



Humans and environmental sustainability: Lessons from the past ecosystems of Europe and Northern Africa

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UNDER THE PATRONAGE OF



Settlements, crops, woods. Land use and natural resources in a changing environment at the time of the Terramare (XVI–XII century BC, N Italy)

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Introduction

The civilization of the Terramare developed between the Middle and the Recent Bronze Ages (XVI–XII century BC) in the Po Plain of Northern Italy, and was based upon cereal farming, herding, and metallurgy (Bernabò Brea et al. 1997). The Terramare people also promoted a wide network of commercial exchanges between Northern Europe and the Mediterranean region. This civilization lasted for c. 500 years, before suddenly collapsing at *ca.* 1150 BC (Cardarelli 2009; Fig. 1), in a period of great civilization upheaval throughout the whole Mediterranean region. This paper discusses the initial results of an on-going research carried out in the framework of the *SUCCESSO-TERRA Project (PRIN20158KBLNB)*, aimed at elucidate the reasons, dynamic and timing of the collapse of the Terramare civilization.

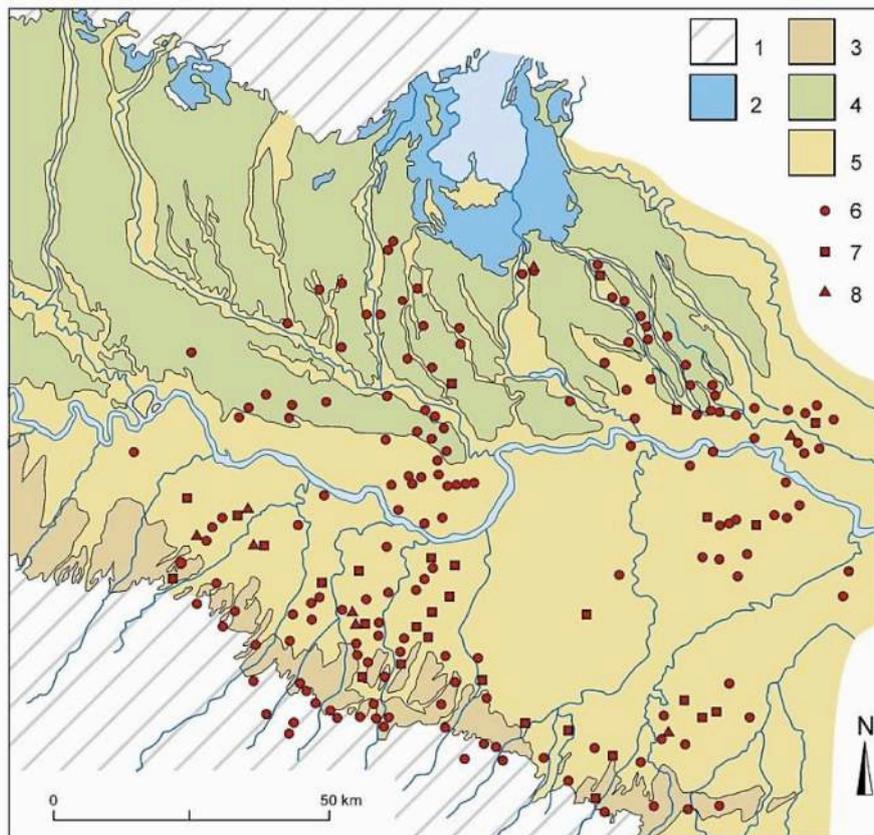


Figure 1 - Distribution of the Terramare and contemporary sites in the central Po Plain.

Materials and Methods

The research project includes the cooperation between geoarchaeologists, archaeologists, palaeoarchaeobotanists, and geochemists. It is based on the archaeological excavation in key sites (Terramara Santa Rosa di Poviglio - Bernabò Brea et al. 2004, Figs. 2,3; Terramara di Noceto - Bernabò Brea and Cremaschi 2009, and San Michele di Valestra sites - Cremaschi 1997), and a regional survey in the areas surrounding the archaeological sites. The results from archaeological, geoarchaeological (including micromorphology), archaeobotanical and archaeozoological studies are interpreted in a multidisciplinary perspective, and in a chronological framework based on many radiocarbon dates on different materials. Moreover, an independent palaeoclimatic reconstruction is investigated through the study of local speleothems.



Figure 2 - Terramara Santa Rosa di Poviglio, Villaggio Grande – plan of houses delimited by postholes

Results and Discussion

The subsistence strategies of the Terramare civilization were mainly based on cereal agriculture supported by the introduction of irrigated agriculture. Beside irrigated agriculture, it also introduced an innovative and sophisticated system of management of the natural hydrographic net. Artificial canals were excavated to draw water from the main watercourses, along which the settlements were located, to the moats of the villages and then redistributed to the fields throughout a dense network of irrigation ditches. The successful contribution of this irrigation method to agricultural practices triggered the Terramare civilization to its apogee and in consequence of it a growing demographic pressure developed from the Middle Bronze Age to the Recent Bronze Age.

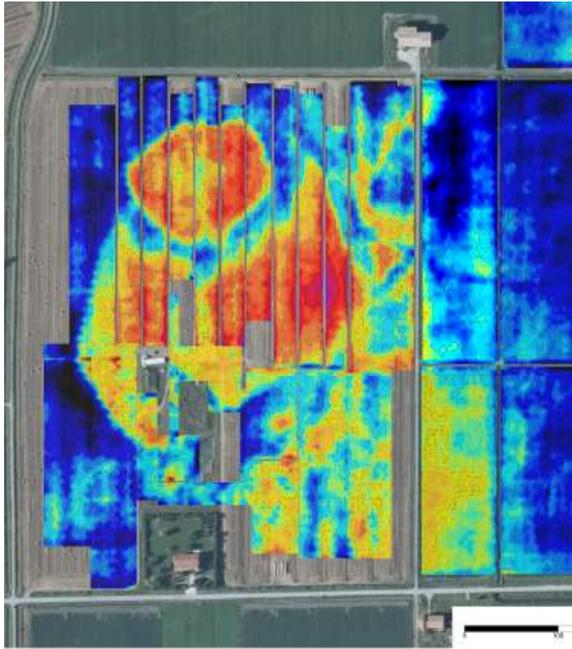


Figure 3 - The map of the Terramara of Santa Rosa di Poviglio as shown by the geophysical survey (Mele et al. 2015 in Cremaschi et al. 2015).

A further and important aspect of the land exploitation performed by the Terramare culture was deforestation, which was extended also to the lowlands that had never been cleared before. The need for extending clearance to larger areas was mandatory, as increased demographic pressure required large areas for cultivation and grazing. Moreover, a large quantity of timber was required to build villages. As a consequence, the pollen diagrams obtained from Terramare sites show a very high rate of deforestation; the latter is higher than in other Bronze Age settlements from the Alps and central Italy (Cremaschi et al. 2016). An estimation of the agricultural yield of cultivated fields of some Terramare sites in the basin of the Enza River (Emilia region, N Italy) indicates that the production of cereals was adequate to the demands of the Middle Bronze Age, but became critical during the period of demographic growth at the apogee of the Terramare culture in the Recent Bronze Age. From this period onwards, a progressively increasing environmental stress is also evident. Parts of the fields were probably left uncultivated and used for livestock grazing. Among domestic animal populations, the number of goats increased, less demanding than other animal species as pigs, which were better represented in previous periods.

The dramatically diminished availability of timber is confirmed by a change in building technique; the construction on deck and posts, which is a technique that demands large quantities of wood, was abandoned. Wooden palisades to improve the fortifications of villages were replaced by earthen ramparts; the necessity to protect villages suggests an increased societal instability due to a growing competition for natural resources (Cremaschi and Pizzi 2013).

An episode of drought at c. 1150 BC (3100 years cal BP), documented on both sides of the Alps and in the Apennines by several palaeohydrological archives, affected the Terramare area (Fig. 4). At the Terramara of Santa Rosa di Poviglio, the dry period caused a dramatic lowering of the water table, and consequently the turning off the hydraulic systems of the site (Cremaschi and Pizzi 2007). This forced the inhabitants to dig wells at the bottom of the moat surrounding the site to reach deeper water tables (Fig. 5). The site was abandoned in coincidence of this drought episode and at the same time the whole Terramare system collapsed. Likely the unexpected and intense drought, affecting a territory exploited beyond the limits of its sustainability, had dramatic effects (Cremaschi et al. 2006). It caused famine among livestock and humans, and pushed the social system to the collapse that led to the disappearance of the Terramare in the turn of a generation.

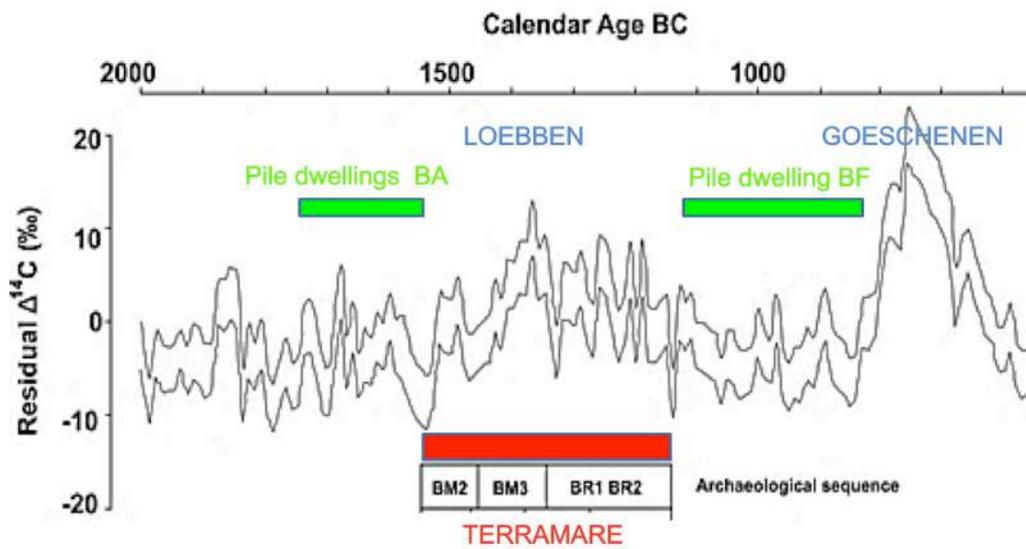


Figura 4 - The period of existence of the terramare (red bar) is compared to the oscillations of the residual ^{14}C , the main phases of advance of the Alpine glaciers (Loebben and Goeschenen) and the periods of presence of the pile dwellings in the Alpine area

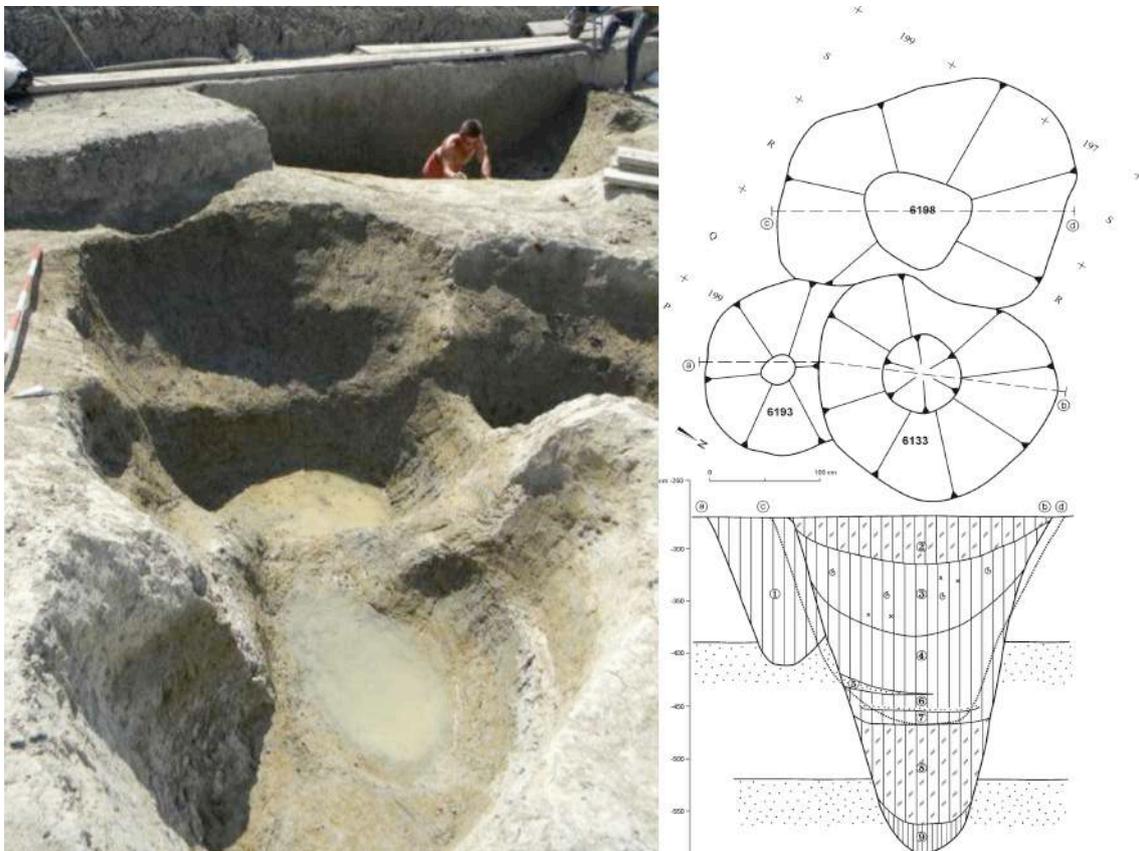


Figure 5 - Terramara Santa Rosa, Interconnected wells of the last phase

Conclusions

The working hypothesis so far followed indicates that the unfavorable concomitance between the exploitation of natural resources and climatic factors strengthened the crisis of the Terramare system. The results of the latest excavation seasons in the Terramara Santa Rosa di Poviglio (Cremaschi et al. 2016) suggest that the construction of fortifications at the end of the late Recent Bronze was suddenly interrupted, confirming the dramatic and instantaneous nature of the social and environmental crisis. The latter, on the basis of fresh radiocarbon dating seems to be placed at the end of III millennium BP. New data also indicate that frequentation of the site continued, albeit in a very limited way, even after the crisis and the consequent collapse of its defensive structures.

The Terramare crisis did not reach the Apennines: therein a recent excavations have established that the site of San Michele di Valestra does not show any interruption coinciding with the collapse of the Terramare, from which it is only 20 km away. The different environment and a different strategy in the exploitation of natural resources, a less impacting agriculture, and a greater role of pastoralism, have probably allowed these settlements to a greater resilience and to survive the climatic event that accompanied to the end of Terramare.

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