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THE AGRO PONTINO SURVEY: RESULTS FROM A FIRST POLLEN CORE

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*Wendy Eisner, Hans Kamermans & Alex T. Wymstra**

1. Introduction

Over the past decades theory and practice in archaeology have shifted toward more regional and systematic approaches. Nowadays the major goal of research projects is more often than not the understanding of the socio-economic processes that produced the observable archaeological record of a region. The aims of archaeological surveys have changed accordingly. Surveys often do not concentrate anymore on «finding sites», but instead on obtaining a picture, be it a rough one, of the spatial and temporal variations in human organization from the distribution of materials available in larger regions, and thus are complementary to fine-grained excavation activities. A variety of survey methods, adapted to differing goals and scopes, has been and is developed, as is shown, for example, in a recent BAR report (Keller & Rupp, 1983).

The results of an archaeological survey cannot be sensibly understood, however, if knowledge about the environmental setting and constraints in a region is not avaible as well. This means that at the beginning, or even before, an archaeological survey, information about the geology, the soils, the prehistoric vegetation, etc., needs to be collected and processed.

In this paper we present the outline of an archaeological survey along these lines and concentrate on the interpretation of palynological data in terms of — change in — the vegetation in prehistoric times of the area under study.

The Albert Egges van Giffen Institute for Pre-and Protohistory, University of Amsterdam, began an extensive archaeological survey program in the Agro Pontino (Italy) in 1982. Preliminary work consisted of two small surveys in June 1979 and June 1980 and the collection of material for palynological studies in June 1981. A major theme in the Agro Pontino project is the development and evolution of prehistoric social systems in the area and the constraints imposed by the palaeoecological situations. The survey will document the distribution and density of archaeological sites through time; palynological, pedological and geomorphological studies will be used to reconstruct past environmental conditions in as much detail as possible in order to construct and test models for the evolution of land use, technology, and social organisation during prehistory. The land evaluation approach has been selected by the Agro Pontino survey project as a framework for synthesizing the palaeoenvironmental data and for analyzing the archaeological data with regard to prehistoric man land relationships (Kamermans et al. 1985, 1986).

Land evaluation is a technique developed by the FAO and used in third world countries for estimating the potential of land for alternative kinds of use (Beek 1978; Brinkman & Smith 1973; Brinkman & Young 1976; Dent & Young 1981; McRae & Burnham 1981). The definition is as follows: «the processs of collating and interpreting basic inventories of soil, vegetation, climate and other aspects of land in order to identify and make a first comparison of promising land use alternatives in simple socioeconomic terms» (Brinkman & Smith 1973: 7, figure 1). The basic feature of land evaluation is the comparison of the requirements of land use with the resources offered by the land. Land evaluation requires information from three sources: land, land use, and economics (Dent & Young 1981).

There are some important differences (figure 1) for using land evaluation in archaeology. First, it is, of course, impossible to measure prehistoric land qualities directly; they have to be reconstructed from data obtained by surveys of recent land characteristics. Second, the economic and social analysis of the ap-

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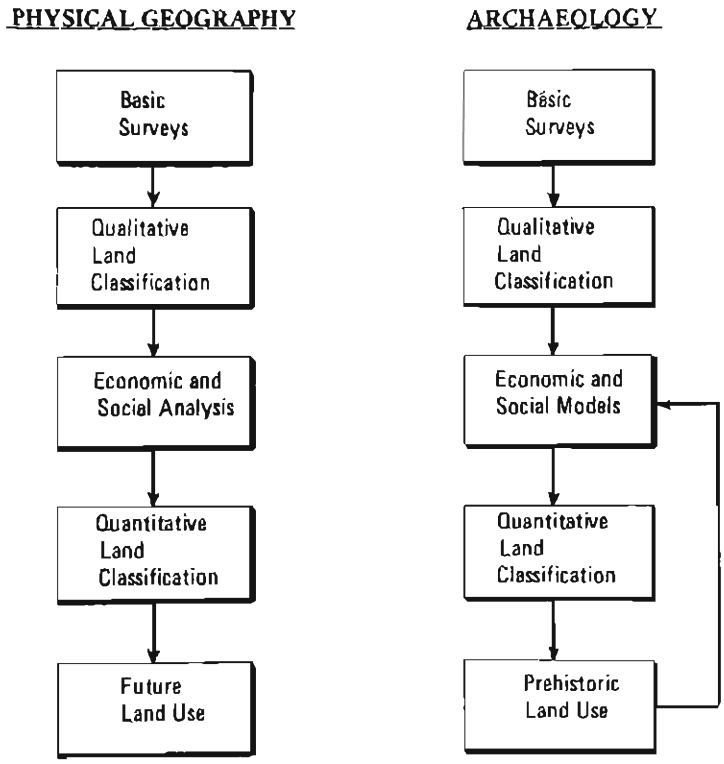


Fig. 1 - Stages in the land evaluation approach in Physical Geography and Archaeology (Adapted from Brinkman & Young 1976).

proach as used in physical geography has to be replaced by models of prehistoric socio-economic situations. To construct these models information on the ecological and technical requirements of different kinds of land use as well as data on the economic and social context has to be generated by using ethnographic, archaeological and historical sources. The outcome is an expected form of land use for every chosen socio-economic model. Third, the purpose of using the land evaluation approach in archaeology is to evaluate our models. The comparison of the expected form of land use with the archaeologically recorded land use provides a basis for modifyng the models. We repeat this procedure until the outcome fits best with the archaeological record.
In the land evaluation approach our reconstructions of the palaeoenvironment are based upon basic surveys and are currently available from geology (Segre 1957b), pedology (Sevink et al. 1984), and the zoological material from excavations in and around the Agro Pontino (Bietti 1984; Blanc & Segre 1953; Segre & Ascenzi 1956; Segre 1957a; Taschini 1964; Zei 1953). Data from a palynological survey of the area, however, are notably lacking, and it is this lack that prompted the collection of the Mezzaluna pollen core (Eisner et al. 1984).
In this article, we first mention previous archaeological and ecological studies, and summarize the pedological evidence. We then present the analytical results of the Mezzaluna pollen core, the first continuous core from the Tyrrhenian coast, and give three tentative reconstructions of the vegetation in the survey area for different time periods using the present-day distribution of soil types and the pollen data.

2. *The Agro Pontino Survey*

The Agro Pontino is a coastal plain, about 60 km long and 15 km wide, between Roma and Naples. Previous archaeological work indicates that the area has been continuously inhabitated since the Middle Palaeolithic. The most important Palaeolithic sites are Canale Mussolini (Blanc 1937; Blanc et al. 1957) and the caves in Monte Circeo (Blanc & Segre 1953). Surface scatters of Palaeolithic flint tools are found in many parts of the plain (Bietti 1969; Blanc 1937, 1957; La Rosa 1984; Radmilli 1974, 1978; Voorrips et al. 1981). Mesolithic-Epipalaeolithic sites in the Agro Pontino are Grotta Jolanda (Monti Lepini) (Zei 1953), Riparo Blanc on Monte Circeo (Taschini 1964, 1965, 1968) and several surface sites (Bietti 1969; Mussi & Zampetti 1978; Voorrips et al. 1981).
The evidence for habitation during the Neolithic and Bronze Age is less well-documented. Neolithic pottery has been found at the Canale Mussolini (Blanc et al. 1957) and at some surface locations (Blanc & Segre 1953). Bronze Age finds come from Caterattino (Blanc & Segre 1953) and several sites at the perimeter of the Agro Pontino (Colonna 1974).
The stone tools are fabricated almost exclusively from flint pebbles which are found in the coastal zone where fossil beach-ridges have been incised. The Mousterian assemblages made from these pebbles have been designated as Pontinian (Blanc 1939). Similarly, the Circeiano (Blanc 1939) is considered to be the regional variant of the Aurignacian. The lighter stone industries (Gravettiano, Epigravettiano, Mesolitico), as well as the industries found in association with Neolithic and Bronze and Iron Age pottery, are also fashioned primarily from beach pebbles but have not been given local names. It is notable that the artifacts of obsidian, which is opaque and very black and comes from Palmarola 30 km off the coast, tend not to be associated with pre-Neolithic assemblages. Very little information about the evolution of palaeoenvironments of the Agro Pontino is available. Faunal remains in the stratified sites on Monte Circeo (Blanc & Segre 1953; Piperno 1976-77), the

Fig. 2 - The major sedimentary complexes in the Agro Pontino (Adapted from Duivenvoorden 1983, 1985; van Huissteede 1983; Kamermans 1980; Sevink et al 1982, 1984; drawing IPP).
I beach ridge deposits, Terracina level; II lagoonal depostis, Terracina level, III beach ridge deposits, Borgo Ermada level; IV lagoonal deposits, Borgo Ermada level; V beach ridge deposits, Minturno level; VI lagoonal deposits, Minturno level; VII beach ridge deposits, Latina level; VIII lagoonal deposits, Latina level; IX aeolian deposits; X tuff deposits; XI travertine; XII alluvial and colluvial deposits; XIII recent colluvio-alluvial valley fills.

Monti Lepini (Zei 1953), the Monti Ausoni (Bietti 1984), and the Pontinian Plain (Blanc 1935; Segre & Ascenzi 1956; Segre 1957a) show changes in the larger mammalian species throughout much of the Würm and possibly somewhat earlier. The only site with faunal remains dated to the Holocene (Barker 1975), Riparo Blanc (Taschini 1964), indicates that shellfish were part of the diet of Mesolithic peoples. The larger mammal species found there are also present at sites dated to the end of the Pleistocene.
There have been no previous palynological studies of this area. Macrofloral remains preserved in the peat layers and associated with Mousterian tools (Tongiorgi 1936) provide evidence for local vegetation changes during a limited period of the Würm. Prior to our study, vegetational changes during the Late Glacial and Holocene could only be inferred from extraregional evidence (see especially Bonatti 1970; Frank 1971; for general overview and references see Butzer 1971 and Phillips 1980).
Since 1967, the area has been studied by the Institute for Physical Geography and Soil Science of the University of Amsterdam, which has resulted in a detailed soil map of part of the Agro Pontino (Sevink et al. 1984). Now the mapping of the area has been completed.

3. Physiography and soils

The Agro Pontino is surrounded by the Monti Lepini, the Monti Ausoni, the Tyrrhenian sea and tuff covered hills south of Rome. The mountains, including the isolated Monte Circeo, consist mainly of calcaric material and were formed during the Mesozoic. The tuff cover on the hills NW of the Agro Pontino dates from a period of volcanic activity that started about 1.0 MY and ended about 0.35 MY ago. The Agro Pontino can be divided into two parts: a graben, approximately 7 km wide running the length of the region, and a more elevated zone bordering the Tyrrhenian sea. The graben is part of a hort and graben system, formed mainly during the Middle-Pleistocene. This formation was accompanied by extensive volcanic activity. The graben is mainly filled with Holocene peaty and clayey sediments, but in its northwestern part Pleistocene clays, travertines, and tuff deposits of the lower tuff complex of the Lazio Volcano occur at the surface, and near the mountains part of it is covered with fluvio-colluvial deposits. On the basis of the soil surveys four marine terraces have been distinguished in the coastal zone. Each terrace consists of a sandy beach ridge and a clayey lagoon (Sevink 1977), representing different sea level changes during the Pleistocene.
The soils (figure 2) in the area reflect the influence of parent material, drainage, slope class, and time. The drainage in the graben is poor and there is no topographic relief. The dominant soils in the central and southeastern parts of the graben are Histosols and Gleysols (FAO/Unesco 1974), and those in the clayey northwestern part are Vertisols. The soils developed in the well drained fluvio-colluvial deposits, where the slope class is level to gently rolling, are Luvisol and Cambisols. The dominant soils in the travertine and the tuff depositions are Chromic Luvisols (Duivenvoorden 1975, Sevink et al. 1984). Luvisols are formed in the well-drained, coarsely textured deposits of the older beach ridges of the marine terraces; in the youngest beach ridge Calcaric Regosols are the dominant soils. In general, the slope class for the beach ridges is rolling to hilly. In the fine and medium textured lagoonal deposits Gleysols, Vertisols and Planosols are dominant and the slope class is level. In the southwestern part of the region the marine complex has been covered by extensive aeolian deposits; in this area the slope class is rolling to hilly and Phaeozems and Arenosols are the dominant soils (Sevink et al. 1984).

4. The Mezzaluna Pollen Core

The location of the Mezzaluna pollen core is indicated on fig. 4. The pollen diagram (figure 3) included in this report is a concentration diagram and depicts the estimated number of pollen grains per cubic centimeter, which are assembled into groups of species on a synoecological basis (table 1) (Rickli 1943; Walter 1968).
A piston core system was use to extract 910 cm of graben filling from Mezzaluna area of the Agro Pontino. The section obtained by the core was composed of clay, sand, shell, and peat.
The samples, which were taken at approximately 10 cm intervals, were boiled in KOH and concentrated with a bromoform/alcohol mixture. A fixed amount of exotic pollen *(Eucalyptus)* was added to each sample. The concentration diagram is calculated on the basis of the *Eucalyptus* count and drawn by computer (Benninghoff 1962; Stockmarr 1971).
The pollen sequence was divided into zones based on general vegetation trends combined with the major strata identified in the core. The zones have only local significance; for a more regional zoning system, more sections would have to be analysed. The pollen of dry, open vegetation, characterized by Poaceae *Artemisia*, and Chenopodiaceae, alternates with arboreal pollen, primarily *Quercus*, *Alnus* and *Pinus*.

Zone A (910-842 cm) is composed of clay sediment, with Poaceae being the dominant pollen type and high values for *Artemisia*. Pollen and spores of fresh water plants are also present in high amounts.

Zone B (814-770 cm) consists of a layer of sand with shells from

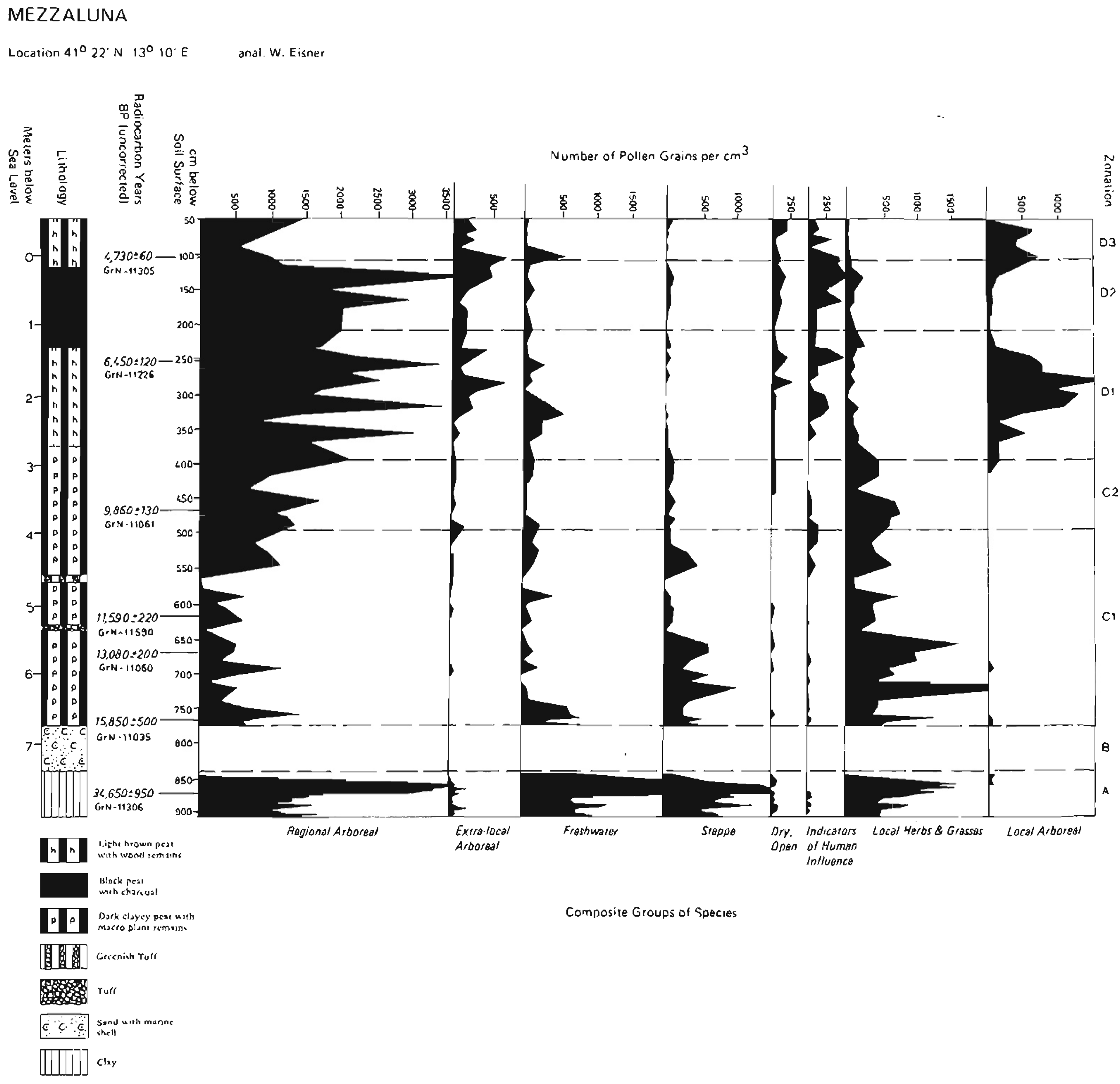


Fig. 3 - Mezzaluna pollen diagram.

Regional arboreal	Extra-local arboreal	Local arboreal
Abies	*Fraxinus*	*Alnus*
Acer	*Tamarix*	*Salix*
Betula	*Tilia*	
Carpinus	*Ulmus*	
Corylus	*Platanus*	
Fagus	*Rhamnaceae*	
Ostrya		
Picea		
Pinus		
Quercus		
Hedera		
Indicators of Human influence	**Local herbs and grasses**	**Freshwater**
Castanea	*Chenopodiaceae*	*Lemna*
Plantago	*Poaceae*	*Myriophyllum*
Rhus	*Ranunculaceae*	*Nuphar*
Rumex	*Cyperaceae*	*Nymphaea*
Vitis	*Symphytum*	*Potamogeton*
	Apiaceae	*Str. aloides*
		Typhaceae
		Sphagnum
Steppe	**Dry, open**	
Ephedra	*Pistacia*	
Juniperus	*Borago*	
Artemisia	*Buxus*	
Arceuthob.	*Cistus*	
Centaurea	*Daphne*	
Helianthemum	*Drosera*	
Sanguisorba	*Dipsacus*	
	Erica	
	Hypericum	
	Lamiaceae	
	Myrtus	

Table 1: Species included in composite groups used for the Mezzaluna pollen diagram (figure 3).

which virtually no pollen could be extracted. Remains of Hystrichosphaerideae signify a marine environment.

Zone C1 (769-490 cm) consists of peat and is characterized by the predominance of pollen from herbaceous vegetation; fresh water vegetation pollen is also well represented. From 640 to 630 cm there is a tuff layer with granules of fine volcanic material mixed with organic soil. From 570 to 560 cm there is a greenish layer which contains volcanic material. Both of these layers are characterized by high and abrupt rises of the values for Chenopodiaceae.

Zone C2 (489-390 cm) shows a rise and decline of *Pinus*, the beginning of a sharp decline of Poaceae, and a steady rise of *Quercus*. Small amounts of other woodland pollen appear.

Zone D1 (389-220 cm) consists of peat. *Alnus* and *Quercus* become abruptly dominant, whereas *Artemisia* and Chenopodiaceae become negligible. Other indicators of increased forest cover also occur in this zone.

Zone D2 (219-120 cm) consists of very black peat in which high proportions of charcoal are found. *Alnus* is (probably) displaced by *Dyopteris* as a local element and high values for *Vitis* sp. are present. The proportion of herbs to trees increases for the first time after zone C1.

Zone D3 (119-50 cm) consists of woody peat which gradually becomes drier until the top soil is reached at 50 cm. *Alnus* rises again, *Vitis* sp. drops sharply and, with the exception of *Ulmus* and *Salix*, other arboreal types also diminish. There is a strong increase in herbs, notably Asteraceae.

5. Interpretation of the pollen diagram and palaeoenvironmental reconstructions.

The interpretation of the palynological results is presented according to the zonation scheme above. Limited and tentative palaeoenvironmental reconstructions relating the vegetation represented in the pollen core to the soil types have been devised for zone C1, D1 and D2. The division of the Agro Pontino into subareas is indicated on figure 4. Figure 3 gives the C14 dates.

Zone A: It is most likely that this section is the deposition of a fresh water lake.

Zone B: The strong possibility of a sea transgression is indicated by the unbroken shells of the Zone B sand layer, and by the Hystrichosphaeridea remains.

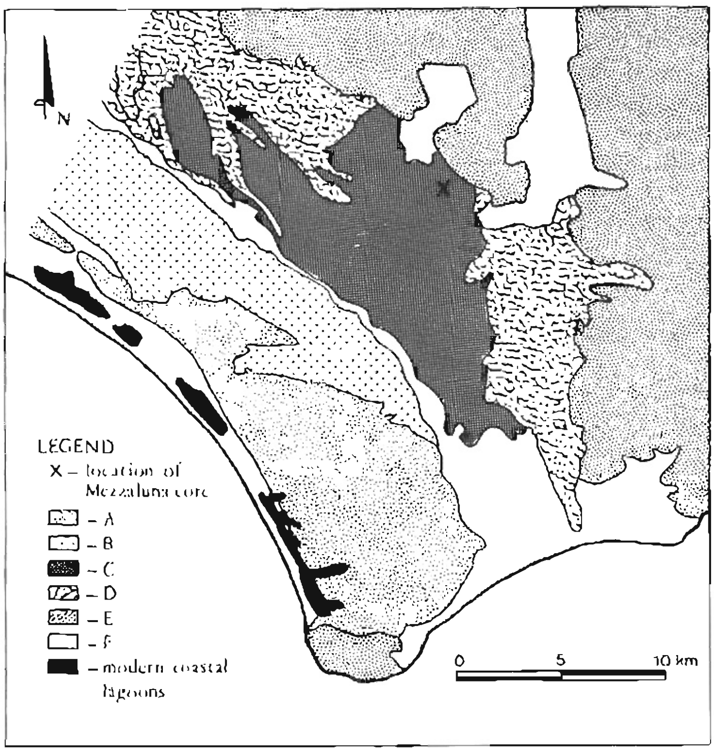
Zone C1: The dominant vegetation postulated for each subarea (figure 4) is as follows:

A — vegetation of Poaceae, *Pinus* and Chenopodiaceae;
B — steppe vegetation with *Ephedra*, *Rumex*, *Juniper* and *Artemisia*;
C — fen vegetation with *Phragmites* and Cyperaceae;
D — sparse oak woods;
E — *Pinus*, *Betula* and *Abies*.

Zone C2: A general continuation of the previous situation, with a natural succession to climax vegetation influenced by more humid conditions.

Zone D1: The dominant vegetation is as follows:

A — vegetation of *Pinus*, Poaceae and *Pistacia*;
B — parkland vegetation with *Artemisia* and low shrubs;
C — alder fen;
D — oak forest;
E — mixed oak forest belt with *Fagus*, with *Carpinus* occurring at higher elevations.



a. Dominant Soil Types
- A - Chromic luvisols formed in sandy beach ridge and aeolian deposits
- B - Planosols formed in fossil lagoons
- C - Histosols and Gleysols formed in the graben area
- D - Luvisols and Cambisols formed in colluvium
- F - Lithosols and Rendzinas formed on mountain slopes
- I - Areas with multiple soil types (*not included in palaeoenvironmental reconstructions*)

b. Pollen Zone C1
- A - *Poaceae, Pinus* and *Chenopodiaceae*
- B - Steppe vegetation
- C - Fen vegetation
- D - Sparse oak woods
- E - *Pinus, Betula* and *Abies*

c. Pollen Zone D1
- A - *Pinus, Poaceae* and *Pistacia*
- B Parkland vegetation
- C - Alder fen
- D - Oak forest
- E Mixed oak forest belt

d. Pollen Zone D2
- A - Dune vegetation
- B - Dry open vegetation
- C *Dryopteris*
- D - *Quercus ilex* forest, macchia-garrigue, and *Vitis sp.*
- E - Mixed oak forest belt

Fig. 4 - Map of the Agro Pontino region showing the distribution of dominant soil types and areal subdivision for synoecological groups used in palaeoenvironmental reconstructions of pollen zones C1, D1 and D2 (map adapted from Sevink et al. 1984).

Zone D2: the dominant vegetation:
A — dune vegetation of *Pinus*, Poaceae and *Pistacia*;
B — dry open vegetation;
C — the alder vegetation is suddenly replaced by *Dryopteris* which often occurs when alder woods are thinned;
D — this area supports three types of vegetational assemblages:
1 — *Quercus ilex* forest;
2 — macchia-garrigue, caused by deforestation of evergreen woods;
3 — *Vitis* sp., which is assumed to be domesticated because of the high concentration values;
E - mixed oak forest belt.

Zone D3: The lower arboreal pollen concentration could be due to human activity or to drier climatic conditions.
General climatic trends can be inferred from the palynological results and their interpretation. In zone C, dated by 14C to the Late Glacial, there is a predominance of open vegetation, Poaceae and *Artemisia*, and typical steppe herbs suggesting that the climate was probably cool and especially dry. During zone D1 the vegetational trend is towards a closed arboreal vegetation consisting mainly of climatic forest species, indicating a more humid and possibly warmer climate. In zone D2 there is a recurrence of more open vegetation, but now the vegetation is more consistent with the modern Mediterranean environment. On the basis of 14C dates this zone can be correlated to the Central Italian Neolithic period. It begins sometime after the Early Neolithic and extends to the inception of the Aeneolithic. The vegetational reconstruction above suggests the presence of human influence at about this time because of the combined evidence of diminishing alder woods, lower *Quercus* values, a macchia-garrigue, and possibly domesticated grapes. This assemblage, however, could just as easily appear in a natural setting, given the drier climatic conditions, and more pollen zones must be analyzed in order to reach any conclusions regarding human activity in zone D2.

6. *Conclusions and plans for future research*

Analysis of the Mezzaluna core is a significant contribution to the palaeoenvironmental study of the Mediterranean in general and to the central Italian Tyrrhenian coastal region in particular. Only three other analyses of pollen cores covering approximately the same period have been reported for Central Italy (Bonatti 1970; Frank 1969); all of these cores were taken from deposits inland at higher elevations.
The Mezzaluna core is only a first step, however, toward the reconstruction of palaeoenvironments. At least two more cores of comparable quality must be analyzed before we can achieve an

acceptable level of evidence for the regional vegetation changes. It is also desirable that we obtain samples of deposits dating from earlier periods. These deposits can be found in the graben and at sites near the coast (Tongiorgi 1936).
We have secured a series of pollen cores from lagoonal deposits along the coast. While we expect the individual cores to cover a relatively short span of time, we hope that with aid of radiocarbon dating and association of regional pollen changes the cores can be seriated. These samples will also be used for palaeoenvironmental reconstruction of the areas not included in this study.
This article has shown the data from basic surveys can be integrated to reconstruct the paleoenvironment or, in land evaluation terms, to construct a qualitative land classification. Even though the palynological survey is incomplete, there is sufficient information to begin to develop procedures for the remaining steps deemed necessary for using land evaluation in archaeology.

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