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Indice

I. DI GERONIMO, E. DI MAURO, I. DI STEFANO, G. MANGANO <i>Riparo sottoroccia a Pedagaggi (Siracusa) con industria dell'epigravettiano finale.</i>	9
P. LEONARDI <i>Su alcuni ritoccatoi epigravettiani del riparo di Serra Paradiso presso Siracusa (Sicilia orientale, Italia).</i>	27
F.M. GAMBARI, M. VENTURINO GAMBARI, F. D'ERRICO <i>Alba e la neolitizzazione del Piemonte.</i>	31
G. GUERRESCHI, P. CATALANI, G. LONGO, A. IANNONE <i>Grotta Bella (Terni). Una sequenza stratigrafica dal Neolitico inferiore all'età imperiale. I livelli preistorici.</i>	143
A. CAZZELLA, M. MOSCOLONI <i>L'insediamento preistorico del Colle della Capriola (Bolsena).</i>	229
M.A. FUGAZZOLA DELPINO <i>Note di topografia preistorica.</i>	279
In appendice:	
C. PERSIANI <i>Presenze preistoriche sui Monti della Tolfa.</i>	323
M. COLADONATO, F. TALARICO, G. VIGLIANO <i>Analisi di alcuni reperti di Poggio della Capanna (Tolfa).</i>	335
E. PELLEGRINI <i>Nuovi dati su due ripostigli dell'età del bronzo finale del grossetano: Piano di Tallone e "tra Manciano e Samprugnano".</i>	341
S.H. LOVING, A. VOORRIPS, H. KAMERMANS <i>Old Finds in New Fields: First Results of the Agro Pontino Archaeological Survey.</i>	361
S. BÓKÖNYI <i>The Possibilities of a Cooperation between Archaeology and Zoology.</i>	391
<i>Abbreviazioni bibliografiche</i>	402
<i>Elenco degli autori</i>	404
<i>Elenco delle località</i>	405

Old Finds in New Fields: First Results of the Agro Pontino Archaeological Survey*

INTRODUCTION

The Agro Pontino project consists primarily of an intensive archaeological survey designed to locate and interpret findspots dating from the Middle Palaeolithic to the Middle Ages in the Agro Pontino plain, Lazio, Italy (fig. 1). Unless one restricts survey to ceramically well-known periods and to areas where those ceramics are found, dating of surface materials is always problematic. The Agro Pontino is not a region containing distinctive prehistoric ceramics, but it is fairly unique for the time range of surface materials; thus it presents more of a challenge for dating and more of an opportunity for learning about prehistoric activities than many other areas.

To be integrated within the Agro Pontino project are a number of more specialized studies: palaeoenvironmental reconstructions based on palaeobotanical and geological samples (EISNER *et al.* 1984); application of the land evaluation approach to the investigation of changing patterns of prehistoric landuse (KAMERMANS *et al.* 1984); restudy of fauna from previous excavations from an anthropological viewpoint; and cultural history investigations, such as locating differences between Middle and Upper Palaeolithic hunting behavior (VOORRIPS *et al.* 1985).

Survey field seasons have taken place in June 1979 (2 weeks), June 1980 (3 weeks), September 1982 (4 weeks) and June 1984 (4 weeks). The first field season in 1979 was primarily a reconnaissance mission to assess whether or not a survey would be appropriate in this area. The 1980 field season was spent working out a field collection strategy and surveying fields in areas not visited in 1979. During the 1982 field season, the survey concentrated on the southern part of the Agro Pontino. The 1984 season concentrated on the northern part of the area.

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The goals of the survey proper are in logical, although not necessarily procedural, order: (1) to describe the distribution of archaeological surface materials in the Agro Pontino as accurately as possible; (2) to place these materials in a rough chronological framework; and (3) to determine for each prehistoric period which factors — prehistoric cultural factors, recent cultural factors, and/or geological factors — account best for the distribution observed. Accomplishment of these goals will allow us to address substantive research questions.

In this article the survey methodology is first described, followed by a summary of data collected through the 1982 survey season. Then, using these data, the effects of survey visibility, geological factors and land reclamation on the archaeological finds distributions observed are evaluated.

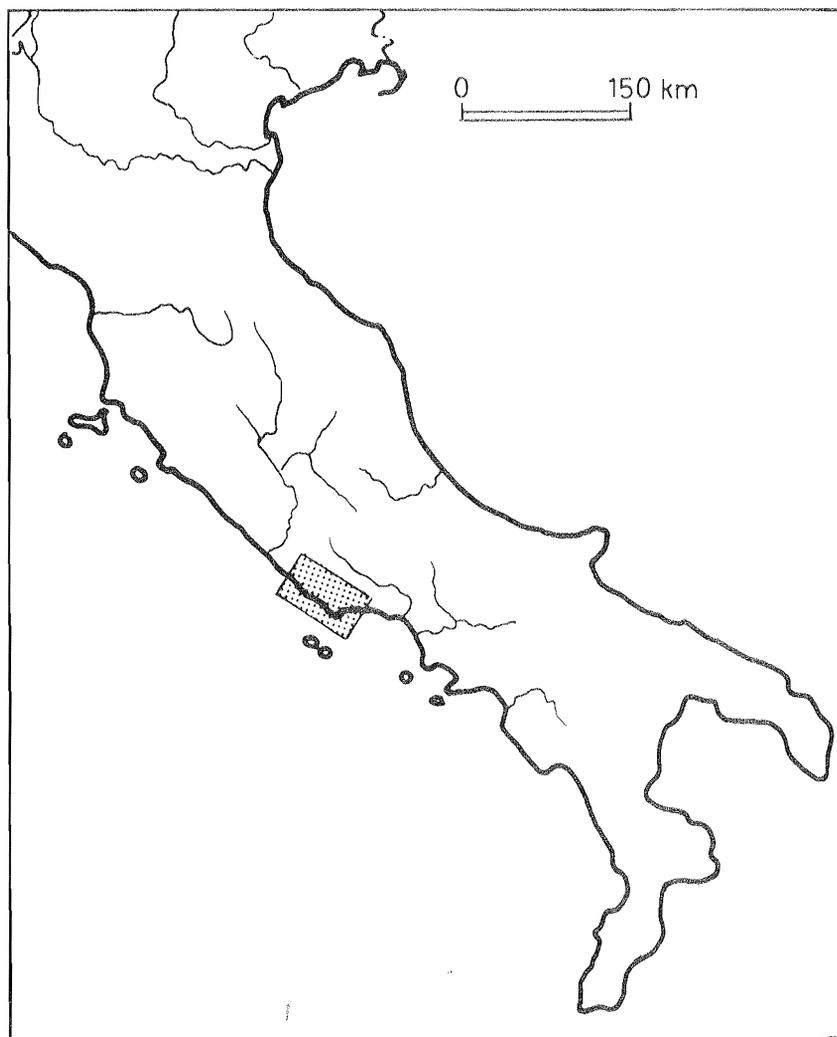


Fig. 1 - Location of the Agro Pontino in West Central Italy. (Drawing by IPP)

SURVEY METHODS

The Agro Pontino is about 60 km long and 15 km wide. Of the total area, ca. 877 km², 678 km² (as measured by planometer) is surveyable. Excluded are urban areas — Latina, Sabaudia, Pontinia, etc. and the tourist development along the Southeast coast —, about 22 km², dispersed development, such as farmhouses, glasshouses, roads, rural villages (Borgo Ermada, Borgo Podgora, etc.), which is an estimated additional 120 km², and the Parco Nazionale, about 57 km², which is surveyable, but is currently excluded because of the very different surface conditions found there.

Except for the urban areas and the park, most of the Agro Pontino is under cultivation and consequently is divided into field units, most of them more or less rectangular. For the survey these agricultural fields are the observation units, in both a practical sense and a statistical sense. Practically, visibility conditions in each field are uniform, but vary greatly among fields, and the fields are easy to locate on air photographs. Statistically, each field is considered a "case", a member of the population of fields in the survey region. Altogether the fields provide a kind of grid for the survey region, although the fields themselves are not uniform in size and shape.

The size distribution of fields was estimated using areal data for 374 fields (343 of which have been surveyed): range = 100 - 137750 m²; median = 9064 m²; mode = 4297 m²; and mean = 12878 (S.D. = ± 13674 m²). Since the distribution of field sizes is highly skewed to the right (skewness = 4189), and only 23% of the fields are larger than the mean, the median was deemed a better statistic for estimating the number of fields in the region as a whole than the mean or the mode. The total surveyable area, 678 km², divided by the median value yielded 74809 fields.

Data collection

During all seasons, while in the field, the following information was collected for each field: area, soil type, soil horizons exposed, degree of slope, slope aspect. Each time a field was surveyed, data on the survey conditions were recorded: time of day, weather conditions, condition of the surface (plowed and irrigated, plowed, but not irrigated, etc.), amount of vegetational coverage, visible erosion and other soil transport. The intensity of field coverage was recorded when the field was surveyed systematically. Beginning in 1980, crew members were spaced approximately 10 meters apart which resulted in a coverage of about 20% for most fields since a surveyor can usually see one meter to each side (adjustments to amount of coverage were made according to visibility conditions).

Plot maps of artifact distributions were made whenever fields were systematically surveyed. Except for plot maps made during the 1979 season, all plots have been keyed to individual artifacts by number. Extremely dense concentrations of material are plotted and bagged together. Prior to 1984, all plot maps were made on millimeter graph paper, usually at a scale of 1:1000. Pre-season selection of fields to be surveyed in 1984 allowed 1:5000 scale blow-ups of aerial photographs (series R.D. 22-7-1939, Stato Maggiore Aeronautica, approximately 1:30000 scale) to be made which were used for artifact plotting except in a few cases where the density of artifacts necessitated making a map at a larger scale. On all maps, slope direction, changes in the soil horizons, erosion channels, etc. were also plotted.

All field locations and datum points for artifact plot maps are tied into a region-wide coordinate system.

The field data are entered into a Scientific Information Retrieval, version 2 (SIR2) database which has a hierarchical structure (ROBINSON *et al.* 1980). At the highest level in the structure is the field record which contains invariant information about the agricultural field. The field record "owns" the next level, the visit record, which contains information pertaining to a visit to a field (date, visibility conditions, references for artifact plot maps, etc.). The number of visit records for each field corresponds to the number of times the field has been visited. If finds are recovered during a visit, the visit record will "own" a series of artifact records, one for each artifact containing information about the individual artifact (material type, map coordinates, technological and typological data, etc.). Since SIR2 has some networking capacity, there is a fourth record which is not tied into the hierarchy, the site record. In a few cases, a field may be said to "own" one site or more, but the more usual situation is that the site "own" more than one field. Thus, the site record aggregates the fields belonging to one site. The designation of a site, of course, is an interpretation, not an observational fact.

The SIR2 database management system is compatible with the Statistical Package for the Social Sciences (NIE *et al.* 1970), which was used for performing the statistical procedures presented in this paper.

Sampling design

The sampling design for the Agro Pontino field survey is a step-wise design, meaning that the results of one phase of the design are taken into consideration when making selections for the next phase. Three major phases are planned, of which only the second entails drawing a probabilistic sample.

The first phase, which was completed at the end of the 1982 field season, consists of a non-random set of observations drawn from all major geological and geographic sections of the area, except the colluvium and the northernmost part of the plain between the Canale delle Acque Alte and the fiume Astura. Within these areas, fields were selected on the basis of their visibility conditions. In addition, two areas — one north of Sabaudia and the other between San Felice Circeo and Terracina — were surveyed intensively in order to assess the degree of aggregation of findspots in the coastal area. The variances of selected variables from this sample were then used as "best estimators" for calculating the required sample size for the second phase of the sampling design.

The second phase, begun in 1984, is a systematic non-aligned transect sample (PLOG 1976) designed to select (1) a sufficient sample size for making probability statements about the archaeological attributes of fields in the Agro Pontino as a whole and (2) a sample which spatially "covers" the Agro Pontino. This phase also admits the drawing of randomly selected transects within sampling strata defined by more specific research questions.

It was decided that the transects should cross-cut the major environmental zones of the region, i.e., should be drawn from the Southwest coast to the mountains, and that these transects should be selected within uniform-sized blocks dividing the

region from NW to SE. The number of transects required would determine the number of blocks so that one transect would be randomly selected within each block.

To calculate a minimal sample size, four questions were asked of the first phase sample:

- (1) What proportion of fields in the Agro Pontino contain archaeological materials?
- (2) Of the fields containing archaeological materials, what is the mean and variance in density of those materials?
- (3) What proportion of fields contain materials of various time periods?
- (4) What proportion of fields contain materials of a density exceeding 20 finds (as an arbitrary amount required for analyzing internal variation among finds) per hectare?

The number of observations required to answer these questions ranged from 293 to 675 with a 0.05 bound on the error of estimation. An unobstructed transect (i.e., one not cross-cutting an urban area) from the coast to the mountains would cross an estimated 150 fields, and thus five such transects, each randomly selected within a 12 x 15 km block, were drawn (fig. 2). Although the number of observations selected, 750, seems more than adequate, it is expected that seasonal field conditions, relative areal proportions required for sampling strata, etc. will necessitate the drawing of additional, but shorter transects.

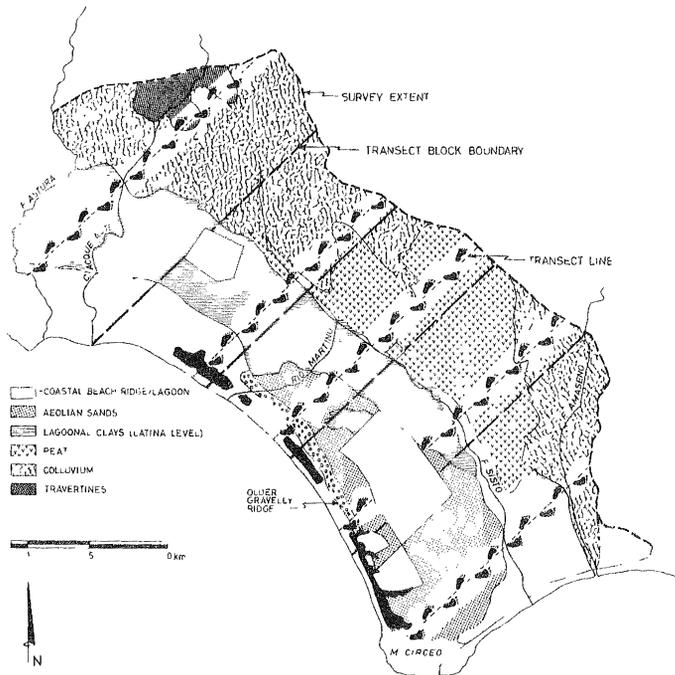


Fig. 2 - Map of the Agro Pontino showing the major environmental zones and the blocks and transects drawn from the second phase of the sampling design.

The third phase is the purposive selection of observations needed for specific research goals. For example, it may be desirable to predict where certain types of sites should be and then check the predictions in the field, or for some studies it may be necessary to enlarge existing collections of archaeological material. Although a small testing program to select candidates for excavation may also seem warranted by this phase, the major purpose of the third phase is to fill in informational gaps so that the studies using primarily survey data can be completed.

If systematic differences in the area of fields found within soil type strata exist, this would require adjustments to the number of observations drawn from sampling strata based on environmental zones. Therefore we have begun to evaluate this possibility.

Using fields having an area below 31000 m² (346, or 93% of all fields for which we have information), a scattergram plotting area of field with environmental zones showed that fields from all zones spanned the entire range of field sizes, except those of the colluvial and alluvial zones (N=19), where no fields were in the upper third of the size range. Among the fields of other zones, only those of the Older Gravelly beach ridge (fig. 2) deviated from the general pattern of decreasing frequency of fields with increasing field size by having a greater frequency in the mid-range of field sizes rather than in the low range. These trends will be checked with the 1984 random transect data and, if they are also found there, the appropriate corrections will be made to the probabilistic sampling design.

SUMMARY OF SURVEY DATA

Area covered

The total area surveyed by the end of the 1982 field season was 5.086.173 m², or approximately 5.09 km². This figure, however, includes area surveyed more than once, 633842 m², and thus only about 4.45 km² (4.452.331 m²) had been surveyed at least once. Most of this coverage was restricted to the southern and central parts of the Agro Pontino.

Archaeological materials collected or recorded

As of 1982, 341 fields and 2 isolated profile sections had been surveyed and 260, or 75.8%, of these have contained archaeological materials. Frequencies range from 1 to 533 finds per field or profile section (fig. 3). As is obvious from the figure, the distribution of finds frequencies for fields with finds is highly skewed to the right (mean = 21.5, s.d. = ± 47.31, skewness = 7.16) with about 75% of the fields containing fewer number of finds than the mean.

Using the first collections of systematically surveyed fields and correcting the field areas with the percentages of them covered, the densities of the material encountered in fields surveyed so far were calculated (fig. 3). Under the category of systematically surveyed fields with finds are 213 fields with a total of 3991 finds. Kolmogorov-Smirnov two-sample tests showed that this subset did not differ

significantly from the whole sample in either the distribution of the find frequencies nor the field size frequencies.

The density of finds in the sample (fig. 3) ranges from 1-2 finds to 820 finds per hectare (10000 m²), with a mean of 70 finds per hectare (s.d. = ± 100; skewness = 3847; kurtosis = 20641). These statistics indicate a very large number of fields with low find density and a few fields with high find density.

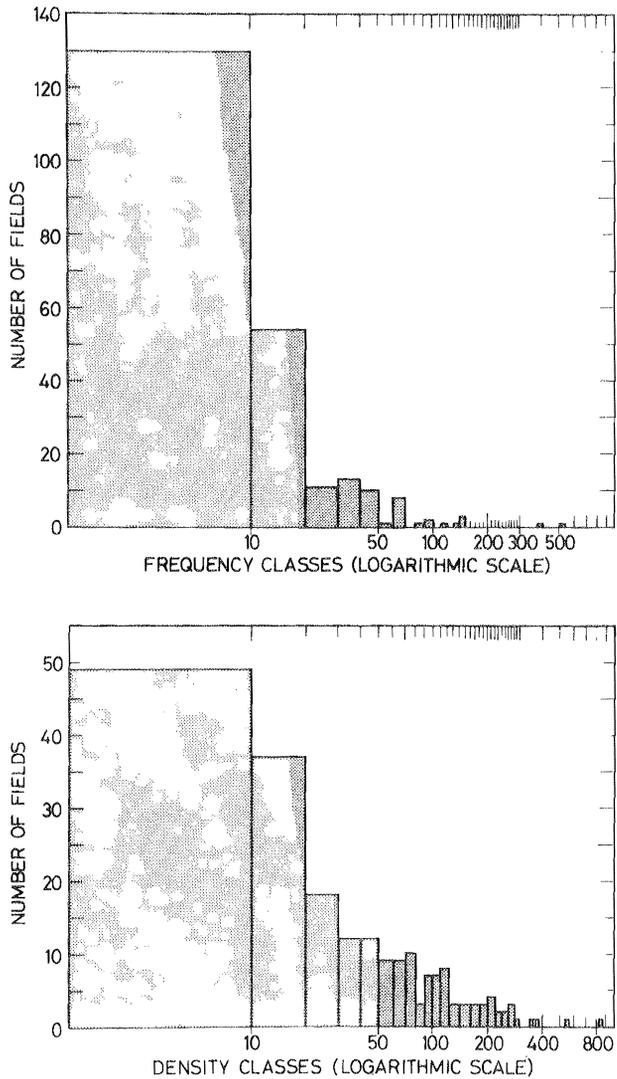


Fig. 3 - Bar graphs showing the field frequencies for find frequency and find density classes as positioned on a logarithmic horizontal scale.

Selected characteristics of archaeological finds

As of 1982, 5595 items had been recorded during the survey. These items consist primarily of flint tools and debitage (3793 items), mainly manufactured from beach pebbles, and ceramic sherds (1577 items), a number of them quite weathered. Obsidian (85 items) has also been found, as well as other stone (29 items), some metal, glass and ceramic tile. Whole pebbles out of geological context are considered artifacts and collected.

Although a number of Lower Palaeolithic sites have been found in areas near the Agro Pontino (e.g., BIDDITTU, CASSOLI 1968; PIPERNO, SEGRE 1982), none have been recognized in the survey area proper nor found stratified below Middle Palaeolithic layers in excavated sites (e.g., BLANC 1937; BLANC, SEGRE 1953; TASCHINI 1970). No surface materials of this age have been encountered by the survey, although because of similarities with Middle Palaeolithic tools (PIPERNO, SEGRE 1982, figs. 2, 3), they might be difficult to recognize in surface scatters.

Typologically, most Middle Palaeolithic materials from the survey area published so far belong to the Pontinian, a term coined by Blanc (1937) to denote the Mousterian artifacts made on pebbles found in coastal central Italy, which is believed to have become widespread along the Latium Tyrrhenian coast after the Riss-Würm Interglacial (PIPERNO, SEGRE 1982). Virtually all of the Middle Palaeolithic tools found by the survey appear to be Pontinian, with the exception of a few not made on pebbles and some Quinson-type ("Musteriano laquinoide Arcaico", RADMILLI 1975, after Palma di Cesnola 1967) pieces.

Upper Palaeolithic assemblages have been found in cave sites, (BLANC, SEGRE 1953; CHIAPPELLA *et al.* 1958-61; TASCHINI 1968), an open air site (TASCHINI 1972), and in surface scatters (BIETTI 1969). Epipalaeolithic assemblages (ZEI 1953; BLANC, SEGRE 1983; SEGRE, ASCENZI 1956; BIETTI 1984a) are also rather well-represented in the area. The survey has found items which are typologically Aurignacian, or "Circean" (BLANC, SEGRE 1953), Gravettian and Epigravettian.

One *in situ* Mesolithic deposit is known from the survey area dated to 8565 ± 80 BP, stratified above the Gravettian layer at Riparo Blanc (TASCHINI 1964, 1968), containing a large number of denticulated tools. A number of surface localities, also with denticulated tools, have been found on the Monte Circeo and are tentatively dated to the Mesolithic (MUSSI, ZAMPETTI 1978). Our survey has located seven possible Mesolithic findspots, which have been identified as such because of a large proportion of microliths and some truncated pieces. These assemblages are similar to some final Epigravettian surface assemblages located north of Anzio (ZEI 1953), however, and so it is possible that they are final Epigravettian, rather than Mesolithic, assemblages (but see discussion by BIETTI 1984b). very few denticulated items have been found by the survey.

Early Neolithic Impressed Ware (PHILLIPS 1980, 156 ff.) may be present in Lazio at Palidoro (BLANC 1955; BARKER 1975; BIETTI 1976-77), northwest of the Agro Pontino near the coast. Although there are a few reports of allegedly Neolithic sherds found near the surface of stratified Palaeolithic deposits, for example at Canale Mussolini (BLANC, SEGRE 1953), neither Impressed Ware nor other ceramics of decided Neolithic age — Sasso ware, Ripoli trichrome, Rinaldone (BARKER 1975, RADMILLI 1975) — are known from the survey area, nor have they been found by our

survey. Obsidian from the Palmarola Island, approximately 30 km off the Agro Pontino coast, begins to appear in West Central Italian sites sometime during the Neolithic. About 1.5% of the items collected by the survey are obsidian and could date from the Neolithic onwards. Foliated dart points, some of them barbed, and ground stone began to be made during the Neolithic. The survey has found four dart points which are typologically similar to those from Late Neolithic (Eneolithic) contexts in Lazio on display at the Museo Pigorini. Also, one ground stone chisel has been found. Bronze Age pottery from excavated contexts come from Cisterna (SEGRE, ASCENZI 1956) and at Caterattino (BLANC, SEGRE 1953). Probable Bronze Age sherds have been found by our survey in small quantities.

In West Central Italy, the Final Bronze Age intersects with the Laziale typonchronological scheme which continues through the Iron Age (COLONNA 1976). Several Iron Age sites have been, or are being, excavated near the border of the Agro Pontino: Terracina, Satricum at Le Ferriere, Antium at Anzio and Caracupa near Sermoneta. Other locations are known between the Torre Astura and Foce Verde (PICARETTA 1977; A. Guidi, personal communication), and our survey has found Iron Age sherds south of this area as well.

Chronological Category	No. of fields
Unknown (entire range).....	36
Middle Palaeolithic.....	93
Upper Palaeolithic.....	84
Epipalaeolithic/Mesolithic.....	7
Unknown ceramic period.....	8
Pre-Roman ceramic period.....	44
Neolithic/Bronze Age.....	8
Neolithic.....	5
Bronze Age.....	1
Iron Age/Roman.....	1
Iron Age.....	31
Roman.....	112
Medieval.....	3

[Categories placed further to the left are more general than those placed further to the right]

Fig. 4 - Number of fields with different chronological components.

Chronological distribution of findspots located by the survey

It must be stressed that our chronological assessments of the findspots is in progress, and that we expect revisions in dating them. For our work, the findspots were first dated (KAMERMANS 1984; KAMERMANS *et al.* 1984) by attributing a chronological component whenever an item type in that findspot conformed to an item in a standard chronotypology (BORDES 1961; SONNEVILLE-BORDES DE, PERROT 1954-56; LAPLACE 1964; BIETTI 1976-77) or was identified by persons having expertise in

local pottery (for this we are particularly indebted to A. Beijer, A. Guidi, O. Colanzingari, and L. Borrello). This information was then reassessed using a statistical procedure (to be described in a forthcoming publication) which transforms age *probabilities* of individual items to the findspot level. These results are summarized on figure 4 and are the chronological data used for the analyses in the next section.

Among the findspots, 115 have a single chronological component, 72 have two components, 26 have three components, 13 have four components, and one has five components.

ANALYSIS OF SURVEY DATA

In this section, the distorting influences of three factors on the archaeological find distributions are analyzed, which we believe to be an essential step in survey methodology. The results of the first factor, visibility conditions of fields visited by the survey, will affect the selection of fields for the next survey season. The results of analyses of the second factor, geological conditions, and the third factor, soil transport stemming from reclamation activities, will affect how we select findspot samples for analysis of prehistoric activities. These analyses will be repeated using the transect sample data, not only for validation purposes, but also so that we can extend them, if necessary, to better understand and control our archaeological samples.

Effect of visibility factors

Since visibility conditions varied from field to field, and from visit to visit, we have assessed the effect of these conditions, primarily to decide if there are any visibility situations to avoid. Visibility variables collected for each field visit — type of plowed surface, amount of vegetation and the irrigation of the field, cloud cover, temperature — were coded according to the following nominal categories:

<i>cloud cover</i>	<i>temperature</i>	<i>plowing</i>	<i>vegetation</i>	<i>irrigation</i>
partly cloudy	warm/cool	large peds	none	recent rain/irrigation
showers	hot	finepeds	< 50%	disturbed since rain
clear		harvested	vineyard	dusty
		rough peds	> 50%	
		rolled		

The variables are not strictly independent because some combinations of the variable categories can't occur. For example, large peds never occur in fields with greater than 50% vegetational coverage, and a vineyard is seldom, if ever, rolled. Nevertheless, in the data screening process, we have initially assumed that they are independent to begin to compare each variable category against presence-absence of finds and find densities. For this analysis we also assumed that visibility conditions were the only variables affecting finds distributions.

We first set up contingency tables for each of the variables vs presence-absence of finds and vs find density for fields with finds. The find density values were transformed into logarithms (because of their skewed distribution) and divided into five classes with an approximately equal number of cases. The chi-square statistic was used to evaluate the associations in tables under the null hypothesis that the visibility variables did not affect collections ($\alpha = .05$).

Using presence-absence of finds only the irrigation and vegetation variables produced significant chi-square values. For the irrigation variable there were more "recent rain/irrigation" fields with finds and more "disturbed since rain" fields without finds than expected from chance alone ($N=257$, $df=2$, $\chi^2=14.53$, $p<.05$). For the vegetation variable, the distribution was also significantly different from that expected ($N=351$, $df=3$, $\chi^2=10.02$, $p<.02$). In this case, however, it wasn't so easy to see which variable categories were controlling the outcome, so pairs of categories were tested, and it could be seen that the number of fields with finds was significantly greater for the "less than 50%" category and significantly less for the "greater than 50%" category.

With the find density classes only the irrigation variable produced a significant chi-square value ($N=185$, $df=8$, $\chi^2=16.98$, $p<.03$).

At this level, it would seem that irrigation and vegetation conditions affect the number of fields where finds are found, but in fields where finds are found only irrigation seems to affect the density of finds collected.

To further assess the effect of the irrigation variable, it was reasoned that if it did effect find density, then there should also be a relationship between it and the size of finds. Using the weights of lithic artifacts for estimates of size, the 20% lightest artifacts of the total collection were classed as "small". Then, for each field, the correlation of the irrigation variable with proportions of small lithic weights per field was obtained with the Kendall's *tau* nonparametric rank order statistic with the expectation that the lower the coded number of the irrigation variable category (1=recent rain, irrigation, 2=disturbance since rain, 3=dusty), the greater the proportion of small lithic finds. The test showed a slight, but significant correlation ($N=257$, $\tau = -.2137$, $p=.001$). So, there is some evidence that irrigation may not only affect the density of finds, but the number of small finds as well.

Chi-square tests on combinations of categories between variables showed that whenever a significant chi-square value was produced, it was linked to the irrigation variable. The tests showed that more fields had finds when the "recent rain" category of the irrigation variables was combined with the "less than 50%" vegetation category, whereas fewer fields had finds in the "greater than 50%" vegetation category, and no differences were observed for the other vegetational categories (i.e., "no vegetation" and "vineyard"). Under the other irrigation categories (i.e., "disturbance since rain" and "dusty") there were no significant differences for number of fields with finds in any of the vegetational categories. For density of finds only the combinations of "recent rain" with "no vegetation" and "recent rain" with "less than 50%" vegetation were significant.

Although it may seem self-evident that field conditions would affect collections, it is helpful to know exactly how they do so. It appears from this initial analysis that recent irrigation is an important factor for field visibility and, in combination with certain vegetational conditions becomes even more critical. It is fortunate that only

22% of our fields surveyed did not have recently irrigated surfaces and only 7% had vegetational cover exceeding 50%. A similar analysis will be performed with the transect sample to see if the same kinds of results are obtained. For the present, it seems reasonable to avoid fields with greater than 50% vegetational cover and to select only those fields whose surfaces have not been disturbed since being irrigated.

Evaluation of effect of Age and Stability of Land surface on find distribution

The Agro Pontino plain can be subdivided into a relatively tectonically stable western half, with elevations ranging from sea level to +41 m a.s.l., and a low-lying (at about sea level) eastern half, with virtually no relief. This division is due to the continuing tectonic subsidence of the eastern part of the plain (hereafter referred to as the graben) governed by the NE-SW fault system (AMADEI *et al.* 1965).

A considerable amount of information has been published about the geological history and composition of the Agro Pontino and surrounding areas (e.g., BLANC *et al.* 1953; SEGRE, ASCENZI 1956; SEGRE 1957; REMMELZWAAL 1978), about the hydrology and sea-level changes (e.g., DURANTE, SETTEPASSI 1974; DRAGONE *et al.* 1969; SEGRE 1968; SEGRE *et al.* 1968) and about the vegetational and climatic history (e.g., TONGIORGI 1936; FRANK 1969; EISNER *et al.* 1984). For evaluating the effect of geological factors on surface finds distributions, however, the most relevant work to date is the soil survey study done by Sevink *et al.* (REMMELZWAAL 1978; SEVINK *et al.* 1982, 1984).

Although the details of fossil beach ridge-lagoon stratigraphy are quite complicated, it was possible for soil survey to demonstrate by the degree of soil development the progressive build-up of the coast and to assign beach ridge-lagoon complexes, each more or less at a different elevation above present day sea level, to transgressive phases (from oldest to youngest): Latina *niveau*, Minturno *niveau*, Borgo Ermada *niveau* and Terracina *niveau*. All four complexes are found on the southwest coast, but only the younger two are on the southeast coast. Of the oldest complex, the Latina *niveau*, only the lagoonal deposits remain. Soils developed in the ridges are predominantly Chromic Luvisols (soil taxonomic terms are according to FAO 1976) except for the youngest ridge, where Calcaric Regosols are found. Soils developed in lagoonal deposits are primarily Gleyic Luvisols, Gleyic Cambisols, Chromic vertisols and Solidic Planosols (fig. 5, tab. 1).

The relative age of the Older Gravelly beach ridge (fig. 5) is believed to be closer to that of the Borgo Ermada *niveau* even though its characteristically higher gravel content, indicative of a high energy beach, is more similar to the beach ridge of the Minturno *niveau* (Jan Sevink, personal communication). For this report, it is considered to be of an intermediate age and is analyzed separately.

Aeolian sands are found sporadically all along the coast area, particularly on the leeward sides of the fossil beach ridges, but an extensive and thick, up to 41 m (BLANC *et al.* 1953), cover occurs in the SW part of the area from Monte Circeo to the north of the National Park. On the basis of the degree of soil development, four main depositional phases have been identified (SEVINK *et al.* 1984, 30 ff), from oldest to youngest: well-developed Chromic Luvisols, primarily exposed in the northern third of the coversand area; less-developed Chromic Luvisols and Orthic Luvisols, primarily as sub-surface formations; Cambic Arenosols, exposed mainly in

the southern two-thirds of the area in sediments and probably post-dating the Middle Paleolithic; Eutric Regosols, primarily in the southern third of the coversand area on its easternmost border (fig. 5) and probably post-dating the Neolithic.

It is important that palaeosols in the aeolian area show depositional episodes alternating with periods of greater surface stability. The younger aeolian cover represented by the Cambic Arenosols (about one m thick) buried much of the older aeolian cover and some of the beach ridge-lagoon complex perhaps toward the end of the Würm, meaning that buried archaeological materials should lie too far below the present-day surface to be exposed by deflation and plowing activities during the Holocene. Thus, the archaeological chronology found on the younger aeolian cover surfaces (the Cambic Arenosols) is expected to begin with the Epigravettian.

Chronological distinctions are also apparent in the development of the colluvial soils with those close to the mountain slopes in several locations being older than the bulk of colluvium in the graben (fig. 5). The former are believed to have begun forming during the Neolithic period, whereas the latter probably began to accumulate in the immediate pre-Roman period (Sevink, personal communication).

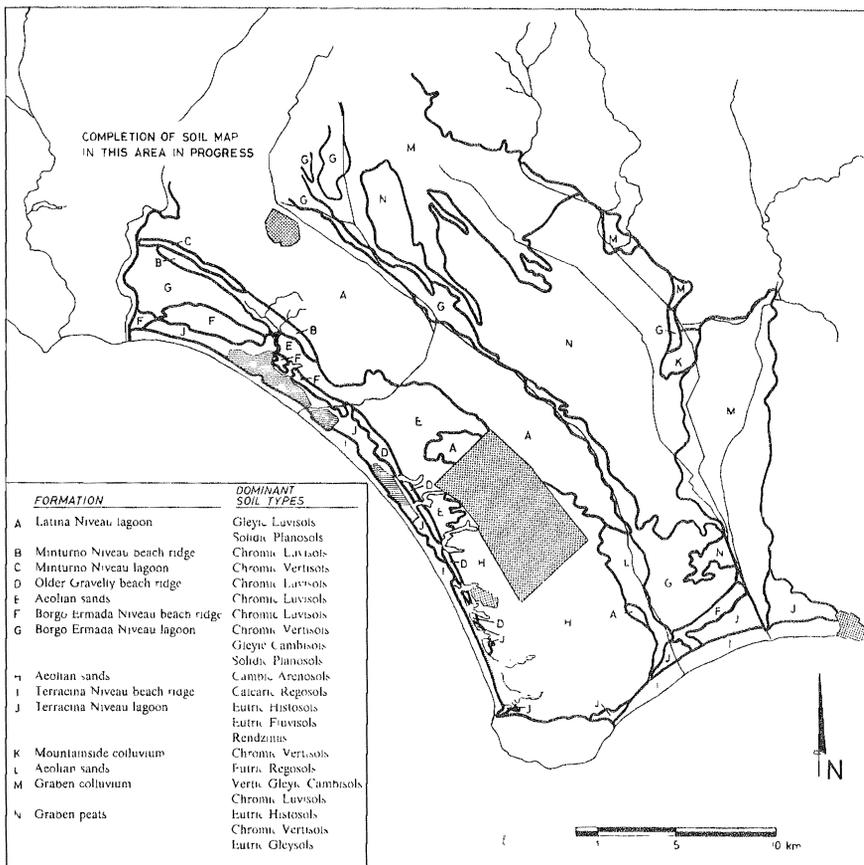


Fig. 5 - Major soil units of the Agro Pontino (see key in tab. 1). (Drawing by IPP)

The graben peats, of course, form more or less continuously and thus present the most recent surfaces in the area.

The relative chronological order of the surfaces is summarized on tab. 1 along with a designation of the youngest surface possible for some of the archaeological periods and an assessment of surface stability, whose importance for surface archaeology has been recently introduced by Sevink (1984).

Briefly, surface stability refers to the susceptibility of a land surface to erosion and/or to burial by new sediments, which depends upon (1) the nature of the sediment and/or soil and (2) the environmental forces to which the soil surface is exposed. For example, in areas of low relief, soils which retain more water, i.e., less permeable soils, will tend to be less susceptible to wind erosion, and hence more stable, than those which retain less, holding climate constant. In areas of pronounced relief, wind erosion and slopewash tend to shift sediments from higher to lower elevations, creating unstable surfaces; how unstable is also partly dependent on water retention capacity, but is a complication not necessary to detail here.

In the Agro Pontino, excluding for a moment the peaty sediments of the graben, surfaces in areas of low relief which are more water-retentive and are more stable are those with clayey parent material, i.e., the fossil lagoons, and next are those with an exposed argillic B-horizon found in Chromic Luvisols, i.e., much of the Minturno and Borgo Ermada *niveaux* beach ridges and some of the aeolian area.

Soil map key*	Area	Age	Stability	Youngest surface for some archaeological periods
A	Latina <i>niveau</i> lagoon	1	1	
B	Minturno <i>niveau</i> beach ridge	2	2	
C	Minturno <i>niveau</i> lagoon	2	1	
D	Older gravelly beach ridge	2-3	2	
E	Aeolian Chromic Luvisols	2-3	3	
F	Borgo Ermada <i>niveau</i> beach ridge	3	2	Middle Palaeolithic
G	Borgo Ermada <i>niveau</i> lagoon	3	1	
H	Aeolian cambic arenosols	4	3	Epipalaeolithic
I	Terracina <i>niveau</i> beach ridge	5	3	Mesolithic
J	Terracina <i>niveau</i> lagoon	5	1	
K	Mountainside colluvium	6	4	Neolithic
L	Aeolian Eutric Regosols	7	3	
M	Graben colluvium	8	4	
N	Graben Holocene soils	9	5	

Tab. 1 - Age and stability classes for soil units (see fig. 5).

Chronological components

Age Class	Total N	Middle Palaeol.		Upper Palaeol.		Pre-Roman Ceramic		Roman	
		N	%	N	%	N	%	N	%
1	38	17	45	9	24	7	18	5	13
2	24	8	33	7	29	5	21	4	17
2-3	84	29	35	28	33	12	14	15	18
3	79	10	12.5	10	12.5	27	34	32	41
4	101	18	18	28	28	28	28	27	27
5	8	1	13	1	13	1	13	5	63
6	1	0	—	0	—	0	—	1	100
7	10	0	—	3	30	1	10	6	60
8	4	0	—	0	—	1	25	3	75
9	39	6	15	4	10	12	31	17	44

Tab. 2 - Frequency of chronological components of fields allocated to age classes of soil units.

Since there is evidence that the Cambic Arenosols of the southern two-thirds of the aeolian cover area have been subjected to local erosion (i.e., they are frequently associated with Haplic Phaenzems occurring at bottoms of slopes) their surfaces are considered somewhat less stable than those areas discussed above. Other sandy areas with little soil development, i.e., the beach ridge of the Terracina *niveau* and the aeolian Eutric Regosol area, are also considered less stable.

The colluvium is generally located in areas of greater relief and is thus subjected to a more or less continuous shifting of surface sediments, and its surface is, therefore, even less stable.

The surface of the graben, an area of low relief and high water retention, is, under natural conditions (i.e., without reclamation) very unstable because of organic accumulation continually burying the surface).

To analyze the effect of geological conditions on finds distributions, we assume the information in table 1 is valid and adopt the stance that these conditions control the archaeological finds distributions. That is, we assume a random distribution of finds of various archaeological time periods and expect that an accumulation, resulting in a palimpsest, of materials from all periods will be found on the oldest and most stable surfaces, and that only the most recent materials will be found on the more recent and least stable surfaces, etc.

Table 2 shows the frequencies of fields for the chronological periods allocated to the age classes of the land surfaces. On this table the Epipalaeolithic and Mesolithic materials are combined with the Upper Palaeolithic category, all of the pre-roman ceramic periods (Neolithic, Bronze Age and Iron Age) are lumped together, and the few Medieval components are not included. Nine fields have been excluded because

the soil type is lacking (four of these fields have finds). There are no samples from the Minturno *niveau* lagoon nor from the Terracina *niveau* beach ridge.

According to our expectations, there are two major discrepancies between the dating of the land surfaces and that of the finds: first, there should be no Middle Palaeolithic artifacts found on surfaces with age classes later than 3, but they are found in areas classed 4, 5 and 9; second, there should be no Upper Palaeolithic artifacts in areas classed later than 4, but these artifacts, none of which are potentially Epigravettian or Mesolithic according to current criteria, are also found in areas classed 5, 7 and 9. Both the Middle Palaeolithic and Upper Palaeolithic anomalies of the Terracina *niveau* lagoon (age class 5) come from one field located where that area intersects with the Borgo Ermada *niveau* beach ridge and contains land fill, and thus we do not consider them as anomalies. Anomalies in the graben can only be due to dredging activity or inaccurate soil classification by the archaeological survey and will be examined in a later publication.

Anomalies in the aeolian cover areas must be due to either erosion down to the lower aeolian cover surface or soil transport. For the Middle Palaeolithic anomalies in the aeolian Cambic Arenosol area (age class 4), the null hypothesis that more of these fields were not eroded as compared with all fields in the area could not be rejected using the chi-square statistic. This result was controlled by the absence of Middle Palaeolithic artifacts in eroded fields, which could, of course, simply mean that none were ever deposited in those locations. Of the 18 fields with Middle Palaeolithic artifacts, however, only four were eroded.

The number of observations of the aeolian Eutric Regosols was too few to be subjected to the same analysis. Simple inspection, however, showed that none of the Upper Palaeolithic artifacts found in those fields could be explained by erosion. Thus, the anomalies which cannot be accounted for by erosion must be explicable in terms of other factors. Otherwise, we have reason to question either dating of the soil surface or that of the artifacts.

We now move on to surface stability for which it is necessary to simultaneously employ age considerations. The *niveaux* lagoonal surfaces are considered the most stable (tab. 1) and should be accumulating surfaces, the longer in existence the greater the accumulation. Erosion should have little effect on density distributions in this class.

Table 3 shows that for areas with a stability class of 1, the density data is exactly counter to our expectations. The proportion of fields with finds and the average density of artifacts in fields with finds is highest on the Terracina *niveau* and lowest on the Latina *niveau*.

Table 4 shows the results of t-tests comparing densities transformed into logarithms under the null hypothesis that differences in material density are not greater on eroded surfaces ($\alpha=.05$). From this table one can see that, in fact, the failure of the stability class 1 areas to conform to density expectations may be due to erosion. Densities in eroded fields of the Latina *niveau* are significantly greater than in non-eroded fields, whereas the average density of materials is greater in non-eroded fields of the Borgo Ermada lagoon, although not significantly so. This may mean that there is more aeolian overburden on the Latina *niveau* than recognized, or alternatively one or more conjunctions of eroded fields with other variables (such as soil transport or prehistoric habitation locations).

Age	Stability- Class	Area	Density/Hectare				
			N*	Mean	S.D.	Median	Range
1	1	Latina <i>niveau</i> lagoon	30	30.44	± 59.00	10	1 - 273
1	3	Borgo Ermada <i>niveau</i> lagoon	27	42.80	± 45.00	30	2 - 183
1	5	Terracina <i>niveau</i> lagoon	4	74.00	± 75.00	35	14 - 180
2	2	Minturno <i>niveau</i> beach ridge	3	142.00	± 187.00	64	7 - 356
2	2-3	Older Gravelly beach ridge	16	101.80	± 155.80	56	4 - 658
2	3	Borgo Ermada <i>niveau</i> beach ridge	19	97.40	± 64.20	96	5 - 231
3	2-3	Aeolian Chromic Luvisols	21	140.90	± 207.00	66	1 - 824
3	4	Aeolian Cambic Arenosols	66	59.78	± 67.70	31	1 - 286
3	7	Aeolian Eutric Regosols	4	22.70	± 19.00	18	6 - 50
4	8	Graben colluvium	5	26.60	± 45.30	8	3 - 107
5	9	Graben peat	23	64.60	± 81.00	26	3 - 279

Tab. 3 - Density of materials shown by age and stability classes.

* Total N is the number of fields that were surveyed systematically making it possible to calculate densities.

The beach ridges of stability class 2 (tab. 1) that are presently exposed, once they were formed and inhabitable, are considered degrading surfaces, thus also accumulating surfaces as far as archaeological materials are concerned, the greater density likewise expected on the older surfaces with little or no relationship between density and erosion.

Material densities in stability class 2 areas are more in accordance with expectations in that the Minturno *niveau* beach ridge has the highest proportion of fields with finds and the greatest density of materials in fields with finds and the

Borgo Ermada *niveau* beach ridge the lowest. Although the average density for the old gravelly beach ridge and the Borgo Ermada *niveau* beach ridge are very close, the median of the latter is considerably higher (tab. 3). The t-test results shown on table 4 suggest that the greater median density on the Borgo Ermada *niveau* may be due to erosional factors.

The aeolian area is more complicated. First we can be reasonably certain that there was a period of more or less rapid deposition of sediments during which time the area was inhabitable, if not continuously, then at intervals. Once the major depositional episode ceased, then, depending on the topography created or emphasized by the accumulation, deflation and erosion would have begun to degrade higher local elevations. Given this sequence and that we cannot control for depositional duration, we simply expect that the longer the surface has been degrading, the greater the palimpsest of archaeological materials and that there would be a positive relationship between erosion and material density.

Material densities in stability class 3 conform best to our expectations, and the Chromic Luvisol densities are significantly (shown by a t-test on densities transformed into logarithms, assessed at the .05 level) greater than the Cambic Arenosol densities (tab. 5). We expected that erosion would be an important factor for densities on aeolian surfaces, but as table 4 shows, this does not appear to be the case.

	N	Mean*	S.D.	Probability (one-tailed)
<i>Latina niveau lagoon</i>				
Eroded fields	12	-2.653	± .697	
Non-eroded fields	18	-3.114	± .314	
				.025
<i>Bor. Erm. beach ridge</i>				
Eroded fields	5	-1.881	+ .182	
Non-eroded fields	12	-2.255	+ .467	
				.015
<i>Old. Grav. beach ridge</i>				
Eroded fields	10	-2.141	± .576	
Non-eroded fields	5	-2.395	+ .260	
				.18
<i>Aeol. Chromic Luvisols</i>				
Eroded fields	14	-2.348	± .710	
Non-eroded fields	7	-2.016	± .509	
				.143
<i>Aeol. Cambic Arenosols</i>				
Eroded fields	23	-2.461	+ .612	
Non-eroded fields	39	-2.551	± .524	
				.27

Tab. 4 - t-Tests comparing densities of eroded and non-eroded surfaces for selected areas.

* Density values transformed to logarithms.

Although the sample from the colluvium is small, the information currently available indicates that both the proportion of fields with finds and the density of materials in fields with finds is considerably less there than in the peaty graben area (tab. 3). Thus, we cannot explain the differences between the two areas on the basis of surface stability.

In summary we can say that the age and stability of surfaces found in the Agro Pontino affect the distribution in some areas more than in others. With the exception of the graben, younger materials are found on the younger surfaces. In the sandy beach and aeolian areas older surfaces have a greater accumulation of materials, whereas in other areas this does not appear to be the case. Local erosion appears to have influenced the observed densities in the Latina *niveau* and the Borgo Ermada beach ridge; this was unexpected given our interpretation of the surfaces. Erosion may also account for four fields having materials older than the postulated age of the surface in the aeolian Cambic Arenosol area.

Area	N	Mean*	S.D.	Probability (one-tailed)
Chromic Luvisol	21	-2.237	.657	
Cambic Arenosol	60	-2.503	.548	
				.034

Tab. 5 - t-Test of find density differences between fields in aeolian chromic luvisol area and fields in aeolian cambic arenosol area.

* Density values transformed to logarithms.

Evaluation of the effect of soil transport on archaeological distributions

The Agro Pontino is neither an area naturally hospitable to permanent human settlement nor an area suitable for year-round agriculture. The chief impediment to human settlement has been, at least in historical periods, malarial infestation. Indeed, most of today's inhabitants have come from other regions of Italy after the 1930s reclamation when malaria was brought under control by regulating the brackish content and water circulation of the coastal lagoons and draining or filling in waterlogged areas (A. Arnoldus-Huyzendveld, personal communication).

The predominance of poorly-drained and excessively-drained soils is responsible for the area's unsuitability for year-round agriculture. At best, portions of the beach ridge area may permit some rainy season agriculture in addition to that possible in the colluvium. Without reclamation, the "natural" human ecology of most of the area would most probably entail hunting, gathering and pastoralism as subsistence activities with their attending settlement behavior.

The reclamation project of the 1930s was the first to irrigate the beach ridge-dune area and render it amenable for year-round agriculture. This was done, for the most part, by deepening and widening, and, in some cases, straightening the existing

channels and extending them to a permanent freshwater source, e.g., the fiume Sisto (actually an older artificial canal) which is positioned near and along the southwestern edge of the graben. Smaller canals, many following natural drainages, were then built to connect to the major channels allowing most of the area to be irrigated with sprinkling equipment.

In contrast, the lure of rich soils in the graben has prompted recurrent reclamation projects to drain the Pontinian marshes beginning in pre-roman times. The projects involved building a fairly intensive network of drainage canals, ultimately connected to a sea outlet via the fiume Amesseno and/or the Rio Martino, with water flow regulated at the mouth (BOLOGNINI 1981). In the 1930s reclamation the fiume Sisto was also provided a sea outlet and the Canale delle Acque Alte (formerly the Canale Mussolini) was dredged to cross cut the northern part of the area and drain on the southwest coast thereby diverting water which otherwise would drain into the graben. It seems reasonable to assume that much of the canal network observed today in the graben bears no necessary relationship to those constructed in the past because the drainage projects have been intermittent, the land-holding patterns discontinuous, and few natural waterways are present.

The reclamation activities which have redistributed soils have undoubtedly redistributed artifacts as well, with some fields acquiring artifacts along with land fill and canal dredgings and some losing artifacts along with soil removal or excavation. The validity of survey data is, to a large extent, dependent on our ability to determine where and how much artifacts have been displaced through these activities.

Without a "theoretical" background to aid selection of relevant variables, the effect of soil transport on distributions observed would seem to demand an analysis conducted "by hand", i.e., on a field-by-field basis. Instead, at this stage it was deemed more efficient to use data from field notes together with "common sense" expectations as stated below, going to the individual field level whenever necessary.

Although artifacts located in land fill are certainly displaced and their source difficult, if not impossible, to identify without information from the landowner, land fill, being recent, is rather easy to recognize from surface coloration of the soil and from shallow borings. Four fields surveyed contained both artifacts and land fill, and in each case the landowner was able to pinpoint the source of the land fill.

Excavated areas are difficult to recognize unless they are adjacent to unexcavated areas, and their identification is frequently dependent on information provided by the landowner. Artifacts found in excavated areas, however, are probably not displaced from their original location, although a palimpsest of finds of different chronological periods may be created when upper stratigraphic items are left behind to be mixed with the lower stratigraphic finds exposed. Such a palimpsest may be expected to differ from that created by plowing in having an overrepresentation of the older materials relative to the younger ones, rather than vice versa.

Using the subset of 122 fields with more than one chronological period and field data on excavated fields, this reasoning was evaluated with the chi-square statistic under the null hypothesis that equal/reversed chronological distributions have no association with excavated areas. The chi-square value of 7.13 allowed us to reject the null hypothesis ($df=1$, $p > .05$) because fewer excavated fields had a "normal"

chronological frequency distribution of materials and more excavated fields had a “reversed” distribution than expected by chance (fig. 6).

	excavated	non-excavated	
chronologically “normal”	4 (8)*	98 (91.5)	102
chronologically “equal”/“reversed”	10 (6)	24 (30.5)	34
	14	122	136

yate’s correction for continuity applied

*expected values in parentheses

$$\chi^2 = 7.13; df = 1; p > .05$$

Fig. 6 - Contingency table showing excavated/non-excavated fields with finds vs presence/absence of chronological “reversals”.

It was reasoned that canal dredging would also not seriously displace archaeological materials, since the dredgings are deposited alongside the canal, but would make visible items which lie too far below the surface to be exposed by plowing. Along the largest canals of the area (e.g., fiume Sisto, Rio Martino), the dredged soils have been used to construct levees, and in some case the levees are farmed, but unfortunately our small survey sample of levee fields has no finds, and so we cannot examine the effect of large-scale dredging. Soils dredged from main canals and small field canals are usually incorporated as part of the adjacent field soil and spread over the field. The extent of the spreading can only be ascertained visually if there are marked differences in colour or texture between the surface soil and the underlying subsoil. In the few cases observed where this was the case, the spreading did not extend more than four meters from the canal, but these cases may not be typical.

To show how we might decide whether or not fields have been the recipients of canal dredgings, the 24 fields with reversals which were not excavated (fig. 6) are considered. To account for these fields, section maps were examined to see which were next to main channels and may have been the recipients of canal dredgings. Six fields were candidates. Then, the individual field plot maps were examined for the spatial distribution of finds relative to either main channels or local field channels and to the slope contours and soil horizons exposed. From this it was seen that in only two fields, one in the Cambic Arenosol area and one from the peaty graben,

were finds clearly coming from a canal. For 14 fields it was quite clear that finds were associated with slight slopes in the field and/or with soil horizons lower in the soil profile than the surrounding horizons exposed, indicative of localized topsoil erosion. For 7 fields it just wasn't possible to account for the reversals in terms of any of these factors. So, for the present we have to consider them as showing an accurate picture of the archaeological record.

We then used the expectations generated about soil transport to examine the chronological anomalies which emerged from the comparison of the archaeological materials with surface age in the previous section.

Of those 18 fields in the Cambic Arenosol aeolian area having Middle Palaeolithic artifacts, four could possibly be accounted for by erosion down to the buried palaeosol, as discussed above. Perusal of field plot maps showed that four other fields were probably the recipient of canal dredgings; these four fields are all in the Borgo Ermada map section where the coversand most probably overlies the Borgo Ermada *niveau*. Of the remaining ten fields, one is immediately downslope from a steeply sloped field with very dense finds on the Old Gravelly ridge, and these finds have probably been transported by agricultural machinery. Another is in a large depression in the aeolian area close to Monte Circeo; the depression may have a very shallow upper aeolian cover. The eight remaining fields are all located in the vicinity of the Fosso Pantano north of Sabaudia (fig. 7). They are at a higher elevation than the Fosso and have very little relief. According to Jan Sevink (personal communication) it was difficult to interpret the soils in this area genetically. There could either be a thin younger aeolian cover here, or the E horizon of the older aeolian cover could have been exposed by erosion of the A horizon. The archaeological evidence supports the latter possibility.

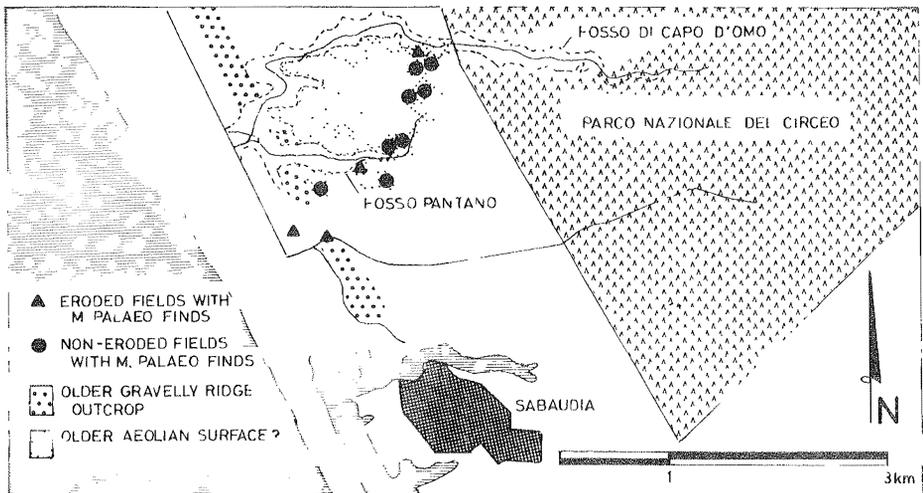


Fig. 7 - Area around the Fosso Pantano (Sabaudia section) which is probably a surface older than the surrounding area.

The three fields in the aeolian Eutric Regosol area with Upper Palaeolithic artifacts are adjacent to one another and a slight rise cross-cuts them. On the rise are Upper Palaeolithic artifacts with Roman ones. One of the fields stretches from a fosso to a roadside canal and Upper Palaeolithic artifacts are found bordering both these channels. Thus, it is probable that the anomalies on this soil can be accounted for both by erosion of a rather thin cover (supported by a very localized exposure of the Latina *niveau* in the same area, see fig. 5) and by the canal dredgings.

It is clear that it is a very tedious process to locate fields which have probably been recipients of canal dredgings. The fields used in the examples above were selected because of their archaeological "anomalies", a selection which, if continued, could result in rather biased results. Thus, it is important to define the relevant variables and collect the necessary data in as efficient manner as possible.

Use of the results from the analyses of surface stability and soil transport to select valid sample areas

In order to use the data from the two areas where there is a significant association between eroded fields and density of finds — the Latina *niveau* and the Borgo Ermada *niveau* beach ridge — it is necessary to decide the more probable causal factor for find density: erosion or prehistoric human occupation. It was reasoned that if erosion played a factor in the find distribution, finds in non-eroded fields in the same area should be controlled by canal dredging. Thus, the find plot maps of the non-eroded fields in both these areas were examined in conjunction with the age assessments of individual finds. If finds tended to be along the edges of the field (where there are almost always shallow field trenches) and/or tended to be denser closer to a main channel, it was decided that at least some of the finds had been dredged up. We considered this decision reinforced if the spatial distribution of the earlier finds followed this pattern more distinctly than did later finds. Fields having more randomly dispersed finds were considered not dredged up, with reinforcement if the finds were associated with a slight slope in the field or with a soil horizon lower in the soil profile than the surrounding horizons exposed, and/or if there was a clear spatial segregation among finds of different time periods. In this way, it was determined that ten of the non-eroded fields for which we had plot maps on the Borgo Ermada *niveau* beach ridge were not recipients of dredgings, whereas two were. On the Latina *niveau*, it was determined that finds on seven non-eroded fields did not come up with dredgings and that eight did.

We then examined the section maps and observed that the two fields with dredgings were at the southernmost end of the Borgo Ermada *niveau* beach ridge on the southeast coast (fig. 8). All of the Latina *niveau* fields which seemed to be affected by dredging were located between the northernmost corner of the Parco Nazionale and the Sisto near the modern town of Pontinia on the Pontinian section map (fig. 9). This area could be rather well-defined because non-eroded fields without dredged up finds occur to the east and west.

It is important to note that this analysis was done in the order described above and was not biased by prior knowledge of the location of the non-eroded fields under examination. To do future analyses of this type it will be necessary to ensure the

same situation or to devise a more formal set of criteria for determining whether or not a non-eroded field has been the recipient of canal dredgings.

Because of the results of this first analysis, not all of the Borgo Ermada *niveau* beach ridge nor all of the Latina *niveau* will be excluded from regional analyses about prehistoric human occupations, but only the portions of those areas where erosion seems to control find distributions.

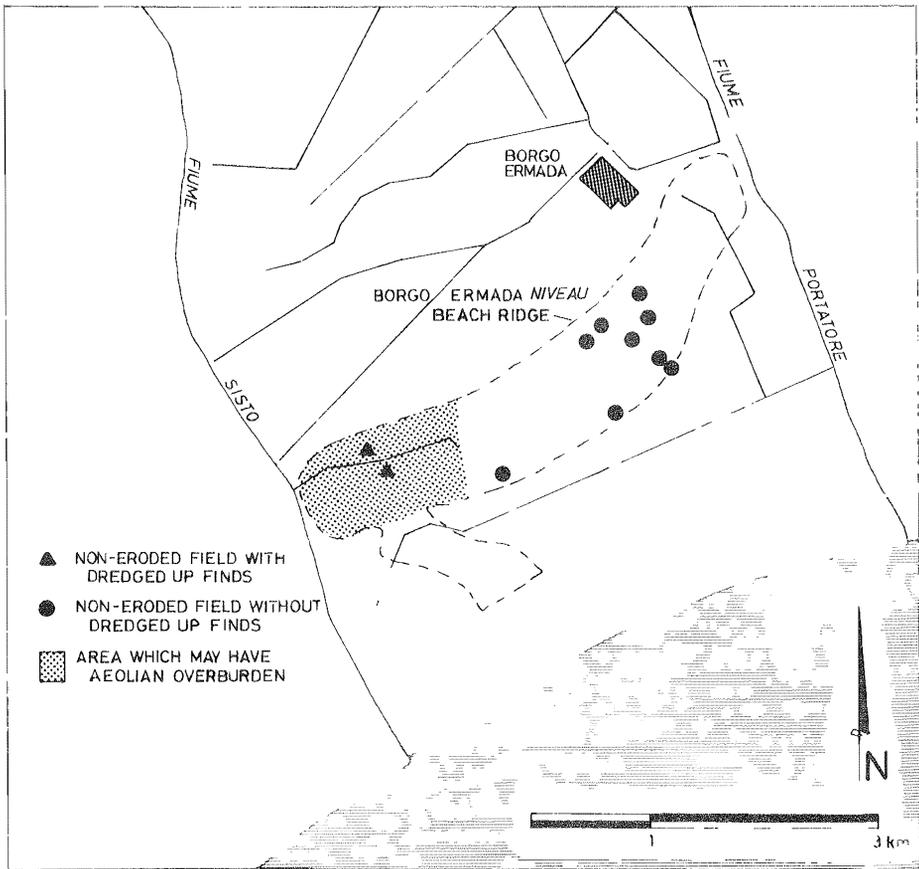


Fig. 8 - Estimated extent of aeolian overburden on the Borgo Ermada *niveau* (Borgo Ermada section) along the southeast coast.

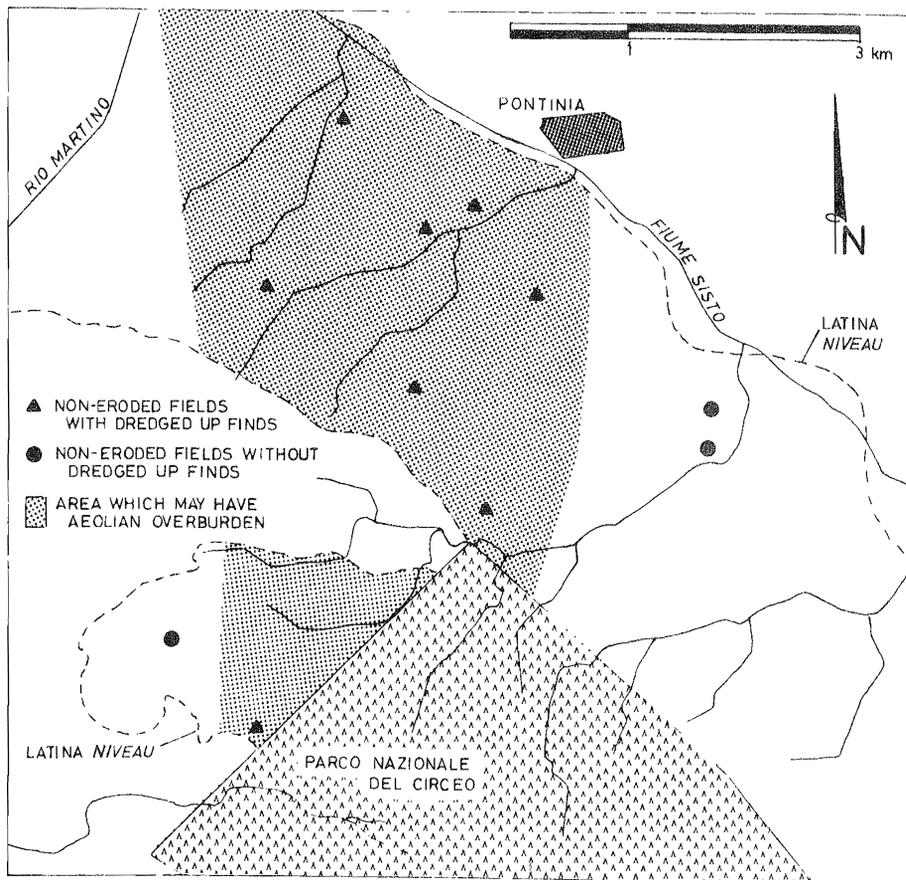


Fig. 9 - Delineated area of aeolian overburden on the Latina *niveau* (Pontinia section).

Discussion

A number of tentative conclusions about the above analyses can be drawn.

First, there is good reason to believe that erosion affects the densities observed on the Latina *niveau* and on the Borgo Ernada *niveau* beach ridge. There is the possibility that either a large number of materials are not visible on non-eroded surfaces or that there is a congruence between the location of prehistoric sites and those fields most likely to be eroded (i.e., on slopes). To evaluate these alternatives, it is necessary to compare the eroded fields with the non-eroded ones, selecting a larger sample of the latter if necessary.

Second, there is good reason to believe that the aeolian cover in the younger coversand areas is sufficiently thick in most areas to completely bury the older materials; where the cover is thin, we have a "window" to the older landscape. This means that the samples of older assemblages from this area cannot be used for any regional analysis, but may be studied to predict where older sites might be buried in the same soil area.

Third, there is good reason to believe that excavation affects the chronological proportions of materials in the field as expected, giving a distorted picture of younger material densities. This particular type of distortion does not appear to be created by canal dredging except for a few cases. Since, however, in a number of cases the reversals appear to be an accurate representation of the archaeological record, it is important to continue to evaluate reversals on a field-by-field basis.

Finally, it is clearly important to scrutinize the effects of canal dredging closely to help determine (1) if our assessment of the stability of surfaces is correct or requires modification and, related to that, (2) if individual observations should be included or excluded for certain types of analysis. For this procedure, it would be prudent and more efficient to develop formal criteria.

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SUMMARY

This article has described our methodological approach to regional survey by describing field procedures and the analyses used for initial data screening of the survey data. The first step in this approach is to attempt to control for non-archaeological factors, and much has been learned from the analyses so far. We now know that certain localized areas in the region affect observations of archaeological finds in ways not evident from the small-scale soil map, i.e., aeolian overburden and problems of soil interpretations. We are also now in a position to develop means to recognize and analyze the effects of soil transport on archaeological distributions in this area. The particular conclusions offered here are nevertheless tentative because they result from analyses using tentative data. In particular, the chronological assessments are not stabilized and the survey sample used was not a random one, and it will be necessary to repeat and extend the analyses with better data.

RIASSUNTO

In questo articolo viene descritto un approccio metodologico ad una ricognizione regionale con la descrizione di procedure di ricerca di campo e delle analisi usate per l'iniziale pulitura dei dati di ricognizione. Il primo passo di questo approccio è il tentativo di controllare i fattori non archeologici e si è ora in grado di sviluppare i mezzi per riconoscere e analizzare gli effetti del trasporto del suolo sulla distribuzione archeologica in quest'area. Le conclusioni qui presentate sono delle ipotesi di lavoro in quanto basate su dati preliminari; in particolare i dati cronologici non sono stabilizzati e i campioni utilizzati non sono casuali; sarà perciò necessario ripetere ed ampliare le analisi con dati migliori.

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