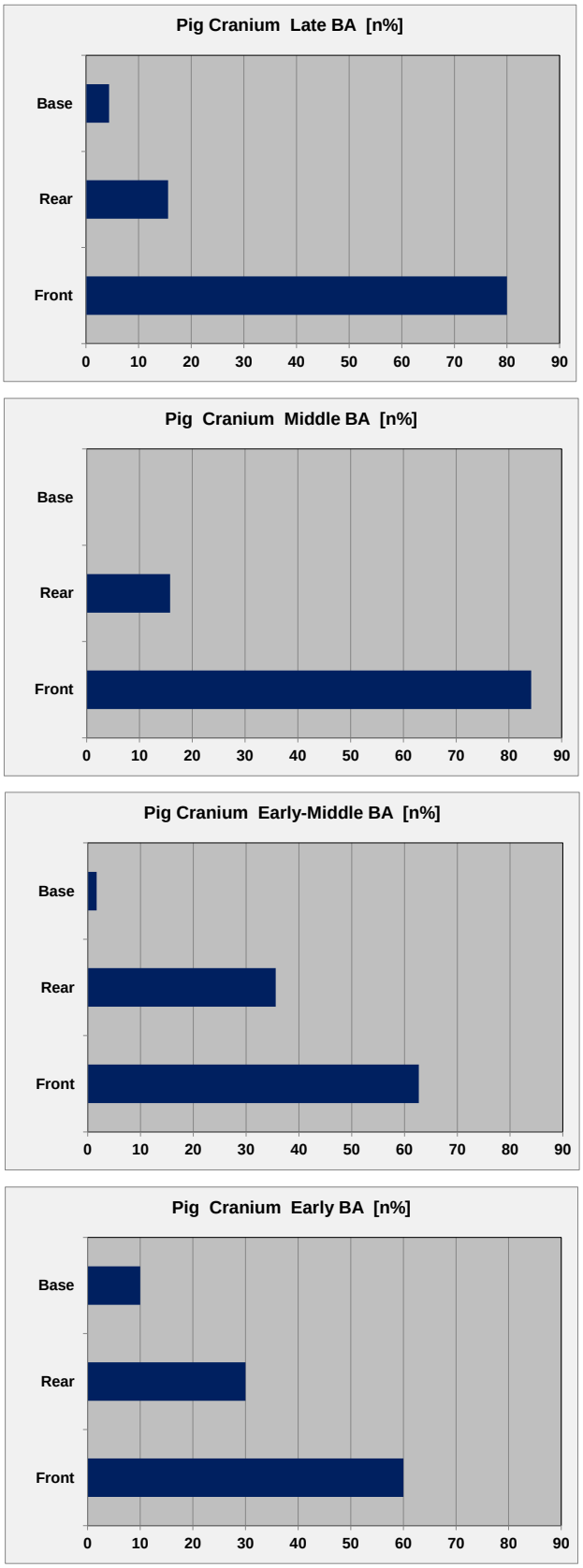
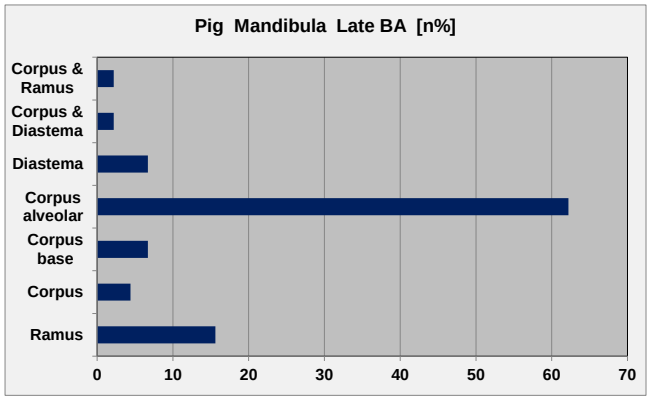
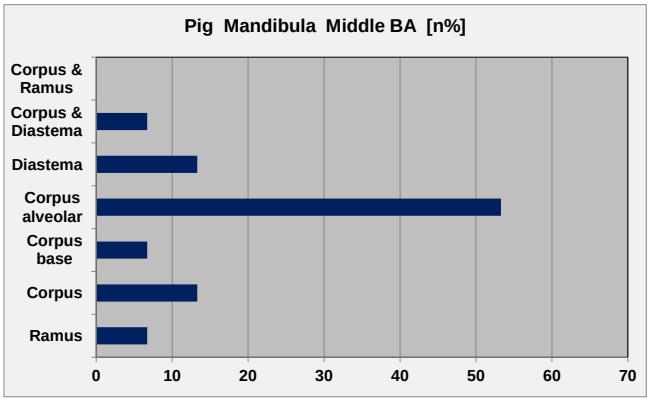
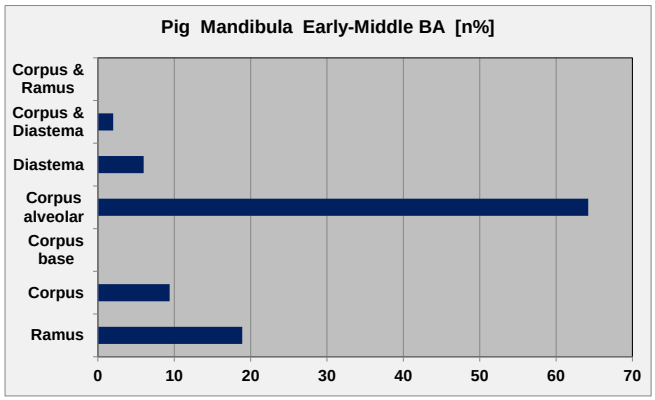
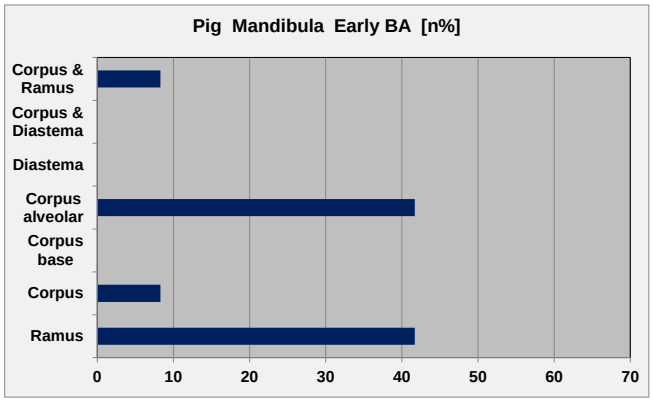


Fig. 3.3.31. Fragmentation of pig Cranium based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.









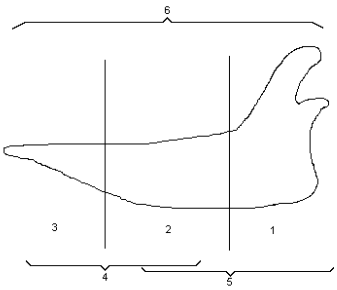


Fig. 3.3.32. Fragmentation of pig Mandibula based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.

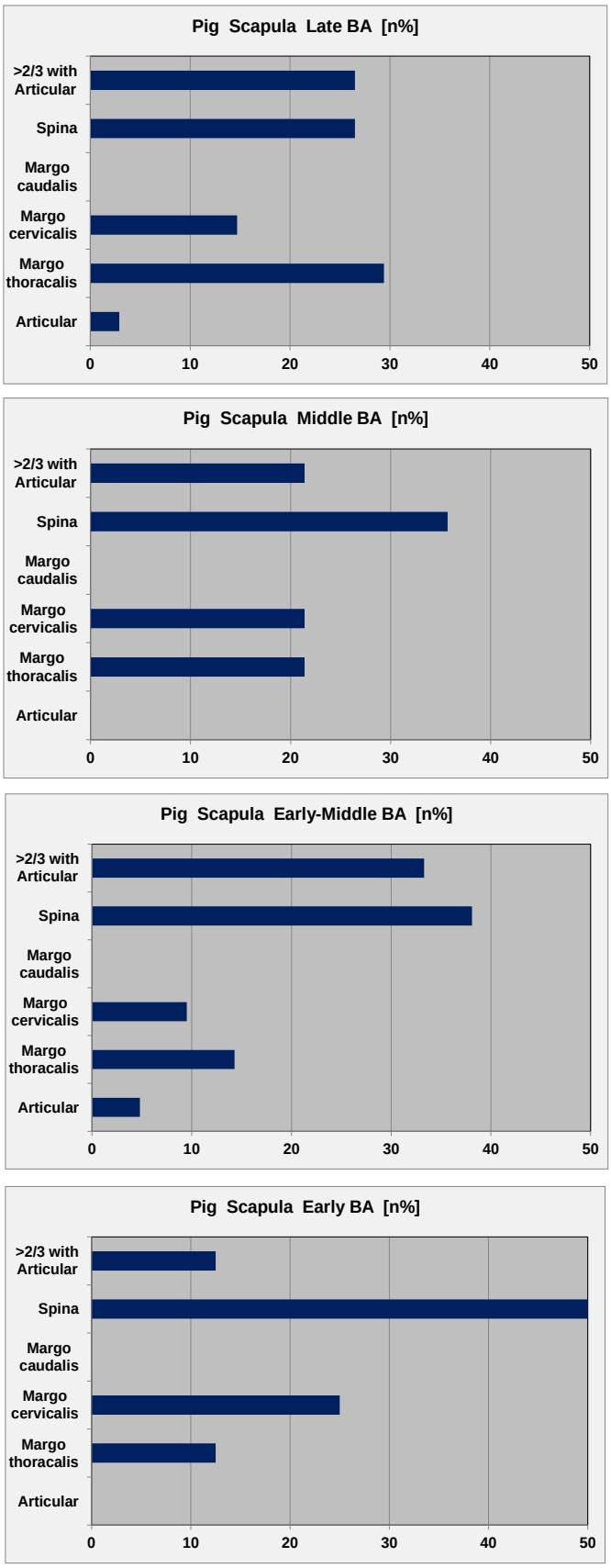
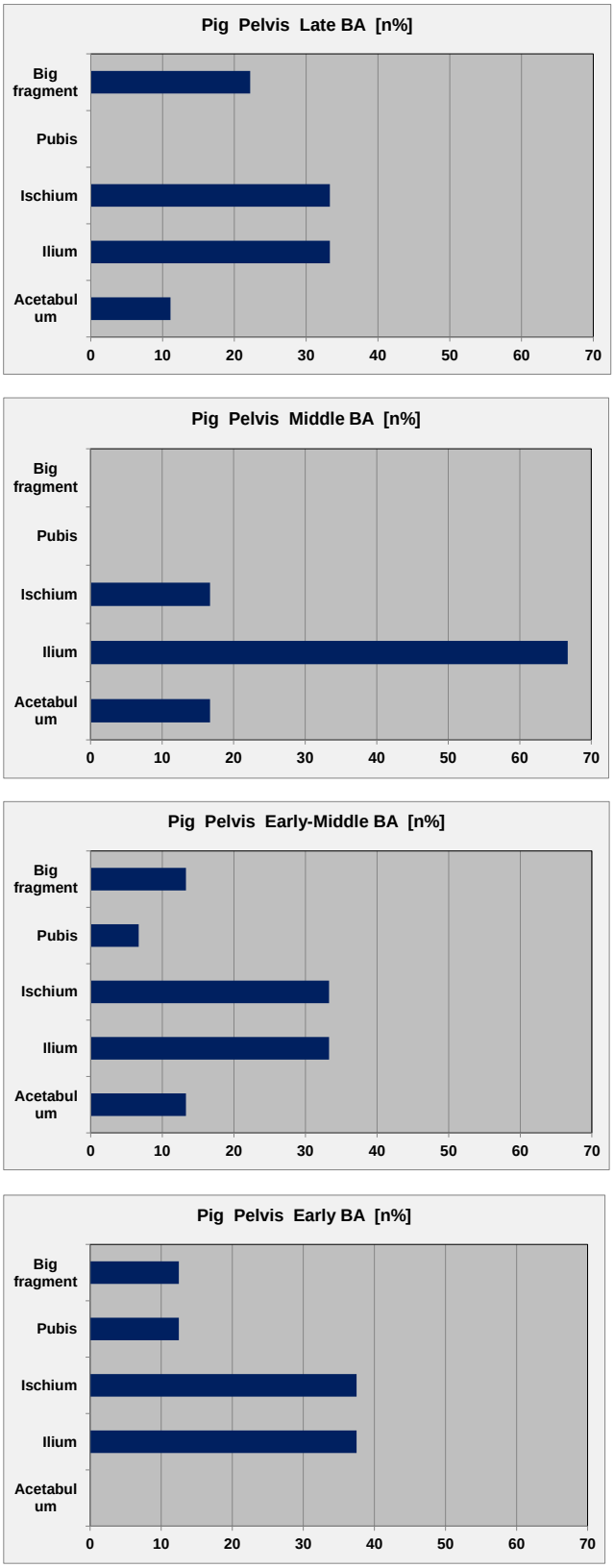


Fig. 3.3.33. Fragmentation of pig Scapula based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland.



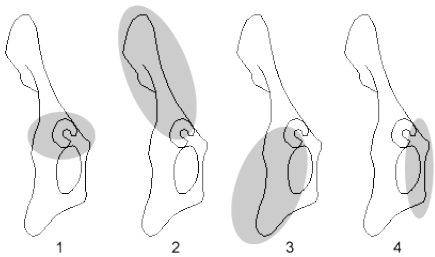
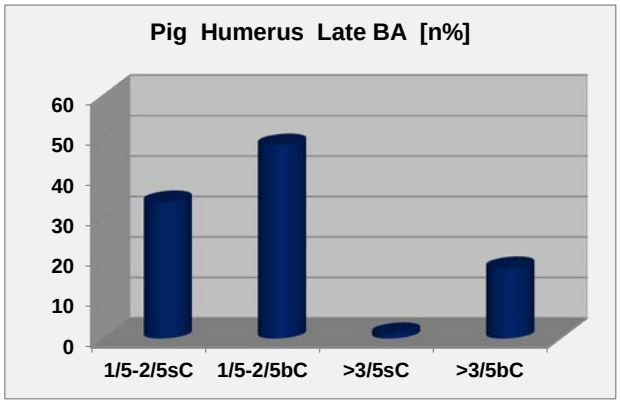
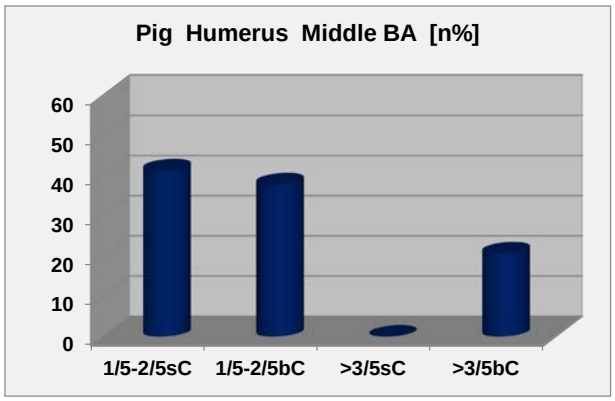
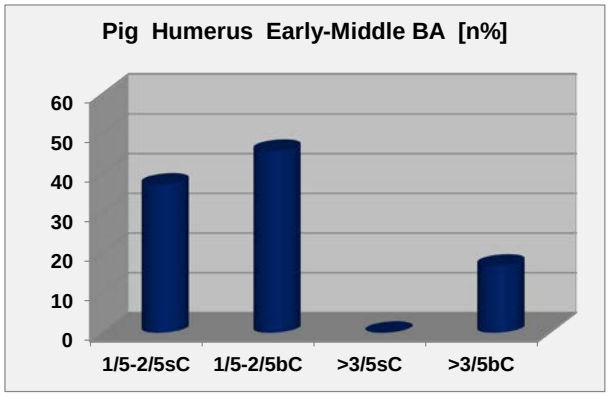


Fig. 3.3.34. Fragmentation of pig Pelvis based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







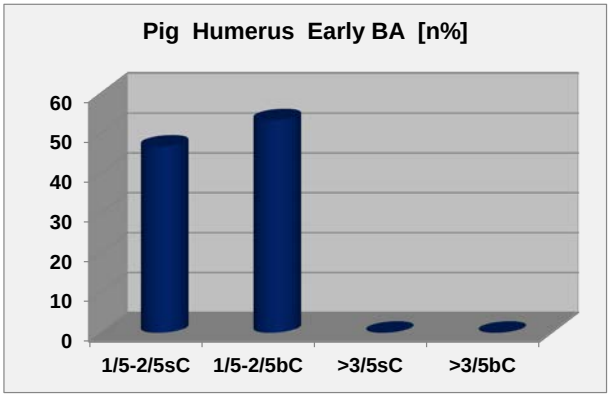
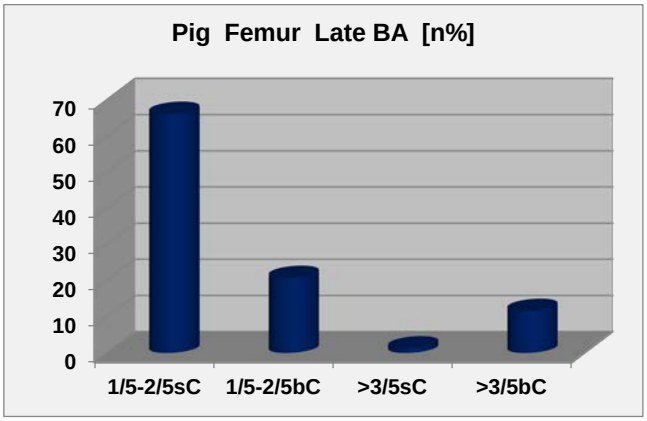
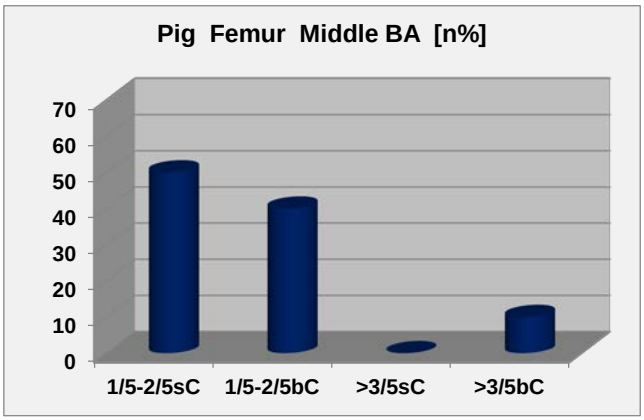
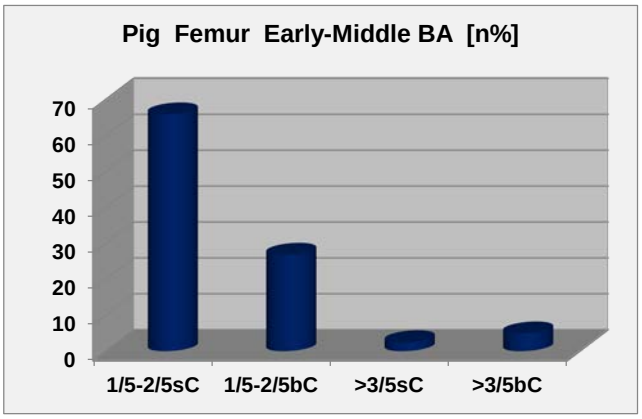


Fig. 3.3.35. Fragmentation of pig Humerus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







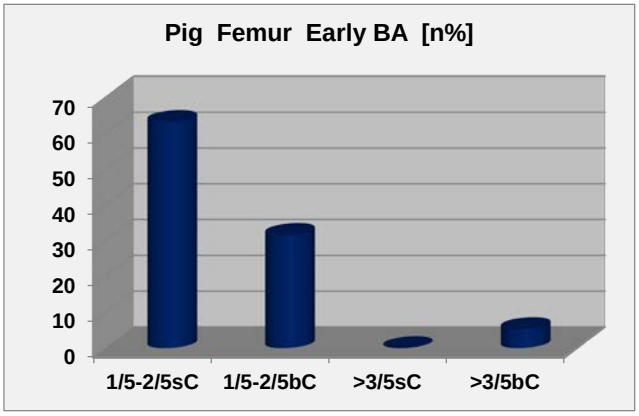


Fig. 3.3.36. Fragmentation of pig Femur based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

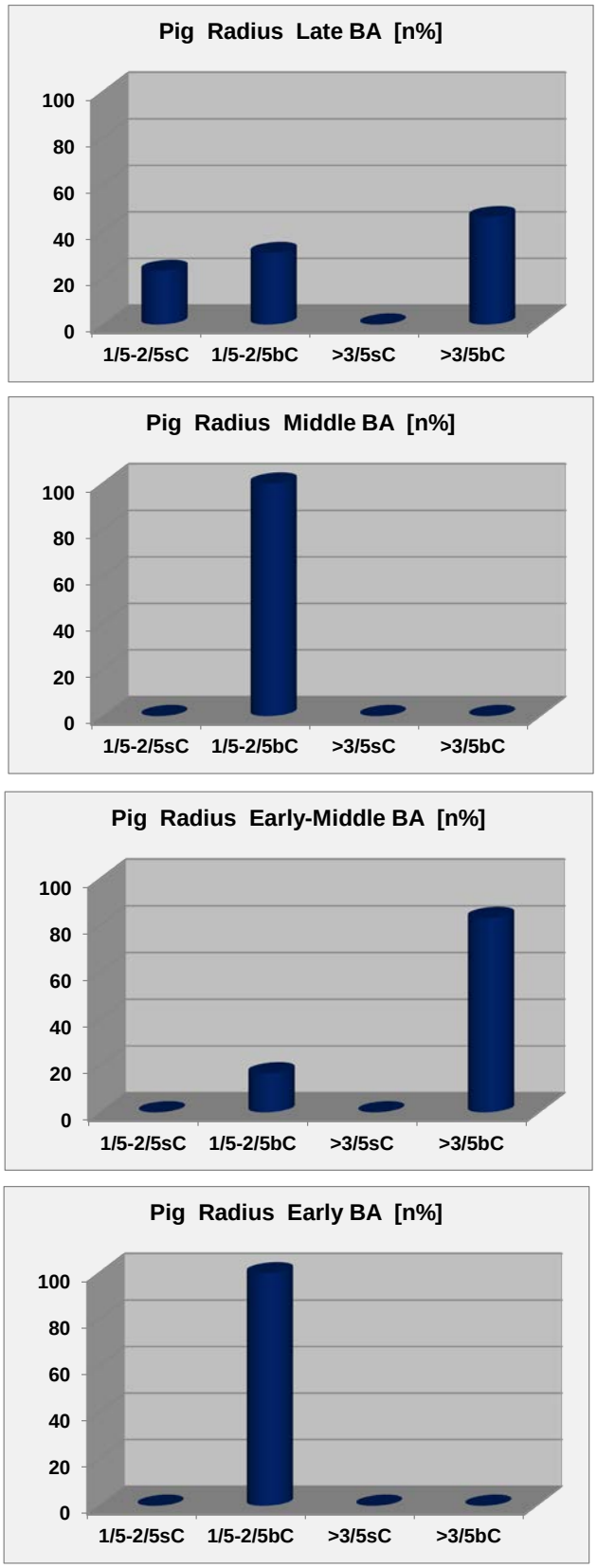
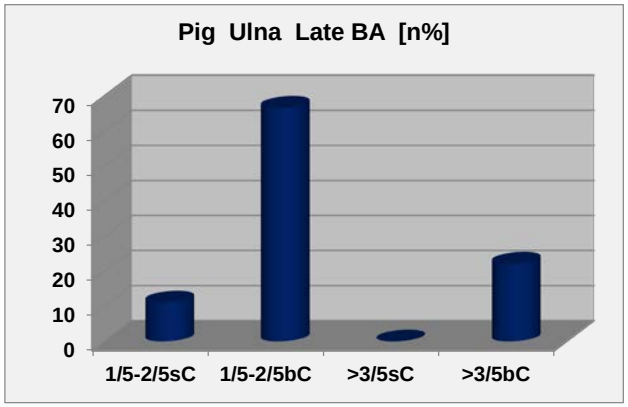
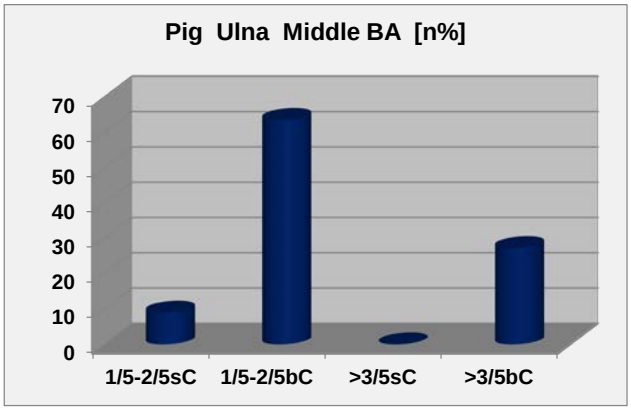
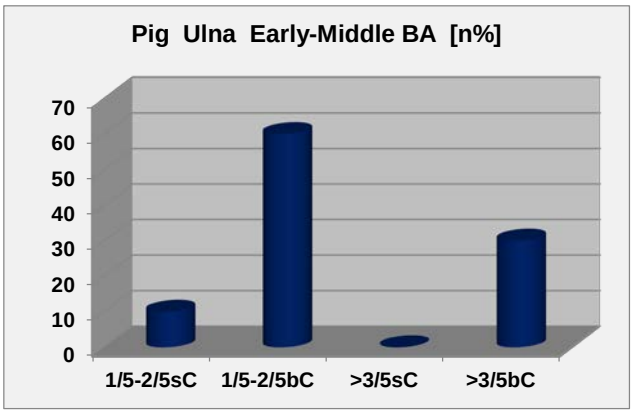


Fig. 3.3.37. Fragmentation of pig Radius based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.







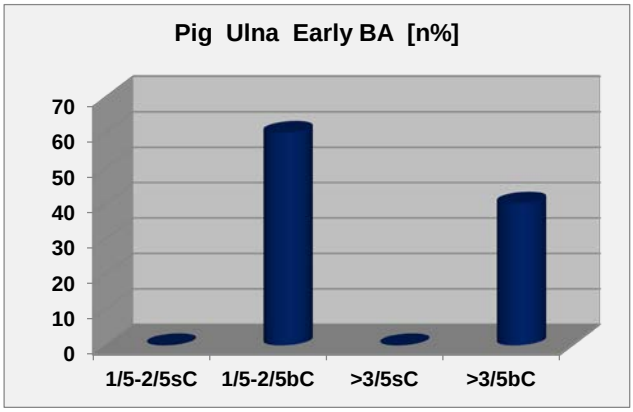


Fig. 3.3.38. Fragmentation of pig Ulna based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

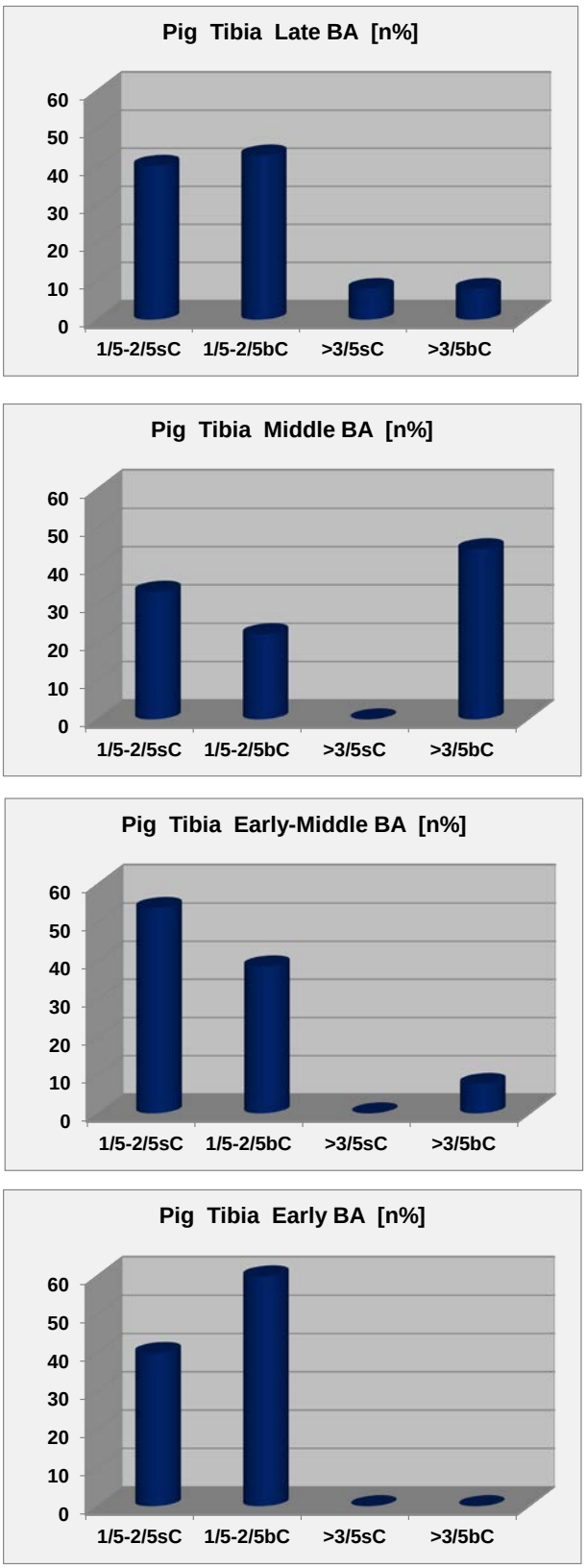


Fig. 3.3.39. Fragmentation of pig Tibia based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

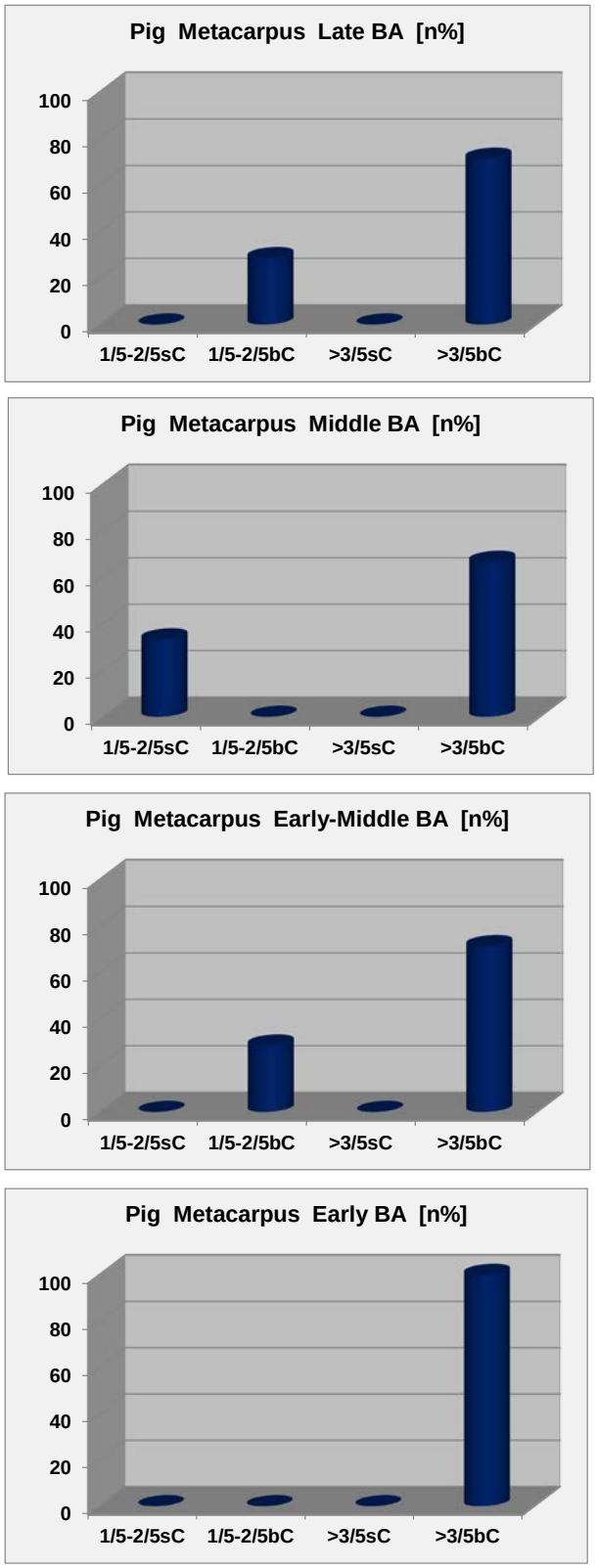


Fig. 3.3.40. Fragmentation of pig Metacarpus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

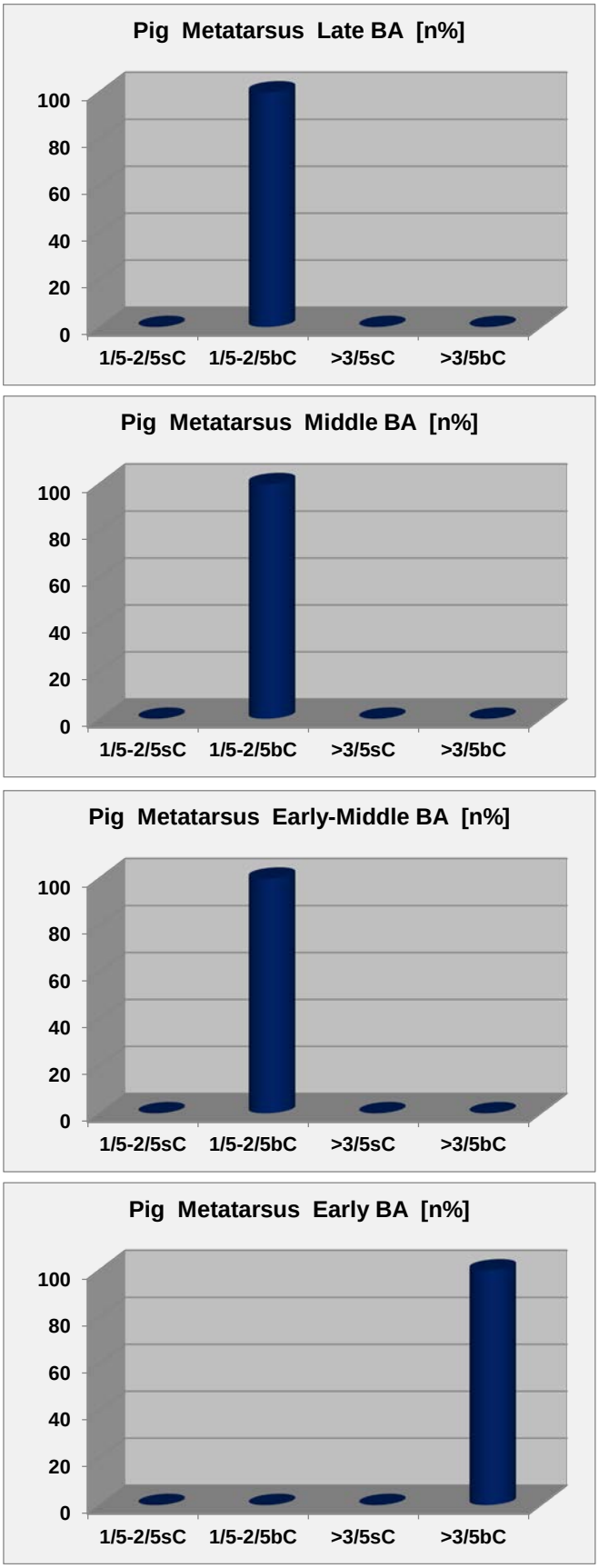


Fig. 3.3.41. Fragmentation of pig Metatarsus based on the number of identified specimens that were excavated at each Bronze Age (BA) phase in the settlement Savognin-Padnal in Switzerland. The four size categories of long bones are described in Figure 3.3.8.

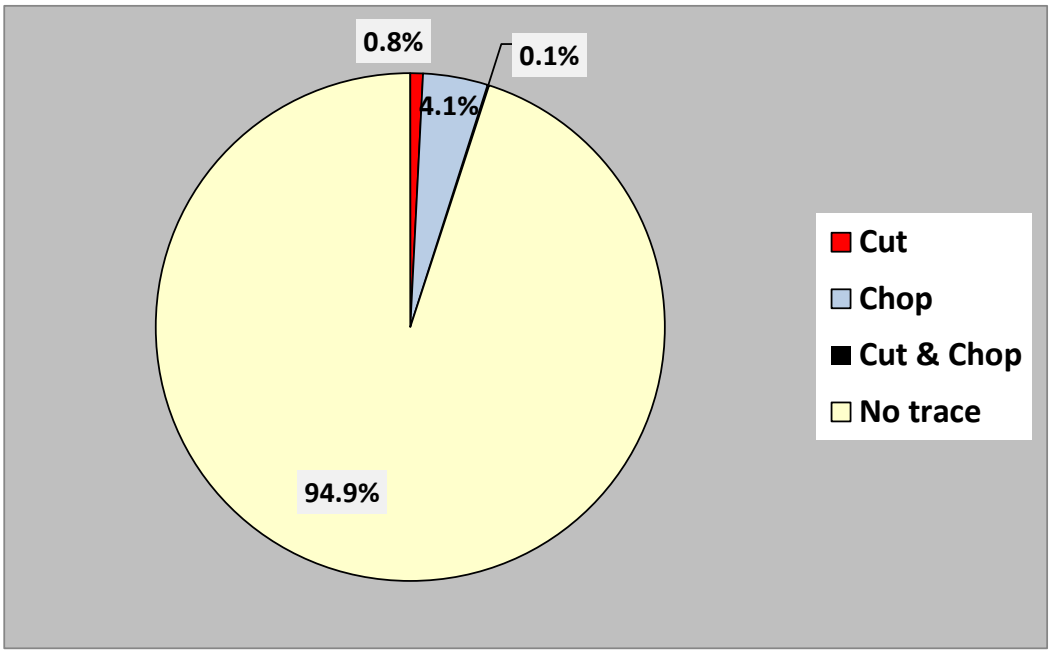


Fig. 3.3.42. Proportion of butchering traces on specimens that were excavated from the Bronze Age settlement Savognin-Padnal.

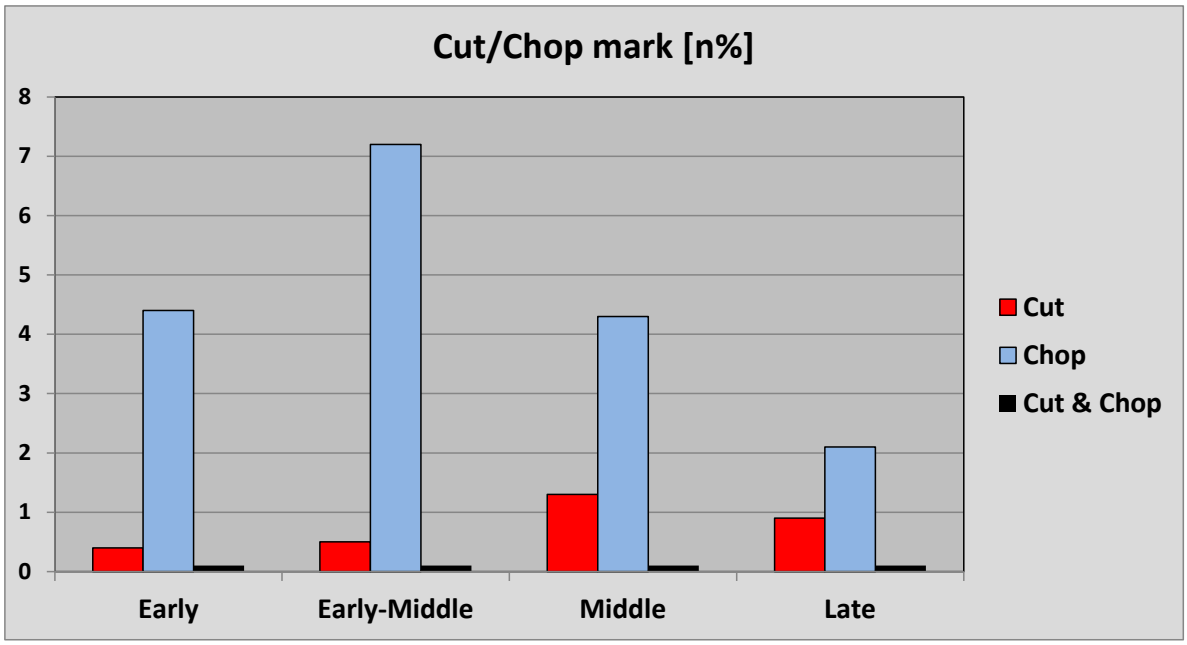


Fig. 3.3.43. Butchering traces on specimens that were excavated from the settlement Savognin-Padnal, in each Bronze Age phase.

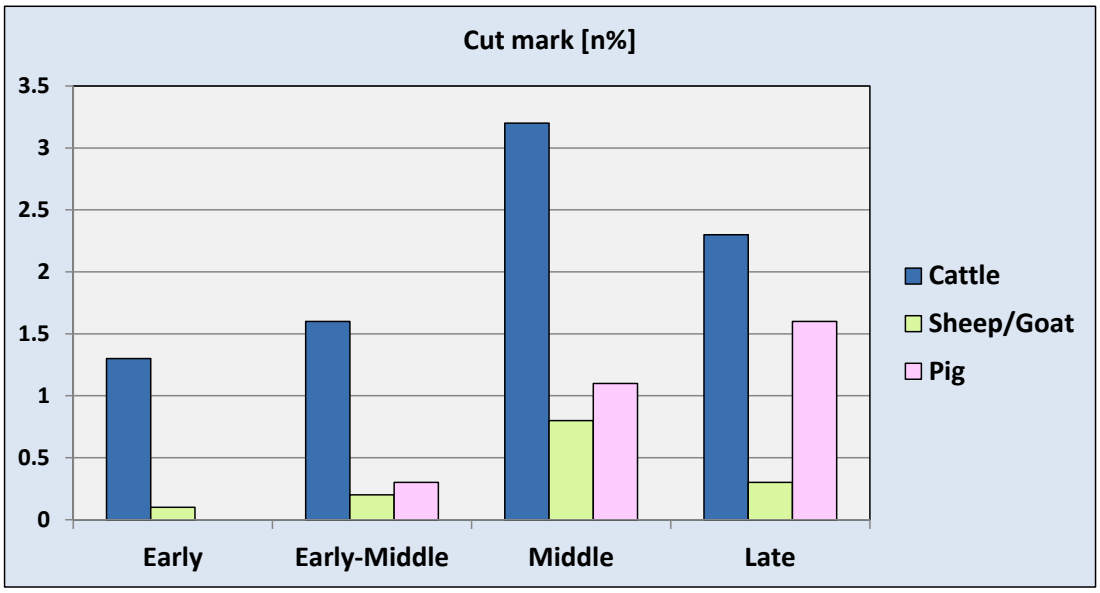


Fig. 3.3.44. Cut marks on specimens from the three main domestic animals from the settlement Savognin-Padnal, in each Bronze Age phase. (100% = total number of cut/chop marks in each phase).

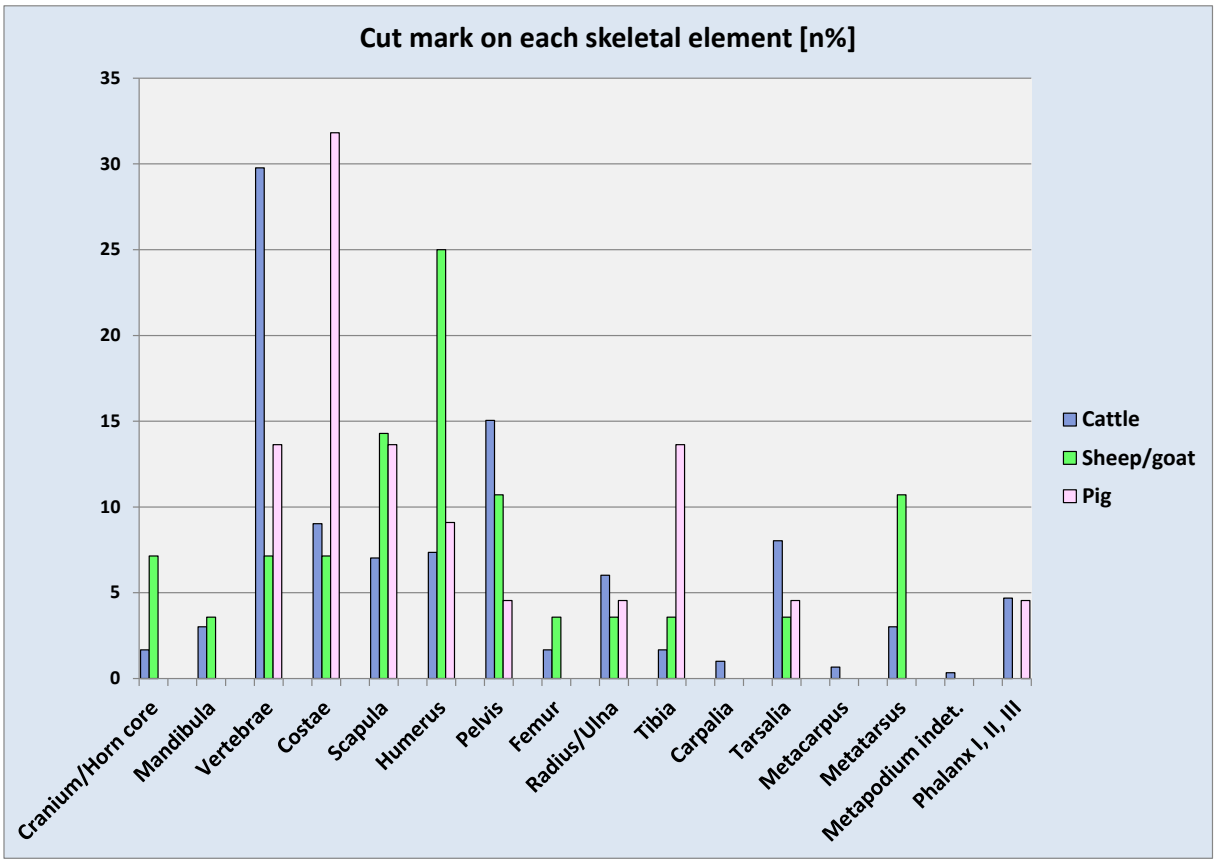


Fig. 3.3.45. Cut marks on each skeletal element from the three main domestic animals from the settlement Savognin-Padnal.

Fig. 3.3.46. Chop marks on specimens from the three main domestic animals from the settlement Savognin-Padnal, in each Bronze Age phase. (100% = total number of cut/chop marks in each phase).

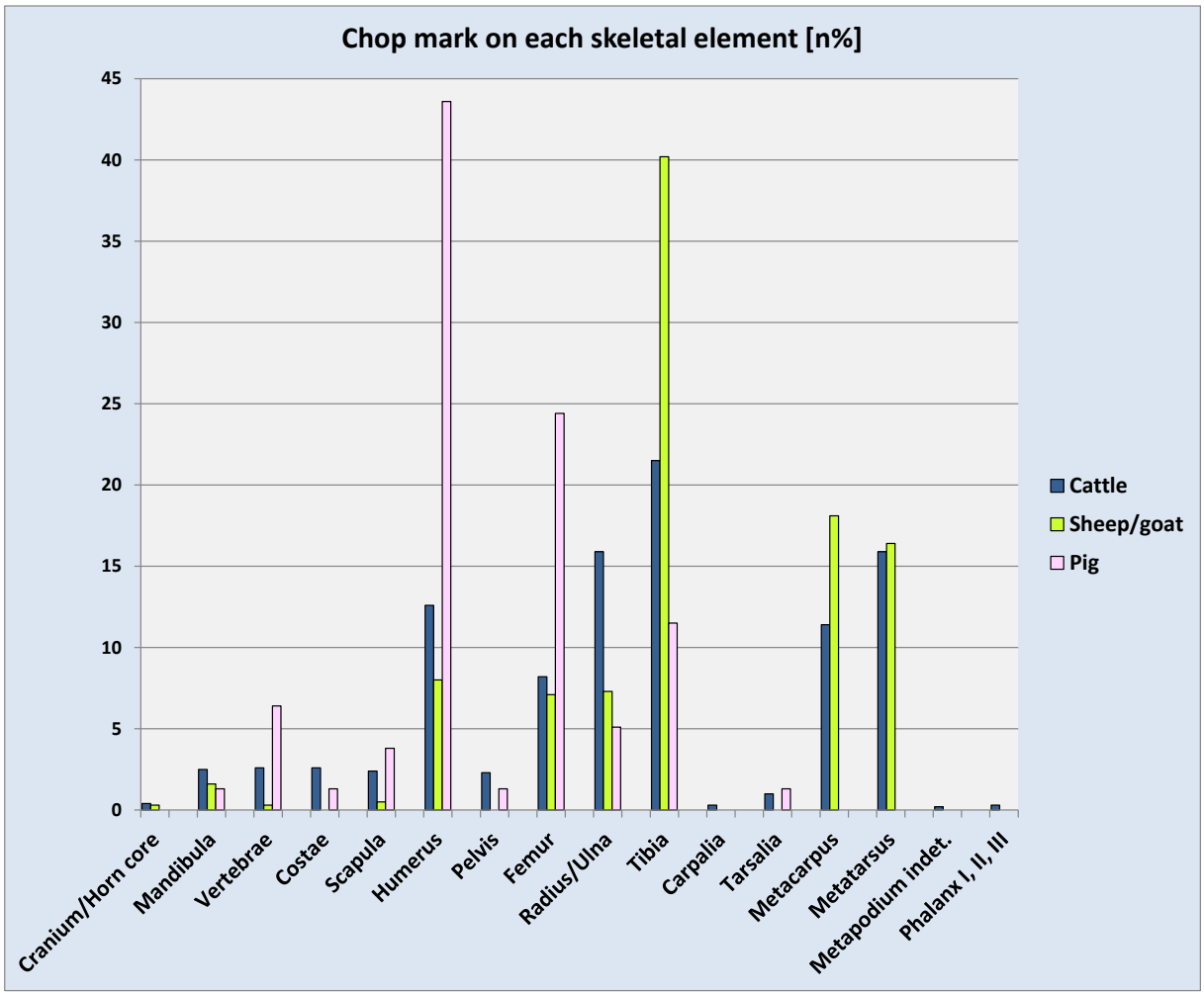


Fig. 3.3.47. Chop marks on each skeletal element from the three main domestic animals in the settlement Savognin-Padnal.

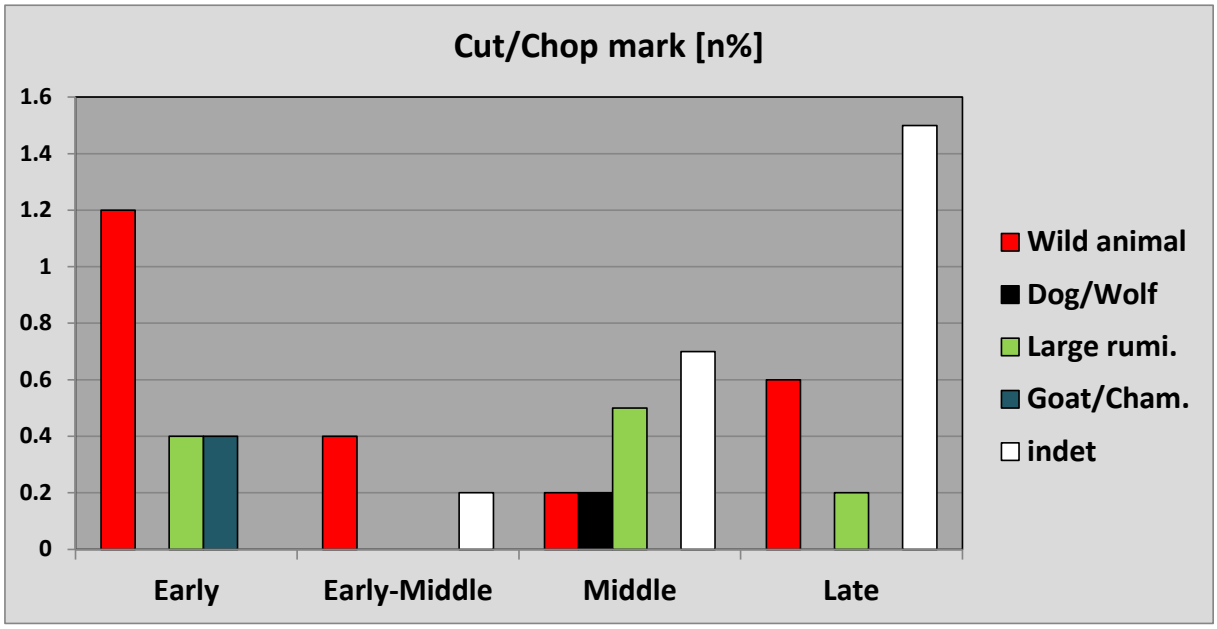


Fig. 3.3.48. Butchering traces on specimens from other species that were excavated from the settlement Savognin-Padnal, in each Bronze Age phase. (100% = total number of cut/chop marks in each phase).

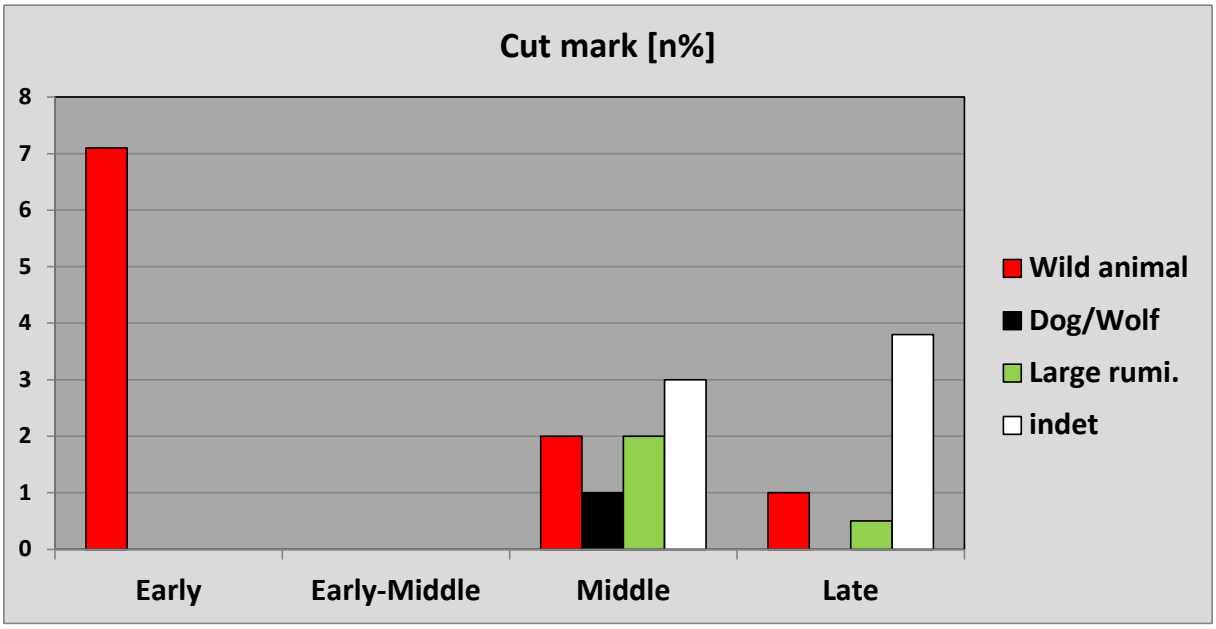


Fig. 3.3.49. Cut marks on specimens from other species that were excavated from the settlement Savognin-Padnal, in each Bronze Age phase. (100% = total number of cut marks in each phase).

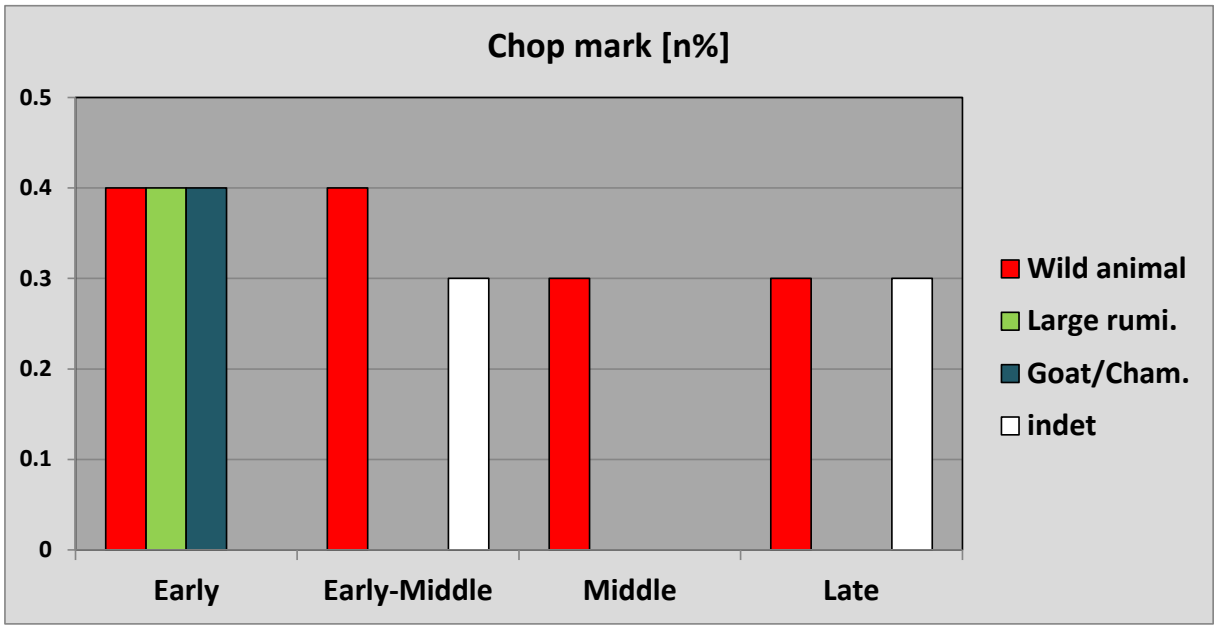


Fig. 3.3.50. Chop marks on specimens from other species that were excavated from the settlement Savognin-Padnal, in each Bronze Age phase. (100% = total number of chop marks in each phase).

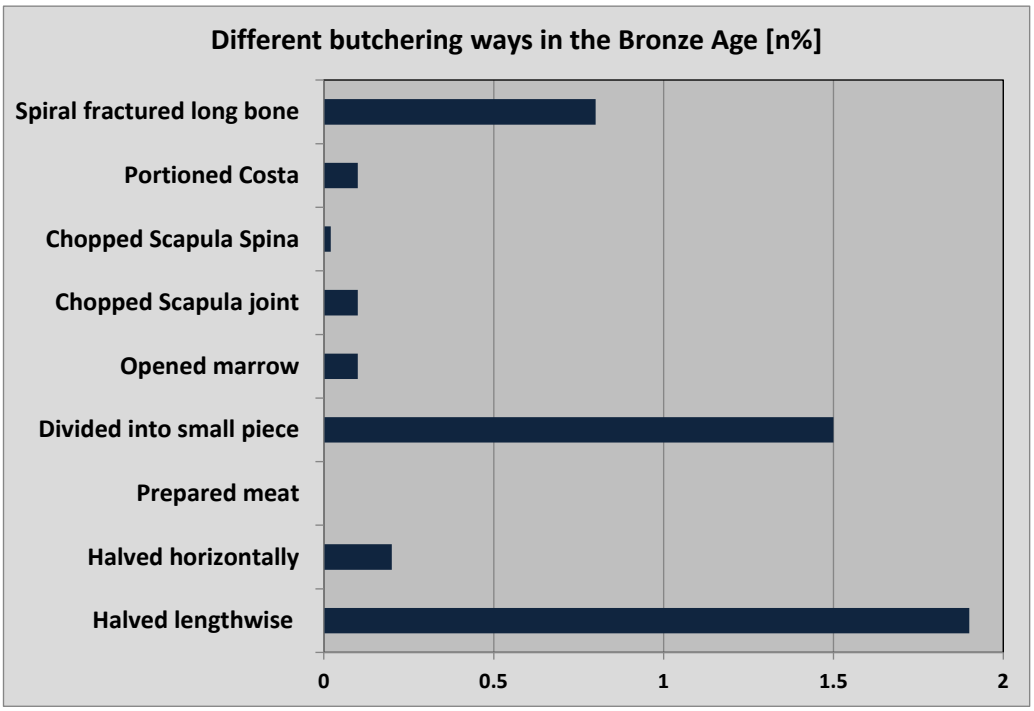


Fig. 3.3.51. Different butchering ways performed on all animal specimens that were excavated from the Bronze Age settlement Savognin-Padnal.

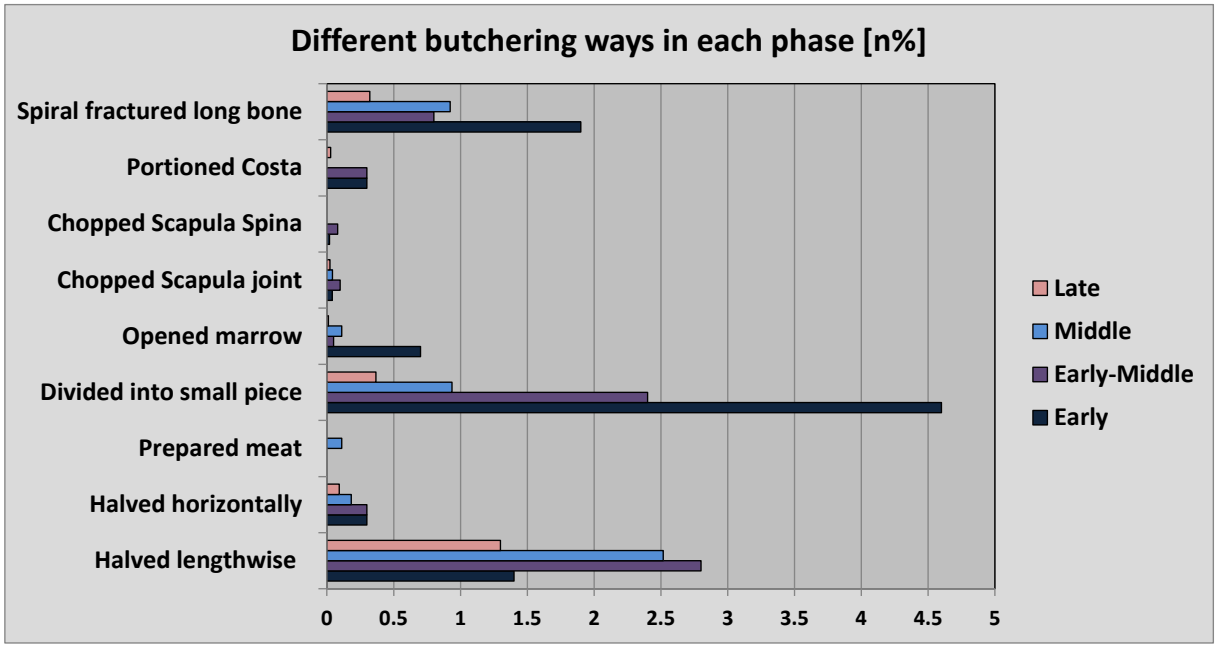


Fig. 3.3.52. Different butchering ways performed on all animal specimens that were excavated from the settlement Savognin-Padnal, in each Bronze Age phase.

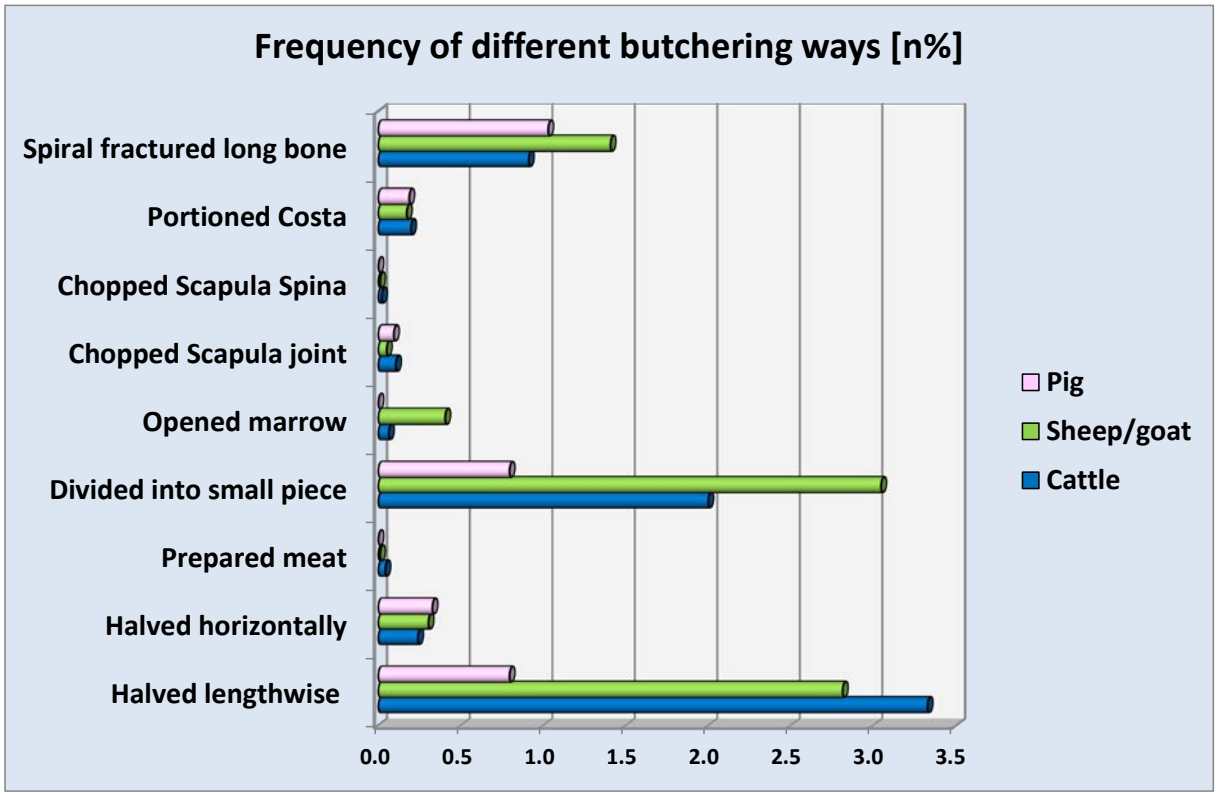


Fig. 3.3.53. Different butchering ways performed on the three main domestic species specimens that were excavated from the settlement Savognin-Padnal.

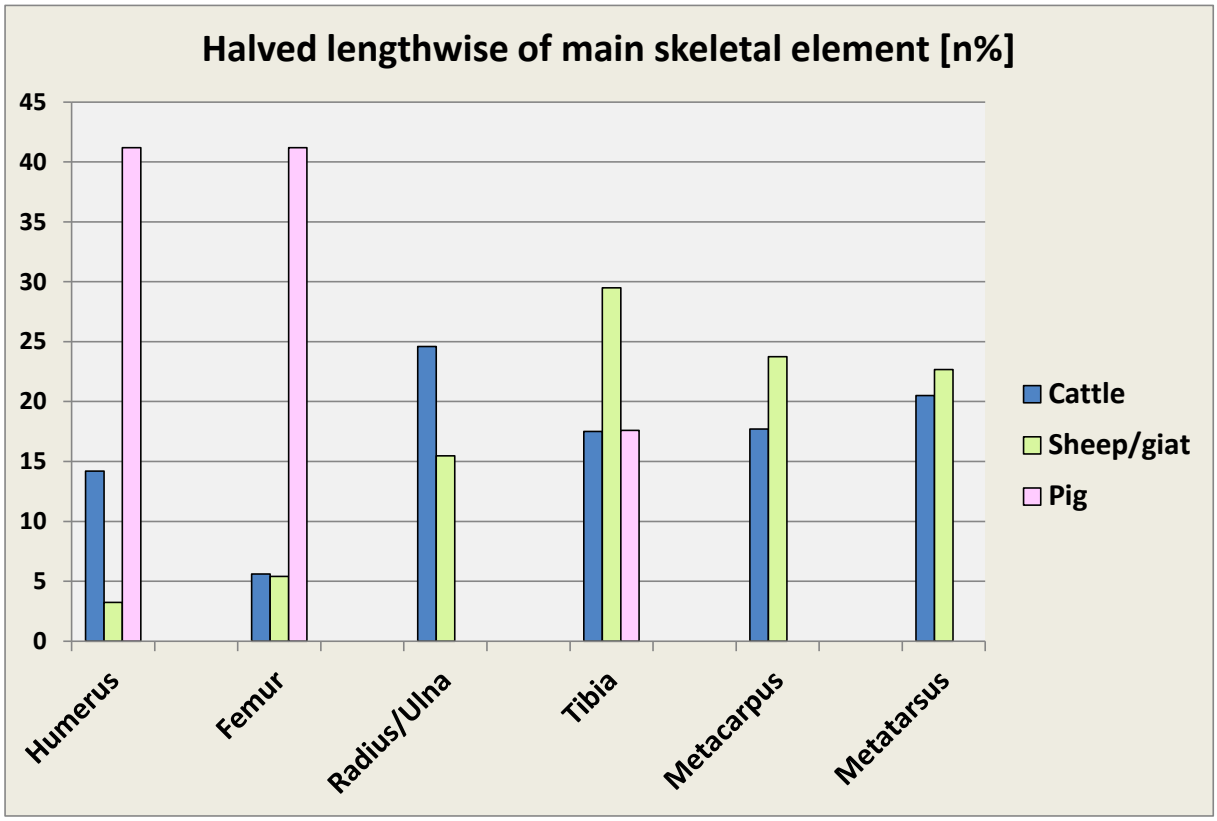
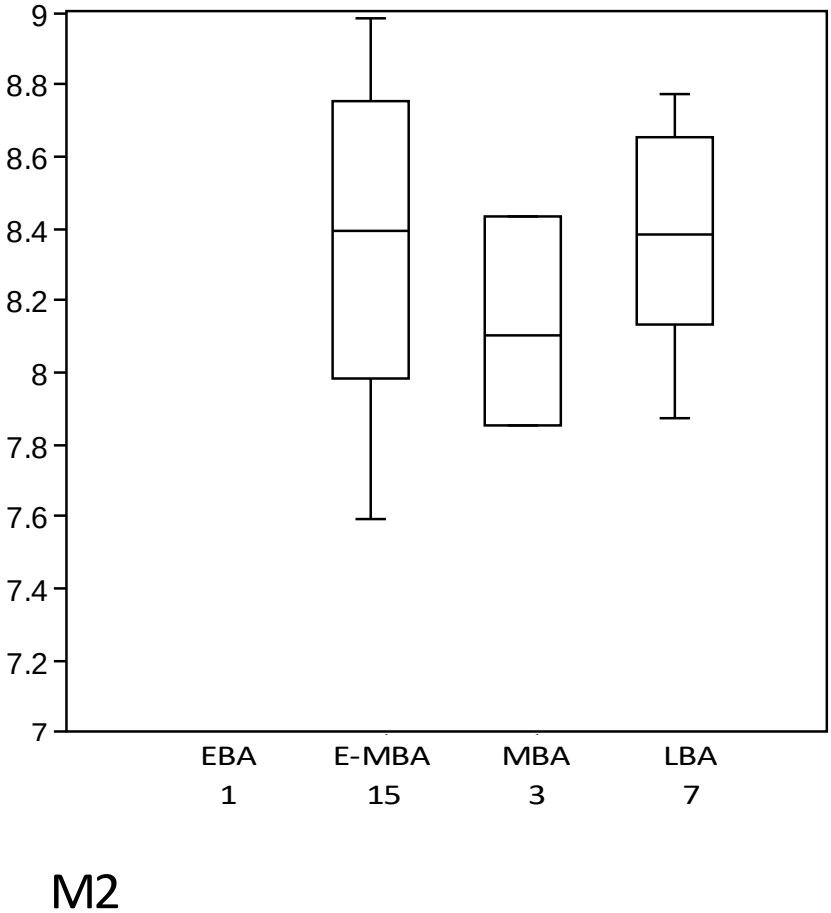
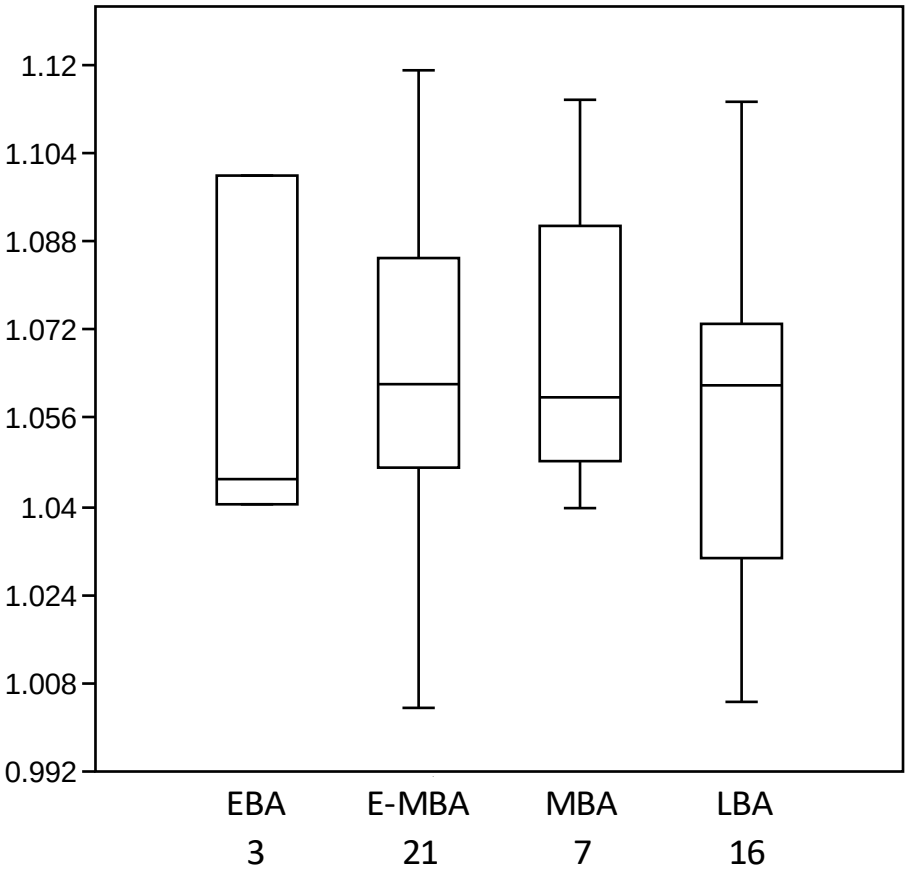


Fig. 3.3.54. Different butchering ways performed on the three main domestic species specimens that were excavated from the settlement Savognin-Padnal.



Welch F test in the case of unequal variances: F=0.738, df=6.51, P=0.5142

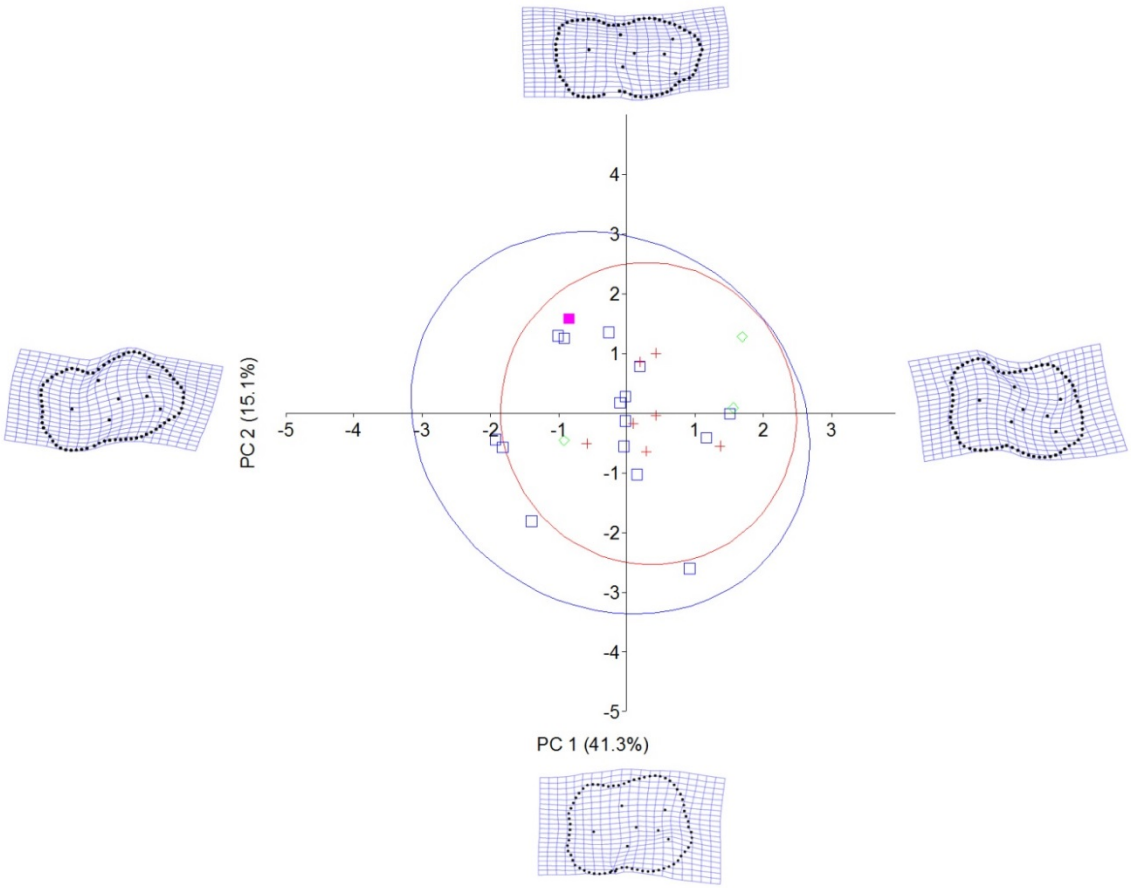
Fig. 3.3.55. Chronological comparison of the settlement Savognin-Padnal based on the Centroid size (CS) of M_2. Numbers indicate the sample size used to obtain the CS. EBA = Early Bronze Age, E-MBA = Early-Middle Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.



M3

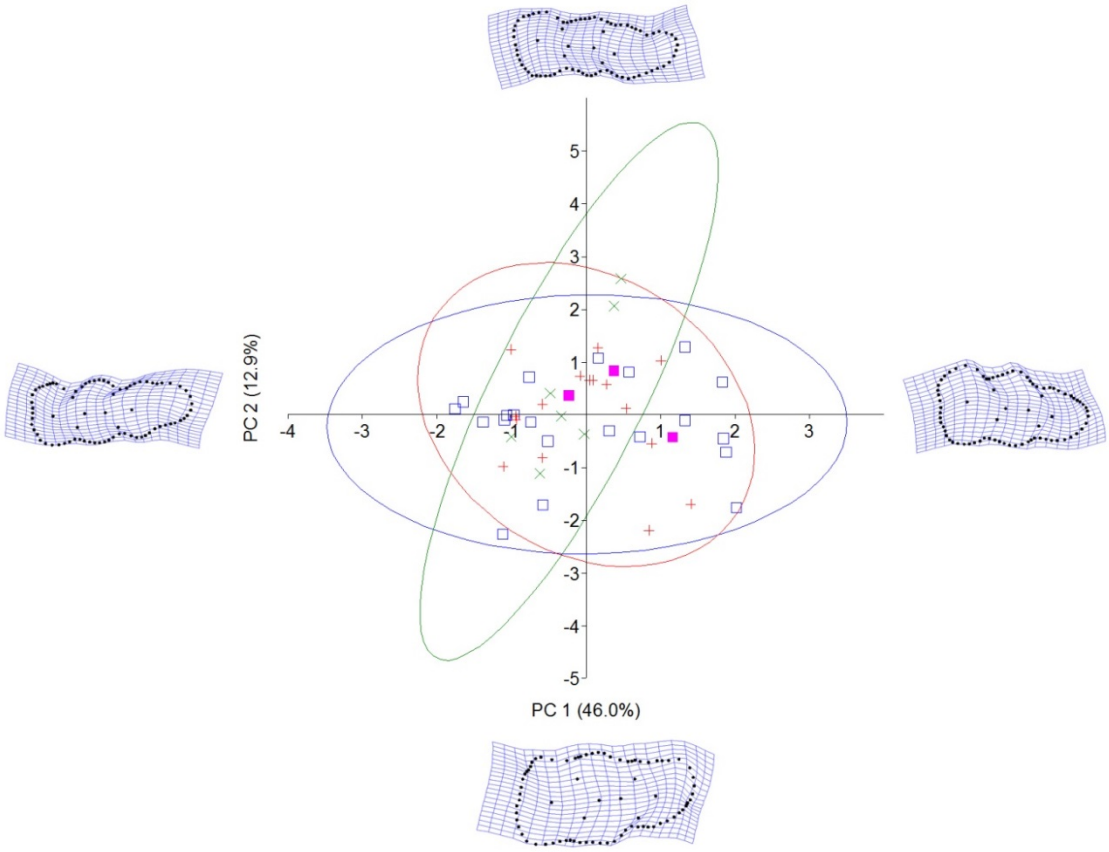
Welch F test in the case of unequal variances: F=0.177, df=8.233, P=0.9091

Fig. 3.3.56. Chronological comparison of the settlement Savognin-Padnal based on the Centroid size (CS) of M_3. Numbers indicate the sample size used to obtain the CS. EBA = Early Bronze Age, E-MBA = Early-Middle Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.



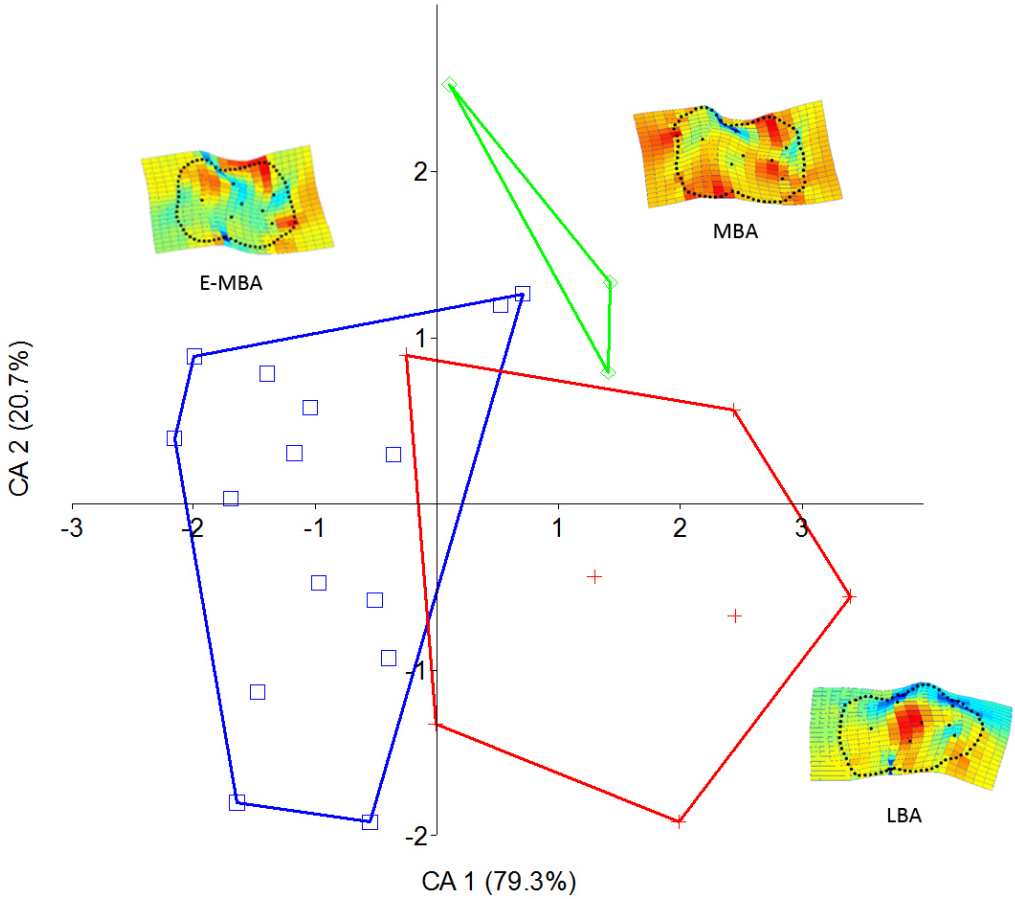
M2

Fig. 3.3.57. Principal Component Analysis (PCA) of M_2 in three phases from the settlement Savognin-Padnal visualised by the projection of each region samples on the PC 1 and PC 2. Values in parentheses indicate the 95% confident interval of ellipses. Thin plate spline deformation grids show the transformation of a theoretical specimen at the end of the negative and positive value of each PCs (EBA: pink n = 1, E-MBA: blue n = 15, MBA: green n = 3, LBA: red n=7). EBA = Early Bronze Age, E-MBA = Early-Middle Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.



M3

Fig. 3.3.58. Principal Component Analysis (PCA) of M_3 in four phases from the settlement Savognin-Padnal visualised by the projection of each region samples on the PC 1 and PC 2. Values in parentheses indicate the 95% confident interval of ellipses. Thin plate spline deformation grids show the transformation of a theoretical specimen at the end of the negative and positive value of each PCs (EBA: pink n = 3, E-MBA: blue n = 21, MBA: green n = 7, LBA: red n=16). EBA = Early Bronze Age, E-MBA = Early-Middle Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.



M2

MANOVA Wilks' lambda: F (72, 24) = 0.9823, P > 0.5

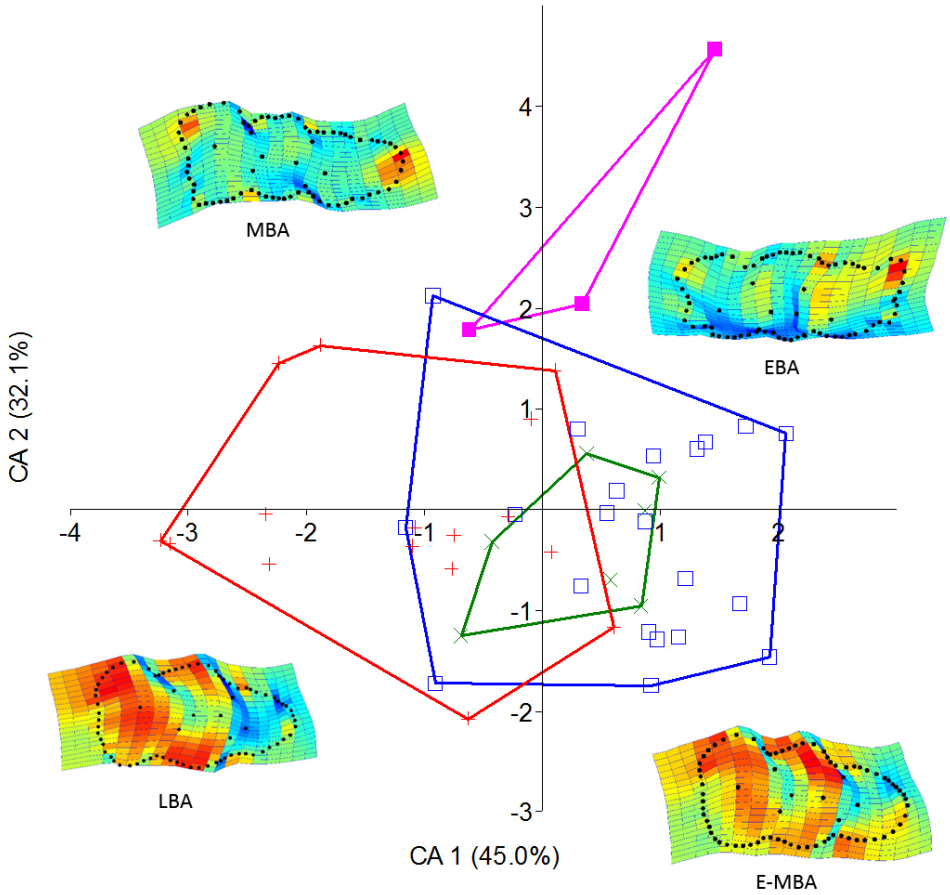
Pairwise comparisons

Hotelling's p values, uncorrected significance

	EMBA	MBA	LBA
EMBA	0	0.823578	0.280306
MBA		0	Fail
LBA			0

Significant p values are coloured. α = 0.05.

Fig. 3.3.59. Canonical Variate Analysis (CVA) of M_2 in three phases from Savognin-Padnal. Thin plate spline deformation grids show the mean figure of samples in each Bronze Age Phase (EBA: no display n = 1, E-MBA: blue n = 15, MBA: green n = 3, LBA: red n=7). EBA = Early Bronze Age, EMBA = Early-Middle Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.



M3

MANOVA Wilks' lambda: F (42, 89.76) = 1.315, P > 0.5

Pairwise comparisons

Hotelling's p values, uncorrected significance

	EBA	EMBA	MBA	LBA
EBA	0	0.705778	Fail	0.876446
EMBA		0	0.771193	0.167432
MBA			0	0.766296
LBA				0

Significant p values are coloured. α = 0.05.

Fig. 3.3.60. Canonical Variate Analysis (CVA) of M_3 in four phases from Savognin-Padnal. Thin plate spline deformation grids show the mean figure of samples in each Bronze Age Phase (EBA: pink n = 3, E-MBA: blue n = 21, MBA: green n = 7, LBA: red n = 16). EBA = Early Bronze Age, EMBA = Early-Middle Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

No.	Phase	Field	Excavated year	Excavated point	Structure	Species	Skeletal element	Body side Bone part	Type	Side view	Cross-section view	Weight (g)
									Schibler, J. 1981			
6	LBA	1	1971	8	unknown	Bos taurus	Ulna	sin. diaphyse	point 1/5	broken	broken	19.2
5	LBA	3	1973	22	House 2	Ovis/Capra	Metatarsus	indet. diaphyse	point 1/?	indet.	indet.	2.5
4	LBA	3	1973	150	Path 1	Ovis/Capra	Ulna	dext. diaphyse	point 1/?	indet.	indet.	1
3	MBA	3	1973	228	Outside	Ovis/Capra	Ulna	dext. diaphyse	point 1/?	indet.	indet.	1.4
2	E-MBA	3	1975	72 (b)	Path 2	Bos taurus	Ulna	dext. diaphyse	point 1/5	2	1	4.1
1	EBA	3	1975	148 (b)	Path 1	Bos taurus	Ulna	dext. diaphyse	point 1/5	9	1	16.9
	TOTAL											45.1

Fig. 3.3.61. List of bone artefacts excavated from the Bronze Age settlement Savognin-Padnal in Switzerland.

No.	Measurement (mm)	Note
6	remaind L=83.59 Pointed end is broken	Above half of the layer Horizone B. Shining by polishment. Completely carbonised, black-ash brown colour.
5	remaind L=63.32 Near pointed end=0.88	Centre house. Old broken edge. Shining by polishment. Bite marks near proximal part
4	remaind L=58.18 Pointed end=1.05	East path between house 1 and house 2. Very bad preservation.
3	remaind L=71.15 Pointed end=0.84	Outside of house. Very bad preservation.
2	remaind L=76.16 Near pointed end=1.87	North path between house 2 and house 4. Pointed end is newly broken. Very bad preservation.
1	remaind L=132.62 Pointed end=1.6	South path between house 1 and house 2. Shining by polishment. Bite marks near proximal part.

Fig. 3.3.62. The details of excavated bone artefacts from the Bronze Age settlement Savognin-Padnal in Switzerland. Numbers refer to the entries in Figure 3.3.61.

Fig. 3.3.63. Ulna point made of cattle from the Early Bronze Age (no. 1 in Fig. 3.3.3.20).

Fig. 3.3.64. Ulna point made of cattle from the Late Bronze Age (no. 6 in Fig. 3.3.3.20).

Fig. 3.3.65. Ulna point made of sheep/goat from the Late Bronze Age (no. 4 in Fig. 3.3.3.20).

Fig. 3.3.66. Metatarsus point made of sheep/goat from the Late Bronze Age (no. 5 in Fig. 3.3.3.20).

Phase	Map No. (Fig. 3.4.3)	Settlement	Arcaeozoological references	Published year	Region	Settlement Type	Identified Specimens
Late Bronze Age	1	Ayent VS-Le Château	Chaix	1990b	Alpine west	Dryland	155
	2	Bavois VD-En Raillon	Chaix	1984	West dryland	Dryland	123
	3	Cortaillod Ne-Est	Chaix	1986	West wetland	Wetland	335
	4	Cresta GR-Cazis, Planum 14	Plüss	2007	Alpine east	Dryland	1594
	5	Fällanden ZH-Riedspitz	Schibler	unpublished	East wetland	Wetland	92
	6	Genève GE-Eaux-Vives	Revilliod/Reverdin	1927	West wetland	Wetland	1101
	7	Greifensee ZH-Böschen 1987	Schibler	1987	East wetland	Wetland	93
	7	Greifensee ZH-Böschen 2007	Veszeli/Hüster Plogmann	2007	East wetland	Wetland	322
	8	Hagnau D-Burg, 2-6	Kokabi	1990	East wetland	Wetland	533
	8	Hagnau D-Burg, 7-12	Kokabi	1990	East wetland	Wetland	255
	9	Hallwil AG-Rostbau	Steinmann	1923 & 1925	East wetland	Wetland	404
	10	Hauterive NE-Champréveyres 1983	Borrello/Chaix	1983	West wetland	Wetland	130
	10	Hauterive NE-Champréveyres C 3	Studer	1991	West wetland	Wetland	5777
	11	Le Landeron NE-Les Marais	Borrello/Chaix	1983	West wetland	Wetland	142
	12	Loppburg NW-Stansstad	Stopp	2007	East dryland	Dryland	102
	13	Meilen ZH-Schellen	Schibler	unpublished	East wetland	Wetland	631
	14	Nunningen SO-Portiflue	Schibler	1996c	Jura	Dryland	395
	15	Oberriet SG-Montlingerberg	Würgler	1962	Alpine east	Dryland	Ca. 1000 (1045)
	16	Pieterlen BE-Under Siedebrunne 3	Deschler-Erb	2005	West dryland	Dryland	98
	17	Möriken AG-Kestenberg II	Schmid	1952	Jura	Dryland	793
	17	Möriken AG-Kestenberg III	Schmid	1955	Jura	Dryland	1964
	18	Ramosch GR-Mottata	Würgler	1962	Alpine east	Dryland	>100 (103)
	19	Savognin GR-Padnal, Horizont B	Bopp-Ito	unpublished	Alpine east	Dryland	10793
	20	Schleitheim SH-Auf der Egg	Rehazek	unpublished	East dryland	Dryland	1971
	22	Uerschhausen TG-Horn (excl. Schicht 1)	Markert	unpublished	East wetland	Wetland	303
	23	Vex VS-Le Château	Chaix	1990a	Alpine west	Dryland	233
	24	Vinelz BE-Ländti	Stampfli	unpublished	West wetland	Wetland	466
	40	Wasserburg D-Buchau	Kokabi	1990	East wetland	Wetland	max. 2496
	25	Wittnau AG-Wittnauerhorn	Schibler	1996a	Jura	Dryland	128
	26	Zug ZG-Sumpf	Schibler	1996b	East wetland	Wetland	876
	27	Zürich ZH-Alpenquai	Wettstein	1924	East wetland	Wetland	5432
	27	Zürich ZH-Grosser Hafner	Schibler	unpublished	East wetland	Wetland	462
Total 32							>39272 (39347)
Middle Bronze Age	28	Cham ZG-Oberwil	Schibler/Veszeli	2001	East dryland	Dryland	134
	29	Cornol JU-Mont Terri	Morel	1988	Jura	Dryland	264
	4	Cresta GR-Cazis, Planum 12	Plüss	2007	Alpine east	Dryland	2300
	4	Cresta GR-Cazis, Planum 11	Plüss	2007	Alpine east	Dryland	820
	4	Cresta GR-Cazis, Planum 10	Plüss	2007	Alpine east	Dryland	453
	30	Kirchberg SG-St. Iddaburg	Würgler	1956	East dryland	Dryland	227
	31	Lumbrein-Srin GR-Crestaulta	Rüeger	1942	Alpine east	Dryland	MNI 887
	19	Savognin GR-Padnal, Horizont C	Bopp-Ito	unpublished	Alpine east	Dryland	4402
	19	Savognin GR-Padnal, Horizont D	Bopp-Ito	unpublished	Alpine east	Dryland	7356
	21	Scuol GR-Avant Muglins	Rehazek	unpublished	Alpine east	Dryland	726
	21	Scuol GR-Munt Baselgia, I-II	Kaufmann	1983	Alpine east	Dryland	510
	21	Scuol GR-Munt Baselgia, I-III	Kaufmann	1983	Alpine east	Dryland	>1918
	32	Zeneggen VS-Kasteltschuggen	Chaix	unpublished	Alpine west	Dryland	102
Total 13							19212 MNI=887
Early Bronze Age	33	Arbon TG-Bleiche 2	Kuhn/Güller	1946	East wetland	Wetland	MNI 173
	1	Ayent VS-Le Château	Chaix	1990b	Alpine west	Dryland	146
	41	Bodman D-Schachen, Befund 4	Kokabi	1990	East wetland	Wetland	57
	41	Bodman D-Schachen, Befund 2	Kokabi	1990	East wetland	Wetland	87
	42	Bad Buchau D-Forschner	Kokabi	1990	East wetland	Wetland	max. 514
	4	Cresta GR-Cazis, Planum 8	Plüss	2007	Alpine east	Dryland	1923
	4	Cresta GR-Cazis, Planum 5	Plüss	2007	Alpine east	Dryland	671
	4	Cresta GR-Cazis, Planum 4	Plüss	2007	Alpine east	Dryland	971
	4	Cresta GR-Cazis, Planum 3	Plüss	2007	Alpine east	Dryland	2529
	4	Cresta GR-Cazis, Planum 2	Plüss	2007	Alpine east	Dryland	845
	4	Cresta GR-Cazis, Planum 1	Plüss	2007	Alpine east	Dryland	507
	34	Hochdorf LU-Baldegg	Hescheler/Rüegger	1940	East wetland	Wetland	MNI 145
	35	Meilen ZH-Obermeilen	Kuhn	1935	East wetland	Wetland	838
	19	Savognin GR-Padnal, Horizont E	Bopp-Ito	unpublished	Alpine east	Dryland	3818
	36	Schellenberg FL-Borscht 1964	Hartmann-Frick	1964	Alpine east	Dryland	1326
	36	Schellenberg FL-Borscht 1937	Kuhn	1937	Alpine east	Dryland	156
	21	Scuol GR-Motta Sfondraz	Schibler in Rageth	1998	Alpine east	Dryland	435
	37	Sion VS-Petit-Chasseur	Chaix	1976a	Alpine west	Dryland	669
	23	Vex VS-Le Château	Chaix	1990a	Alpine west	Dryland	202
	38	Wädenswil ZH-Vorder Au S.1	Rehazek	2005	East wetland	Wetland	139
	38	Wädenswil ZH-Vorder Au S.0	Rehazek	2005	East wetland	Wetland	627
	39	Yverdon VD-Garage Martin	Chaix	1976b	West wetland	Wetland	200
	27	Zürich ZH-Bauschanze	Rehazek	unpublished	East wetland	Wetland	460
	27	Zürich ZH-Mozartstrasse, 1o	Hüster Plogmann/Schibler	1997	East wetland	Wetland	1401
	27	Zürich ZH-Mozartstrasse, 1u	Hüster Plogmann/Schibler	1997	East wetland	Wetland	1999
Total 25							20520 MNI=318
TOTAL assemblage 70							**>79004 (79079) MNI=1205**

Fig. 3.4.1. List of the Bronze Age settlements from Switzerland and neighbouring countries (40 dryland and 30 wetland assemblages) from which faunal remains were excavated.

Phase	Map No. (Fig. 3.4.3)	Settlement	Dating C14, Dendrochronology		Dating References
Late Bronze Age	1	Ayent VS-Le Château	C14	1210-906 BC	David-El Biali, M., 1990
	2	Bavois VD-En Raillon	C14	1520-990 BC	Hochuli, S., et al., 1998 (SPM III)
	3	Cortaillod Ne-Est	Den.	1010-955 BC	Hochuli, S., et al., 1998 (SPM III)
	4	Cresta GR-Cazis, Planum 14	C14	1350-1100/800 BC	Wyss, R., 2002
	5	Fällanden ZH-Riedspitz	Den.	ca. 950-880 BC	Bauer, I. 1985; Seifert, M., 1996
	6	Genève GE-Eaux-Vives	Typology	Late Bronze Age	Revilliod, P./Reverdin, L., 1927; Barde, E., 1930; Hochuli, S., et al., 1998 (SPM III)
	7	Greifensee ZH-Böschen 1987	Den.	1063-1042 BC	Eberschweiler, B., et al., 2007
	7	Greifensee ZH-Böschen 2007	Den.	1063-1042 BC	Eberschweiler, B., et al., 2007
	8	Hagnau D-Burg, 2-6	Den.	1061-874 BC	Billamboz, A. & Schöbel, G., 1996
	8	Hagnau D-Burg, 7-12	Den.	1061-874 BC	Billamboz, A. & Schöbel, G., 1996
	9	Hallwil AG-Rostbau	Typology	1200-800 BC	Bosch, R., 1925
	10	Hauterive NE-Champréveyres 1983	Typology	HaB1-HaB3	Hochuli, S., et al., 1998 (SPM III)
	10	Hauterive NE-Champréveyres C 3	Den.	1054-1037 BC	Hochuli, S., et al., 1998 (SPM III)
	11	Le Landeron NE-Les Marais	Den.	961-957 BC	Hochuli, S., et al., 1998 (SPM III)
	12	Loppburg NW-Stansstad Layer 21-22	C14	1395-1113, 1389-1056, 1313-1004, 913-761 BC	Gutzwiller, P., 2007
	13	Meilen ZH-Schellen	Den.	964 BC	Francuz, J., et al., 1986
	14	Nunningen SO-Portiflue	Typology	Late Bronze Age	Gutzwiller, P., et al., 1996
	15	Oberriet SG-Montlingerberg	Typology	HaB1-HaB3	Hochuli, S., et al., 1998 (SPM III)
	16	Pieterlen BE-Under Siedebrunne 3	C14	1300-1100 BC	Ramstein, M. & Deschler-Erb, S., 2005
	17	Möriken AG-Kestenberg II	Typology	HaB1, B3	Hochuli, S., et al., 1998 (SPM III)
	17	Möriken AG-Kestenberg III	Typology	HaB1, B3	Hochuli, S., et al., 1998 (SPM III)
	18	Ramosch GR-Mottata	Typology	Middle-Late Bronze Age	Hochuli, S., et al., 1998 (SPM III)
	19	Savognin GR-Padnal, Horizont B	C14	1350/1300-900/800 BC	Rageth, J., 1986 & pers. com.
	20	Schleitheim SH-Auf der Egg	Typology	Late Bronze Age	Rehazek, A., pers. com.
	22	Uerschhausen TG-Horn (excl. Schicht 1)	Den.	ca. 850 BC	Seifert, M., 1996; Houchli, S., et al., 1998 (SPM III)
	23	Vex VS-Le Château	Typology	Late Bronze Age	David-El Biali, M., 1990
	24	Vinelz BE-Ländti	Den.	1005, 944, 920 BC	Hochuli, S., et al., 1998 (SPM III)
	40	Wasserburg D-Buchau	Den.	1058-1054, 1006-988, 964-945, 932-925, 867-852 BC	Billamboz, A., 2009
	25	Wittnau AG-Wittnauerhorn Layer 3b	C14	1519-793 BC	Hochuli, S., et al., 1998 (SPM III)
	26	Zug ZG-Sumpf	Den.	1050-940 BC, 880 BC	Seifert, M., 1996; Houchli, S., et al., 1998 (SPM III)
	27	Zürich ZH-Alpenquai	Den.	1034/1035, 862 BC	Mäder, A., 2001a, 2001b
	27	Zürich ZH-Grosser Hafner	Den.	1132, 1098, 1087, 1077, 1036, 1014, 1000 BC	Primas, M./Ruoff, U., 1981
Middle Bronze Age	28	Cham ZG-Oberwil	Typology	BzA1/A2	Hochuli, S., et al., 1998 (SPM III)
	29	Cornol JU-Mont Terri	C14	1517-1410 BC	Müller, F., 1988
	4	Cresta GR-Cazis, Planum 12	C14	1800-1550 BC	Wyss, R., 2002
	4	Cresta GR-Cazis, Planum 11	C14	1800-1550 BC	Wyss, R., 2002
	4	Cresta GR-Cazis, Planum 10	C14	1800-1550 BC	Wyss, R., 2002
	30	Kirchberg SG-St. Iddaburg	Typology	Middle-Late Bronze Age	Würgler, F. E., 1956; Hochuli, S., et al., 1998 (SPM III)
	31	Lumbrein-Srin GR-Crestaulta	Typology	BzB	Hochuli, S., et al., 1998 (SPM III)
	19	Savognin GR-Padnal, Horizont C	C14	1450-1350/1300 BC	Rageth, J., 1986 & pers. com.
	19	Savognin GR-Padnal, Horizont D	C14	1550-1450 BC	Rageth, J., 1986 & pers. com.
	21	Scuol GR-Avant Muglins	C14	1400 BC	Seifert, M., pers. com.
	21	Scuol GR-Munt Baselgia, I-II	Typology	Middle-beginning of Late BA	Kaufmann, B., 1983; Stauffer-Isenring, L., 1983
	21	Scuol GR-Munt Baselgia, I-III	Typology	Middle-Late Bronze Age	Kaufmann, B., 1983; Stauffer-Isenring, L., 1983
	32	Zeneggen VS-Kasteltschuggen	C14	1510-1260 BC	Hochuli, S., et al., 1998 (SPM III)
Early Bronze Age	33	Arbon TG-Bleiche 2	C14 & Den.	1600-1500 BC?	Hochuli, S., et al., 1998 (SPM III)
	1	Ayent VS-Le Château	Typology	BzA3-BzA4	David-El Biali, M., 1990
	41	Bodman D-Schachen, Befund 4	Den.	1644-1640 BC	Hochuli, S., et al., 1998 (SPM III)
	41	Bodman D-Schachen, Befund 2	Den.	1618-1591 BC	Hochuli, S., et al., 1998 (SPM III)
	42	Bad Buchau D-Forschner	Den.	1500 BC	Hochuli, S., et al., 1998 (SPM III)
	4	Cresta GR-Cazis, Planum 8	C14	2400-1800 BC	Wyss, R., 2002
	4	Cresta GR-Cazis, Planum 5	C14	2400-1800 BC	Wyss, R., 2002
	4	Cresta GR-Cazis, Planum 4	C14	2400-1800 BC	Wyss, R., 2002
	4	Cresta GR-Cazis, Planum 3	C14	2400-1800 BC	Wyss, R., 2002
	4	Cresta GR-Cazis, Planum 2	C14	2400-1800 BC	Wyss, R., 2002
	4	Cresta GR-Cazis, Planum 1	C14	2400-1800 BC	Wyss, R., 2002
	34	Hochdorf LU-Baldegg	Typology	Early Bronze Age	Hescheler, K., & Rüeger, J., 1940 Hochuli, S., et al., 1998 (SPM III)
	35	Meilen ZH-Obermeilen	Typology	Early Bronze Age	Kuhn, M., 1935; Keller, F., 1870; Hochuli, S., et al., 1998 (SPM III)
	19	Savognin GR-Padnal, Horizont E	C14	1950/1900-1550 BC	Rageth, J., 1986 & pers. com.
	36	Schellenberg FL-Borscht 1964	Typology	2000 BC	Hild, A., 1935, 1936
	36	Schellenberg FL-Borscht 1937	Typology	2000 BC	Hild, A., 1935, 1936
	21	Scuol GR-Motta Sfondraz	Typology	Main part in EBA (some in MBA and LBA)	Rageth, J. 1998b
	37	Sion VS-Petit-Chasseur	C14	2464-1460 BC	Hochuli, S., et al., 1998 (SPM III)
	23	Vex VS-Le Château	Typology	Early Bronze Age	David-El Biali, M., 1990
	38	Wädenswil ZH-Vorder Au S.1	Den.	1616-1598 BC	Conscience, A.-C., 2005
	38	Wädenswil ZH-Vorder Au S.0	Den.	1616-1598 BC	Conscience, A.-C., 2005
	39	Yverdon VD-Garage Martin	Den.	2000, 1600-1500 BC	Kaenel, G., 1976
	27	Zürich ZH-Bauschanze	Typology	Early Bronze Age	Rehazek, A., pers. com.
	27	Zürich ZH-Mozartstrasse, 1o	Typology	Early Bronze Age	Bleicher, N., 2011
	27	Zürich ZH-Mozartstrasse, 1u	Typology	Early Bronze Age	Bleicher, N., 2011

Fig. 3.4.2. Dating of the Bronze Age settlements from Switzerland and neighbouring countries from which faunal remains were excavated. Den. = Dendrochronology, pers. com. = personal communication.

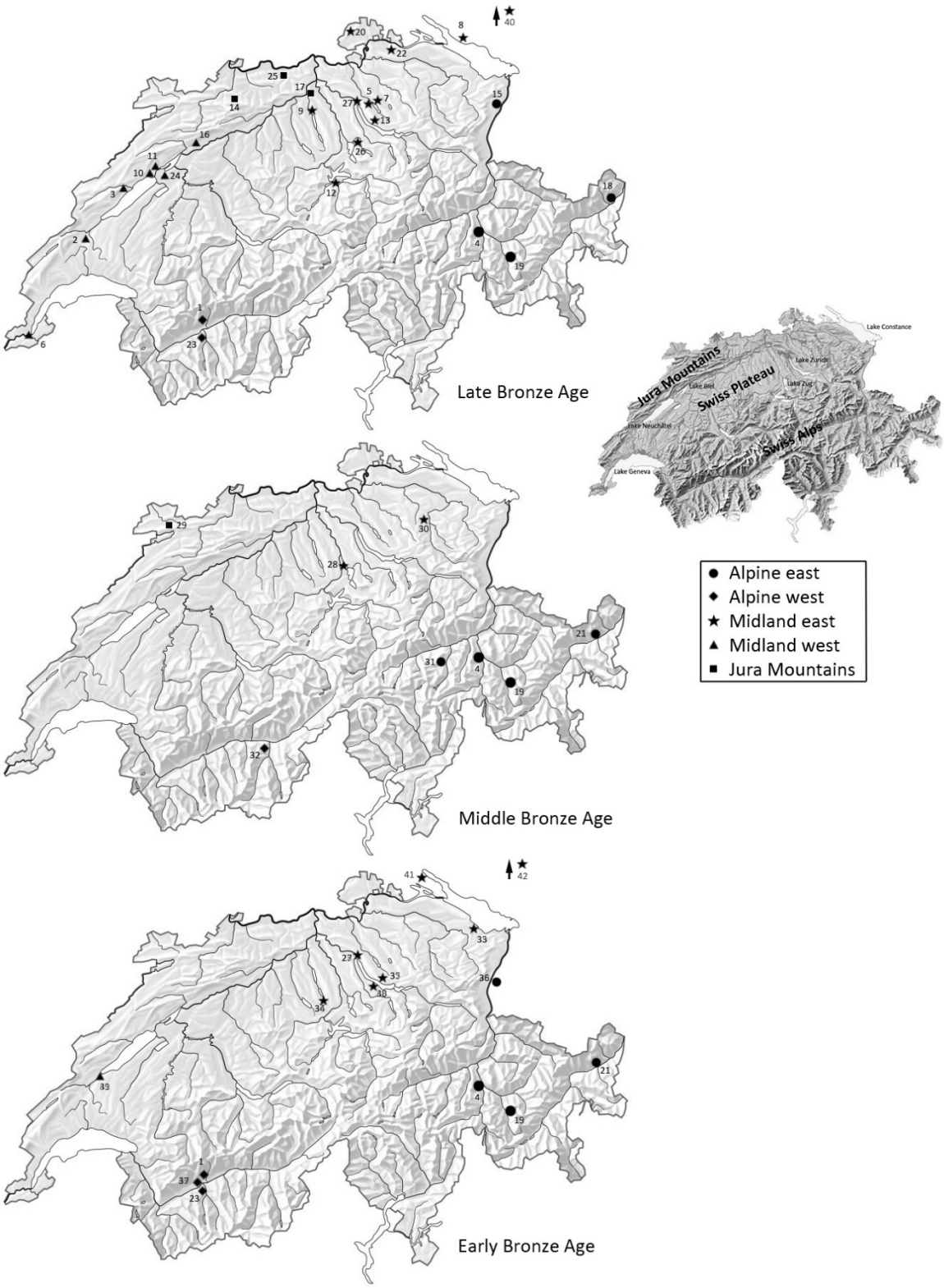


Fig. 3.4.3. Location of the Bronze Age settlements in the five regions in Switzerland and neighbouring countries. Numbers refer to the entries in Figure 3.4.1.

Assemblage n

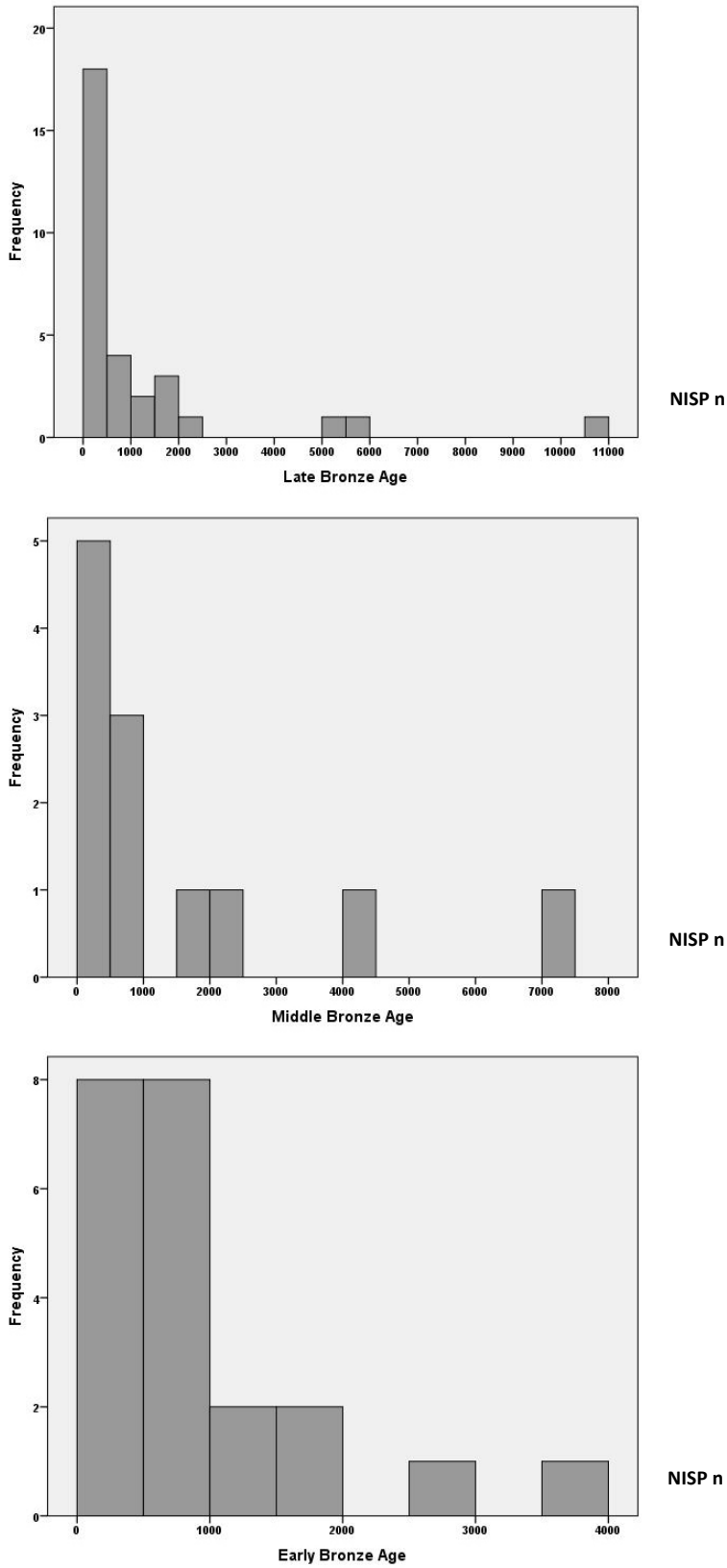


Fig. 3.4.4. The distribution of assemblages and the number of identified specimens (NISP) of domestic and wild animals over three Bronze Age phases.

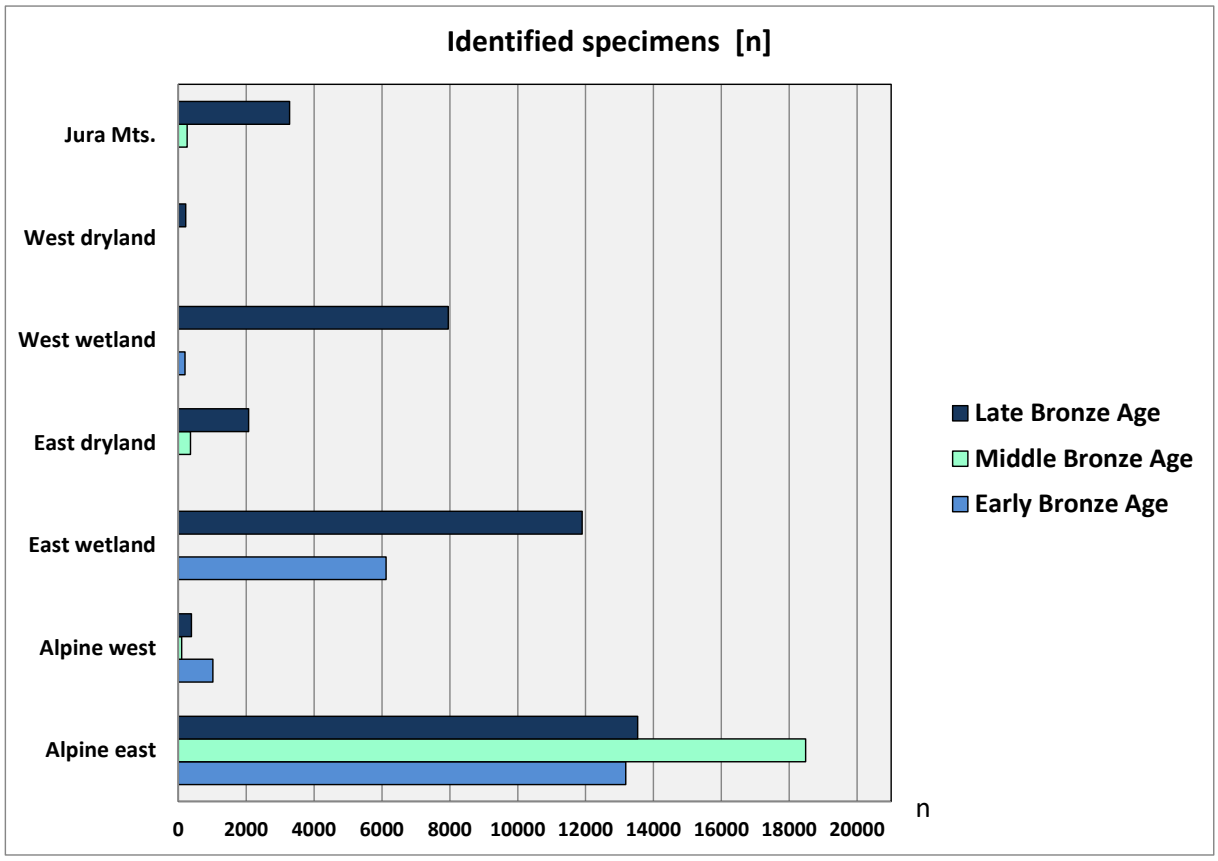


Fig. 3.4.5. The number of identified specimens of domestic and wild animals over three Bronze Age phases in the seven regions from the Swiss Alps, Plateau, and Jura Mountains: East wetland = East Midland wetland, East dryland = East Midland dryland, West wetland = West Midland wetland, West dryland = West Midland dryland, and Jura Mts. = Jura Mountains.

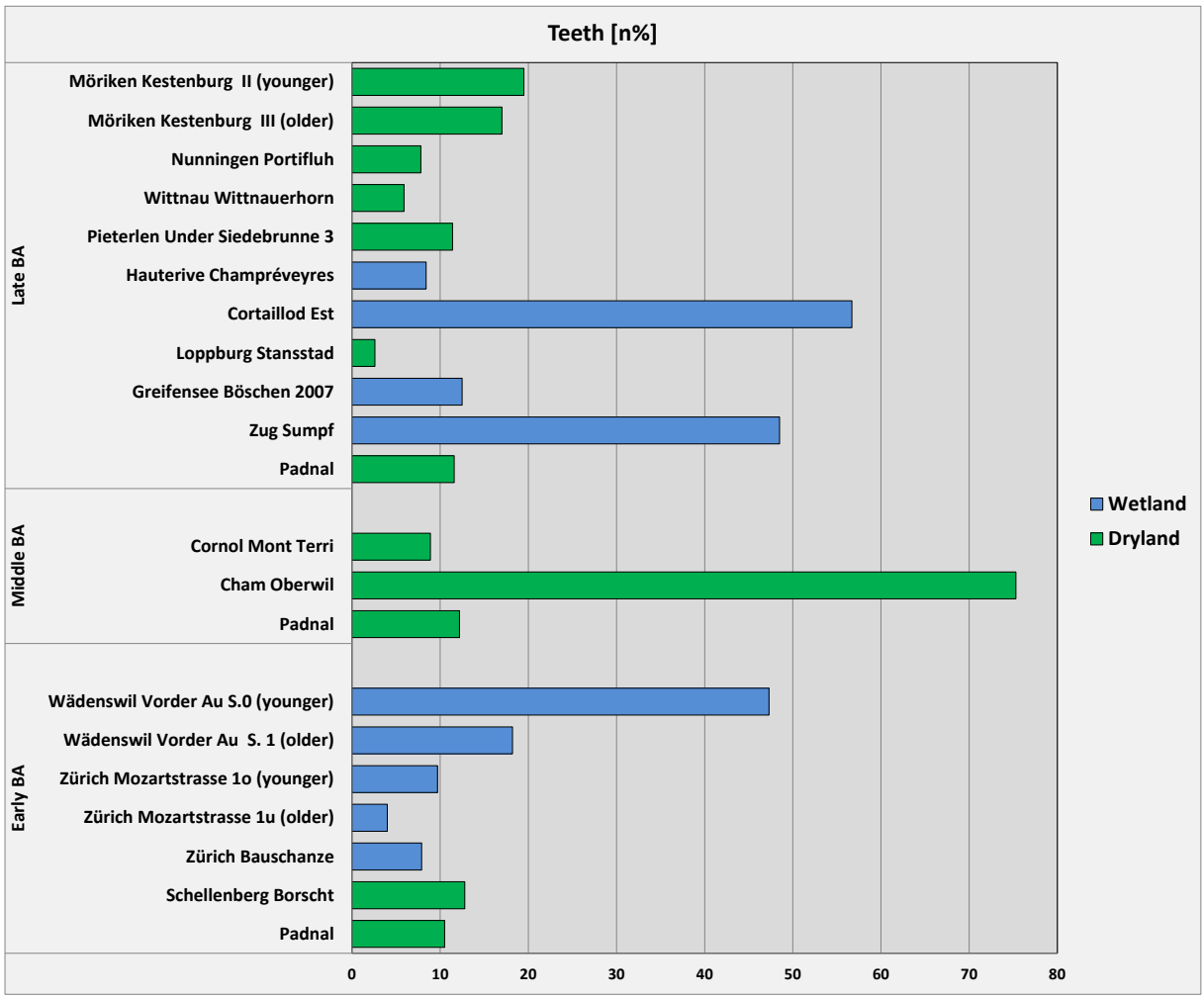


Fig. 3.4.6. Proportion of lost teeth remains from the Swiss Bronze Age (BA) settlements. For settlement names and details, see Figure 3.4.1.

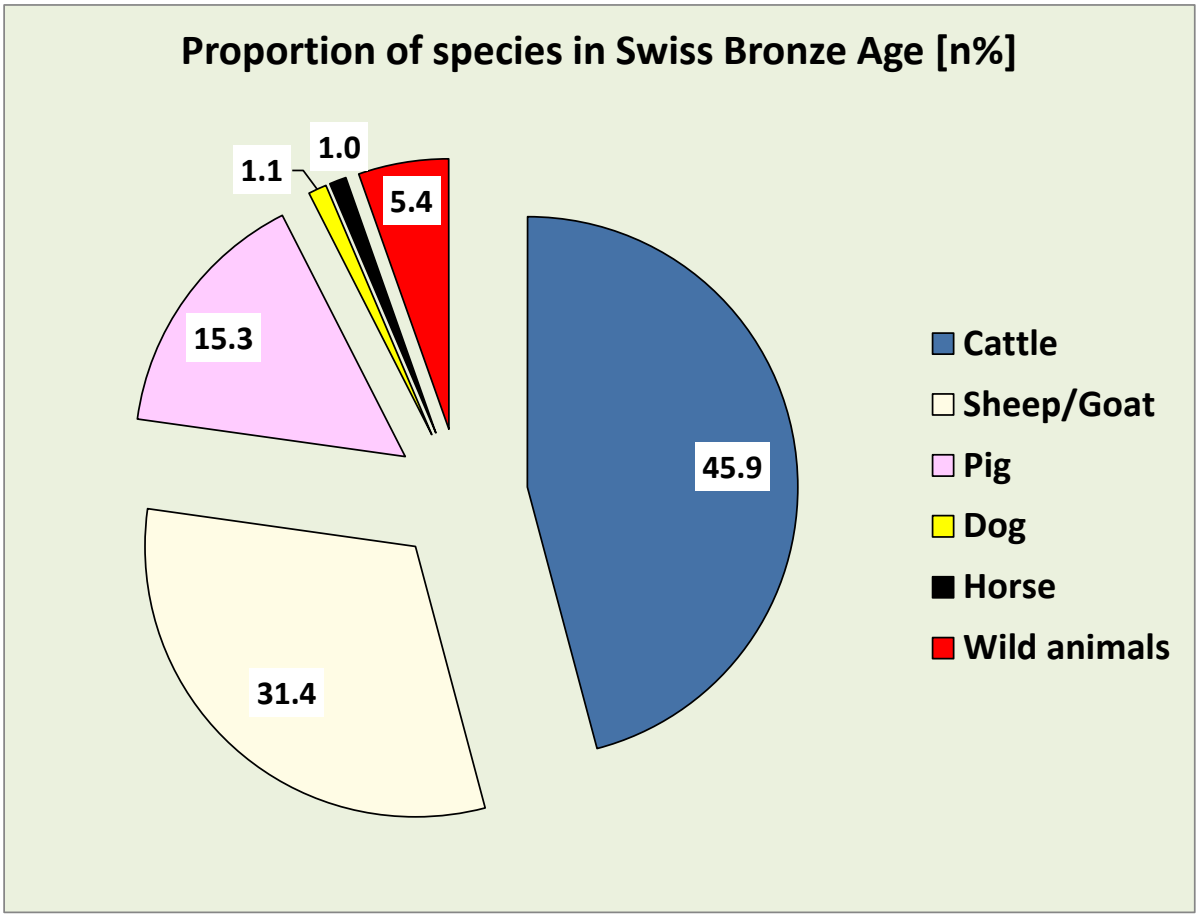


Fig. 3.4.7. Proportion of species from studied Bronze Age settlements in Switzerland and neighbouring countries.

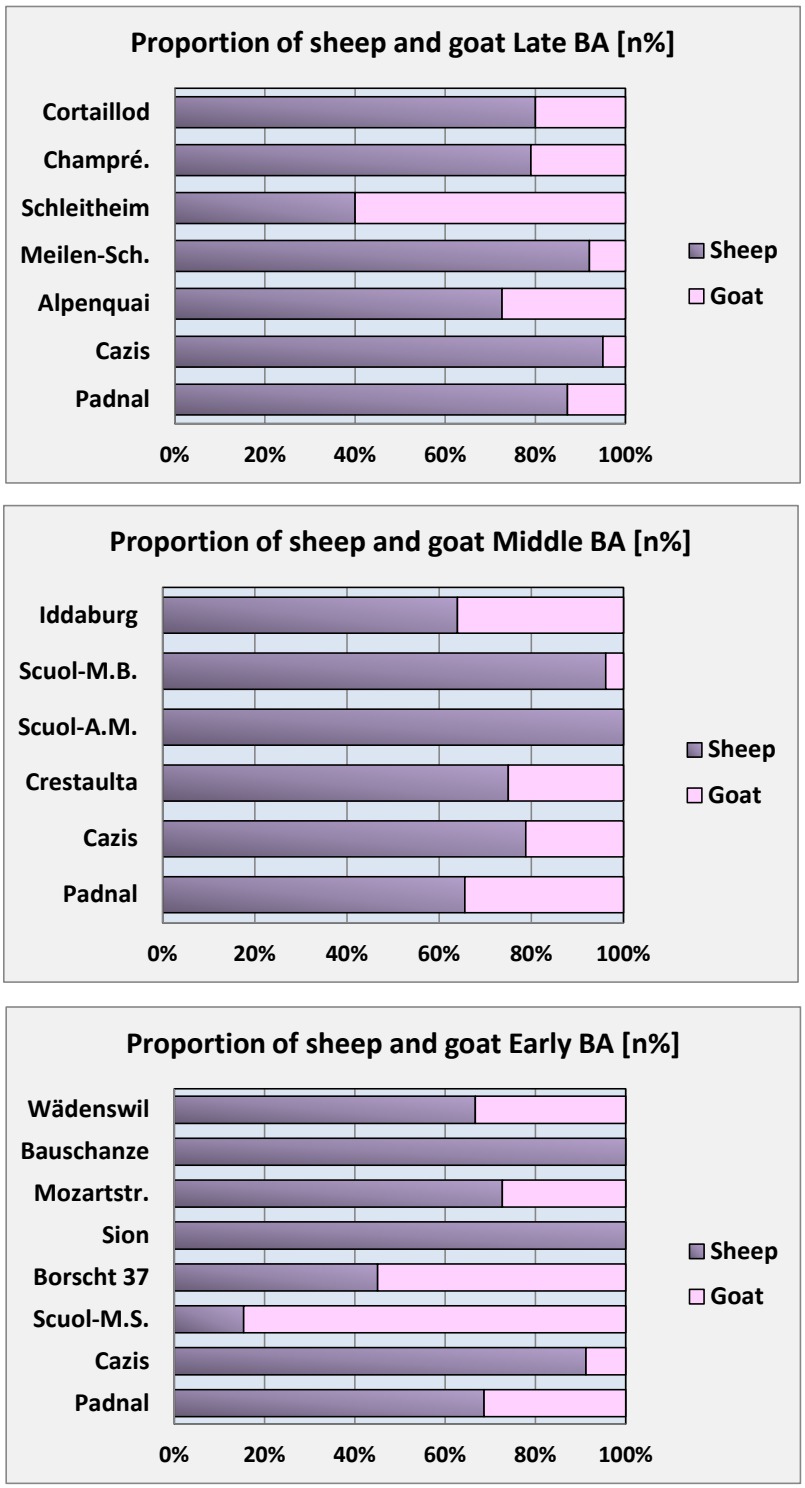


Fig. 3.4.8. Proportion of sheep and goats based on the number of identified specimens in Bronze Age (BA) settlements. Cazis = Cresta-Cazis, Scuol-M.S. = Scuol-Motta Sfondraz, Borscht 37 = Schellenberg-Borscht 1937, Sion = Sion-Petit Chasseur, Mozartstr. = Zürich-Mozartstrasse, Scuol-A.M. = Scuol-Avant Muglins, Scuol-M.B. = Scuol-Munt Baselgia I-III, Iddaburg = Kirchberg-St. Iddaburg, Meilen-Sch. = Meilen-Schellen, Champré. = Hauterive-Champréveyres (*cf.* Fig. 3.4.1).

Phase	Settlement	Withers height (cm)
LBA	Alpenquai	57.5
	Champéveyres	62.3
	Cortaillod	57.7
EBA	Cazis	not available
	Mozartstrasse	51.3
	Padnal	45.2

Fig. 3.4.9. Withers height of Swiss Bronze Age dogs calculated based on the factor by Harcourt (1974). (*cf.* Appx. Tab. 6). EBA = Early Bronze Age, LBA = Late Bronze Age. For settlement names and details, see Figure 3.4.1.

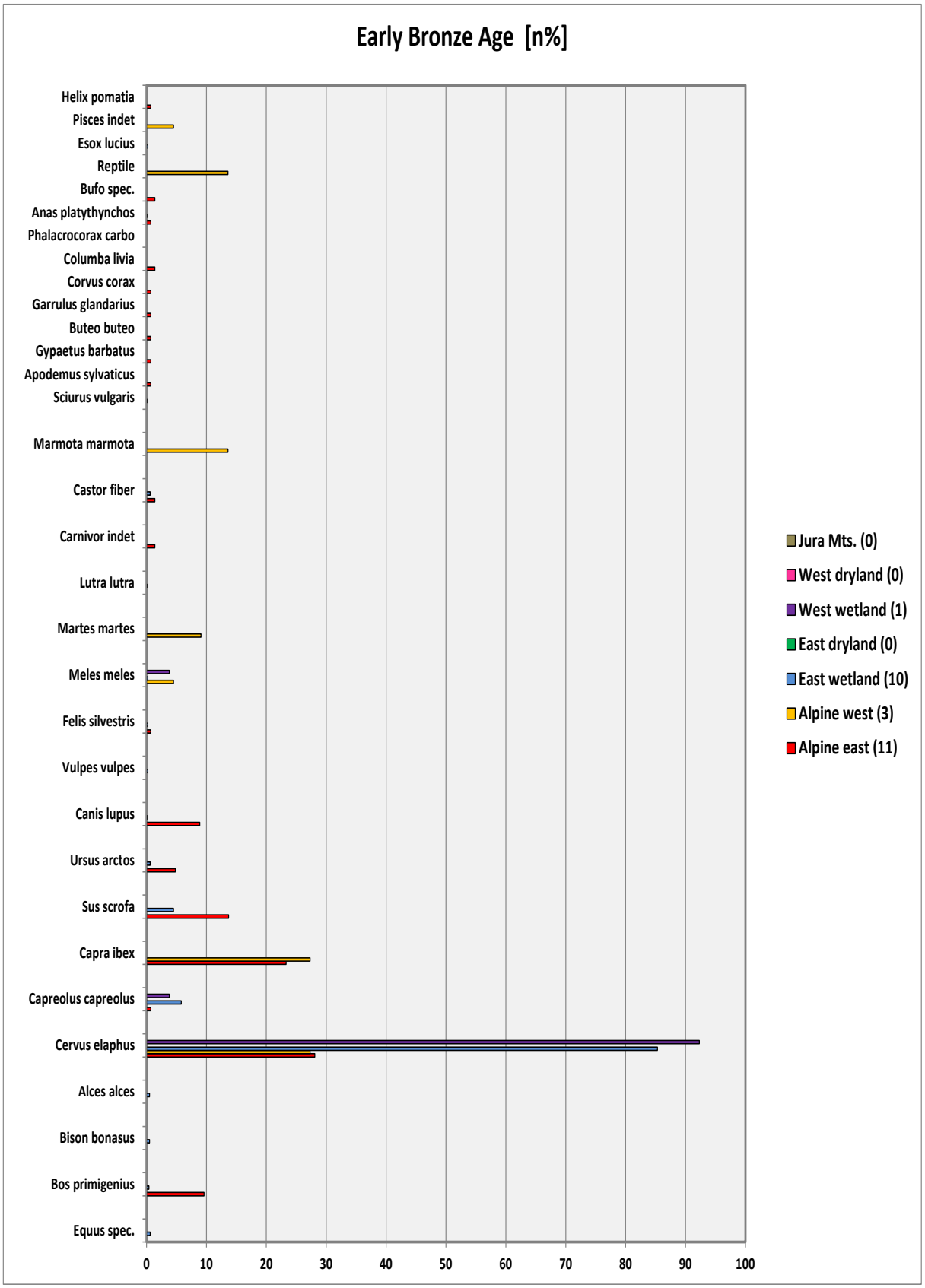


Fig. 3.4.10. Proportion of wild animals during the Early Bronze Age excavated from Swiss and Lichtenstein settlements. Numbers in parentheses indicate the number of assemblages.

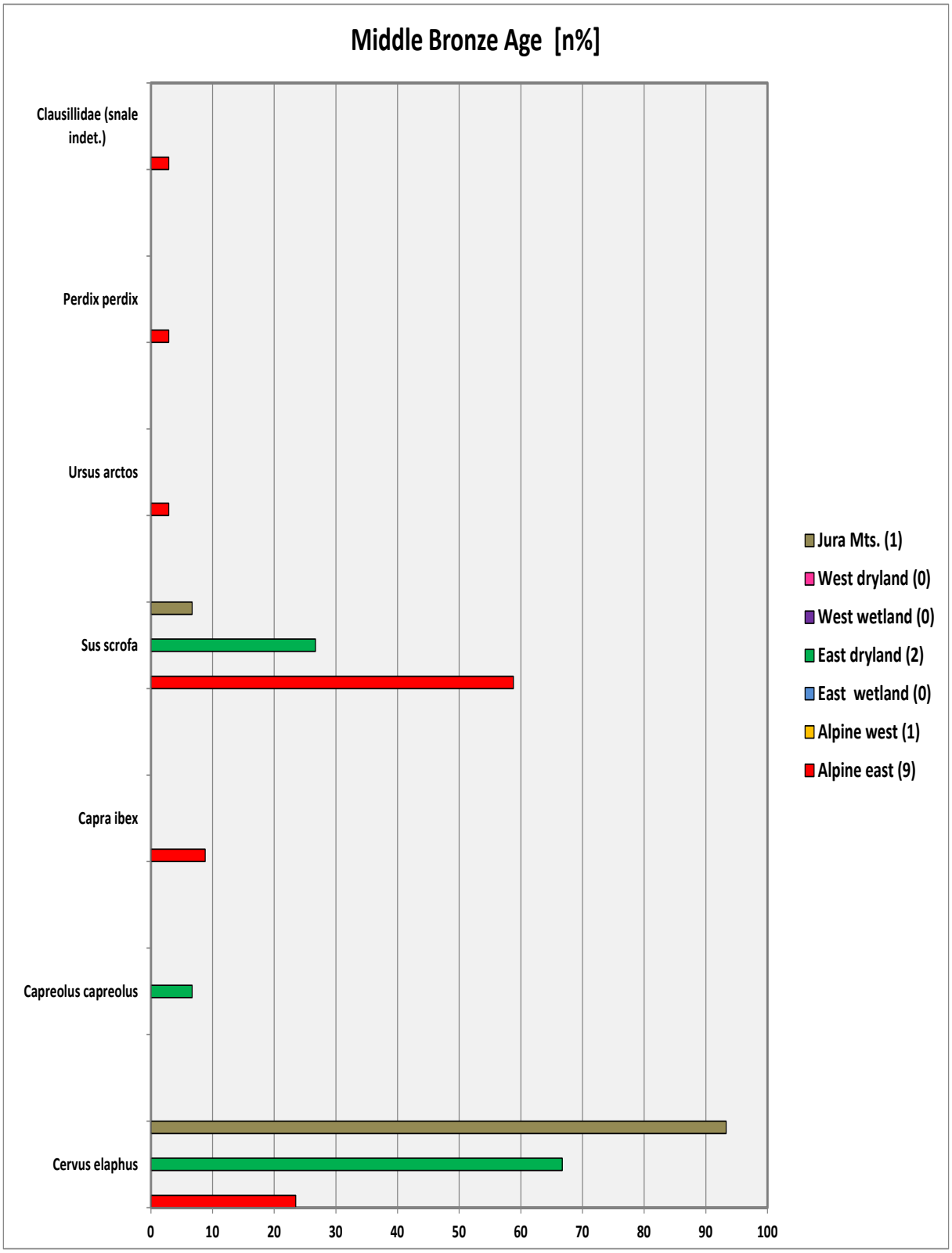


Fig. 3.4.11. Proportion of wild animals during the Middle Bronze Age excavated from Swiss and Lichtenstein settlements. Numbers in parentheses indicate the number of assemblages.

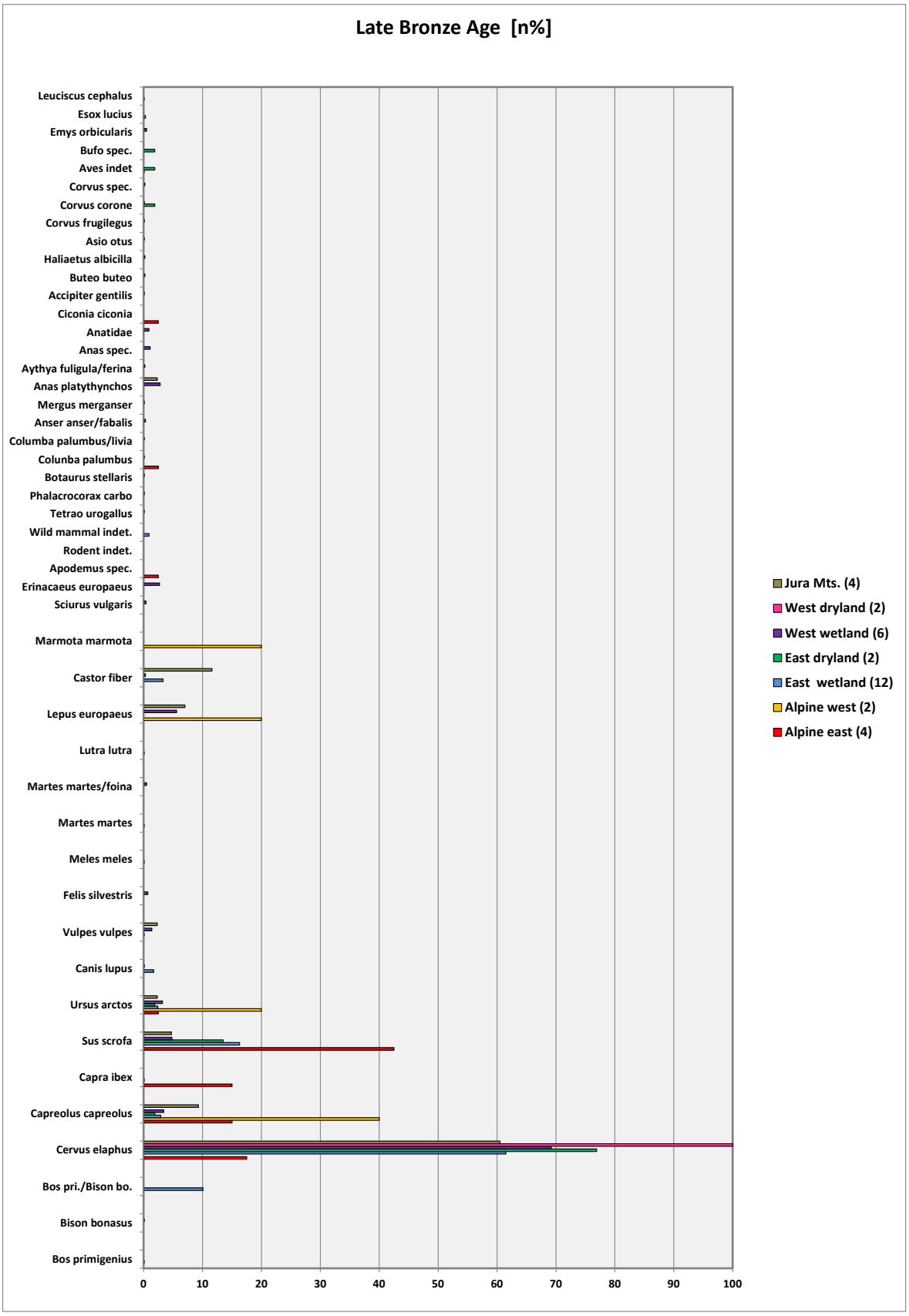


Fig. 3.4.12. Proportion of wild animals during the Late Bronze Age excavated from Swiss and Lichtenstein settlements. Numbers in parentheses indicate the number of assemblages.

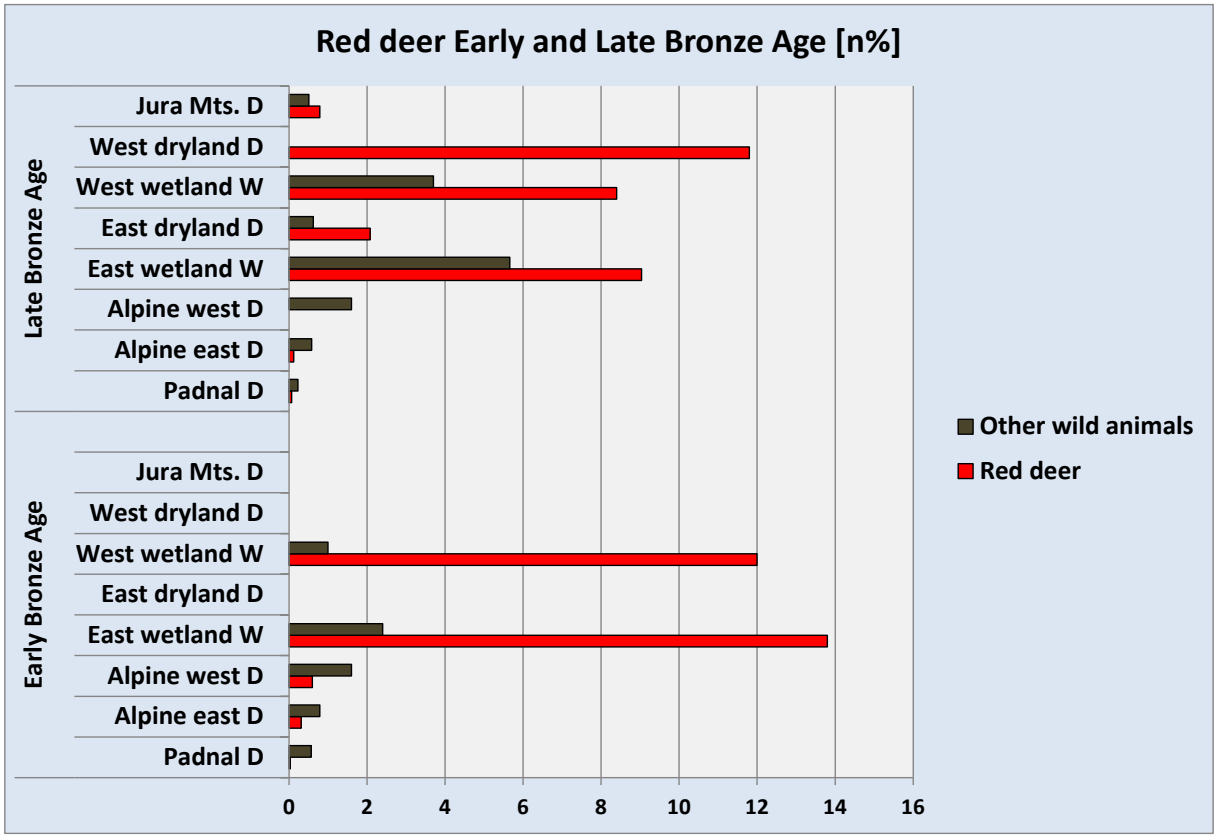


Fig. 3.4.13. Proportion of red deer and other wild animals from Savognin-Padnal and different regional groups between the Early and Late Bronze Age. Padnal data is included in the Alpine east D group. D = dryland, W = wetland.

Phase	Phase detail	Map No. (Fig. 3.4.13)	Settlement	Bibliography	Year	Region	Settlement Type	Identified Specimens
Late Bronze Age	M-LBA	45	Albanbühel	Riedel and Rizzi	1995. 1998	South tyrol	Dryland	10403
	final LBA	46	Bressanone-Elvas	Boschin	2006	South tyrol	Dryland	309
	final LBA	47	Eppan	Riedel	1985	South tyrol	Dryland	1426
	M-LBA	48	Sotćiastel	Riedel and Tecchiati	1998	South tyrol	Dryland	2060
	LBA	49	Pfatten-Vadena	Riedel	2001	South tyrol	Dryland	585
	LBA	50	Mauken-Radfeld	Schibler et al., Stopp et al.	2009, 2010	East tyrol	Dryland	2599
	M-LBA	51	Fondo-Tomollero	Jarman	1976b	South lowland	Dryland	284
	LBA	52	Isolone-Prevaldesca	Riedel	1975	South lowland	Dryland	3179
	M-LBA	53	Peschiera	Riedel	1982	South lowland	Wetland	399
	Late Neo.-Bronze	54	Rivoli	Jarman	1976a	South lowland	Dryland	8045
	LBA	55	Sabbionara-Veronella	Riedel	1993	South lowland	Dryland	1115
	M-LBA	56	Torri	Jarman	1976b	South lowland	Dryland	362
	LBA	57	Stillfried-an der March	Pucher	1986b	East lowland	Dryland	21
Total 13								**30787**
Middle Bronze Age	E-MBA	58	Nössing	Riedel and Tecchiati	1999	South tyrol	Dryland	1797
	E-MBA	59	Sonnenburg	Riedel	1984a	South tyrol	Dryland	386
	E-MBA	60	Cisano-Palafitta	Riedel	1990	South lowland	Wetland	589
	MBA	61	Fiavé-Corera	Jarman	1975	South lowland	Wetland	4831
	E-MBA	62	Ledro	Riedel	1976b	South lowland	Wetland	9276
	E-MBA	63	Monte-Tondo	Jarman	1976b	South lowland	Dryland	938
	MBA	64	Nogarole-Rocca	Riedel	1992	South lowland	Dryland	1118
	E-MBA	65	Quarto-Tormine	Riedel	1987	South lowland	Dryland	262
	E-MBA	66	Buhuberg	Pucher	1987, 1996b	East lowland	Dryland	1807
Total 9								**21004**
Early Bronze Age	EBA	67	Fingerhof-Bozen	Riedel	1986b	South tyrol	Dryland	99
	EBA	68	Monte-Mezzana	Riedel	1979	South tyrol	Dryland	138
	EBA	69	Naturno-Schnalserhof	Riedel and Tecchiati	2000	South tyrol	Dryland	374
	EBA	70	Ripario-Santuario	Riedel and Tecchiati	1993	South tyrol	Dryland	2058
	EBA	71	Buchberg-Wiesing	Pucher	1986a	East tyrol	Dryland	1858
	Late Neo.-EBA	72	Thauer-Kiechlberg	Deschler-Erb	2010	East tyrol	Dryland	1170
	EBA	73	Barche-Solferino	Riedel	1976a	South lowland	Wetland	3096
	EBA	74	Felici-Cervia	Farello and Lacchini	2006	South lowland	Dryland	55
	EBA	75	Lagazzi-Piadena	Cavallo	2000	South lowland	Dryland	1644
	EBA	76	Michelberg	Schmitzberger	2001	East lowland	Dryland	626
	EBA	77	Schleinbacher-Ziegelei	Pucher	1996a	East lowland	Dryland	918
Total 11								**12036**
TOTAL assemblage 33								**Total specimens 63827**

Fig. 3.4.14. List of Bronze Age settlements from northern Italy and Austria from which faunal remains were excavated. Late Neo = Late Neolithic, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

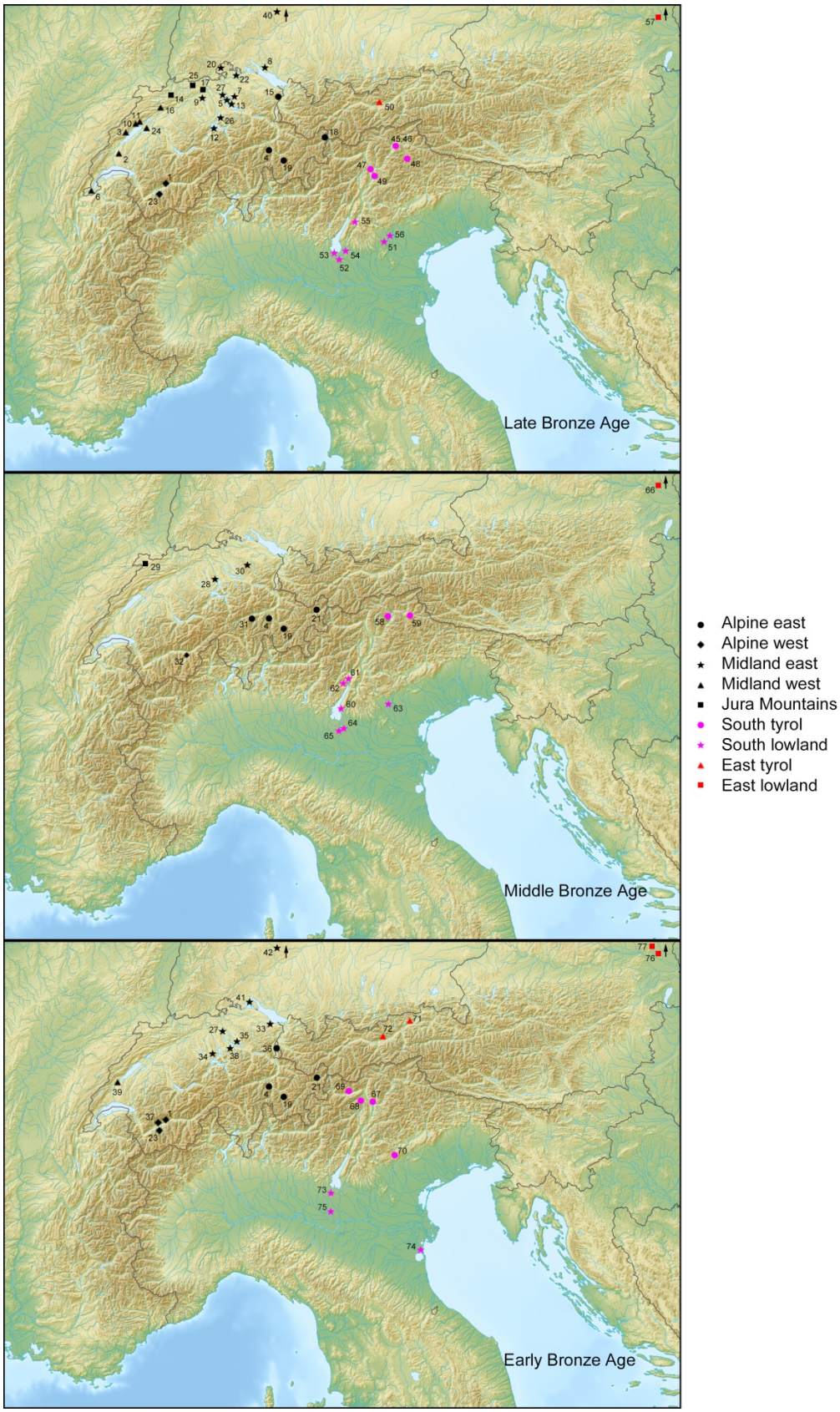


Fig. 3.4.15. Locations of the Bronze Age settlements in northern Italy and Austria. Numbers refer to the entries in Figure 3.4.14.

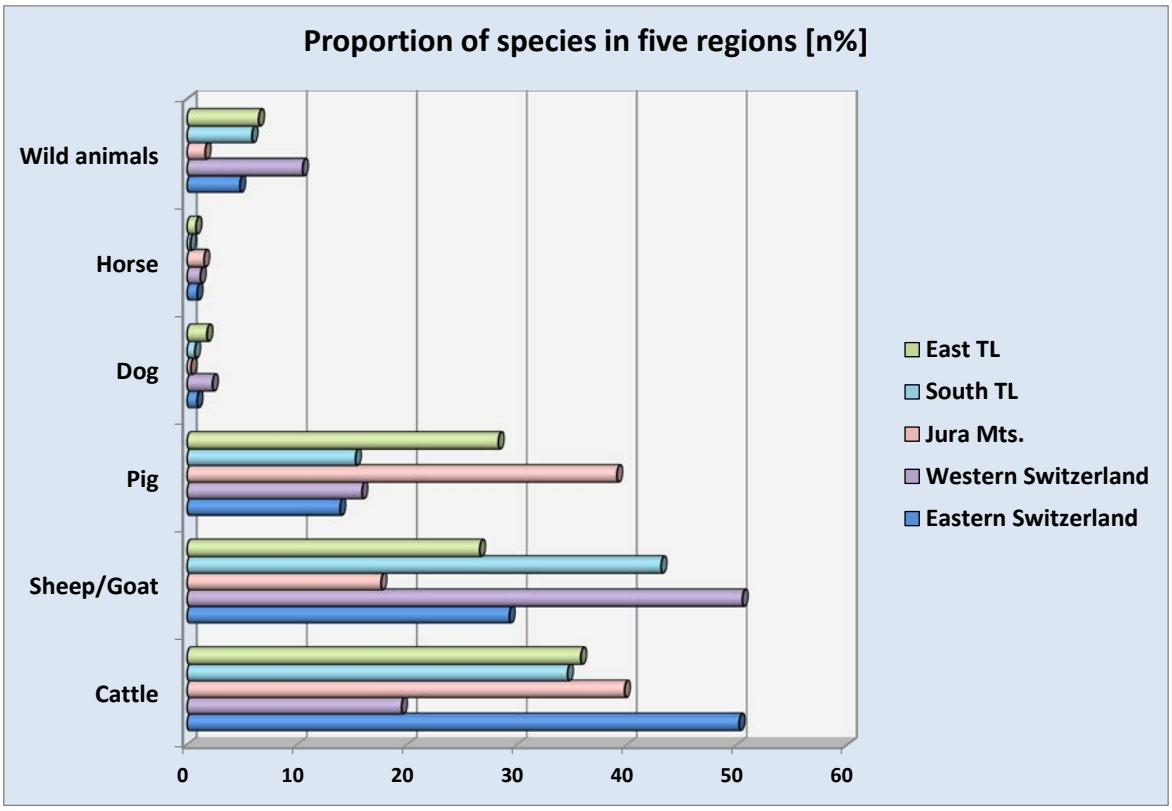


Fig. 3.4.16. Proportion of species in five regions based on the number of identified specimens. Jura Mts. = Jura Mountains, South TL = South Tyrol and lowland. East TL = East Tyrol and lowland.

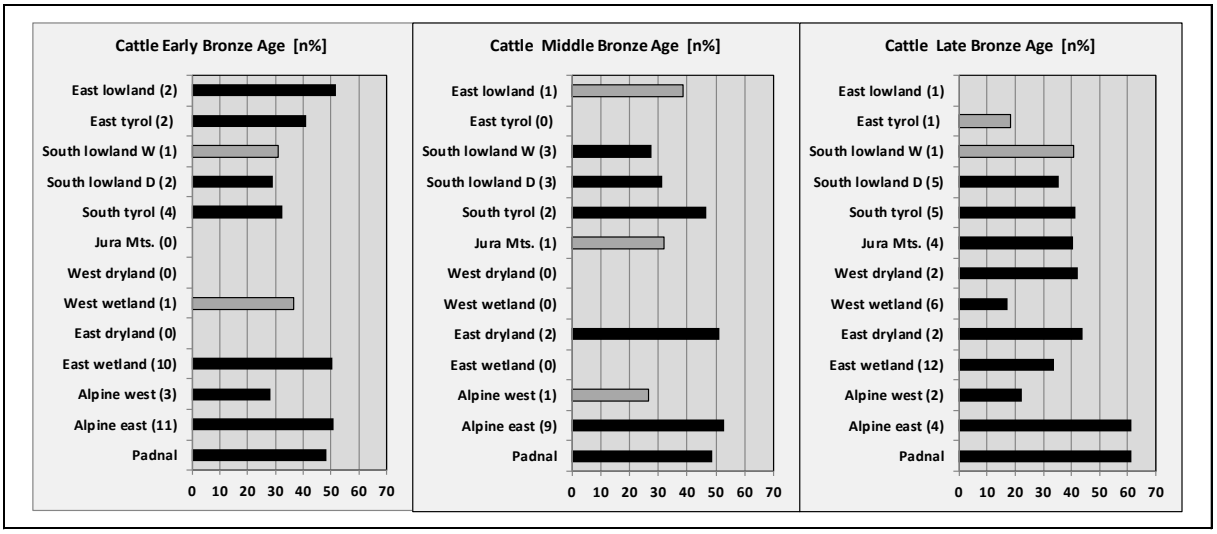


Fig. 3.4.17. Proportion of cattle between regions and over Bronze Age phases, based on the number of identified specimens. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

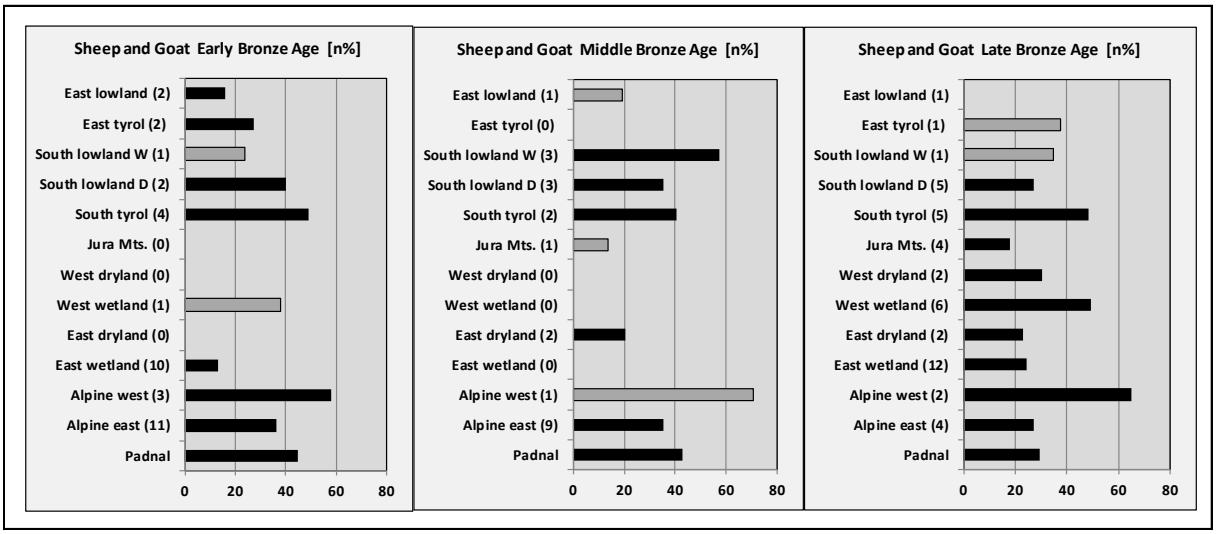


Fig. 3.4.18. Proportion of sheep and goats between regions and over Bronze Age phases, based on the number of identified specimens. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

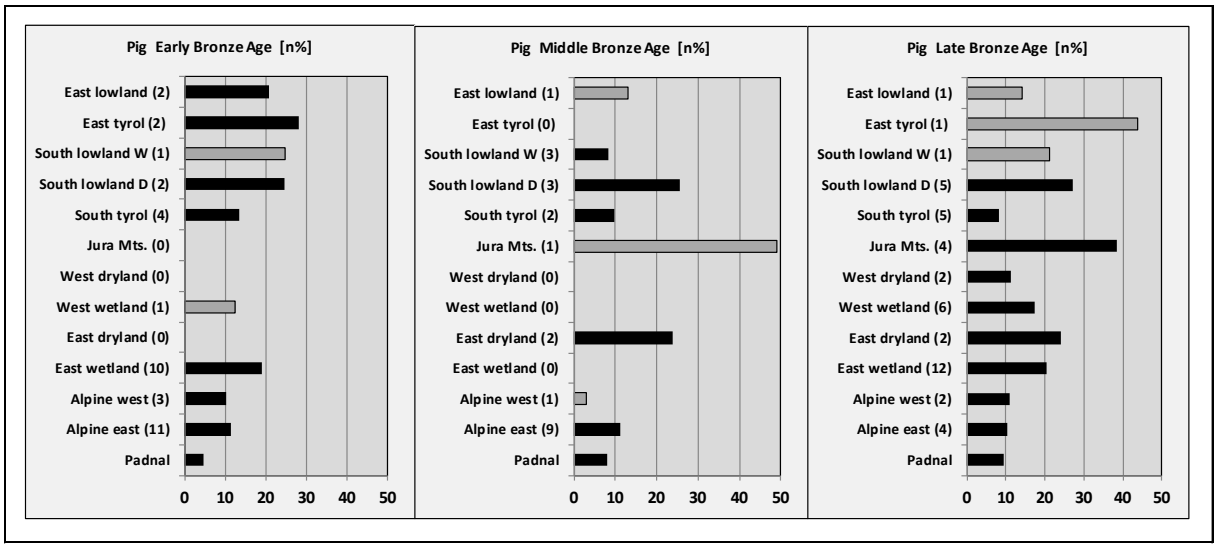


Fig. 3.4.19. Proportion of pigs between regions and over Bronze Age phases, based on the number of identified specimens. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

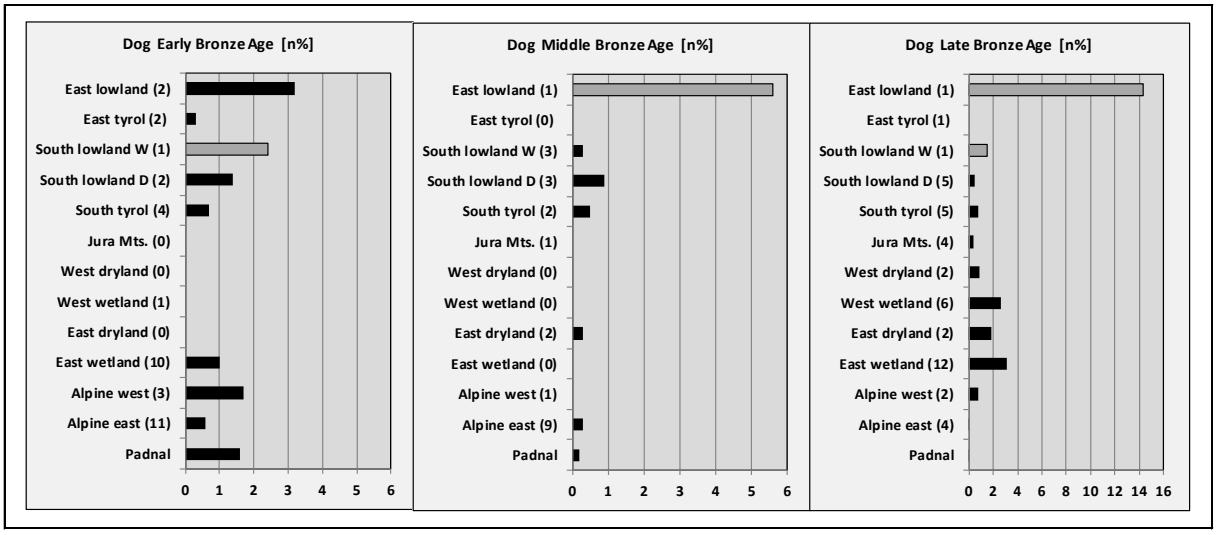


Fig. 3.4.20. Proportion of dogs between regions and over Bronze Age phases, based on the number of identified specimens. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

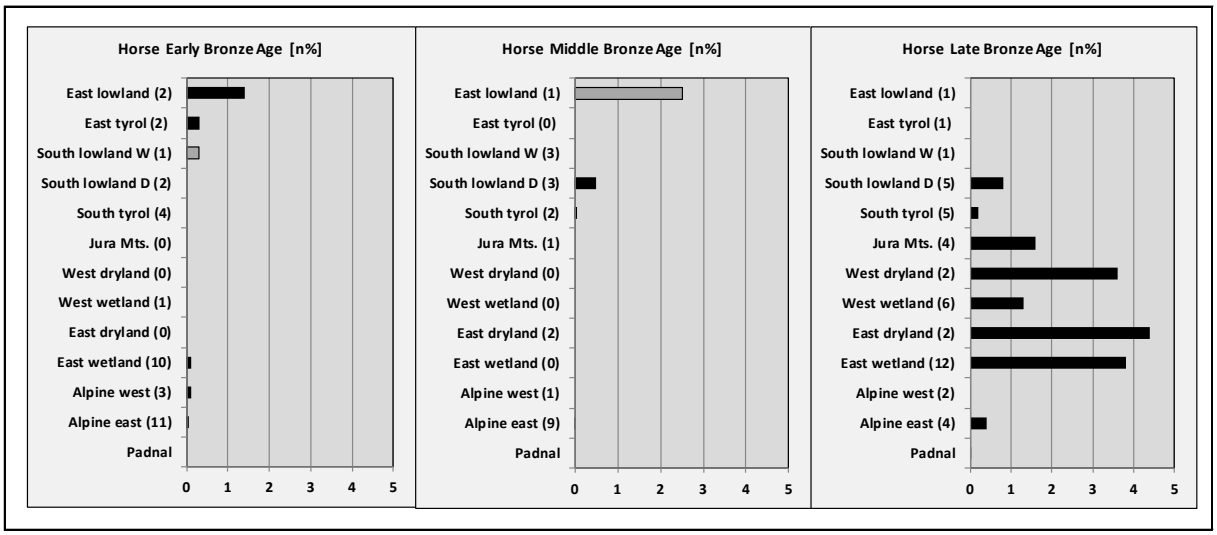


Fig. 3.4.21. Proportion of horses between regions and over Bronze Age phases, based on the number of identified specimens. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

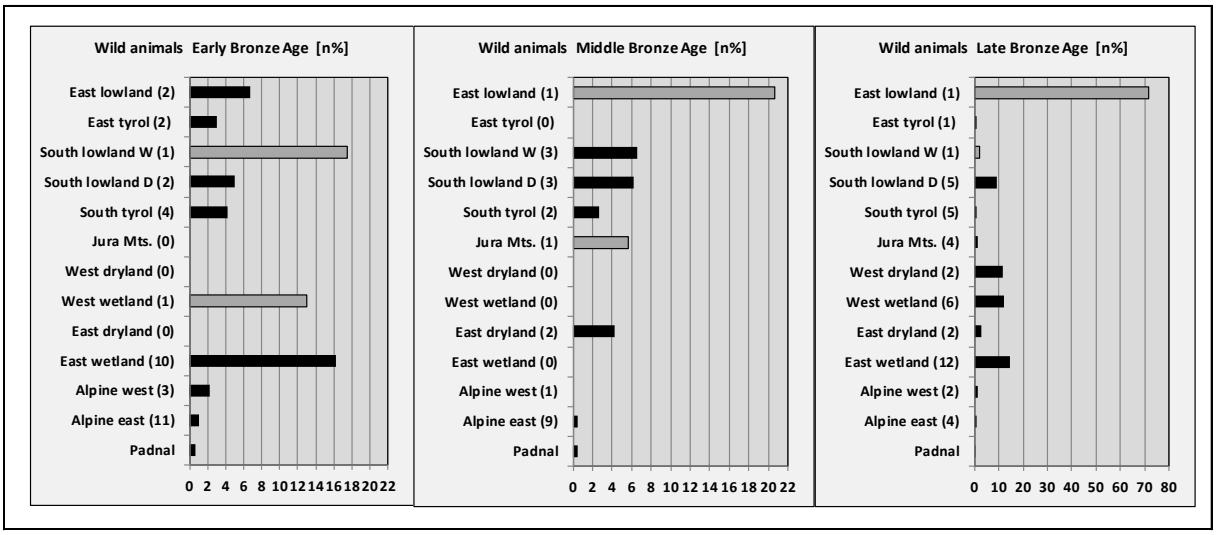


Fig. 3.4.22. Proportion of wild animals between regions and over Bronze Age phases, based on the number of identified specimens. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

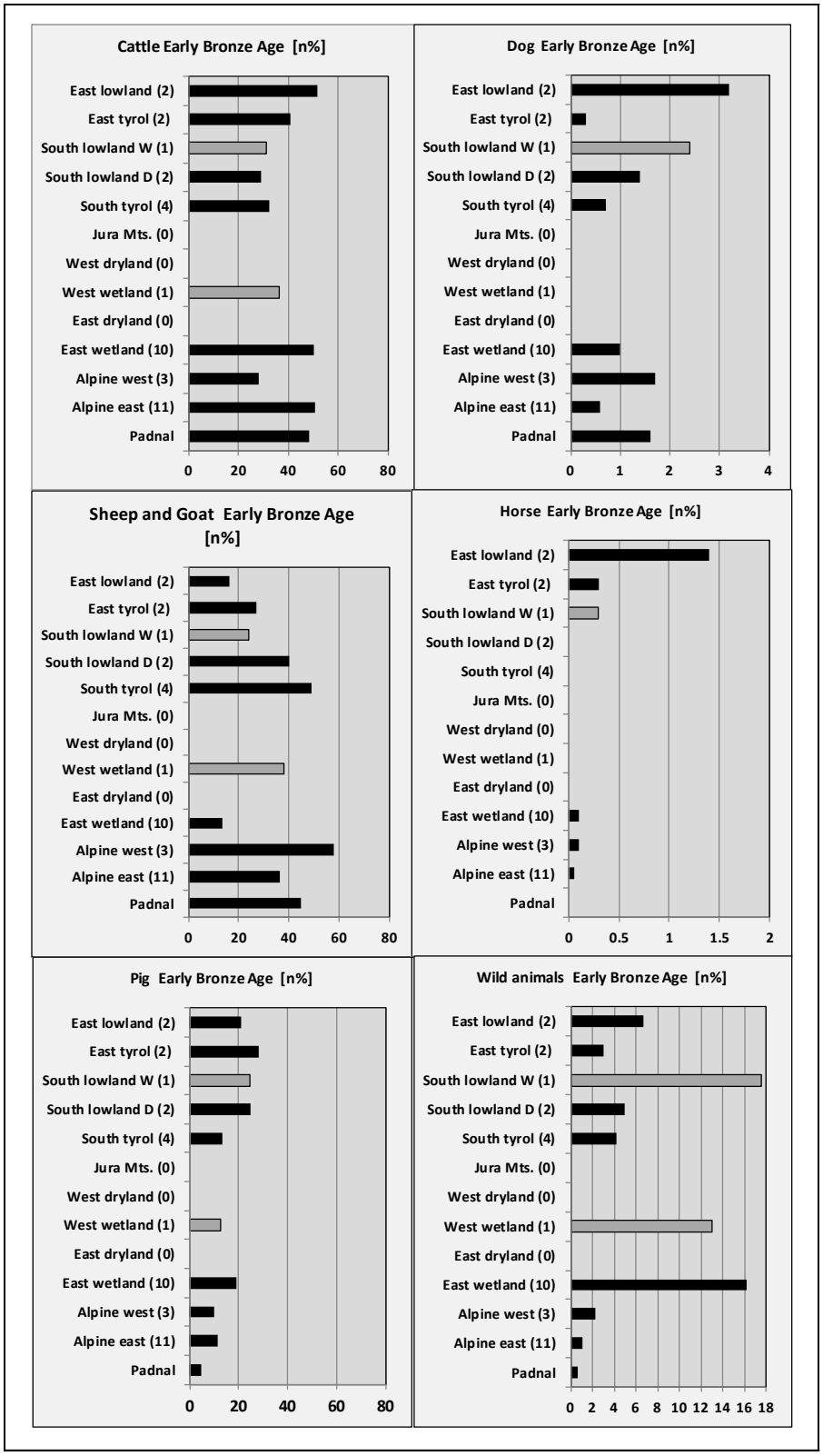


Fig. 3.4.23. Proportion of domestic and wild animals between regions and over Bronze Age phases, based on the number of identified specimens during the Early Bronze Age. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

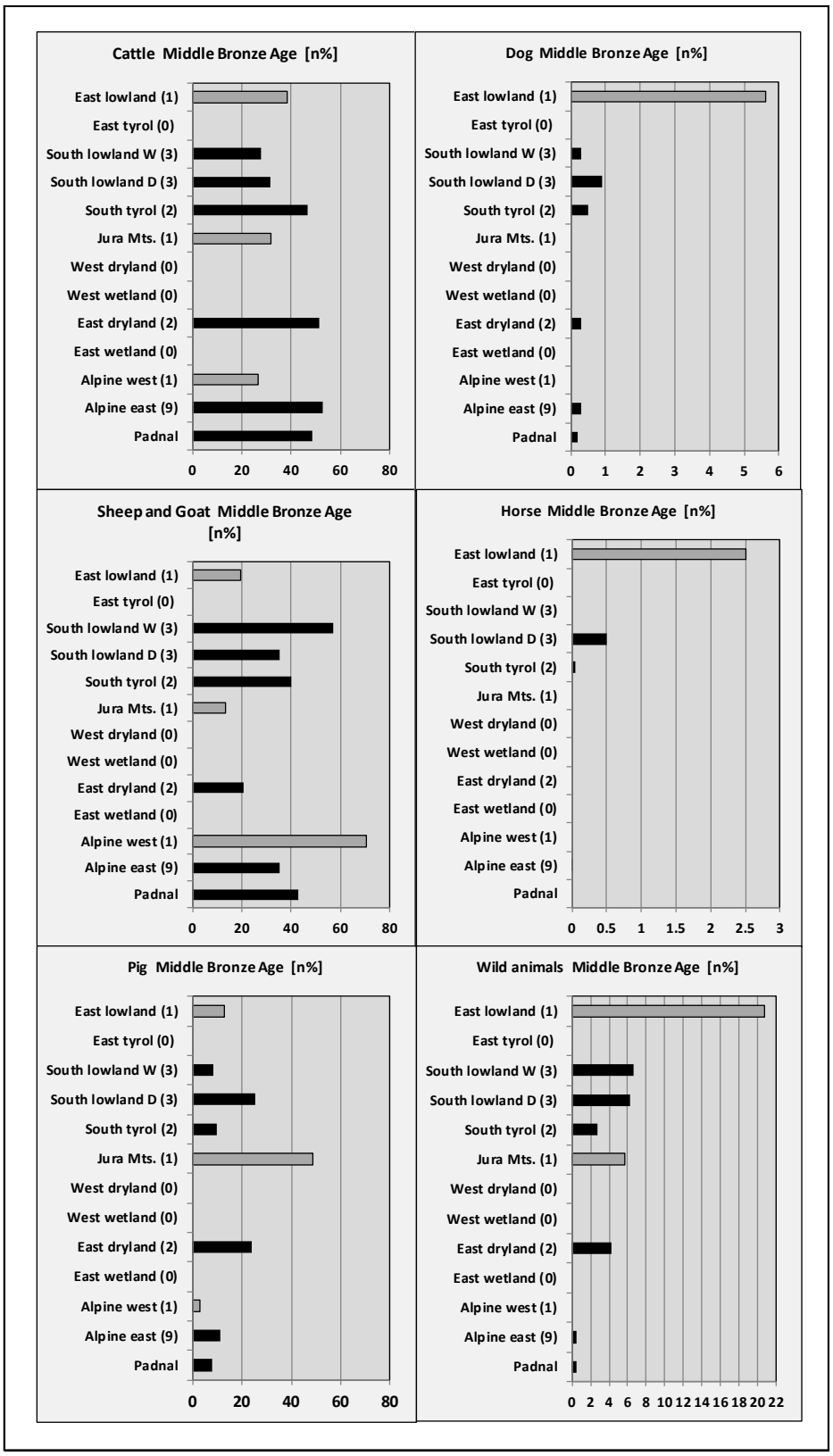


Fig. 3.4.24. Proportion of domestic and wild animals between regions and over Bronze Age phases, based on the number of identified specimens during the Middle Bronze Age. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

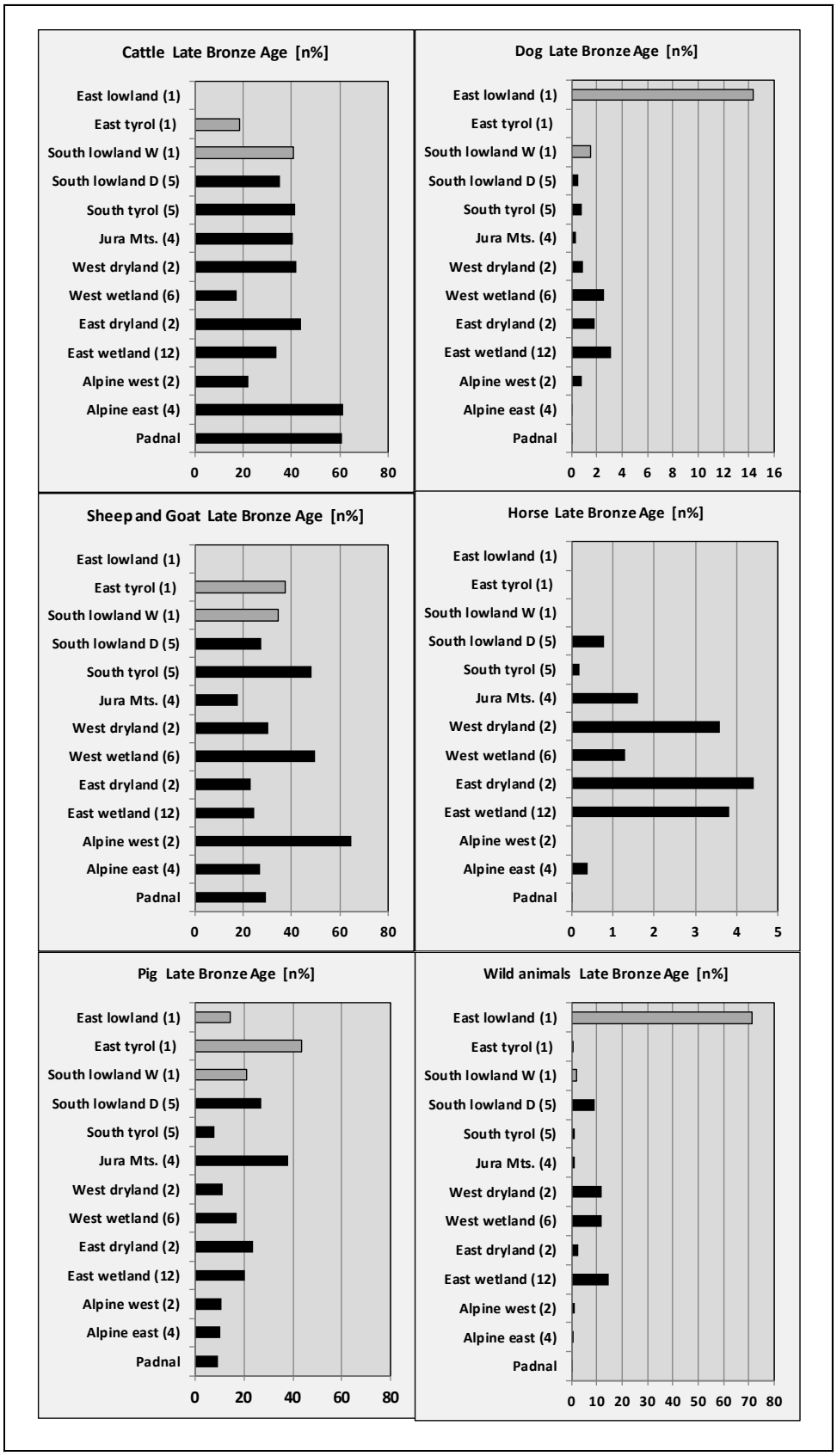


Fig. 3.4.25. Proportion of domestic and wild animals between regions and over Bronze Age phases, based on the number of identified specimens during the Late Bronze Age. Numbers in parentheses indicate the number of assemblages. Padnal data is included in the Alpine east group. Single settlements are indicated by grey bars. Jura Mts. = Jura Mountains. D = dryland, W = wetland.

Phase	Map No. (Fig. 3.4.28)	Settlement	Arcaeozoological references	Published year	Region	Settlement Type	LSI data (n) Bos taurus	LSI data (n) Ovis aries	LSI data (n) Ovis/Capra	LSI data (n) Sus dom.
Early Iron Age	10	Breisach-Münsterberg, "Dr. Löwe"	Arbinger-Vogt, H.	1978	Germany	Dryland	23	40	60	9
	11	Heuneburg	Ekkenga, U.	1984	Germany	Dryland	838	0	0	0
	11	Heuneburg	McEneaney-Schneider	1984	Germany	Dryland	0	228	311	0
	11	Heuneburg	Willburger	1983	Germany	Dryland	0	0	0	759
	11	Heuneburg-Aussensiedlung	Kokabi, M./Schatz, K.	2000	Germany	Dryland	2	0	0	0
Total 3							863	268	371	768
Late Bronze Age	4	Ayent VS-Le Château	Chaix	1990	Alpine west	Dryland	1	1	1	0
	4	Vex VS-Le Château	Chaix	1990	Alpine west	Dryland	0	3	3	2
	2	Cresta GR-Cazis	Plüss	2007	Alpine east	Dryland	10	2	3	10
	1	Savognin GR-Padnal, H-B	Bopp-Ito	unpublished	Alpine east	Dryland	39	7	27	36
	7	Wittnau AG-Wittnauerhorn	Schibler	1996a	Jura	Dryland	2	0	0	0
	12	Nunningen SO-Portifluh	Schibler	1996c	Jura	Dryland	0	0	2	7
	6	Zürich ZH-Alpenquai	Wettstein	1924	East wetland	Wetland	70	28	40	13
Total 5							122	41	76	68
Middle Bronze Age	2	Cresta GR-Cazis	Plüss	2007	Alpine east	Dryland	30	9	18	30
	1	Savognin GR-Padnal, H-C	Bopp-Ito	unpublished	Alpine east	Dryland	12	0	9	9
	1	Savognin GR-Padnal, H-D	Bopp-Ito	unpublished	Alpine east	Dryland	13	9	23	17
Total 3							55	18	50	56
Early Bronze Age	4	Ayent VS-Le Château	Chaix	1990	Alpine west	Dryland	1	0	0	0
	2	Cresta GR-Cazis	Plüss	2007	Alpine east	Dryland	49	42	62	25
	5	Meilen ZH-Obermeilen	Kuhn	1935	East wetland	Wetland	26	0	5	18
	1	Savognin GR-Padnal, H-E	Bopp-Ito	unpublished	Alpine east	Dryland	6	1	7	7
	3	Schellenberg FL-Borscht 1965	Hartmann-Frick	1965	Alpine east	Dryland	14	0	11	15
	3	Schellenberg FL-Borscht 1937	Kuhn	1937	Alpine east	Dryland	3	0	4	
	6	Zürich ZH-Mozartstrasse, 1o	Hüster Plogmann/Schibler	1997	East wetland	Wetland	27	1	5	3
	6	Zürich ZH-Mozartstrasse, 1u	Hüster Plogmann/Schibler	1997	East wetland	Wetland	38	0	0	8
Total 8							164	44	94	76
Late Neolithic	8	Auvernier La Saunerie	Stampfli	1976	West wetland	Wetland	56	35	93	10
	8	Auvernier Brise-Lames	Desse	1976	West wetland	Wetland	9	0	0	0
	9	Thielle Wavre, Pont-de-Thielle	Chaix	1977	West wetland	Wetland	7	0	0	0
	6	Zürich ZH-Mozartstrasse, 2o	Hüster Plogmann/Schibler	1997	Midland east	Wetland	44	0	0	30
	6	Zürich ZH-Mozartstrasse, 2u	Hüster Plogmann/Schibler	1997	East wetland	Wetland	15	0	0	19
	6	Zürich ZH-Mythenschloss 2.1, 2.2-3, 2.4	Hüster Plogmann/Schibler	1997	East wetland	Wetland	19	0	0	6
	6	Zürich ZH-Pressehaus C2	Hüster Plogmann/Schibler	1997	East wetland	Wetland	4	0	0	7
	6	Zürich Seefeld Kan. San. A, C/B, D, E, F	Hüster Plogmann/Schibler	1997	East wetland	Wetland	70	0	0	28
Total 8							224	35	93	100
TOTAL assemblage n=27						**Total n**	**1428**	**406**	**684**	**1068**

Fig. 3.4.26. List of the assemblages for obtaining logarithmic size index (LSI) data from Switzerland and neighbouring countries between the Late Neolithic and Early Iron Age.

Phase	Map No. (Fig. 3.4.28)	Settlement	Dating	C14, Dendrochronology	Dating References
Early Iron Age	10	Breisach-Münsterberg, "Dr. Löwe"	Typology	Ha D1-Ha D2, Ha D3, LT A, LT D2	Müller, et al., 1999
	11	Heuneburg Die Rinder (1966-1979)	Typology	Late Hallstatt/Early Latène	Ekkenga, U., 1984
	11	Heuneburg-Aussensiedlung	Typology	Ha D1-Ha D2	Kurz, S., 2000
Late Bronze Age	4	Ayent VS-Le Château	C14	1210-906 BC	David-El Biali, M., 1990
	2	Cresta GR-Cazis, Planum 14	C14	1350-1100/800 BC	Wyss, R., 2002
			Typology	Late Bronze-Iron Age 1300-400 BC	Murbach-Wende, I., 2016
	1	Savognin GR-Padnal, H-B	C14	1350/1300-900/800 BC	Rageth, J., 1986 & pers. com.
	7	Wittnau AG-Wittnauerhorn	C14	1519-793 BC	Hochuli, S., et al., 1998 (SPM III)
	6	Zürich ZH-Alpenquai	Typology	Late Bronze Age	Hochuli, S., et al., 1998 (SPM III)
Middle Bronze Age	2	Cresta GR-Cazis, Planum 10-12	C14	1800-1550 BC	Wyss, R., 2002
			C14	1750-1300 BC	Murbach-Wende, I., 2016
	1	Savognin GR-Padnal, H-C	C14	1450-1350/1300 BC	Rageth, J., 1986 & pers. com.
Early-Middle BA	1	Savognin GR-Padnal, H-D	C14	1550-1450 BC	Rageth, J., 1986 & pers. com.
Early Bronze Age	4	Ayent VS-Le Château	Typology	BzA3-BzA4	David-El Biali, M., 1990
	2	Cresta GR-Cazis, Planum 1-5, 8	C14	2400-1800 BC	Wyss, R., 2002
		Cresta GR-Cazis, Planum 8	C14	1850-1700 BC	Murbach-Wende, I., 2016
		Cresta GR-Cazis, Planum 1-5	C14	2000-1850 BC	Murbach-Wende, I., 2016
	5	Meilen ZH-Obermeilen	Typology	Early Bronze Age	Kuhn, M., 1935; Keller, F., 1870; Hochuli, S., et al., 1998 (SPM III)
	1	Savognin GR-Padnal, H-E	C14	1950/1900-1550 BC	Rageth, J., 1986 & pers. com.
	3	Schellenberg FL-Borscht 1965	Typology	2000 BC	Hild, A., 1935, 1936
	3	Schellenberg FL-Borscht 1937	Typology	2000 BC	Hild, A., 1935, 1936
	6	Zürich ZH-Mozartstrasse, 1o	Typology	Early Bronze Age	Bleicher, N., 2011
	6	Zürich ZH-Mozartstrasse, 1u	Typology	Early Bronze Age	Bleicher, N., 2011
Late Neolithic	8	Auvernier La Saunerie	Den.	2800-2450 BC	Stöckli, E., et al., 1995 (SPM II)
	8	Auvernier Brise-Lames	Den.	2800-2450 BC	Stöckli, E., et al., 1995 (SPM II)
	9	Thielle Wavre, Pont-de-Thielle	Den.	2701 BC	Stöckli, E., et al., 1995 (SPM II)
	6	Zürich ZH-Mozartstrasse, 2o	Den.	2605-2568 BC	Gross-Klee, E., 1997
	6	Zürich ZH-Mozartstrasse, 2u	Den.	2625-2605 BC	Gross-Klee, E., 1997
	6	Zürich ZH-Mythenschloss 2.1	Den.	2548 BC	Stöckli, E., et al., 1995 (SPM II)
	6	Zürich ZH-Mythenschloss 2.2, 2.3, 2.4	Den.	2680 BC	Stöckli, E., et al., 1995 (SPM II)
	6	Zürich ZH-Pressehaus C2	Den.	2719-2713, 2690-2683 BC	Stöckli, E., et al., 1995 (SPM II)
	6	Zürich Seefeld Kan. San. A, C/B, D, E, F	Den.	2718-2675 BC	Gross-Klee, E., 1997

Fig. 3.4.27. Dating of the assemblages for obtaining logarithmic size index (LSI) data in Switzerland and neighbouring countries between the Late Neolithic and Early Iron Age. Den. = Dendrochronology, pers. com. = personal communication.

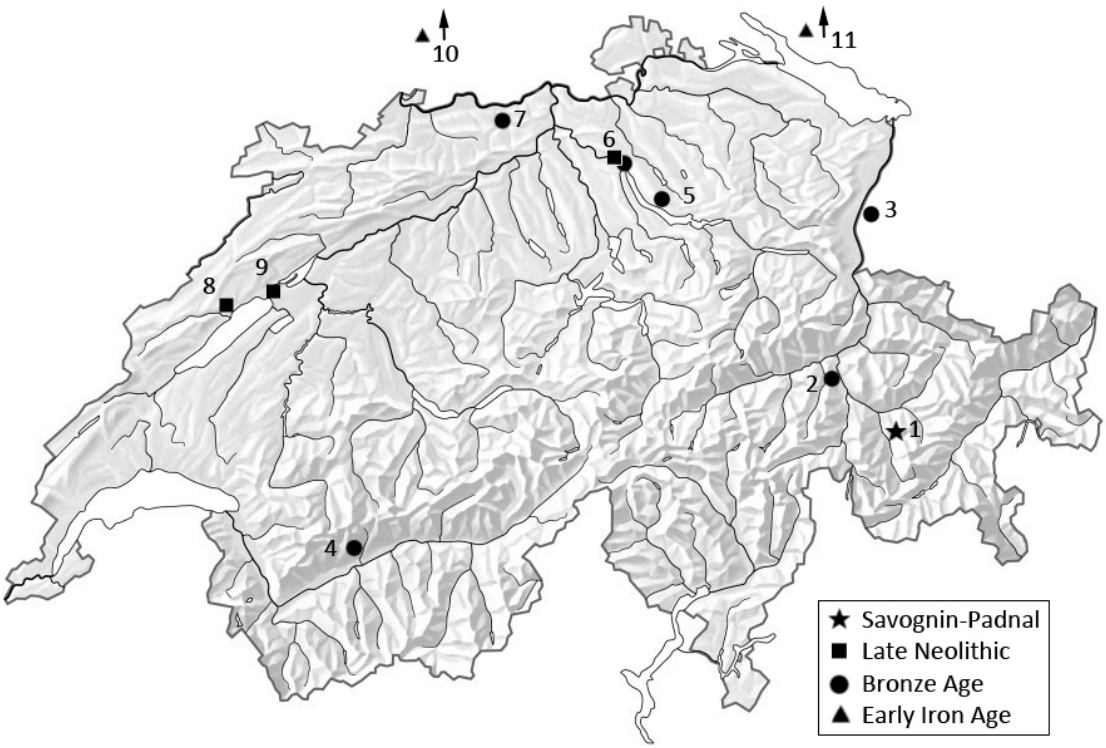


Fig. 3.4.28. Location of the studied settlements for obtaining logarithmic size index (LSI) data in Switzerland and neighbouring countries between the Late Neolithic and Early Iron Age. Numbers refer to the entries in Figure 3.4.26.

Phase	Phase detail	Map No. (Fig. 3.4.28)	Settlement	Bibliography	Year	Region	Settlement type	LSI data (n) Bos taurus subadult-adult	LSI data (n) Ovis subadult-adult	LSI data (n) Ovis/Capra subadult-adult	LSI data (n) Sus dom. adult
Early Iron Age	7. BC-4. BC	12	Bressanone-Stufles	Riedel	1986c	South tyrol	Dryland	13	20	33	1
	6. BC-3. BC	12	Bressanone-Stufles	Rizzi	2006	South tyrol	Dryland	11	25	32	0
	850-600 BC	13	Pfatten-Vadena II	Riedel	2001	South tyrol	Dryland	4	0	14	15
Total 3								**28**	**45**	**79**	**16**
Late Bronze Age	final LBA	14	Bressanone-Elvas	Boschin	2006	South tyrol	Dryland	2	3	3	0
	final LBA	15	Eppan	Riedel	1985	South tyrol	Dryland	18	24	27	11
	M-LBA	16	Sotćiastel	Riedel and Tecchiati	1998	South tyrol	Dryland	3	0	11	1
	1000-850 BC	17	Pfatten-Vadena III	Riedel	2001	South tyrol	Dryland	2	0	9	5
	LBA	18	Isolone-Prevaldesca	Riedel	1975	South lowland	Dryland	72	84	98	3
	LBA	19	Pozzuolo-Friuli	Riedel	1981b	South lowland	Dryland	1	4	7	1
	M-LBA	20	Peschiera	Riedel	1982	South lowland	Wetland	3	5	6	9
Total 7								**101**	**120**	**161**	**30**
Middle Bronze Age	E-MBA	21	Nössing	Riedel and Tecchiati	1999	South tyrol	Dryland	8	8	8	3
	E-MBA	22	Sonnenburg	Riedel	1984a	South tyrol	Dryland	4	5	5	0
	E-MBA	23	Cisano-Palafitta	Riedel	1990	South lowland	Wetland	6	2	3	0
	MBA	24	Nogarole-Rocca	Riedel	1992	South lowland	Dryland	8	3	3	2
	E-MBA	25	Quarto-Tormine	Riedel	1987	South lowland	Dryland	1	4	4	0
	E-MBA	26	Buhuberg	Pucher	1987, 1996b	East lowland	Dryland	13	5	7	1
Total 6								**40**	**27**	**30**	**6**
Early Bronze Age	EBA	27	Fingerhof-Bozen	Riedel	1986b	South tyrol	Dryland	2	1	1	0
	EBA	28	Monte-Mezzana	Riedel	1979	South tyrol	Dryland	1	0	1	0
	EBA	29	Naturno-Schnalserhof	Riedel and Tecchiati	2000	South tyrol	Dryland	0	0	0	1
	EBA	30	Ripario-Santuario	Riedel and Tecchiati	1993	South tyrol	Dryland	4	0	1	0
	EBA	31	Buchberg-Wiesing	Pucher	1986a	East tyrol	Dryland	25	7	9	30
	EBA	32	Barche-Solferino	Riedel	1976a	South lowland	Wetland	51	61	74	8
	EBA	33	Lagazzi-Piadena	Cavallo	2000	South lowland	Dryland	21	14	16	13
	EBA	34	Michelberg	Schmitzberger	2001	East lowland	Dryland	3	1	3	2
	EBA	35	Schleinbacher-Ziegelei	Pucher	1996a	East lowland	Dryland	29	6	6	3
Total 9								**136**	**90**	**111**	**57**
Late Neolithic	Late Neolithic	36	Fingerhof-Bozen	Riedel	1986b	South tyrol	Dryland	6	0	0	0
	3000 BC	37	Cladrecis	Riedel	1986a	South lowland	Dryland	2	11	11	5
Total 2								**8**	**11**	**11**	**5**
TOTAL assemblage 26							**Total**	**313**	**293**	**392**	**114**

Fig. 3.4.29. List of the assemblages for obtaining logarithmic size index (LSI) data from northern Italy and Austria between the Late Neolithic and Early Iron Age.

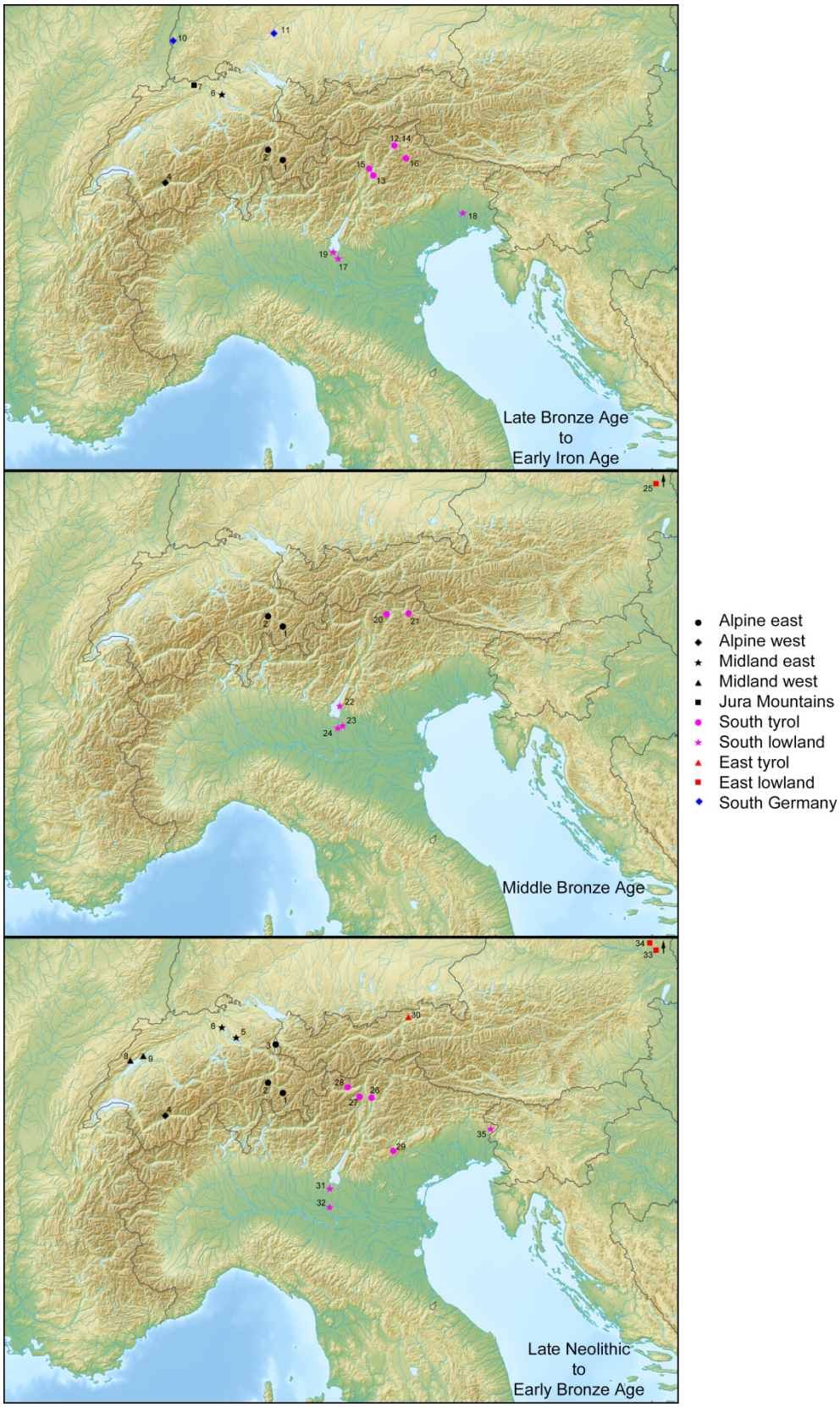
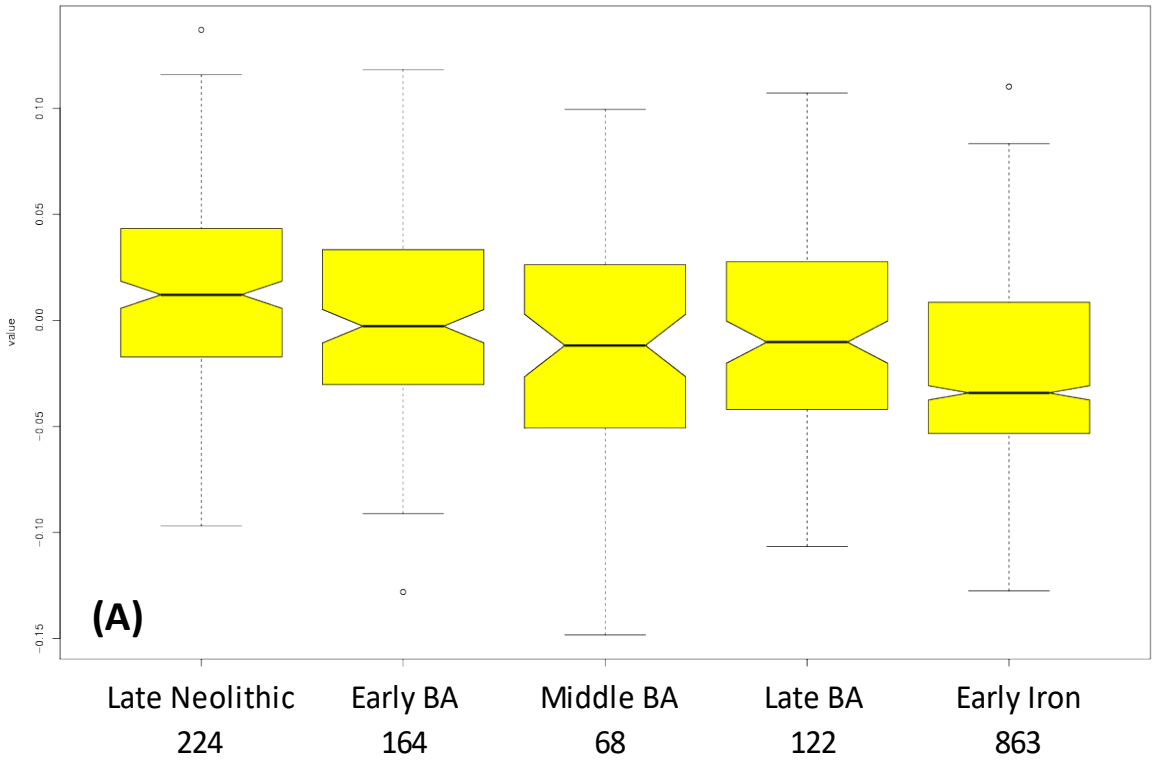


Fig. 3.4.30. Location of the settlements for obtaining logarithmic size index (LSI) data from Switzerland, Lichtenstein, south Germany, northern Italy, and Austria between the Late Neolithic and Early Iron Age. Numbers refer to the entries in Figure 3.4.26 and Figure 3.4.29.

Bos taurus



(B) Kruskal-Wallis test for equal medians

H (chi2): 140.1
Hc (tie cor 140.1
p (same): 2.62E-29

There is a significant difference between sample medians

(C)

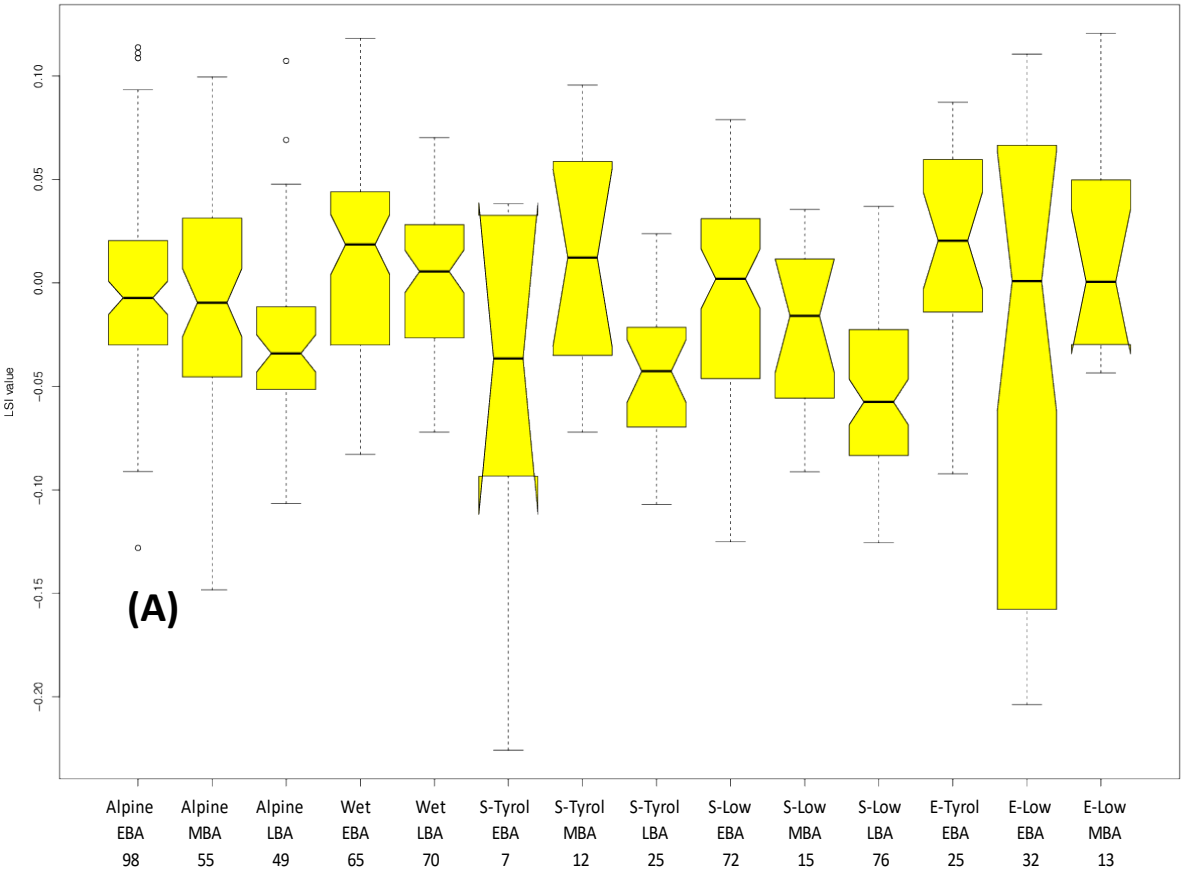
Mann-Whitney U test

	Late Neolithic	Early Bronze Age	Middle Bronze Age	Late Bronze Age	Early Iron Age
Late Neolithic		**< 0.01**	**< 0.001**	**< 0.0001**	**< 0.0001**
Early Bronze Age			0.1268	0.06777	**< 0.0001**
Middle Bronze Age				0.7694	**< 0.05**
Late Bronze Age					**< 0.001**
Early Iron Age					

Significant p values are bold and highlighted. α = 0.05.

Fig. 3.4.31. The logarithmic size index (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of cattle between the Late Neolithic and Early Iron Age. Numbers indicate the sample size used to obtain LSI. BA = Bronze Age, Early Iron = Early Iron Age.

Bos taurus



(B) Kruskal-Wallis test for equal medians

H (chi2): 101.4
Hc (tie cor 101.4
p (same): 8.89E-16

There is a significant difference between sample medians

(C)

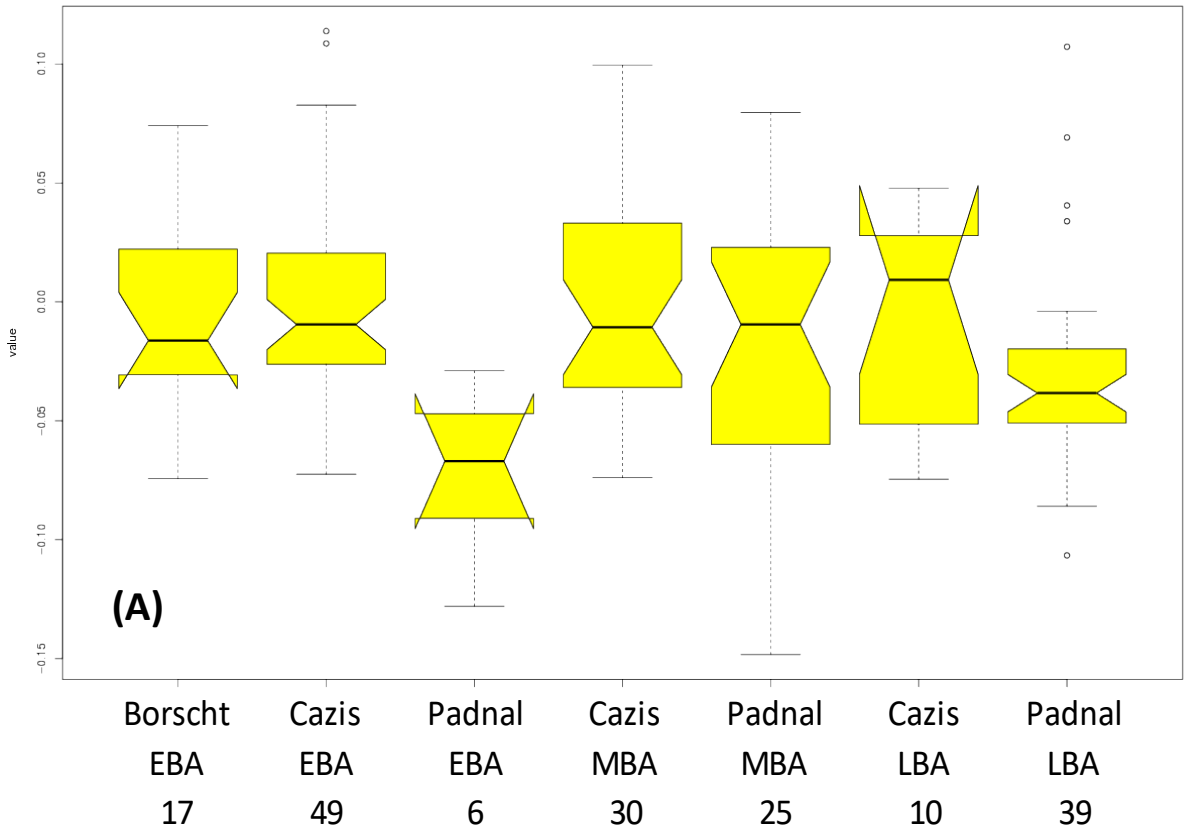
Mann-Whitney U test

	Alp EBA	Alp MBA	Alp LBA	Wet EBA	Wet LBA	Sty EBA	Sty MBA	Sty LBA	Slw EBA	Slw MBA	Slw LBA	Ety EBA	Elw EBA	Elw MBA
Alp EBA		0.702	**< 0.01**	0.084	0.189	0.289	0.423	**< 0.001**	0.712	0.200	**< 0.0001**	**< 0.05**	0.946	0.477
Alp MBA			**< 0.05**	0.072	0.183	0.317	0.339	**< 0.01**	0.926	0.296	**< 0.0001**	**< 0.05**	0.782	0.311
Alp LBA				**< 0.0001**	**< 0.0001**	0.692	**< 0.05**	0.100	**< 0.05**	0.657	**< 0.01**	**< 0.0001**	0.265	**< 0.05**
Wet EBA					0.333	0.106	0.961	**< 0.0001**	**< 0.05**	**< 0.05**	**< 0.0001**	0.418	0.568	0.968
Wet LBA						0.225	0.591	**< 0.0001**	0.188	**< 0.01**	**< 0.0001**	0.085	0.971	0.603
Sty EBA							0.163	0.750	0.365	0.832	0.606	0.062	0.370	0.178
Sty MBA								**< 0.05**	0.245	0.113	**< 0.001**	0.661	0.635	0.978
Sty LBA									**< 0.01**	0.142	0.243	**< 0.0001**	0.150	**< 0.01**
Slw EBA										0.268	**< 0.0001**	**< 0.05**	0.860	0.160
Slw MBA											**< 0.05**	**< 0.01**	0.479	0.088
Slw LBA												**< 0.0001**	**< 0.05**	**< 0.001**
Ety EBA													0.505	0.590
Elw EBA														0.616
Elw MBA														

Significant p values are bold and highlighted. α = 0.05.

Fig. 3.4.32. The logarithmic size index (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of cattle between regions during the Bronze Age. Numbers indicate the sample size used to obtain LSI. Alp = Alpine, Wet = Wetland, Sty = South Tyrol, Slw = South lowland, Ety = East Tyrol, Elw = East lowland, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

Bos taurus



(B) Kruskal-Wallis test for equal medians

H (chi2):	25.36
Hc (tie correcte	25.36
p (same):	0.0002923

There is a significant difference between sample medians

(C)

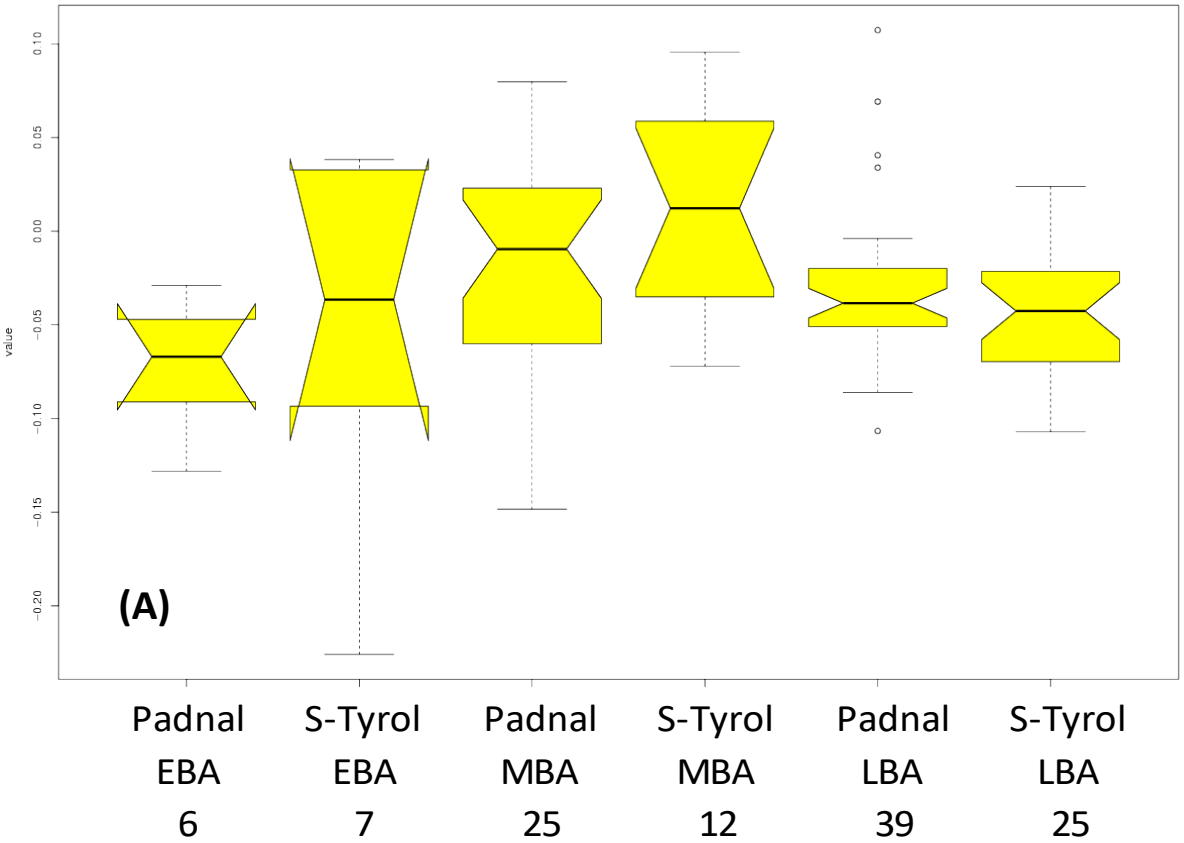
Mann-Whitney U test

	Borscht EBA	Cazis EBA	Padnal EBA	Cazis MBA	Padnal MBA	Cazis LBA	Padnal LBA
Borscht EBA		0.6078	**< 0.01**	0.6984	0.7007	0.7441	**< 0.05**
Cazis EBA			**< 0.001**	0.758	0.3546	0.832	**< 0.0001**
Padnal EBA				**< 0.01**	**< 0.05**	**< 0.05**	**< 0.05**
Cazis MBA					0.4519	0.9378	**< 0.01**
Padnal MBA						0.5468	0.2105
Cazis LBA							0.08469
Padnal LBA							

Significant p values are bold and highlighted. α = 0.05.

Fig. 3.4.33. The logarithmic size index (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of cattle between Padnal, Borscht, and Cazis during the Bronze Age. Numbers indicate the sample size used to obtain LSI. Padnal = Savognin-Padnal, Borscht = Schellenberg-Borscht, Cazis = Cresta-Cazis, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

Bos taurus



(B)

Kruskal-Wallis test for equal medians

H (chi2):	13.8
Hc (tie cor	13.8
p (same):	0.01696

(C)

There is a significant difference between sample medians

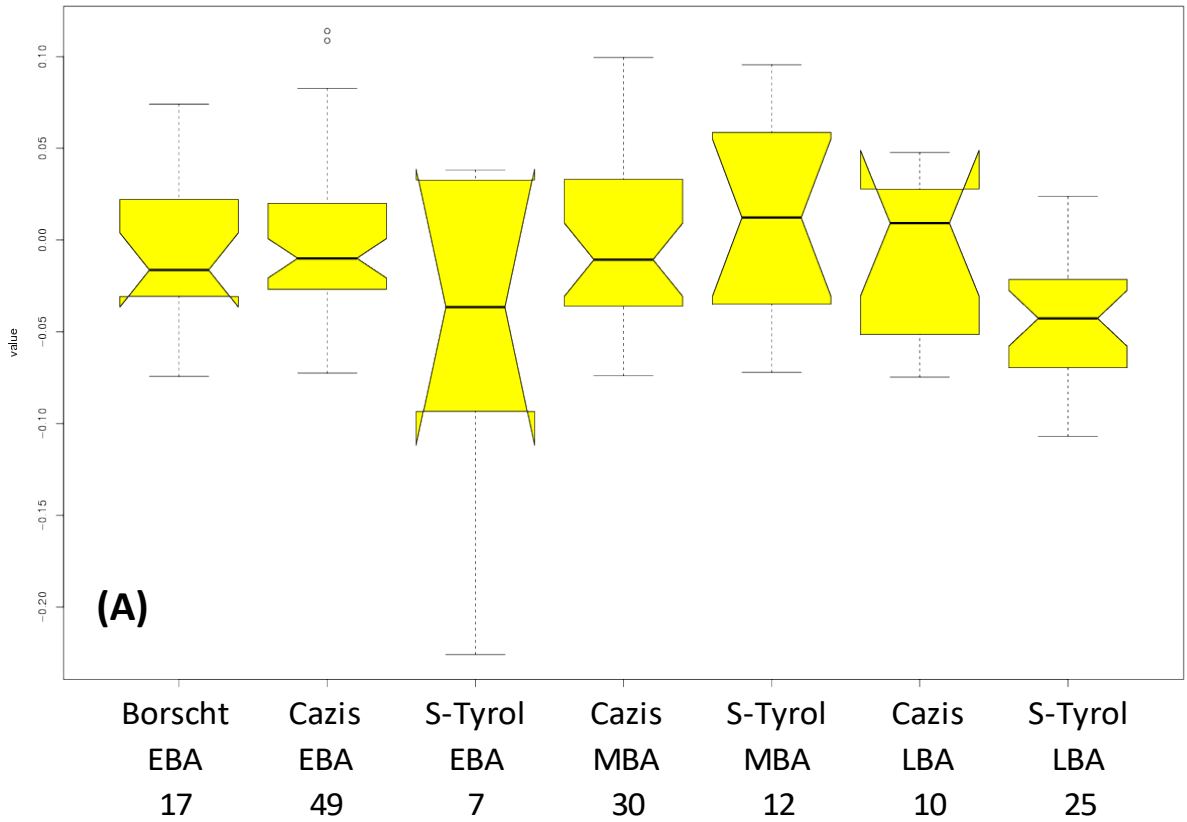
Mann-Whitney U test

	Padnal EBA	S-Tyrol EBA	Padnal MBA	S-Tyrol MBA	Padnal LBA	S-Tyrol LBA
Padnal EBA		0.5197	**< 0.05**	**< 0.01**	**< 0.05**	0.1273
S-Tyrol EBA			0.4657	0.163	0.8067	0.7496
Padnal MBA				0.2237	0.2105	0.07116
S-Tyrol MBA					**< 0.05**	**< 0.05**
Padnal LBA						0.2477
S-Tyrol LBA						

Significant p values are bold and highlighted. α = 0.05.

Fig. 3.4.34. The logarithmic size index (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of cattle between Padnal and South Tyrol during the Bronze Age. Numbers indicate the sample size used to obtain LSI. Padnal = Savognin-Padnal, S-Tyrol = South Tyrol, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

Bos taurus



(B)

Kruskal-Wallis test for equal medians

H (chi2):	18.53
Hc (tie cor	18.53
p (same):	0.005026

There is a significant difference between sample medians

(C)

Mann-Whitney U test

	Borscht EBA	Cazis EBA	S-Tyrol EBA	Cazis MBA	S-Tyrol MBA	Cazis LBA	S-Tyrol LBA
Borscht EBA		0.6078	0.4847	0.6984	0.3879	0.7441	**< 0.01**
Cazis EBA			0.2154	0.7580	0.6242	0.8320	**< 0.0001**
S-Tyrol EBA				0.2690	0.1630	0.4639	0.7496
Cazis MBA					0.5681	0.9378	**< 0.001**
S-Tyrol MBA						0.4483	**< 0.05**
Cazis LBA							**< 0.05**
S-Tyrol LBA							

Significant p values are bold and highlighted. α = 0.05.

Fig. 3.4.35. The logarithmic size index (LSI) (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of cattle between Schellenberg-Borscht, Cresta-Cazis, and South Tyrol during the Bronze Age. Numbers indicate the sample size used to obtain LSI. S-Tyrol = South Tyrol, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

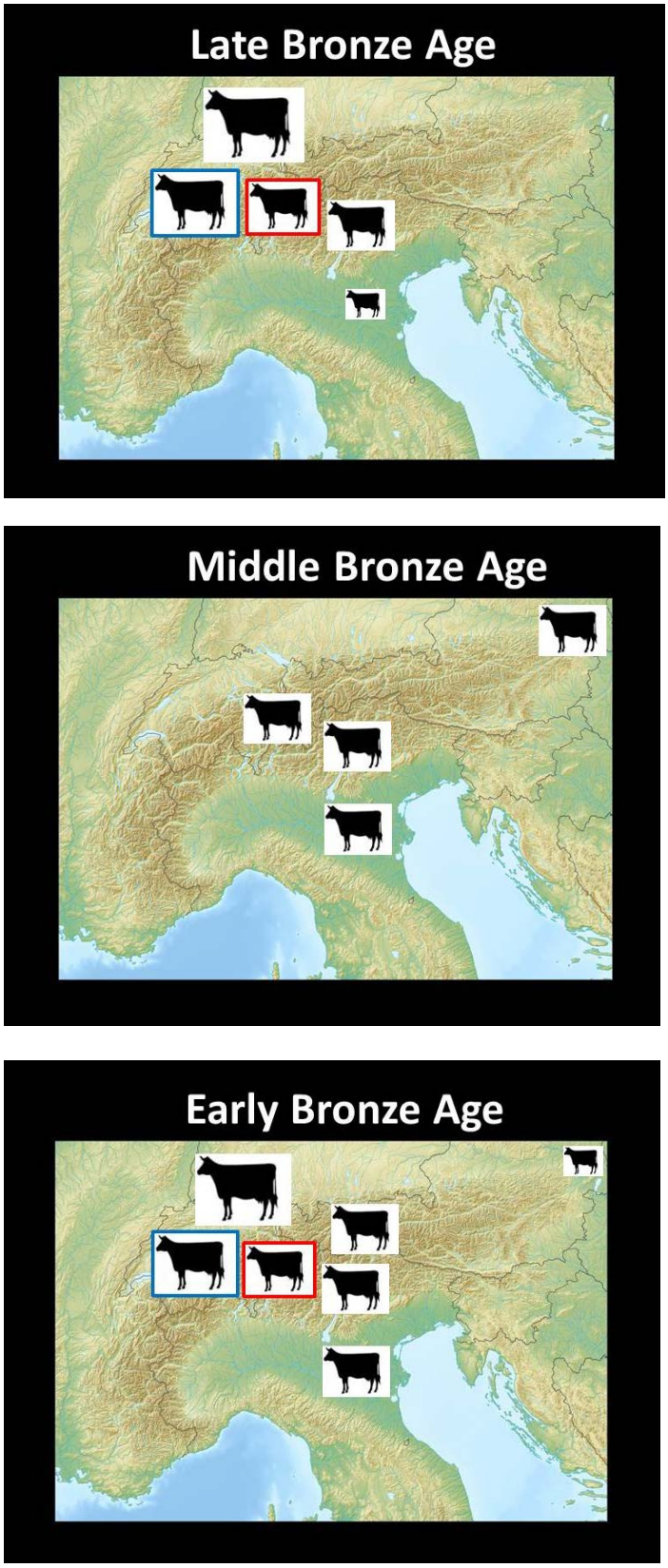
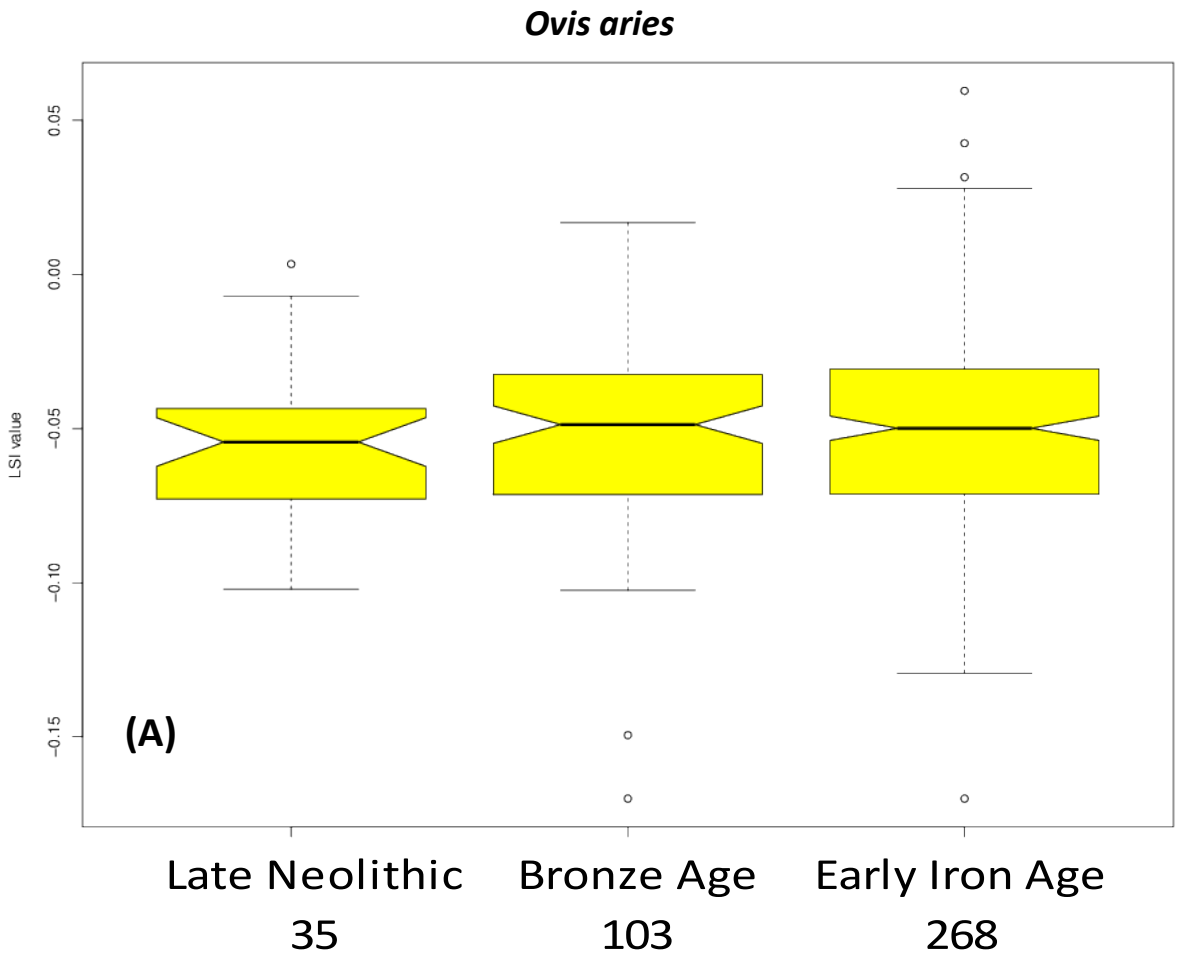


Fig. 3.4.36. Size diversity in Bronze Age cattle from Switzerland and neighbouring countries. Red border indicates cattle from Savognin-Padnal, blue border indicates cattle from Schellenberg-Borscht (only Early Bronze Age) and Cresta-Cazis.

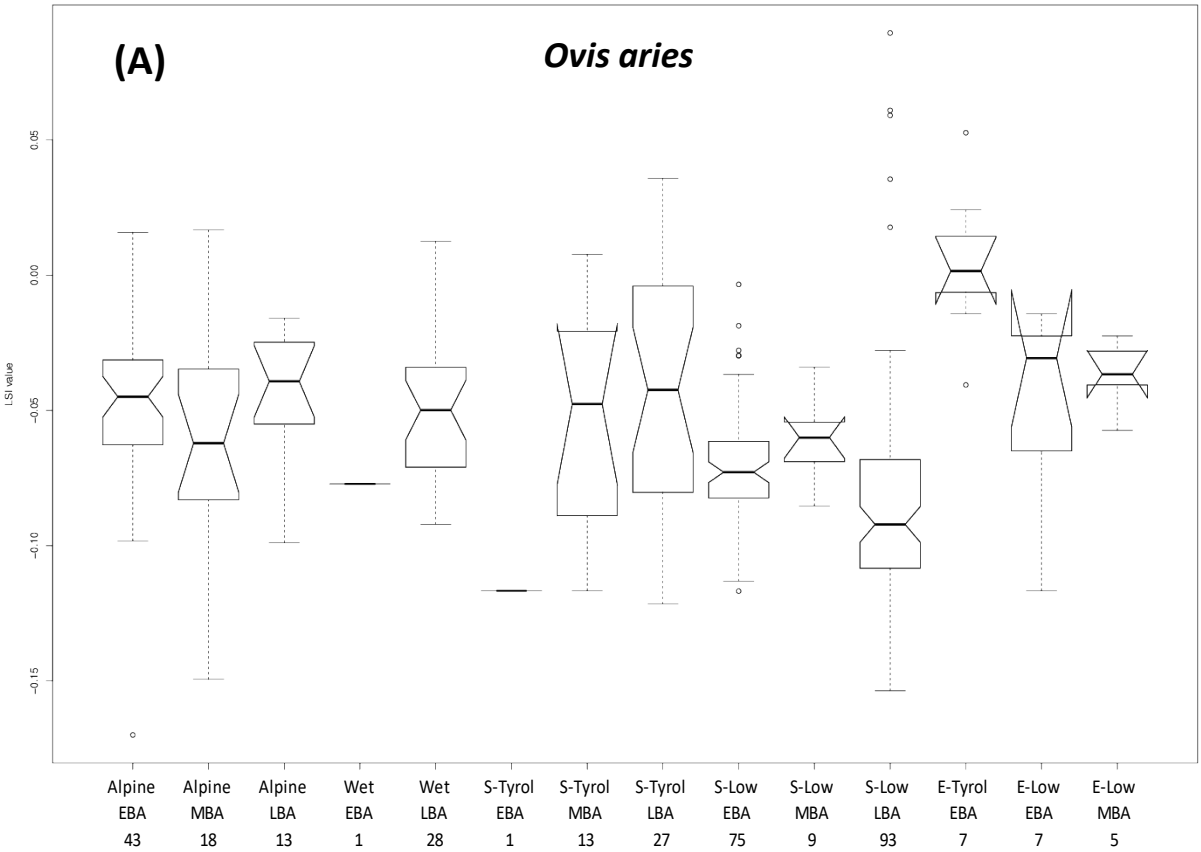


(B) Kruskal-Wallis test for equal medians

H (chi2):	0.9624
Hc (tie cor	0.963
p (same):	0.6179

There is no significant difference between sample medians

Fig. 3.4.37. The logarithmic size index (LSI) (A) and Kruskal-Wallis test (B) of sheep between the Late Neolithic and Early Iron Age. Numbers indicate the sample size used to obtain LSI.



(B)

Kruskal-Wallis test for equal medians

H (chi2):	89.32
Hc (tie cor	89.33
p (same):	2.26E-14

There is a significant difference between sample medians

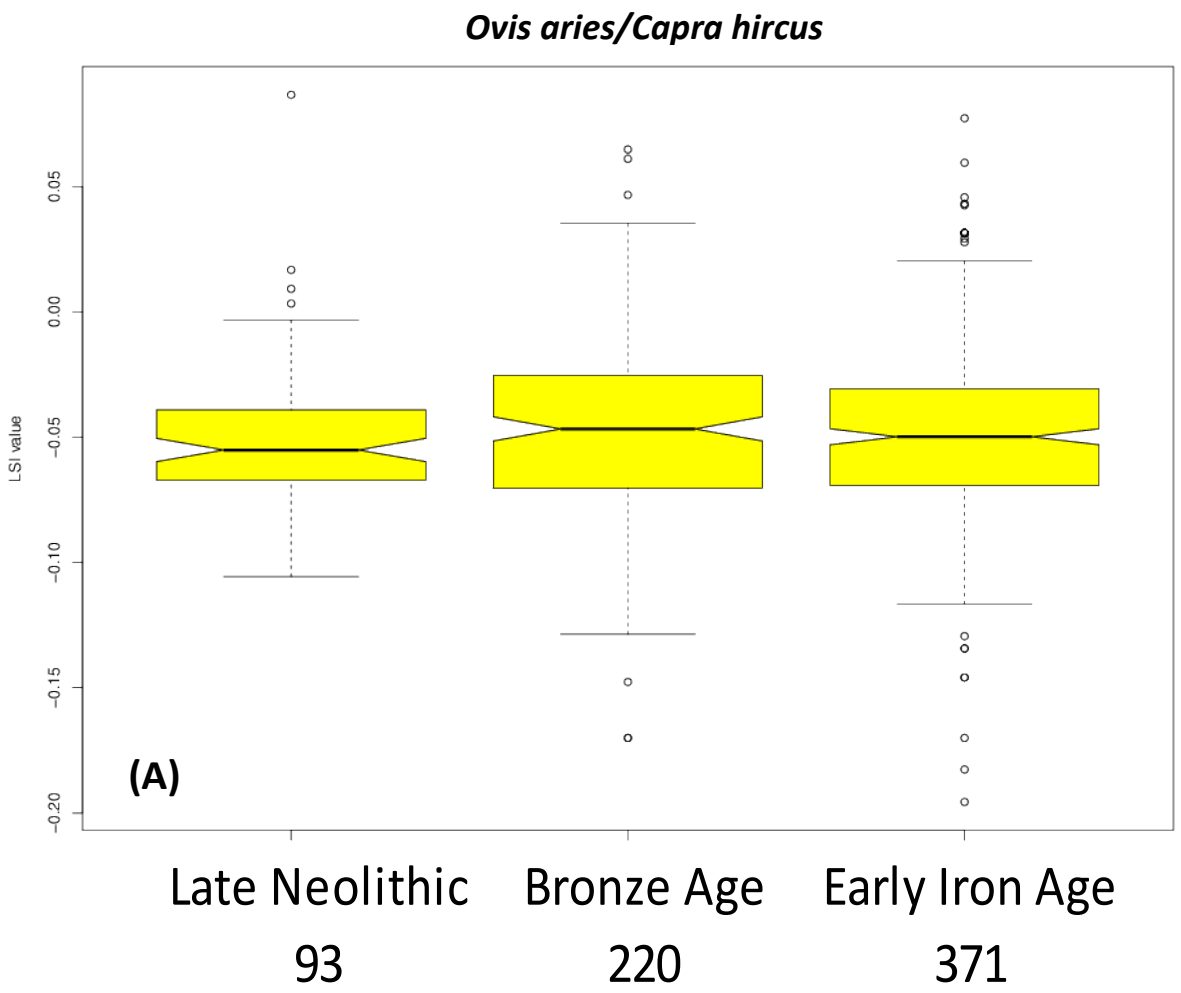
(C)

Ma.... ....ey U test

	Alp EBA	Alp MBA	Alp LBA	Wet LBA	Sty MBA	Sty LBA	Slw EBA	Slw MBA	Slw LBA	Ety EBA	Elw EBA	Elw MBA
Alp EBA		0.09215	0.5736	0.5761	0.9536	0.4258	**< 0.0001**	0.08158	**< 0.0001**	**< 0.001**	0.6148	0.2954
Alp MBA			0.1553	0.2366	0.435	0.1291	0.3948	0.8977	**< 0.05**	**< 0.0001**	0.3482	0.109
Alp LBA				0.4235	1	0.6649	**< 0.01**	0.08244	**< 0.001**	**< 0.01**	0.6919	0.7674
Wet LBA					0.8332	0.3854	**< 0.01**	0.3114	**< 0.0001**	**< 0.01**	0.4438	0.2162
Sty MBA						0.5538	0.07195	0.5042	**< 0.01**	**< 0.01**	0.9684	0.6934
Sty LBA							**< 0.01**	0.134	**< 0.0001**	**< 0.05**	0.7818	0.9793
Slw EBA								0.12	**< 0.001**	**< 0.0001**	0.06187	**< 0.01**
Slw MBA									**< 0.01**	**< 0.01**	0.1685	**< 0.05**
Slw LBA										**< 0.0001**	**< 0.05**	**< 0.01**
Ety EBA											**< 0.05**	**< 0.05**
Elw EBA												0.9352
Elw MBA												

Significant p values are coloured and highlighted. α = 0.05.

Fig. 3.4.38. The logarithmic size index (LSI) (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of sheep between regions during the Bronze Age. Numbers indicate the sample size used to obtain LSI. Alp = Alpine, Wet = Wetland, Sty = South Tyrol, Slw = South lowland, Ety = East Tyrol, Elw = East lowland, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

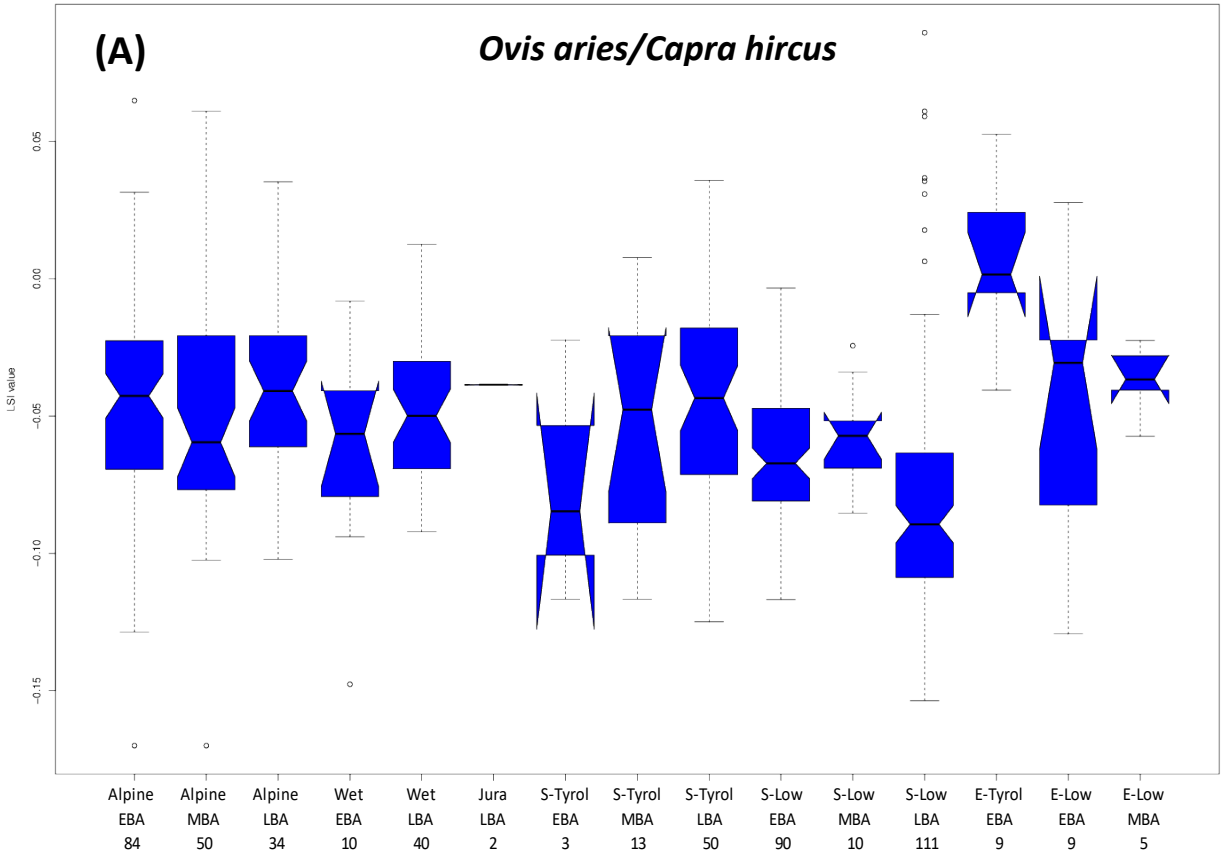


(B) Kruskal-Wallis test for equal medians

H (chi2):	2.156
Hc (tie cor	2.157
p (same):	0.3401

There is no significant difference between sample medians

Fig. 3.4.39. The logarithmic size index (LSI) (A) and Kruskal-Wallis test (B) of sheep and goats between the Late Neolithic and Early Iron Age. Numbers indicate the sample size used to obtain LSI.



(B)

Kruskal-Wallis test for equal medians

H (chi2):	100.8
Hc (tie cor	100.8
p (same):	3.39E-15

There is a significant difference between sample medians

(C)

Mann-Whitney U test

	Alp EBA	Alp MBA	Alp LBA	Wet EBA	Wet LBA	Jmt LBA	Sty EBA	Sty MBA	Sty LBA	Slw EBA	Slw MBA	Slw LBA	Ety EBA	Elw EBA	Elw MBA
Alp EBA		0.3071	0.8422	0.1874	0.8873	0.7310	0.3060	0.7871	0.7544	**< 0.0001**	0.1754	**< 0.0001**	**< 0.001**	0.9172	0.5506
Alp MBA			0.2905	0.5991	0.3439	0.6512	0.2404	0.9526	0.2525	**< 0.05**	0.8042	**< 0.0001**	**< 0.001**	0.7921	0.2852
Alp LBA				0.2026	0.6999	0.9175	0.2106	0.7124	0.8375	**< 0.001**	0.1415	**< 0.0001**	**< 0.001**	0.9881	0.7527
Wet EBA					0.1224	0.2374	0.5541	0.5766	0.1650	0.6499	0.9698	0.0643	**< 0.001**	0.4877	0.1590
Wet LBA						0.9290	0.3030	0.9422	0.6846	**< 0.001**	0.1847	**< 0.0001**	**< 0.001**	0.6503	0.3738
Jmt LBA							0.7728	0.9323	0.7935	0.1445	0.2365	0.0796	0.1246	0.9062	0.8465
Sty EBA								0.4590	0.2726	0.4663	0.5536	0.8249	**< 0.05**	0.6433	0.5510
Sty MBA									0.6283	0.1984	0.6418	**< 0.01**	**< 0.01**	0.9733	0.6934
Sty LBA										**< 0.001**	0.1342	**< 0.0001**	**< 0.001**	0.9412	0.7474
Slw EBA											0.3344	**< 0.0001**	**< 0.0001**	0.2055	**< 0.05**
Slw MBA												**< 0.01**	**< 0.001**	0.3072	0.0755
Slw LBA													**< 0.0001**	0.0551	**< 0.01**
Ety EBA														**< 0.05**	**< 0.05**
Elw EBA															0.9468
Elw MBA															

Significant p values are coloured and highlighted. α = 0.05.

Fig. 3.4.40. The logarithmic size index (LSI) (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of sheep and goats between regions during the Bronze Age. Numbers indicate the sample size used to obtain LSI. Alp = Alpine, Wet = Wetland, Jmt = Jura Mountains, Sty = South Tyrol, Slw = South lowland, Ety = East Tyrol, Elw = East lowland, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

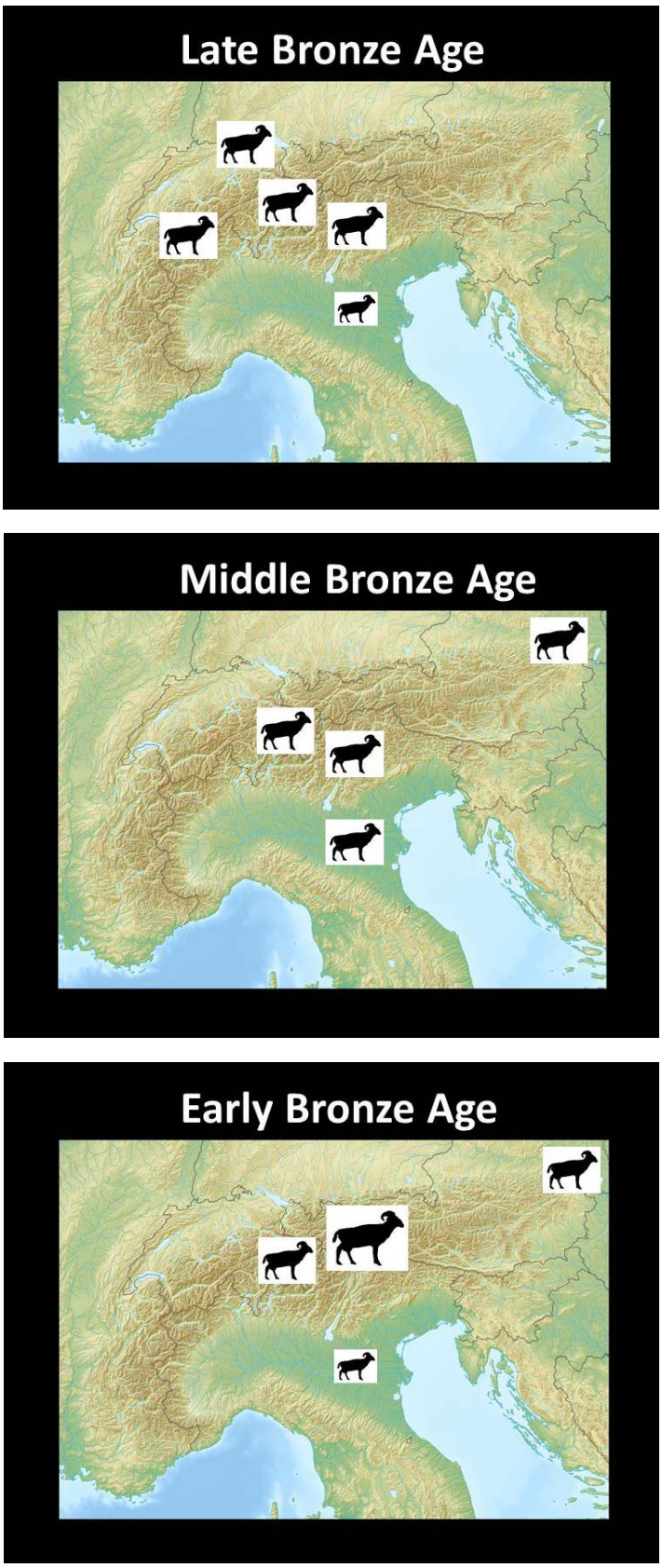
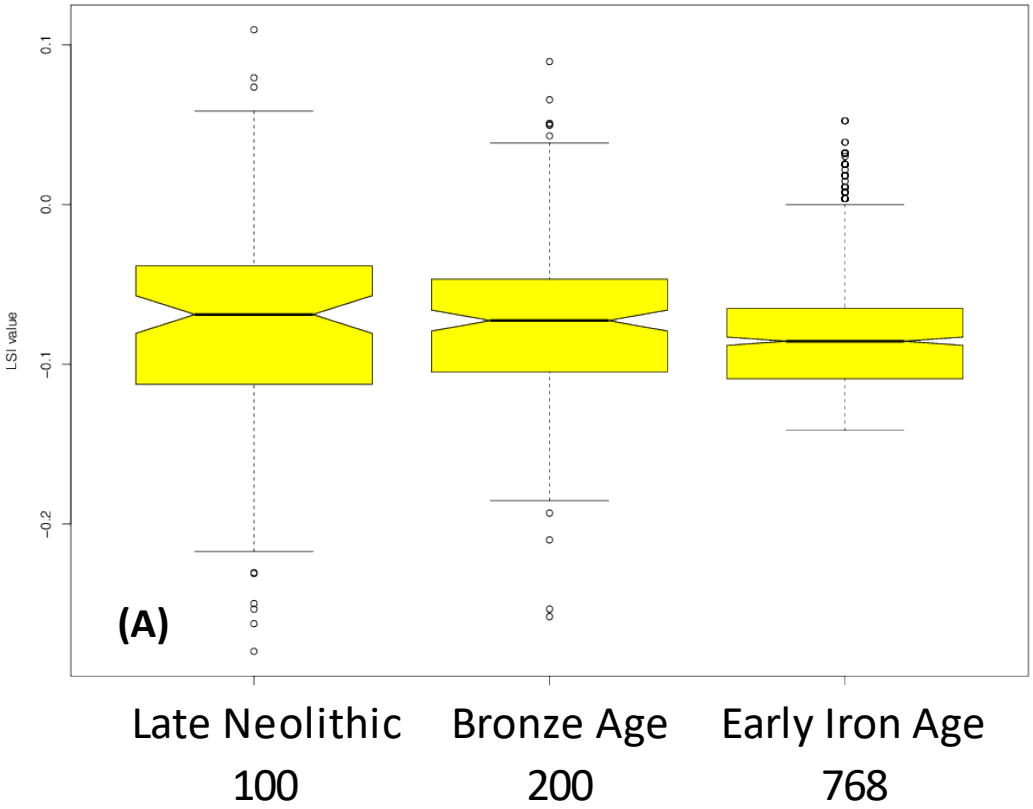


Fig. 3.4.41. Size diversity in Bronze Age sheep and goats from Switzerland and neighbouring countries.

Sus domesticus



(B)

Kruskal-Wallis test for equal medians

H (chi2):	6.595
Hc (tie cor	6.618
p (same):	0.03655

There is a significant difference between sample medians

(C)

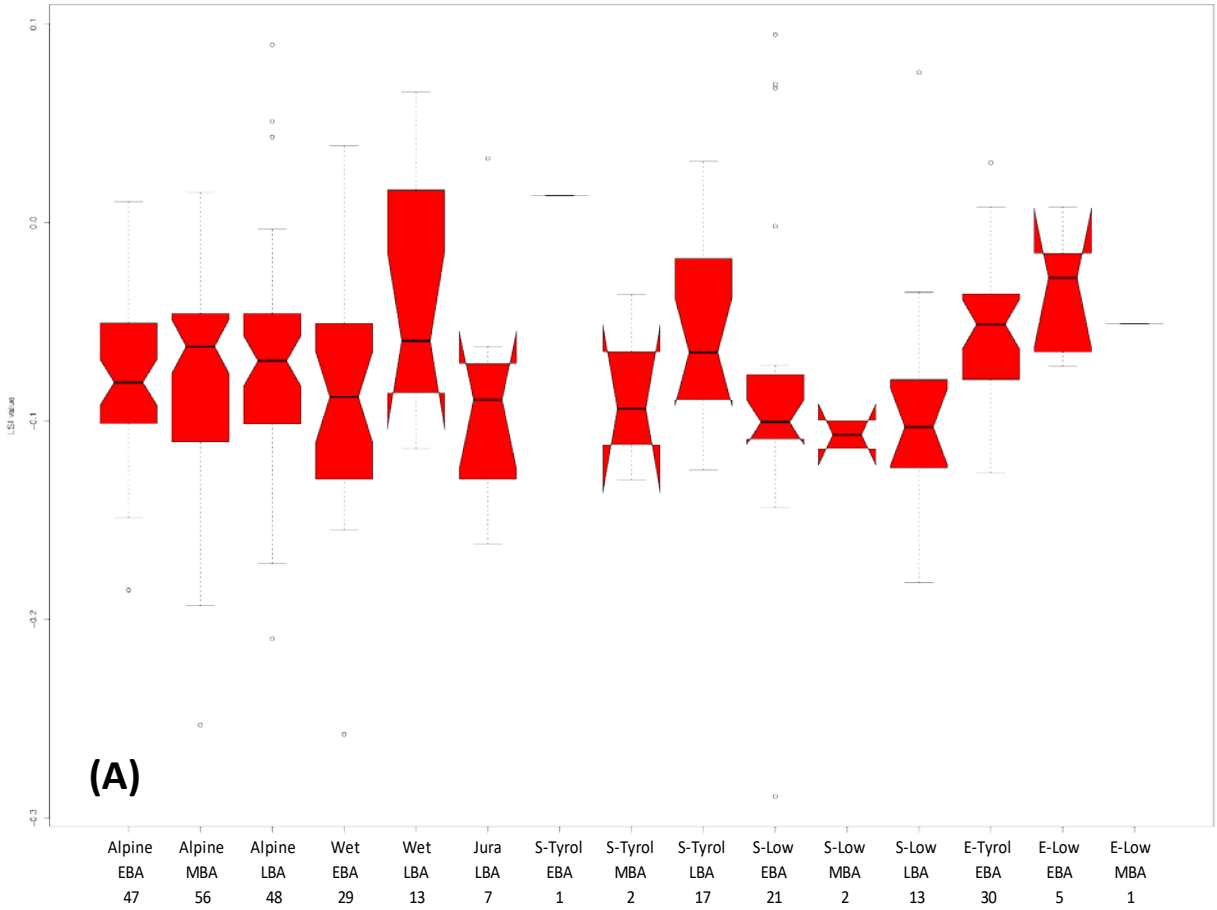
Mann-Whitney U test

	Late Neolithic	Bronze Age	Early Iron Age
Late Neolithic		0.8838	0.0736
Bronze Age			**< 0.05**
Early Iron Age			

Significant p values are bold and highlighted. α = 0.05.

Fig. 3.4.42. The logarithmic size index (LSI) (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of pigs between the Late Neolithic and Early Iron Age. Numbers indicate the sample size used to obtain LSI.

Sus domesticus



(B) Kruskal-Wallis test for equal medians

H (chi2): 25.17
Hc (tie cor 25.17
p (same): 0.01404

(C) **There is a significant difference between sample medians**

Mann-Whitney U test

	Alp EBA	Alp MBA	Alp LBA	Wet EBA	Wet LBA	Jmt LBA	Sty MBA	Sty LBA	Slw EBA	Slw MBA	Slw LBA	Ety EBA	Elw EBA
Alp EBA		0.4523	0.5100	0.7003	0.0526	0.4247	0.7749	0.0658	0.1979	0.1805	0.1486	**< 0.05**	**< 0.05**
Alp MBA			0.9117	0.5194	0.1268	0.2420	0.7693	0.1567	0.1240	0.2588	0.1346	**< 0.05**	0.0638
Alp LBA				0.3308	0.1233	0.2505	0.6168	0.2181	0.1176	0.2252	0.0607	0.0826	0.0913
Wet EBA					0.0517	0.6894	0.9484	0.1273	0.8906	0.6876	0.6052	**< 0.05**	0.1317
Wet LBA						0.0957	0.2249	0.3792	**< 0.05**	0.0738	**< 0.05**	0.5517	0.8822
Jmt LBA							1	0.1622	0.9577	0.8836	1	**< 0.05**	0.1044
Sty MBA								0.2037	0.9304	0.7728	0.8398	0.2728	0.1360
Sty LBA									**< 0.05**	0.0965	**< 0.05**	0.9382	0.3270
Slw EBA										0.5482	0.5949	**< 0.05**	**< 0.05**
Slw MBA											0.9323	0.0796	0.0814
Slw LBA												**< 0.01**	**< 0.05**
Ety EBA													0.2777
Elw EBA													

Significant p values are bold and highlighted. α = 0.05.

Fig. 3.4.43. The logarithmic size index (LSI) (A), Kruskal-Wallis (B), and Mann-Whitney U tests (C) of pigs between regions during the Bronze Age. Numbers indicate the sample size used to obtain LSI. Alp = Alpine, Wet = Wetland, Jmt = Jura Mountains, Sty = South Tyrol, Slw = South lowland, Ety = East Tyrol, Elw = East lowland, EBA = Early Bronze Age, MBA = Middle Bronze Age, LBA = Late Bronze Age.

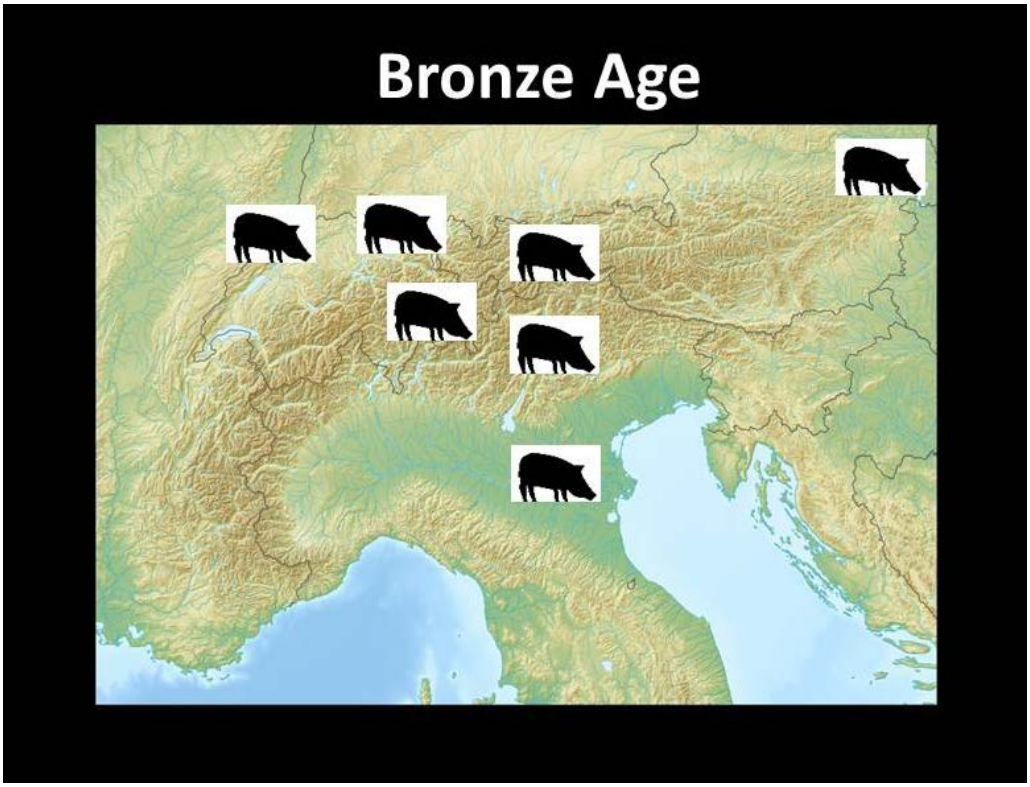


Fig. 3.4.44. Size diversity in Bronze Age pigs from Switzerland and neighbouring countries.

9. APPENDIXES

9.1. Abbreviation

Fig. = Figure
Tab. = Table
Appx. = Appendix
Photo. = Photograph
IPAS = Integrative Prehistory and Archaeological Science
EBA = Early Bronze Age
E-MBA = End of Early Bronze Age to beginning of Middle Bronze Age
MBA = Middle Bronze Age
LBA = Late Bronze Age
BA = Bronze Age
Padnal = Savognin-Padnal
a.s.l. = above sea level
ca. = circa, about, approximately
cal. = calendar or calibrated years for non-radiocarbon dating
ka = kiloannus for C14 dating = $(10)^3$
NISP = Number of identified specimens
MNI = Minimum number of individuals
LSI = logarithmic size index = $(\log x - \log m) = \log (x/m)$
Bd = (Greatest) breadth of the distal end
Bp = (Greatest) breadth of the proximal end
GMM = Geometric and morphometrics
GPA = Generalized Procrustes analysis
CS = Centroid size
M_2 = Second lower Molar
M_3 = Third lower Molar
ANOVA = Analysis of Variance
PCA = Principal Component Analysis
MANOVA = Multivariate analysis of Variance
TPS = Thin-plate spline
df = degrees of freedom
PCs = Principal Component score
W.-AVE. = Average of weight (Mean of weight)
Plateau = Central Plateau

9.2. Caption of Tables

Appx. Tab. 1. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Savognin-Padnal in Switzerland during the Bronze Age.

Appx. Tab. 2. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizonts E, D, C, and B at Savognin-Padnal in Switzerland during the Bronze Age.

Appx. Tab. 3. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 Horizonts C and B at Savognin-Padnal in Switzerland during the Middle and Late Bronze Age.

Appx. Tab. 4. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizont E in Savognin-Padnal during the Early Bronze Age.

Appx. Tab. 5. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizont D in Savognin-Padnal during the Early-Middle Bronze Age.

Appx. Tab. 6. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizont C in Savognin-Padnal during the Middle Bronze Age.

Appx. Tab. 7. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 Horizont C in Savognin-Padnal during the Middle Bronze Age.

Appx. Tab. 8. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 and 3 Horizont C in Savognin-Padnal during the Middle Bronze Age.

Appx. Tab. 9. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizont B in Savognin-Padnal during the Late Bronze Age.

Appx. Tab. 10. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 Horizont B in Savognin-Padnal during the Late Bronze Age.

Appx. Tab. 11. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 and 3 Horizont B in Savognin-Padnal during the Late Bronze Age.

Appx. Tab. 12. The age code of cattle in OSSOBOOK (version autumn 2005), IPAS, University of Basel.

Appx. Tab. 13. The age code of sheep and goat in OSSOBOOK (version autumn 2005), IPAS, University of Basel.

Appx. Tab. 14. The age code of pig in OSSOBOOK (version autumn 2005), IPAS, University of Basel.

Appx. Tab. 15. Factor of withers height for cattle (*Bos taurus*) by Matolcsi.

Appx. Tab. 16. Factor of withers height for sheep (*Ovis aries*) by Teichert.

Appx. Tab. 17. Factor of withers height for pig (*Sus domesticus and Sus scrofa*) by Teichert.

Appx. Tab. 18. Factor of withers height for dog (*Canis familiaris*) by Harcoat.

Appx. Tab. 19. Factor of withers height for human (*Homo sapiens*) by Fazekas & Kasa.

Appx. Tab. 20. Individuals for standard value of logarithmic size index analysis. No. = Collection number at IPAS, University of Basel.

Appx. Tab. 21. Osteometric list of the Early Bronze Age (Field 3, Horizon E).

Appx. Tab. 22. Osteometric list of the Early-Middle Bronze Age (Field 3, Horizon D).

Appx. Tab. 23. Osteometric list of the Middle Bronze Age (Field 3, Horizon C).

Appx. Tab. 24. Osteometric list of the Middle Bronze Age (Field 1, Horizon C).

Appx. Tab. 25. Osteometric list of the Late Bronze Age (Field 3, Horizon B).

Appx. Tab. 26. Osteometric list of the Late Bronze Age (Field 1, Horizon B).

Appx. Tab. 27. Skeletal element (n): Early Bronze Age (Field 3, Horizon E)

Appx. Tab. 28. Skeletal element (g): Early Bronze Age (Field 3, Horizon E)

Appx. Tab. 29. Skeletal element (n): Early-Middle Bronze Age (Field 3, Horizon D)

Appx. Tab. 30. Skeletal element (g): Early-Middle Bronze Age (Field 3, Horizon D)

Appx. Tab. 31. Skeletal element (n): Middle Bronze Age (Field 3, Horizon C)

Appx. Tab. 32. Skeletal element (g): Middle Bronze Age (Field 3, Horizon C)

Appx. Tab. 33. Skeletal element (n): Middle Bronze Age (Field 1, Horizon C)

Appx. Tab. 34. Skeletal element (g): Middle Bronze Age (Field 1, Horizon C)

Appx. Tab. 35. Skeletal element (n): Late Bronze Age (Field 3, Horizon B)

Appx. Tab. 36. Skeletal element (g): Late Bronze Age (Field 3, Horizon B)

Appx. Tab. 37. Skeletal element (n): Late Bronze Age (Field 1, Horizon B)

Appx. Tab. 38. Skeletal element (g): Late Bronze Age (Field 1, Horizon B)

9.3. Tables

SPECIES	Savognin-Padnal Whole Bronze Age: Horizon E, D, C, B Field 1 & 3				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Horse (Equus caballus)	1	0.004	35.5	0.02	35.5
Cattle (*Bos taurus*)	14151	53.7	167872.0	78.6	11.9
Sheep (*Ovis aries*)	314	1.2	1702.7	0.8	5.4
Sheep? (*Ovis aries?*)	7	0.03	21.1	0.01	3.0
Goat (*Capra hircus*)	94	0.4	584.1	0.3	6.2
Goat? *(Capra hircus?*)	6	0.02	10.9	0.01	1.8
Sheep/Goat (*Ovis a./Capra h.*)	9457	35.9	27084.2	12.7	2.9
Pig (*Sus domesticus*)	2138	8.11	14210.4	6.7	6.6
Dog (*Canis familiaris*)	93	0.35	506.0	0.2	5.4
Total domestic animal	26261	99.6	212026.9	99.3	8.1
Red deer (*Cervus elaphus*)	15	0.06	206.5	0.1	13.8
Ibex (*Capra ibex*)	17	0.06	353.4	0.2	20.8
Roe deer (*Capreolus capreolus*)	7	0.03	34.2	0.02	4.9
Brown bear (*Ursus arctos*)	1	0.004	25.7	0.01	25.7
Wild boar (*Sus scrofa*)	59	0.2	950.1	0.4	16.1
Yellow-necked field mouse (*Apodemus flavicollis*)	1	0.004	0.4	0.0002	0.4
Apodemus spec.	1	0.004	0.1	0.00005	0.1
Graylag goose (*Anser anser*)	2	0.01	1.3	0.001	0.7
White stork *(Ciconia ciconia)*	1	0.004	1.7	0.001	1.7
Stock pigeon (*Columba oenas*)	1	0.004	0.4	0.0002	0.4
Wood pigeon (*Columba palumbus*)	1	0.004	0.6	0.0003	0.6
Toad (*Bufo spec.*)	1	0.004	0.3	0.0001	0.3
Grapevine snail (*Helix pomatia*)	1	0.004	1.2	0.001	1.2
Total wild animal	108	0.4	1575.9	0.7	14.6
Total domestic/wild animal	**26369**	**100**	**213602.8**	**100**	**8.1**
Goat/Ibex (*Capra h./ibex*)	3		33.0		11.0
Goat/Chamois (*Capra h./rupicapra*)	3		42.1		14.0
Pig/Wild boar (*Sus dom./scrofa*)	5		101.8		20.4
Dog/Wolf (*Canis fam./lup.*)	3		2.7		0.9
Large ruminants	1162		2113.0		1.8
Small ruminants	312		206.7		0.7
Total large groups	1488		2499.3		1.7
Unidentified	12135		16955.6		1.4
Total unidentified	13623		19454.9		1.4
Total identified & unidentified animals	**39992**		**233057.7**		**5.8**
Human (*Homo sapiens*)	39		88.6		2.3
Total identified animals & humans	**26408**		**213691.4**		**8.1**
TOTAL	**40031**		**233146.3**		**5.8**

Total O/C NISP, Weight (MV)

NISP 9878
n% 37.6%
Weight 29403g
g% 13.8%
Mean Value 3.0g

Appx. Tab. 1. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Savognin-Padnal in Switzerland during the Bronze Age.

SPECIES	Savognin-Padnal Whole Bronze Age: Horizon E, D, C, B Field 3				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Cattle (*Bos taurus*)	8518	49.1	106464.6	76.9	12.5
Sheep (*Ovis aries*)	237	1.4	1159.7	0.8	4.9
Sheep? (*Ovis aries?*)	4	0.02	10.3	0.01	2.6
Goat (*Capra hircus*)	82	0.5	471.1	0.3	5.7
Goat? *(Capra hircus?*)	5	0.03	6.7	0.00	1.3
Sheep/Goat (*Ovis a./Capra h.*)	7071	40.7	19681	14.2	2.8
Pig (*Sus domesticus*)	1275	7.3	8951.7	6.5	7.0
Dog (*Canis familiaris*)	88	0.5	449.9	0.3	5.1
Total domestic animal	17280	99.5	137195.0	99.1	7.9
Red deer (*Cervus elaphus*)	4	0.02	28.9	0.0	7.2
Ibex (*Capra ibex*)	15	0.09	338.1	0.2	22.5
Roe deer (*Capreolus capreolus*)	1	0.01	4.5	0.00	4.5
Wild boar (*Sus scrofa*)	53	0.3	862.1	0.6	16.3
Yellow-necked field mouse (*Apodemus flavicollis*)	1	0.006	0.4	0.0003	0.4
Apodemus spec.	1	0.006	0.1	0.00007	0.1
Graylag goose (*Anser anser*)	2	0.01	1.3	0.001	0.7
White stork *(Ciconia ciconia)*	1	0.006	1.7	0.001	1.7
Stock pigeon (*Columba oenas*)	1	0.006	0.4	0.0003	0.4
Toad (*Bufo spec.*)	1	0.006	0.3	0.0002	0.3
Grapevine snail (*Helix pomatia*)	1	0.006	1.2	0.001	1.2
Total wild animal	81	0.5	1239	0.9	15.3
Total domestic/wild animal	**17361**	**100**	**138434.0**	**100**	**8.0**
Goat/Ibex (*Capra h./ibex*)	3		33.0		11.0
Goat/Chamois (*Capra h./rupicapra*)	1		36.4		36.4
Pig/Wild boar (*Sus dom./scrofa*)	1		32.2		32.2
Large ruminants	723		1074.3		1.5
Small ruminants	234		145.1		0.6
Total large groups	962		1321.0		1.4
Unidentified	6546		8893.8		1.4
Total unidentified	7508		10214.8		1.4
Total identified & unidentified animals	**24869**		**148648.8**		**6.0**
Human (*Homo sapiens*)	26		30.2		1.2
Total identified animals & humans	**17387**		**138464.2**		**8.0**
TOTAL	**24895**		**148679.0**		**6.0**

Total O/C NISP, Weight (MV)

NISP 7399
n% 42.6%
Weight 21328.8g
g% 15.41%
Mean Value 2.9g

Appx. Tab. 2. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizonts E, D, C, and B at Savognin-Padnal in Switzerland during the Bronze Age.

SPECIES	Savognin-Padnal Middle & Late Bronze Age: Horizon C & B Field 1				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Horse (*Equus caballus*)	1	0.011	35.5	0.05	35.5
Cattle (*Bos taurus*)	5633	62.5	61407.4	81.7	10.9
Sheep (*Ovis aries*)	77	0.9	543.0	0.7	7.1
Sheep? (*Ovis aries?*)	3	0.03	10.8	0.01	3.6
Goat (*Capra hircus*)	12	0.1	113.0	0.2	9.4
Goat? (*Capra hircus?*)	1	0.01	4.2	0.01	4.2
Sheep/Goat (*Ovis a./Capra h.*)	2386	26.5	7403.2	9.8	3.1
Pig (*Sus domesticus*)	863	9.58	5258.7	7.0	6.1
Dog (*Canis familiaris*)	5	0.06	56.1	0.1	11.2
Total domestic animal	8981	99.7	74831.9	99.6	8.3
Red deer (*Cervus elaphus*)	11	0.12	177.6	0.2	16.1
Ibex (*Capra ibex*)	2	0.02	15.3	0.0	7.7
Roe deer (*Capreolus capreolus*)	6	0.07	29.7	0.04	5.0
Brown bear (*Ursus arctos*)	1	0.011	25.7	0.03	25.7
Wild boar (*Sus scrofa*)	6	0.1	88.0	0.1	14.7
Wood pigeon (*Columba palumbus*)	1	0.011	0.6	0.0008	0.6
Total wild animal	27	0.3	336.9	0.4	12.5
Total domestic/wild animal	**9008**	**100**	**75168.8**	**100**	**8.3**
Goat/Chamois (*Capra h./rupicapra*)	2		5.7		2.9
Pig/Wild boar (*Sus dom./scrofa*)	4		69.6		17.4
Dog/Wolf (*Canis fam./lup.*)	3		2.7		0.9
Large ruminants	439		1038.7		2.4
Small ruminants	78		61.6		0.8
Total large groups	526		1178.3		2.2
Unidentified	5589		8061.8		1.4
Total unidentified	6115		9240.1		1.5
Total identified & unidentified animals	**15123**		**84408.9**		**5.6**
Human (*Homo sapiens*)	13		58.4		4.5
Total identified animals & humans	**9021**		**75227.2**		**8.3**
TOTAL	**15136**		**84467.3**		**5.6**

Total O/C NISP, Weight (MV)

NISP 2479
n% 27.5%
Weight 8074.2g
g% 10.74%
Mean Value 3.3g

Appx. Tab. 3. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 Horizonts C and B at Savognin-Padnal in Switzerland during the Middle and Late Bronze Age.

SPECIES	Savognin-Padnal Early Bronze Age: Horizon E Field 3				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Cattle (*Bos taurus*)	1849	48.4	26859.6	78.24	14.5
Sheep (*Ovis aries*)	35	0.9	129.9	0.38	3.7
Goat (*Capra hircus*)	16	0.4	162.8	0.47	10.2
Sheep/Goat (*Ovis a./Capra h.*)	1652	43.3	5029.7	14.65	3.0
Pig (*Sus domesticus*)	181	4.7	1359.6	3.96	7.5
Dog (*Canis familiaris*)	61	1.6	301.6	0.88	4.9
Total domestic animal	3794	99.4	33843.2	98.59	8.9
Red deer (*Cervus elaphus*)	1	0.03	2.7	0.01	2.7
Ibex (*Capra ibex*)	9	0.2	179.1	0.52	19.9
Wild boar (*Sus scrofa*)	13	0.3	302.2	0.88	23.2
Grapevine snail (*Helix pomatia*)	1	0.03	1.2	0.003	1.2
Total wild animal	24	0.6	485.2	1.41	20.2
Total domestic/wild animal	**3818**	**100**	**34328.4**	**100**	**9.0**
Goat/Ibex (*Capra h./ibex*)	2		19.3		9.7
Goat/Chamois (*Capra h./rupicapra*)	1		36.4		36.4
Large ruminants	65		117.8		1.8
Small ruminants	38		13		0.3
Total large groups	106		186.5		1.8
Unidentified	1076		1332.3		1.2
Total unidentified	1182		1518.8		1.3
Total identified & unidentified animals	**5000**		**35847.2**		**7.2**
Human (*Homo sapiens*)	1		4		4.0
Total identified animals & humans	**3819**		**34332.4**		**9.0**
TOTAL	**5001**		**35851.2**		**7.2**

Total O/C NISP, Weight (MV)

NISP 1703
n% 44.6%
Weight 5322.4g
g% 15.5%
Mean Value 3.1g

Appx. Tab. 4. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizont E in Savognin-Padnal during the Early Bronze Age.

SPECIES	Savognin-Padnal Early-Middle Bronze Age: Horizon D Field 3				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Cattle (*Bos taurus*)	3439	46.8	40839.63	75.25	11.9
Sheep (*Ovis aries*)	124	1.7	666.4	1.23	5.4
Sheep? (*Ovis aries?*)	3	0.04	8.8	0.02	2.9
Goat (*Capra hircus*)	40	0.5	186.7	0.34	4.7
Sheep/Goat (*Ovis a./Capra h.*)	3095	42.1	7693.8	14.18	2.5
Pig (*Sus domesticus*)	597	8.1	4316.1	7.95	7.2
Dog (*Canis familiaris*)	24	0.3	139.8	0.26	5.8
Total domestic animal	7322	99.5	53851.2	99.22	7.4
Red deer (*Cervus elaphus*)	3	0.04	26.2	0.05	8.7
Roe deer (*capreolus capreolus*)	1	0.01	4.5	0.01	4.5
Wild boar (*Sus scrofa*)	25	0.3	388.8	0.72	15.6
Yellow-necked field mouse (*Apodemus flavicollis*)	1	0.01	0.4	0.001	0.4
Graylag goose (*Anser anser*)	2	0.03	1.3	0.002	0.7
Stock pigeon (*Columba oenas*)	1	0.01	0.4	0.001	0.4
Toad (*Bufo spec.*)	1	0.01	0.3	0.001	0.3
Total wild animal	34	0.5	421.9	0.78	12.4
Total domestic/wild animal	**7356**	**100**	**54273.1**	**100**	**7.4**
Pig/Wild boar (*Sus dom./scrofa*)	1		32.2		32.2
Large ruminants	222		231.4		1.0
Small ruminants	82		42.1		0.5
Total large groups	305		305.7		1.0
Unidentified	2803		3400.8		1.2
Total unidentified	3108		3706.5		1.2
Total identified & unidentified animals	**10464**		**57979.6**		**5.5**
Human (*Homo sapiens*)	12		18.5		1.5
Total identified animals & humans	**7368**		**54291.6**		**7.4**
TOTAL	**10476**		**57998.1**		**5.5**

Total O/C NISP, Weight (MV)

NISP 3262
n% 44.3%
Weight 8555.7g
g% 15.8%
Mean Value 3.9g

Appx. Tab. 5. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizont D in Savognin-Padnal during the Early-Middle Bronze Age.

SPECIES	Savognin-Padnal Middle Bronze Age: Horizon C Field 3				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Cattle (*Bos taurus*)	1451	47.6	19170.4	76.64	13.2
Sheep (*Ovis aries*)	33	1.1	98.7	0.39	3.0
Goat (*Capra hircus*)	19	0.6	76	0.30	4.0
Sheep/Goat (*Ovis a./Capra h.*)	1319	43.3	3909.2	15.63	3.0
Pig (*Sus domesticus*)	211	6.9	1575.6	6.30	7.5
Dog (*Canis familiaris*)	2	0.1	2.5	0.01	1.3
Total domestic animal	3035	99.5	24832.4	99.28	8.2
Ibex (*Capra ibex*)	1	0.03	27.7	0.11	27.7
Wild boar (*Sus scrofa*)	13	0.4	152.1	0.61	11.7
Total wild animal	14	0.5	179.8	0.72	12.8
Total domestic/wild animal	**3049**	**100**	**25012.2**	**100**	**8.2**
Goat/Ibex (*Capra h./ibex*)	1		13.7		13.7
Large ruminants	184		326.6		1.8
Small ruminants	54		42.5		0.8
Total large groups	239		382.8		1.6
Unidentified	1456		2427.6		1.7
Total unidentified	1695		2810.4		1.7
Total identified & unidentified animals	**4744**		**27822.6**		**5.9**
Human (*Homo sapiens*)	13		7.7		0.6
Total identified animals & humans	**3062**		**25019.9**		**8.2**
TOTAL	**4757**		**27830.3**		**5.9**

Total O/C NISP, Weight (MV)

NISP 1371
n% 45%
Weight 4083.9g
g% 16.32%
Mean Value 3.3g

Appx. Tab. 6. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizont C in Savognin-Padnal during the Middle Bronze Age.

SPECIES	Savognin-Padnal Middle Bronze Age: Horizon C Field 1				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Cattle (*Bos taurus*)	815	60.2	9678.2	80.6	11.9
Sheep (*Ovis aries*)	7	0.5	50.8	0.4	7.3
Sheep? (*Ovis aries?*)	1	0.1	5.1	0.04	5.1
Goat (*Capra hircus*)	2	0.1	61.3	0.5	30.7
Goat? (*Capra hircus?*)	1	0.1	4.2	0.03	4.2
Sheep/Goat (*Ovis a./Capra h.*)	383	28.3	1376.7	11.5	3.6
Pig (*Sus domesticus*)	137	10.1	748	6.2	5.5
Dog (*Canis familiaris*)	2	0.1	5.9	0.05	3.0
Total domestic animal	1348	99.6	11930.2	99.4	8.9
Red deer (*Cervus elaphus*)	4	0.3	63.1	0.5	15.8
Ibex (*Capra ibex*)	1	0.1	7.1	0.1	7.1
Total wild animal	5	0.4	70.2	0.6	14.0
Total domestic/wild animal	**1353**	**100**	**12000.4**	**100**	**8.9**
Goat/Chamois (*Capra h./Rupicapra rupicapra*)	2		5.7		2.85
Pig/Wild Boar (*Sus dom./scrofa*)	4		69.6		17.4
Dog/Wolf (*Canis fam./lup.*)	1		1.1		1.1
Large ruminants	67		198.5		3.0
Small ruminants	5		6		1.2
Total large groups	79		280.9		3.6
Unidentified	959		1599.1		1.7
Total unidentified	1038		1880.0		1.8
Total identified & unidentified animals	**2391**		**13880.4**		**5.8**
Human (*Homo sapiens*)	5		17.1		3.4
Total identified animals & humans	**1358**		**12017.5**		**8.8**
TOTAL	**2396**		**13897.5**		**5.8**

Total O/C NISP, Weight (MV)

NISP 394
n% 29.1%
Weight 1498.1g
g% 12.5%
Mean Value 3.8g

Appx. Tab. 7. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 Horizont C in Savognin-Padnal during the Middle Bronze Age.

SPECIES	Savognin-Padnal Middle Bronze Age: Horizon C Field 1 & 3				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Cattle (*Bos taurus*)	2266	51.5	28848.6	77.9	12.7
Sheep (*Ovis aries*)	40	0.9	149.5	0.4	3.7
Sheep? (*Ovis aries?*)	1	0.02	5.1	0.01	5.1
Goat (*Capra hircus*)	21	0.5	137.3	0.4	6.5
Goat? (*Capra hircus?*)	1	0.02	4.2	0.01	4.2
Sheep/Goat (*Ovis a./Capra h.*)	1702	38.7	5285.9	14.3	3.1
Pig (*Sus domesticus*)	348	7.9	2323.6	6.3	6.7
Dog (*Canis familiaris*)	4	0.1	8.4	0.02	2.1
Total domestic animal	4383	99.6	36762.6	99.3	8.4
Red deer (*Cervus elaphus*)	4	0.1	63.1	0.2	15.8
Ibex (*Capra ibex*)	2	0.05	34.8	0.1	17.4
Wild boar (*Sus scrofa*)	13	0.3	152.1	0.4	11.7
Total wild animal	19	0.4	250	0.7	13.2
Total domestic/wild animal	**4402**	**100**	**37012.6**	**100**	**8.4**
Total unidentified	2733		4690.4		1.7
Total identified & unidentified animals	**7135**		**41703**		**5.8**
Human (*Homo sapiens*)	18		24.8		1.4
Total identified animals & humans	**4420**		**37037.4**		**8.4**
TOTAL	**7153**		**41727.8**		**5.8**

Total O/C NISP, Weight (MV)

NISP 1765
n% 40.1%
Weight 5582g
g% 15.1%
Mean Value 3.2g

Appx. Tab. 8. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 and 3 Horizont C in Savognin-Padnal during the Middle Bronze Age.

SPECIES	Savognin-Padnal Late Bronze Age: Horizon B Field 3				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Cattle (*Bos taurus*)	1779	56.7	19595	78.95	11.0
Sheep (*Ovis aries*)	45	1.4	264.7	1.07	5.9
Sheep? (*Ovis aries?*)	1	0.03	1.5	0.01	1.5
Goat (*Capra hircus*)	7	0.2	45.6	0.18	6.5
Goat? (*Capra hircus?*)	5	0.2	6.7	0.03	1.3
Sheep/Goat (*Ovis a./Capra h.*)	1005	32.0	3048.3	12.28	3.0
Pig (*Sus domesticus*)	286	9.1	1700.4	6.85	5.9
Dog (*Canis familiaris*)	1	0.03	6	0.02	6.0
Total domestic animal	3129	99.7	24668.2	99.39	7.9
Ibex (*Capra ibex*)	5	0.16	131.3	0.53	26.3
Wild boar (*Sus scrofa*)	2	0.1	19	0.08	9.5
Wild mouse (*Apodemus spec.*)	1	0.03	0.1	0.0004	0.1
White stork *(Ciconia ciconia)*	1	0.03	1.7	0.007	1.7
Total wild animal	9	0.3	152.1	0.61	16.9
Total domestic/wild animal	**3138**	**100**	**24820.3**	**100**	**7.9**
Large ruminants	252		398.5		1.6
Small ruminants	60		47.5		0.8
Total large groups	312		446		1.4
Unidentified	1211		1733.1		1.4
Total unidentified	1523		2179.1		1.4
Total identified & unidentified animals	**4661**		**26999.4**		**5.8**
Human (*Homo sapiens*)	0		0		0
Total identified animals & humans	**3138**		**24820.3**		**7.9**
TOTAL	**4661**		**26999.4**		**5.8**

Total O/C NISP, Weight (MV)

NISP 1063
n% 33.8%
Weight 3366.8g
g% 13.6%
Mean Value 3.4g

Appx. Tab. 9. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 3 Horizont B in Savognin-Padnal during the Late Bronze Age.

SPECIES	Savognin-Padnal Late Bronze Age: Horizon B Field 1				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Horse (*Equus caballus*)	1	0.01	35.5	0.06	35.5
Cattle (*Bos taurus*)	4818	62.9	51729.2	81.89	10.7
Sheep (*Ovis aries*)	70	0.9	492.2	0.78	7.0
Sheep? (*Ovis aries?*)	2	0.03	5.7	0.01	2.9
Goat (*Capra hircus*)	10	0.1	51.7	0.08	5.2
Sheep/Goat (*Ovis a./Capra h.*)	2003	26.2	6026.5	9.54	3.0
Pig (*Sus domesticus*)	726	9.5	4510.7	7.14	6.2
Dog (*Canis familiaris*)	3	0.04	50.2	0.08	16.7
Total domestic animal	7633	99.7	62901.7	99.58	8.2
Red deer (*Cervus elaphus*)	7	0.1	114.5	0.18	16.4
Ibex (*Capra ibex*)	1	0.01	8.2	0.01	8.2
Roe deer (*Capreolus capreolus*)	6	0.1	29.7	0.05	5.0
Brown bear (*Ursus arctos*)	1	0.01	25.7	0.04	25.7
Wild boar (*Sus scrofa*)	6	0.1	88	0.14	14.7
Wood pigeon (*Columba palumbus*)	1	0.01	0.6	0.00	0.6
Total wild animal	22	0.3	266.7	0.42	12.1
Total domestic/wild animal	**7655**	**100**	**63168.4**	**100**	**8.3**
Dog/Wolf (*Canis fam./lup.*)	2		1.6		0.8
Large ruminants	372		840.2		2.3
Small ruminants	73		55.6		0.8
Total large groups	447		897.4		2.0
Unidentified	4630		6462.7		1.4
Total unidentified	5077		7360.1		1.4
Total identified & unidentified animals	**12732**		**70528.5**		**5.5**
Human (*Homo sapiens*)	8		41.3		5.2
Total identified animals & humans	**7663**		**63209.7**		**8.2**
TOTAL	**12740**		**70569.8**		**5.5**

Total O/C NISP, Weight (MV)

NISP 2085
n% 27.2%
Weight 6576.1g
g% 10.4%
Mean Value 3.2g

Appx. Tab. 10. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 Horizont B in Savognin-Padnal during the Late Bronze Age.

SPECIES	Savognin-Padnal Late Bronze Age: Horizon B Field 1 & 3				
	NISP		Weight		W.-AVE.
	n	n%	g	g%	g
Horse (*Equus caballus*)	1	0.009	35.5	0.04	35.5
Cattle (*Bos taurus*)	6597	61.1	71324.2	81.1	10.8
Sheep (*Ovis aries*)	115	1.1	756.9	0.9	6.6
Sheep? (*Ovis aries?*)	3	0.03	7.2	0.01	2.4
Goat (*Capra hircus*)	17	0.2	97.3	0.1	5.7
Goat? (*Capra hircus?*)	5	0.05	6.7	0.01	1.3
Sheep/Goat (*Ovis a./Capra h.*)	3008	27.9	9074.8	10.3	3.0
Pig (*Sus domesticus*)	1012	9.4	6211.1	7.1	6.1
Dog (*Canis familiaris*)	4	0.04	56.2	0.06	14.1
Total domestic animal	10762	99.7	87569.9	99.5	8.1
Red deer (*Cervus elaphus*)	7	0.06	114.5	0.1	16.4
Ibex (*Capra ibex*)	6	0.06	139.5	0.2	23.3
Roe deer (*Capreolus capreolus*)	6	0.06	29.7	0.03	5.0
Brown bear (*Ursus arctos*)	1	0.01	25.7	0.03	25.7
Wild boar (*Sus scrofa*)	8	0.07	107	0.1	13.4
Wild mouse (*Apodemus spec.*)	1	0.01	0.1	0.0001	0.1
White stork *(Ciconia ciconia)*	1	0.01	1.7	0.002	1.7
Wood pigeon (*Columba palumbus*)	1	0.01	0.6	0.0007	0.6
Total wild animal	31	0.3	418.8	0.5	13.5
Total domestic/wild animal	**10793**	**100**	**87988.7**	**100**	**8.2**
Total unidentified	6600		9539.2		1.4
Total identified & unidentified animals	**17393**		**97527.9**		**5.6**
Human (*Homo sapiens*)	8		41.3		5.2
Total identified animals & humans	**10801**		**88030.0**		**8.2**
TOTAL	**17401**		**97569.2**		**5.6**

Total O/C NISP, Weight (MV)

NISP 3148
n% 29.3%
Weight 9942.9g
g% 11.3%
Mean Value 3.2g

Appx. Tab. 11. Numbers, weights, and mean weights of total examined fragments and identified specimens including *Homo sapiens* from Field 1 and 3 Horizont B in Savognin-Padnal during the Late Bronze Age.

Code AI1		11	10	9	8	7	6	5	4	3	2	1
dazugehörende AI2: (nur für Zähne)	M3	39 stark bis sehr stark abg.	38 deutlich abg.	37 leicht abg.	36 hochgewachsen, nicht od. partiell abgekaut	35 im Durchbruch	34 nicht gewechselt					
	Ducos	Ok: 0.95; Uk: 1.00	Ok: 1.30; Uk: 2.40	Ok: 1.85; Uk: 3.01	Ok: 2.40							
	M2	29 stark bis sehr stark abg.	28 deutlich bis stark abg.	28 deutl. abg.	28 leicht bis deutl. abg.	27 leicht abg.	26 hochgewachsen, nicht od. partiell abgekaut	25 im Durchbruch	24 nicht gewechselt			
	Ducos	Ok: 0.70; Uk: 1.45	Ok: 1.10; Uk: 1.80	Ok: 1.50; Uk: 2.35	Ok: 2.00; Uk: 3.00	Ok: 2.40; Uk: 3.50						
	M1	19 stark bis sehr stark abg.	18 deutlich bis stark abg.	18 deutl. abg.	18 deutl. abg.	17 leicht bis deutl. abg.	17 leicht abg.	17 part. bis leicht abg.	16 hochgewachsen, nicht od. partiell abgekaut	15 im Durchbruch	14 nicht gewechselt	
	Ducos	Ok: 0.65; Uk: 0.90	Ok: 0.90; Uk: 1.10	Ok: 1.20; Uk: 1.55	Ok: 1.55; Uk: 2.00	Ok: 1.85; Uk: 2.50						
	PM	9 stark bis sehr stark abg.	8 deutlich abg.	7 leicht abg.	6 hochgewachsen, nicht od. partiell abgekaut	5 im Durchbruch	4 nicht gewechselt					
	m					63 (m1, m2) sehr stark abg.	63 (m3) stark abg.	62 deutl. abg.	62 leicht bis deutl. abg.	62 leicht abg.	61 hochgewachsen, nicht od. partiell abgekaut	60 im Durchbruch
Alter ca.		11.5 J	9 J.	6.5 J.	> 3 J.	25 - 34 Mt.	19 - 24 Mt.	15 - 18 Mt.	7 - 14 Mt.	4 - 6 Mt.	1 bis 3 Mt.	bis 3 Wo.
postkranial, Epiphysenfugen verwachsen ca. im Alter von:				Vert.,Hu.prox.,Rad.dist., Ulna, Pelv.höcker, Fe,Ti.prox.		Ti.dist.,Mp, Calc.	Ph.1	Hu.dist., Ph.2	Scap.,Rad.prox.			
Code AI1 (Knochenoberfläche, keine Epiphysen vorhanden)	**0 Indet.**	**29** "adult-senil"		**27** "jung-adult"		**26** "subadult"		**24** "juvenil"		**22** "infantil"		**21** "fötal-neonat"
		28 erwachsen				**25** nicht erwachsen			**23** < subadult (22 oder 24)			

abg. = abgekaut, J. = Jahr, Mt. = Monate, Ok = Oberkieferzahn, Uk = Unterkieferzahn

Die AI1-Codes von 1 bis 11 können als einigermassen genau angesehen werden, da sie anhand der Zahnalter definiert werden.
Zusätzlich werden auch diejenigen postkranialen Altersangaben mit eingearbeitet, die durch den Zustand der Epiphysenfugen ebenfalls eine einigermassen korrekte Alterseinschätzung ermöglichen.
Die Altersangaben "postkranial, Epiphysenfugen" gelten nur für den Zeitpunkt der Verwachsung der Epiphysenfugen, so dass je nach deren Zustand (unverwachsen, im Verwachsen, Naht sichtbar, keine Naht sichtbar) eine entsprechende Alterscodierung gewählt werden muss.

Die AI1-Codes von 21 bis 28 sind Alterseinschätzungen, die hauptsächlich auf der Beurteilung der Knochenoberfläche beruhen, bei Jungtieren auch auf der Knochengrösse.

Die AI2-Angaben könnten fakultativ verwendet werden und beinhalten Angaben zur genauen Abkauung eines Zahnes bzw. zum Epiphysenfugenzustand.

Die Altersangaben basieren auf Angaben von Barone 1986, Becker/Johansson 1981, Ducos 1968, Habermehl 1975 und Grigson 1982.

Appx. Tab. 12. The age code of cattle in OSSOBOOK (version autumn 2005), IPAS, University of Basel.

Code AI1		11	10	9	8	7	6	5	4	3	2	1
dazugehörende AI2: (nur für Zähne)	M3	39 stark bis sehr stark abg.	38 deutl. abg.	37 leicht abg.	36 hochgewachsen, nicht od. partiell abgekaut	35 im Durchbruch	34 nicht gewechselt					
	M2	29 stark bis sehr stark abg.	28 deutl. bis stark abg.	28 deutl. abg.	27 leicht bis deutl. abg.	27 leicht abgekaut	26 hochgewachsen, nicht od. partiell abgekaut	25 im Durchbruch	24 nicht gewechselt			
	M1	19 stark bis sehr stark abg.	18 deutl. bis stark abg.	18 deutl. abg.	18 deutl. abg.	18 leicht bis deutl. abg.	17 leicht abg.	17 part. bis leicht abg.	16 hochgewachsen, nicht od. partiell abgekaut	15 im Durchbruch	14 nicht gewechselt	
	PM	9 stark bis sehr stark abg.	8 deutl. abg.	7 leicht abg.	6 hochgewachsen, nicht od. partiell abgekaut	5 im Durchbruch	4 nicht gewechselt					
	m					63 sehr stark abg.	63 stark abg.	63 deutl. abg.	62 leicht bis deutl. abg.	62 leicht abg.	61 hochgewachsen, nicht od. partiell abgekaut	60 im Durchbruch
Stufen nach Payne:	H (6-8 J.) + I (8-10 J.)		G (4-6 J.)	F (3-4 J.)	E (2-3 J.) + D (1-2 J.)		C (6-12 Mt.)		B (2-6 Mt.)		A (0-2 Mt.)	
Alter ca.				> 3 J.	> 2 J.	18 - 24 Mt.	12 - 17 Mt.	9 - 12 Mt.	5 - 8Mt.	3 - 4 Mt.	1 bis 2 Mt.	bis 4 Wo
postkranial, Epiphysenfugen verwachsen ca. im Alter von:			Vert., Hum.prox.,Rad.dist., Ulna,Pelvishöcker, Fem., Tib.prox.	Calcaneus		Tib.dist.,Mp		Phal.I	Phal.II,Scap.	Hum.dist., Rad. prox.		
Code AI1 (Knochenoberfläche, keine Epiphysen vorhanden)	**0 Indet.**	**29** "adult-senil"		**27** "jung-adult"		**26** "subadult"		**24** "juvenil"		**22** "infantil"		**21** "fötal - neonat"
		28 erwachsen				**25** nicht erwachsen (24 oder 26)			**23** < subadult (22 oder 24)			

abg. = abgekaut, J. = Jahr, Mt. = Monat

Die AI1-Codes von 1 bis 11 können als einigermassen genau angesehen werden, da sie anhand der Zahnalter definiert werden.
Zusätzlich werden auch diejenigen postkranialen Altersangaben mit eingearbeitet, die durch den Zustand der Epiphysenfugen ebenfalls eine einigermassen korrekte Alterseinschätzung ermöglichen.
Die Altersangaben "postkranial, Epiphysenfugen" gelten nur für den Zeitpunkt der Verwachsung der Epiphysenfugen, so dass je nach deren Zustand (unverwachsen, im Verwachsen, Naht sichtbar, keine Naht sichtbar) eine entsprechende Alterscodierung gewählt werden muss.

Die AI1-Codes von 21 bis 28 sind Alterseinschätzungen, die hauptsächlich auf der Beurteilung der Oberfläche beruhen, bei Jungtieren auch auf der Knochengrösse.

Die AI2-Angaben könnten fakultativ verwendet werden und beinhalten Angaben zur genauen Abkauung eines Zahnes bzw. zum Epiphysenfugenzustand.

Die Altersangaben basieren auf Angaben von Barone 1986, Becker/Johansson 1981, Habermehl 1975 und Payne 1973.

Appx. Tab. 13. The age code of sheep and goat in OSSOBOOK (version autumn 2005), IPAS, University of Basel.

Code Al1		**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
dazugehörende Al2: (nur für Zähne)	M3	39 stark bis sehr stark abg.	38 deutl. abg,	37 leicht abgekaut	36 hochgewachsen, nich od. partiell abgekaut	35 im Durchbruch	34 nicht gewechselt					
	M2	29 stark bis sehr stark abg.	28 deutl. bis stark abg.	28 deutl. abg.	28 leicht bis deutl. abg.	27 leicht abgekaut	26 hochgewachsen, nicht od. partiell abgekaut	25 im Durchbruch	24 nicht gewechselt			
	M1	19 stark bis sehr stark abg.	18 deutl. bis stark abg.	18 deutl. abg.	18 deutl. abg.	18 leicht bis deutl. abg.	17 leicht abg.	17 partiell bis leicht abg.	16 hochgewachsen, nicht od. partiell abgekaut	15 im Durchbruch	14 nicht gewechselt	
	PM	9 stark bis sehr stark abg.	8 deutl. bis stark abg.	7 leicht bis deutl. abg.	7 leicht abgekaut	6 hochgewachsen, nicht od. partiell abgekaut	5 im Durchbruch	4 nicht gewechselt		(P1: 5) P1: im Wechsel		
	m						63 sehr stark abgekaut	63 deutl. bis stark abg.	62 leicht bis deutl.abg.	62 leicht abgekaut	61 hochgewachsen, nich od. partiell abgekaut	60 im Durchbruch
	I/C					46 I2 im Wechsel	41,45 I1 im Wechsel, I2 nicht gewechselt	40 I1 nicht gewechselt	51,56 I3 u. C im Wechsel	50,55 I3 u. C nicht gewechselt		
	i						68 sehr stark abgekaut	68 deutl. bis stark abg.	67 leicht bis deutl.abg.	67 leicht abgekaut	66 hochgewachsen, nich od. partiell abgekaut	65 im Durchbruch
Alter ca.			> 3 J.		2 - 3 J.	16 - 24 Mt.	12 - 16 Mt.	10 - 12 Mt.	6 - 10 Mt.	4 - 6 Mt.	2 - 3 Mt.	bis 8 W.
postkranial, Epiphysenfugen verwachsen ca. im Alter von:			Vert.,Hu.prox.,Rad.dist., Ul.dist.,Fe,Ti.prox.,Fi	Ul.prox.	Ti.dist.,Mp,Ph.1,Calc.			Scap.,Hu.dist., Rad.prox.,Ph.2	Pelvis Höcker			
Code Al1 (Knochenoberfläche, keine Epiphysen vorhanden)	**0 Indet.**	**29** "adult-senil"		**27** "jung-adult"		**26** "subadult"		**24** "juvenil"		**22** "infantil"		**21** "fötal-neonat"
		28 erwachsen				**25** nicht erwachsen (24 oder 26)			**23** < subadult (22 oder 24)			

abg. = abgekaut, J. = Jahr, Mt. = Monat

Die Al1-Codes von 1 bis 11 können als einigermassen genau angesehen werden, da sie anhand der Zahnalter definiert werden.
Zusätzlich werden auch diejenigen postkranialen Altersangaben mit eingearbeitet, die durch den Zustand der Epiphysenfugen ebenfalls eine einigermassen korrekte Alterseinschätzung ermöglichen.
Die Altersangaben "postkranial, Epiphysenfugen" gelten nur für den Zeitpunkt der Verwachsung der Epiphysenfugen, so dass je nach deren Zustand (unverwachsen, im Verwachsen, Naht sichtbar, keine Naht sichtbar) eine entsprechende Alterscodierung gewählt werden muss.

Die Al1-Codes von 21 bis 28 sind Alterseinschätzungen, die hauptsächlich auf der Beurteilung der Oberfläche beruhen, bei Jungtieren auch auf der Knochengrösse.

Die Al2-Angaben könnten fakultativ verwendet werden und beinhalten wie bisher Angaben zur genauen Abkauung eines Zahnes bzw. zum Epiphysenfugenzustand.

Die Altersangaben basieren auf Angaben von Barone 1986, Becker/Johansson 1981, Habermehl 1975 und Horard-Herbin 1997.

Appx. Tab. 14. The age code of pig in OSSOBOOK (version autumn 2005), IPAS, University of Basel.

Matolcsi, J. 1970

Bos taurus	Factor (cm)		
	female	male	castrator/indet.
Metacarpus	6	6.3	6.2
Metatarsus	5.3	5.6	5.5
		all sex	
Humerus GL		4.14	
Humerus Length from Caput		4.77	
Femur GL		3.23	
Femur Length from Caput		3.47	
Radius GL		4.30	
Tibia GL		3.45	

Appx. Tab. 15. Factor of withers height for cattle (*Bos taurus*) by Matolcsi.

Teichert, M. 1975

Ovis aries	Factor (cm)
Humerus	4.3
Radius	4
Metacarpus	4.9
Metatarsus	4.5
Calcaneus	11.4

Appx. Tab. 16. Factor of withers height for sheep (*Ovis aries*) by Teichert.

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Teichert, M. 1969

Sus domesticus	20th C. Sus dom. Factor (cm)	**Archaeological Sus dom. & Sus scrofa Factor (cm)**
Scapula	3.57	**3.80**
Humerus	4.09	**4.05**
Radius	5.37	**5.26**
Ulna	4.01	**3.97**
Metacarpus III	11.01	**10.72**
Metacarpus IV	10.79	**10.53**
Pelvis	2.94	**3.04**
Femur	3.63	**3.65**
Tibia	4.02	**3.92**
Fibila	4.24	**4.23**
Calcaneus	9.07	**9.34**
Talus (Astragalus)	17.20	**17.90**
Metatarsus III	10.03	**9.34**
Metatarsus IV	9.34	**8.84**

Appx. Tab. 17. Factor of withers height for pig (*Sus domesticus and Sus scrofa*) by Teichert.

Harcourt, R. A. 1974

Canis familiaris	**Factor (cm)**
Humerus	**(3.43Xtl)-26.54**
Radius	**(3.18Xtl)+19.51**
Ulna	**(2.78Xtl)+6.21**
Humerus & Radius	**(1.65Xtl)-4.32**
Femur	**(3.14Xtl)-12.96**
Tibia	**(2.92Xtl)+9.41**
Femur & Tibia	**(1.52Xtl)-2.47**

Appx. Tab. 18. Factor of withers height for dog (*Canis familiaris*) by Harcoat.

Fazekas, I. G. & Kosa, F. 1978

Homo sapiens	Factor (cm)
Petrosum GL	**11.71+8.00**
Clavicula Length	**11.94-1.22**
Costa Length	**7.67+1.43**
Scapula Width	**16.66+2.96**
Humerus GL	**7.52+2.47**
Femur GL	**6.44+4.51**
Radius GL	**10.61-2.11**
Tibia GL	**7.24+4.90**

Appx. Tab. 19. Factor of withers height for human (*Homo sapiens*) by Fazekas & Kasa.

Species		standard individual for LSI				
		No.	Age (years old)	Sex	Shoulder hight	Weight
Bos taurus	Hinterwälderkuh	2431	13	female	116.9 cm	?
Ovis musi	Moufflon	2266	adult	male	73 cm	?
Capra hirc	Goat	1597	adult	male	?	?
Sus scrofa	Wild boar	1446	3	male	?	120 kg

Appx. Tab. 20. Individuals for standard value of logarithmic size index analysis. No. = Collection number at IPAS, University of Basel.

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Bos taurus

BOS TAURUS

lost upper tooth M3	B	L
	17.32	28.95
	17.55	26.55
	18.64	27.57

lost lower tooth M3	B	L
	13.54	36.12
	14.90	35.63
	13.22	35.71
	11.45	32.87
	11.79	31.14
	12.86	35.01
	14.30	36.49

Horn core	LD base
	69.49

Cranium with Horn core	GD base	LD base	Basal circumference
	52.44	41.71	150.00
	49.13	37.68	145.00
	51.02	39.64	149.00
	47.25	36.74	143.00

Mandibula	L diastema	L P4-P2	H front P2
	78.03		31.68
	50.55		29.94
	58.66		
		45.36	
			34.46

Scapula	GLP	LG	BG	SLC
	53.10	48.18	39.08	39.76
	66.28	57.15	45.00	50.23
	64.27	56.42	47.74	49.39
	59.69	53.04	39.93	50.53
	61.39	51.58	42.99	44.62
	63.86	56.82	42.73	50.14
	59.69	53.04	39.93	50.53
			41.42	
			43.29	
			46.24	
				42.99
				40.63

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Bos taurus

Humerus	SD	DD	Bd	BT	Dd
	33.01		73.13	63.81	65.48
	31.40	35.40			
	25.14	28.98			
	31.11	43.57			
	33.42	40.60			
	32.30	41.38			
	32.95	38.36			
	36.21				
	29.80				
	31.88				
	34.56				
	39.26				
		38.8			48.49
		34.35			
		40.11			
		45.76			
		38.100			
		39.00			
		33.01			
		36.73			
		46.03			
		33.57			
		44.03			
		40.81			
		42.05			
		44.86			
		42.74			
		37.60			
		37.49			
		41.82			
		35.72			
		26.76			
		23.86			
			70.52	70.44	42.22
					52.84

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Bos taurus

Radius	Bp	BFp	Dp	SD	DD	Bd	BFd	Dd
	71.23	64.81		34.70	20.62			
	70.21	64.77	35.00		25.99			
	76.94	70.47	38.22	24.09				
	75.65	67.13	41.61		22.95			
	75.61	69.51	38.39		23.29			
	82.44	76.95	39.40		22.24			
	70.68	64.47						
	69.54	63.55						
			40.05		25.72			
			35.99	38.10	20.84			
			38.97		24.7			
			39.72		22.29			
			36.22		21.45			
			39.80		22.5			
			34.56		22.61			
			34.37					
				31.42	24.12			
				36.02	18.1			
				29.46	19.51			
				32.71	23.01			
					22.50			
					23.90			
					20.92			
					20.64			
					14.88			
					18.76			
					26.15			
					22.92			
					22.76			
					20.48			
					25.45			
					20.10			
					20.87			
					26.77			
					24.86			
					21.23			
					22.57			
						66.05	60.7	46.91
								27.53

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Bos taurus

Ulna	DPA	BPC
	44.11	
		40.60
		40.50
		43.13

Carpalia	GB
	33.02

Ulnare (C.)	GB
	44.25

Radiale (C.)	GB
	39.35
	35.42

Intermedium (C.)	GB
	38.58

Metacarpus III + IV	Bp	Dp	SD	DD
	47.86	29.15	23.37	18.17
	58.45	35.31	35.7	25.51
	53.79	32.11	29.84	21.78
	53.29	32.01	28.04	21.26
	63.64	38.86	34.96	25.26
	55.17	35.14	28.44	22.97
	55.65	35.24		22.68
	60.55		37.12	25.22
	50.73		32.21	25.21
		40.62	25.93	26.13
		33.03		22.63
		33.99		25.12
		38.91		
			35.53	21.76
				22.71

Atlas	GL	BFcr	GLF	BFcd	H
	71.37	88.51	68.54		70.10
	74.20			39.17	

Epistropheus	BFcr	BFcd	LCDe	LAPa	BPacd
	99.77	47.56	95.32	88.72	65.14

Vertebra cervicalis	GL
	75.99

Vertebra lumbalis	BFcr
	64.73

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Bos taurus

Pelvis	SB	LA	LFo
	25.48		
	42.22	74.5	
		69.75	
			83.69

Femur	DC	SD	DD
	38.60		
	36.98		
	39.58		
	40.93		
		31.88	33.79
		30.39	35.41
		32.66	35.91
		33.22	31.21
		32.65	
			36.63
			33.30
			32.68
			35.45

Tibia	SD	DD	Bd	Dd
	39.45	27.63	66.05	44.75
	30.76	23.78		
	35.88	25.29		
	30.58	28.18		
	34.40	24.06		
	33.12	22.94		
	33.22	24.81		
	31.58	23.55		
	35.64	25.38		
	31.24	27.75		
	34.00			
	33.63			
		25.14		
		24.38		
		23.72		
		28.66		
		23.15		
		22.37		
		25.17		
		26.87		
		27.16		
		29.67		
		25.39		
		24.08		
		24.53		
		29.28		
				37.63
				44.89

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Bos taurus

Astragalus	GLl	GLm	Dl	Dm	Bd
	61.96	57.82	36.76	32.88	40.29
	67.32	63.01	37.24	37.34	42.98
	61.24	55.28	35.84	32.84	39.99
	65.67	56.76	37.43	35.12	44.99
	57.40	52.25	33.12	33.49	38.85
	61.33	54.24	34.13	33.14	37.91
	61.85	55.25	36.15	34.46	42.83
	60.13	54.68	34.42	28.25	33.58
	64.58	58.88	39.40	33.16	43.27
	57.77	53.94	34.78	33.10	36.61
	60.65	55.95	34.98	33.76	40.46
	64.80	59.82	37.42	34.32	45.31
	58.93	54.62	33.33	31.36	35.40
	56.74	52.78	32.02	29.52	37.09
	57.50	55.83	34.72	31.60	36.17
	61.05	55.30	32.99	28.37	38.34
			32.29		

Calcaneus	GB
	37.73
	35.59
	43.18
	35.57
	37.04
	40.11
	45.22
	41.76
	41.13
	34.07
	35.43
	38.13

Centrotarsale	GB
	47.39
	54.52
	48.73

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Bos taurus

Metatarsus III + IV	Bp	Dp	SD	DD	Dd
	40.46	41.17	23.68	24.99	
	42.21	42.38	25.54	28.95	
	43.58	41.14	25.72	26.09	
	46.28	46.98	27.21		
	45.21	44.14			
	55.25		30.73	34.27	
	39.68		26.26	28.80	
		41.44		32.67	
			26.85	28.77	
			23.72	22.79	
			23.20	20.47	
			22.38	23.78	25.89
			22.28		
				26.12	27.20
				21.92	27.98
				23.4	28.96
				22.07	30.01
				22.86	28.39
				26.57	
				22.01	
				28.44	
				26.65	
				18.20	
				25.82	
				21.09	
				28.95	
				32.67	
				16.83	
				25.51	
				26.15	
					28.30
					23.89
					27.68

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Bos taurus

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	56.95	25.52	31.79	22.11	19.64	23.81	18.84
	58.37	25.25	31.04	21.23	21.24	23.95	20.69
	52.52	24.99	30.46	23.82	20.70	25.38	18.85
	50.83	27.42	28.15	22.29	20.11	23.64	19.96
		26.44	30.46	23.80	21.33	26.71	19.15

Phalanx 1 ant. / post.	GLpe	Dp	SD	DD
	56.49		30.88	24.61
	44.88			
		32.32		
		32.80		
			25.06	19.88
			20.83	20.35
				19.16

Phalanx 2 anterior	GL	Bp	Dp	SD	DD	Bd	Dd
	41.40	26.69	29.33	20.54	21.18	19.96	25.29
	44.25	32.43	34.35	26.16	28.28	26.82	30.59
	36.35	24.82	27.14	18.74	18.39	21.54	24.46
	40.56	30.78	24.71	23.45	22.71	25.21	27.36
	36.73	29.48	29.06	24.28	24.76	25.92	29.17
	40.82	27.42	29.95	21.43	22.61	21.72	25.57
	35.21	24.97	26.43	20.13	21.43	20.54	24.67
	36.75	31.51	30.82	25.38	27.40	27.46	32.70

Phalanx 2 posterior	GL	Bp	Dp	SD	DD	Bd	Dd
	38.70	26.66	27.92	21.68	20.95	21.83	25.37
	39.06	31.24	28.24	22.69	21.01	23.53	25.84
	34.83	26.36	27.59	20.9	20.74	22.60	26.36
	39.62		32.68	19.65	21.90	21.05	29.90

Phalanx 3 posterior	MBS
	21.32
	22.29

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries, Capra hircus

OVIS ARIES

Humerus	Bd	BT	Dd
	31.20	29.32	21.04

Tibia	DD	Dd
	12.40	17.20

Astragalus	GLl	GLm	Dl	Dm	Bd
	29.30	28.37	17.03	18.29	19.48
	30.02	27.69	18.06	17.93	19.42

Calcaneus	GB	GL
	19.91	55.30

Centrotarsale	GB
	20.07

CAPRA HIRCUS

Cranium with horn core	GD base	LD base	Basal circumference	L outer curvature
	31.85	21.12	88.00	
	32.86	24.51	92.00	
	29.54	21.34	95.00	
		25.98		189.00

Radius	Bp	BFp	Dp
	31.77	29.45	16.9

Radius & Ulna	Bp	BFp	Dp	SD	DD	Bd	BFd	Dd
	30.71	29.80	14.03	17.87	10.93	27.36	25.44	18.60

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries / Capra hircus

lost upper tooth M3	B	L
	12.57	18.59
	11.14	18.81
	10.17	18.61
	11.40	20.10
	11.52	16.66
	10.92	17.19
	12.25	18.55
	11.70	16.72
	10.84	18.06
	11.30	17.98
	11.16	19.73
	10.03	17.39

lost lower tooth M3	B	L
	8.30	22.11
	7.89	20.78
	8.38	21.11
	8.22	22.03
	7.81	21.44
	8.91	24.01
	8.39	23.71
	8.15	22.20
	10.17	22.65
	7.91	21.85
	8.19	22.26
	8.50	21.06
	8.10	21.53
	8.48	22.56
	7.21	20.93
	7.31	20.85
	7.97	21.41
	7.94	21.86
	7.64	22.71
	8.42	21.16
	7.89	21.07
	9.33	24.21
	8.00	21.94
	8.31	
	7.97	
	7.79	
	8.36	

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries/Capra hircus

Maxilla	L M3-M1
	42.1

Mandibula	L M3-P2	L M3-M1	L P4-P2	L diastema	H front P2	H front M1	H behind M3
	79.44	55.31	23.30		18.02	20.11	32.94
	77.67	52.24	26.22		16.50	18.97	
	71.38	46.5	23.97		15.42	22.15	
	76.43	52.06	25.16			22.71	
		49.95				21.52	
		46.08				18.15	
			21.61	36.03	18.82	20.59	
			23.79		16.52	20.23	
			27.94		16.21	20.27	
			29.83		14.56	20.86	
			25.62		13.88	19.88	
			23.79		16.52	20.23	
			30.82		16.45	21.40	
			21.97		18.84		
			34.58		15.25		
			25.11				
			22.89				
			25.62				
					15.28	18.43	
					12.41		
					14.69		
					18.55		
					15.67		
					19.26		
					21.25		
					14.43		
					15.59		
					15.18		
						20.42	

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries/Capra hircus

Scapula	GLP	LG	BG	SLC
	28.33	27.27	17.16	
		22.84		14.55
				19.3
				17.63
				19.07
				15.26

Humerus	Dp	SD	DD	Bd	BT	Dd
	22.14					
		16.87		32.05	30.10	23.04
		14.95	18.15			
		15.40	16.96			
		13.58	14.77			
		15.68	15.51			
		15.65	17.03			
		15.28	15.33			
		10.83	16.45			
		13.48	16.45			
		11.08				
			16.62	31.89	28.71	24.76
			18.61			
			16.10			
			14.59			
			16.20			
			15.67			
			16.21			
			12.82			
			17.03			
			15.43			
			15.03			
			16.07			
			14.00			
				27.97	25.74	19.65
				33.21	31.45	24.5
						18.03
						18.16

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries/Capra hircus

Radius	Bp	BFp	Dp	SD	DD
	33.17	30.85	16.50	23.72	12.85
	30.04	28.59	15.56	17.23	9.01
	28.63	28.57	16.36		
			15.89	15.76	10.44
			15.79		8.44
				12.50	9.94
				14.49	9.41
				17.37	9.50
				16.15	9.81
				15.00	8.35
				16.96	9.93
				14.47	8.04
				18.41	11.32
				17.69	9.32
				15.32	8.77
				16.84	8.34
				15.46	9.51
				17.06	9.73
				17.28	8.78
				15.88	8.86
				17.39	11.85
				16.63	9.06
				13.79	11.27
				12.82	6.30
					8.78
					7.81
					8.69
					7.67
					11.08
					8.67
					9.14
					13.24
					9.13
					9.33
					8.30
					8.37
					6.10
					7.11
					10.69
					9.08
					7.18
					9.36
					7.62
					7.56
					8.86
					8.61
					9.99
					8.09
					8.81
					9.16
					10.75
					8.14
					7.03

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries/Capra hircus

Ulna	DPA	BPC	SDO
	26.53	14.16	22.35
		14.43	
		15.50	

Radius / Ulna	DD
	7.84
	10.70

Intermedium (C.)	GB
	17.06

Metacarpus III + IV	Dp	SD	DD
	14.26		10.11
		13.31	10.61
		12.38	9.29
		12.79	10.23
		14.42	10.34
			9.86
			10.59
			9.16
			11.19
			9.99
			11.65
			8.46
			8.26
			9.88
			10.52
			10.98
			8.75
			9.53
			13.22
			11.03
			10.16
			10.17
			8.04
			9.68
			10.82
			11.49

Vertebra lumbalis	BFcr	BFcd
	19.82	
		20.97

Pelvis	SB	SH	LFo	LA
	9.60	14.32		25.88
	12.23	16.67		30.54
	11.39	15.09		
	12.12	16.15		
	9.83	14.95		
	8.78	15.74		
	8.27	12.48		
	10.55	15.90		
	10.65	15.06		
	7.61	16.16		
	11.31			
	10.86			
			37.76	30.75
			41.60	

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries/Capra hircus

Femur	DC	SD	DD
	20.02		
	18.03		
	26.59		
	18.46		
		13.62	15.46
		16.23	18.79
		17.34	18.80
		16.51	17.57
		15.92	17.12
		17.18	19.19
		16.33	18.32
		15.96	18.20
		14.50	14.20
		17.35	
		20.69	
		20.40	
		17.10	
		17.22	
		16.01	
		17.19	
		13.92	
		14.57	
			18.35
			15.85
			12.89
			13.49
			17.15
			15.85
			16.64
			13.37
			14.67
			14.40

Patella	GL	GB
	26.13	18.51
	28.27	21.56
	23.91	18.03

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries/Capra hircus

Tibia	SD	DD	Dd
	11.87	9.9	
	15.47	14	
	14.51	14.49	
	14.78	13.66	
	14.35	11.66	
	14.29	11.32	
	13.33	9.94	
	14.78	11.68	
	14.14	12.85	
	18.51	14.48	
	13.74	11.60	
	15.85	15.40	
	13.98	13.22	
	18.96	16.27	
	14.81	11.94	
	13.72	11.08	
	15.13	11.50	
	11.82	10.97	
	11.41	10.2	
	13.62	12.02	
	14.45	12.16	
	13.03	10.85	
	14.66	11.57	
	13.15	11.17	
	14.11	11.09	
	10.87	10.47	
	15.74	12.14	
	13.51	11.29	
	13.17	11.21	
	11.41	10.43	
	14.29	12.29	
	12.04	10.95	
	11.09		
	12.51		
	10.37		
	11.07		
	13.12		
		14.72	17.71
		11.14	
		10.97	
		14.39	
		10.31	
		18.64	
		10.72	
		13.87	
		15.81	
		16.60	
		11.81	
		9.60	
		8.40	
		13.53	
		11.26	
		14.68	
		14.72	
		10.91	
		11.03	
		10.05	
		12.83	
			20.99
			20.59
			17.06

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Ovis aries/Capra hircus

Centrotarsale	GB
	21.59
	23.69

Metatarsus III + IV	Dp	SD	DD	Dd
	16.73		11.20	
		11.88	10.85	
		13.10	10.83	
		11.15	11.54	
		11.22	10.26	
		10.92	11.32	
		11.28	12.61	
		11.83	9.16	
		10.62		
		12.88		
			11.38	
			11.22	
			11.61	
			12.91	
			13.32	
			13.91	
			10.10	
			10.82	
			12.25	
			10.56	
			8.44	
				12.83
				14.53

Phalanx 1 anterior	Bp	Dp	SD	DD	Bd	Dd
	12.31	13.61	9.70	9.27	11.63	10.10

Phalanx 2 anterior	GL	Bp	Dp	SD	DD	Bd	Dd
	24.36	11.66	13.51	9.24	9.01	9.97	10.09
	20.19	10.68	11.51	7.55	8.14	7.88	9.11
		11.46	12.71	8.42	8.68	9.38	11.38
		11.26	12.76	8.03	9.03		

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	37.37	11.33	14.18	9.44	9.81	10.29	9.15
		10.59	13.19	8.36	8.35	9.92	8.98
		10.71	13.83	8.65	9.48	10.41	8.92
		10.95	13.44	8.90	8.79	10.05	8.74
		12.82	15.57	11.37	15.38		

Phalanx 2 posterior	Bp	Dp	SD	DD	Bd	Dd
	10.42	11.99	8.26	8.54	9.29	9.82
	11.51	12.33	7.70	8.19	7.66	9.67
	10.30	12.04	7.48	7.84	8.76	9.73

Phalanx 3 posterior	DLS	Ld	MBS
	25.93	21.29	6.18

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Sus domesticus

SUS DOMESTICUS

lost upper tooth M3	B	L
	19.74	33.35
	15.99	19.01
	19.57	32.71

lost lower tooth M3	B	L
	14.40	34.28
	14.27	21.57

Mandibula	L M3-P	L M3-P2	L M3-M1	L P4-P1	L P4-P2	H front P2	H front M1
	111.21	93.60	60.51	52.18	32.30	44.75	40.12
				55.27	37.49		

Scapula	GLP	BG	SLC
	29.47	21.00	24.48

Humerus	SD
	16.49
	15.72
	21.71
	18.99
	17.97
	21.46

Radius	Bp	Dp	SD
	28.44	19.36	17.06
			20.67

Ulna	DPA	BPC	SDO
	39.43	20.61	33.19
	31.43	18.04	

Metacarpus III	GL	Bp	Dp	SD	Bd	Dd
	75.88	21.66	17.66	15.44	21.66	14.46

Atlas	H
	46.2

Pelvis	SB	SH	LFo	LA	LAR
	9.93	15.97			
	13.14			33.58	30.74
	17.32				
			44.75		
				36.38	33.25

Femur	SD
	19.14
	20.03
	21.39
	17.68

Tibia	SD	Bd	Dd
	21.35	31.51	25.78

Metatarsus III	Bp	Dp	SD
	14.95	19.03	12.60

Metatarsus IV	Bp	Dp	SD
	12.28	22.25	9.37

Phalanx 1 anterior	GLpe	Bp	Dp	SD	Bd
	32.17	15.5	16.32	13.03	15.04

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Canis familiaris

CANIS FAMILIARIS								
lost upper tooth P4	**GB**	**B**	**L**					
	9.34	7.11	18.84					
lost upper tooth M1	**B**	**L**						
	15.7	12.78						
lost lower tooth M2	**B**	**L**						
	5.93	11.74						
lost lower tooth M1	**B**	**L**	**L & B carnassial**	**L carnassial alveolus**				
	7.26	17.3	17.5	16.94				
	8.72	19.47	20.16	17.45				
lost lower tooth M2	**B**	**L**						
	6.51	8.56						
Cranium	**L horizontal palatine**	**L holizontal palatine to M**	**Palatal length**	**Median palatal L**				
	26.53	29.24	76.51	79.7				
Cranium	**B canine alveoli**	**Least palatal B**	**GB foramen magnum**	**GB occipital condyles**				
	32.47	32.06	14.75	31.74				
Cranium	**H foramen magnum**							
	14.8							
Maxilla	**L P4-P1**	**L P4-P2**						
	44.76	40.32						
Mandibula	**L M3-P2**	**L M3-M1**	**L P4-P2**	**L P4-P1**	**L M3-C**	**H front P2**	**H front M1**	**H behind M3**
	61.77	34.31	31.35	35.16	68.76	17.70	15.36	20.63
	64.84	34.80	31.49	34.79	71.84	17.48	16.62	24.43
		28.78						
Scapula	**GLP**	**LG**	**BG**					
	28.83	21.74	14.86					
Humerus	**Bp**	**Dp**	**SD**	**Bd**	**Dd**			
	27.73	34.68	11.26	27.85	20.60			
Radius	**GL**	**Bp**	**Dp**	**SD**	**DD**	**Bd**	**Dd**	
	131.35	14.71	8.76	10.86	7.56	13.83	8.1	
Ulna	**DPA**	**BPC**	**SDO**					
	20.94	13.58	18.61					

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Canis familiaris

Metacarpus II	GL	Bp	Dp	SD	Bd	Dd	
	47.21	5.57	8.87	5.56	7.62	6.62	

Metacarpus III	GL	Bp	Dp	SD	DD	Bd	Dd
	52.24	5.76	7.58	5.4	4.39	7.42	5.45
	54.46	6.78	9.83	5.47		7.22	6.54

Metacarpus IV	GL	Bp	Dp	SD	DD	Bd	Dd
	54.34	6.79	9.25	5.25	4.93	6.75	7.44

Metacarpus V	GL	Bp	Dp	SD	DD	Bd	Dd
	45.97	8.37	8.43	5.91	4.24	7.88	6.88

Vertebra thoracalis	BFcr	BFcd	PL	HFcr
	17.92	18.26	14.46	17.27

Vertebra lumbalis	BFcr	BFcd	PL	HFcr
	18.29	19.32	22.36	11.81
	18.75	18.58	21.39	12.09

Sacrum	GB	GL	BFcr	BFcd	PL	HFcr
	41.03	31.62	17.24	11.68	31.51	10.86

Pelvis	SB	SH	LA	LAR
	7.44	16.28	19.58	17.98

Femur	GL	DC	Bp	Dp	SD	Bd	Dd
	151.35	15.82	31.43	15.69	11.73	27.37	27.8
		16.01	28.16	15.71	15.4		
		15.69	28.15	15.73	12.33		
					14.94	29.07	30.42
					12.54		

Tibia	GL	Bp	Dp	SD	Bd	Dd
	152.75	32.07	27.85	11.14	19.92	13.38
	154.41	29.57	31.37	11.42	18.78	13.25
				9.66	16.26	14.21

Fibula	GL	Bp	Dp	SD	Bd	Dd
	141.95	10.56	5.21	5.27	6.45	4.46

Metatarsus II	GL	Bp	Dp	SD	Bd	Dd
	52.34	7.89	4.6	5.08	7.6	6.46

Metatarsus III	Bp	Dp	SD	DD
	6.7	9.3	5.88	5.36

Metatarsus IV	GL	Bp	Dp	SD	Bd	Dd
	61.45	6.3	10.56	5.32	6.27	7.75
		6.99	8.54	5.29		

Metatarsus V	GL	Bp	Dp	SD	DD	Bd	Dd
	54.84	6.62	9.79	5.56	5.31	7.35	6.58

Main Metapodium indet.	SD	DD	Bd
	4.68	5.02	6.44

Appx. Tab. 21. Osteometry; Early Bronze Age (Field 3, Horizon E).

Capra ibex, Sus scrofa, Capra hircus/Capra ibex, Capra hircus/Rupicapra rupicapra

CAPRA IBEX

Astragalus	GLl	GLm	Dl	Dm	Bd
	40.77	37.14	22.85	21.38	27.47

SUS SCROFA

Scapula	SLC
	24.13

Humerus	SD	Bd	Dd
	20.36	44.53	44.27

Pelvis	SB	SH	LA	LAR
	14.86	27.94	39.05	32.85
	23.4	24.34	41.11	37.16
	13.63		29.82	34.72

Femur	SD
	17.36

CAPRA H./IBEX

Tibia	DD
	18.92

CAPRA H./RUPICAPRA R.

Metacarpus III + IV	SD	DD
	16.43	13.91

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

BOS TAURUS

lost upper tooth M3	B	L
	22.76	28.34
	22.95	28.33
	22.67	28.49
	21.54	28.16
	21.58	28.52
	22.62	24.91
	21.80	27.70
	19.93	26.90
	21.74	25.11
	23.12	28.46

lost lower tooth M3	B	L
	13.97	33.61
	15.64	32.8
	15.87	37.07
	14.99	31.12
	14.42	33.43
	14.35	32.20
	14.76	34.19
	14.46	35.95

Os cornu	LD base
	54.4

Cranium with Os cornu	GD base	LD base	Basal circum.
	53.61	52.42	16.80

Maxilla	L M3-M1
	82.21

Mandibula	L P4-P2	L diastema	H front P2	H front M1
	50.98		37.59	48.37
	53.49			
	53.68			
		65.04	28.25	

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Scapula	GLP	LG	BG	SLC
	65.99	55.18	45.53	55.05
	51.38	44.31	34.04	45.28
	60.06	52.79	43.93	47.46
	57.95	50.45	45.01	46.6
	61.81	54.49	41.48	49.68
	58.26	49.92	39.16	43.55
	62.74	53.79	45.59	46.25
	56.99	47.67	34.89	36.9
	74.35	65.06	43.73	59.92
	48.52	44.71	34.9	38.92
	55.35	48.33	36.74	42.87
	68.82	61.64	47.77	52.66
	60.8	47.4	40.02	45.93
	70.33	61.51	47.49	48.37
	57.47	48.05	40.07	
	70.87	58.84	53.55	
	62.65	50.69	43.66	
	61.67		38.04	52.96
		56.17	43.03	
		46.28	45.47	
		36.94		
		45.07		
			34.28	43.81
			38.45	48.66
			45.46	
			39.74	
			39.26	
			38.19	
			39.34	
			49.83	
			43.78	
				46.6
				41.5
				39.18

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Humerus	Dp	SD	DD	Bd	BT	Dd
	38.67					
		32.84	36.05	70.31	67.85	46.52
		38.02	47.07	76.3	74.68	
		31.7	37.43			
		30.26	35.21			
		31.35	31.25			
		33.49	39.5			
		32.78	38.89			
		37.81	47.63			
		34.91	39.88			
		31.21	39.15			
		32.59				
		31.98				
		22.85				
		31.57				
		40.52				
			47.97	75.25		42.1
			34.99			41.47
			30.83			66.53
			36.09			66.89
			34.75			
			48.58			
			37.94			
			31.13			
			31.56			
			32.31			
			37.14			
			40.33			
			33.11			
			39.1			
			35.06			
			38.31			
			35.78			
			39.46			
			38.67			
			38.7			
			33.16			
			43.85			
			40.85			
			37.77			
			38.32			
			36.35			
			36.16			
			40.11			
			33.87			
			36.74			
				84.09	78.94	46.47
						66.53

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Radius	Bp	Dp	BFp	SD	DD	Dd
	63.01	36.52	62.87	36.85	20.73	
	72.15	36.04	67.43	47.39	28.12	
	63.09	31.76	62.04	37.51	21.15	
	68.06	31.87	63.4	40.35	20.36	
	64.28	36.24	56.73		22.78	
		32.9			22.94	
		32.09			23.18	
		32.43			26.46	
		27.97			19.09	
		30.63			21.72	
		38.53			21.35	
		32.81			18.26	
		34.04			21.83	
		31.2			24.19	
		34.42			22.85	
		35.04			20.31	
		43.49			25.41	
		32.98			21.98	
		39.4			19.8	
		31.51			22.41	
		40.19			22.14	
		31.1			28.72	
		49.39			32.79	
		34.36			21.65	
		39.87			23.47	
		36.43				
		23.39				
				38.89	22.22	
				30.21	22.86	
				33.82		
				30.21	22.86	
					31.06	36.07
					20.06	
					23.39	
					20.51	
					19.45	
					21.38	
					16.17	
					17.68	
					21.87	
					20.86	
					19.18	
					22.36	
					22.52	
					17.71	
					28.25	
					19.73	
					20.77	
					17.77	
					25.69	
					25.43	
					18.01	
					18.49	
					23.91	
					27.94	
					19.07	
					19.5	
					19.54	
					24.03	
					22.39	
					19.53	
					22.68	
					16.91	
					17.1	
					15.47	
					22.71	
					20.71	
					17.07	
					19.14	
					19.36	
					21.41	
					18.91	
					23.54	
					23.7	
					19.7	
					23.07	
					16.32	
					17.95	
					17.51	
					22.07	
						32.22
						38.37

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Ulna	SDO	DPA	BPC
	50.4	60.59	49.55
	52.41	67.77	38.06
	53.81	58.05	39
	47.53	60.24	
	34.75	42.1	
		47.09	40.78
		51.59	
		57.35	
			30.75

Radius/Ulna	DD
	21.75
	29.11

Intermedium (C.)	GB
	43.14

Ulnare (C.)	GB
	34.59
	49.25

Os carpale II & III	GB
	34.01
	37.19
	44.66

Other Carpalia	GB
	39.99
	29.75
	37.79
	37.36
	37.1
	25.04

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Metacarpus III + IV	Bp	Dp	SD	DD	Bd	Dd
	61.6	36.7	39.09	28.63		
	54.46	30.36	31.14	21.85		
		35.51	37.84	26.69		56.91
		33.61	24.23			
		28.3	19.88			
		28.07	19.89			
		36.57	21.73			
		28.55	18.77			
		39.45	20.3			
		31.11	23.18			
			29.13	22.33		
			26.3	19.96		
			26.97	20.3		
			30.08	21.64		
			32.3	20.89		
			26.07			
				19.54	49.59	26.65
				19.79		28.01
				19.8		29.65
				21.98		29.46
				22.42		
				19.68		
				20.91		
				25.84		
				25.79		
				19.81		
				21.73		
				17.56		
				16.7		
				16.23		
				24.73		
				20.17		
				21.37		
				23.19		
				23.14		
				23.33		
				17.31		
				23.51		
				15.92		
						25.68

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Atlas	GL	GB	BFcr	BFcd	GLF
	68.41	104.32	92.39	76.97	60.86
	73				71.39

Sacrum	BFcr	HFcr
	59.38	23.84
	54.28	

Pelvis	SB	SH	LFo	LA
	24.48	31.69	61.17	60.52
	21.41	31.69		59.41
	26.55	42.91		73.06
	21.84	56.81		67.3
	26.45	44.66		66.53
	21.24	29.22		
	20.07	33.73		
	20.34	33.71		
	23.62	34.38		
	20.56	33.51		
	18.66	34.16		
	17.76	31.74		
	19.09	38.54		
	21.76	39.74		
	26.97			63.72
	32.28			79.06
	23.3			
	24.37			
	22.19			
	19.99			
	25.66			
	24.57			
	24.66			
	26.85			
	31.69			
			83.17	
			75.67	

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Femur	DC	SD	DD
	38.66		
	47.59		
	37.64		
		28.4	32.33
		31.34	34.33
		32.42	36.46
		38.94	42.91
		30.9	35.91
		30.01	33.72
		28.71	30.66
		36.82	40.77
		35.39	
		34.08	
		31.36	
		29.34	
		31.21	
		29.25	
		29.79	
		32.56	
		35.75	
			28.03
			30.83
			36.06
			30.93
			32.59
			34.08
			31.29
			36.31
			30.28
			33.2

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Tibia	SD	DD	Bd	Dd
	33.22	23.98	56.14	43.6
	31.57	21.96	53.6	40.28
	32.58	24.9	48.9	38.79
	35.77	24.15	38.03	
	35.77	24.15		38.03
	31.76	25.24		
	43.32	29.12		
	35.13	25.12		
	32.4	25.62		
	31.28	25.48		
	34.07	31.3		
	44.65	33.38		
	31.74	23.39		
	30.9	30.66		
		43.5	53.2	
		36.89	60.19	48.11
		23.28		48.78
		26.21		
		27.21		
		25.73		
		21.19		
		27.42		
		29.28		
		24.77		
		28.64		
		26.13		
		25.51		
		21.32		
		27.59		
		27.32		
		31.66		
		27.43		
		25.33		
		23.73		
		26.58		
		22.88		

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Astragalus	GLl	GLm	Dl	Dm	Bd
	57.57	55.42	34.54	32.38	35.6
	57.28	51.05	35.17	29.74	37.48
	59.62	53.42	34.51	32.02	39.92
	63.69	58.47	36.76	33.6	44.48
	55.71	51.25	32.76	26.59	32.41
	61.93	58.7	37.1	30.62	38.55
	65.04	60.27	37.54	34.02	44.83
	60.12	53.22	34.41	30.2	36.69
	57.23	53.18	32.98	33.49	38.16
	60.75	55.84	35.6	28.54	37.86
	58.81	55.04	33.52	29.62	38.7
	67.95	61.4	40.23	35.17	46.5
	65.33	59.05	40.57	38.65	40.32
	62.66	57.18	35.21	32.77	39.18
	57.16	53.25	32.3	29.46	35.28
	57.36	51.94	33.83	30.61	34.64
	61.51	55.18	36.07	30.41	36.79
	59.55	53.27	33.23	27.88	36.03
	61.31		34.16	33.16	36.91
	60.85		35.8		37.41
	56.1		30.92		
	56.81		34.56		
		53.64	34.16	33.55	43.66
			33.76		

Calcaneus	GB
	36.31
	29.72
	36.65
	37.49
	31.67
	34.39
	31.89
	31.43
	36.81

Centrotarsale	GB
	57.98
	55.07
	53.42
	54.76

Other Tarsalia	GB
	39.08

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Metatarsus III + IV	Bp	Dp	SD	DD	Bd	Dd
	38.96	35.02	21.09	26.53		
	43.08	48.8	28.19	33.24		
	49.91	48.02	35.04	35.15		
	40.13	36.33	22.93	23.65		
	38.69	37.83	21.68	34.36		
	49.4	45.25	27.73	30.04		
	47.63	42.95		26.44		
	36.26		28.17	31.51		
	42.86		23.68			
	42.24		24.92			
	46.45			31.67		33.95
	42.08					
	45.47					
		41.22		24.64		
		40.65		24.58		
		35.79				
		34.24				
			40.12	23.54	57.24	31.79
			23.88	23.28		
			23.21	23.31		
			28.67			
			27.25			
			23.84			
			19.72			
			23.14			
				21.56		23.32
				26.8		29.05
				20.82		27.1
				24.05		31.21
				26.84		32.31
				26.4		
				25.65		
				21.4		
				25.9		
				24.9		
				24.23		
				23.76		
				24.88		
				19.8		
				26.04		
				21.76		
				25.59		
				23.96		
				21.15		
				25.27		
				23.5		
				23.49		
				24.23		
						27.58

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Phalanx 1 anterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	55.34	28.07	29.09	23.21	20.85	29.97	20.92
	60.46	32.04	35.48	24.87	24.47	35.48	22.21
	51.31	28.47	33.5	25.14	20.51	30.42	22.09
	53.52	27.19	31.5	24.4	23.05	25.73	22.22
	56.01	31.38	34.67	31.38	26.27	27.24	20.33
	52.01	27.69	30.01	24	19.91	26.25	19.84
	51.48	29.57	33.37	20.41	22.41		20.52
	59.72		34.69	24.5	24.01	27.96	21.53
		30.48		27.75		31.12	
			35.19	27.24	24.13		

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	57.16	26.7	28.89	21.73	19.09	24.04	18.4
	63.29	26.64	32.07	23.19	21.33	25.15	20.6
	48.69	23.91	24.46	19.58	16.71	22.52	17.11
	52.49	25.1	29.58	20.81	20.6	23.92	20.63
	53.61	26.84	30.74	21.37	21.22	23.74	21.13
	56.22			21.67		23.57	18.33
		24.18	26.31	20.57	18.48	23.44	18.38
		22.73	31.57	21.57	20.67	24.29	18.06
		26.72	27.86	22.55	23.27		
			32.21		21.26		25.81
			34.37		19.48		
			30.48				

Phalanx 1 ant. / post.	GLpe	Dp	SD	DD	Dd
	49.84	30.05		17.83	19.22
			26.49	23.21	
					23.91

Phalanx 2 anterior	GL	Bp	Dp	SD	DD	Bd	Dd
	38.73	26.42	29.64	21.55	21.13	24.48	25.24
	35.9	25.5	29.68	21.62	19.66	22.36	25.63
	36.57	28.53	28.59	23.24	22.87	24.68	31.55
	35.98	27.59	28.29	22.32	25.87	22.43	31.24
	37.91	26.56	28.43	21.1	20.9	21.81	25.26
	40.34	31.4	32.27	25.99	25.4	26.01	28.28
	34.17	30.06	32.34	23.84	23.8	26.19	31.87
	37.93	28.46	28.33	22.96	21.74	24.88	28.31
		28.55	31.2				

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Bos taurus

Phalanx 2 posterior	GL	Bp	Dp	SD	DD	Bd	Dd
	35.24	23.42	25.34	18.04	18.74	19.56	24.12
	30.61	23.56	24.63	19.46	18.67	20.3	23.39
			26.94	20.81	18.51	22.07	16.53
					20.29		23.13

Phalanx 2 ant. / post.	Dp	DD	Bd	Dd
	32.71	24.01		22.56
	34.37	20.49		20.58
			30.64	

Phalanx 3 anterior	MBS	Ld	DLS
	21.23	52.09	66.68
	23.02	56.21	75.2
	21.74	54.35	64.96
	24.81		
	22.54		
	22.50		
		61.45	76.77

Phalanx 3 posterior	MBS	Ld	DLS
	20.58	52.75	71.81
	18.88	47.71	63.17
	21.79	54.73	64.57
	21.11	54.42	68.35
	19.94		
	16.07		

Phalanx 3 ant. / post.	MBS
	25.79

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries

OVIS ARIES

Os cornu	GD base	LD base	Basal circum.
	56.75	49.63	18.3

Scapula	GLP	LG	BG	SLC
	33.25	26.67	19.97	17.72

Humerus	Bp	Dp	SD	DD	Bd	BT	Dd
	41.11	34.30	14.48	16.95	27.43	25.34	23.95
			12.55	16.58	28.10	26.98	24.16
			14.87	17.40	29.39	28.98	26.24
			15.28	15.02	29.94	28.87	26.58
			15.25	16.88	29.96	28.41	25.16
			14.52		29.12	28.31	25.13
							23.58

Radius	Dp	DD
	12.66	8.92

Ulna	SDO	DPA	BPC
	23.42	27.89	17.51
	20.06	23.82	
	23.44	24.22	

Radiale (C.)	GB
	19.06

Tibia	SD	DD	Bd	Dd
	13.99	12.98	23.04	16.75
			24.33	19.29
			25.02	

Astragalus	GLl	GLm	Dl	Dm	Bd
	28.38	26.19	13.99	15.56	18.01
	34.16	33.41	19.70	16.35	19.19
	28.87	27.80	17.13	17.51	20.03
	28.81	27.63	16.72	16.44	19.30
	27.16	26.15	15.28	16.31	17.61
	31.97	29.58	17.57	18.13	20.85
	27.83	28.86	16.35	16.45	19.23
	26.41	25.16	15.61	14.86	17.53

Calcaneus	GL	GB
	51.38	18.64
	51.64	20.90

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries, Ovis aries?

Phalanx 1 anterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	34.32	11.57	13.96	9.02	8.88	10.43	10.02
	37.53	12.45	15.44	10.74	10.06	12.77	11.52
	34.32	12.17	14.51	10.13	9.39	11.30	10.19
	35.13	12.33	14.22	9.65	9.36	11.53	9.51
	34.50	12.45	14.20	10.12	9.43	11.33	10.38

Phalanx 2 anterior	GL	Bp	Dp	SD	DD	Bd	Dd
	26.93	13.02	14.40	9.76	10.67	9.17	11.98
	24.45	12.28	12.99	9.87	9.75	9.30	11.87
	21.66	10.71	11.66	7.84	8.10	8.23	9.84
	20.73	12.33	12.80	9.03	9.15	9.28	10.60
	23.71	12.55	13.02	9.05	9.38	9.36	11.13
	20.48	11.32	12.26	9.28	9.28	9.52	10.87

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	36.39	11.28	14.05	10.07	10.45	11.34	9.69
	33.48	11.90	12.82	9.48	9.64	10.16	10.08
	29.52	10.39	12.34	8.26	8.52	9.08	7.45
	35.58	13.00	14.30	10.14	11.76	10.31	10.21
	35.39	11.43	12.86	8.48	8.19	8.82	8.14
	34.04	11.65	14.64	9.41	9.87	11.06	10.43
	36.09	11.92	14.15	9.46	9.51	10.50	9.43
	37.05	12.09	13.08	9.74	10.40		9.37

Phalanx 2 posterior	GL	Bp	Dp	SD	DD	Bd	Dd
	23.83	11.18	12.01	7.65	8.14	8.50	9.14
	24.30	11.45	12.72	9.59	10.49	9.74	9.60
	24.56	11.81	13.17	8.93	10.53	8.06	11.27
	22.69	10.83	11.94	8.60	8.17	8.38	10.17
	21.13	10.25	11.26	8.29	7.78	8.21	9.52
	29.09	9.77	10.31	7.54	8.00	7.97	8.93
	22.21	11.64	13.25	9.09	10.02	9.37	11.07
		10.37	11.24	7.89	8.25	8.81	10.04
		11.24					

OVIS ARIES?

Astragalus	GLl	GLm	Dl	Dm	Bd
	28.71	27.34	16.19	15.62	18.74

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Capra hircus

CAPRA HIRCUS							
Os cornu	**LD base**	**LD base**	**Basal circumference**				
	26.23						
Cranium with horn core	**GD base**	**LD base**	**Basal circum.**				
	36.52	24.93	10.60				
Scapula	**GLP**	**LG**	**SLC**				
	33.02	28.6	23.05				
Humerus	**SD**	**DD**	**Bd**	**BT**	**Dd**		
	15.85	17.85	29.74	28.48	23.98		
Ulna	**DPA**	**BPC**					
	27.99	16.95					
Pelvis	**SB**	**SH**	**LA**				
	10.10	13.19	27.36				
Tibia	**SD**	**DD**	**Dd**				
	13.74	10.90					
		13.91	19.50				
Phalanx 1 anterior	**GLpe**	**Bp**	**Dp**	**SD**	**DD**	**Bd**	**Dd**
	40.63	13.33	16.89	11.88	10.99	13.07	12.07
Phalanx 1 posterior	**GLpe**	**Bp**	**Dp**	**SD**	**DD**	**Bd**	**Dd**
	37.77	12.92	14.66	9.57	9.19	11.17	9.89
	38.10	12.43	15.29	11.29	9.81	12.26	10.14

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

OVIS ARIES / CAPRA HIRCUS

lost upper tooth M3	B	L
	12.03	17.12
	11.81	18.87
	12.58	18.56
	11.10	17.87
	11.78	16.83
	10.75	19.04
	11.49	17.73
	11.18	15.72
	11.76	19.65
	11.70	19.30
	12.11	19.37
	12.26	17.29
	11.55	17.29
	11.42	16.16
	10.44	16.26
	10.17	16.85
	13.35	17.21
	11.81	17.47
	12.56	19.31
	10.90	17.12
	13.27	17.62
	9.83	17.39
	11.63	20.05
	10.99	17.43
	11.10	15.36

lost lower tooth M3	B	L
	7.42	20.83
	8.93	21.96
	7.91	22.14
	7.04	20.59
	7.12	20.10
	8.55	23.22
	8.09	20.92
	8.57	20.82
	7.82	20.54
	7.92	21.35
	8.02	21.23
	7.69	20.97
	8.55	22.99
	7.84	22.09
	7.69	21.74
	8.35	20.90
	9.61	22.60
	8.29	22.20
	8.21	20.01
	8.21	20.54
	7.83	21.38
	8.50	22.33
	7.51	21.05
	7.07	18.63
	7.49	18.79
	9.18	21.95
	7.95	22.22
	8.94	22.69
	7.75	22.14
	8.14	20.69
	8.07	20.75
	8.51	22.52
	8.48	20.99
	8.08	22.72
	8.61	22.52
	7.63	20.33
	8.10	20.08
	8.97	

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Mandibula	L M3-P2	L M3-M1	L P4-P2	L diastema	H front P2	H front M1	H behind M3
	74.08	50.39	23.69		15.39	21.20	
	71.35	49.41	21.94		16.27	20.11	
		52.17				19.33	40.16
		46.43					
			23.11	31.61	15.11	17.50	
			26.19		13.35	19.86	
			21.67		17.64	20.01	
			22.35		17.39	20.44	
			22.61		11.13	14.90	
			22.14		15.64	22.10	
			22.43		14.46		
			23.07		15.72		
			24.05			20.65	
			24.61			19.96	
					12.60		
					12.20		
					15.34		
					15.09		
					15.02		
					15.86		
					12.74		
					12.74		
					16.67		
						20.61	

Scapula	GLP	LG	BG	SLC
	33.41	28.16	21.4	21.36
	27.75	25.77	18.82	21.97
	32.15	27.15	18.82	20.24
	32.86	27.56	19.97	
	19.98			16.42
		24.37	18.46	18.61
			17.96	21.91
				19.61
				13.46

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Humerus	SD	DD	Bd	BT	Dd
	14.75	18.11	30.47	28.59	24.94
	16.83	19.82			25.89
	14.59	18.09			
	17.66	14.49			
	17.93	16.67			
	15.20	17.48			
	16.61	22.12			
	15.82	18.59			
	16.65	19.36			
	11.91	14.59			
	14.07	17.19			
	15.56	15.64			
	14.40	16.70			
	15.57	17.48			
	13.88	16.17			
	18.90	15.60			
	17.32	18.04			
	16.94	18.96			
	13.83	18.00			
	15.45	15.91			
	18.98	21.48			
	18.63	20.18			
	15.69				
	16.11				
	13.58				
	14.05				
	13.02				
	15.03				
	14.77				
	14.80				
	17.00				
	14.98				
	14.26				
	15.72				
	13.62				
	17.90				
	17.34				
	16.04				
	18.87				
		17.37			
		19.82			
		14.12			
		14.50			
		15.84			
		16.39			
		15.69			
		17.61			
		20.24			
		15.40			
		14.25			
		15.96			
		19.36			
		16.58			
		14.35			
		19.05			
		15.71			
		16.51			
		15.54			
		13.30			
		13.73			
		15.51			
		16.68			
			27.43	26.65	18.57
			29.41		17.22

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Radius	Bp	Dp	SD	DD	Dd
	30.28	16.44	18.30	11.50	
		17.92	20.79	10.23	
		16.15		9.53	
		16.99		10.90	
		15.30		12.26	
		17.60			
		17.69			
			16.15	9.01	16.83
			11.92	6.90	
			16.78	9.11	
			17.15	10.18	
			16.49	9.58	
			17.67	12.43	
			17.04	8.60	
			15.48	8.59	
			19.54	12.74	
			15.44	8.15	
			13.91	9.03	
			14.36	7.67	
			18.68	9.89	
			13.94	7.14	
			16.56	9.19	
			18.52	11.09	
			14.38	9.23	
			15.72	9.59	
			14.37	7.51	
			14.97	8.48	
			16.21	9.32	
			16.28	8.36	
			17.03	9.48	
			17.34	9.54	
			11.28	7.30	
			19.36	10.34	
			14.60	8.61	
			18.73	9.65	
				13.26	15.98

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Radius	Bp	Dp	SD	DD	Dd
				10.51	
				5.73	
				8.35	
				8.98	
				7.26	
				9.98	
				6.61	
				8.45	
				8.41	
				17.28	
				8.49	
				9.49	
				8.53	
				6.75	
				8.70	
				8.05	
				8.79	
				7.39	
				11.48	
				8.16	
				9.19	
				6.00	
				8.04	
				7.40	
				8.94	
				8.44	
				8.74	
				8.76	
				9.37	
				9.26	
				6.83	
				8.97	
				11.50	
				8.38	
				9.74	
				7.19	
				8.81	
				9.99	
				10.89	
				8.31	
				9.45	
				8.42	
				9.82	
				9.45	
				8.63	
				8.40	
				7.99	
				10.13	
				8.54	
				7.64	
				7.93	
				10.41	
				9.54	
				6.05	
				9.39	
				7.82	
				8.43	
				6.47	

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Ulna	SDO	DPA	BPC
	22.50	28.14	17.34
	20.99	24.13	11.80
	21.44	24.68	16.00
	23.77	28.97	16.80
	21.53	23.37	
	20.91	24.39	

Intermedium (C.)	GB
	17.84

Ulnare (C.)	GB
	18.57

Os carpale II & III	GB
	20.82
	15.03

Other Carpalia	GB
	14.38
	16.48

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Metacarpus III + IV	Bp	Dp	SD	DD
	21.86			12.48
		16.87		11.12
		15.74		10.15
		14.32		10.89
		16.05		9.61
		14.07		9.63
		12.37		11.57
			13.95	9.13
			13.80	8.88
			15.46	
			12.61	
				9.60
				8.83
				14.58
				9.89
				10.58
				10.57
				10.24
				10.35
				11.13
				11.23
				11.34
				8.88
				12.62
				7.82
				9.84
				10.74
				8.66
				9.88
				9.79
				13.47
				11.06
				9.24
				9.15
				9.44
				10.88
				9.86
				8.63
				10.91
				8.83
				9.30
				9.80
				9.99
				9.02
				9.31
				9.18
				9.08
				9.76
				11.52
				9.45
				9.56

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Vertebra cervicalis	BFcr	BFcd	H	BPacd	PL	HFcr
	14.47	16.99			26.28	11.98
			32.86	32.90	28.45	15.50

Vertebra luumbalis	PL
	33.96

Pelvis	SB	SH	LFo	LA
	11.74	19.53		
	13.80	17.13		
	8.68	14.40		
	11.79	15.07		
	8.64	16.20		
	12.18			
	13.26			
	11.09			
	11.24			
	11.38			
	10.77			
	11.93			
			36.04	
			38.36	
			32.54	
			31.69	
			32.57	
			32.61	
				28.38

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Femur	DC	SD	DD	Dd
	18.77			
	18.88			
	21.58			
	21.14			
	26.36			
	25.50			
	21.03			
		14.42	16.48	
		12.90	13.50	
		18.27	19.93	
		16.14	17.00	
		17.78	20.60	
		13.35	14.37	
		16.58	17.98	
		15.72	17.35	
		16.30	18.41	
		15.80	17.09	
		16.99	19.38	
		15.11	16.56	
		15.38	16.86	
		17.38	18.55	
		18.43		
		14.98		
		13.14		
		14.54		
		16.53		
		17.31		
		18.17		
		15.83		
		16.80		
		12.39		
		14.48		
		16.63		
		16.45		
		15.49		
		15.36		
		16.14		
		12.57		
		13.44		
		15.77		
		15.89		
		15.80		
		17.71		
		12.81		
		14.24		
		19.41		
			15.84	
			18.41	
			16.10	
			14.18	
			14.97	
			17.10	
			15.07	
			15.35	
			19.67	
			18.07	
			18.21	
			14.75	
			12.19	
			13.86	
			14.44	
				45.37

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Patella	GL	GB
	24.10	14.06

Tibia	Dp	SD	DD	Dd
	32.04			
		20.46	16.22	
		14.33	12.63	
		14.19	12.19	
		15.77	15.12	
		13.81	12.10	
		13.86	11.37	
		14.53	11.96	
		14.88	12.53	
		13.89	11.19	
		13.02	10.86	
		13.40	11.49	
		12.85	10.43	
		13.91	11.31	
		12.23	10.81	
		15.79	15.71	
		13.69	11.97	
		13.96	12.53	
		14.08	11.65	
		13.14	9.92	
		14.02	13.20	
		11.37	9.04	
		14.91	12.67	
		12.92	11.33	
		15.90	18.86	
		13.54	11.62	
		13.14	14.06	
		11.73	9.35	
		11.33	10.94	
		14.97	12.87	
		16.30	13.42	
		13.66	12.54	
		11.70	10.17	
		18.81	17.82	
		16.21	13.74	
		14.94	13.10	
		14.17	12.32	
		12.91	12.48	
		13.22	11.02	
		11.41	11.22	
		12.91	12.95	
		21.29	15.80	
		14.68	12.12	
		12.75	10.45	
		12.78	10.30	
		13.81	10.72	
		14.62	12.34	
		12.37	10.93	
		14.06	11.71	
		14.05	12.09	
		12.58		
		12.46		
		10.48		
		11.11		
		12.41		
		13.74		
		13.11		
		12.14		
		11.13		
		11.90		
		14.56		
		11.51		
		11.88		

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Tibia	Dp	SD	DD	Dd
			14.22	17.81
			10.97	
			12.43	
			11.98	
			14.61	
			12.02	
			12.85	
			11.88	
			16.86	
			9.75	
			11.93	
			12.73	
			11.24	
			11.79	
			11.78	
			11.19	
			10.85	
			8.11	
			12.79	
			12.41	
			12.07	
			10.45	
			11.88	
			10.41	
			12.41	
			14.09	
			13.05	
			11.07	
			11.09	
			11.37	
			13.55	
			10.39	
			12.37	
			14.74	
			12.20	
			11.84	
			10.67	
			11.00	
			11.86	
			12.55	
			10.94	
			11.07	
			10.08	
			11.44	
			12.12	
			10.65	
			14.96	
			11.16	
			10.60	
				20.97
				18.55
				18.34

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Astragalus	GLl	GLm	Dl	Dm	Bd
	34.50	31.83	16.51	15.32	21.44
	24.96	22.88	16.09	11.69	17.06

Metatarsus III + IV	Bp	Dp	SD	DD
	18.91		10.80	
		17.14		8.43
		16.68		11.72
		13.93		
			12.68	10.50
			12.93	11.40
			11.76	10.66
			15.25	14.66
			11.97	
			12.40	
			13.00	
			10.80	
			14.33	
				11.54
				9.82
				11.11
				12.88
				14.17
				10.70
				11.29
				12.15
				16.53
				10.06
				9.17
				9.19
				12.35
				13.55
				9.67
				9.46
				9.88
				9.98
				14.25
				11.43

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Ovis aries/Capra hircus

Phalanx 1 anterior	**GLpe**	**Bp**	**Dp**	**SD**	**DD**	**Bd**	**Dd**
	34.11	12.37	13.45	9.83	9.60	10.83	10.28
		12.93	14.04	9.77	10.26		

Phalanx 3 anterior	**MBS**	**Ld**	**DLS**
	6.59	22.95	28.12

Phalanx 1 posterior	**GLpe**	**Bp**	**Dp**	**SD**	**DD**	**Bd**	**Dd**
	34.86	11.27	13.98	9.38	9.04	9.52	8.55
	32.44		10.27	8.73	9.13	10.62	9.13
		12.16	14.59				
			16.06	9.33	9.59	10.25	9.34

Phalanx 3 posterior	**MBS**	**Ld**	**DLS**
	5.05	17.16	23.25

Phalanx 1 ant. / post.	**GLpe**	**Dp**	**SD**	**DD**	**Bd**	**Dd**
	34.41	14.04		8.64		7.15
			9.91	9.20	10.52	9.08
			9.30	9.14	9.82	8.30
			9.18	8.52	10.48	8.78
			8.53	7.88		
					10.32	9.65

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Sus domesticus

SUS DOMESTICUS

lost upper tooth M3	B	L
	20.22	33.3
	16.61	32.64
	19.23	31.76

lost lower tooth M3	B	L
	16.28	34.68
	15.35	35.64
	16.9	37.69
	15.23	33.64
	17.38	38.3
	16.77	33.3
	17.26	

Mandibula	L M3-M1	L P4-P2	L P4-P1
	69.95		
		42.4	63.89
		39.35	
		35.37	
		36.74	

Scapula	GLP	LG	BG	SLC
	28.83	28.4	23.62	22.16
	31.49	26.95	20.71	23.32
		31.32	27.14	25.5
			22.6	22.21
			18.27	21.1
			27.42	
			17.08	
			28.24	
				25.06
				23.35
				23.34
				24.46

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Sus domesticus

Humerus	SD	Bd	Dd
	17.16	37.25	
	16.29		
	16.54		
	18.85		
	16.22		
	16.12		
	16.52		
	17.56		
	17.52		
	16.25		
	17.72		
	19.8		
	20		
	16		
	19.46		
	17.9		
	18.54		
	17.42		
	19.83		
	18.36		
	17.18		
		36.19	33
		37.72	35.17
		31.44	27.04
		37.82	25.79
		35.1	39.06

Radius	Bp	Dp	SD
	32.23	23.54	18.94
	32.67	22.19	21.17
	32.38	21.67	22.16
	27.45	19.55	19.7
			19.05
			18.11
			19.98

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Sus domesticus

Ulna	SDO	DPA	BPC
	32.43	39.62	23.07
	27.39	33.66	19.4
	30.26	37.73	
		43.62	22.55
		44.1	21.6
		36.51	20.98
			20.42

Radius/Ulna	SD
	21.5

Metacarpus II	Bp	Dp	SD	Bd	Dd
	9.11	12.47	7.02	7.82	4.87

Metacarpus III	Bp	Dp	SD
	19.37	21.21	15.74
	18.99	20.44	13.21
	21.28	17.68	15.49

Metacarpus IV	Bp	Dp	SD
	16.93	20.08	11.49
	16.41	15.58	15.18
	14.01	12.93	
	14.88	13.75	

Atlas	BFcr	BFcd	H
	55.9	52.68	46.05

Pelvis	SB	SH	LFo	LA	LAR
	14.93	24.08	41.58	35.25	32.69
	17.14	26.52		35.69	33.93
	13.53	26.14			
	15.18				
				36.83	31.89
				33.14	30.01

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Sus domesticus

Femur	SD
	21.9
	18.72
	18.47
	18.82
	20.76
	20.44
	19.56
	19.94
	25.88
	21.06
	19.23
	26.8
	16.68
	24.79

Tibia	SD	Bd	Dd
	18.88		
	23.27		
		30.77	27.21
		31.24	28.19

Astragalus	GLl	GLm	Dl	Dm	Bd
	44.06	41.16	24.01	25.82	28.5
	42.82		22.43	21.29	
	43.92		25.19	23.68	24.3
			25.4		

Calcaneus	GB
	21.42
	26.37
	19.43

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Sus domesticus

Metatarsus IV	**Bp**	**Dp**	**SD**		
	11.09	24.23	9.44		

Phalanx 2 anterior	**Bp**	**Dp**	**SD**	**Bd**	**Dd**
	15.75	16.21	13.51	14.24	13.27

Phalanx 1 ant. / post.	**SD**	**Bd**	**Dd**		
	14.9	15.94	14.44		
	19.15	21.38			

Phalanx 2 ant. / post.	**Bp**	**Dp**	**SD**	**Bd**	**Dd**
	15.39	17.53	13.31	13.75	14.83
	16.77	17.06	14.3	15	14.55
	15.31	14.08			12.54
			13.07	14.26	7.72

side Phalanx 2 a. / p.	**Bp**	**Dp**	**SD**	**Bd**	**Dd**
	8.82	9.85	8.29	6.69	7.91

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Canis familiaris

CANIS FAMILIARIS

lost upper tooth P4	**GB**	**B**	**L**
	9.54	7.1	18.9

lost upper tooth M2	**B**	**L**
	16.12	12.9

lost upper tooth M3	**B**	**L**
	10.09	6.82

lost lower tooth P4	**B**	**L**
	6.17	11.62

lost lower tooth M1	**B**	**L**
	9.09	22.07

Cranium	**L upper neurocranium**	**GB mastoid**	**GB bases paraoccipital processes**	**GB neurocranium**
	92.09	62.09	56.32	56.27
				41.99

Cranium	**Least B skull**	**H occipital triangle**	**B Frontal**	**Least B between orbits**
	36.11	38.5		
	38.27		44.15	34.51

Mandibula	**H vertical ramus**
	57.04

Humerus	**Bd**
	33.4

Pelvis	**SB**	**SH**	**LFo**	**LA**	**LAR**
	9.3	19.69	28.77	23.82	22.09

Tibia	**SD**	**Bd**	**Dd**
	12.31	20.8	13.85

Appx. Tab. 22. Osteometry; Early-Middle Bronze Age (Field 3, Horizon D).

Cervus elaphus, Capreolus capreolus, Sus scrofa

CERVUS ELAPHUS

Sacrum	HFcr
	23.46

Phalanx 2 posterior	Bp	Dp	SD	DD	Bd	Dd
	18.14	26.18	19.14	21.27	18.67	23.6

CAPREOLUS CAP.

Astragalus	GLl	GLm	Dl	Dm	Bd
	27.28	26.22	15.24	17.12	17.58

SUS SCROFA

lost upper tooth M3	B	L
	19.86	39.11
	19.84	39.15

Humerus	SD	Bd	Dd
	20.01	43.66	42.39

Ulna	DPA
	43.18

Calcaneus	GB
	29.15

Metatarsus III	SD	Bp	Dp
	14.48	17.32	24.59

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Bos taurus

BOS TAURUS

lost upper tooth M3	B	L
	24.56	27.31
	22.87	27.41
	25.21	25.64

lost lower tooth M3	B	L
	15.84	33.82
	13.61	32.4
	14.31	34.59
	12.49	

Os cornu	LD base

Cranium with Os cornu	GD base	LD base	Basal circum.

Maxilla	L M3-M1

Mandibula	L P4-P2	H front P2	H front M1
	48.53	29.38	37.91
		28.9	38.67
		34.45	
		28.4	

Scapula	GLP	LG	BG	SLC
	64.69	54.12	43.49	49.22
	66.19	56.44	43.83	49.39
	60.72	53.49	42.65	49.15
			38.66	43.32
			40.7	43.57
			48.61	
			47.42	
			50.72	
			36.04	
			41.36	
			40.72	

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Bos taurus

Humerus	Dp	SD	DD	Bd	BT	Dd
	31.75					
		32.76	40.36			
		32.86	40.43			
		28.19	33.58			
		42.78	51.77			
		45.51				
		29.52				
			33.58			
			31.69			
			25.71			
			16.2			
			37.13			
			36.26			
			43.39			
			42.39			
			35.97			
			32.26			
			33.66			
			33.94			
			36.45			
			34.65			
			33.05			
			37.73			
			36.41			
			36.01			
			38.98			
			37.99			
			31.08			
			36.12			
			35.27			
			42.48			
				87.97	75.62	51.64
				60.22	56.22	32.43
					68.87	
						56.97

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Bos taurus

Radius	Bp	Dp	BFp	SD	DD	Dd
	73.75	36.32	67.31	39.03	22.24	
	74.31	35.17	67.71	37.07	19.96	
		35.81			20.61	
		21.44				
				34.35	21.7	
				39.17	21.93	
					32.72	44.51
					36.99	39.75
					16.41	
					18.33	
					23.59	
					17.28	
					25.38	
					22.18	
					17.03	
					12.9	
					22.55	
					23.4	
					21.38	
					22.08	
					19.99	
					17.42	
					19.3	
					22.51	
					21.86	
					21.03	
					21.63	
					18.08	

Ulna	SDO	DPA	BPC
	46.06	56.66	43.55
	46.16	53.89	34.75
	43.21	59.32	41.29

Radius/Ulna	DD
	21.38
	23.39

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Bos taurus

Intermedium (C.)	GB
	32.53
	41.01

Radiale (C.)	GB
	43.67

Ulnare (C.)	GB
	38.49
	36.37

Os carpale IV	GB
	26.51

Metacarpus III + IV	Bp	Dp	SD	DD	Dd
	46.13	26.93	24.03	18.78	
	47.58	27.71	27.01	20.46	
	58.37	36.88		27.29	
	49.18	29.5		22.65	
		29.62		19.62	
		29.36		22.21	
		27.78		21.13	
		26.76		17.56	
			34.55	25.27	
			35.22	24.06	
			27.94	21.14	
				20.06	29.68
				20.43	
				21.17	
				13.87	
				20.96	
				20.46	
				23.86	
				20.35	
				20.5	
				19.85	
				20.77	
				19.48	
				24.29	
				22.65	

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Bos taurus

Pelvis	SB	SH	LFo	LA
	25.22	37.39		65.94
	20.32	37.27		
	21.83	37.83		
	23.29	51.26		
			56.43	
				63.01

Femur	DC	SD	DD
	40.05		33.06
		29.95	36.88
		30.75	34.66
		30.31	
		33.78	
		31.89	
		33.93	
		26.18	
			29.39
			31.26
			36.47
			31.42
			31.56
			32.34
			40.87
			35.31

Patella	GB
	51.72

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Bos taurus

Tibia	SD	DD	Bd	Dd
	30.77	20.87		
	30.22	21.1		
	38.51	27.27		
	35.55	25.09		
	30.52	22.21		
	29.88			
		27.72		38.08
		27.22		
		23.14		
		25.33		
		31.54		
		20.55		
		21.87		
		33.7		
		33.24		
		29.6		
		24.54		
		23.6		
			61.15	46.17

Astragalus	GLl	GLm	Dl	Dm	Bd
	63.6	58.45	36.84	35.46	40.59
	56.84	51.7	29.7	28.22	34.68
	66.77	60.18	36.75	33.55	44.12
	60.98	56.74	35.39	32.8	37.7
	59.92	53.89	34.22	30.42	38.18
	60.31	56.08	33.75	29.55	36.7
	60.05	56.66	33.44	32.85	38.78
	59.3	54.66	33.45	30.82	39.66
		50.86	29.65	28.57	
					37.53

Calcaneus	GB
	42.05
	49.36
	35.74
	32.99
	28.34
	30.74
	32.25

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Bos taurus

Centrotarsale	GB
	47.4

Other Tarsalia	GB
	38.42
	36.1

Os malleolare (T.)	GB
	29.96

Metatarsus III + IV	Bp	Dp	SD	DD	Bd	Dd
	47.11	45.61	27.71	30.81		
	41.33	37.36	25.25	27.76		
	34.98					
	52.12					
		34.44		23.55		
		38.38		25.62		
		31.28				
			23.81	22.4		
			25.73	25.94		
			23.62	24.58		
			20.45	20.52		
			26.55			
				22.82	54.76	29.65
				23.53		28.12
				26.39		28.51
				25.35		
				23.55		
				20.86		
				23.95		
				30.84		
				22.94		
				30.77		
				24.69		

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Bos taurus

Phalanx 1 anterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	53.99	31.44	32.62	26.17	22.28	29.84	20.88
	51.34	25.54	25.18	20.22	19.91	22.37	17.95
	58.89	28.67	33.03	24.51	22.24	29.59	18.14
	47.99	22.52		20.3	17.25	23.22	18.46
	67.15	32.5	39.64	25.51	23.27	29.09	20.35

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	50.77	24.22	28.03	20.51	18.53	22.99	17.41
	61.81	29.73	36.35	23.47	23.91	26.97	21.5
	53.91	25.82	30.87	22.15	20.36		
	52.63		23.66	21.75	19.23	25.23	19.58
		25.29	29.84	21.49	22.18		

Phalanx 1 ant. / post.	GLpe	DD	Bd	Dd
	58.13	22.59		
			22.95	24.88

Phalanx 2 anterior	GL	Bp	Dp	SD	DD	Bd	Dd
	43.36	29.24	27.69	22.42	22.65	23.16	27.34
	39.87	33	30.19	27.27	26.59	27.1	29.75
	41.14	31.53	31.79	25.71	24.1	25.24	28.72
	35.24	25.55	26.19	19.96	20.87	22.09	24.63
	33.39	24.66	24.93	19.21	19.86	20.03	22.78
	35.76	27.96	28.79	21.2	20.86	21	25.88
	38.17		26.05	20.67	22.3	20.33	27.11

Phalanx 2 posterior	GL	Bp	Dp	SD	DD	Bd	Dd
	38.73	26.32	26.76	20.64	21.89	23.28	25.02
	35.15		27.87	21.18	20.75	22.54	27.28

Phalanx 3 anterior	MBS	Ld	DLS
	19.99	50.63	68.94
	21.18		
	22.26		

Phalanx 3 posterior	MBS	Ld	DLS
	18.65	48.68	60.8
	19.07	27.92	57.67
	18.39	44.24	56.04
	20.19	52.63	68.08
	19.46	46.16	61.62

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries

OVIS ARIES

Metacarpus	SD	DD	Dd				
	12.15	9.57	15.34				
Astragalus	GLl	GLm	Dl	Dm	Bd		
	30.37	27.62	16.43	15.78	18.89		
	26.85	27.48	16.87	15.54	19.02		
	28.94	27.57	15.9	18.15	19.8		
	27.26	24.13	14.38	14.24			
Metatarsus	GL	Dp	DD	Dd			
	105.67	15.82	9.78	15.31			
Phalanx 1 anterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	38.87	12.4	15.98	10.81	10.71	12.18	11.38
Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	33.32	11.21	12.69	9.79	9.01	11.1	9.73
	35.33	11.7	13.77	8.79	8.64	11.58	9.21
Phalanx 2 anterior	GL	Bp	Dp	SD	DD	Bd	Dd
	23.51	11.55	13.02	8.88	10.14	9.68	10.83
	20.66	10.15	9.92	7.84	8.73	7.84	9.63
	21.71	11.1	11.95	8.41	8.97	9.17	10.78
		11.07	11.97	9.05	9.5		
Phalanx 2 posterior	GL	Bp	Dp	SD	DD	Bd	Dd
	23.28	10.57	12.15	7.66	7.94	7.74	10

Capra hircus

CAPRA HIRCUS

Os cornu	LD base	LD base	Basal circum.
	33.91	25.41	89.89
	29.5		
Humerus	Bd	Dd	
	25.79	21.85	
Phalanx 3 posterior	MBS	Ld	DLS
	5.72	21.06	27.32

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries/Capra hircus

OVIS ARIES / CAPRA HIRCUS

lost upper tooth M3	B	L
	9.36	20.03
	11.51	17.19
	12.56	18.14
	11.78	18.93
	10.48	17.27
	11.57	18.1
	11.7	18.02
	12.13	21.56
	9.07	16.68
	11.16	17.36
	13.13	19.82
	10.6	15.88
	10.56	17.04
	12.01	18.28
	12.36	18.47
	12.21	18.55

lost lower tooth M3	B	L
	6.86	18.2
	7.49	22.07
	8.3	24.11
	7.8	21.66
	7.76	20.89
	7.93	22.09
	7.74	20.24
	7.39	20.5
	7.67	21.87
	7.02	20.61
	7.61	21.13
	7.89	18.06
	8.52	22.67
	8.13	21.31
	8.55	
	8.86	
	7.61	

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries/Capra hircus

Mandibula	L P4-P2	H front P2	H front M1
	22.81	16.9	21.94
	21.99	16.48	20.91
	22.68	13.08	19.19
	21.1	14.45	18.65
	21.58	18.76	21.03
	20.97		19.48
	24.24		
		15.92	18.04
		13.11	16.12
		17.36	
		15.58	
		14.63	
		15.25	
		14.1	
		10.42	
		15.39	
		15.87	
		13.99	
		17.34	
		12.92	
		15.21	
		11.89	

Scapula	LG	BG	SLC
	25.69	20.38	21.91
			14.93
			19.57

Humerus	SD	DD	Bd	BT	Dd
	17.85	16.83	27.62	27.11	23.37
	16.51	16.48	27.41	26.89	24.15
	14.67	15.37	30.55	28.01	21.91
	13.62	13.68			18.3
	13.19	16.64			
	13.58	14.7			
	16.99	21.55			
	16.13	16.58			
	13.66	15.3			
	14.68	17.16			
	19.12	17.95			
	13.48	18.06			
	20.5				
	15.6				
	16.49				
		15.07			
		14.15			
		16.74			
		17.76			
		14.61			
		14.25			
			32.2	30.75	20.17
			29.99	27.41	24.08
			29.53		25.41

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries/Capra hircus

Radius	Dp	SD	DD	Bd	BFd	Dd
	14.04	15.81	9.3			
		13.73	6.83			
		19.01	10.94			
		15.74	8.33			
		15.64	8.92			
		15.2	7.38			
		14.69	8.11			
		15.66	10.76			
		17.06	9.97			
		16.67	8.02			
		14.67	8.29			
		16.12	8.07			
		15.35	7.73			
		16.4	7.82			
		18.22	9.32			
		15	7.99			
			12.67	28.11	24.87	19.27
			9.6			
			8.86			
			10.51			
			7.55			
			9.8			
			9.44			
			7.99			
			8.69			
			9.07			
			9.17			
			10.72			
			8.19			
			10.11			
			9.19			
			8.21			
			9.8			
			8.74			
			8.83			
			10.04			
			7.52			
			8.12			
			8.06			
			10.03			
			8.56			
			8.45			
			9.28			
			9.12			
			7.48			
			8.27			
			8.5			
			7.83			
			8.55			
			7.86			
			10.3			
			9.17			
			8.1			
			9.51			
			9.57			
			9.88			
			7.78			

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries/Capra hircus

Ulna	SDO	DPA	BPC
	21.27	23.92	14.33
	23.86	28.75	
	23.8	28.15	
	21.86	24.88	
	19.95	24.19	

Metacarpus III + IV	Bp	Dp	SD	DD	Dd
	22.48	14.59	13.02	9.7	
		17.45		9.82	
		17.72		10.74	
		16.81		11.43	
			18.21	11.11	
			16.08	12.46	
			12.13	9.1	
			12.69	9.17	
				9.62	14.94
				8.82	
				9.18	
				10.89	
				9.43	
				11.23	
				11.81	
				11.14	
				11.08	
				7.46	
				13.23	
				8.77	
				9.48	
				10.02	
				9.53	
				7.54	
				8.81	
				9.96	
				9.35	
				10.04	
				8.39	
				8.37	
				12.15	
				7.87	
				9.76	
				9.61	
				7.79	
				8.89	
				8.46	
				9.62	
				9.53	
				10.67	
				7.54	
				8.58	
				9.42	
				7.41	
				7.91	
				10.14	
				9.93	
				9.89	
				9.28	
				9.48	
				9.33	
				10.46	

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries/Capra hircus

Vertebra cervicalis	PL
	32.46

Vertebra luumbalis	BFcr	BFcd	PL	HFcr
	18.97	20.64	31.62	16.65

Pelvis	SB	SH	LFo	LA
	10.93	18.15		27.82
	7.21	15.53		
	9.08	16.26		
	11.96	14.88		
	10.94	15.2		
	11.9	19.45		
	8.81			
			36.86	31.33
			30.61	

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries/Capra hircus

Femur	DC	SD	DD
	22.99		
		17.14	17.05
		18.2	17.82
		19.99	19.73
		16.83	14.81
		13.45	14.85
		14.33	13.96
		14.27	13.62
		15.25	16.56
		17.67	18.48
		16.85	16.76
		15.7	16.06
		15.09	16
		14.99	
		14.68	
		15.18	
		19.31	
		16.47	
		16.46	
		14.94	
		17.57	
		17.2	
		18.77	
		15.12	
		13.73	
		14.46	
		11.48	
		19.85	
		15.81	
		15.73	
		13.38	
		15.31	
		15.75	
		14.53	
		19.88	
			14.93
			14.49
			15.89
			14.28
			19.83
			20.14
			14.96
			14.36
			15.36
			16.95
			15.79
			14.69
			13.7
			16.68
			16.11
			16.1
			15.54
			16.06
			16.47
			14.34
			16.54

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries/Capra hircus

Tibia	Bp	SD	DD
	36.2		
		12.02	9.98
		13.76	11.68
		13.85	10.38
		15.11	13.29
		14.06	12.01
		14.36	13.12
		14.36	13.12
		14.38	13.48
		11.88	11.03
		15.24	15.03
		13.54	10.76
		14.12	11.78
		14.37	12.61
		16.28	14.71
		13.51	10.57
		10.85	8.74
		17.04	14.47
		13.81	11.7
		10.39	9.64
		13.35	11.03
		14.77	12.06
		14.8	11.76
		10.43	11.54
		14.35	12.29
		12.11	
		12.3	
		13.7	
		12.4	
		11.44	
		10.84	
			11.08
			12.64
			10.2
			11.32
			13.84
			12.89
			10.2
			9.05
			10.54
			11.21
			13.48
			10.72
			10.66
			10.24
			15.85
			11.9
			14.76

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Ovis aries/Capra hircus

Astragalus	GLl	GLm	Dl	Dm	Bd
	26.28	25.9	14.05	14.25	16.66

Calcaneus	GB
	13.3

Metatarsus III + IV	Bp	Dp	SD	DD
	17.55	21.01	13.36	12.52
			12.07	10.8
			12.52	11.23
			10.93	10.44
			16.96	15.71
			11.11	13.05
			12.58	11.18
			10.77	10.84
			11.45	10.12
			10.28	
			11.61	
				9.21
				10.56
				11.3
				10.57
				11.99
				11.59
				8.83
				9.71
				10.7
				10.22
				10.79

Phalanx 1 ant. / post.	Bd	Dd
	11.53	10.68

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Sus domesticus

SUS DOMESTICUS

lost upper tooth M3	B	L
	19.78	31.94
	18.81	30.97
	18.97	34.42
	20.22	33.88
	18.91	32.74
	20.23	
	18.82	
	17.75	

lost lower tooth M3	B	L
	16.83	35.61

Scapula	GLP	LG	BG	SLC
	24.57	36.54	30.92	27.61
	25.06			
	27.73			
	20.01			
	25.11			
	19.69			
	24.52			

Humerus	SD
	18.56
	16.96
	20.37
	14.21
	17.3
	17.02
	19.48
	18.1
	16.55
	16.16
	20.51
	21.1

Radius	Dp
	20.28

Ulna	SDO	DPA	BPC
	31.04	35.54	19.95
		40.37	21.24
		26.88	

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Sus domesticus

Ulnare (C.)	GB		
	22.34		

Other Carpalia	GB		
	22.45		

Metacarpus III	Bp	Dp	SD
	16.51	18.87	14.02

Metacarpus IV	Bp	Dp	SD
	16.12	15.09	11.41

Metacarpus V	Bp	Dp	SD
	6.45	11.15	5.67

Pelvis	SB	SH	LFo
	13.46	27.01	
			46.21

Femur	SD
	18.01
	16.41
	15.94
	19.07

Tibia	SD
	22.11
	21.53
	18.62

Appx. Tab. 23. Osteometry; Middle Bronze Age (Field 3, Horizon C).

Sus domesticus

Astragalus	GLl	GLm	Bd
	43.5	38.59	20.25
	43.72	39.41	27.93
			22.32

Calcaneus	GL	GB
	82.26	21.87
		24.7
		19.99
		19.62

Metatarsus III	Bp	SD
	16.98	13.58

Phalanx 1 anterior	Bp	Dp	SD	Bd	Dd
	16.92	16.35	14.36	15.9	10.59

Phalanx 2 anterior	Bp	Dp	SD	Bd	Dd
	17.03	16.87	14.32	15.9	13.59

Phalanx 3 a. / p.	MBS	Ld	DLS
	12.98	29.04	31.27
	10.69	22.31	27.96

Canis familiaris

CANIS FAMILIARIS

Phalanx 2 posterior	GL	Bp	Dp	SD	DD	Bd	Dd
	26.21	9.01	8.59	5.37		7.54	5.87

Capra ibex, Sus scrofa, Capra hircus/Capra ibex

CAPRA IBEX

Humerus	Bd	Dd
	43.7	34.39

SUS SCROFA

Tibia	SD
	19.49

CAPRA H. /IBEX

Tibia	SD
	20.84

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Bos taurus

BOS TAURUS

lost upper tooth M3	B	L
	18.66	27.22
	19.49	27.96
	18.63	25.67
	16.38	26.67
	12.09	28.75
	19.31	25.67
	20.08	28.91
	17.18	27.89
	17.34	27.94
	19.76	27.6
	17.59	26.03
	23.22	30.5
	20.22	30.08
	19.48	28.05
	19.97	30.2

lost lower tooth M3	B	L
	14.2	
	11.06	36.7
	13.27	37.49
	12.58	32.39
	12.06	33.62
	12.66	35.35
	12.09	28.75

Scapula	GLP	LG	BG	SLC
	68.85	59.84	50.19	
	44.84			
		42.99	37.95	43.99
	51.39	47.58	37.48	

Humerus	SD	DD	Bd	Dd	BT
			84.47	48.24	79.81
	30.23	40.45	71.5	60.89	68.64
	37.53				
				51.68	
	44.38				
	26.51				
	38.41				
		37.03			
		33.66			
		40.98			

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Bos taurus

Radius	Dp	DD		
	35.35	21.46		
	33.98	20.43		
	36.13	16.15		
		16.9		
		15.56		
		19.66		
		18.87		
		18.9		
		18.03		
		18.8		
		17.91		
		20.27		

Ulna	SDO	DPA
	35.89	50.29

Carpalia	GB
	31.97
	36.85

Metacarpus III + IV	DD	Bd	Dd
	18.85		27.45
	23.37		
	14.53		
		60.31	32.05
		62.4	21.92

Pelvis	SB	SH	LA
	13.07	34.67	
			68.47

Femur	DC	SD	DD
	44.62		
	38.28		
		36.98	
		30.63	
			36.66

Tibia	SD	DD	Bd	Dd
	26.01			
	33.64	24.81		
	30.62	21.6		
	32.49	22.19		
	32.77	23.18	53.8	37.67
		23.78		
		23.85		
		23		

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Bos taurus

Astragalus	GLl	GLm	Dl	Dm	Bd		
	54.21	49.43	32.3	29.83	31.11		
		54.9	29.2	28.73	40.61		
			37.67				

Calcaneus	GB
	33.43
	40.2
	31.83
	40.5

Metatarsus III + IV	Bp	Dp	SD	DD	Dd		
	44.46	45.36	26.13	26.86			
	44.3						
			23.04				
			23.33				
			23.91	25.35	28.96		
				23.39	26.72		
				22.99	28.93		
				20.6			
				23.29			
				25.3			
Phalanx 1 anterior	GL	Bp	Dp	SD	DD	Bd	Dd
	52.43	28.08	23.75	27.36			
	59.88	33.03	33.94	29.04	23.42	30.61	21.43
Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	57.21	29.83	33.77	26.46	21.15	30.62	18.77
	55.58	25.9		20.97			17.79
		27.78	30.23	23.94	21.66		19.12
		24.48					
				18.74		24.46	

Phalanx 1 ant. / post.	Dp
	32.78

Phalanx 2 anterior	GL	Bp	SD	Bd
	42.33	29.07	25.43	20.39

Phalanx 2 ant. / post.	GL	Bp	SD	Bd
	33.67	25.49		
	33.58		22.18	25.37
	36.06			25.49
	34.98			
		26.45		

Phalanx 3 posterior	MBS
	22.08

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Ovis aries, Ovis aries?, Capra hircus

OVIS ARIES

Pelvis	LA
	29.35

Metacarpus III + IV	Bp	Dp	SD	DD
	22.36	15.76	14.92	10.77

OVIS ARIES?

Astragalus	GLl	GLm
	33.96	31.98

CAPRA HIRCUS

Cranium with horn core	GD base	LD base	Basal circumference
	51.34	28.31	161.2

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Ovis aries/Capra hircus

OVIS A. / CAPRA H.

lost upper tooth M3	B	L
	11.64	16.66
	9.36	16.5
	11.52	16.83
	10.31	16.28
	9.07	16.18
	7.79	13.05
	10.71	16.42
	12.01	18.63

lost lower tooth M3	B	L
	7.21	20.07
	7.67	23.21
	6.76	19.06
	6.87	18.91
	7.42	19.52
	7.21	19.9
	7.42	
	6.44	

Mandibula	L M3-P2	L M3-M1	L P4-P2	H front P2	H front M1
	72.23	47.82	24.63	14.7	20.22
	19.76			12.77	18.13
	21.04			16.06	19.71
	26.09			15.77	18.79
	22.88			14.08	18.23
				16.56	
				13.44	
				16.07	
				17.67	

Scapula	GLP	LG	BG	SLC
	24.83	22.6	17.21	18.56
	27.03	21.65	17.67	19.35
	26.31	22.24	16.55	17.6
	27.99	23.69	17.07	17.56
	30.52	25.43		19.81
			20.62	19.03

Humerus	SD
	12.64
	14.35
	13.97

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Ovis aries/Capra hircus

Radius	SD	DD	Bd	BFd	Dd
	18.62	12.03	30.77	26.88	21.29
	18.57	11.12			
	16.05	9.4			
	16.02	7.48			
	15.98	9.03			
	16.91	9.22			
	12.72	6.9			
	15.41	8.89			
		8.65			
		7.1			
		9.89			
		9.04			
		9.09			

Radius / Ulna	SD	DD
	15.36	10.36

Metacarpus III + IV	Dp	SD	DD
	14.65	12.52	10.45
	14.37		8.74
	16.16		9.68
		13.73	10.83
			10.54
			8.66
			9.63

Vertebra cervicalis	BFcr	BFcd	PL
	23.85	21.44	27.54

Pelvis	SB	SH
	8.48	16.26

Femur	DC	SD	DD
	19.66		
		13.57	13.2
		18.17	19.9
		16.13	17.79

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Ovis aries/Capra hircus

Tibia	SD	DD
	15.66	13.31
	13.74	11.13
	14.41	12.11
	15.51	13.05
	14.71	12.34
	12.63	10.56
	16.16	14.25
	16.78	13.49
	13.43	12.25
	14.12	12.38
	13.31	11.84
	13.38	10.69
	13.28	11.12
	14.8	12.35
	16.95	14.92
	13.84	10.84
	11.24	
	13.63	
	12.75	
	14.34	
	16.42	

Astragalus	GLl	GLm	Dl	Dm
	28.72	27.52	16.84	14.66

Metatarsus III + IV	Bp	Dp	SD	DD
	20.26	19.09	10.57	10.16
			11.19	9.51
			15.13	12.85
			10.69	11.88
			10.94	10.71
			12.32	11.65
			11.32	9.63
			11.58	10.1
			10.41	
			11.39	
				10.44
				11.11
				10.06

Phalanx 1 posterior	Glpe	Bp	Dp	SD	DD	Bd	Dd
	34.21	11.74	14.11	9.99	9.47	11.42	11.13

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Sus domesticus

SUS DOMESTICUS				
lost upper tooth M3	**B**	**L**		
	18.96	35.74		
lost lower tooth M3	**B**	**L**		
	13.83	32.91		
	14.14	34.31		
	16.18	36.85		
	14.39	34.65		
Mandibula	**L P4-P2**	**L P4-P1**		
	38.17	55.84		
Scapula	**GLP**	**LG**	**BG**	**SLC**
	39.34	32.43	27.75	25.8
	31.98			
Humerus	**SD**	**Bd**	**Dd**	
	15.61	36.38	36.7	
	17.4			
		36.73	29.9	
		42.03	35.12	
			28.89	
Radius	**Bp**	**Dp**	**SD**	
	32.79	21.17	20.53	
	27.49			
Metacarpus III	**Bp**			
	18.92			
Pelvis	**LA**	**LAR**		
	33.83	28.45		
Femur	**SD**			
	18.54			
	18.15			

Canis familiaris

CANIS FAMILIARIS	
Mandibula	**H behind M1**
	14.4
Ulna	**DPA**
	17.89

Appx. Tab. 24. Osteometry; Middle Bronze Age (Field 1, Horizon C).

Cervus elaphus, Capra ibex, Sus domesticus/Sus scrofa, Capra hircus/Rupicapra rupicapra, Large ruminants (GWK)

CERVUS ELAPHUS			
Tibia	**SD**		
	29.99		
Phalanx 2 ant. / post.	**Bd**		
	16.56		
CAPRA IBEX			
Astragalus	**GLl**		
	37.16		
SUS DOM./SCROFA			
Pelvis	**Lfo**	**LA**	**LAR**
	39.86	36.91	32.25
CAPRA H./RUPICAPRA RUP.			
Metacarpus III + IV	**DD**		
	11.22		
GWK			
Astragalus	**Bd**		
	33.78		
	31.67		

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

BOS TAURUS

lost upper tooth M3	B	L
	25.48	28.73
	23.23	26.81
	22.74	27.34
	22.21	26.48
	23.61	28.22
	22.81	27.18
	20.93	26.43
	23.12	28.9
	25.53	28.33
	23.04	24.58

lost lower tooth M3	B	L
	14.68	33.37
	14.89	32.9
	13.46	31.05
	15.96	37.14
	13.66	32.04
	15.14	33.24
	16.31	39.86
	13.98	33.18
	14.86	34.04
	15.48	35.46
	15.52	35.9
	15.14	34.16
	15.56	35.53
	16.7	39.94
	14.3	31.54
	15.81	34.95
	16.25	38.63
	15.56	25.26
	15.12	35.6
	14.38	34.01
	15.95	40.97
	14.39	

Os cornu	GD base	LD base
	47.96	
	51.95	
		39.59

Mandibula	L diastema	H front P2
	72.89	29.65
		30.41

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

Scapula	GLP	LG	BG	SLC
	60.23	50.01	40.17	37.08
	60.12	50.31	40.27	48.42
	58.41	49.54	39.06	42.55
	52.14	48.59	33.84	38.23
	58.4	48.6	38.61	45.2
	56.02	45.46	41.18	51.27
	55.91	55.17	41.29	54.4
	59.83	48.59	42.27	49.74
	57.51	50.36	44.31	45.25
	51.48	45.76	37.88	42.65
	58.02	52.17	40.34	49.07
	69.68	57.97	46.11	52.83
	59.24	49.03	44.63	46.47
	55.25	45.4	41.31	
	55.43	50.24	43.82	
	51.78	47.26		
			42.54	
			41.66	
				43.05
				38.96
				46.22
				40.17

Humerus	SD	DD	Bd	BT	Dd
	29.16	36.39	70.2	67.01	46.2
	33.87	38.89			
	33.64	40.32			
	33.61	43.42			
	29.8				
		31.45			51.29
		34.82			
		32.66			
		32.74			
		39.87			
		36.06			
		41.04			
		38.04			
		41.73			
		33.24			
		34.43			
		34.4			
		37.14			
		41.54			
		30.99			
			64.07	63.88	38.35
					45.52

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

Radius	Bp	BFp	Dp	SD	DD
	78.4	72.55	37.94	44.4	24.33
	75.72	68.81	37.7	39.67	23.17
	71.24	66.28	36.68		21.03
	46.49				23.07
		61.14	35.13	36.35	21.7
			36.37		26.63
			33.81		21.41
			36.36		27.48
			29.61		23.56
			31.93		19.15
			37.22		29.56
			35.38		24.68
			38.6		
			28.92		
			39.81		
			33.81		21.41
				40.87	20.54
				42.09	23.45
					23.72
					22.84
					19.14
					19.07
					18.94
					14.49
					15.17
					16.34
					19.19
					22.13
					19.26
					24.8
					20.22
					11.64
					19.76
					19.51
					14.2
					23.26
					18.1
					19.79
					17.94
					16.91

Ulna	SDO	DPA	BPC
	56.36	75.84	44.01
	44.12	53.04	35.63
	45.48	52.81	42.57
	48.86	58.14	
	38.47		33.89
			34.24
			33.38
			35.6

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

Radius/Ulna	Bp	Dp	DD	SDO	DPA	BPC
	61.6	34.28	19.9	43.4	53.6	35.19
			19.9			

Intermedium (C.)	GB
	45.87

Radiale (C.)	GB
	41.33
	38.2
	35.01
	43.91
	33.51

Ulnare (C.)	GB
	38.8
	35.34
	44.74

Os carpale II & III (C.)	GB
	42.22
	42.07
	42.47
	44.33

Os carpale IV (C.)	GB
	27.85
	29.68
	33.25
	34.24
	38.5

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

Metacarpus III + IV	Bp	Dp	SD	DD	Bd	Dd
	50.35	29.71	29.56	22.35		
	47.55	29.65	32.53	21.62		
	52.37	30.49	31.54	22.15		
		36.71		21.8		
		32.83		23.25		
		40.1		20.75		
		32.09		20.53		
		27.97		17.67		
		29.42		18.48		
		31.48		20.65		
		26.19		19.39		
		36.71		21.8		
			39.07	21.02	51.83	26.52
			28.96	20.72		
				17.74	51.12	26.15
				18.32	50.53	26.17
				20.35		26.86
				22.56		35.15
				22.69		30.99
				23.08		31.46
				18.79		
				20.21		
				28.14		
				18.18		
				22.04		
				24.22		
				17.24		
				21.17		
				23.38		
				24.86		

Vertebrae cervicalis	PL
	49.64

Pelvis	SB	SH
	22.5	43.51
	20.51	34.26
	19.96	
	24.46	
	23.99	
	22.78	
	25.57	

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

Femur	DC	SD	DD
	37.42		
	43.42		
	43.59		
		30.67	35.72
		31.96	29.54
		33.98	31.11
		31.21	
		30.69	
		37.47	
			38.97

Patella	GL	GB
	56.2	47.42

Tibia	SD	DD	Bd	Dd
	46.34	30.24	60.05	42.68
	37.68	27.15		
	30.82	21.01		
	33.31	21.05		
	29.92	22.32		
	36.07	26.79		
	41.81	34.85		
	34.72	23.75		
	37.77			
		28.51	57.16	42.5
		29.52		48.8
		31.08		
		21.04		
		21.64		
		23.81		
		26.85		
		29.57		
		26.76		
		27.27		
		21.18		
		24.83		
		25.03		
		28.49		
			54.09	38.38
				41.88

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

Astragalus	GLl	GLm	Dl	Dm	Bd
	58.76	55.3	33.68	28.84	36.73
	57.86	50.91	32.43	32.24	37.11
	61.99	55.26	34.2	31.15	38.54
	65.64	58.62	36.97	32.11	43
	65.57	59.66	38.53	34.75	42.38
	59.07	55.68	36.39	30.61	38.72
	58.11	51.59	34.85	32.52	38.27
	62.55	55.45	35.32	28.97	40.06
	64.19		34.21	29.12	41.62
	59.04		32.5	29.42	
					34.48

Calcaneus	GL	GB
	111.25	36.2
	106.34	30.43
		36.87
		29.98
		29.15
		30.64
		31.24
		37.22
		39.68

Centrotarsale	GB
	58.59
	48.33
	49.92
	51.68
	44.01

Os malleolare (T.)	GB
	26.53

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

Metatarsus III + IV	Bp	Dp	SD	DD	Dd
	46.25	39.12	26.47	30.26	
	45.12	45.16	25.16	26.46	
	52.9	49.44	26.41	31.11	
	41.72		30.04		
	39.45		24.68		
	36.82				
		24.79	26.57	24.05	
		40.92		28.41	
		36.44		24.89	
		28.31		22.02	
			24.48		
			22.15		
			26.44		
			27.55	28.82	
				19.98	29.16
				21.19	23.57
				23.92	30.43
				21.12	26.84
				28.79	33.71
				22.03	32.17
				20.89	
				25.12	
				23.3	
				23.09	
				20.93	
				22.44	
				20.9	
				27.7	
				22.96	
				20.84	
				34.68	

Phalanx 1 anterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	58.42	29.94	34.48	24.41	22.92	27.62	20.46
	64.6	29.68	37.2	27.35	24.27	30.43	25.36
	59.42	30.14	33.77	23.54	21.85	29.02	21.05
	62.24	30.27	30.49	24.39	24.05	28.8	22.03
	61.82	34.66	36.51	28.88	24.01	31.27	23.28
	51.82	29.14	31.97		18.95		20.04
					26.25	29.92	

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Bos taurus

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	55.27	24.74	30.01	21.4	19.58	23.98	19.51
	57.19	24.27	30.35	20.14	19.23	21.92	18.71
	60.5	27.86	33.16	24.22	21.41	27.13	21.02
	59.45	27.3	32.6	24.31	21.96	27.43	19.59
	57.29	25.77	30.92	23.19	22.48	25.2	18.55
	59.86	26.23	26.91	22.47	19.34	26.22	19.56
	55.51	26.3	30.09	23.77	20.42	30.56	20.56
	59.15	23.32	31.66	20.81	19.87		19.73
		23.51	30.2	20.19	21.32		
				22.76	19.44	25.99	21.49

Phalanx 1 ant. / post.	SD	DD	Bd	Dd
	21.05	17.97	22.37	18.17
	19.77		24.53	
		18.97		18.13
		22.96		23.29
		18.57		19.83
		19.9		19.81
		19.36		
			26.68	19.21
			28.98	21.99
				18.79

Phalanx 2 anterior	GL	Bp	Dp	SD	DD	Bd	Dd
	37.07	27.3	26.95	23.26	25.74	22.13	28.63
	39.2	27.92	32.23	24.15	26.55	26.47	34.56
	42.38	30.41	31.92	24.37	24.92	26.32	31.31
	41.41	31.73	33.95	24.78	26.32	27.38	29.69

Phalanx 2 posterior	GL	Bp	Dp	SD	DD	Bd	Dd
	42.94	26.99	29.02	21.51	21.77	21.31	24.59

Phalanx 3 posterior	MBS	Ld
	18.76	43.15
	17.47	
	14.92	

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Ovis aries, Capra hircus

OVIS ARIES

Os cornu	GD base	LD base	Basal circum. circumference	L outer curvature	L inner curvature
	40.91	22.1	210	220.4	186
	58.25	41.7	364		

Humerus	SD	DD	Bd	BT	Dd
	15.85	19.64	33.39	32.71	23.69
	16.01	16.35	32.81	32.02	24.96
	17.53	15.39	29.25	28.97	24.82
	21.62	14.33	29.85	27.94	

Radius	Bp	BFp	Dp	SD	DD
	29.57	26.83	14.5	18.25	9.13
	30.51	28.65	15.83	17.47	

Astragalus	GLl	GLm	Dl	Dm	Bd
	28.7	27.33	15.83	13.18	17.38
	26.91	25.96	15.06	16.39	18.18
	27.67	26.43	15.2	16.6	17.81

Calcaneus	GL	GB
	61.45	22.12

Metatarsus	SD	DD	Dd
	11.49	10.05	14.48

CAPRA HIRCUS

Os cornu	GD base	LD base
	24.37	20.07
		25.24

Humerus	SD	DD	Bd	BT	Dd
		16.16	33.34	32.61	21.95

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Ovis aries/Capra hircus

OVIS ARIES / CAPRA HIRCUS

lost upper tooth M3	B	L
	10.93	19.94
	12.56	17.49
	11.93	19.18
	10.93	19.1
	12.23	19.04
	12.48	11.81
	11.43	19.8
	10.48	19.32
	11.71	20.31
	11.41	17.98
	11.43	20.32
	10.69	16.72
	12.93	16.51
	12.54	19.03
	12.54	18.96
	13.56	18.01
	12.71	17.72
	11.12	18.51
	12.3	19.77
	11.07	16.76
	13.49	19.81
	11.36	15.89
	11.48	16.78
	12.32	19.79

lost lower tooth M3	B	L
	8.16	20.62
	7.55	21.06
	7.88	22.19
	8.44	21.61
	8.51	21.51
	7.48	22.15
	7.81	20.74
	7.24	18.82
	7.51	20.4
	7.33	17.98
	7.74	20.96
	7.83	20.74
	7.93	20.43
	7.21	20.35
	7.46	21.69
	7.66	22.33
	8.09	22.09
	8.05	23.46
	7.94	20.08
	8.23	22.17
	7.2	20.86
	8.15	21.29
	8.74	24.72
	8.21	22.33
	7.71	19.77
	8.21	21.43
	8.24	21.19
	8.34	21.72
	7.13	18.4
	7.75	21.83
	8.58	20.78
	8.02	23.03
	7.71	20.73
	8.77	

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Ovis aries/Capra hircus

Maxilla	L M3-M1
	43.37

Mandibula	L M3-P2	L M3-M1	L P4-P2	H front P2	H front M1	H behind M3
	72.73	49.94	23.17	17.06	19.89	35.69
	71.79	48.39	23.18	17.44	20.07	
			23.35	16.55	22.42	
			31.95	17.83	20.84	
			21.16			
				12.61		
				11.23		
				13.79		
				15.99		
				14.08		
				16.17		
				11.98		
				13.15		
				16.68		
					18.33	
					17.59	

Scapula	GLP	LG	BG	SLC
	28.18	21.01	18.74	16.84
		19.73	17.25	13.95
		26.59	17.63	
		28.4	22.95	
			20.91	
				16.86
				15.9
				19.87
				20.8

Humerus	SD	DD	Bd	BT	Dd
	12.7	12.58			
	17.46	14.5			
	14.49	15.17			
	16.83	18.04			
	17.98	17.89			
	15.52				
	17.07				
	17.74				
	12.82				
		15.09			
		13.96			
		16.06			
		12.71			
		17.45			
		16.58			

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Ovis aries/Capra hircus

Radius	Bp	BFp	Dp	SD	DD
	29.69	27.43	14.77		
			15.22		9.07
				15.58	9.18
				16.12	8.99
				15.05	8.28
				18.27	10.27
				17.47	8.97
				18.65	10.53
				15.32	8.37
				16.56	7.83
				14.42	7.4
				15.15	8.46
				19.61	10.29
					9.1
					8.33
					9.74
					10.87
					8.97
					10.78
					10.37
					13.73
					10.79
					9.05
					11.11
					9.78
					8.24
					9.61
					15.11
					8.71
					9.55
					8.93
					8.45
					8.78
					9.01
					10.82
					7.46
					10.88
					10.76
					8.35

Ulna	SDO	DPA	BPC
	23.08	26.38	16.88
	19.59	23.91	
		27.06	18.3
		28.97	20.74

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Ovis aries/Capra hircus

Metacarpus III + IV	**Bp**	**Dp**	**SD**	**DD**
	24.73	16.9	15.56	11.73
		13.77		10.24
		17.12		9.33
		16.98		14.06
			10.64	8.14
			11.08	9.17
			14.41	11.82
				9.44
				6.92
				7.61
				8.86
				9.42
				10.97
				10.59
				9.34
				10.38
				10.55
				12.25
				9.81
				9.45
				8.07
				8.71

Vertebra cervicalis	**PL**
	28.46
	27.04

Pelvis	**SB**	**SH**	**LA**
	10.23	16.1	30.01
	10	18.27	
	7.69		
			31.65

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Ovis aries/Capra hircus

Femur	DC	SD	DD
	19.89		
		15.15	16.21
		17.23	17.28
		17.35	19.78
		15.41	15.08
		17.42	17.51
		15.21	17.09
		17.17	17.18
		16.66	17.67
		18.01	
		15.95	
		15.89	
		14.56	
		12.45	
		15.62	
		15.09	
		13.71	
		13.26	
		17.71	
		17.61	
		14.5	
		16.9	
		17.73	
		16.48	
		16.52	
		18.7	
		14.48	
			15.56
			17.55
			16.28
			15.85
			14.51
			16.09
			16.34
			16.02
			14.84
			16.58

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Ovis aries/Capra hircus

Tibia	SD	DD
	15.67	13.27
	14.44	13.91
	12.71	10.45
	11.92	9.75
	12.61	11.41
	13.9	11.38
	13.18	12.6
	14.59	14.06
	13.34	11.35
	13.46	11.16
	14.63	11.74
	13.35	11.72
	12.75	10.22
	13.85	11.29
	14.11	11.96
	16.31	13.37
	14.05	13.29
	14.43	12.11
	14.79	11.25
	14.09	12.14
	15.12	11.38
	13.77	11.42
	14.17	10.26
	14.35	11.38
	14.43	12.35
	14.61	12.09
	12.03	10.23
	13.51	11.47
	13.5	11.22
	15.38	12.01
	11.03	10.56
	15.83	12.82
	13.56	11.61
	14.76	13.01
	13.98	11.95
	15.52	
	10.29	
	12.57	
	15.28	
	14.57	
	15.08	
	13.37	
		9.73
		9.77
		8.98
		9.88
		9.96
		12.39
		12.08
		13.28
		14.51
		12.52
		11.13
		12.89
		12.58
		12.05

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Ovis aries/Capra hircus

Astragalus	GLl	GLm	Dl	Dm	Bd	
	26.04	24.91	14.36		15.99	
	24.82		13.74	13.44	16.26	
	31.87		16.3		17.26	
	28.02		15.94			

Metatarsus	Bp	Dp	SD	DD	Bd	Dd
	19.35	19.22	10.87	11.2		
	19.58		14.02	14.65		
	21.59		13.54			
	16.43					
	20.98					
		16.15				
		18.6				
			16.59	11.07	24.62	15.85
			11.16	9.53	24.87	17.47
			12.93	10.43		16.93
			10.72	11.12		
			10.61	10.6		
			12.49	11.5		
			10.38	9.6		
			13.08	9.88		
			11.91	11.63		
			11.5	11.81		
			19.26			
			12.02			
			10.38			
			13.08			
			11.93			
			13.54			
				8.65		14.61
				11.59		
				9.22		
				9.92		
				11.39		
				9.94		
				13.92		
					22.75	13.68

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	34.06	10.95	13.67	8.49	8.64	10.39	8.29
	34.74	11.97	14.37	9.88	9.38	11.55	10.85

Phalanx 2 posterior	GL	Bp	Dp	SD	DD	Bd	Dd
	23.78	10.8	11.7	7.5	9.45	8.67	9.24

Phalanx 1 ant. / post.	SD	DD	Bd	Dd
	10.49	8.42	11.2	10.16
	10.28	8.12	10.97	9.88

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Sus domesticus

SUS DOMESTICUS

lost upper tooth M3	B	L
	20.22	37.58
	20.07	38.09
	18.89	35.1

lost lower tooth M3	B	L
	15.38	37.6
	14.5	33.9
	15.9	35.73

Scapula	GLP	LG	BG	SLC
	38.49	33.14	28.95	27.81
	35.18	30.81	25.24	23.79
	30.2	28.56	21.72	
			29.11	
				25.62
				21.7

Humerus	SD
	19.5
	17.19
	18.79
	18.21
	18.04
	17.55
	17.32

Radius	Bp	Dp	SD
	28.49	20.69	20.94
		18.53	22.25

Ulna	SDO	DPA	BPC
	27.3	32.41	22.6
	29.02	36.7	19.8
	28.64	38.48	
	30.43	38.41	
		42.97	24.54

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Sus domesticus

Metacarpus IV	Bp	Dp	SD
	16.53	16.51	13.11
	16.18	16.81	

Atlas	H
	48.37

Pelvis	SB	SH
	15.15	24.59
	15.83	25.42
	11.21	

Femur	SD
	20.65
	22.06
	19.65
	20.76
	24.04
	19.7
	18.09
	20.87
	20.67
	20.58
	20.49
	18.96
	18.48

Patella	GL	GB
	39.42	24.69

Tibia	SD	Bd	Dd
	20.8		
	20.84		
		31.09	26.06

Calcaneus	GB
	26.33
	23.31
	22.49

Centrotarsale	GB
	35.31

Naviculare (T.)	GB
	31.63

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Sus domesticus

Metatarsus III	**Bp**
	18.44

Metatarsus IV	**Bp**	**Dp**	**SD**
	16.12	22.07	12.87

Phalanx 1 anterior	**GLpe**	**Bp**	**Dp**	**SD**	**Bd**	**Dd**
	35.72	17.47	18.04	14.3	16.68	11.4

Phalanx 2 anterior	**GL**	**Bp**	**Dp**	**SD**	**Bd**	**Dd**
	24.34	16.69	17.42	13.6	14.54	12.89
	25.4	17.94	17.64	15.06	16.73	15.49
		18.1	17.75	14.92	15.68	14.33

Phalanx 2 posterior	**GL**	**Bp**	**Dp**	**SD**	**Bd**	**Dd**
	24.2	16.3	17.09	14.02	13.77	15.54

Phalanx 3 ant. / post.	**MBS**	**DLS**	**Ld**
	12.64	31.89	26.55

Canis familiaris

CANIS FAMILIARIS	
Femur	**SD**
	13.29

Appx. Tab. 25. Osteometry; Late Bronze Age (Field 3, Horizon B).

Capra ibex, Apodemus spec., Ciconia ciconia

CAPRA IBEX									
Radius	**GL**	**Bp**	**BFp**	**Dp**	**SD**	**DD**	**Bd**	**BT**	**Dd**
	215.72	38.35	33.61	19.96	22.31	14.89	33.59	26.74	21.03
Pelvis	**SB**	**SH**							
	11.35	17.3							
Femur	**SD**								
	21.97								
Tibia	**SD**	**DD**							
	21.5	16.93							

APODEMUS SPEC.	**GL**	**L condyle**	**L M1-M3**	**H front M1**	**Width Incisivus**
Mandibula	14.65	12.39	4.67	3.56	1.17

CICONIA CICONIA			
Ulna	**SC**	**Dd**	**Did**
	10.26	13.37	17.44

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Equus caballus

EQUUS CABALLUS Vertebra lumbalis	BFcr	BFcd	PL	HFcr
	47.42	44.28	42.26	23.24

Bos Taurus

BOS TAURUS lost upper tooth M3	B	L
	20.63	31.09
	21.3	31.01
	18.89	29.1
	20.1	30.06
	18.21	26.7
	21.37	30.24
	17.95	26.91
	18.57	29.01
	17.86	27.56
	15.67	26.93
	20.71	28.73
	19.57	28.71
	19.11	29.06
	19.41	29.02
	18.43	25.83
	18.46	25.81
	19.13	26.86
	18.85	26.75
	18.64	28.3
	18.47	29.66
	18.07	26.58
	14.93	28.53
	18.3	26.28
	15.77	26.79
	15.94	27.33
	15.57	26
	20.16	29.8
	16.83	28.03
	15.29	25.94
	17.15	29.19
	16.48	29.33
	14.43	26.27
	18.34	27.26
	14.81	25.73
	13.76	26.43
	16.3	26.37
	15.45	29.23
	15.76	27.89
	12.88	25.12
	14.53	28.37
	15.69	24.94
	15.44	23.36
	15.51	25.33
	13.17	24.51
	15.44	26.58
	15.9	29.36
	14.39	26.64
	11.63	24.54
	14.34	24.46
	14.25	28.81

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

lost lower tooth M3	B	L
	17.06	35.03
	15.11	36.49
	15.08	36.23
	12.55	34.78
	14.03	32.94
	13.42	34.88
	14.86	34.45
	14.36	36.19
	16.03	34.66
	15.63	40.33
	13.73	35.89
	11.13	32.08
	11.68	33.2
	13.12	36.26
	13.03	35.28
	12.56	34.84
	11.19	33.89
	12.21	33.68
	13.26	39.22
	12.21	34.28
	12.87	36.22
	12.19	34.82
	13.4	34.01
	14.13	35.77
	12.71	35.33
	11.66	35.95
	12.97	34.16
	13.34	35.95
	10.96	34.62
	12.05	33.43
	14.29	37.72
	13.09	37.51
	11.51	32.57
	10.94	30.24
	10.6	32.66
	11	32.47
	10.74	32.42
	14.45	
	11.26	
	12.88	
	10.72	
	12.39	

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Cranium with horn core	GD base	LD base	Basal circumference
	42.57	42.2	110
	44.22	39.01	110
	43.63	36.3	

Mandibula	L P4-P2	L G	L d	H front P2	H front M1
	53.04			30.33	
	51.18				
		84.69			
			91.12	34.56	
			71.58	30.41	
			45.78	22.26	
			76.4	34.31	
				28.58	
				33.62	
					40.51

Scapula	GLP	LG	BG	SLC
	60.35	49.5	41.39	46.51
	42.29	37.51	28.75	29.72
	58	51	40.17	45.59
	58.9	50.84	40.86	43.77
	48.04	43.44	34.12	38.54
	56.42	50.83	40.66	44.09
	61.82	54.38	45.79	55.31
	56.8	50.64	39.69	32.94
	58.1	51.69	40.7	37.93
	55.13	47.93	40.9	46.45
	51.85	45.89	36.62	39.56
	63.02	53.34	40.19	49.44
	60.93	53.34	40.19	49.44
	60.18	51.33	40.08	53.17
	58.08	46.09	42.01	48.11
	62.26	52.21	41.26	48.77
	60.66	53.42	45.03	54.72
	68	57.87	47.23	52.7
	70.22	60.53	51.66	52.12
	64.9	54.42	42.28	52.73
	53.7	48.19	43.36	41.98
	55.83	48.81	35.97	47.4
	71.43	56.79	50.48	
	54.09	46.42	39.15	
	50.62	41.84	32.69	
	52.51	43.69	35.9	
	59.11	51.08		45.59
	60.47			53.37
	56.72	52.79		
	60.09	53.77		
	64.79	56.85		
	44.37			
		42.8	39.12	43.29
		53.21	39.79	50.74
		56.7	43.31	
		45.22		
			35.42	
			39.62	42.04

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Humerus	Dp	SD	DD	Bd	BT	Dd
	32.8					
		32.33	39.04	79.73	67.32	71.5
		29.79		63.28	60.45	47.92
		27.67		63.4	60.72	
		35.7	41.94			57.09
		31	37.74			
		29.69	36.42			
		27.8	35.67			
		32.63	40.18			
		33.61	40.42			
		34.58				
		30.18				
		33.12				
		35.05				
		33.55				
		27.79				
		33.55				
		33.49				
		34.42				
		36.94				
			34.15			
			34.31			
			38.73			
			35.67			
			30.76			
			31.93			
			36.53			
			37.08			
			33.4			
			28.13			
			53.83			
			39.14			
			37.85			
			39.43			
			30.42			
			34.19			
				69.46	62.34	45.48
				76.02	65.44	49.07
				85	72.06	
				70.06	69.19	
						34.89
						81.83
						50.95
						69.54
						37.78
						60.59
						39.77

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Radius	Bp	BFp	Dp	SD	DD	Bd	BFd	Dd
	75.52	71.33	40.65					
	84.59	76.59	44.97		24.07			
	68.59	63.93	33.36					
	68.59		27.82					
			28.13		17.52		83.34	
			39.06		23.57			
			34.85		20.56			
			36.85		24.81			
			31.2		20.57			
			27.07		17.51			
			34.1		21.63			
			29.46		17.86			
			36.87		24.03			
			36.27					
			34.13					
			32.8					
			35.15					
			33.14					
			37.68					
			37.71					
			35.98					
			22.61					
			26.71					
			32.12					
			35.95					
			35.98					
				33.36				

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Radius	Bp	BFp	Dp	SD	DD	Bd	BFd	Dd
					21.95			
					22.65			
					18.94			
					21.87			
					18.77			
					19.28			
					22.84			
					23.15			
					21.84			
					17.21			
					16.88			
					33.16			
					18.11			
					17.28			
					22.32			
					21.35			
					20.65			
					28.22			
					24.11			
					18.56			
					27.19			
					19.4			
					25.46			
					20.98			
					20.25			
					16.45			
					21.02			
					22.65			
					24.73			
					19.24			
					21.97			
					17.9			
					19.91			
					17.59			
					20.23			
					14.83			
					19.16			
					20.2			
					25.9			
					21.64			
					18			
					17.34			
						60.54	54.47	30.97
						41.9		
							35.67	
							37.78	
							60.69	
							39.77	
							37.66	

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Ulna	DPA	SDO	BPC
	50.58		37.63
	58.7		
	50.48		
	54.09		
	57.69		
		26.54	
		42.27	
			29.44
			28.17

Radius & Ulna	SD	DD
	35.08	18.92
	34.43	22.18

Carpalia	GB
	41.74
	33.76
	32.73
	32.35
	40.36
	36.02

Radiale (Carpus)	GB
	34.7
	36.57
	35.7

Ulnare (Carpus)	GB
	34.45

Intermedium (Carpus)	GB
	42.24
	40.21
	41.84
	31.13

Os carpale IV (Carpus)	GB
	26.88

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Metacarpus III + IV	Bp	Dp	SD	DD	Bd	Dd
	51.38	31.32	26.95	20.43		
	39.18		28.75	22.19		
	57.15	33.28	32.07	24.24		
	60.96	36.55	34.29	22.26		
		33.66		23.05		
		27.2				
		24.85				
		44.53				
		30.99		22.24		
		19.69		18.96		
		29.18				
		34.35				
		35.68				
		35.18				
		27.59				
		28.4				
		32.69		25.31		
		31.91		24.85		
		25.27				
		34.47				
			34.9	24.5		
			23.65	16.68		
			24.47	17.76		
				20.07		
				20.7		
				22.75		
				19.22		
				19,15		
				17.02		
				15.97		
				16.81		
				18.99		
				19.35		
				20.52		
				19.86		
				19.67		
				20.7		
				21.1		
				20.07		
				24.61		
				18.1		
				23.9		
				19.47		
				21.67		
				18.73		
				20.17		
				23.73		
				23.59		
				25.49		
				20.41		
				21.21		
				21.23	49.04	25.51
				17.87		26.66
				17.38		
				22.42		
				23.61		
				18.12		
					59.78	29.87
					51.28	27.77
					60.7	29.43
					50.2	25.88
					64.83	32.27
					50.61	27.64
						26.43
						34.47

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Epistropheus	BFcr	SBV		
	77.39	45.16		
	82.51			

Vertebra cervicalis	BFcr	HFcr	PL	BPacd
	22.21	29.62		
	28.51		44.75	
			52.58	
			50.66	
				57.04

Vertebra thoracalis	PL
	48.33

Vertebra lumbalis	BFcr	BFcd	HFcr	PL
	42.95	32.65	40.41	60.81
	35.79	36.72		58.19
	42.07	47.38	37.95	64.93
	35.76	36.87	28.2	55.87
				59.33
				55.18

Pelvis	SB	SH	LA	
	11.9	38.4		
	21.71	37.23		
	12.47	41.37		
	23.19	38.97		
	10.15	32.24		
	19.9	34.95		
	11.45			
	12.29			
	15.6			
	16.22			
	9.9			
	10.42			
	12.9			
	13.98			
	26			
	83			
	22.4			
	22.75			
	32.24			
	22.67			
	17.54			
	26.22			
	19.01			
			68.56	
			57.73	
			41.17	
			76.67	
			63.21	
			74.96	
			65.49	

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Femur	DC	SD	DD
	40.76		
	43.04		
	39.85		
	35.68		
	43.82		
	39.41		
	43.56		
		38.16	32.5
		35.18	31.95
		27.39	25.64
		37.3	34.43
		41.13	31.99
		36.07	30.63
		34.96	31.73
		31.43	
		39.27	
		38.58	
		30.74	
		35.03	
		35.22	
		35.96	
		39.36	
		30.7	
		37.95	
		34.4	
		31.89	
		28.75	
		28.53	
			34.31
			27.87
			27.7
			33.51
			25.77
			32.94

Patella	GL	GB
	58.29	51.23
	64.52	50.94

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Tibia	SD	DD	Bd	Dd
	34.67	24.2	52.84	38.06
	31.51	23.48	53.57	39.04
	35.37	24.6		
	34.11	24.41		
	32.9	23.42		
	35.55	30.7		
	34.23	23.06		
	37.03	26.23		
	31.02	23.76		
	33.1	24.85		
	28.38			34.86
	28.29			
	31.6			
	29.6			
	28.74			
	30.76			
	41.06			
	29.12			
		23.35	51.51	37.07
		26.81		
		25.56		
		26.55		
		25.24		
		25.01		
		27.25		
		27.86		
		27.27		
		22.92		
		19.64		
		23.61		
		24.18		
		25.15		
		25.54		
		19.51		
		23.56		
		25.31		
			52.18	36.83
			39.01	35.59
			51.29	36.54
			39.94	
			48.15	
				42.49

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Astragalus	GLl	GLm	Dl	Dm	Bd
	58.25	51.59	32.72	30.77	35.81
	53.65	51.38	30.27	32.07	35.69
	57.17	51.55	29.40	30.07	37.24
	61.71	54.19	35.54	31.45	35.72
	52.00	47.72	28.54	27.62	34.30
	57.21	52.46	32.30	27.97	34.10
	59.27	53.53	32.84	34.41	39.22
	65.07	57.77	33.90	33.75	40.81
	60.19	55.10	35.82	30.48	37.58
	61.74	56.54	33.90	33.11	37.75
	59.85	54.13	30.83	30.99	37.74
	60.39	54.62	33.5	30.47	37.19
	61.59	57.72	35.51	30.71	38.33
	58.19	52.6	34.68	31.81	36.80
	58.15	51.89	32.94	29.32	38.27
	56.48	53.86	31.94	26.00	35.67
	64.83	59.83	36.96	36.85	42.31
	63.05	59.42	36.44	37.21	39.85
	62.87	54.73	35.35	33.24	39.22
	55.42	52.21	31.50	31.01	33.68
	60.02	54.56	32.60	32.68	36.86
	55.35	51.74	33.04	32.05	34.65
	63.06	58.58	37.56	32.14	42.61
	61.38	54.66	35.80	33.69	38.20
	61.50	56.72	35.99	32.51	
	59.63	55.55	33.38	32.96	
	60.09	54.22	32.43	33.86	
	61.00	54.91	34.38	34.68	
	57.51	56.09	33.98	31.58	
	55.39	50.24	30.07		31.74
	59.35	54.20			
	63.90	58.78			
	60.45		33.85	30.95	39.33
	56.52	51.90	32.53	31.50	
	57.23		32.77		34.76
	58.45		35.84		
	57.28		32.88		
	60.40			31.26	
	57.32		31.20	31.11	34.15
	58.02		34.18		
			32.53	31.50	
		52.60	32.66	31.66	
		55.43		30.98	
			29.90		
			38.87	32.84	41.90

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Calcaneus	GL	GB
	113.75	31.88
	114.34	34.55
	116.53	41.27
	112.66	
		32.78
		37.46
		47.83
		38.62
		35.24
		42.29
		38.41
		39.35
		35.5
		36.41
		41.01
		38.4
		31.06
		31.58

Centrotarsale	GB
	48.09
	52.01
	50.70
	47.62
	51.10
	50.36
	54.89

Os malleolare (Tarsus)	GB
	42.85

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Metatarsus III + IV	Bp	Dp	SD	DD	Bd	Dd
	48.16	45.93		30.25		
	43.26	38.35				
	40.37	37.14				
	43.02	40.3				
	54.64		27.42			
	45.24			26.27		
	39.66					
	33.28					
		43.84	26.53	28.04		
		31.09		20.49		25.53
		43.46		27.18		
		42.37		25.7		
		50.84		36.26		
		43.31				
		45.4				
		29.49				
			21.67	20.73		
			25.27	22.04		
			21.71	24.44		
			22.44	24.22		
			25.78			
			21.73			
			23.86	26.57		
			20.61			
			22.47			
			23.34			
			23.04	21.8		
			22.3	23.43		
			23.47	20.88		
				24.32		
				23.21		
				18.57		
				20.15		
				23.15		
				25.68		
				25.17		31.2
				29.7		
				24.76		
				23.95		31.25
				24.04		
				23.79		
				24.27		
				24.11		
				21.91		
				23.23	50.57	28.15
				22.7		
				21.64		
				23.69		
				23.39		
				24.45		
				22.21		
				20.37		
					49.15	27.72
					47.76	26.28
						25.52
						27.03
						26.44

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Phalanx 1 anterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	56.31	34.97	36.63	28.95	24.86	31.96	21.64
	54.13	28.47	31.16	23.39	20.52	26.77	18.28
	55.48	31.56	34.22	24.84	20.74	25.89	22.16
	59.2	29.53	34.26	27.46	22.73	28.05	19.67
	61.45	33.19	33.97	27.47	23.61	29.49	25.46
	60.76	29.79	34.67	25.7	23.54	29.55	22.33
	51.79		31.68	26	22.47	28.56	20.1
		38.35	27.29				

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	51.94	26.19	28.43	22.15	21.37	25.47	20.67
	54.16	25.67	31.22	22.1	19.61	23.7	19.91
	55.61	25.32	29.65	20	19	22.5	18.66
	55.34	25.92	30.61	21.81	23.16	24.01	19.3
	57.09	26.82	33.22	23.27	21.79	27.52	21.54
	59.2	27.81	33.83	25.91	22.81	28.72	20.52
	57.28	28.53	31.61	24.91	19.42	26.4	20.06
	58.9	28.93	33.37	25.71	23.2	27.26	20.94
			28.45		19.24		

Phalanx 1 ant. / post.	Glpe	Bp	Bd	SD	DD	Dd
	53.98					
		23.39	26.87	21.65		
		20.55	19.89	10.09		
		24.11		19.23		
			28.6	25.57	21.7	20.82

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Bos taurus

Phalanx 2 anterior	Glpe	Bp	Dp	SD	DD	Bd	Dd
	33	27.36	28.45	21.73	23.15	22.39	25.35
	38.42	32	32.56	24.64	23.85	25.31	31.26
	35.81	30.58	32.29	23.61	26.15	25.52	31.89
	42.83	30.09	32.6	23.88	24.58	25.78	31.91
	37.32	28.26	30.09	21.9	25.62	22.71	28.86
	34.92	28.06	27.92	22.51	23.32	23.22	27.89
	34.35	26.87		22.16		24.81	
	35.29	27.84		21.81		22.8	

Phalanx 2 ant. / post.	Glpe	Bp	Dp	SD	DD	Bd	Dd
	35.76	24.5	26.92	19.91	18.95	20.77	22.76
	36.49	26.37	29.27	21.2	21.85	21.9	25.67
	37.61		29.28	19.79	20.47	19.91	23.79
	44.27	24.33		20.54		20.62	
	30.1						
				19.74	18.15	22.16	15.5
				16.09	16.25		
						18.54	

Phalanx 3 ant. / post.	MBS	Ld	DLS
	18.84	46.81	59.41
	24.08	49.05	63.13
	19.37	47.13	61.47
	23.18	48.94	64.72
	27.58	56.27	65.58
	26.88	53.59	73.84
	24.11	47.07	60.54
	23.08	51.07	
	20.71		60.54
	20.01		
	24.7		
	19.32		
	23.46		
	22.33		
		44.79	

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries

OVIS ARIES

Cranium with horn core	GD base	LD base	Basal circumference	
	57.29	48.77	150	
	48.36	44.24	135	

Scapula	GLP	LG	BG	SLC
	30	25.54	21.83	21.75

Humerus	SD	DD	Bd	BT	Dd
	11.08				
	16.57				
	18.95	15.9	31.2	29.46	25.95
	15.76	16.6	30.02	28.53	24.06
	16.86		33.5	32.73	29.35
			30.58	28.27	26.41
			35.34	33.51	31.04
			33.66	32.78	29.08
			29.98		

Radius	Bp	Dp	BFp	Bd
	30.18	16.72	28.32	
				28.65

Ulna	DPA	SDO
	25.37	21.58
	27.46	24.52

Metacarpus III + IV	Bp	Dp	SD	DD
	24.16	17.44	14.54	11.59

Pelvis	SB	SH	LA
	9.73	14.97	30.85
	6.91	17.84	

Tibia	Bd	Dd
	25.83	20.31

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries

Astragalus	GLl	GLm	Dl	Dm	Bd
	29.5	28.01	16.72	17.05	19.14
	29.57	27.82	17.1	17.31	19.52
	27.22	25.34	16.99	17.69	17.42
	29.43	27.08	15.76	16.67	20.14
	28.17	26.53	16.75	16.35	18.11
	28.65	27.79	16.52	17.19	

Calcaneus	GL	GB
	51.8	17.25
		17.58
		18.57

Centrotarsale	GB
	24.9

Phalanx 1 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	37.2	13.6	14.42	8.76	9.35	10.52	9.18

Phalanx 2 posterior	GLpe	Bp	Dp	SD	DD	Bd	Dd
	22.82	12.41	12.32	8.79	9.1	9.6	11.6
	24.63	10.65	11.36	7.67	8.04	8.67	9.78

Ovis aries?

OVIS ARIES?

Radius	Bd	BFd
	29.28	26.88

Capra hircus

CAPRA HIRCUS

Cranium with horn core	GD base	LD base
	27.87	22.96
	34.29	32.01

Humerus	Bd	BT	Dd
	29.85	26.91	24.15

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

lost upper tooth M3	B	L
	10.14	17.64
	11.08	17.45
	10.44	18.18
	10.72	17.45
	10.1	17
	10.05	17.7
	10.99	17.26
	11.45	17.02
	9.28	16.24
	10.92	17.83
	10.73	18.17
	10.48	16.38
	11.47	17.41
	12.53	17.87
	12.05	17.17
	11.71	16.66
	11.49	18.66
	12.97	18.97
	12.87	18.51
	11.02	17.04
	10.34	17.25
	11.32	17.88
	12.27	18.78
	8.87	
	8.88	

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

lost lower tooth M3	B	L
	8.43	19.44
	7.74	22.06
	8.95	23.9
	9.02	23.79
	7.87	22.41
	8.41	22.16
	9.27	22.3
	8.37	21.77
	7.74	20.26
	7.43	19.54
	7.8	23.35
	9.34	26.13
	7.17	19.45
	8.12	22.19
	8.01	22.84
	7.97	21.1
	8.56	21.08
	7.84	21.33
	8.11	21.04
	7.66	22
	7.56	20.69
	8.89	24.24
	7.98	22.68
	7.66	20.02
	7.91	20.62
	7.93	21.94
	7.51	19.35
	7.06	21.41
	7.44	20.71
	8.09	22.04
	8.49	21.15
	7.88	21.28
	7.52	20.23
	7.44	20.32
	7.88	19.86
	7.79	21.75
	7.87	22.74
	7.15	20.34
	7.46	21.94
	7.28	19.52
	6.88	19.72
	7.52	22.51
	7.57	23.37
	7.59	21.96
	7.44	
	7.12	
	7.86	
	7.47	
	8.06	
	8.03	
	7.3	

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Mandibula	L diastema	L P4-P2	L M3-M1	H front P2	H front M1
	32.98	21.03		15.88	
	35			15.42	
	27.85			14.38	
	30.18			15.39	
	32.44			15.29	
	24.59			12.42	
	29.34			14.1	
			48.75		
				9.95	
				11.93	
				13.25	
				11.6	
				17.07	
				17.8	
				14.68	
				13.58	
				12.58	
				14.76	
				14.21	
					13.58
					12.64

Scapula	GLP	LG	BG	SLC
	29.46	21.05	19.25	22.22
	30.08	20.09	20.85	24.45
	24.56	21.49	17.83	17.72
	27.84	23.36	17.92	21.71
	20.11	18.01		14.67
	22.67	19.93		
	29.08			
		27.34	22.11	20.65
		19.8	18.06	
		25.02		
			20.83	17.59
			14.88	16.3
			17.52	
				15.86
				16.27
				18.34

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Humerus	SD	DD	Bd	BT	Dd
	15.73	16.6	30.83	28.74	27.02
	12.91	15.55			
	13.86	15.56			
	17.19	18.87			
	13.24	10.01			
	18.93				
	14.96				
	13.15				
	16.65				
	13.19				
	15.82				
	18.09				
	16.35				
	15.1				
	17.04				
	14.93				
	14.67				21.28
		17.13			
		11.71			
		16.52			
		16.321			
		17.2			
		17.11			
		18.06			
		13.64			
			31.63	28.15	18.14
			31.36	28.84	21.27
			27.67	25.02	23.57
			26.11	25.5	18.87
			29.05	28.8	20.36
			31.41	29.37	23.46
			28.78	28.47	
			31.83	30.55	
			29.08		

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Radius	SD	DD	Dd
	15.51	9.7	
	13.6	7.32	
	17.21	9.75	
	14.98	9.17	
	14.67	6.74	
	16.78	9.25	
	16.21	10.81	
	16.63	8.64	
	17.62	9.59	
	15.69	7.76	
	18.25	10.33	
	14.45	8.83	
	14.96	7.95	
	14.19	6.98	
	13.3	7.57	
	13.87	7.86	
	12.56	7.81	
	15.98	10.01	
	16.38	9.97	
	18.66	10.9	
	16.06	8.51	
	16.55	9.82	
	16.52	9.96	
	14.33	8.11	
	17.84	9.81	
	13.91	7.9	
	14.93		
		8.06	15.16
		8.31	15.15
		9.8	
		7.77	
		9.31	
		7.9	
		7.72	
		8.92	
		8.01	
		6.9	
		7.15	
		7.98	
		10.1	
		8.6	
		10.67	
		8.38	
		8.82	
		9.8	
		8.49	
		9.75	
		10.67	
		10.04	
		9.58	
		8.08	
		10.12	
		9.94	
		8.92	
		9.06	
		9.55	
		10.95	
		7	
		6.64	
		8.74	
		6.88	
		8.73	
		8.17	
		7.13	
			14.47
			12.59
			14.88
			8.5
			9.25
			20.14

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Ulna	DPA	SDO
	31.24	23.49
		31.55

Radius / Ulna	SD	DD
	16.51	9.57

Metacarpus III + IV	Bp	Dp	SD	DD
	22.88	15.07	15.2	10.2
		13.87		9.22
		16.65		
		19.31		
		14.49		
		15.4		
			13.59	10.07
			14.21	9.62
			11.42	8.45
			16.18	12.28
			13.18	10.41
			13.1	9.71
			16.86	11.31
			14.98	11.45
			11.46	8.3
			12.11	8.78
			12.04	
			13.78	
			11.73	
				7.95
				9.48
				10.53
				10.2
				9.2
				11.71
				11.76
				10.44
				11.48
				8.89
				11.07
				13.19
				8.55
				9.72

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Epistropheus	LCDe	SBV		
	51.78	20.52		

Vertebra cervicalis	BFcr	BFcd		
	23.49	19.72		

Vertebra lumbalis	BFcr	BFcd	PL	HFcr
	22.85	20.28	33.27	16.59
	24.73	21.56	33.66	15.84
	20.7	22.71	33.97	19.58
	17.97		29.5	15.54
	18.54			15.66
			31.28	

Pelvis	SB	SH	LF0	LA
	8.82	16.69		28.51
	7.48	10.01		
	12.63	16.04		
	10.38	14.53		
	8.46	12.85		
	8.32	16.77		
	13.44		39.68	
	17.91			33.23
	17.13			30.51
	9.64			
	9.05			
	13.41			
			33.92	22.45
				28.43
				28.35
				29.14

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Femur	DC	SD	DD	Bd	Dd
	20.31				
	21.85				
	19.97				
	19.08				
	22.06				
	22.08				
		16.61	18.76		
		15.19	17.47		
		15.84	17.32		
		16.15	12.86		
		17.54	15.4		
		12.1	13.88		
		13.86	14.63		
		15.94	15.55		
		15.52	14.81		
		13.15	12.72		
		17.8	15.04		
		15.97	16.05		
		20.73	20.92		
		16.38	16.47		
		14.94	15.67		
		16.99	18.71		
		18.32	19.8		

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Femur	DC	SD	DD	Bd	Dd
		17.9			
		15.84			
		14.33			
		15.37			
		13.67			
		15.29			
		16.01			
		16.1			
		13.24			
		14.92			
		11.43			
		15.73			
		15.1			
		21.2			
		15.47			
		15.98			
		15.95			
		16.63			
		19.82			
		18.99			
		16.21			
		14.24			
		15.96			
		15.61			
		18.33			
		15.78			
		14.71			
		16.89			
		11.02			
		12.7			
		14.53			
		14.51			
		17.93			
		16.83			
		14.63			
			15.42		
			14.4		
			13.64		
				35.8	46.4
					21.69

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Tibia	SD	DD	Bd	Dd
	12.05	10.46		
	13.45	11.86		
	15.91	13.52		
	13.82	12.3		
	13.5	12.45		
	11.83	8.23		
	13.68	12.03		
	12.51	10.92		
	11.87	8.91		
	13.69	11.7		
	11.6	9.89		
	13.72	11.66		
	10.25	11.09		
	12.75	15.22		
	10.88	10.13		
	12.5	12.78		
	13.67	10.9		
	13.26	13.06		
	13.65	10.88		
	15.82	12.18		
	15.57	13.73		
	12.41	12.02		
	12.86	10.23		
	15.12	12.36		
	15.52	14.04		
	13.46	11.2		
	13.84	11.4		
	11.49	11		
	16.15	12.7		
	13.83	12.03		
	13.59	12.12		
	13.82	13.26		
	16.83	13.91		
	15.45	15.12		
	15.21	12.5		
	11.9	10.52		
	15.36	12.37		
	14.3	12.02		
	12.43	10.55		
	13.25	10.14		
	15.02	15.73		
	13.37	10.44		
	15.14	12.25		
	12.43	10.08		
	12.82	10.78		
	13.03	11.48		
	12.81	10.53		
	14.67	11.62		
	13.75	11.68		
	14.12	12.99		
	12.82	11.18		
	12.52	11.36		
	13.39	10.46		
	17.2	13.02		
	12.7	11.6		
	13.62	11.79		
	13.06	12.27		
	11.13	10.66		
	13.55	11.9		
	16.87	15.85		
	13.71	12.01		
	13.81	11.93		
	15.42	12.63		
	13.38	11.09		
	12.96	11.21		
	13.13	11.94		
	14.37	12.07		
	13.55	12.06		
	13.83	10.93		
	10.44	9.87		
	17.42	17.28		
	15	11.64		
	13.49	11.55		
	14.87	12.03		
	15.57	12.94		

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Tibia	SD	DD	Bd	Dd
	11.3			
	13.45			
	15.11			
	11.74			
	11.13			
	17.25			
	12.92			
	10.44			
	11.89			
	12.25			
	12.17			
	14.63			
	13.11			
	12.15			
	13.46			
	12.34			
	12.37			
	12.93			
	14.82			
	11.64			
	10.51			
	16.86			
		11.12		
		12.91		
		11.64		
		14.2		
		11.8		
		11.45		
		15.04		
		12.63		
		12.1		
		12.93		
		10.53		
		12.4		
		14.71		
		10.92		
		11.41		
		9.41		
		13.51		
		12.76		
		11.18		
		13.07		
			24.49	18.54
			23.24	16.9
			23.76	20.28
			22.05	14.83
				17.23
				20.57

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Astragalus	GLl	GLm	Dl	Dm	Bd	
	29.96	28.37	17.65	17.73	19.58	

Calcaneus	GB
	17.77

Centrotarsale	GB
	19.13
	23.1
	22.5

Metatarsus III + IV	Bp	Dp	SD	DD	Bd	Dd
	21.87		12.37	13.08		
		15.81		10.52		
		20.11				
		19.5		11.62		
			10.96	1079		
			11.3	11.91		
			13.41	13.14		
			11.2	9.45		
			10.56	9.62		
			10.18	10.37		
			12.25	12.53		
			11.84	9.34		
			12.5	12.78		
			11.04	10.58		
			12.94	11.01		
			12.26	11.2		
			10.33	10.23		
			11.5	10.57		
			11.17	9.62		
			10.03	9.23		
			9.22	8.96		
			11.15	9.84		
			11.17	10.34		
			12.46	12.22		
			12.33	10.93		
			11.36	10.64		
			13.1	12.04		
			14.05	13.26		
			11.05	11.53		
			13.88	11.04		
			10.44			
			11.69			
			11.12			
			12.8			
			11.47			
			12.09			
			10.61			
			17.34			
				11.67		
				9.82		
				11.72		
				11.96		
				9.94		
				9.56		
				12.19		
				11.62		
				9.89		
					24.06	16.2

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Ovis aries/Capra hircus

Phalanx 1 anterior	**Bp**	**Dp**	**DD**
	12.77	15.33	11.91

Phalanx 2 posterior	**Bp**	**Dp**	**SD**	**DD**	**Bd**	**Dd**
	9.95	10.73	7.23	7.81	6.94	7.81

Phalanx 1 ant./post.	**GLpe**	**Bp**	**SD**	**Bd**
	32.11			
	11.58	11.58		
			9.01	9.92
			9.57	11.01
				10.17

Phalanx 3 ant./post.	**MBS**	**Ld**	**DLS**
	6.39	22.26	28.18
	10.11	19.97	
	10.11	19.97	

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Sus domesticus

SUS DOMESTICUS

lost upper tooth M3	B	L
	18.42	34.9
	15.04	33.48
	18.21	29.72
	14.95	

lost lower tooth M2	B	L
	14.82	22.46
	14.38	21.67
	12.76	22.45
	12.84	21.51
	14.96	21.81
	12.97	22.69
	14.35	20.88

lost lower tooth M3	B	L
	15.23	36.62
	15.66	38.51
	14.33	31.43
	14.62	34.18
	15.4	34.6
	15.15	30.57
	14.62	36.74
	16.12	37.32
	16.57	35.31
	18.08	40.42

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Sus domesticus

Mandibula	L M3-P2	L M3-P1	L M3-M1	L P4-P2	L P4-P1	L diastema	H front P2
	108.98	126.31	72.04	36.41	54.27		
						40.73	46.54

Scapula	GLP	LG	BG	SLC
	34.93	29.58	21.96	25.06
	35.89	27.63	25.51	23.59
	34.90	30.99	22.13	22.58
	39.28	32.73	26.26	27.76
	28.83	25.16		20.29
	38.60	33.84		29.41
	32.48	26.94	25.32	
	32.78		22.14	24.45
		29.60	26.77	22.38
		23.95	19.23	24.34
		27.88	25.17	25.31
		29.28	23.83	
			18.86	18.49
			16.63	21.03
			24.75	23.58
			25.92	27.38
				20.93
				19.80
				24.50
				21.21
				24.76
				23.44
				21.58
				23.31
				24.93
				23.93
				22.23

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Sus domesticus

Humerus	SD	Bd	Dd
	15.72	36.72	36.35
	20.41	42.82	44.84
	15.85	40.63	40.67
	17.56	41.21	41.91
	16.65	44.76	46.73
	18.85	41.64	40.95
	16.33		
	16.24		
	16.05		
	17.05		
	17.93		
	16.94		
	19.53		
	18.38		
	17.86		
	23.53		
	18.84		
	23.36		
	14.14		
		40.63	33.57
		43.22	36.35
		43.49	39.96
		35.60	29.05
		38.96	
			33.14

Radius	Bp	SD
	31.16	21.25
	32.37	21.80
	29.42	
	31.35	
	28.95	
		18.34
		18.13

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Sus domesticus

Ulna	DPA	SDO	BPC	
	39.14	36.96	21.46	
	36.99	29.57	20.42	
	38.11	25.9	18.61	
	46.12	36.42	21.15	
	34.56	27.34	22.08	
	38.59	33.34		
	38.1		21.91	
	35.48			
			21.73	

Metacarpus II	SD	Bd	Dd	
	6.73	11.59	15.86	

Metacarpus III	Bp	Dp	SD	
	18.73	15.56		
	14.03		13.26	

Metacarpus IV	Bp	SD		
	16.67	13,43		

Ulnare (C.)	GB			
	25.96			

Atlas	GB	GLF	H	
	53.73	46.22	46.38	

Vertebra thoracalis	BFcr	BFcd	PL	HFcr
	24.83	27.03	30.54	17.77

Vertebra lumbalis	BFcr	BFcd	PL	HFcr
	23.2	27.68	33.9	18.17

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Sus domesticus

Pelvis	SB	SH	LFo	LA	LAR
	13.1	24.32			
	13.8	26.03			
	12.42	23.86			
	13.76	24.98			
	10.66	16.2			
	10.8		41.34	35.75	31.48
	18.65			36.29	31.73
	19.24			36.31	31.87
	10.8				
	6.36				
	12.5				
	13.22				
	6.81				
				27.38	23.47
				33.77	29.01
				34.49	32.92
				35.83	29.05

Femur	SD
	18.31
	23.16
	20.69
	18.7
	23.86
	22.01
	20.65
	20.76

Patella	GL	GB
	36.43	27.21

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Sus domesticus

Tibia	Bp	Dp	SD	Bd	Dd
	47.55	33.87			
			23.43	30.42	25.89
			19.97	30.71	25.14
			22.35	32.46	27.15
			21.28		
			22.18		
			15.76		
			20.19		
			22.15		
				30.64	24.63
				31.76	28.57
					22.35
					26.45

Astragalus	GLl	GLm	Dl	Dm	Bd
	40.82	38.79	22.8	25.08	26.83
	43.48	39.5		23.1	25.15
	41.27		23.47	24.11	25.14
	43.39	40.35			25.39
	41.62	39.96			
	40.65	39.65			24.68

Calcaneus	GL	GB
	72.42	21.54
	81.01	24.97

Metatarsus IV	GL	LeP	Bp	Dp	SD	Bd	Dd
	92.57	90.74	16.45		14.56	18.21	17.03
		92.95	19.1		16.99	19.92	19.96
				23.13			

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Sus domesticus

Cuboid (T.)	GB
	27.18

Cuneiformes (T.)	GB
	17.05

Phalanx 1 anterior	Bp	Dp
	17.44	17.45

Phalanx 1 posterior	Bp	Dp	SD	Bd
	16.11	17.42	13.51	14.82

Phalanx 1 ant./post.	Bp	SD	Dd
	14.31	12.68	10.04
	22.93		

Phalanx 2 ant./post.	Bp	Dp	SD	Bd	Dd
	15.53	16.95	13.28	14.63	14.29
	16.29	17.3	13.54	13.72	14.23
	16.6	15.49	13.21	12.63	11.5

Canis familiaris

CANIS FAMILIARIS

Humerus	SD
	13.76

Pelvis	SB	SH
	9.54	18.52

Appx. Tab. 26. Osteometry; Late Bronze Age (Field 1, Horizon B).

Cervus elaphus

CELVUS ELAPHUS

Pelvis	SB
	11.23

Femur	SD
	27.30

CAPREOLUS CAP.

Tibia	SD	DD	Bd	Dd
	13.8	11.19	26.05	18.93

Astragalus	GLl	GLm	Dl	Dm	Bd
	27.82	26.37	15.11	15.5	16.46
	28.38	26.92	16.49	16.57	17.53

Sus scrofa

SUS SCROFA

Pelvis	SB	SH	LA	LAR
	14.59	26.04	38.23	35.69

Phalanx 1 ant./post.	GLpe	Bp	Dp	SD	Bd	Dd
	46.73	19.43	24.04	18.2	18.63	11.69

Colimba palumbus

COLUMBA PALUMBUS

Ulna	GL	Bp	SC	Dd	Dip	Did
	54.5	6.45	3.58	5.78	9.44	7.14

Vulpes vulpes/Canis familiaris, Large ruminant (GWK), Small ruminant (KWK)

VULPES V./CANIS F.

Tibia	SD
	8.19

LARGE RUMINANT

Tibia	Bd
	18.17

Phalanx 2 ant./post.	SD
	20.9

SMALL RUMINANT

Femur	SD
	13.85

Appx. Tab. 27. Skeletal element (n): Early Bronze Age (Field 3, Horizon E).

Skeletal element	Feld 3 Horizon E																													
	Species																													
	Bos taurus		Ovis aries		Capra hircus		Ovis/Capra		Sus domesticus		Canis familiaris		Cervus elaphus		Capra ibex		Sus scrofa		Helix pomatia		Capra h./ Capra ibex		Capra h./ Rupicapra rup.		Large ruminants		Small ruminants		Homo sapiens	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%			n	%	n	%	n	%	n	%	n	%
Os cornu	261	14.1	5	14.3	11	68.8	7	0.4	0	0	0	0	0		8	88.9	0		0		0		0		0		1	2.6	0	
Antler	0	0	0	0	0	0	0	0.0	0	0	0	0	1		0		0		0		0		0		0		0		0	
Cranium with Os cornu	69	3.7	0	0	1	6.3	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Cranium with Antler	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Cranium	227	12.3	0	0	0	0	133	8.1	8	4.4	9	14.8	0		0		0		0		0		0		0		0		1	100
Maxilla	27	1.5	0	0	0	0	6	0.4	2	1.1	1	1.6	0		0		0		0		0		0		0		0		0	
Lost tooth of Maxilla	50	2.7	0	0	0	0	80	4.8	9	5.0	2	3.3	0		0		0		0		0		0		0		0		0	
Mandibula	151	8.2	2	5.7	0	0	190	11.5	16	8.8	5	8.2	0		0		1	7.7	0		0		0		0		0		0	
Lost tooth of Mandibula	87	4.7	12	34.3	2	12.5	168	10.2	5	2.8	1	1.6	0		0		0		0		0		0		0		0		0	
Maxilla or Mandibula fragment	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Lost tooth of Maxilla or Mandibula	72	3.9	0	0	0	0	35	2.1	0	0	0	0	0		0		0		0		0		0		0		0		0	
Hyoid	0	0	0	0	0	0	3	0.2	0	0	0	0	0		0		0		0		0		0		0		0		0	
Total Cranium	944	51.1	19	54.3	14	87.5	622	37.7	40	22.1	18	29.5	1	100	8	88.9	1	7.7	0		0		0		0		1	2.6	1	100
Atlas	10	0.5	0	0	0	0	0	0	3	1.7	0	0	0		0		0		0		0		0		0		0		0	
Epistropheus	6	0.3	0	0	0	0	1	0.1	0	0	0	0	0		0		0		0		0		0		0		0		0	
Vertebra cervicalis	19	1.0	0	0	0	0	4	0.2	2	1.1	0	0	0		0		0		0		0		0		0		0		0	
Vertebra thoracalis	12	0.6	0	0	0	0	15	0.9	1	0.6	1	1.6	0		0		0		0		0		0		0		0		0	
Vertebra lumbalis	26	1.4	0	0	0	0	20	1.2	1	0.6	2	3.3	0		0		1	7.7	0		0		0		0		0		0	
Vertebra sacrum	0	0	0	0	0	0	0	0.0	0	0	1	1.6	0		0		0		0		0		0		0		0		0	
Vertebra caudalis	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Vertebra indet.	0	0	0	0	0	0	1	0.1	0	0	0	0	0		0		0		0		0		0		14	21.5	3	7.9	0	
Costae	64	3.5	0	0	0	0	135	8.2	28	15.5	10	16.4	0		0		2	15.4	0		0		0		27	41.5	22	57.9	0	
Sternum	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Costae knorpel	0	0	0	0	0	0	1	0.1	0	0	0	0	0		0		0		0		0		0		0		0		0	
Clavicula	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Coracoid	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Schuppen	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Total Rumpf	137	7.4	0	0	0	0	177	10.7	35	19.3	14	23.0	0		0		3	23.1	0		0		0		41	63.1	25	65.8	0	
Scapula	119	6.4	0	0	0	0	84	5.1	19	10.5	4	6.6	0		0		1	7.7	0		1	50	0		18	27.7	10	26.3	0	
Humerus	102	5.5	2	5.7	0	0	65	3.9	16	8.8	1	1.6	0		0		1	7.7	0		0		0		0		0		0	
Pelvis	49	2.7	3	8.6	1	6.3	49	3.0	14	7.7	1	1.6	0		0		3	23.1	0		0		0		0		0		0	
Femur	80	4.3	1	2.9	0	0	138	8.4	27	14.9	5	8.2	0		0		1	7.7	0		0		0		0		0		0	
Patella	1	0.1	0	0	0	0	4	0.2	0	0	0	0	0		0		0		0		0		0		0		0		0	
Total Stylopodium	351	19.0	6	17.1	1	6.3	340	20.6	76	42.0	11	18.0	0		0		6	46.2	0		0	50	0		18	27.7	10	26.3	0	
		0.0																												
Radius	62	3.4	0	0	0	0	78	4.7	2	1.1	1	1.6	0		0		0		0		0		0		0		0		0	
Ulna	33	1.8	0	0	0	0	12	0.7	7	3.9	2	3.3	0		0		2	15.4	0		0		0		0		0		0	
Radius/Ulna	0	0	0	0	1	6.3	2	0.1	0	0	0	0	0		0		0		0		0		0		0		0		0	
Tibia	133	7.2	1	2.9	0	0	263	15.9	10	5.5	3	4.9	0		0		0		0		1	50	1	100	1	1.5	1	2.6	0	
Fibula	0	0	0	0	0	0	0	0.0	0	0	1	1.6	0		0		0		0		0		0		0		0		0	
Total Zygopodium	228	12.3	1	2.9	1	6.3	355	21.5	19	10.5	7	11.5	0		0		2	15.4	0		1	50	1	100	1	1.5	1	2.6	0	
Carpale	6	0.3	0	0	0	0	3	0.2	0	0	0	0	0		0		0		0		0		0		0		0		0	
Astragalus	18	1.0	4	11.4	0	0	0	0	0	0	0	0	0		1	11.1	0		0		0		0		0		0		0	
Calcaneus	25	1.4	4	11.4	0	0	2	0.1	1	0.6	0	0	0		0		1	7.7	0		0		0		0		0		0	
Centrotarsale	6	0.3	1	2.9	0	0	5	0.3	0	0	0	0	0		0		0		0		0		0		0		0		0	
Tarsus-Rest	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Carpale/Tarsale	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Metacarpus	36	1.9	0	0	0	0	49	3.0	2	1.1	5	8.2	0		0		0		0		0		0		0		1	2.6	0	
Metatarsus	51	2.8	0	0	0	0	68	4.1	4	2.2	5	8.2	0		0		0		0		0		0		0		0		0	
Metapodium indet.	8	0.4	0	0	0	0	9	0.5	1	0.6	1	1.6	0		0		0		0		0		0		0		0		0	
Phalanges ant.	10	0.5	0	0	0	0	5	0.3	1	0.6	0	0	0		0		0		0		0		0		0		0		0	
Phalanges post.	13	0.7	0	0	0	0	9	0.5	0	0	0	0	0		0		0		0		0		0		0		0		0	
Phalanges	16	0.9	0	0	0	0	8	0.5	2	1.1	0	0	0		0		0		0		0		0		0		0		0	
Sesamoidea	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Total Autopodium	189	10.2	9	25.7	0	0	158	9.6	11	6.1	11	18.0	0		1	11.1	1	7.7	0		0		0		0		1	2.6	0	
indet.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100	0	0	0	0	5	7.7	0	0	0	0
TOTAL	1849	100	35	100	16	100	1652	100	181	100	61	100	1	100	9	100	13	100	1	100	2	100	1	100	65	100	38	100	1	100

Appx. Tab. 28. Skeletal element (g): Early Bronze Age (Field 3, Horizon E).

Skeletal element	Feld 3 Horizon E																											
	Species																											
	Bos taurus		Ovis aries		Capra hircus		Ovis/Capra		Sus domesticus		Canis familiaris		Cervus elaphus		Capra ibex		Sus scrofa		Helix pomatia		Capra h./ Capra ibex		Capra h./ Rupicapra rup.		Large ruminants		Small ruminants		Homo sapiens	
	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%
Os comu	846.4	3.2	18.9	14.5	120.2	73.8	2.7	0.1	0	0	0	0	0		161.9	90.4	0		0		0		0		0		0.5	3.8	0	
Antler	0	0.0	0	0	0	0	0	0	0	0	0	0	2.7	100	0		0		0		0		0		0		0		0	
Cranium with Os comu	846.6	3.2	0	0	1.8	1.1	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Cranium with Antler	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Cranium	938	3.5	0	0	0	0	101.4	2.0	29.9	2.2	19.1	6.3	0		0		0		0		0		0		0		0		4	100
Maxilla	388	1.4	0	0	0	0	42.5	0.8	13.2	1.0	25.5	8.5	0		0		0		0		0		0		0		0		0	
Lost tooth of Maxilla	817.1	3.0	0	0	0	0	351.1	7.0	45.1	3.3	3.9	1.3	0		0		0		0		0		0		0		0		0	
Mandibula	2179.5	8.1	2.4	1.8	0	0	902.2	17.9	237.4	17.5	58.5	19.4	0		0		16.6	5.5	0		0		0		0		0		0	
Lost tooth of Mandibula	802.9	3.0	17.3	13.3	2.9	1.8	540.2	10.7	24.5	1.8	1.9	0.6	0		0		0		0		0		0		0		0		0	
Maxilla or Mandibula fragment	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Lost tooth of Maxilla or Mandibula	23.2	0.1	0	0	0	0	8.7	0.2	0	0	0	0	0		0		0		0		0		0		0		0		0	
Hyoid	0	0	0	0	0	0	1.3	0.0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Total Cranium	6841.7	25.5	38.6	29.7	124.9	76.7	1950.1	38.8	350.1	25.8	108.9	36.1	2.7	100	161.9	90.4	16.6	5.5	0		0		0		0		0.5	3.8	4	100
Atlas	320.5	1.2	0	0	0	0	0	0	26.4	1.9	0	0	0		0		0		0		0		0		0		0		0	
Epistropheus	203.3	0.8	0	0	0	0	1.6	0.03	0	0	0	0	0		0		0		0		0		0		0		0		0	
Vertebra cervicalis	317.3	1.2	0	0	0	0	10.7	0.2	5.5	0.4	0	0	0		0		0		0		0		0		0		0		0	
Vertebra thoracalis	173.9	0.6	0	0	0	0	15.1	0.3	2.8	0.2	1.8	0.6	0		0		0		0		0		0		0		0		0	
Vertebra lumbalis	449.8	1.7	0	0	0	0	39	0.8	1.5	0.1	7.9	2.6	0		0		5.1	1.7	0		0		0		0		0		0	
Vertebra sacrum	0	0	0	0	0	0	0	0	0	0	5.6	1.9	0		0		0		0		0		0		0		0		0	
Vertebra caudalis	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Vertebra indet.	0	0	0	0	0	0	1.2	0.02	0	0	0	0	0		0		0		0		0		0		37.1	31.5	2.3	17.7	0	
Costae	444	1.7	0	0	0	0	145.3	2.9	68.2	5.0	10.2	3.4	0		0		13.6	4.5	0		0		0		29	24.6	5		0	
Sternum	0	0	0	0	0	0	0	0.0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Costae knorpel	0	0	0	0	0	0	0.5	0.01	0	0	0	0	0		0		0		0		0		0		0		0		0	
Clavicula	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Coracoid	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Schuppen	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Total Rumpf	1908.8	7.1	0	0	0	0	213.4	4.2	104.4	7.7	25.5	8.5	0		0		18.7		0		0		0		66.1	56.1	7.3	56.2	0	
Scapula	1914.2	7.1	0	0	0	0	135.1	2.7	148.3	10.9	5.1	1.7	0		0		23.5	7.8	0		4.3	22.3	0		18.9	16.0	3.5	26.9	0	
Humerus	3474.6	12.9	22.9	17.6	0	0	277.6	5.5	177.7	13.1	21.2	7.0	0		0		67.6	22.4	0		0		0		0		0		0	
Pelvis	901.6	3.4	15.7	12.1	6.2	3.8	193.7	3.9	116	8.5	10.6	3.5	0		0		99.1	32.8	0		0		0		0		0		0	
Femur	1880.4	7.0	5.7	4.4	0	0	397.6	7.9	211.9	15.6	49.2	16.3	0		0		14.1	4.7	0		0		0		0		0		0	
Patella	9	0.0	0	0	0	0	9.1	0.2	0	0	0	0	0		0		0		0		0		0		0		0		0	
Total Stylopodium	8179.8	30.5	44.3	34.1	6.2	3.8	1013.1	20.1	653.9	48.1	86.1	28.5	0		0		204.3	67.6	0		4.3	22.3	0		18.9	16.0	3.5	26.9	0	
Radius	1962.6	7.3	0	0	0	0	353.2	7.0	20.5	1.5	8.8	2.9	0		0		0		0		0		0		0		0		0	
Ulna	420.5	1.6	0	0	0	0	25.1	0.5	113.7	8.4	8.1	2.7	0		0		46.6	15.4	0		0		0		0		0		0	
Radius/Ulna	0	0	0	0	31.7	19.5	5.9	0.1	0	0	0	0	0		0		0		0		0		0		0		0		0	
Tibia	2881.5	10.7	4.1	3.2	0	0	1056.3	21.0	68.2	5.0	47.7	15.8	0		0		0		0		15	77.7	36.4	100	3.2	2.7	1	7.7	0	
Fibula	0	0	0	0	0	0	0	0	0	0	2.1	0.7	0		0		0		0		0		0		0		0		0	
Total Zygopodium	5264.6	19.6	4.1	3.2	31.7	19.5	1440.5	28.6	202.4	14.9	66.7	22.1	0		0		46.6	15.4	0		15	77.7	36.4	100	3.2	2.7	1	7.7	0	
Carpale	55.1	0.2	0	0	0	0	2.2	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Astragalus	728.1	2.7	18.2	14.0	0	0	0	0	0	0	0	0	0		17.2	9.6	0		0		0		0		0		0		0	
Calcaneus	782.2	2.9	23.3	17.9	0	0	7.4	0.1	2.6	0.2	0	0	0		0		16	5.3	0		0		0		0		0		0	
Centrotarsale	133.9	0.5	1.4	1.1	0	0	7.5	0.1	0	0	0	0	0		0		0		0		0		0		0		0		0	
Tarsus-Rest	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Carpale/Tarsale	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Metacarpus	1209.9	4.5	0	0	0	0	140.2	2.8	22.8	1.7	6.8	2.3	0		0		0		0		0		0		0		0.7	5.4	0	
Metatarsus	1316.4	4.9	0	0	0	0	220.1	4.4	13.7	1.0	7.1	2.4	0		0		0		0		0		0		0		0		0	
Metapodium indet.	41.1	0.2	0	0	0	0	9.1	0.2	1.7	0.1	0.5	0.2	0		0		0		0		0		0		0		0		0	
Phalanges ant.	129.1	0.5	0	0	0	0	5.5	0.1	4.8	0.4	0	0	0		0		0		0		0		0		0		0		0	
Phalanges post.	160.7	0.6	0	0	0	0	12.6	0.3	0	0	0	0	0		0		0		0		0		0		0		0		0	
Phalanges	108.2	0.4	0	0	0	0	8	0.2	3.2	0.2	0	0	0		0		0		0		0		0		0		0		0	
Sesamoidea	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		0		0		0		0		0		0	
Total Autopodium	4664.7	17.4	42.9	33.0	0	0	412.6	8.2	48.8	3.6	14.4	4.8	0		17.2	9.6	16	5.3	0		0		0		0		0.7	5.4	0	
indet.	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0		1.2	100	0		0		29.6	25.1	0		0	
TOTAL	26859.6	100	129.9	100	162.8	100	5029.7	100	1359.6	100	301.6	100	2.7	100	179.1	100	302.2	100.0	1.2	100	19.3	100.0	36.4	100	117.8	100.0	13	100	4	100

Appx. Tab. 29. Skeletal element (n): Early-Middle Bronze Age (Field 3, Horizon D).

Skeletal element	Feld 3 Horizon D																																	
	Species																																	
	Bos taurus		Ovis aries		Ovis aries?		Capra hircus		Ovis/Capra		Sus domesticus		Canis familiaris		Cervus elaphus		Capreolus Capreolus		Sus scrofa		Apodemus flavicollis		Anser anser		Columba oenas		Bufo spec.		Sus dom./ Sus scrofa		Large ruminants		Small ruminants		Homo sapiens	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Os cornu	231	6.7	16	12.9	0		14	35.0	33	1.1	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Antler	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Cranium with Os cornu	31	0.9	1	0.8	0		5	12.5	1	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Cranium with Antler	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Cranium	522	15.2	0	0	0		0		335	10.8	43	7.2	13	54.2	0		0		1	4.0	1	100	0		0		0		0		0		0		0	
Maxilla	7	0.2	0	0	0		0		20	0.6	17	2.8	2	8.3	0		0		0		0		0		0		0		0		0		0		0	
Lost tooth of Maxilla	97	2.8	0	0	0		0		204	6.6	40	6.7	1	4.2	0		0		4	16.0	0		0		0		0		0		1	0.5	0		0	
Mandibula	235	6.8	14	11.3	0		1	2.5	305	9.9	54	9.0	1	4.2	0		0		2	8.0	0		0		0		0		1	100	0		0		0	
Lost tooth of Mandibula	140	4.1	20	16.1	0		3	7.5	290	9.4	81	13.6	4	16.7	0		0		4	16.0	0		0		0		0		0		0		0		0	
Maxilla or Mandibula fragment	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Lost tooth of Maxilla or Mandibula	74	2.2	0	0	0		0		86	2.8	1	0.2	0		0		0		0		0		0		0		0		0		6	2.7	1	1.2	0	
Hyoid	1	0	0	0	0		0		2	0.1	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Cranium	1338	38.9	51	41.1	0		23	57.5	1276	41.2	236	39.5	21	87.5	0		0		11	44.0	1	100	0		0		0		1	100	7	3.2	1	1.2	0	
Atlas	17	0.5	1	0.8	0		0		0	0	2	0.3	0		0		0		0		0		0		0		0		0		0		0		0	
Epistropheus	10	0.3	0	0	0		0		2	0.1	1	0.2	0		0		0		0		0		0		0		0		0		0		0		0	
Vertebra cervicalis	35	1.0	0	0	0		0		19	0.6	1	0.2	0		0		0		0		0		0		0		0		0		0		0		0	
Vertebra thoracalis	23	0.7	0	0	0		0		21	0.7	1	0.2	0		4.2	16.0	0		0		0		0		0		0		0		0		0		0	
Vertebra lumbalis	37	1.1	0	0	0		0		50	1.6	3	0.5	0		0		0		0		0		0		0		0		0		0		0		0	
Vertebra sacrum	5	0.1	0	0	0		0		3	0.1	0	0	0		17.9	68.3	0		0		0		0		0		0		0		0		0		0	
Vertebra caudalis	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Vertebra indet.	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		20	9.0	23	28.0	0	
Costae	307	8.9	0	0	0		0		231	7.5	134	22.4	0		0		0		2	8.0	0		0		0		0		0		164	73.9	34	41.5	1	8.3
Sternum	1	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Costae knorpel	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Clavicula	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		2	16.7
Coracoid	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Schuppen	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Rumpf	435	12.6	1	0.8	0		0		326	10.5	142	23.8	0		22.1	84.4	0		2	8.0	0		0		0		0		0		184	82.9	57	69.5	3	25.0
Scapula	271	7.9	1	0.8	0		2	5.0	172	5.6	27	4.5	0		0		0		1	4.0	0		0		0		0		0		30	13.5	23	28.0	0	
Humerus	140	4.1	8	6.5	0		1	2.5	145	4.7	64	10.7	1	4.2	0		0		3	12.0	0		0		0		1	100	0		0		0		2	16.7
Pelvis	153	4.4	0	0	0		1	2.5	62	2.0	16	2.7	1	4.2	0		0		0		0		2	100	0		0		0		1	0.5	0		0	
Femur	163	4.7	1	0.8	0		0		203	6.6	46	7.7	0		0		0		0		0		0		0		0		0		0		1	1.2	4	33.3
Patella	0	0	0	0	0		0		3	0.1	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Stylopodium	727	21.1	10	8.1	0		4	10.0	585	18.9	153	25.6	2	8.3	0		0		4	16.0	0		2	100	0		1	100	0		31	14.0	24	29.3	6	50.0
Radius	141	4.1	2	1.6	0		0		141	4.6	8	1.3	0		0		0		2	8.0	0		0		0		0		0		0		0		1	8.3
Ulna	91	2.6	10	8.1	0		2	5.0	40	1.3	10	1.7	0		0		0		1	4.0	0		0		1	100	0		0		0		0		0	
Radius/Ulna	5	0.1	0	0	0		0		2	0.1	1	0.2	0		0		0		0		0		0		0		0		0		0		0		0	
Tibia	233	6.8	4	3.2	0		4	10.0	384	12.4	13	2.2	1	4.2	0		0		1	4.0	0		0		0		0		0		0		0		2	16.7
Fibula	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Zygopodium	470	13.7	16	12.9	0		6	15.0	567	18.3	32	5.4	1	4.2	0		0		4	16.0	0		0		1	100	0		0		0		0		3	25.0
Carpale	22	0.6	1	0.8	0		0		7	0.2	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Astragalus	33	1.0	11	8.9	2	66.7	1	2.5	10	0.3	4	0.7	0		0		4.5	100	0		0		0		0		0		0		0		0		0	
Calcaneus	34	1.0	3	2.4	0		0		4	0.1	7	1.2	0		0		0		2	8.0	0		0		0		0		0		0		0		0	
Centrotarsale	9	0.3	0	0	1	33.3	0		4	0.1	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Tarsus-Rest	4	0.1	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Carpale/Tarsale	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Metacarpus	112	3.3	2	1.6	0		0		133	4.3	8	1.3	0		0		0		0		0		0		0		0		0		0		0		0	
Metatarsus	154	4.5	1	0.8	0		2	5.0	130	4.2	1	0.2	0		0		0		2	8.0	0		0		0		0		0		0		0		0	
Metapodium indet.	20	0.6	0	0	0		0		19	0.6	4	0.7	0		0		0		0		0		0		0		0		0		0		0		0	
Phalanges ant.	28	0.8	11	8.9	0		2	5.0	4	0.1	1	0.2	0		0		0		0		0		0		0		0		0		0		0		0	
Phalanges post.	27	0.8	17	13.7	0		2	5.0	5	0.2	0	0	0		4.1	15.6	0		0		0		0		0		0		0		0		0		0	
Phalanges	22	0.6	0	0	0		0		25	0.8	9	1.5	0		0		0		0		0		0		0		0		0		0		0		0	
Sesamoidea	4	0.1	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Autopodium	469	13.6	46	37.1	3	100	7	17.5	341	11.0	34	5.7	0		4.1	15.6	4.5	100	4	16.0	0		0		0		0		0		0		0		0	
indet.	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
TOTAL	3439	100	124	100	3	100	40	100	3095	100	597	100	24	100	26.2	100	4.5	100	25	100	1	100	2	100	1	100	1	100	1	100	222	100	82	100	12	100

Appx. Tab. 30. Skeletal element (g): Early-Middle Bronze Age (Field 3, Horizon D).

Skeletal element	Feld 3 Horizon D																															
	Species																															
	Bos taurus		Ovis aries		Ovis aries?		Capra hircus		Ovis/Capra		Sus domesticus		Canis familiaris		Cervus elaphus		Capreolus Capreolus		Sus scrofa		Apodemus flavicollis		Anser anser		Columba oenas		Bufo spec.		Sus dom./ Sus scrofa		Large ruminants		Small ruminants		Homo sapiens	
	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%
Os cornu	830.8	2.0	133.7	20.1	0		52.9	28.3	12.9	0.2	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Antler	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Cranium with Os cornu	253.2	0.6	9	1.4	0		26	13.9	2	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Cranium with Antler	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Cranium	1577.4	3.9	0	0	0		0		319.6	4.2	115.6	2.7	72	51.5	0		0		3.6	0.9	0.4	100	0		0		0		0		0		0		0	
Maxilla	244.7	0.6	0	0	0		0		145.6	1.9	222.5	5.2	16.2	11.6	0		0		0		0		0		0		0		0		0		0		0	
Lost tooth of Maxilla	1487.4	3.6	0	0	0		0		865.3	11.2	196	4.5	0.5	0.4	0		0		48.6	12.5	0		0		0		0		0		2.8	1.2	0		0	
Mandibula	2318.5	5.7	175.9	26.4	0		6.9	3.7	747.4	9.7	924.6	21.4	11.7	8.4	0		0		44	11.3	0		0		0		0		32.2	100	0		0		0	
Lost tooth of Mandibula	965.2	2.4	25.3	3.8	0		4		925	12.0	330.7	7.7	7.2	5.2	0		0		88.7	22.8	0		0		0		0		0		0		0		0	
Maxilla or Mandibula fragment	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Lost tooth of Maxilla or Mandibula	56.5	0.1	0	0	0		0		32.5	0.4	0.9	0.0	0		0		0		0		0		0		0		0		0		2.5	1.1	0.4	1.0	0	
Hyoid	4.9	0	0	0	0		0		0.7	0.0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Cranium	7738.6	18.9	343.9	51.6	0		89.8	48.1	3051	39.7	1790.3	41.5	107.6	77.0	0		0		184.9	47.6	0.4	100	0		0		0		32.2	100	5.3	2.3	0.4	1.0	0	
Atlas	305.4	0.7	2.3	0.3	0		0		0	0	19.9	0.5	0		0		0		0		0		0		0		0		0		0		0		0	
Epistropheus	99	0.2	0	0	0		0		3.7	0.0	7.2	0.2	0		0		0		0		0		0		0		0		0		0		0		0	
Vertebra cervicalis	305.4	0.7	0	0	0		0		57.5	0.7	5.7	0.1	0		0		0		0		0		0		0		0		0		0		0		0	
Vertebra thoracalis	193.8	0.5	0	0	0		0		26.6	0.3	0.9	0.0	0		4.2	16.0	0		0		0		0		0		0		0		0		0		0	
Vertebra lumbalis	261.3	0.6	0	0	0		0		68.6	0.9	10.3	0.2	0		0		0		0		0		0		0		0		0		0		0		0	
Vertebra sacrum	71.6	0.2	0	0	0		0		7	0.1	0	0	0		17.9	68.3	0		0		0		0		0		0		0		0		0		0	
Vertebra caudalis	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Vertebra indet.	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		51.5	22.3	19.5	46.3	0	
Costae	1460.2	3.6	0	0	0		0		215.9	2.8	227.1	5.3	0		0		0		15.1	3.9	0		0		0		0		0		141.4	61.1	11.7	27.8	0.6	3.2
Sternum	4	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Costae knorpel	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Clavicula	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0.8	4.3
Coracoid	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Schuppen	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Rumpf	2700.7	6.6	2.3	0.3	0		0		379.3	4.9	271.1	6.3	0		22.1	84.4	0		15.1	3.9	0		0		0		0		0		192.9	83.4	31.2	74.1	1.4	7.6
Scapula	4027.5	9.9	7.5	1.1	0		24.2	13.0	286.5	3.7	300.7	7.0	0		0		0		12.1	3.1	0		0		0		0		0		31.2	13.5	9.9	23.5	0	
Humerus	4048.6	9.9	104.2	15.6	0		6.6	3.5	559.1	7.3	905	21.0	6.1	4.4	0		0		95.3	24.5	0		0		0		0.3	100	0		0		0		2.3	12.4
Pelvis	2774	6.8	0	0	0		15.2	8.1	183	2.4	210.5	4.9	14	10.0	0		0		0		0		1.3	100	0		0		0		2	0.9	0		0	
Femur	3213.1	7.9	3.1	0.5	0		0		558.9	7.3	333	7.7	0		0		0		0		0		0		0		0		0		0		0.6	1.4	10.5	56.8
Patella	0	0	0	0	0		0		3.2	0.0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Stylopodium	14063.2	34.4	114.8	17.2	0		46	24.6	1590.7	20.7	1749.2	40.5	20.1	14.4	0		0		107.4	27.6	0		1.3	100	0		0.3	100	0		33.2	14.3	10.5	24.9	12.8	69.2
Radius	3499	8.6	15.2	2.3	0		0		559.9	7.3	112.9	2.6	0		0		0		17.5	4.5	0		0		0		0		0		0		0		0.9	4.9
Ulna	1164.6	2.9	37.1	5.6	0		6.9	3.7	70.4	0.9	136.4	3.2	0		0		0		22	5.7	0		0		0.4	100	0		0		0		0		0	
Radius/Ulna	111.4	0.3	0	0	0		0		8.8	0.1	19.7	0.5	0		0		0		0		0		0		0		0		0		0		0		0	
Tibia	4507.1	11.0	15.1	2.3	0		21.9	11.7	1360.3	17.7	95.9	2.2	12.1	8.7	0		0		9	2.3	0		0		0		0		0		0		0		3.4	18.4
Fibula	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Zygopodium	9282.1	22.7	67.4	10.1	0		28.8	15.4	1999.4	26.0	364.9	8.5	12.1	8.7	0		0		48.5	12.5	0		0		0.4	100	0		0		0		0		4.3	23.2
Carpale	155.3	0.4	1	0.2	0		0		6.2	0.1	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Astragalus	989.4	2.4	46.7	7.0	6.5	73.9	5.2	2.8	22.2	0.3	33.8	0.8	0		0		1	100	0		0		0		0		0		0		0		0		0	
Calcaneus	846.8	2.1	12.3	1.8	0		0		12.9	0.2	59.5	1.4	0		0		0		28	7.2	0		0		0		0		0		0		0		0	
Centrotarsale	139.4	0.3	0	0	2.3	26.1	0		4	0.1	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Tarsus-Rest	20.2	0.0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Carpale/Tarsale	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Metacarpus	1404.6	3.4	30.7	4.6	0		0		296.1	3.8	24.8	0.6	0		0		0		0		0		0		0		0		0		0		0		0	
Metatarsus	2540.0	6.2	6.6	1.0	0		4.1	2.2	267.1	3.5	1.8	0.0	0		0		0		4.9	1.3	0		0		0		0		0		0		0		0	
Metapodium indet.	85.5	0.2	0	0	0		0		23.9	0.3	2.7	0.1	0		0		0		0		0		0		0		0		0		0		0		0	
Phalanges ant.	458.9	1.1	15.3	2.3	0		7.3	3.9	6.5	0.1	2	0.0	0		0		0		0		0		0		0		0		0		0		0		0	
Phalanges post.	272.4	0.7	25.4	3.8	0		5.5	2.9	7.3	0.1	0	0	0		4.1	15.6	0		0		0		0		0		0		0		0		0		0	
Phalanges	129.6	0.3	0	0	0		0		27.2	0.4	16	0.4	0		0		0		0		0		0		0		0		0		0		0		0	
Sesamoidea	12.9	0.0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
Total Autopodium	7055.0	17.3	138	20.7	8.8	100	22.1	11.8	673.4	8.8	140.6	3.3	0		4.1	15.6	1	100	32.9	8.5	0		0		0		0		0		0		0		0	
indet.	0	0	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0		0		0		0		0		0	
TOTAL	40839.6	100	666.4	100	8.8	100	186.7	100	7693.8	100	4316.1	100	139.8	100	26.2	100	1	100	388.8	100	0.4	100	1.3	100	0.4	100	0.3	100	32.2	100	231.4	100	42.1	100	18.5	100

Appx. Tab. 31. Skeletal element (n): Middle Bronze Age (Field 3, Horizon C).

Skeletal element	Feld 3 Horizon C																							
	Species																							
	Bos taurus		Ovis aries		Capra hircus		Ovis/Capra		Sus domesticus		Canis familiaris		Capra ibex		Sus scrofa		Capra h./ Capra ibex		Large ruminants		Small ruminants		Homo sapiens	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Os cornu	80	5.5	3	9.1	8	42.1	3	0.2	0	0	0		0		0		0		0		0		0	
Antler	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium with Os cornu	8	0.6	0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium with Antler	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium	170	11.7	0		0		77	5.8	5	2.4	0		0		0		0		2	1.1	0		0	
Maxilla	6	0.4	0		0		10	0.8	5	2.4	0		0		0		0		0		0		0	
Lost tooth of Maxilla	52	3.6	0		0		102	7.7	17	8.1	0		0		0		0		0		0		0	
Mandibula	137	9.4	2	6.1	2	10.5	127	9.6	6	2.8	0		0		1	7.7	0		0		0		0	
Lost tooth of Mandibula	66	4.5	10	30.3	3	15.8	137	10.4	25	11.8	0		0		1	7.7	0		0		0		0	
Maxilla or Mandibula fragment	0	0	0		0		0		0	0	0		0		0		0		0		0		0	
Lost tooth of Maxilla or Mandibula	39	2.7	0		0		65	4.9	0	0	0		0		0		0		0		0		0	
Hyoid	0	0	0		0		0		1	0.5	0		0		0		0		0		0		0	
Total Cranium	558	38.5	15	45.5	13	68.4	521	39.5	59	28.0	0		0		2	15.4	0		2	1.1	0		0	
										0														
Atlas	10	0.7	0		0		2	0.2	3	1.4	0		0		0		0		0		0		0	
Epistropheus	6	0.4	0		0		5	0.4	0	0	0		0		0		0		0		0		0	
Vertebra cervicalis	20	1.4	0		0		5	0.4	0	0	0		0		0		0		0		0		0	
Vertebra thoracalis	12	0.8	0		0		2	0.2	0	0	0		0		0		0		0		0		0	
Vertebra lumbalis	27	1.9	0		0		19	1.4	2	0.9	0		0		0		0		0		0		0	
Vertebra sacrum	1	0.1	0		0		0	0	0	0	0		0		0		0		0		0		0	
Vertebra caudalis	1	0.1	0		0		3	0.2	0	0	0		0		0		0		0		0		0	
Vertebra indet.	0	0.0	0		0		0	0	0	0	0		0		0		0		27	14.7	14	25.9	0	
Costae	159	11.0	0		0		72	5.5	45	21.3	1	50	0		0		0		135	73.4	27	50	11	84.6
Sternum	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Costae knorpel	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Clavicula	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Coracoid	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Schuppen	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Rumpf	236	16.3	0		0		108	8.2	50	23.7	1	50	0		0		0		162	88	41	75.9	11	84.6
										0														
Scapula	99	6.8	0		0		40	3.0	14	6.6	0		0		0		0		20	10.9	11	20.4	1	7.7
Humerus	77	5.3	0		1	5.3	63	4.8	24	11.4	0		1	100	0		0		0		1	1.9	0	
Pelvis	41	2.8	0		0		23	1.7	3	1.4	0		0		0		0		0		0		0	
Femur	59	4.1	0		0		123	9.3	14	6.6	0		0		9	69.2	0		0		1	1.9	1	7.7
Patella	1	0.1	0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Stylopodium	277	19.1	0		1	5.3	249	18.9	55	26.1	0		1	100	9	69.2	0		20	10.9	13	24.1	2	15.4
										0														
Radius	45	3.1	0		0		80	6.1	2	0.9	0		0		0		0		0		0		0	
Ulna	27	1.9	1	3.0	1	5.3	16	1.2	10	4.7	0		0		0		0		0		0		0	
Radius/Ulna	6	0.4	0		0		0	0	0	0	0		0		0		0		0		0		0	
Tibia	105	7.2	0		0		183	13.9	7	3.3	0		0		2	15.4	1	100	0		0		0	
Fibula	0	0	0		0		0	0	2	0.9	0		0		0		0		0		0		0	
Total Zygopodium	183	12.6	1	3.0	1	5.3	279	21.2	21	10.0	0		0		2	15.4	1	100	0		0		0	
										0														
Carpale	10	0.7	0		0		0	0	2	0.9	0		0		0		0		0		0		0	
Astragalus	14	1.0	5	15.2	0		1	0.1	3	1.4	0		0		0		0		0		0		0	
Calcaneus	17	1.2	0		0		8	0.6	5	2.4	0		0		0		0		0		0		0	
Centrotarsale	4	0.3	0		0		0	0.0	0	0	0		0		0		0		0		0		0	
Tarsus-Rest	7	0.5	0		0		1	0.1	0	0	0		0		0		0		0		0		0	
Carpale/Tarsale	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Metacarpus	45	3.1	1	3.0	0		76	5.8	4	1.9	0		0		0		0		0		0		0	
Metatarsus	58	4.0	1	3.0	0		73	5.5	2	0.9	0		0		0		0		0		0		0	
Metapodium indet.	5	0.3	1	3.0	1	5.3	0	0	0	0	0		0		0		0		0		0		0	
Phalanges ant.	16	1.1	5	15.2	1	5.3	1	0.1	3	1.4	0		0		0		0		0		0		0	
Phalanges post.	13	0.9	3	9.1	1	5.3	0	0	0	0	1	50	0		0		0		0		0		0	
Phalanges	8	0.6	1	3.0	1	5.3	2	0.2	7	3.3	0		0		0		0		0		0		0	
Sesamoidea	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Autopodium	197	13.6	17	51.5	4	21.1	162	12.3	26	12.3	1	50	0		0		0		0		0		0	
										0														
indet.	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
										0														
TOTAL	1451	100	33	100	19	100	1319	100	211	100	2	100	1	100	13	100	1	100	184	100	54	100	13	100

Appx. Tab. 32. Skeletal element (g): Middle Bronze Age (Field 3, Horizon C).

Skeletal element	Feld 3 Horizon C																							
	Species																							
	Bos taurus		Ovis aries		Capra hircus		Ovis/Capra		Sus domesticus		Canis familiaris		Capra ibex		Sus scrofa		Capra h./ Capra ibex		Large ruminants		Small ruminants		Homo sapiens	
	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%
Os cornu	303.6	1.6	11.7	11.9	41.8	55.0	5.7	0.1	0	0	0		0		0		0		0		0		0	
Antler	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium with Os cornu	33.2	0.2	0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium with Antler	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium	784.2	4.1	0		0		56.6	1.4	18.7	1.2	0		0		0		0		4.2	1.3	0		0	
Maxilla	31.8	0.2	0		0		49.6	1.3	56.7	3.6	0		0		0		0		0		0		0	
Lost tooth of Maxilla	742.2	3.9	0		0		416.6	10.7	99.8	6.3	0		0		0		0		0		0		0	
Mandibula	1616.7	8.4	22.2	22.5	12.4	16.3	384.4	9.8	50.2	3.2	0		0		26.6	17.5	0		0		0		0	
Lost tooth of Mandibula	505.9	2.6	13.2	13.4	3.5	4.6	399.5	10.2	71.1	4.5	0		0		18.4	12.1	0		0		0		0	
Maxilla or Mandibula fragment	0	0	0		0		0		0	0	0		0		0		0		0		0		0	
Lost tooth of Maxilla or Mandibula	31.3	0.2	0		0		23.6	0.6	0	0	0		0		0		0		0		0		0	
Hyoid	0	0	0		0		0		1.8	0.1	0		0		0		0		0		0		0	
Total Cranium	4048.9	21.1	47.1	47.7	57.7	75.9	1336	34.2	298.3	18.9	0		0		45	29.6	0		4.2	1.3	0		0	
										0														
Atlas	148.4	0.8	0		0		5.8	0.1	19.4	1.2	0		0		0		0		0		0		0	
Epistropheus	67.5	0.4	0		0		10.7	0.3	0	0	0		0		0		0		0		0		0	
Vertebra cervicalis	187.5	1.0	0		0		22.9	0.6	0	0	0		0		0		0		0		0		0	
Vertebra thoracalis	69.7	0.4	0		0		3.9	0.1	0	0	0		0		0		0		0		0		0	
Vertebra lumbalis	183.7	1.0	0		0		48.2	1.2	23.8	1.5	0		0		0		0		0		0		0	
Vertebra sacrum	1.7	0.0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Vertebra caudalis	1.5	0.0	0		0		2.6	0.1	0	0	0		0		0		0		0		0		0	
Vertebra indet.	0	0.0	0		0		0	0	0	0	0		0		0		0		77.5	23.7	20.2	47.5	0	
Costae	940.4	4.9	0		0		58.9	1.5	100.6	6.4	1.3	52	0		0		0		190.6	58.4	10	24	4.1	53.2
Sternum	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Costae knorpel	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Clavicula	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Coracoid	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Schuppen	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Rumpf	1600.4	8.3	0		0		153	3.9	143.8	9.1	1.3	52	0		0		0		268.1	82	30.2	71.1	4.1	53.2
										0														
Scapula	1649.4	8.6	0		0		73.1	1.9	174.9	11.1	0		0		0		0		54.3	16.6	10.2	24.0	0.9	11.7
Humerus	2354.4	12.3	0		6.1	8.0	275.7	7.1	407.2	25.8	0		27.7	100	0		0		0		1.3	3.1	0	
Pelvis	799.3	4.2	0		0		110.7	2.8	40.1	2.5	0		0		0		0		0		0		0	
Femur	1279.8	6.7	0		0		428.9	11.0	128.7	8.2	0		0		73.4	48.3	0		0		0.8	1.9	2.7	35.1
Patella	17.9	0.1	0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Stylopodium	6100.8	31.8	0		6.1	8.0	888.4	22.7	750.9	47.7	0		27.7	100	73.4	48.3	0		54.3	16.6	12.3	28.9	3.6	46.8
										0														
Radius	1064.6	5.6	0		0		323.3	8.3	11.5	0.7	0		0		0		0		0		0		0	
Ulna	409.7	2.1	3.4	3.4	5.6	7.4	33.1	0.8	106.2	6.7	0		0		0		0		0		0		0	
Radius/Ulna	105.6	0.6	0		0		0	0	0	0	0		0		0		0		0		0		0	
Tibia	2538.6	13.2	0		0		722.9	18.5	117.5	7.5	0		0		33.7	22.2	13.7	100	0		0		0	
Fibula	0	0	0		0		0	0	6.1	0.4	0		0		0		0		0		0		0	
Total Zygopodium	4118.5	21.5	3.4	3.4	5.6	7.4	1079.3	27.6	241.3	15.3	0		0		33.7	22.2	13.7	100	0		0		0	
										0														
Carpale	75.1	0.4	0		0		0	0	4	0.3	0		0		0		0		0		0		0	
Astragalus	392.9	2.0	16.1	16.3	0		3.4	0.1	31.5	2.0	0		0		0		0		0		0		0	
Calcaneus	422.5	2.2	0		0		20.9	0.5	64.6	4.1	0		0		0		0		0		0		0	
Centrotarsale	61.5	0.3	0		0		0	0.0	0	0	0		0		0		0		0		0		0	
Tarsus-Rest	24.6	0.1	0		0		1.3	0.0	0	0	0		0		0		0		0		0		0	
Carpale/Tarsale	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Metacarpus	847.9	4.4	8.1	8.2	0		201.3	5.1	13	0.8	0		0		0		0		0		0		0	
Metatarsus	1102.4	5.8	6.9	7.0	0		223.3	5.7	4.5	0.3	0		0		0		0		0		0		0	
Metapodium indet.	22.5	0.1	3.8	3.9	3.7	4.9	0	0	0	0	0		0		0		0		0		0		0	
Phalanges ant.	184.5	1.0	6.9	7.0	0.6	0.8	1.1	0.0	7.6	0.5	0		0		0		0		0		0		0	
Phalanges post.	128	0.7	5.1	5.2	1.2	1.6	0	0	0	0	1.2	48	0		0		0		0		0		0	
Phalanges	39.9	0.2	1.3	1.3	1.1	1.4	1.2	0.0	16.1	1.0	0		0		0		0		0		0		0	
Sesamoidea	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Autopodium	3301.8	17.2	48.2	48.8	6.6	8.7	452.5	11.6	141.3	9.0	1.2	48	0		0		0		0		0		0	
										0														
indet.	0	0	0		0		0	0	0	0	0		0		0		0		0		0		0	
										0														
TOTAL	19170.4	100	98.7	100	76	100	3909.2	100	1575.6	100	2.5	100	27.7	100	152.1	100	13.7	100	326.6	100	42.5	100	7.7	100

Appx. Tab. 33. Skeletal element (n): Middle Bronze Age (Field 1, Horizon C).

Skeletal element	Feld 1 Horizon C																											
	Species																											
	Bos taurus		Ovis aries		Ovis aries?		Capra hircus		Capra hircus?		Ovis/Capra		Sus domesticus		Canis familiaris		Cervus elaphus		Capra ibex		Capra h./ Rupicapra rup.		Sus dom./ Sus scrofa		Canis fam./ Canis lup.		Large ruminants		Small ruminants		Homo sapiens	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Os cornu	12	1.5	1	14.3	0		1	50.0	0		5	1.3	0	0	0		0		0		0		0		0		0	0	0		0	
Cranium with Os cornu	5	0.6	0		0		1	50.0	0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Cranium with Antler	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Cranium	62	7.6	1	14.3	0		0		0		10	2.6	11	8.0	0		1	25.0	0		0		0		0		14	20.9	0		1	20.0
Maxilla	2	0.2	0		0		0		0		1	0.3	1	0.7	0		0		0		0		0		0		0	0	0		0	
Lost tooth of Maxilla	67	8.2	0		0		0		0		28	7.3	8	5.8	0		0		0		0		0		0		0		0		0	
Mandibula	68	8.3	0		0		0		0		32	8.4	15	10.9	1	50.0	0		0		0		0		0		14	20.9	4	80.0	0	
Lost tooth of Mandibula	53	6.5	3		0		0		0		44	11.5	27	19.7	0		0		0		0		0		0		0		0		0	
Maxilla or Mandibula fragment	2	0.2	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Lost tooth of Maxilla or Mandibula	2	0.2	0		0		0		0		11	2.9	0	0	0		0		0		0		0		0		0		0		0	
Hyoid	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Total Cranium	273	33.5	5	71.4	0		2	100	0		131	34.2	62	45.3	1	50.0	1	25.0	0		0		0		0		28	41.8	4	80.0	1	20.0
Atlas	7	0.9	0		0		0		0		0	0	0	0	0		0		0		0		0		0		2	3.0	0		0	
Epistropheus	6	0.7	0		0		0		0		0	0	1	0.7	0		0		0		0		0		0		0	0	0		0	
Vert. cerv.	14	1.7	0		0		0		0		3	0.8	1	0.7	0		0		0		0		0		0		0	0	0		0	
Vert. thor.	16	2.0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Vert. lumb.	13	1.6	0		0		0		0		0	0	1	0.7	0		0		0		0		0		0		0	0	1	20.0	0	
Vert. sacrum	0	0	0		0		0		0		1	0.3	0	0	0		0		0		0		0		0		0	0	0		0	
Vert. caud.	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Vert. ind.	1	0.1	0		0		0		0		0	0	0	0	0		0		0		0		0		0		6	9.0	0		0	
Costae	94	11.5	0		0		0		0		19	5.0	14	10.2	0		0		0		0		3	75.0	0		4	6.0	0		0	
Sternum	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Clavicula	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Coracoid	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Schuppen	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Total Rumpf	151	18.5	0		0		0		0		23	6.0	17	12.4	0		0		0		0		3	75.0	0		12	17.9	1	20.0	0	
Scapula	31	3.8	0		0		0		0		22	5.7	9	6.6	0		0		0		0		0		0		10	14.9	0		0	
Humerus	64	7.9	0		0		0		0		19	5.0	17	12.4	0		1	25.0	0		0		0		0		4	6.0	0		2	40.0
Pelvis	36	4.4	1	14.3	0		0		0		10	2.6	6	4.4	0		0		0		0		1	25.0	0		3	4.5	0		0	
Femur	42	5.2	0		0		0		0		21	5.5	10	7.3	0		0		0		0		0		0		3	4.5	0		0	
Patella	0	0	0		0		0		0		1	0.3	0	0	0		0		0		0		0		0		0	0	0		0	
Total Stylopodium	173	21.2	1	14.3	0		0		0		73	19.1	42	30.7	0		1	25.0	0		0		1	25.0	0		20	29.9	0		2	40.0
Radius	47	5.8	0		0		0		0		39	10.2	2	1.5	0		0		0		0		0		1	100	0		0		0	
Ulna	13	1.6	0		0		0		0		2	0.5	4	2.9	1	50.0	0		0		0		0		0		0		0		2	40.0
Radius/Ulna	3	0.4	0		0		0		0		1	0.3	0	0	0		0		0		0		0		0		0		0		0	
Tibia	44	5.4	0		0		0		1	100	53	13.8	4	2.9	0		1	25.0	0		0		0		0		0		0		0	
Fibula	0	0	0		0		0		0		0	0.0	1	0.7	0		0		0		0		0		0		0		0		0	
Total Zygopodium	107	13.1	0		0		0		1	100	95	24.8	11	8.0	0	50.0	1	25.0	0		0		0		1	100	0		0		2	40.0
Carpale	3	0.4	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Astragalus	4	0.5	0		1		0		0		2	0.5	0	0	0		0		1		0		0		0		3	4.5	0		0	
Calcaneus	12	1.5	0		0		0		0		1	0.3	3	2.2	0		0		0		0		0		0		1	1.5	0		0	
Centrotarsale	2	0.2	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Tarsus-Rest	2	0.2	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Carpale/Tarsale	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Metacarpus	20	2.5	1	14.3	0		0		0		11	2.9	1	0.7	0		0		0		1	50.0	0		0		0	0	0		0	
Metatarsus	33	4.0	0		0		0		0		41	10.7	0	0	0		0		0		1	50.0	0		0		0	0	0		0	
Metapodium indet.	11	1.3	0		0		0		0		3	0.8	0	0	0		0		0		0		0		0		0	0	0		0	
Phalanges ant.	4	0.5	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Phalanges post.	7	0.9	0		0		0		0		2	0.5	0	0	0		0		0		0		0		0		0	0	0		0	
Phalanges	13	1.6	0		0		0		0		1	0.3	1	0.7	0		1	25.0	0		0		0		0		3	4.5	0		0	
Sesamoidea	0	0	0		0		0		0		0	0.0	0	0	0		0		0		0		0		0		0	0	0		0	
Total Autopodium	111	13.6	1	14.3	1	100	0		0		61	15.9	5	3.6	0		1	25.0	1	100	2	100	0		0		7	10.4	0		0	
indet.	0	0	0		0		0		0		0		0		0		0		0		0		0		0		0		0		0	
TOTAL	815	100	7	100	1	100	2	100	1	100	383	100	137	100	2	100	4	100	1	100	2	100	4	100	1	100	67	100	5	100	5	100

Appx. Tab. 34. Skeletal element (g): Middle Bronze Age (Field 1, Horizon C).

Skeletal element	Feld 1 Horizon C																													
	Species																													
	Bos taurus		Ovis aries		Ovis aries?		Capra hircus		Capra hircus?		Ovis/Capra		Sus domesticus		Canis familiaris		Cervus elaphus		Capra ibex		Capra h./ Rupicapra rup.		Sus dom./ Sus scrofa		Canis fam./ Canis lup.		Large ruminants		Small ruminants		Homo sapiens	
	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%
Os cornu	54.2	0.6	11.2	22.0	0		4.9	8	0		7.4	0.5	0	0	0		0		0		0		0		0		0	0	0		0	
Cranium with Os cornu	31.1	0.3	0		0		56.4	92	0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Cranium with Antler	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Cranium	235.7	2.4	4.9	9.6	0		0		0		17.7	1.3	27.6	3.7	0		1.6	2.5	0		0		0		0		22	11.1	0		14.6	85.4
Maxilla	75.2	0.8	0		0		0		0		2.7	0.2	20.6	2.8	0		0		0		0		0		0		0	0	0		0	
Lost tooth of Maxilla	1296.9	13.4	0		0		0		0		109.4	7.9	47.5	6.4	0		0		0		0		0		0		0		0		0	
Mandibula	517.1	5.3	0		0		0		0		165.8	12.0	78.6	10.5	3.3	44.1	0		0		0		0		0		22.3	11.2	4.9	81.7	0	
Lost tooth of Mandibula	637.7	6.6	4		0		0		0		172.2	12.5	115.1	15.4	0		0		0		0		0		0		0		0		0	
Maxilla or Mandibula fragment	1.1	0.01	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Lost tooth of Maxilla or Mandibula	1.2	0.01	0		0		0		0		2.7	0.2	0	0	0		0		0		0		0		0		0		0		0	
Hyoid	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Total Schädel	2850.2	29.4	20.1	39.6	0		61.3	100	0		477.9	34.7	289.4	38.7	3.3	44.1	1.6	2.5	0		0		0		0		44.3	22.3	4.9	81.7	14.6	85.4
Atlas	98.6	1.0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		6.7	3.4	0		0	
Epistropheus	31.8	0.3	0		0		0		0		0	0	3.8	0.5	0		0		0		0		0		0		0	0	0		0	
Vert. cerv.	80.5	0.8	0		0		0		0		12.2	0.9	2	0.3	0		0		0		0		0		0		0	0	0		0	
Vert. thor.	87.9	0.9	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Vert. lumb.	121	1.3	0		0		0		0		0	0	1.1	0.1	0		0		0		0		0		0		0	0	1.1	18.3	0	
Vert. sacrum	0	0	0		0		0		0		2.2	0.2	0	0	0		0		0		0		0		0		0	0	0		0	
Vert. caud.	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Vert. ind.	5.8	0.1	0		0		0		0		0	0	0	0	0		0		0		0		0		0		16.8	8.5	0		0	
Costae	544.4	5.6	0		0		0		0		26.4	1.9	22.9	3.1	0		0		0		0		14.6	21	0		15.2	7.7	0		0	
Sternum	0	0	0		0		0		0		0	0	0	0	1		0		0		0		0		0		0	0	0		0	
Clavicula	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Coracoid	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Schuppen	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Total Rumpf	970	10	0		0		0		0		40.8	3.0	29.8	4.0	0		0		0		0		14.6	21	0		38.7	19.5	1.1	18.3	0	
Scapula	405.8	4.2	0		0		0		0		72.5	5.3	83.9	11.2	0		0		0		0		0		0		27.7	14.0	0		0	
Humerus	1474.7	15.2	0		0		0		0		55.3	4.0	188.3	25.2	0		10.3	16.3	0		0		0		0		16.1	8.1	0		1.8	10.5
Pelvis	445.7	4.6	9.4	18.5	0		0		0		26.4	1.9	37.9	5.1	0		0		0		0		55	79	0		20.5	10.3	0		0	
Femur	627.1	6.5	0		0		0		0		76	5.5	44.8	6.0	0		0		0		0		0		0		13.4	6.8	0		0	
Patella	0	0	0		0		0		0		2.9	0.2	0	0	0		0		0		0		0		0		0	0	0		0	
Total Stylopodium	2953.3	30.5	9.4	18.5	0		0		0		233.1	16.9	354.9	47.4	0		10.3	16.3	0		0		55	79	0		77.7	39.1	0		1.8	10.5
Radius	606.2	6.3	0		0		0		0		156.5	11.4	17.2	2.3	0		0		0		0		0		1.1	100	0	0	0		0	
Ulna	85.8	0.9	0		0		0		0		4.3	0.3	19.1	2.6	2.6	55.9	0		0		0		0		0		0	0	0		0.7	4.1
Radius/Ulna	13.2	0.1	0		0		0		0		5.6	0.4	0	0	0		0		0		0		0		0		0	0	0		0	
Tibia	827.8	8.6	0		0		0		4.2	100	280.3	20.4	10.7	1.4	0		48.8	77.3	0		0		0		0		0	0	0		0	
Fibula	0	0	0		0		0		0		0	0	3.9	0.5	0		0		0		0		0		0		0	0	0		0	
Total Zygopodium	1533	15.8	0		0		0		4.2	100	446.7	32.4	50.9	6.8	2.6	55.9	48.8	77.3	0		0		0		1.1	100	0	0	0		0.7	4.1
Carpale	19.3	0.2	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Astragalus	94.3	1.0	0		5.1	100	0		0		4.8	0.3	0	0	0		0		7.1	100	0		0		0		29.1	14.7	0		0	
Calcaneus	265.4	2.7	0		0		0		0		3.9	0.3	19.6	2.6	0		0		0		0		0		0		5.1	2.6	0		0	
Centrotarsale	25.4	0.3	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Tarsus-Rest	9.8	0.1	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Carpale/Tarsale	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Metacarpus	275.2	2.8	21.3	41.9	0		0		0		36.2	2.6	2.6	0.3	0		0		0		3.8	66.7	0		0		0	0	0		0	
Metatarsus	471.5	4.9	0		0		0		0		125.6	9.1	0	0	0		0		0		1.9	33.3	0		0		0	0	0		0	
Metapodium indet.	42.5	0.4	0		0		0		0		4.1	0.3	0	0	0		0		0		0		0		0		0	0	0		0	
Phalanges ant.	47.7	0.5	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Phalanges post.	71.7	0.7	0		0		0		0		3.2	0.2	0	0	0		0		0		0		0		0		0	0	0		0	
Phalanges	48.9	0.5	0		0		0		0		0.4	0.03	0.8	0.1	0		2.4	3.8	0		0		0		0		3.6	1.8	0		0	
Sesamoidea	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	0	0		0	
Total Autopodium	1371.7	14.2	21.3	41.9	5.1	100	0		0		178.2	12.9	23	3.1	0		2.4	3.8	7.1	100	5.7	100	0		0		37.8	19	0		0	
indet.	0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0	
TOTAL	9678.2	100	50.8	100	5.1	100	61.3	100	4.2	100	1376.7	100	748	100	5.9	100	63.1	100	7.1	100	5.7	100	69.6	100	1.1	100	198.5	100	6	100	17.1	100

Appx. Tab. 35. Skeletal element (n): Late Bronze Age (Field 3, Horizon B).

Skeletal element	Feld 3 Horizon B																									
	Species																									
	Bos taurus		Ovis aries		Ovis aries?		Capra hircus		Capra hircus?		Ovis/Capra		Sus domesticus		Canis familiaris		Capra ibex		Sus scrofa		Apodemus spec.		Ciconia Ciconia		Large ruminants		Small ruminants	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%			n	%	n	%	n	%
Os cornu	93	5.2	4	8.9	1	100	5	71.4	5	100	3	0.3	0	0	0		1	20.0	0		0		0		0		0	
Antler	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium with Os cornu	2	0.1	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium with Antler	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium	170	9.6	0		0		0		0		50	5.0	7	2.4	0		0		1	50	0		0		1	0.4	2	3.3
Maxilla	3	0.2	0		0		0		0		2	0.2	6	2.1	0		0		0		0		0		0		0	
Lost tooth of Maxilla	121	6.8	0		0		0		0		116	11.5	15	5.2	0		0		0		0		0		0		0	
Mandibula	144	8.1	2	4.4	0		0		0		95	9.5	23	8.0	0		0		0		1	100	0		3	1.2	2	3.3
Lost tooth of Mandibula	131	7.4	19	42.2	0		1	14.3	0		167	16.6	50	17.5	0		0		1	50	0		0		0		0	
Maxilla or Mandibula fragment	0	0	0		0		0		0		1	0.1	0	0	0		0		0		0		0		0		0	
Lost tooth of Maxilla or Mandibula	40	2.2	0		0		0		0		57	5.7	0	0	0		0		0		0		0		0		0	
Hyoid	1	0.1	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Cranium	705	39.6	25	55.6	1	100	6	85.7	5	100	491	48.9	101	35.3	0		1	20.0	2	100	1	100	0		4	1.6	4	6.7
Atlas	14	0.8	0		0		0		0		1	0.1	1	0.3	0		0		0		0		0		0		0	
Epistropheus	3	0.2	0		0		0		0		2	0.2	0	0	0		0		0		0		0		0		0	
Vertebra cervicalis	25	1.4	0		0		0		0		3	0.3	2	0.7	0		0		0		0		0		0		0	
Vertebra thoracalis	16	0.9	0		0		0		0		6	0.6	0	0	0		0		0		0		0		0		0	
Vertebra lumbalis	25	1.4	0		0		0		0		18	1.8	2	0.7	0		0		0		0		0		0		2	3.3
Vertebra sacrum	3	0.2	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Vertebra caudalis	1	0.1	0		0		0		0		0	0	1	0.3	0		0		0		0		0		0		0	
Vertebra indet.	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		18	7.1	9	15.0
Costae	202	11.4	0		0		0		0		25	2.5	42	14.7	0		0		0		0		0		169	67.1	23	38.3
Sternum	0	0.0	0		0		0		0		0	0.0	0	0	0		0		0		0		0		0		0	
Costae knorpel	1	0.1	0		0		0		0		1	0.1	0	0	0		0		0		0		0		0		0	
Clavicula	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Coracoid	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Schuppen	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Rumpf	290	16.3	0		0		0		0		56	5.6	48	16.8	0		0		0		0		0		187	74.2	34	56.7
Scapula	123	6.9	0		0		0		0		35	3.5	20	7.0	0		0		0		0		0		56	22.2	17	28.3
Humerus	69	3.9	10	22.2	0		1	14.3	0		40	4.0	25	8.7	0		0		0		0		0		2	0.8	1	1.7
Pelvis	70	3.9	1	2.2	0		0		0		14	1.4	6	2.1	0		1	20.0	0		0		0		1	0.4	0	
Femur	55	3.1	0		0		0		0		85	8.5	33	11.5	1	100	1	20.0	0		0		0		0		1	1.7
Patella	1	0.1	0		0		0		0		2	0.2	1	0.3	0		0		0		0		0		0		0	
Total Stylopodium	318	17.9	11	24.4	0		1	14.3	0		176	17.5	85	29.7	1	100	2	40.0	0		0		0		59	23.4	19	31.7
Radius	65	3.7	2	4.4	0		0		0		47	4.7	4	1.4	0		1	20.0	0		0		0		1	0.4	0	
Ulna	38	2.1	0		0		0		0		9	0.9	9	3.1	0		0		0		0		1	100	0		0	
Radius/Ulna	5	0.3	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Tibia	121	6.8	0		0		0		0		126	12.5	14	4.9	0		1	20.0	0		0		0		0		3	5.0
Fibula	0	0	0		0		0		0		0	0	1	0.3	0		0		0		0		0		0		0	
Total Zygopodium	229	12.9	2	4.4	0		0		0		182	18.1	28	9.8	0		2	40.0	0		0		1	100	1	0.4	3	5.0
Carpale	23	1.3	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Astragalus	14	0.8	5	11.1	0		0		0		8	0.8	0	0	0		0		0		0		0		0		0	
Calcaneus	20	1.1	1	2.2	0		0		0		4	0.4	7	2.4	0		0		0		0		0		0		0	
Centrotarsale	8	0.4	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Tarsus-Rest	3	0.2	0		0		0		0		0	0	2	0.7	0		0		0		0		0		0		0	
Carpale/Tarsale	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Metacarpus	48	2.7	0		0		0		0		34	3.4	2	0.7	0		0		0		0		0		0		0	
Metatarsus	67	3.8	1	2.2	0		0		0		40	4.0	2	0.7	0		0		0		0		0		0		0	
Metapodium indet.	8	0.4	0		0		0		0		7	0.7	1	0.3	0		0		0		0		0		0		0	
Phalanges ant.	14	0.8	0		0		0		0		0	0	4	1.4	0		0		0		0		0		0		0	
Phalanges post.	15	0.8	0		0		0		0		3	0.3	1	0.3	0		0		0		0		0		0		0	
Phalanges	17	1.0	0		0		0		0		4	0.4	5	1.7	0		0		0		0		0		1	0.40	0	
Sesamoidea	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Autopodium	237	13.3	7	15.6	0		0		0		100	10.0	24	8.4	0		0		0		0		0		1	0.40	0	
indet.	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
TOTAL	1779	100	45	100	1	100	7	100	5	100	1005	100	286	100	1	100	5	100	2	100	1	100	1	100	252	100	60	100

Appx. Tab. 36. Skeletal element (g): Late Bronze Age (Field 3, Horizon B).

Skeletal element	Feld 3 Horizon B																									
	Species																									
	Bos taurus		Ovis aries		Ovis aries?		Capra hircus		Capra hircus?		Ovis/Capra		Sus domesticus		Canis familiaris		Capra ibex		Sus scrofa		Apodemus spec.		Ciconia Ciconia		Large ruminants		Small ruminants	
	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%
Os cornu	371.3	1.9	93.5	35.3	1.5	100	36.4	79.8	6.7	100	3.1	0.1	0	0	0		3.6	2.7	0		0		0		0		0	
Antler	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium with Os cornu	57.5	0.3	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium with Antler	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Cranium	551.7	2.8	0		0		0		0		44.9	1.5	42.6	2.5	0		0		4.7	24.7	0		0		1.0	0.3	0.7	1.5
Maxilla	201.7	1.0	0		0		0		0		27.6	0.9	55.2	3.2	0		0		0		0		0		0		0	
Lost tooth of Maxilla	1639.7	8.4	0		0		0		0		522.4	17.1	92.0	5.4	0		0		0		0		0		0		0	
Mandibula	928.1	4.7	17.3	6.5	0		0		0		321.4	10.5	159.8	9.4	0		0		0		0.1	100	0		6.5	1.6	0.9	1.9
Lost tooth of Mandibula	1578.9	8.1	26.5	10.0	0		1.9	4.2	0		540.8	17.7	188.4	11.1	0		0		14.3	75.3	0		0		0		0	
Maxilla or Mandibula fragment	0	0	0		0		0		0		0.3	0.01	0	0	0		0		0		0		0		0		0	
Lost tooth of Maxilla or Mandibula	40.0	0.2	0		0		0		0		15.4	0.5	0	0	0		0		0		0		0		0		0	
Hyoid	1.4	0.0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Cranium	5370.3	27.4	137.3	51.9	1.5	100	38.3	84.0	6.7	100	1475.9	48.4	538	31.6	0		3.6	2.7	19.0	100	0.1	100	0		7.5	1.9	1.6	3.4
Atlas	169.3	0.9	0		0		0		0		3.4	0.1	13.8	0.8	0		0		0		0		0		0		0	
Epistropheus	81.3	0.4	0		0		0		0		13.9	0.5	0	0	0		0		0		0		0		0		0	
Vertebra cervicalis	225.0	1.1	0		0		0		0		8.6	0.3	12.0	0.7	0		0		0		0		0		0		0	
Vertebra thoracalis	159.5	0.8	0		0		0		0		4.6	0.2	0	0	0		0		0		0		0		0		0	
Vertebra lumbalis	154.1	0.8	0		0		0		0		39.5	1.3	32.0	1.9	0		0		0		0		0		0		2.0	4.2
Vertebra sacrum	14.6	0.1	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Vertebra caudalis	1.8	0.0	0		0		0		0		0	0	0.6	0.0	0		0		0		0		0		0		0	
Vertebra indet.	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		69.0	17.3	11.4	24.0
Costae	1072.7	5.5	0		0		0		0		20.0	0.7	95.3	5.6	0		0		0		0		0		192.6	48.3	11.6	24.4
Sternum	0	0.0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Costae knorpel	0.7	0.0	0		0		0		0		1.0	0.03	0	0	0		0		0		0		0		0		0	
Clavicula	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Coracoid	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Schuppen	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Rumpf	1879	9.6	0		0		0		0		91	3.0	153.7	9.0	0		0		0		0		0		261.6	65.6	25	52.6
Scapula	1862.6	9.5	0		0		0		0		102.7	3.4	123.5	7.3	0		0		0		0		0		117.6	29.5	13.6	28.6
Humerus	1505.8	7.7	79.6	30.1	0		7.3	16.0	0		127.5	4.2	256.4	15.1	0		0		0		0		0		6.2	1.6	1.9	4.0
Pelvis	902.2	4.6	11.2	4.2	0		0		0		49.3	1.6	46.0	2.7	0		10.3	7.8	0		0		0		2.6	0.7	0	
Femur	927.2	4.7	0		0		0		0		231.9	7.6	246.7	14.5	6.0	100	19.7	15.0	0		0		0		0		1.7	3.6
Patella	10.6	0.1	0		0		0		0		2.6	0.1	2.7	0.2	0		0		0		0		0		0		0	
Total Stylopodium	5208.4	26.6	90.8	34.3	0		7.3	16.0	0		514	16.9	675.3	39.7	6.0	100	30	22.8	0		0		0		126.4	31.7	17.2	36.2
Radius	1215.8	6.2	10.3	3.9	0		0		0		195.7	6.4	28.5	1.7	0		36.1	27.5	0		0		0		1.7	0.4	0	
Ulna	382.8	2.0	0		0		0		0		25.7	0.8	86.2	5.1	0		0		0		0		1.7	100	0		0	
Radius/Ulna	100.8	0.5	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Tibia	2179.4	11.1	0		0		0		0		479.2	15.7	118.0	6.9	0		61.6	46.9	0		0		0		0		3.7	7.8
Fibula	0	0	0		0		0		0		0	0	6.0	0.4	0		0		0		0		0		0		0	
Total Zygopodium	3878.8	19.8	10.3	3.9	0		0		0		700.6	23.0	238.7	14.0	0		97.7	74.4	0		0		1.7	100	1.7	0.4	3.7	7.8
Carpale	146.8	0.7	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Astragalus	390.5	2.0	15.6	5.9	0		0		0		13.2	0.4	0	0	0		0		0		0		0		0		0	
Calcaneus	366.4	1.9	5.6	2.1	0		0		0		9.9	0.3	43	2.5	0		0		0		0		0		0		0	
Centrotarsale	135.9	0.7	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Tarsus-Rest	12.6	0.1	0		0		0		0		0	0	6.8	0.4	0		0		0		0		0		0		0	
Carpale/Tarsale	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Metacarpus	768.1	3.9	0		0		0		0		90.9	3.0	7.4	0.4	0		0		0		0		0		0		0	
Metatarsus	1037.8	5.3	5.1	1.9	0		0		0		140.3	4.6	5.4	0.3	0		0		0		0		0		0		0	
Metapodium indet.	25.6	0.1	0		0		0		0		6.1	0.2	11.7	0.7	0		0		0		0		0		0		0	
Phalanges ant.	161.2	0.8	0		0		0		0		0	0	11.8	0.7	0		0		0		0		0		0		0	
Phalanges post.	155.7	0.8	0		0		0		0		4.2	0.1	3.2	0.2	0		0		0		0		0		0		0	
Phalanges	57.9	0.3	0		0		0		0		2.2	0.1	5.4	0.3	0		0		0		0		0		1.3	0.3	0	
Sesamoidea	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
Total Autopodium	3258.5	16.6	26.3	9.9	0		0		0		266.8	8.8	94.7	5.6	0		0		0		0		0		1.3	0.3	0	
indet.	0	0	0		0		0		0		0	0	0	0	0		0		0		0		0		0		0	
TOTAL	19595	100	264.7	100	1.5	100	45.6	100	6.7	100	3048.3	100	1700.4	100	6.0	100	131.3	100	19.0	100	0.1	100	1.7	100	398.5	100	47.5	100

Appx. Tab. 37. Skeletal element (n): Late Bronze Age (Field 1, Horizon B).

Skeletal element	Feld 1 Horizon B																									
	Species																									
	Equus caballus		Bos taurus		Ovis aries		Ovis aries?		Capra hircus		Ovis / Capra		Sus domesticus		Canis familiaris		Ursus arctos	Cervus elaphus	Capra ibex	Capreolus Capreolus	Sus scrofa	Columba palumbus	Vulpes vul./ Canis fam.	Large ruminants		Small ruminants	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	n	n	n	n	n	n	n	%	n	%
Os cornu	0		152	3.2	9	12.9	0	0	1	10.0	19	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1.4
Cranium with Os cornu	0		19	0.4	4	5.7	0	0	2	20.0	2	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Cranium	0		594	12.3	4	5.7	0	0	0	0	110	5.5	31	4.3	1	33.3	0	0	0	0	0	0	0	8	2.2	11	15.1
Maxilla	0		9	0.2	0	0	0	0	0	0	3	0.1	21	2.9	0	0	0	0	0	0	0	0	0	0		0	0
lost tooth of Maxilla	0		251	5.2	0	0	0	0	0	0	181	9.0	42	5.8	0	0	0	0	0	0	0	0	0	0		0	0
Mandibula	0		425	8.8	4	5.7	0	0	1	10.0	183	9.1	65	9.0	0	0	0	0	0	0	2	0	0	33	8.9	3	4.1
lost tooth of Mandibula	0		327	6.8	7	10	0	0	3	30.0	270	13.5	46	6.3	0	0	0	0	0	0	0	0	0	0	0	0	0
Maxilla or Mandibula fragment	0		17	0.4	0	0	0	0	0	0	3	0.1	3	0.4	0	0	0	0	0	0	0	0	0	3	0.8	8	11.0
Lost tooth of Maxilla or Mandibula	0		114	2.4	0	0	0	0	0	0	42	2.1	10	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0
Os hyoidum	0		2	0.04	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cranium	0	0	1910	39.6	28	40.0	0	0	7	70.0	813	40.6	218	30.0	1	33.3	0	0	0	0	2	0	0	44	11.8	23	31.5
	0																										0.0
Atlas	0		32	0.7	1	1.4	0	0	0	0	1	0	4	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
Epistropheus	0		12	0.2	0	0	0	0	0	0	3	0.1	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebra cervicalis	0		89	1.8	0	0	0	0	0	0	15	0.7	6	0.8	0	0	0	0	0	0	0	0	0	21	5.6	0	0
Vertebra thoracalis	0		84	1.7	0	0	0	0	0	0	5	0.2	7	1.0	0	0	0	0	0	0	0	0	0	8	2.2	0	0
Vertebra lumbalis	1	100	60	1.2	0	0	0	0	1	10.0	18	0.9	11	1.5	0	0	0	1	0	0	1	0	0	7	1.9	0	0
Sacrum	0		4	0.1	0	0	0	0	0	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0	1	0	0	0
Vertebra caudalis	0		2	0.04	0	0	0	0	0	0	1	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebra indet.	0		8	0.2	0	0	0	0	0	0	2	0.1	1	0.1	0	0	0	0	0	0	0	0	0	74	19.9	8	11.0
Costa	0		676	14.0	0	0	0	0	0	0	123	6.1	113	15.6	0	0	0	0	0	0	0	0	1	158	42.5	20	27.4
Sternum	0		2	0.04	0	0	0	0	0	0	1	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0
Rippenknorpel	0		0	0	0	0	0	0	0	0	1	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Rumpf	1	100	969	20.1	1	1.4	0	0	1	10.0	170	8.5	144	19.8	0	0	0	1	0	0	1	0	1	269	72.3	28	38.4
Scapula	0		253	5.3	3	4.3	0	0	0	0	83	4.1	73	10.1	0	0	0	0	0	0	0	0	0	34	9.1	8	11.0
Humerus	0		213	4.4	10	14.3	0	0	1	10.0	97	4.8	73	10.1	1	33.3	0	1	1	0	0	0	0	3	0.8	0	0
Pelvis	0		192	4.0	5	7.1	0	0	0	0	62	3.1	34	4.7	1	33.3	0	1	0	0	1	0	0	4	1.1	1	1.4
Femur	0		179	3.7	0	0	0	0	0	0	146	7.3	55	7.6	0	0	0	1	0	0	0	0	0	4	1.1	2	2.7
Patella	0		3	0.1	0	0	0	0	0	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0	0	0.0	0	0
Total Stylopodium	0	0	840	17.4	18	25.7	0	0	1	10.0	388	19.4	236	32.5	2	66.6	0	3	0	0	1	0	0	45	12.1	11	15.1
																											0
Radius	0		171	3.5	2	2.9	1	50	0	0	110	5.5	19	2.6	0	0	0	0	0	0	1	0	0	1	0.3	0	0
Ulna	0		80	1.7	2	2.9	0	0	0	0	17	0.8	19	2.6	0	0	1	0	0	0	0	1	0	0	0	0	0
Radius/Ulna	0		6	0.1	0	0	0	0	0	0	2	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tibia	0		236	4.9	1	1.4	0	0	0	0	284	14.2	40	5.5	0	0	0	1	0	3	0	0	1	7	1.9	10	13.7
Fibula	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Total Zygopodium	0	0	493	10.2	5	7.1	1	50	0	0	413	20.6	78	10.7	0	0	1	1	0	3	1	0	1	8	2.2	10	13.7
																											0
Carpale	0		29	0.6	0	0	0	0	0	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Astragalus	0		54	1.1	6	8.6	1	50	0	0	4	0.2	7	1.0	0	0	0	0	0	2	0	0	0	1	0.3	0	0
Calcaneus	0		48	1.0	6	8.6	0	0	1	10.0	5	0.2	11	1.5	0	0	0	0	0	0	0	0	0	0	0.0	0	0
Centrotarsale	0		20	0.4	1	1.4	0	0	0	0	4	0.2	0	0	0	0	0	0	0	0	0	0	0	1	0.3	0	0
Tarsus-Rest	0		2	0.04	0	0	0	0	0	0	0	0	2	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0
Carpale/Tarsale	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metacarpus	0		145	3.0	1	1.4	0	0	0	0	95	4.7	6	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0
Metatarsus	0		158	3.3	0	0	0	0	0	0	82	4.1	3	0.4	0	0	0	2	0	1	0	0	0	0	0	1	1.4
Metapodium indet.	0		48	1.0	0	0	0	0	0	0	14	0.7	9	1.2	0	0	0	0	0	0	0	0	0	1	0.3	0	0
Phalanx anterior	0		22	0.5	1	1.4	0	0	0	0	1	0.05	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Phalanx posterior	0		21	0.4	3	4.3	0	0	0	0	2	0.1	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Phalanx ant./post.	0		57	1.2	0	0	0	0	0	0	12	0.6	9	1.2	0	0	0	0	0	0	1	0	0	3	0.8	0	0
Sesamoidea	0		2	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Autopodium	0		606	12.6	18	25.7	1	100	1	10.0	219	10.9	50	6.9	0	0	0	2	0	3	1	0	0	6	1.6	1	1.4
																									0		0
indet.	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
																									0		0
TOTAL	1	100	4818	100	70	100	2	100	10	100	2003	100	726	100	3	100	1	7	1	6	6	1	2	372	100	73	100

Appx. Tab. 38. Skeletal element (g): Late Bronze Age (Field 1, Horizon B).

Skeletal element	Feld 1 Horizon B																											
	Species																											
	Equus caballus		Bos taurus		Ovis aries		Ovis aries?		Capra hircus		Ovis/Capra		Sus domesticus		Canis familiaris		Ursus arctos	Cervus elaphus	Capra ibex	Capreolus Capreolus	Sus scrofa	Columba palumbus	Vulpes vul./ Canis fam.	Large ruminants		Small ruminants	
	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	%	g	g	g	g	g	g	g	g	%	g	%
Os cornu	0		332.7	0.6	95.3	20.459	0		2	4.6	26.5	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.4
Cranium with Os cornu	0		241.7	0.5	70.3	15.1	0		23.2	53.3	2.9	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Cranium	0		1869.8	4	30.4	6.5	0		0	0	83.2	1.4	122	2.7	36.2	72.1	0	0	0	0	0	0	0	6	0.7	5.5	9.9
Maxilla	0		288.7	0.6	0	0	0		0	0	15.3	0.3	220.5	4.9	0	0	0	0	0	0	0	0	0	0	0.0	0	0
lost tooth of Maxilla	0		4562.6	8.8	0	0	0		0	0	781.8	12.9	196.4	4.4	0	0	0	0	0	0	0	0	0	0	0.0	0	0
Mandibula	0		3565.3	6.9	12.9	2.8	0		0	0	465	7.7	443.6	9.8	0	0	0	0	0	0	27.2	0	0	76.4	9.1	2.1	3.8
lost tooth of Mandibula	0		3640.1	7.0	0	0	0		0	0	1018.9	16.8	192.5	4.3	0	0	0	0	0	0	0	0	0	0	0	0	0
Maxilla or Mandibula fragment	0		21.8	0.04	0	0	0		0	0	3.3	0.1	3.5	0.1	0	0	0	0	0	0	0	0	0	2.8	0.3	2.3	4.1
Lost tooth of Maxilla or Mandibula	0		95.9	0.2	0	0	0		0	0	16.1	0.3	6.5	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Os hyoidum	0		7.3	0.01	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cranium	0	0	14626	28.3	208.9	44.848	0	0	25.2	57.931	2413	39.8	1185	26.3	36.2	72.1	0	0	0	0	27.2	0	0	85.2	10.1	10.1	18.2
	0																										0.0
Atlas	0		349.7	0.7	5.7	1.2	0		0		4.6	0	30.5	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0
Epistropheus	0		180.5	0.3	0	0	0		0		13	0.2	4.4	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebra cervicalis	0		810.3	1.6	0	0	0		0		75.9	1.3	22.7	0.5	0	0	0	0	0	0	0	0	0	6.1	0.7	0	0
Vertebra thoracalis	0		717.5	1.4	0	0	0		0		8.6	0.1	16.2	0.4	0	0	0	0	0	0	0	0	0	18.7	2.2	0	0
Vertebra lumbalis	35.5	100	646.9	1.3	0	0	0		7.3	16.8	63.3	1.0	39.8	0.9	0	0	0	1.9	0	0	20.1	0	0	16.5	2.0	0	0
Sacrum	0		57.3	0.1	0	0	0		0			0	1.2	0.0	0	0	0	0	0	0	0	0	0	2.4	0	0	0
Vertebra caudalis	0		11.3	0.02	0	0	0		0		0.5	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertebra indet.	0		49.2	0.1	0	0	0		0		5	0.1	2.4	0.1	0	0	0	0	0	0	0	0	0	190.9	22.7	10.3	18.5
Costa	0		2957	5.7	0	0	0		0		112.2	1.9	219	4.9	0	0	0	0	0	0	0	0	0.5	215.9	25.7	6.1	11.0
Sternum	0		9.4	0.02	0	0	0		0		1.2	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0
Rippenknorpel	0		0	0	0	0	0		0		0.8	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Rumpf	35.5	100	5789.1	11.2	5.7	1.2	0	0	7.3	16.8	285.1	4.7	336.2	7.5	0	0	0	1.9	0	0	20.1	0	0.5	450.5	53.6	16.4	29.5
Scapula	0		3503.5	6.8	24.2	5.2	0		0		176.9	2.9	540.6	12.0	0	0	0	0	0	0	0	0	0	97.3	11.6	7.8	14.0
Humerus	0		4619.9	8.9	93.1	20.0	0		6.7	15.4	328.3	5.4	790.5	17.5	7.8	15.5	0	4.8	8.2	0	0	0	0	12	1.4	0	0
Pelvis	0		2994.4	5.8	44.4	9.5	0		0		205.2	3.4	327.6	7.3	6.2	12.4	0	10.3	0	0	22.7	0	0	21.3	2.5	0.7	1.3
Femur	0		3320.0	6.4	0	0	0		0		436.2	7.2	341.8	7.6	0	0	0	33.3	0	0	0	0	0	46.7	5.6	2.5	4.5
Patella	0		58.8	0.1	0	0	0		0		0	0	5.1	0.1	0	0	0	0	0	0	0	0	0	0	0.0	0	0
Total Stylopodium	0	0	14497	28.0	161.7	34.714	0	0	6.7	15.4	1146.6	18.9	2005.6	44.5	14	27.9	0	48.4	0	0	22.7	0	0	177.3	21.1	11	19.8
																											0
Radius	0		2879.4	5.6	9.3	2.0	2.9	50	0		381	6.3	119.4	2.6	0	0	0	0	0	0	11.9	0	0	2.8	0.3	0	0
Ulna	0		811.8	1.6	11	2.4	0		0		33.9	0.6	214	4.7	0	0	25.7	0	0	0	0	0.6	0	0	0	0	0
Radius/Ulna	0		167.2	0.3	0	0	0		0		10.5	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tibia	0		4604.1	8.9	2.5	0.5	0		0		1184.4	19.5	393.4	8.7	0	0	0	52.9	0	21.9	0	0	1.1	103.2	12.3	17.4	31.3
Fibula	0		0	0	0	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Total Zygopodium	0	0	8462.5	16.4	22.8	4.9	2.9	50	0	0	1609.8	26.6	726.8	16.1	0	0	25.7	52.9	0	21.9	11.9	0.6	1.1	106	12.6	17.4	31.3
																											0
Carpale	0		158.7	0.3	0	0	0		0		0	0	2.9	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Astragalus	0		1366.8	2.6	22.5	4.8	2.8	50	0		15.2	0.3	63.6	1.4	0	0	0	0	0	6.4	0	0	0	9.3	1.1	0	0
Calcaneus	0		999.2	1.9	21.5	4.6	0		4.3	9.9	14.6	0.2	90	2.0	0	0	0	0	0	0	0	0	0	0	0.0	0	0
Centrotarsale	0		243.2	0.5	2.6	0.6	0		0		5.6	0.1	0	0	0	0	0	0	0	0	0	0	0	2.6	0.3	0	0
Tarsus-Rest	0		11.9	0.02	0	0	0		0		0	0	6.1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Carpale/Tarsale	0		0	0	0	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metacarpus	0		1997.2	3.9	13.2	2.8	0		0		262	4.3	19.8	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
Metatarsus	0		2472.4	4.8	0	0	0		0		274.9	4.5	25.7	0.6	0	0	0	11.3	0	1.4	0	0	0	0	0	0.7	1.3
Metapodium indet.	0		220.1	0.4	0	0	0		0		18.6	0.3	21.6	0.5	0	0	0	0	0	0	0	0	0	2.3	0.3	0	0
Phalanx anterior	0		273.3	0.5	1.7	0.4	0		0		1.1	0.02	2.2	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phalanx posterior	0		230.3	0.4	5.2	1.1	0		0		1.3	0.0	5	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
Phalanx ant./post.	0		378.7	0.7	0	0	0		0		11.7	0.2	20.2	0.4	0	0	0	0	0	0	6.1	0	0	7	0.8	0	0
Sesamoidea	0		3.3	0.01	0	0	0		0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Autopodium	0		8355.1	16.2	66.7	14.319	2.8	100	4.3	9.9	605	10.0	257.1	5.7	0	0	0	11.3	0	7.8	6.1	0	0	21.2	2.5	0.7	1.3
																									0		0
indet.	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
																									0		0
TOTAL	35.5	100	51729	100	465.8	100	5.7	100	43.5	100	6059.5	100	4510.7	100	50.2	100	25.7	114.5	8.2	29.7	88	0.6	1.6	840.2	100	55.6	100

9.4. Caption of Figures

Appx. Fig. 1. Fragmentation of Mandible based on the cord number of OSSOBOOK (version autumn 2005).

Appx. Fig. 2. Fragmentation of Scapula based on the cord number of OSSOBOOK (version autumn 2005).

Appx. Fig. 3. Fragmentation of Pelvis based on the cord number of OSSOBOOK (version autumn 2005).

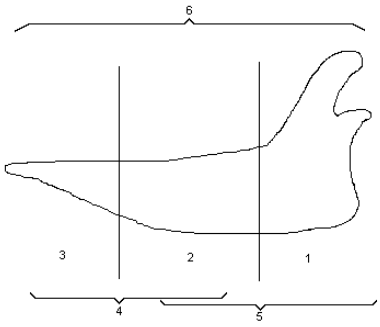
Appx. Fig. 4. Fragmentation of long bones based on the cord number of OSSOBOOK (version autumn 2005).

Appx. Fig. 5. Bite mark on each skeletal element of cattle.

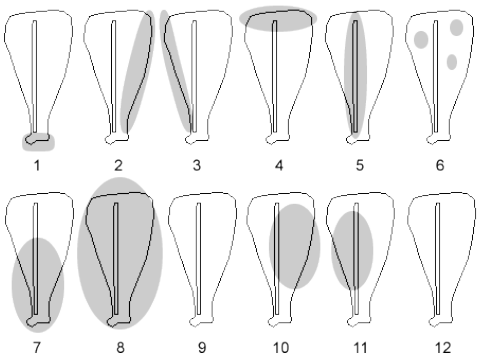
Appx. Fig. 6. Bite mark on each skeletal element of sheep/goat.

Appx. Fig. 7. Bite mark on each skeletal element of pig.

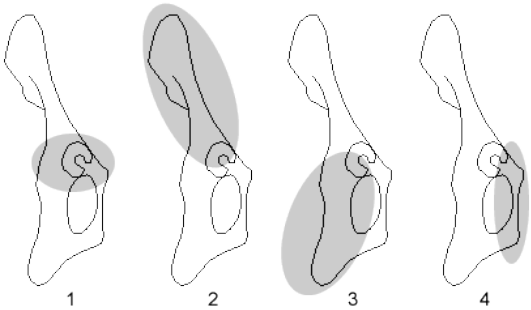
9.5. Figures



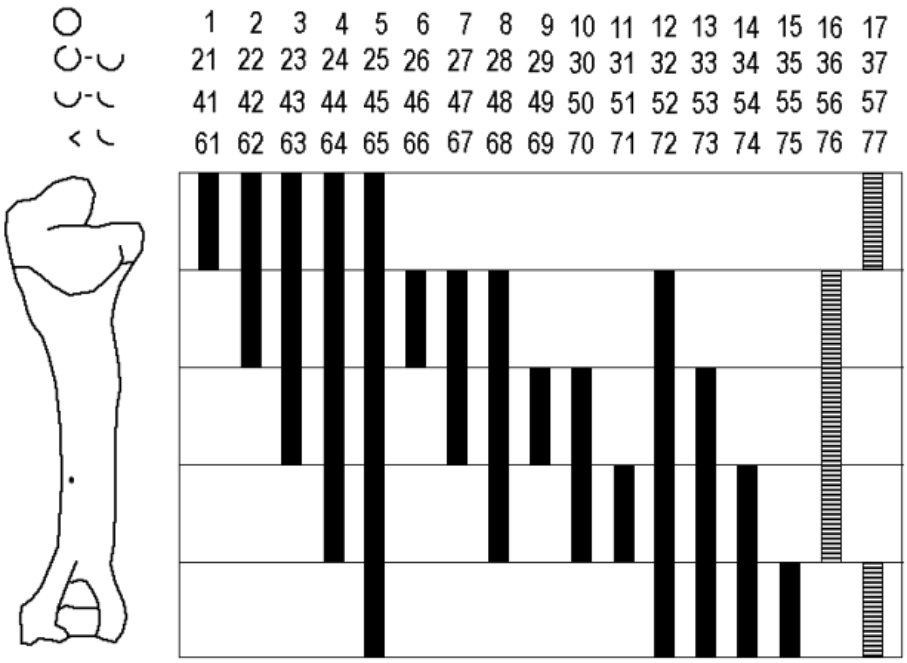
Appx. Fig. 1. Fragmentation of Mandible based on the cord number of OSSOBOOK (version autumn 2005).



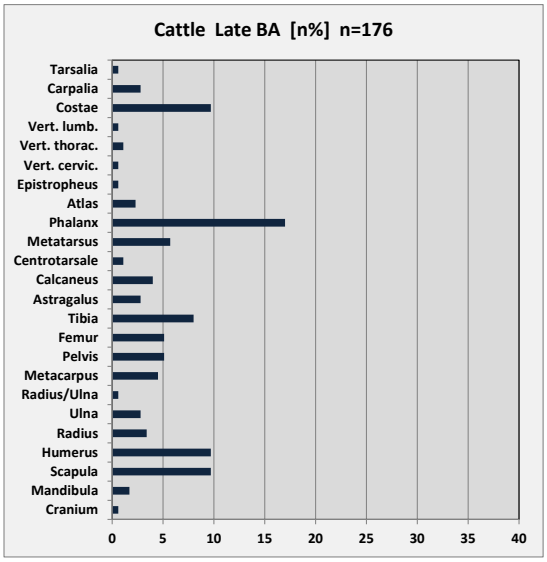
Appx. Fig. 2. Fragmentation of Scapula based on the cord number of OSSOBOOK (version autumn 2005).

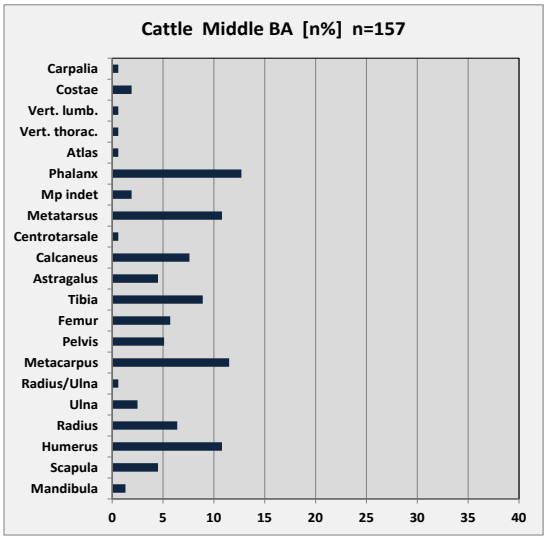


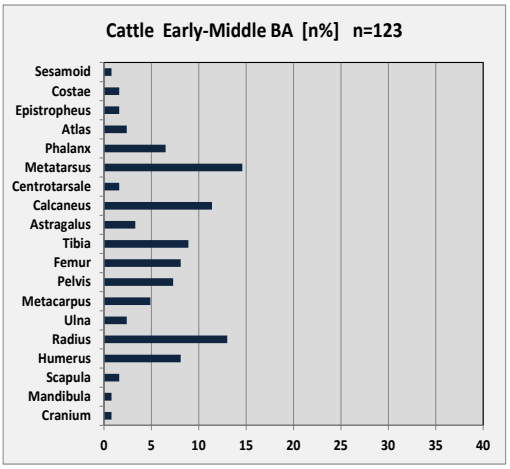
Appx. Fig. 3. Fragmentation of Pelvis based on the cord number of OSSOBOOK (version autumn 2005).

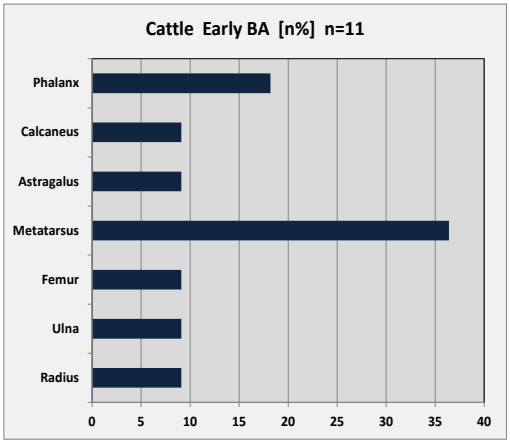


Appx. Fig. 4. Fragmentation of long bones based on the cord number of OSSOBOOK (version autumn 2005).

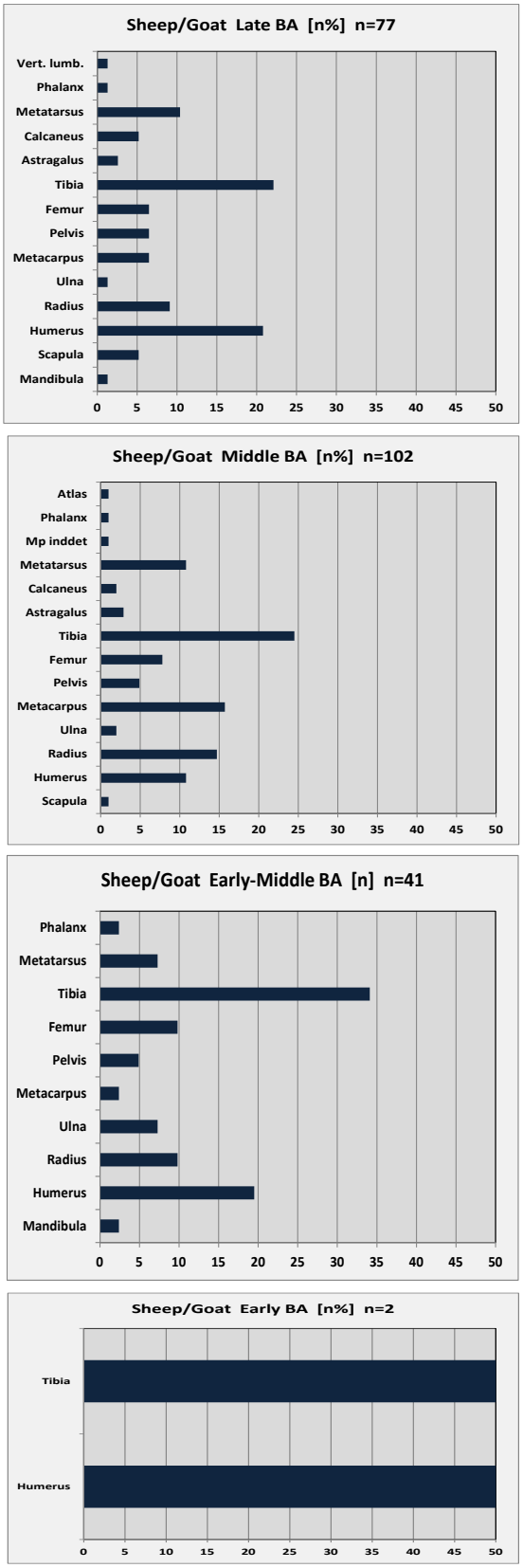




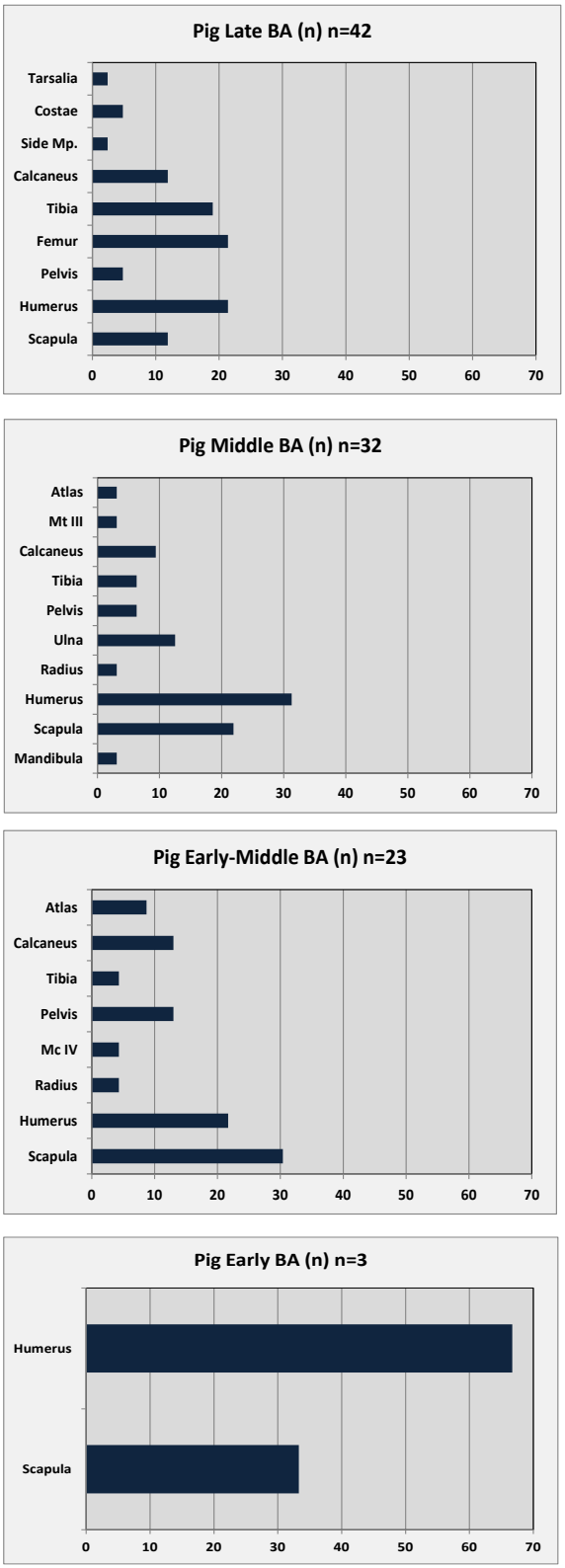




Appx. Fig. 5. Bite mark on each skeletal element of cattle.



Appx. Fig. 6. Bite mark on each skeletal element of sheep/goat.



Appx. Fig. 7. Bite mark on each skeletal element of pig.

9.6. Caption of Photographs

Appx. Photo. 1. Bite mark: Radius of cattle.

Appx. Photo. 2. Bite mark: Metatarsus of sheep/goat.

Appx. Photo. 3. Bite mark: Scapula of pig.

Appx. Photo. 4. Bite mark: Ulna of dog.

Appx. Photo. 5. Burnt trace: Femur of sheep/goat.

Appx. Photo. 6. Burnt trace: Tibia of pig.

Appx. Photo. 7. Cut mark: Atlas of cattle.

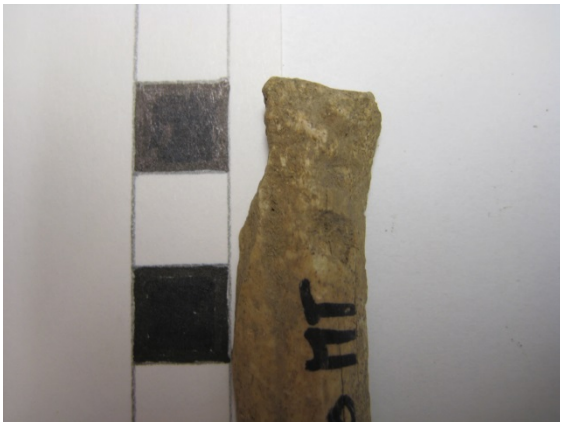
Appx. Photo. 8. Cut mark: Pelvis of cattle.

Appx. Photo. 9. Chop mark: Humerus of pig.

Appx. Photo. 10. The butchering technique of regular fragmentation performed on Mandibula of sheep/goat.

9.7. Photographs

Appx. Photo. 1. Bite mark: Radius of cattle.

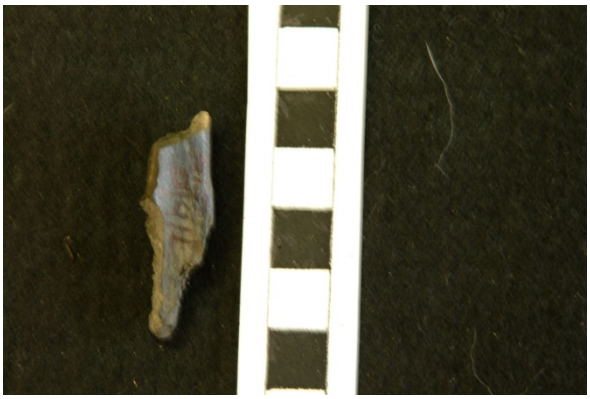


Appx. Photo. 2. Bite mark: Metatarsus of sheep/goat.

Appx. Photo. 3. Bite mark: Scapula of pig.

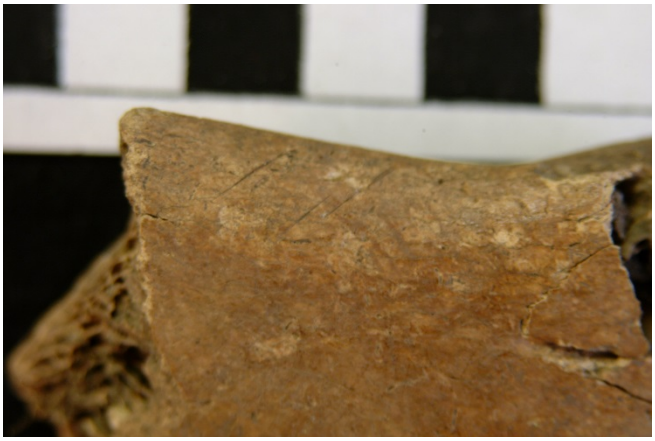
Appx. Photo. 4. Bite mark: Ulna of dog.

Appx. Photo. 5. Burnt trace: Femur of sheep/goat.



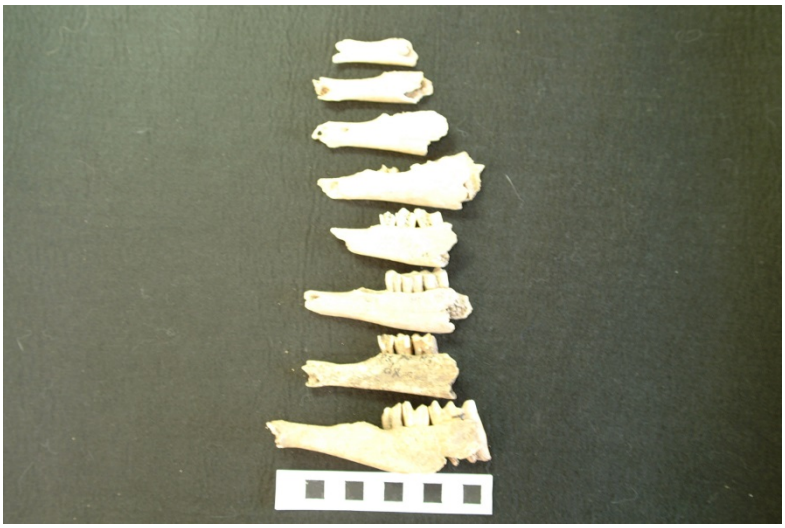
Appx. Photo. 6. Burnt trace: Tibia of pig.

Appx. Photo. 7. Cut mark: Atlas of cattle.



Appx. Photo. 8. Cut mark: Pelvis of cattle.

Appx. Photo. 9. Chop mark: Humerus of pig.



Appx. Photo. 10. The butchering technique of regular fragmentation performed on Mandibula of sheep/goat.