



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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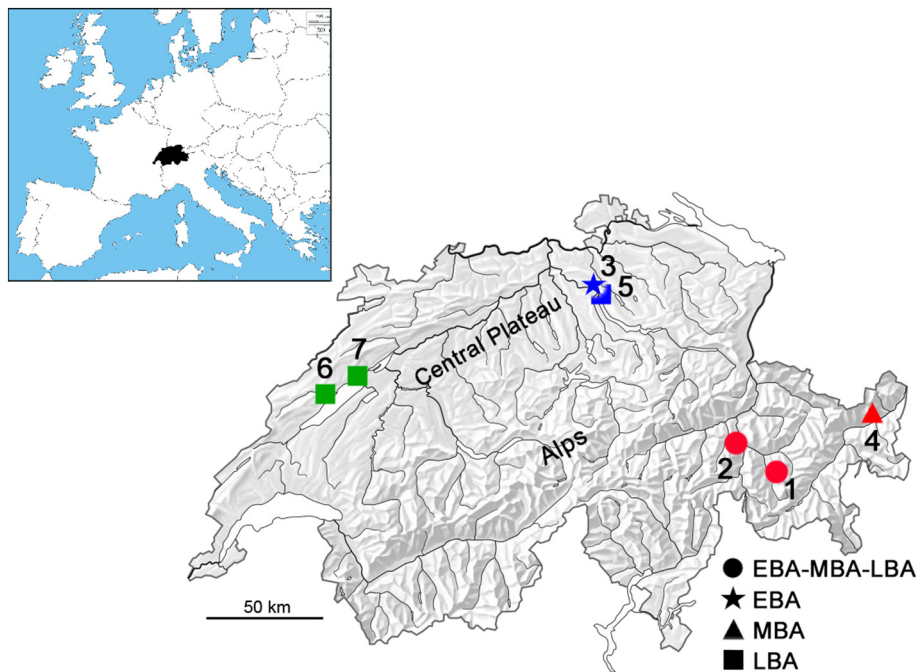


Fig. 1. Location of studied sites: numbers refer to the archaeological sites listed in Table 1. Red symbols (Nos. 1, 2, and 4) indicate Alpine sites, blue symbols (Nos. 3 and 5) indicate sites from the east Plateau, and green symbols (Nos. 6 and 7) indicate sites from the west Plateau. EBA = Early Bronze 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 No.	Settlement	Sample size		Archaeozoological References
				M2	M3	
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	Cortailod-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.,

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