



# Environment, human impact and the role of trees on the Po plain during the Middle and Recent Bronze Age: Pollen evidence from the local influence of the *terramare* of Baggiovara and Casinalbo



Anna Maria Mercuri<sup>a</sup>, Maria Chiara Montecchi<sup>a,\*</sup>, Gianluca Pellacani<sup>b</sup>, Assunta Florenzano<sup>a</sup>, Eleonora Rattighieri<sup>a</sup>, Andrea Cardarelli<sup>c</sup>

<sup>a</sup> Laboratorio di Palinologia e Paleobotanica, Dipartimento di Scienze della Vita, Università di Modena e Reggio Emilia, Italy

<sup>b</sup> Museo Archeologico Etnologico di Modena, Italy

<sup>c</sup> Dipartimento di Scienze dell'Antichità, Università Sapienza di Roma, Italy

## ARTICLE INFO

### Article history:

Received 4 October 2013

Received in revised form 18 July 2014

Accepted 21 August 2014

Available online 16 September 2014

### Keywords:

Palynology

Cultural landscape

Bronze Age

Terramare

Po plain

Northern Italy

## ABSTRACT

A new interpretation of the crisis of the *terramare* as being caused by wood loss and water shortages is suggested from on-site pollen analyses. A *multi-point sampling strategy* in one site, and a *multi-site sampling strategy* in one area allowed us to obtain a reliable plant landscape reconstruction even though cultural variables strongly influenced the pollen spectra.

Pollen data from two archaeological sites, the Terramara di Baggiovara and the Necropoli di Casinalbo, which are about 1.6 km from each other, close to the Terramara di Montale, offer the chance to understand in depth the land-use at the time of the *terramare* culture, during the Middle–Recent Bronze Age in Northern Italy. Overall, the sites were inhabited from c. 1650 to c. 1150 BC. They show affinities and dissimilarities as regards natural and cultural backgrounds across the large territory occupied by the *terramare*.

Baggiovara and Casinalbo pollen diagrams show exceptionally similar mean data, demonstrating how the on-sites with classically human-influenced stratigraphies may be useful for palaeoenvironmental studies. According to pollen data, settlements were built in areas characterised by scarce human presence, and woodland became thinner, or virtually disappeared, following the establishment of the villages. Woody plants provided timber, and then might have been protected to collect fruits. Much of the open landscape around the villages was used as pasturelands, and part was cultivated to grow cereals.

One of the most striking pieces of data arising from this study is the role that woods must have had in the Middle Bronze Age in this area. On the Po plain, forest cover was thin even before the beginning of the *terramare*, and this attracted people to settle there. However, trees and shrubs also satisfied basic needs, being indispensable for building houses, collecting fruits and providing wood for the fire. The wood loss may have been a factor of crisis that determined the decline of some villages before or during the water deficit that caused the disappearance of this culture.

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## 1. Introduction

By the Bronze Age in Italy (Table 1), hundreds of settlements had been established at the area joining the three northern regions, covering part of the current Lombardy, Veneto and, most of all, Emilia (Bernabò Brea et al., 1997; Cremaschi et al., 2006; Cardarelli, 2009). The word *terramara* has been used since the 19th century to designate specifically those typical Bronze Age settlements established on the Po plain. Furthermore, this name indicates the important culture that developed at c. 1650–1150 BC, reaching a very high demographic density at the peak of its development at c. 1400–1250 BC. The *terramare* may be defined as

mainly quadrangular settlements surrounded by an embankment and a ditch into which the waters of a nearby river were re-routed (Cardarelli, 2010, p. 450). The embankment and ditch provided protection to the houses, which were arranged in rows, and divided the village from the 'area of influence' that was maintained around the houses to exploit resources.

Settlement patterns changed over time. Generally, in the early phases, the *terramare* sites were no bigger than 2 ha. Then, in the late Middle and Recent Bronze Age within a general increase in the density of sites (which meant an increase in demographic pressure), the differences between settlements developed in a hierarchical system including both large (up to 20 ha) and small (2 ha) villages. Extended settlement territories grew even larger, especially across the plain (Cardarelli, 2009).

\* Corresponding author.

E-mail address: [mariachiara.montecchi@unimore.it](mailto:mariachiara.montecchi@unimore.it) (M.C. Montecchi).

**Table 1**  
The Bronze Age in Italy: chronological phases and cultures in main geographical districts.

|                                     | North Western Italy                   | Central and Eastern Po plain         | Italian Alps (central area) | Central Italy                                 |
|-------------------------------------|---------------------------------------|--------------------------------------|-----------------------------|---|
| Early Bronze Age 1<br>2200–1900 BC  | Polada culture and north–west aspects | Polada culture A                     | Polada culture A            | Late and Post Bell-Beaker groups              |
| Early Bronze Age 2<br>1900–1650 BC  | Polada culture and north–west aspects | Polada culture B                     | Polada culture B            | Mezzano Lake and Beato Benincasa Cave aspects |
| Middle Bronze Age 1<br>1650–1550 BC | Mercurago aspect                      | Terramare culture                    | Palafitte culture/Fiavè IV  | Grotta Nuova aspects                          |
| Middle Bronze Age 2<br>1550–1450 BC | Viverone aspect                       | Terramare culture                    | Palafitte culture/Fiavè V   | Grotta Nuova aspects                          |
| Middle Bronze Age 3<br>1450–1320 BC | Alba–Scamozzina culture               | Terramare culture                    | Palafitte culture/Fiavè VI  | Apennine culture                              |
| Recent Bronze Age<br>1320–1150 BC   | Canegrate culture                     | Terramare culture                    | Pre-Luco culture            | Sub-Apennine culture                          |
| Final Bronze Age<br>1150–950 BC     | Protogolasecca culture                | Protovillanova groups/<br>Frattesina | Luco culture                | Protovillanova culture                        |

Critical connections between the environmental and cultural dynamics were probably more relevant in this culture than in others. In general, continuous human activity on a limited area has inevitable consequences on local ecological systems and their equilibria. The progressive reduction of forest thickness and the profound transformation of soils began a trend that seems irreversible from many pollen diagrams of that time, and that was the result of many interconnected causes (Nicosia et al., 2011; Mercuri and Sadori, 2012). Specifically, the fairly simultaneous action of different settlements and the high demographic pressure in this area had also major consequences on a regional scale (Cremaschi et al., 2006; Cardarelli, 2010). The expansion of agrarian lands – pastures, fields and orchards – produced the first explicit cultural shaping of landscapes. Pollen from terrestrial and marine records shows that the *terramara* culture eventually resulted in the development of a cultural landscape in the Po valley (Mercuri et al., 2012).

This matches the timing and general trend of anthropogenic pollen indicators observable in the central Mediterranean area. According to Roberts et al. (2011), climate and human forces were strictly interconnected in a ‘mid-Holocene mélange’ particularly for the period between approximately 4500 and 1000 years BC (6.5–3.0 ka cal. BP). Mercuri et al. (2013a,b) found that transformations of soil composition and land morphology occurred irreversibly from the second half of the mid-Holocene in the Italian peninsula.

Archaeobotanical studies from the *terramare* have given strong evidence that a complex and diversified land-use occurred following their establishment (Table 2). In the record of the Terramara di Montale, forest clearance, coppicing, the use of selected tree species for building or fodder, fire, breeding, manuring, and cereal and legume cultivation/rotation were evident (Mercuri et al., 2006a,b), while flax cultivation, shrub planting and grazing may be inferred from the record of the Vasca di Noceto (Aceti et al., 2009). The hydraulic system discovered at the fringes of the Terramara di Santa Rosa di Poviglio, consisting of water wells and ditches, offers evidence of the strategic importance that water management had for the people of the *terramare*. Similar hydraulic systems were constructed to irrigate fields around the ditches, and have been discovered in other *terramare* such as that in Castello del Tartaro near Verona (Veneto), and Redù near Modena (Emilia Romagna). Cremaschi et al. (2006), who studied the groundwater table and management changes at the Terramara di Santa Rosa di Poviglio, state that aridity was a limiting factor affecting land use at the final stage of the settlement, and suggest that this was among the major causes that endangered the economy and in turn the very survival of the *terramare*.

Was the land transformation actually a cause of the crisis, further reducing environmental sustainability? The link between climatic aridity crises and new cultural trajectories at different Holocene chronological phases is emphasised by many authors (Jalut et al., 2009; Mercuri et al., 2011). At around the end of the third millennium BC (4.2–4.1 ka cal. BP), a dry phase fairly concomitant with an increase in

anthropogenic pollen indicators, including olive and cereals, became evident in central Italy, as for example at Lago Albano and Lago di Nemi (Mercuri et al., 2002), Lago di Mezzano (Sadori et al., 2004) and Lago di Vico (Magri and Sadori, 1999). The human-modified landscape, however, had become especially visible in many contexts by the middle of the second millennium BC (c. 3.6 ka cal. BP), just the time when the *terramara* culture was developing across the Po plain (Mercuri and Sadori, 2012; Mercuri et al., 2013a).

### 1.1. Aim of the paper

Most previous research has been devoted to studying general traits of the *terramare* landscape, but an understanding of land exploitation in this area is needed for a definition of similarities and dissimilarities among the settlements, considering their diverse locations and chronologies. What were the common characteristics of the *terramare* landscape? Were different land uses made by different settlements?

On the large scale, it is clear that human environmental disturbance was patchy, meaning that ‘the timing of the first deforestation varied locally as well as regionally across the Mediterranean’ (Roberts et al., 2011, p. 9). Concerning the *terramare*, archaeological data have shown that material culture featured significant differences in the early phase; then, the main synchronous changes became evident, and the economic and socio-political system became more and more complex. A chronological list of cultural phases was adopted, with three phases in the Middle Bronze Age (1650–1325 BC) and two in the Recent Bronze Age (1325–1150 BC) (Table 1; Cardarelli, 2010). Therefore, a micro-regional variability in resource exploitation or the implementation of local agrarian activities may be expected.

In this paper, details from two new sites, the Terramara di Baggiovara and the Necropoli di Casinalbo, offer the opportunity to explore some variability in the land use at the time of the *terramare*. These sites were located close to the Terramara di Montale, whose long on-site pollen sequence has been published (Mercuri et al., 2006a,b, 2012). Due to their mutual proximity, the three sites may have had affinities in terms of natural and cultural backgrounds. Altogether, about 100 pollen samples from the three site records cover approximately 500 years, giving a resolution for the Bronze Age which is difficult to obtain from non-archaeological sites in the Po plain. Pollen data from the two new sites chronologically precede, parallel and follow those analysed from the Terramara di Montale, thus adding a unique set of archaeobotanical evidence for palaeoenvironmental reconstruction.

## 2. Materials and methods

The Terramara di Baggiovara and the Necropoli di Casinalbo are located in the high plain of Modena (59–60 m a.s.l.), below the hill belt of the Tusco-Emilian Apennines. They are about 1.6 km distant

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