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Chapter 5. Surface visibility and legacy survey data: between desktop-based analysis and new fieldwork\textsuperscript{16}

Abstract
In archaeological fieldwalking surveys, ground visibility conditions of the walked fields can facilitate or prevent the detection of archaeological sites (e.g. Ammerman 1981; Cherry \textit{et al}. 1991; Terrenato & Ammerman 1996; Banning \textit{et al}. 2011; 2017). It is increasingly becoming customary practice in landscape archaeology projects to test survey data for visibility distortions when inferences about the underlying ancient settlement behavior are to be made. This paper proposes such a test for the territory around the ancient town of Venusia (southern Italy), for which the regional \textit{Forma Italiae} survey project produced a large dataset of archaeological sites from 1989 to 2000. We first analyzed whether there is a relationship between surface visibility and the density of sites for the Hellenistic period (c. 350 – 50 B.C.) by means of a statistical analysis. Subsequently, we tested the reliability of the site patterns in the legacy data by comparing them with new data recovered from the field in recent re-surveys of this territory, which we carried out from 2013 to 2016 as part of the ‘Landscapes of Early Roman Colonization’ (LERC) project. We thus assessed the compatibility of the pattern of sites detected by the \textit{Forma Italiae} and the new LERC field surveys. It is especially in this second part of the analysis that we, against more pessimistic estimations, argue that there is no strong correlation between ground survey visibility and the overall regional pattern of discovered legacy sites. We conclude that, on the regional level, legacy survey data are representative and offer significant evidence for the study of ancient settlement patterns.

5.1 INTRODUCTION
The site pattern recorded during regional field survey is not exclusively determined by ancient settlement strategies: there is a multitude of other factors that influence the configuration of the surface record as we see it now in the field (for a synthesis see e.g. Cambi & Terrenato 1994, 151-158). In this paper we focus on one important biasing factor: surface visibility as a function of land use and land cover conditions, and we assess whether it affected the number and the pattern of Hellenistic-period archaeological sites registered by the \textit{Forma Italiae} (FI onwards) field survey project in the area around Venosa in southern Italy\textsuperscript{17} (Azzena & Tascio 1996; Marchi & Sabbatini

\textsuperscript{16} This Chapter corresponds to a forthcoming article titled “Surface visibility and legacy survey data: between desktop-based analysis and new fieldwork” by Anita Casarotto, Jesús García Sánchez, Tesse D. Stek & Jeremia Pelgrom, submitted to \textit{FOLD&R: the Journal of Fasti Online} (http://www.fastionline.org/folder.php?view=home).

\textsuperscript{17} For methodological information on this survey, reference is made to section 2.2 of Chapter 2 and 3.2 of Chapter 3.
Fig. 5.1 Forma Italiae site dataset for the territory surrounding the ancient town of Venusia. In total, 1899 archaeological sites (dating from Prehistory to the Middle Ages) were recorded in a territory of ca. 700 sq km (Marchi, Sabbatini 1996; Sabbatini 2001; Marchi 2010). The labels indicate the IGM maps (Istituto Geografico Militare, 1:25,000) used to register archaeological sites. The raster base map is the shaded relief calculated from the 10 m-resolution DEM named TINITALY/01 (Tarquini et al. 2007; 2012; Tarquini & Nannipieri 2017).
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1996; Sabbatini 2001; Marchi 2010; Marchi 2016) (Fig. 5.1).

This paper consists of two parts. In the first part the site density recorded by the FI survey project is tested. Possible correlations between survey visibility conditions and the number of Hellenistic sites were tested through a linear regression analysis. The aim of this approach was to evaluate whether localized high densities of sites (registered by the original FI survey on distribution maps as point clusters) significantly occur in zones with good visibility conditions and if, instead, low site density or empty spaces significantly appear in zones with low visibility conditions.

In the second part, we designed a special testing strategy to analyze the pattern of the Hellenistic settlements (see also García Sánchez et al. 2017). In previous investigations (Chapters 2 and 3), it was demonstrated that the spatial pattern behind the Hellenistic settlement distribution is clustered. Here, the aim is to test whether this pattern is reliable or, instead, affected by survey visibility conditions. To test the validity of the settlement distribution recorded some decades ago by the FI team, we carried out re-surveys in the Venosa area, as part of the LERC project (Landscapes of Early Roman Colonization, campaigns 2013 – 2016) for a similar approach see Seubers & Tol 2016; see also Ammerman et al. 2013). Our re-surveys targeted those landscape areas with strong clustering of Hellenistic sites as well as low density and entirely empty zones. “Ground truthing” the original dataset in these distinctive zones, allowed us to establish whether the site patterns and processes documented in the FI survey could still be seen, or if they instead had changed.

5.2 DESKTOP-BASED ANALYSIS: TESTING THE LEGACY SITE DENSITY

In this section we ask whether the density of Hellenistic settlements has been affected by surface visibility conditions. For this analysis, we use the visibility map of the territory close to the ancient town of Venusia, which is based on land use and land cover factors (c. 120 sq. km, contoured with a white rectangle in Fig. 5.1) (Azzena & Tascio 1996; Marchi & Sabbatini 1996, 107). This map proved to be powerful for the statistical analysis presented in this paper (for another useful application see Chapter 2). Within said sample area, c. 600 archaeological sites were recorded by the FI team, of which 262 settlements were generally dated to the Hellenistic period (350 -50 B.C.) (Marchi & Sabbatini 1996) (Fig. 5.2).

Using a linear regression analysis, we assessed whether there was a significant correlation between site agglomerations and survey units in good visibility conditions and, conversely, if less sites were attested in units with less optimal visibility conditions (for the same approach see Terrenato & Ammerman 1996).

Since no information is available about the extension and/or the shape of the original survey units (Pelgrom et al. 2014, 33 – 34), we created an arbitrary sampling grid composed by units of 1 sq km (Fig. 5.3). We then tested for each and every unit whether a direct proportional relationship existed between the extension of the surveyed surface in good visibility conditions (i.e. class 5) and the number of Hellenistic sites recorded. If a significant relationship between the two factors exists, one expects that the more surface is well visible within each unit, the higher the number of sites recorded in these units should be.

As we show in Fig. 5.4 however, we did not find a direct proportional relationship between the percentage of area with good visibility and the number of Hellenistic-period sites documented by

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18 Funds were provided by NWO (Netherlands Organization for Scientific Research) and the KNIR (Royal Netherlands Institute in Rome). See also Stek & Pelgrom 2013.

19 It is important to note that the tiny and localized zone in ‘class 6’ (optimal visibility, 0.48% of the territory) (see Fig. 5.2, p. 94) corresponds to a small land plot where a vineyard was in the process of being planted precisely when the survey took place there in July 1988 (Marchi & Sabbatini 1996, 113, footnote 134). Sites in this zone were recorded under exceptional conditions (while sites were being dug up from the subsoil and destroyed immediately after when the field was leveled and prepared for the vineyard plantation). This site sample is thus unrepresentative for the process of recording sites at the surface through field walking. For this reason, in the following analyses, class 6 is merged with class 5, corresponding to the ‘good visibility’ land type.
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The FI survey. This result therefore seems to support the accuracy of the number of recorded sites, and also of their pattern in space, at least on this scale of analysis. However, it must be noted that the scale of the visibility map does not provide the OHYHORIGHWDLOQHHGHGWRDOORZD¿QHUDQDO\VLVRIYLVLELOLW\GLVWRUWLRQVVHHGLVFXVVLRQLQ&KDSWHUVDQG+LJKHUUHVROXWLRQYLVLELOLW\PDSVDUHQRWDYDLODEOHDWWKHPRPHQWRQFHPRUHGHWDLOHGPDSDQIRU DVVHVVLQJ VPDOOHUVFDOH YLVLELOLW\ GLVWRUWLRQV would become accessible, the results from this regression analysis may likely change. In light of these limitations, an additional test of a possible correlation between visibility and site patterns was carried out (see below).

5.3 CONTROL SAMPLES FROM NEW FIELDWORK: TESTING THE LEGACY SITE PATTERN

Within the context of the LERC project (Stek & Pelgrom 2013; Stek et al. 2016), 3283 ha of the territory of Venosa (PZ, Basilicata) and its surrounding municipalities have been systematically re-surveyed in the falls of 2013 to 2016\(^3\) (Fig. 5.5). As the original FI survey, the LERC survey also worked with teams of five field walkers spaced ten m apart in line transects in each field unit, and set a shard density threshold of five fragments per square meter to identify archaeological sites at the surface.

20 Such re-visits offered the opportunity to assess the state of preservation of the legacy survey record. It was sadly acknowledged that mechanized agricultural activities (vegetation clearance, tillage, and land leveling) and water erosion (Torri et al. 2006; Torri & Borselli 2011), are triggering the disappearance of the archaeological record both at the surface and beneath it. In particular, modern plantations of vineyards, orchards, and olive trees, which require land leveling and extensive sediment movement, strongly affect the soil stratigraphy in this region (Borselli et al. 2006), and thereby the archaeology contained in it. This dramatic situation has called for the monitoring of the geomorphic modifications caused by unregulated plowing and land leveling activities. EU funds were recently budgeted to monitor and prevent the widespread degradation of this landscape, and to foster sustainable territorial planning strategies for the preservation of the soil (see the DESIRE project and the Rendina case-study: http://desire-project.eu/, Torri et al. 2012).
These sites were mapped in the field by means of GPS positioning systems and mobile devices (i.e. tablets), and in the laboratory they were integrated through the GIS platform.

As noted, the LERC team aimed to verify the reliability of the overall large-scale clustered pattern documented by the legacy Hellenistic settlement distribution (cf. Chapter 3) by means of site-oriented field survey. The strategy adopted for this test can be defined as a local “ground-truthing” of a. localized clusters of sites, b. lower density zones, and c. empty areas in-between these clusters. Several of the detected site clusters were classified by the FI team as large nucleated villages. The LERC re-visits confirmed these interpretations and also documented significant new information about the dating and the spatial configuration of these large rural settlements (Pelgrom et al. 2014; 2016). For the aim of this paper, we focus here on three of the control sample areas re-surveyed by the LERC team (shown in Fig. 5.6). The first sample area (A - Messero – Lo Scannato) was chosen because several high and localized site concentrations (clusters) were originally documented by the FI survey here (these point clusters have a Hellenistic site density equal to or greater than five sites per sq km, see Chapter 3). The second sample (B - Salto dei Paladini/Lasano) had, in contrast, a remarkably low density of Hellenistic settlements (an average of one or two Hellenistic sites per sq km). The third sample area was devoid of sites altogether (C - Li Castellani) and located between the landscape zones with clusters of sites.

In selecting the sample areas, we also took into account the visibility conditions. We selected those areas with comparable visibility conditions during
the previous FI surveys and our re-surveys (for the FI surveys, we used the published FI visibility maps: Marchi & Sabbatini 1996, 107; Sabbatini 2001, 59). Moreover, the Corine Land Cover 1990, 2000, 2006, 2012 (1: 100,000)\(^2\), the map Carta dell’Uso Suolo della Regione Basilicata 2013 (1: 5000)\(^3\), and the Coltura Agricola 2006 map (1: 5000)\(^3\), indicate that the land use in these areas did not remarkably change over the last decades (i.e. mainly non-irrigated arable land, with associated sporadic vineyards, orchards, and other crops). Thanks to this continuity over time in visibility and land use conditions, we could theoretically exclude that major variations in surface conditions (occurring in the last decades, after the FI survey and before the LERC survey) were responsible for possible differences in site patterns recorded by the two surveys at two different moments in time.

Fig. 5.7 clearly shows that the LERC data patterns are comparable to the FI data patterns in all three sample zones, in both empty and densely settled areas. In sample area A (surveyed area 748 ha) (Fig. 5.8), the LERC team recorded localized site densities (clusters) in the same zones where the FI team did several decades before. Many LERC sites were even found in the precise position and extension with the legacy sites. Additionally, some

\(^3\) Regione Basilicata - Centro cartografico dipartimentale della Direzione Generale del Dipartimento Ambiente e Territorio, Infrastrutture, Opere pubbliche e Trasporti. https://rsdi.regione.basilicata.it
\(^4\) Regione Basilicata - Centro cartografico dipartimentale della Direzione Generale del Dipartimento Ambiente e Territorio. https://rsdi.regione.basilicata.it
### Fig. 5.7

Percentages of matching and non-matching re-surveyed area in each control sample zone (A, B, and C).

<table>
<thead>
<tr>
<th>Zone</th>
<th>Match</th>
<th>No Match</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (747.96 ha)</td>
<td>10.6%</td>
<td>89.9%</td>
</tr>
<tr>
<td>B (559.9 ha)</td>
<td>9%</td>
<td>91%</td>
</tr>
<tr>
<td>C (274.2 ha)</td>
<td>0.8%</td>
<td>99.2%</td>
</tr>
</tbody>
</table>

![Bar chart showing percentages](chart.png)

### Fig. 5.8

Comparison between the LERC site pattern and the FI site pattern in sample area A. The material scatters documented by the LERC team are indicated as well (black polygons).

![Map showing site patterns](map.png)
new sites were identified\textsuperscript{24}, and a few others were not found, probably because these sites were destroyed by recent intensive agricultural activities.

\textsuperscript{24} It is possible that some of these new sites are the same sites recorded by the FI team, but shifted on the map one or few dozens of meters away from their original position. If that is the case, this shift in mapped position can be explained in two ways. First, it is possible that topsoil movements within the field induced by plowing, land leveling, and shallow landslides had moved the original sites (or, alternatively, had unearthed new material, thus creating new sites). Second, the different scale adopted by the two surveys to register sites can explain the "imperfect" match in the mapped position between some FI and LERC sites. In this analysis we used the 1:25,000 scale distribution maps produced by the FI team (Marchi & Sabbatini 1996; Sabbatini 2001; Marchi 2010) as a support to digitalize in GIS the position of the legacy sites. GPS coordinates were used, instead, to map the position of the LERC sites. To incorporate this discrepancy in mapping resolution techniques, field units, rather than the point locations of the FI and LERC sites, were considered when comparing the two datasets (see Figs. 5.8-10).

The same effect is documented for sample area B (surveyed area 360 ha) (Fig. 5.9). Also in this case, there was a strong correlation between the pattern mapped by the LERC re-surveys and the pattern recorded by the original FI survey.

Particularly interesting is the comparison between the legacy pattern and LERC pattern in sample area C, the ‘empty’ area (Fig. 5.10). The LERC team adopted an intensive survey strategy for mapping an area of 274 ha. Within rectangular units of c. 2500 sq m in size, sherds and other finds were collected by surveyors along each walking line. GPS and tablets were used in this case as well to record the position and the extension of archaeological sites. Although working in different time periods and under perfect visibility conditions (clear, arable fields), both teams found little to nothing: just two scatters of material

\textbf{Fig. 5.9} Comparison between the LERC site pattern and the FI site pattern in sample area B. The material scatters documented by the LERC team are indicated as well (black polygons).
were detected at the edge of this empty zone (by both teams, in the same area, with comparable extension), which were interpreted as the remains of a Republican period settlement.

5.4 CONCLUSIONS

The two types of analysis carried out in this paper indicate that the site patterns recorded by field survey are not just the product of distortions by visibility factors. This underlines the value of legacy survey data for reconstructing ancient settlement organization and historical developments on a regional scale (Chapter 3 and 6). The statistical, desktop-based approach confirms the reliability of the number of sites registered by the FI team, and new fieldwork conducted by the LERC team indicates that there is no significant relationship between the recorded clustered site pattern and surface visibility. There is instead a significant match between the legacy site pattern and the survey data recently collected by the LERC team. Especially this latter, field-based probing shows that the site pattern exhibited by legacy site survey data in this area is not just the result of surface visibility distortions (see discussion in Barker 1991).

Of course, due to the generally problematic nature of survey data (Lloyd & Barker 1981; Ammerman 1985; Pasquinucci & Trement 1999; Francovich et al. 2000; Fentress 2000), and the difference in resolution in mapping strategies adopted by the two surveys (cf. footnote 24, p. 99), we cannot expect

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**Fig. 5.10** Comparison between the LERC site pattern and the FI site pattern in sample area C. The material scatters documented by the LERC team are indicated as well (black polygons).
that the sites recorded by the FI team are the very same sites recorded by the LERC team; this is not our point here. It is significant, however, that on a regional scale the macro patterns produced by the FI and LERC surveys are very similar, and lead to similar historical reconstructions of ancient settlement in this area.

It is seminal to underscore, however, that, in line with our research questions, for this analysis we only selected areas with good visibility and minimal impact by modern anthropogenic practices following the FI survey, with thus optimal preservation of the archaeological record. The results will of course be very different for those areas that, after the FI survey, have been subjected to strong human interventions. In the Venosa area, there are zones that have been drastically modified during the recent years of intensive agricultural activity. An example is the land where extensive permanent crops such as vineyards and olive orchards were planted recently (Borselli et al. 2006). While surveying those portions of the landscape, it became clear that the surface record registered only a few decades ago is disappearing rapidly. There are large zones where modern agricultural practices are unsustainable for the preservation of the soil and the archaeological record on and under the surface. Erosion and desertification are tangible threats in these areas. Despite the existence of still-preserved patches where archaeological information can as yet be retrieved, the entire archaeological landscape of the Venosa area is currently under threat. If no action is taken to control unregulated farming practices it is only a matter of time before the whole archaeological landscape will be lost forever (see discussion in section 1.2 of Chapter 1).

The FI dataset represents a unique source of information for the investigation of ancient settlement patterns. The FI team was likely able to record sites at the surface immediately before the rise of both a massive production of wine and olive oil and the destructive activities related to intensive mechanized agriculture. This legacy dataset is the most representative evidence that can ever be recorded for this landscape, and thus constitutes an invaluable archive for studying the past.

### 5.5 REFERENCES


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25 Detailed and extensive analyses aimed at studying the relationship between modern agrarian practices and the recording of the LERC data in Venosa are planned for the future.


Marchi, M.L. 2010. Ager Venusinus II (IGM 175 II SO; 187 I NO; 187 I SE; 188 IV NO; 188 IV SO) (Forma Italie 43). Firenze: Leo S. Olschki.


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