Mapping the anthropic occupation of the territory. Tracing dynamics of human settlement from archaeological records and historic cartographies

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ABSTRACT

The dynamics of anthropic occupation of a territory over time play a central role in shaping the cultural landscape we see today. This paper presents a methodology for visually representing this phenomenon. The method consists of transforming data from archaeological records and historic cartography into a series of maps that allow historic settlement patterns to be interpreted and the historic depth of contemporary urban areas to be revealed. To create these maps, a series of geospatial analyses were carried out, including density analysis and weighted overlay. The methodology was applied to the peri-urban area of Seville in southern Spain, although it may be extrapolated to other regions.

1. Introduction

The cultural approach to the geographical sciences and the emergence of a paradigm proposing an archaeology of the landscape allowed an understanding of territory as the product of a process of transformation over time to develop throughout the course of the twentieth century. According to the tenets of cultural geography (Meinig, 1979), the landscape is a visible manifestation of the territory’s value as a historical document; that is, the landscape shows that territory is the result of constant interaction between the natural and human factors operating on it over time, rather than a static entity (Ortega Valcárcel, 1998).

When the temporal, evolutionary dimension of the territory is taken into consideration, the importance of a diachronic analysis of the landscape becomes clear (Crumley et al., 2017). Research into methodologies revealing historic settlement patterns (Aucelli et al., 2020; Ławniczak & Kubiak, 2021), changing land use dynamics (Aldred & Fairclough, 2002; Beilin et al., 2014; Dolejš et al., 2019; Gu & Subramanian, 2014), past communication systems (Stanish et al., 2010; Supernant, 2017) and other historical anthropic processes occurring on the territory (Maio et al., 2013) is particularly relevant for this reason. Besides, it is essential that analysis of the environmental, cultural, social and economic phenomena which have historically shaped the landscape is incorporated into contemporary landscape planning and design (López Sánchez et al., 2020a). Thus, the study of the historical processes and dynamics of interaction between the human being and the territory are more than pertinent (Bavusi et al., 2015; Di Leo et al., 2018; Gioia et al., 2020), but it is also necessary to reflect on the way in which these specialised studies can be integrated in proactive decision-making scenarios (Roymans et al., 2009).

Against this backdrop, this paper aims to reveal the patterns and dynamics of human settlement of the territory over time using cartographic representation. It seeks to develop a cartographic method allowing georreferenced archaeological records and historic cartography relating to a particular territory to be simply and effectively transformed into a visual instrument. Mapping historical information facilitates its integration in planning and design processes, as well as the communication and dissemination of archaeological information to a broad audience. Therefore, the proposed map is also intended for use as a potential teaching or training resource.

The methodology proposed in this paper is applied to a specific territory, the rural land to the west of the city of Seville (Spain) (Figure 1) although it may be extrapolated to other areas. Seville is the most highly populated city in the south of Spain. It currently has a population of around 700,000 inhabitants, or 1,000,000 including the metropolitan area. The selected area covers approximately 800 km² and brings together five different landscapes: the foothills of Seville’s Sierra Norte, to the north (1); the green corridor of the river Guadalmaret, a protected area of...
ecological interest that has recently been restored, to the west (2); the plain of the river Guadalquivir, characterised by a mosaic of irrigated crops, to the east (3); the dry farming landscape of the Campo de Gerena in the central area (4); and the metropolitan landscape of Aljarafe to the south, where olive crops are found along with inhabited centres which in the last couple of decades of the twentieth century have increased their surface area exponentially through successive urban developments, especially those closer to Seville (5).

Aljarafe is bordered to the north by a ledge, which stands out over an agricultural landscape that is predominantly flat (Figure 2). It is an area with

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**Figure 1.** Case study area. Source: By the main author through ArcGIS® and ArcMap™ 10.4.1. software by Esri, 2020.

**Figure 2.** North cornice of El Aljarafe. View from Campo de Gerena. Source: Main author.
historical-territorial cohesion, i.e. a heritage area
where intertwined historic processes have taken
place, due to being the territorial field associated
with the last navigable branch of the river Guadalu-
pir, the main historical commercial route in the
southern peninsula.

The entire area is a representative example of
those rural territories located near to large cities,
where the landscape diversity and historical depth of
the territory coexist with fast roads, industrial areas,
commercial infrastructures and intense residential
developments that fragment the landscape and make
it very difficult to perform a reading of its heritage
(Figure 3) (Muñoz, 2010). Research into the historic
landscape in fragmented spaces which have under-
gone aggressive recent urban development is funda-
mental for reworking landscape planning and
management to incorporate new approaches reflecting
a commitment to the landscape’s cultural significance
and heritage value.

2. Materials and methods

The raw data used to create the Main Map were
taken from georeferenced records of archaeological
sites on the territory. In the selected study area,
this information is produced and managed by the
Instituto Andaluz de Patrimonio Histórico [Andalu-
sian Historical Heritage Institute] (IAPH). The
Institute’s Documentation and Study Centre sup-
plied the research team with two point and polygon
vector layers in shape format (.shp) corresponding
to the study area. This information is georeferenced
under the ETRS89 European Terrestrial Reference
System. The polygon layer was processed by extract-
ing the centroids for each polygon. These centroids
were added to the other layer to create a single point
vector layer. This unified vector layer of archaeolo-
gical sites was completed and updated by the team.
By consulting the archaeological maps of the muni-
cipalities in the study area and archaeological informa-
tion from municipal planning documents, new
sites that had not been listed in the original IAPH
records were added. A systematic review of histori-
cal maps covering the study area was then carried
out. The maps providing the most detailed rep-
resentation of the settlements in the study area
were incorporated into the study (Tables 1 and 2).
Analysis of these historic maps revealed the pres-
ence of more recent urban and rural settlements
(Ławniczak & Kubiak, 2021; San-Antonio-Gómez
et al., 2014) (Figure 4). These settlements were
added to the inventory. In total, 427 point data
items were studied.

The second phase of the methodology involved
defining three fields in the attribute table, which cor-
responded to: historical period, type of settlement
and intensity of settlement. The fields ‘type of settle-
ment’ and ‘intensity of settlement’ are complemen-
tary to each other. They are respectively the
qualitative and quantitative expression of the same
information. The data used to complete these fields
were determined by historical research and archaeo-
logical evidence.

In the ‘historical period’ field, six broad phases of
anthropisation were identified: prehistory (Palaeo-
lithic, Neolithic and Chalcolithic), up to 2000 BC; pro-
thistory (Bronze and Iron Age), up to 237 BC;
Roman era and late antiquity, up to the end of the
7th century; early Muslim middle ages and late Chris-
tian middle ages, up to the end of the 15th century;
modern era, up to the end of the eighteenth century,
Table 1. Historic cartography consulted for the modern era. Source: Main author.

| No. | Original Name | Autor | Date | Available at |
|-----|---------------|-------|------|--------------|
| 1   | Regni Hispaniae post Omnium editiones locuple[t]issima descriptio | Abraham Ortelius | 1572 | Instituto Geográfico Nacional. Code: 11-F-12. |
| 2   | Hispalensis conventus delineatio | Hieronymo Chiaves, Abraham Ortelius | 1579 | Instituto Geográfico Nacional. Code: 33-E-17. |
| 3   | Andaluziae nova descript | Jodocus Hondius, N. Johannis Vischer | 1606 | Biblioteca de Andalucía (Granada). Code: md-2-40 Instituto Geográfico Nacional. Code: 13-E-9 |
| 4   | Nova et accurata Tabula Hispaniae: Praecipuis Urbis, Vastiti, Insig nibus, et Antiquitiatibus exornata | Pedro Texeira | 1634 | Österreichische Nationalbibliothek (Viena). Code: 46 ff. 55v-56. |
| 5   | Tabla del Reyno de Andaluzia | Willem Janszoon Blaeu | 1652 | Instituto Geográfico Nacional. Code: 32-F-3. |
| 6   | Regnorum Castellae Novae, Granadae, Valentiae, et Murciae: Accurata Tabula in Episcopatus etc Regni di Granata, e D' Andaluzia | Iohann Stridbeik Iun. | 1704 | Instituto Geográfico Nacional. Code: 12-D-7 |
| 7   | Les Estats de la Couronne de Castille, dans les Parties Plus Meridionales de l'Espagne, et la ou sont Castille Nouvelle, Andalousie, Grenade et Murcie | Nicolas Sanson d'Abbeville | 1705–1714 | Instituto Geográfico Nacional. Code: 32-F-21 |
| 8   | Regnorum Castellae Novae, Granadae, Valentiae, et Murciae: Accurata Tabula in Episcopatus etc Regni di Granata, e D' Andaluzia | Giacomo Cantelli | 1706 | Instituto Geográfico Nacional. Code: 30-G-10 |
| 9   | Il Regni di Granata, e D' Andaluzia continens Sevillam et Cordubam Willem Janszoon Blaeu | Frederik de Wit | 1670 | Instituto Geográfico Nacional. Code: 32-F-14 |
| 10  | Royaumes de Granade et de Grande = Kaart van Andalusien en Granade | Johann Stridbeek Iun. | 1704 | Instituto Geográfico Nacional. Code: 12-D-7 |
| 11  | Regnorum Castellae Novae Andaluziae nova descript Jodocus Hondius | Nicolas Visscher | 1705–1714 | Instituto Geográfico Nacional. Code: 32-F-21 |
| 12  | Perfectissima geographical delineatio regnorum Vandalitiae, Granatæ, et Algæariae, tractuum meridionalium Portugalia, Extremadurae ac Castellæ Novæ / suma diligientia correcta et edita a R. & I. Ottens | Ottens, Reiner & Josua | 1745 | Institut Cartogràfic i Geogràfic de Catalunya. Code: RM.6098 (3) |
| 13  | Map of the Reynado de Sevilla, executado por el Ingeniero en Gefe Dn. Francisco Llobet | Francisco Llobet | 1748 | Instituto Geográfico Nacional. Code: 32-D-69 |
| 14  | Mapa de la provincia de Sevilla. A la Dirección General del Cuerpo de Estado-Mayor / el Teniente Coronel del mismo | Federico Salazar | 1844 | Centro Geográfico del Ejército (Madrid). Code: Arm. G TBLA. 7ª carp. 2ª núm. 386. |
| 15  | Partie meridionale des Estats de Castille, où se trouvent la Castille Nile. [Nouvelle] … | Didier Robert de Vaugondy | 1751 | Instituto Geográfico Nacional. Code: 12-M-26 |
| 16  | Mapa de Andalucía con las nuevas divisiones | Nicolas Guérard, Philippe V | 1762 | Bibliothèque nationale de France. Code: Collection d'Anville: 01706 |
| 17  | Mapa de Andalucía. the Bureau Topographique de l'Armée d'Espagne. Hoja nº 230. | J. Charles M. Bentabole | 1765 | Biblioteca Nacional. Code: A-35-0962 |
| 18  | Li regni di Siviglia, Cordova e Jaen: compresi nell'antica Andalusia, ed il regno di Granata | A.B. Borghi | 1813 | Biblioteca Nacional. Code: 11-F-12. |
| 19  | Carte Politique de L'Espagne et de Portugal: pour servir au voyage pittoresque de M. le Comte Alex. de Laborde | Philippe V | 1765 | Biblioteca Nacional. Code: A-35-0962 |
| 20  | TBLA. 7ª carp. 2ª núm. 386. | Federico Salazar | 1844 | Centro Geográfico del Ejército (Madrid). Code: Arm. G TBLA. 7ª carp. 2ª núm. 386. |
| 21  | Provincias de Sevilla y Huelva. | R. Alabern i Moles, Ramón y E. Mabon | 1853 | Instituto Geográfico Nacional. Code: 41-K-21(MAP09) |
| 22  | Mapa de Andalucía con las nuevas divisiones | Auguste-Henri Dufour, Bulla et Jouy | 1837 | Archivo Cartogràfic i Geogràfic de Catalunya. Code: Ar.E-T.1-C.3-57 (3) |
| 23  | Mapa de la provincia de Sevilla. A la Dirección General del Cuerpo de Estado-Mayor / el Teniente Coronel del mismo | C. Santigosa | 1855 | Biblioteca Nacional (Madrid). Code: M. 9v Sevilla |
| 24  | Mapa de la provincia de Sevilla | C. Santigosa | 1855 | Archivo Cartogràfic i Geogràfic de Catalunya. Code: Ar.E-T.1-C.3-57 (3) |
| 25  | Mapa de la provincia de Sevilla. A la Dirección General del Cuerpo de Estado-Mayor / el Teniente Coronel del mismo | F. Corbel | 1869 | Centro Geográfico del Ejército (Madrid). Code: Arm. G TBLA. 7ª carp. 2ª núm. 386. |
| 26  | Sevilla. Mapa topográfico Nacional. | Cuerpo de E.M. del Ejército | 1881 | Instituto Geográfico Nacional. Code: 32-F-3. |
| 27  | Sevilla. Mapa topográfico Nacional. | Dirección General del Instituto Geográfico y Estadístico. | 1918 | Instituto Geográfico Nacional. Code: 11-F-12. |
| 28  | Alcalá del Río. Mapa topográfico Nacional. | Dirección General del Instituto Geográfico y Estadístico. | 1918 | Instituto Geográfico Nacional. Code: A-35-0962 (ED1918NNN) |
| 29  | Alcalá del Río. Mapa topográfico Nacional. | Dirección General del Instituto Geográfico y Estadístico. | 1972 | Instituto Geográfico Nacional. Code: A-35-0962 (ED1912NNN) |
| 30  | Sevilla. Mapa topográfico Nacional. | Dirección General del Instituto Geográfico Nacional. | 1988 | Instituto Geográfico Nacional. Code: A-35-0962 (ED1988NNN) |

and contemporary era, up to the end of the twentieth century.

The ‘type of settlement’ field classifies into urban settlements, with very high, high and moderate intensity, and rural settlements, with high, moderate and low intensity. The criteria used to associate each settlement with one of these typologies are listed in Table 3. It is important to note that the criteria are intended to turn the information already available in the archaeological records, historical studies and
historical cartographies into a scheme of classification for settlements. Where possible, the typological classification already made by archaeologists is used as a reference. On the other hand, the ‘intensity of settlement’ field corresponds to the quantitative expression of the field ‘type of settlement’. The ‘intensity of settlement’ field is a numeric value defined by the type of settlement allocated, as shown also in Table 3.

Once this information had been filled out, a kernel density analysis was conducted for each of the six historical periods identified. The search algorithm predetermined by the software applied the following bandwidth formula:

\[
\text{SearchRadius} = 0.9 \times \min\left( SD, \sqrt{\frac{1}{\ln(2)} \times Dm} \right) \times n^{-0.2}
\]

where:
- \( SD \) is the standard distance
- \( Dm \) is the median distance
- \( n \) is the number of points if no population field is used, or if a population field is supplied, \( n \) is the sum of the population field values

The density value is higher at the point and falls as we move away from the point, reaching zero at the \( \text{SearchRadius} \) distance. The volume determining the density values is equal to the value determined in the population field, which corresponds to the ‘intensity of settlement’ field in this case. This produces a weighting which allocates higher density values to the points corresponding to larger settlements with a higher density of settlement and territorial significance.

When the density analyses were complete, a collection of raster-type layers was obtained. These images show the parts of the territory which, according to the archaeological evidence obtained to date and the historic cartography available, experienced the most intense settlement in each of the historical periods identified, revealing the patterns of settlement characterising each era.
The information obtained was then used to produce a summary map allowing the areas of the territory which had experienced the most decisive, intense processes of human settlement throughout history to be visualised. To do this, the duration of the settlement processes which took place in these areas and their historical depth were considered. In order to create the summary map, the values allocated to each of the raster cells on the output layers underwent geospatial reclassification. Since these raster layers are content layers, the reclassification table allows the cut-off values automatically classified by the density analysis to be imported. The reclassified values correspond to whole numbers from 1 to 10. The highest values correspond to the cells where settlement occurred with the greatest intensity. A weighted overlay analysis was then performed, which was applied over all the reclassified raster layers. The weighted overlay analysis allowed the values allocated to each raster cell in the different layers to be added, with the result that the areas of the territory which were occupied with the greatest intensity during the highest number of historical periods obtained the highest final values. In addition, a new criterion allocating greater weight to older settlements was incorporated to assess the historical depth of the territory.

Table 3. Fields added to the attribute table. Source: Main author.

| Historical period field | Type of settlement field | Summary of the main criteria used to establish the classification | Intensity of settlement field |
|-------------------------|--------------------------|---------------------------------------------------------------|-----------------------------|
| Prehistory/Protohistory | Urban settlements        | Very high intensity: Archaeological sites with evidence of urbanisation and shown by historical research to have played a relevant role in the territorial patterns of commerce and defence | 18                          |
|                         | High intensity           | Rest of archaeological sites with evidence of urbanisation     | 14                          |
|                         | Moderate intensity       | -                                                             | 10                          |
| Rural settlements       | High intensity           | Archaeological sites with abundant and concentrated presence of lithic and/or ceramic material | 6                           |
|                         | Moderate intensity       | Archaeological sites with minor scattered ceramic and/or lithic fragments | 4                           |
|                         | Low intensity            | Sites with archaeological evidence from these periods but very punctual and limited | 2                           |
| Roman era and late antiquity | Urban settlements        | Very high intensity: Archaeological sites with evidence of urbanisation and shown by historical research to have operated as nodes in the roman road network and have had an official legal status | 18                          |
|                         | High intensity           | Archaeological sites with evidence of urbanisation and shown by historical research to have played a relevant role in territorial patterns of commerce and defence | 14                          |
|                         | Moderate intensity       | Rest of archaeological sites with evidence of urbanisation     | 10                          |
| Rural settlements       | High intensity           | Archaeological sites with abundant and concentrated presence of ceramic and construction materials | 6                           |
|                         | Moderate intensity       | Archaeological sites classified as villae                     | 4                           |
|                         | Low intensity            | Archaeological sites classified as small agricultural settlements, farms, cottages or shacks | 2                           |
| Middle Age              | Urban settlements        | Very high intensity: Main city: central position in the middle age road network; evidence of very relevant defensive structures and religious buildings | 18                          |
|                         | High intensity           | Archaeological sites classified as villa or castillo with relevant defensive structures | 14                          |
|                         | Moderate intensity       | Archaeological sites classified as villa without relevant defensive structures | 10                          |
| Rural settlements       | High intensity           | Archaeological sites classified as lugar señorial or aldea     | 6                           |
|                         | Moderate intensity       | Archaeological sites classified as alquería                    | 4                           |
|                         | Low intensity            | Archaeological sites classified as villos                       | 2                           |
| Modern era              | Urban settlements        | Very high intensity: Main city: central position in the modern road network; appears as the major city in the available mapping | 18                          |
|                         | High intensity           | Towns drawn and named in the 16th-18th centuries cartography with relevant religious architecture | 14                          |
|                         | Moderate intensity       | Towns drawn and named in the 16th-18th centuries cartography without relevant religious architecture | 10                          |
| Rural settlements       | High intensity           | -                                                             | 6                           |
|                         | Moderate intensity       | Sites with archaeological evidence of the 16th-18th centuries that are not drawn in the cartography or sites drawn as hacienda, cortijo or casa in the 19th-20th centuries cartography with architectural features that date their origin to the 16th-18th centuries | 4                           |
|                         | Low intensity            | -                                                             | 2                           |
| Contemporary era        | Urban settlements        | Very high intensity: Main city: central position in the contemporary road network; appears as the major city in the available mapping | 18                          |
|                         | High intensity           | Major towns drawn and named in the 19th-20th centuries cartography | 14                          |
|                         | Moderate intensity       | Minor towns drawn and named in the 19th-20th centuries cartography | 10                          |
| Rural settlements       | High intensity           | -                                                             | 6                           |
|                         | Moderate intensity       | Sites indicated as hacienda, cortijo o casa in the 19th-20th centuries cartography | 4                           |
|                         | Low intensity            | -                                                             | 2                           |
This criterion was applied via the weights allocated in the weighted sum: a weighting of 22% was allocated to the prehistoric period, 20% to the protohistoric period, 18% to the Roman era, 16% to the middle ages, 14% to the modern era and 10% to the contemporary era. The result of this analysis was a new raster layer showing the historic occupation of the territory and revealing the areas that were most significant for human settlement.

3. Results

The results obtained allow historic settlement patterns in the area to be visually interpreted. They offer a concise overview, showing how evidence of settlement in the prehistoric era is concentrated in a very specific area of the ledge. These archaeological remains correspond to the Chalcolithic necropolis of Valencina de la Concepción. The concentration of archaeological evidence in this area is very high and there are almost no other prehistoric archaeological sites in the area, with the exception of those already identified in the foothills of the Sierra Norte. This casts light on the archaeological debates currently taking place in the area, which question whether the necropolis was associated with a significant town with high levels of territorial hegemony or, otherwise, if the dimensions of the necropolis are justified because it was used for episodic funeral rituals by various dispersed nearby settlements (Escacena Carrasco et al., 2018; Martínez-Sevilla et al., 2020; Sanjuán et al., 2018). In the second hypothesis, the symbolic variable supersedes the strategic-defensive variable in the occupation of the ledge.

The transition into the protohistoric era reveals far-reaching changes in settlement patterns. The settlement axes can be seen to shift towards river courses, especially the area surrounding the river Guadalquivir, and settlement in the foothills of the Sierra Norte intensifies. The economic variable stood out as the main shaping factor of the landscape (García Fernández, 2018). Trade routes produced an incipient concentration of the population around them, meaning the creation of the urban system in the territory. Three main trade axes were defined: the river routes of the Guadalquivir and Guadiamar and the mining and metallurgy belt of the foothills. The mining trade was an essential factor in the cultural, economic, social, and political transformations of the territory during this period (Amores et al., 2014; Garrido González, 2020).

The cartography corresponding to the Roman era shows an unprecedented intensity of settlement, which is characterised by significant territorial dispersion following patterns of imperial exploitation of the territory. Although the settlement pattern from the previous period partially persists and the main urban areas are still located in riverside areas and in the mountain foothills, there is a significant shift towards settlement in rural areas, which was driven by the importance of agriculture in the economy of the Roman Empire. The proliferation of Roman archaeological evidence dispersed through the rural area confirms that this period was key in the anthropisation process of the landscape in the western area of the lower Guadalquivir valley.

This dispersion contrasts with the results of the cartography for the middle ages, which indicates a reversal of the process of population concentration. The loss of power of Rome and the successive confrontations and changes of power reversed the phenomenon of territorial dispersion, resulting in an incipient model of centrality. The topographic conditions of the Aljarafe, together with its closeness to the central city Ishbilia (Seville), made it a prestigious rural environment given the ease of defending it, which encouraged its occupation to intensify considerably. The cartography clearly shows how intense settlement in this upland area differs from the plain extending to the north.

In the middle ages, the majority of the population was located in Seville, which was already consolidated as the central city. Outside this area, the population is primarily concentrated in Aljarafe in small urban areas with low settlement densities. These settlement patterns cast light on a key feature of the current landscape in the area: the marked contrast between Aljarafe and Campo de Gerena. Whereas the landscape in Aljarafe is characterised by the presence of urban areas, a dense communications network and olive cultivation (Figure 5), Campo de Gerena is a large agricultural area of arable crops with almost zero population density (Figure 6).

Finally, the cartography for the contemporary era shows a considerable rise in population density, revealing the intense processes of urban development taking place in the twentieth century. This intensification occurs in the areas closest to Seville, confirming the presence of an emerging metropolitan phenomenon. The resurgence of mining in the late nineteenth century explains the higher intensity of settlement in the foothills. Increasingly intense settlement on the floodplain of the river Guadalquivir, meanwhile, is the result of regenerationist hydraulic policies, through which irrigation became the main instrument for agricultural modernisation. In the twentieth century, a project was undertaken to irrigate the plain of the Guadalquivir, which provoked a substantial change in the landscape and the emergence of new urban areas or colonising settlements, built to house workers employed on the hydraulic works and other works to prevent flooding from the river channel as it passes through Seville.

These processes are represented on a summary map showing the four main settlement patterns in the area:
the foothills of Sierra Morena, given the historic importance of mining activity; the floodplain of the river Guadalquivir, due to the proximity of what was once the main commercial channel in the area; Aljarafe, given its symbolic and strategic conditions as an upland area close to the main city; and finally, the city of Seville itself, which gradually emerged as the central urban area for the region at the southernmost point at which the river Guadalquivir was navigable, allowing the city to function as a point of contact between the eastern and western territories of the ancient Kingdom of Seville.

4. Discussion

The proposed methodology offers a graphic output mechanism for archaeological records. When supplemented by historic cartography for more recent periods, these records represent a suitable tool for creating a hierarchical historical inventory of urban and rural settlements in a territory. The maps obtained offer a very useful summary explaining essential processes of anthropic occupation of the territory. Through a sequence of relatively simple geospatial processes, the visual and graphic potential of an inventory whose original purpose was to record and document archaeological data can be explored. The graphic representation of these records via maps make them a convenient resource for facilitating historic interpretation and the transmission of ideas. It allows georeferenced data from archaeological sites to be transformed into a resource with clear value as a visualisation and communication tool.

This cartographic method can be used in diachronic analyses of the landscape. In recent decades, progress has been made on consolidating methodologies which allow the historic landscape to be fully reconstructed from prehistory to the present day (Fairclough & Herrling, 2016; Kolen et al., 2015; Poli, 2017). Monitoring the evolution of a cultural landscape through to the present day, as if producing a long-term overview of the

Figure 5. Landscape of the North Cornice of El Aljarafe from ‘Santa Brígida’ viewpoint. Source: Main author.

Figure 6. Landscape of Campo de Gerena from the trail ‘ruta del Agua’. Source: Main author.
ongoing processes of restructuring and revaluation to which it is subject, holds intrinsic potential for creating powerful, innovative narratives concerning the ways in which communities have used, organised and read the territory over time (Kolen & Renes, 2015). The aim of these lines of research is to transpose the historical, cultural and heritage component of the territory into contemporary processes of landscape planning and design (López Sánchez et al., 2021).

Indeed, it is a relevant research challenge to explore how the long-term vision provided by historical and archaeological studies on the landscape, as well as by historical documents directly related to said analyses, such as historical cartography, are integrated into current landscape planning and design processes (Burgers et al., 2014; Kolen et al., 2014). The use of Geographic Information Systems is particularly relevant in this regard, as their intrinsic integrating potential allows them to function as a shared tool and language for use between different stakeholders and areas of expertise (López Sánchez et al., 2020b). Furthermore, exploring graphical outputs and mapping mechanisms is pertinent in the search for those synergies between spatial disciplines. Specifically, the need for convergence between historical research and landscape planning is directly linked to the development of mechanisms which are capable of synthesising historical data into an information layer for application to the contemporary territory. In this regard, the summary map compiled as part of this study allows valuable information from archaeological records and analysis of historic cartography to be used in decision-making relating to processes of landscape protection, planning and spatial design by showing the parts of the territory which have experienced the most significant, intense settlement patterns over time.

**Data availability statement**

The georeferenced information with which these maps have been developed cannot be publicly available. A part of the used spatial information has been provided to the authors through an external institution for the exclusive purpose of research and was not aimed to be distributed by the authors.

**Declaration of interest statement**

The interest of the proposed method lies in its capacity for extrapolation to different territorial areas and its use by researchers from different disciplinary backgrounds. The paper also contributes to research into cartographic techniques, creating a methodological sequence based on specific geospatial processes to produce a graphic output which enables the results to be read visually.

**Disclosure statement**

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