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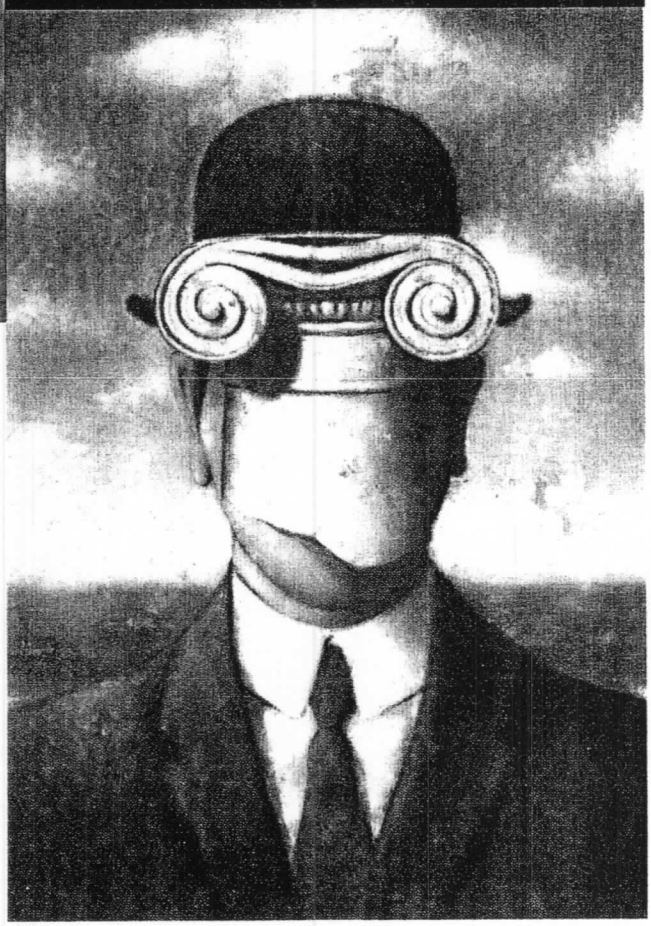

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ANTHROPIC POLLEN AND SEEDS/FRUITS FROM THE ARCHAEOLOGICAL SITE OF MONTE CASTELLACCIO (IMOLA-BOLOGNA, NORTHERN ITALY) – ENEOLITHIC AND BRONZE AGE HUMAN INFLUENCE ON VEGETAL LANDSCAPE

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1. INTRODUCTION

Monte Castellaccio is a hillock, 76 m a.s.l., located in Imola (44°21'N, 11°42'E; Northern Italy). In the 2nd half of the past century, a Bronze Age site was excavated there and studied by G. Scarabelli who collected a large amount of materials. These include a number of seeds/fruits and a stratigraphic sequence of the site, currently kept in the Civic Museum of Imola. The materials underwent new studies[1]: **a)** archaeological research established that the site mainly belonged to the Bronze Age (from BM1-2 and BM3? to BR), but Eneolithic records (2600-2400 B.C.) were also found; **b)** based on radiocarbon dates the Bronze Age settlement dated 3340±50–3265±75 uncal. bp (cal. 1680-1524 and 1619-1435 B.C.); **c)** stratigraphic and micromorphological analyses of the sequence evidenced a forest soil under the Eneolithic settlement and subsequently, during the Bronze Age, a series of layers with hearths and coprolites, straw and organic matter, closed by a floor surface[2]; **d)** pollen analysis of the sequence suggested that the Eneolithic occupation occurred in a middle-forested environment, characterised by mixed oak wood, during a cooler and wetter climatic phase of the Early Subboreal. Subsequently, the first step of the Bronze Age settlement (BM 1-2) occurred in a dryer and warmer phase; the vegetation was more open and dominated by Compositae and Gramineae. At the end of the Subboreal (Bronze Age 3?), a slight cooling was suggested by the rise of pine and decline of oak wood[3]. Pollen samples from the youngest occupational phase, BR, were sterile; **e)** the re-examination of seeds/fruits[4] (nearly a thousand and a half records) mainly provided information about cultivated cereals; they were attributed by G. Scarabelli to the Bronze Age settlement, but unfortunately the lack of further information about their stratigraphic position prevented any further detail in their chronology; **f)** archeozoological studies[5] showed the high prevalence of domestic animals (mainly cattle, sheep/goats, pigs and dogs) on wild species (roe deer, wild boar, etc.).

The present paper focuses on anthropogenic pollen and seeds/fruits, i.e. pollen and carpological taxa testifying to human presence and activities[6,7], which are useful to evaluate the human influence on the landscape and the role of plants in the economy and culture.

2. MATERIALS AND METHODS

Pollen - 8 sub-samples taken in the sequence (60 cm long) were studied. About 9-11 grams of materials were treated (see note 3 for details). *Lycopodium* spores were added to evaluate pollen concentrations (p/g = number of pollen grains per gram). Percentage and concentration spectra were calculated. Anthropogenic Indicators belonged to three categories: 1) C = Cultivable/cultivated woody plants; 2) c = cultivable/cultivated herbaceous plants; both groups include taxa currently cultivated in the region; in the period concerned, they were definitely or probably cultivated (see below); 3) As = wild anthropogenic plants (weeds growing in fields, trampled areas, or ruderal and nitrophilous plants growing in human settlements). Moreover some Indexes[8] were used to evaluate the relationships between humans and plants:

Human Influence on Vegetation Index (*HIVI ; Italian IFA* "Indice di Frequentazione Antropica"[9]) = percentage sum of Anthropogenic Indicators * 100 / percentage sum of woody taxa; this index increases with the increase of human activities, assuming that anthropogenic pollen increases with the increase of human activity while the woody sum decreases (see note 8 for details);

Human Impact Index (*HII;* Italian *IA* "Indice di Antropizzazione"[10])= HIVI * number of Anthropogenic Indicator taxa; compared with the previous index it also

shows how varied the human influence on the vegetal landscape is;

Human Influence on Flora Index (HIFI; Italian *IAF* "Indice di Antropizzazione Floristica"[10])= number of taxa of Anthropogenic Indicators * 100 / total number of pollen taxa; it shows how much of the flora is affected by humans activity.

Seeds and fruits – all available records were counted, identified and measured at the stereomicroscope. They all were anthropogenic taxa; the same categories were used as those for pollen.

3. RESULTS AND DISCUSSION

3.1 Pollen Data[3]

117 pollen taxa were recorded (38 woody and 79 herbaceous plants). Forest consistence (= AP sum: trees+shrubs+lianes) had from very low to medium values (5-42%; mean 19%), and pollen diagram was herb-dominated with a prevalence of Cichorioideae and Gramineae. Anthropogenic Indicators included 25 taxa (21% of total number), from 7 to 15 taxa (= 5 - 28%) per sample. These were:

C = cultivable/cultivated woody plants: *Castanea sativa* Miller, *Juglans regia* L., *Vitis vinifera* L., *Platanus* cf. *orientalis*. Their low diffusion (walnut was present in 2 samples; the other in one) and low percentages (max 0.4% = 1.6 % of forest pollen), interpreted taking into account the whole Holocene picture of the region[8] suggested that the three first were probably wild plants, possibly under human care; as for the plane record, which is the most ancient of our region, an anthropic introduction from more southern Italian areas, as well as long distance transport or a relict station can be considered (see also note 8);

c = cultivable/cultivated herbaceous plants: these were always present with low to high values (3-23%), and included cereals, legumes and textile plants.

b.1 Cereals = they were present in all samples and belonged to three pollen types: **b.1.1)** *Hordeum* group (*sensu* Andersen[11]) was 1-16% with a continuous curve; **b.1.2)** *Avena/Triticum* group was 1-10% with a continuous curve, too; our records had a *Triticum* type exine[12]); the largest records (max. diameter >65 mm; porus + annulus >15 mm; annulus protrudence > 4 mm) suggested exaploid wheats in BM; **b.1.3)** *Panicum* cf. was recorded in one BM1-2 sample with a low value (0.2%);

b.2 Legumes = only *Vicia faba* L., in three BM1-2 samples (< 0.5%); **b.3** Textiles = only *Linum usitatissimum* type, in one BM1-2 sample (< 0.5%). The general context suggested that these plants were cultivated in the area in question.

As = wild anthropogenic indicators: there were 16 pollen types of weeds common in human settlements (e.g. *Papaver rhoeas* type and *Urtica dioica* type). This pollen group was constant but less abundant than the cereals. Cichorioideae, not included in this sum for reasons of causion, could have actually belonged to it, as meadow/pasture indicators[3] reflected domestic animal breeding, in agreement with straw and coprolites observed in the thin soil sections[2].

3.2 Carpological Data[4]

All seeds and fruits were charred, and generally badly-preserved. A total of 1395 records belonging to 13 herbaceous taxa were identified. They included two categories: c= Cultivated cultivable herbaceous plants (cereals and legumes), and a few weeds:

Cereals = were dominant (1356 = 97 % of total records) and consisted of caryopses belonging to 4 taxa[12,13]: **a.1)** *Hordeum* (barley): 136 caryopses of *Hordeum vulgare* L. convar. *vulgare*; **a.2)** *Triticum* (wheat): 1209 caryopses, the most abundant group, mainly consisting of *T. aestivum* s.l./*durum* s.l. type (1208), probably *T. aestivum* subsp. *vulgare* <Vill.> MacKey and *T. aestivum* subsp. *compactum* <Host.> MacKey, and a single caryopses of *T. turgidum* L. subsp. *dicoccum* (Schrank) Thell.; **a.3)** *Secale* (rye): three caryopses of *Secale cereale* L.; **a.4)** *Avena* (oat): 8 small-sized caryopses probably belonged to wild oats.

Legumes = 22 seeds from four taxa: **b.1)** *Lathyrus sativus* L. (grass pea), one seed, possibly cultivated; **b.2)** *Lathyrus* cf. *cicera* (dwarf chickling), four seeds smaller in size than the previous; **b.3)** *Vicia* cf. *sativa* (narrow-leafed vetch), one seed of an intermediate size between the cultivated and wild species; **b.4)** *Lathyrus/Vicia,* 16 greatly deteriorated seeds. These legumes could have been wild or cultivated; they were more probably used for fodder and less frequently for food.

Wild anthropogenic indicators = 15 seeds/fruits belonging to three taxa: **c.1)** *Agrostemma githago* L., a cereal weed currently reduced by modern agricultural practices, was the most abundant species (11 seeds); **c.2)** *Galium* sp., 3 merycarps; **c.3)** *Convolvulus* cf. *arvensis*, one seed. All these plants could have grown *in situ,* or could have even arrived in the settlement together with the cereal ears.

3.3 The Trend of Human Influence in Pollen Spectra

Pollen spectra were subdivided into three Zones (named I = Imola, see note 3 for details; tab.I), partly corresponding to cultural phases. Their main features with regards to forest cover (AP sum) and anthropogenic pollen indicators (AI) were discussed below. Data reported were mean values of the zones. The main general trends showed by these data remained even when human influence was excluded from pollen record i.e. excluding anthropogenic indicators and Cichorioideae from the pollen sum. A few discordant data

were noted.

Pollen Zone I1 - one sample - Eneolithic – In the oldest part of the sequence, forest pollen had its highest values (42% - conc. = 499 p/g), even if low, testifying that Eneolithic people settled in an open site in a middle-forested environment. Human Influence Indexes and anthropogenic indicators were the lowest, signs that the settlement was not large. Nevetheless the latter (5%, 57 p/g) suggested that cultivation of cereals were already established at that time (*Avena/Triticum* group = 1.9%; *Hordeum* group 1.3%).

Pollen Zone I2 –Middle Bronze Age (BM1-2) (5 samples): in the middle part of the sequence, forest consistence significantly declined (AP = 13%; 385 p/g). Pollen and seed/fruits suggested that the forest could have been cleared by Bronze Age people to enlarge the settlement and designate larger areas to cultivation. Oak was temporarily affected, resulting in a forest pollen decrease, and Elm was also greatly affected. On the contrary, anthropogenic pollen notably increased (12%; 371 p/g). Both wild pollen indicators (plants of trampling areas, ruderals/nitrophilous plants, and many indicators of meadow/ pasture lands) and cultivated plants increased (broad bean, flax, cereals). Cereal pollen, i.e. *Avena /Triticum* group, *Hordeum* group and *Panicum* cf., increased significantly (8%, 277 p/g) and sometimes had very high values (>12 % in two samples). The low dispersal of cereal pollen, and the record of their pollen in clusters suggested that plants were present *in loco*. Moreover, as the site's surface was not wide, probably there were not fields *in loco*, but areas for cereal processing or straw accumulation for animal fodder. The presence of pollen grains of exaploid wheats agreed with caryopses typology. In this zone all Human Influence Indexes notably increased, showing a rise in activities that suggest a demographic increase and enlargement of the anthropic environment. Pollen records testified that during the phase human activities increased in comparison with the previous phase, and were clearly well-established in the site and its surroundings.

Pollen Zone I3 – Middle Bronze Age (BM 1-2 and 3?) two top samples - in the youngest part of the sequence, forest consistence was probably similar to the previous zone, though percentage and concentration were not completely consistent, the first increasing (AP = 20%) and the second decreasing (143 p/g), in part due to the scarcity in pollen of the top sample. Moreover woods showed a more mesophilous character. Anthropogenic Indicators had a further notable increase (24% versus 12%), especially evident in cereal types which had their highest values in individual samples (*Hordeum* type = 18%; *Avena-Triticum* type = 9%). Neither legumes nor other herbaceous cultivated plants were present then. Wild plants from meadow/pasture lands testified that the relevant human activitities persisted. The two Human Influence Indexes indicating the intensity of human activities (HIVI and HII) were higher than before, while the other, which also depends on the variety of plants involved (HIFI), was quite steady. Human influence appeared intensively concentrated on fewer of the previous cultivations, without a significant change in the typology of plants used.

CULTURE	Bronze Age		Eneolithic
POLLEN ZONES	**I3**	**I2**	**I1**
HIVI (IFA) – Total pollen	124	95	13
HII (IA) – Total pollen	1178	1121	91
HIFI (IAF) – Total pollen	21	22	18
HIVI (IFA) – Forest pollen	13	4	0
HII (IA) – Forest pollen	22	4	0
HIFI (IAF) – Forest pollen	8	2	0
Forest pollen %	20	13	42
Forest pollen Conc.	143	385	499
Herbs pollen %	80	87	57
Herbs pollen Conc.	666	3033	563
Anthrop. Indic. %	24	12	5
Anthrop. Indic. Conc.	222	371	57
Total pollen counted	643	2829	466
Mean pol. counted/sample	322	566	466
Mean pol. conc./sample	809	3418	1062
Number of samples	2	5	1

Tab. I - Selected pollen data from Monte Castellaccio's sequence3: Zone Pollen Indexes on Human Influence on total pollen and on woody pollen sum (only woody species are considered in the second case8); Forest consistence and Anthropogenic Indicators calculated as mean percentage and concentration values in the three pollen zones; total pollen counted per zone; mean pollen concentration and number of samples per zone.

4. CONCLUSIONS

Pollen data obtained from the Scarabelli's sequence of Monte Castellaccio suggested that at the beginning of the Subboreal, Eneolithic people could have slightly influenced the vegetal landscape of the area. Later on, pollen and seeds/fruits showed that the Bronze Age was a period of increasing human activity. In particular, during the first and middle part of the BM 1-2 = Pollen Zone I2, around 1619 (1680-1524 B.C.), the major increase in Anthropogenic pollen Indicators and Human Influence pollen Indexes was observed. They showed cultivation and processing of cereals, including exaploid wheats confirmed by caryopses, together with legumes and probably flax, and wide open lands used as pastures, in agreement with the abundance of cattle and sheep/goats in archaeozoological records[5]. The woody pollen decrease observed in the Bronze Age was possibly, at least in part, due to humans clearing the forest to use the land for farming and breeding. The occupation of the site and use of the surrounding land continued till the Late Subboreal (Middle Bronze Age-BM3). Afterwards the environmental history preserved in Scarabelli's sequence was interrupted, and nothing remains of the decline and covering of the site.

Pollen evidence of human influence was unambiguous, in this site. Nevertheless the evaluation of the degree of human impact on the vegetal landscape of that area would probably only be possible with a general discussion of regional pollen data, trying to disentangle the complex frame of environmental/ climatic changes and human activity that took place in the periods represented in pollen spectra.

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