

## **Polycentric and reticular nature of the urban and infrastructural settlement systems of the territory of the lower Guadalquivir: method and applications**

**Abstract:** In this paper a procedure is proposed to recognise the polycentric and reticular nature of the urban and infrastructural settlement systems based on a morphotypological analysis. We locate the precedents in the foundations and the methodology developed by the Italian Territorialist School. The territory of the lower Guadalquivir around the city of Seville is used as a case study to exemplify the procedure and the possible benefits of its application to urban and regional planning. Applying the method to a case study also allows us to detect its limitations and to recognise future lines of research.

**Keywords:** landscape feature; morphotypological analysis; urban and infrastructural settlement systems.

**JEL Codes:** O18; O21.

## Introduction

The entry into force of the European Landscape Convention (Council of Europe, 2000) prompted an adaptation of analysis and evaluation methods, as well as of the instruments to protect, manage, and organise landscapes – plans, projects, sector policies, etc. – in the light of the new landscape legal protection regime. In this paper a procedure is proposed to recognise the polycentric and reticular nature of the urban and infrastructural settlement systems based on a morphotypological analysis. This interpretation can be instrumental in the elaboration of land-use or landscape plans and is particularly appropriate when it comes to promoting a polycentric and balanced development of the territories. The method is based on the territorialist approach to urban and regional planning and design. In this approach, the recognition of place identity, through a series of analyses that focus on territorial heritage, is the basis for land-use and landscape plans (Magnaghi, 2001). The territory of the lower Guadalquivir around the city of Seville is used as a case study to exemplify the procedure and the possible benefits of its application to regional planning.

We identify, by restricting our search in the main databases to the term ‘landscape planning’, numerous essays exploring the implications of the entry into force of the European Landscape Convention for urban and regional planning and design (Colavitti, Serra, 2021; Dempsey, Wilbrand, 2017; Fairclough *et al.*, 2018; López *et al.*, 2020; Lungo *et al.*, 2015; Montis, 2014; Scott, 2011; Solecka, 2019). The authors agree in highlighting the integrative potential of the landscape concept, a potential that, to be exploited, requires adaptation not only of the methods of analysis, interpretation, and design, but also of the scope of actions and the means to achieve them.

We are primarily interested in studies that focus on the relationship between place identity and planning. We find a relatively small number of entries on the representation and manipulation of place identity through planning. We highlight the production of Marichela Sepe (Sepe, 2006; 2013) or compilation works such as *Place Identity, Participation and Planning* (Hague, Jenkins, 2005). The recognition of place identity is presented in them as an opportunity for spatial planning. This recognition is the basis for its subsequent promotion through the definition of specific strategies, a promotion that is associated with high levels of sustainability.

The method for interpreting the polycentric and reticular nature of the urban and infrastructural settlement systems and the suggested applications contribute in turn to the polycentric and balanced development of territories. This kind of development is already considered in the Territorial Agenda 2020 as “essential to achieve territorial cohesion” (CEC, 2011). The most recent reports on sustainable urbanisation and land-use practices in Europe place the polycentric scenario as the one called to “avoid both the disadvantages of disorderly urbanisation, which have resulted in the destruction of natural resources and undermined the vitality of cities, and the urban containment, which would create problems of large cities” (ESPON, 2020a). The concept of polycentrism has been a central theme in the scientific literature in recent years. Most of the authors highlight the potential of this model to

advance sustainable development and address the shortcomings of the metropolitan model (Capello, 2020; Fior *et al.*, 2023; Lorens, Gołędzinowska, 2022; Marull *et al.*, 2023; Vidovich, Scolari, 2022; Waite, 2023). Particularly relevant is the work of Van Meeteren and others in which a systematic review of scientific literature in urban studies on polycentrism is presented with the intention of identifying the different meanings of the term and its scope (Meeteren *et al.*, 2016). Based on this study and others (Burger, Meijers, 2012; Davoudi, 2007; Kloosterman, Musterd, 2001), our work focuses on the morphological dimension of polycentrism and refers to the interurban scale. The number of works analysed gives a measure of the international interest in this issue and the timeliness of a topic such as the one proposed.

With regard to the structure, firstly the state of the art is analysed, paying attention to the scientific debates the paper contributes to. Secondly, the background to the method is set out. The focus is on the analytical methodology for the identity projection of the territory and on the landscape plans of Tuscany and Puglia, where we identify direct references to the application of this morphotypological analysis in regional planning. Thirdly, the method is described: its foundations are analysed and then its phases are specified. Fourth, an example of how the method works is given by applying it to the case study of the lower Guadalquivir: GIS-based georeferenced databases that shape the digital model of the territory are specified; then, the results regarding the component figures, the morphotypes of the settlements, and the territorial articulations extracted from the analysis are summarised. Fifth, some possible uses of the analysis for planning are described, such as the redefinition of landscape areas or the design of a system of infrastructures for slow mobility. Finally, the strengths and weaknesses of the method are discussed, with an indication of future lines of research.

## **Background**

The precedents of the interpretation are found in the theoretical and practical production of the Italian territorialist school. Headed by Professor Alberto Magnaghi, this school was institutionalised around the *Società dei Territorialisti/e* (Poli, 2018). Research and works carried out by its members, coming from a variety of disciplines, are oriented towards a common goal: to promote self-sustainable local development through a series of actions that affect the spatial organisation and governance of the territory (Territorialist Society, 2011).

The analytical methodology for the identity projection of the territory is a framework specifically designed to guide planning instruments to the ultimate goal of promoting self-sustainable local development (Magnaghi, 2001). The scientific literature concludes that the achievement of this objective is linked to the growth of the territorial heritage (Dematteis, Magnaghi, 2018; Magnaghi, 2021, p. 101; Poli, 2015b). The methodology aims to counteract the undermining and destruction of territorial heritage – one of the negative effects of a global economy on the territory – by promoting its enlargement.

The starting point is the definition of territory as “the historical product of long-term co-evolutionary processes of human settlements and the environment” (Magnaghi, 2000, p. 16). Territorial heritage is defined as the material assets and knowledge favouring and enabling the co-evolution of human settlements and the environment. The material assets of the territorial heritage include both natural resources and those elements of anthropic origin that have conditioned the subsequent development of a given area (Merino, 2021a).

Until the mid-twentieth century, decisions and actions carried out by human groups on the environment to establish their settlements and ensure their subsistence had entailed an overall growth of the territorial heritage. This growth had guaranteed the sustainability of the co-evolutionary processes over time. In this approach, the generalised undermining and destruction of territorial heritage since the mid-twentieth century is associated with an interruption of the process of territory construction (Becattini, 2015; Magnaghi, 2001, p. 24; 2021, p. 63; Raffestin, 1984).

Examples of landscape plans such as the *Piano di Indirizzo Territoriale della Toscana con valenza di Piano Paesaggistico* (Regione Toscana, 2015) or the *Piano Paesaggistico Regionale Territoriale della Puglia* (Regione Puglia, 2015), developed on the basis of the territorialist methodology, make us wonder how territorial heritage and landscape are related in this approach. A recent study focuses on this matter (Merino, 2021a). It is concluded that the landscape represents in this approach the perceptible dimension of the co-evolutionary processes of human settlements and the environment. The interruption of the co-evolutionary processes also implies that of the dynamics of landscape formation.

For the territorial heritage to grow, it is necessary to reactivate the co-evolutionary processes, *i.e.*, the dynamics of landscape formation (Merino, 2021a). Such reactivation is achieved through the valorisation and sustainable use of the territorial heritage. To this end, the process of sedimentation of the territorial heritage is analysed, on the one hand, and, on the other, its consolidated form prior to the beginning of the phase of generalised undermining and destruction. This way, its values are recognised and the keys to its sustainable use are extracted. This link between territorial heritage and landscape is echoed in the territorialist landscape plans. In these plans, the evaluation of the nature of the landscape prior to the definition of the quality objectives and specific use rules is carried out fundamentally through a systematic study of the morphotypologies around which the territorial heritage has been consolidated (Magnaghi, 2014, p. 115).

The expression ‘place ordering’ (*statuto dei luoghi*) refers to the specific form that the territorial heritage has taken for each place. In the analytical methodology, this ordering is interpreted by means of the extraction of the structural invariants of a landscape nature (Maggio, 2014, p. 35; Poli, 2017, p. 43). We understand this interpretation to be equivalent to a landscape characterisation precisely because of such landscape nature. The place ordering is described by the combination of the results obtained from four morphotypological analyses of the territorial heritage (Magnaghi, 2012, p. 17; 2016), from which four landscape features are extracted. These are: the hydrogeomorphological features of the morphogenetic systems and of

the hydrographic basins, the ecosystemic features of the landscape, the polycentric and reticular nature of the systems of urban and infrastructural settlements, and the identity traits of rural landscapes (Magnaghi, 2014, p. 115). The specific combination of the four features for each location yields a comprehensive description of the place ordering, which is the basis for defining the quality objectives and specific use rules (Poli, 2017). Thus, the polycentric and reticular nature of the urban and infrastructural settlement systems is one of the four landscape features identified by the territorialist school, and its interpretation is carried out by means of the morphotypological analysis of the territorial heritage (Fanfani, 2001).

The references for the particular definition of the method are found in the landscape plans of Tuscany and Puglia. A recent study analyses the degree of adaptation of the analytical methodology for the identity projection of the territory in these plans (Merino, 2021b). Based on it, the highest degree of correspondence with the theory is found in the Tuscan case, where the place ordering is described through the structural invariants of a landscape nature. The device is based on a systematic analysis of the manner in which the territorial heritage has been consolidated in search of the morphotypologies that characterise the landscape. On a regional scale, invariants allow the delimitation of landscape areas and then the discovery of their characteristic features (Poli, 2015a, p. 151; 2016). Specifically, in the third invariant – where the polycentric and reticular nature of the urban and infrastructural settlement systems is extracted – the graphic analysis concentrates on the settlements and the transit and communication routes with a historical foundation. This analysis constitutes the starting point of our method.

In the case of Puglia, the only reference to structural invariants is found in the information sheets in which the landscape areas are described. The invariants are used to literally describe the systems and elements that make up the so-called territorial figures into which the landscape areas are divided. The analytical device is devoid of graphical content in this case. However, we find a graphic morphotypological analysis in the initial section of the structural descriptions of synthesis, where the elements and relationships that characterise the settlement systems are identified.

## **Method**

Next, we present our proposed method to interpret the polycentric and reticular nature of urban and infrastructural settlement systems. It is based on an analysis of the morphologies that settlement and infrastructure systems founded in historical times have acquired as a result of a consolidation process over time, influenced by both natural and human factors.

Saragosa and Chiti define this consolidation as a process of evaluation and correction of errors that is similar to what we can observe in the constitution of the genetic heritage of the different species of living beings, likewise conditioned by both internal and external factors (Saragosa, Chiti, 2020a, p. 56; 2020b). The environment

– fundamentally, the hydrogeomorphological structure – imposes a series of limitations that determine the consolidation process of the settlement systems. Therefore, hydrogeomorphology must be taken into account in the analysis. Just as the architectural elements tend to consolidate following different archetypal forms, in which Martí Arís claims that the identity of the architecture is encrypted (Martí Arís, 1993, p. 19), settlements tend to consolidate following different morphotypes. According to Arís' reasoning, the identity of the settlement systems is encrypted in these morphotypes. The objective of our analysis is to decipher this identity trait, which we have called the 'polycentric and reticular nature of the urban and infrastructural settlement systems' in line with the territorialist theory.

The interpretation of this identity trait is carried out by means of the recognition of the morphotypes of the systems of settlements, in urban and infrastructural terms, a recognition that occurs in parallel to the identification of territorial articulations and for which it is necessary to first detect the component figures of morphotypes.

The component figures of morphotypes constitute the simplest archetypal schemes around which the settlements are deployed. Due to their limited scope and homogeneity, they are not believed to denote identifying features of the place. Morphotypes are complex archetypal schemes of urban and infrastructural settlement systems linked to different situations generated by the hydrogeomorphological structure. The very composition of the word 'morphotype' refers, on the one hand, to the form or spatial organisation of a series of elements and, on the other, to the archetypal nature of the scheme that underlies this spatial organisation (Alexander *et al.*, 1977; Crawford *et al.*, 2008). Morphotypes are made up of one or more component figures and denote identifying features of the place. Their recognition, previously considering that of the component figures, is the starting point to discover the territorial articulations. Territorial articulations are the particular schemes adopted by the urban and infrastructural settlement systems of a given place as a result of a consolidation process influenced by different natural and human factors. Underlying each of the articulations is one of the morphotypes that we would have recognised, which are the complex archetypal schemes that the specific morphologies tend towards (Marson, 2008).

In our view, the work process should begin with detecting and cataloguing the component figures, identified for the case study in a map of the component figures later. The next step is to detect and catalogue the morphotypes of the settlement systems, identified for the case study in the form of the territorial articulations in a map of the morphotypes of the settlement systems later. Broadly speaking, extracting the morphotype of the settlements that underlies the organisation of the elements allows us to establish the approximate area covered by the territorial articulation and allows its delimitation, which conforms to the component figures identified for the case study. The work process is detailed below.

Prior to commencing the analysis, a schematic working basis on which to perform the interpretation is developed. In it, the following is represented: urban nodes – differentiating between the centres founded in historical times and those urban centres that were recently established –, the infrastructure networks – highlighting

the main roads and railway lines founded in historical times versus those built in the contemporary era – and, finally, the main river courses and the relief. In the Tuscan case, the existence of georeferenced records of the population distribution around 1950 and today allowed the team of authors to automatically determine – using the representation options offered by the GIS software – those population centres that had a larger population and that were more developed towards the middle of the 20th century. These centres consist fundamentally of those of historical foundation.

In the working basis used in the Tuscan case, recent settlements and infrastructures are graphically relegated to the background, which makes it easier to recognise those that date back to historical times, on which the interpretation is focused. The black grid represents the population of the centres towards the middle of the 20th century, while the grey one represents the distribution of the population today. This decision is consistent with the critical reading that the territorialist school makes of the dramatic transformations that the territory has undergone since the mid-20th century (Balducci *et al.*, 2017a; Balducci *et al.*, 2017b; Magnaghi, 2001, p. 24; 2021, p. 63; Raffestin, 1984). The establishment of settlements and infrastructures was historically conditioned by local environmental or cultural factors. In the establishment of most of the settlements and infrastructures since the mid-20th century the limitations of the environment have been obviated, thanks to technological advances. Their location, dimensions, layouts, etc., have been fundamentally conditioned by exogenous, global, and economic factors. Thus, these settlements and infrastructures are often not consistent with the historical schemes that could hold the keys to local development.

The work of interpretation aims, first of all, to identify the component figures of the morphotypes for the case study (Figure 1). To do so, it is necessary to have a catalogue of component figures. This catalogue may resemble the one proposed in the Tuscan landscape plan, which covers a wide spectrum of simple settlement organisation patterns ranging from high mountain locations to coastal locations. The catalogue must be the result of an interpretation that, based on conventional systematisations, is amended, expanded or reduced according to the particularities of the place (Alexander, 2002). For example, some of the figures that are part of the catalogue in the Tuscan case, such as the reticular system of villages and small centres of the century-old plain mesh or the reticular system of the Etruscan highlands, are patterns based on conventional figures that have a specific development in some areas of the region of Tuscany and that may not exist in other locations. The cataloguing of the component figures, both conventional and particular, is based on the analysis of territorialisation processes (Poli, 2017). In the analytical methodology for the identity projection of the territory, this preliminary analysis sets out to detect and identify the values of the territorial and landscape heritage of different time intervals. It allows us to recognise the settlement patterns that derive from specific historical intervals, as well as to observe how they have evolved. The former contributes to the definition of the component figures. For its part, the latter is the basis on which the conclusions regarding the long-term structure are drawn.

Figure 1. Map of the component figures of morphotypes of the systems of settlements, scale 1:250:000. Source: PIT Toscana 2015.

Figure 2. Map of the morphotypes of the systems of settlements, scale 1:250:000. Source: PIT Toscana 2015.

Secondly, the interpretation seeks to identify the territorial articulation(s), *i.e.*, the morphotype(s) of the settlement systems as materialised for the case study. To do so, it is necessary to have previously detected and catalogued the territorial morphotype(s) (Figure 2). The identification is based, on the one hand, on a proposal for the systematisation of the morphotypes and, on the other, on the identification of the component figures for the case study already carried out. As with the component figures, as a result of the interpretation of the place, a catalogue of morphotypes must be generated that will guide the search. The collection of morphotypes specified in the Tuscan plan can be taken as a reference, modifying it according to the particularities of the case study. The approximate area of each territorial articulation is made to coincide with that of the component figure(s) that make(s) up the morphotype, to which the proposed order contributes.

It is important to note that this interpretation has, in the territorialist approach, a practical purpose. Insofar as it involves the extraction of a structural invariant, the interpretation of the polycentric and reticular nature of the urban and infrastructural settlement systems reveals a “reciprocal relationship” between certain settlements and infrastructures and the environment, which has been shown to be essential for the increase in the values of territorial heritage over time. Territorialist authors regard this relationship of reciprocity as positive (Maggio, 2014, p. 35) inasmuch as they believe that it incorporates the keys to self-sustainable local development based on the growth of territorial heritage. If this relationship is considered positive in the evaluation of the criticality of the landscape and in the definition of the mobility objectives, the sustainability of the mobility actions can be increased and contribute through these to local development.

### **Application of the method to the case study of the territory of the lower Guadalquivir**

To demonstrate the application of the method, we use the case study of the area of the lower Guadalquivir River as it passes through the city of Seville. To establish the size of the study area, we took as a reference a previous study on territorialisation processes carried out by Merino, Linares, and Tejedor. It is concluded that the lands delimited by Tejada la Nueva to the West, El Ronquillo to the North, Alcolea del Río to the East, and Dos Hermanas and Coria del Río to the South are linked as they have historically been affected by common natural and cultural factors to which they have responded jointly, which has favoured the local development of the whole area and fostered a sense of common belonging (Merino *et al.*, 2021).

Based on the *Policy Brief: Sustainable Urbanisation in Europe* (ESPON 2020b), the urban form of the central city in the study area, in this case Seville, follows a compact pattern. In turn, according to *Policy Brief Indicators for integrated territorial and urban development* (ESPON, 2018), the main potential for greater polycentric development in the territory where the study area is located is, precisely, its urban structure. The report highlights the low degree of accessibility and territorial cooperation for this purpose. The morphotypological analysis and applications to regional planning and design proposed in this paper aim to consolidate the urban structure and increase accessibility. These reports are indicative of the threats and opportunities of the study area and the relevance of applying innovative methodologies for integrated urban and territorial development.

The development of this area is currently regulated by two plans: *Plan de Ordenación del Territorio de Andalucía* (Junta de Andalucía, 2007) and *Plan de Ordenación del Territorio de la Aglomeración Urbana de Sevilla* (Junta de Andalucía, 2009). This area is also included in *Estrategia de Paisaje de Andalucía* (Junta de Andalucía, 2012), although it lacks a normative character.

of the settlements (Merino *et al.*, 2021).

Figure 3. Map of land consumed for urban and infrastructure use in 1956 (left) and 2007 (right) in the territory of the lower Guadalquivir, 2023.

Source: Elaborated by the author in collaboration with Geomalandar S.L.

The starting point is to draw up a schematic map that facilitates the interpretation. In our case study, to prepare the schematic map we apply the data set of the “Map of land uses and vegetation cover of Andalusia” (MUCVA) provided by the Environmental Information Network of Andalusia (REDIAM) to the model of the territory that has been generated fundamentally with downloads from the DERA repository. This will be the set that we will use to identify the variations that have occurred in settlements and terrestrial infrastructures since the 1950s. The elements of the maps of land uses and vegetation cover that represent urban land uses and mobility infrastructures in 1956 and 2007 are selected.

In addition to the MUCVA, we extract and incorporate the layers of the road network, the rail network and the livestock trails that form the DERA’s “Transport and Communications” data set. Finally, we superimpose the layer of the population centres identified in the Spanish National Statistics Institute’s Nomenclature within the set of “Layers of the Andalusian Population Information System” in the DERA information preview. This is transformed into a vector layer of points with the geometry tool “Centroids of polygons”. This allows us to work with the municipalities as specific entities, which, with a view to an abstraction of the model, means they are perceived as the nodes of the settlement systems. Taking as the origin the calculated layer of the centroids, those municipalities that date back to historical times are selected and extracted in a new layer based on the 1956 MUCVA and on the conclusions drawn by Merino, Linares, and Tejedor in relation to the long-term structure, collected in the historical synthesis map of the matrices and the permanence

The elements selected from the MUCVA and those related to transport and communications from the DERA are differentiated into two categories: on the one hand, the systems of urban and infrastructural settlements that date back to historical times (which have resulted from a consolidation process after a long period of time) and, on the other, those developed in recent times. The graphical code must support this differentiation. Black is chosen to reflect the situation around 1956 and grey to represent land use in 2007 (Figure 3). The extraction of the polycentric and reticular nature of the urban and infrastructural settlement systems is based on the elements that date back to historical times.

Figure 4. Map of the component figures identified in the territory of the lower Guadalquivir, 2023 (the corresponding catalogue of the component figures is shown in figure 5).

Source: Elaborated by the author in collaboration with Geomalandar S.L.

To accomplish the identification, a catalogue is made of the component figures, taking as a reference the one that complements the corresponding map of the Tuscan landscape plan. The list of component figures proposed for Tuscany is subject to revision and adaptation to the territory of the lower Guadalquivir.

The identification of the component figures for the case study is carried out by selecting and extracting elements from the layers of the population centres and from the transport and communications that date back to historical times. The new sets are grouped, systematised, and recoded for each component figure detected and catalogued. The map of the identified component figures in the territory of the lower Guadalquivir (Figure 4) is complemented with a catalogue where the seven component figures that have been detected at an abstract level are described (Figure 5).

The proposed catalogue is the result of an interpretation process and may be subject to critique and undergo modifications. In the field of study, Seville – the provincial and regional capital – is the main node of historical origin. From a morphotypological point of view, Seville is the gravitational centre of a ‘radiocentric settlement system characteristic of the great alluvial plains’, the first component figure. Population centres such as Santiponce (*Italica*), Camas, Alcalá del Río (*Ilipa Magna*), La Rinconada and Dos Hermanas (including the Herberos Tower site) are examples of this figure, according to our interpretation. Their establishment and subsequent consolidation were motivated and conditioned by this organisational scheme in which Seville constitutes a focal point that absorbs traffic and communication flows along a series of radial guidelines, on which the main supra-regional links have been developed.

The second component figure refers to the ‘comb-shaped systems of the heads of the valleys and of the double centres along the road at the foot of the hill’ identified in the lower Sierra Norte of Western Seville and in the lower Sierra Norte of Eastern Seville. In the eastern highlands, the comb-shaped towns and villages system converges with the linear system of small and medium-sized plain centres that develop around the Guadalquivir River.

The third component figure is precisely the ‘linear system of small and medium plain centres along infrastructural corridors’. On the left bank of the Guadalquivir River, along the multi-modal infrastructural corridor formed by the river, the roads, and the railroad, are the towns of La Rinconada, Brenes, and Tocina. On the right bank we find La Algaba, Alcalá del Río, Villaverde del Río, Cantillana, Villanueva del Río y Minas, Alcolea del Río, and Lora del Río. At the foot of the Aljarafe, on the right bank of the Guadalquivir River, Gelves, Coria del Río, and Puebla del Río follow a similar pattern.

The fourth component figure is the ‘reticular hill system’ that we find in the Gerena fields, the Tejada fields and in the Aljarafe region. This is a system of historical settlements made up of small and medium-sized towns and centres that generally appear along the main road half-way up or on the crests of the hills. A secondary road in the transverse direction completes the mesh.

Figure 5. Catalogue of the component figures, 2023.

Source: Elaborated by the author in collaboration with Geomalandar S.L.

The fifth component figure, the ‘reticular system of the Tartesian or Turdetan plateau matrix’, is a particular and specific figure that develops on the Aljarafe plateau, an area that borders Santiponce and Seville to the north-east. It is a variation of the above-mentioned figure that stands out for its proto-historical origin.

The sixth component figure is the ‘hill radiocentric system’ that prevails in a wide area around Carmona, a figure that competes with and at the same time feeds on the radiocentric system of the Guadalquivir alluvial plain. The neighbouring territory is visually dominated from the fortresses of Carmona, which is situated in a strategic position on the Los Alcores ledge.

Lastly, the seventh component figure that is detected is the ‘comb-shaped system of the mountain slopes along the ridges and/or valleys’. This is the component figure that prevails throughout the Sierra Morena. Access to the mountain settlements is through a road that generally runs parallel to the river courses that run through the valleys and along the ridges.

Based on the conclusions collected in the map of the component figures in the territory of the lower Guadalquivir, we proceed with the detection at an abstract level of the morphotypes of the settlements and the identification of the territorial articulations under which these morphotypes lie. For this, as with the component figures, we take as a reference the morphotype catalogue used in the Tuscan landscape plan. To carry out the detection of the morphotypes, we analyse the component figures previously identified in search of the complex archetypal schemes of the settlements. We group those figures that we consider to be part of each morphotype. The draft list of morphotypes considered is then revised and adjusted to the case study. In the study area, we detect the morphotype of polycentric urban settlements of the great alluvial plains, the morphotype of the mesh polycentric settlements of the historical hill landscape, and the morphotype of the spine-shaped settlements of the mountain valleys.

From a practical point of view, the identification of the territorial articulations entails a regrouping of the layers that form the georeferenced set of the component figures (Figure 6). The catalogue that accompanies the map contains a brief description of each morphotype of the settlements (following the information sheets of the areas of the Tuscan landscape plan), after which the proposal for territorial articulations in the study area is presented (Figure 7).

Next, we describe the morphotypes of the systems of settlements identified in the study area in the form of territorial articulations, focusing on the component figures drawn from each territorial articulation.

Figure 6. Map of the morphotypes of the systems of settlements identified in the territory of the lower Guadalquivir, 2023 (the corresponding catalogue of the morphotypes of the systems of settlements is shown in figure 7).

Source: Elaborated by the author in collaboration with Geomalandar S.L.

The first morphotype detected is that of the polycentric urban settlements of the great alluvial plains. This is a system of settlements that develops in large plains characterised by a high density of buildings and infrastructures and by the dominance of urban culture over rural. The territorial articulation that this morphotype takes for the case study has been named *the alluvial plain of Seville* (01.1). This articulation is believed to summarise the main characteristics that define the morphotype, since it is a settlement system that develops on mostly flat lands within the alluvial plain formed by the Guadalquivir as it passes through Seville, in which there is a high concentration of buildings and infrastructures (especially in the metropolitan area of Seville) and where the predominant culture is urban versus rural. Three component figures underpin this articulation: the radiocentric system around Seville in the alluvial plain of the Guadalquivir, the linear system of small and medium population centres of the plain along the infrastructural corridor formed by the Guadalquivir, the railway line in the direction of Cordoba and Madrid and a dense set of roads and the comb-shaped system of the heads of the valleys and double centres all along the road at the foot of the lower Sierra Norte in east Seville.

Figure 7. Catalogue of the morphotypes of the systems of settlements and territorial articulations in the territory of the lower Guadalquivir, 2023.

Source: Elaborated by the author in collaboration with Geomalandar S.L.

The second morphotype detected in the study area is that of the mesh-patterned polycentric settlements of the historical hill landscape, which characterises the historical landscape of the hill areas and which is made up of small and medium population centres, mostly of medieval origin, that are positioned along a longitudinal road on the crests of the hills. The population centres are related to each other visually and physically, the latter by means of a main road that traverses them. In the study area considered, this morphotype underlies three articulations. The first articulation refers to the *fields from Gerena to Tejada la Nueva* (02.1), which encompasses the lands with gentle or medium slopes that are dominated from the emerging positions

of Gerena, Aznalcóllar, and Tejada la Nueva. In this case, two component figures underpin this articulation: on the one hand, the comb-shaped system of the heads of the valleys and the double centres along the foothills of the Sierra Norte in west Seville and, on the other, the reticular hill system of the fields of Gerena and Tejada that links the villages in the foothills of the mountains with the fields of the Aljarafe county. The second articulation is that of the *Aljarafe plateau* (02.2), which comprises the system of towns and villages that develop on the elevation of the Aljarafe near Seville. This articulation is formed by a single component figure that has been defined as the reticular system of the high plains of the Tartesian or Turdetan matrix, in which not only the protohistoric origin of the settlements stands out – which differs from the eminently medieval origin that defines the reticular hill system – but also the urban character that this area has specifically developed, encouraged by its proximity to Seville. The last articulation is called *Carmona and the Los Alcores ledge* (02.3). The component figures underlying this articulation are the radiocentric hill system, with Carmona as a focal point, and the reticular hill system that is believed to have led to the layout of the towns and villages on the Los Alcores ledge and of the road that passes through them.

The third morphotype is that of the spine-shaped settlements of the mountain valleys. In it, the small and medium rural towns and villages are located along the river valleys and their tributaries. It can be seen that, usually, the main historically laid road and the railway run parallel to the course of the river, linking the main valley bottom population centres with one another. This morphotype underlies the articulation of the *Rivera de Huelva valley* (03.1). In this case, a single component figure underpins the articulation that corresponds to the comb-shaped system of the mountainous slopes. This organises the territory bathed by the Rivera de Huelva up to Almadén and affects the sections of road that were laid in Roman times.

## **Synthesis of results**

The territorialist analysis of urban morphology can become a basis for urban and regional planning and design. In the landscape plans of Tuscany and Puglia, the definition of strategies at regional and sub-regional level is conditioned by the result of this analysis, which is part of the process of extracting structural invariants. This analysis is essential, first, for the delimitation of landscape areas. Quality objectives and specific use rules are defined with reference to these landscape areas. Secondly, this analysis makes it possible to identify certain elements, such as the structuring roads and livestock trails with landscape value, which, when properly activated, guarantee visual access to the landscapes and, subsidiarily, the promotion of local development.

Far from using conventional landscape delimitations based on criteria of visual or functional homogeneity, a demarcation of landscape areas is used in the territorialist approach which contributes to a more balanced development of the territories. The demarcation of landscape areas brings together adjoining areas which have

historically been linked to ensure the survival of settlement systems and which therefore share common identifying features (Merino, 2021c). Land-use regulation and quality objectives defined for each landscape area are intended to highlight the historical relationships between different centres as a means of counteracting the undermining and destruction of the territorial heritage that has taken place in recent decades.

For the delimitation of the landscape areas in the landscape plans of reference, the morphotypological analysis is taken into account on the one hand, and the historical-structural analysis on the other (Regione Puglia, 2015). In both plans, the landscape areas have been established as the sum of minimum units, which correspond to the component figures identified in the territories, considering multiple factors: the historical conformation of the geographical regions, the hydrogeomorphology, the environmental and ecosystemic characteristics, the typologies of the settlements, etc. In the case of Puglia, 11 landscape areas are identified, while in the case of Tuscany, the territory is divided into 20 landscape areas. Each area is made up of a certain number of figures underlying one or more territorial articulations.

In the application of the method to the case study of Seville, the starting point is not the region, but an area of the lower Guadalquivir which is thought to constitute a landscape area in the terms described above after a historical-structural study (Merino *et al.*, 2021). The analysis of the urban morphology corroborates the initial hypothesis and contributes to outlining the landscape area. In this case, the landscape area is formed by the aggregation of five territorial articulations in which we identify up to seven different component figures.

This demarcation represents an alternative to the delimitation of landscape areas included in *Estrategia de los Paisajes de Andalucía* (Junta de Andalucía, 2012), drawn up according to criteria of ecosystemic homogeneity. It also differs from the boundary of the first metropolitan crown of Seville, made up of 22 municipalities, to which actions of *Plan de Ordenación del Territorio de la Aglomeración Urbana de Sevilla* (Junta de Andalucía, 2009) are effectively circumscribed. This alternative geographical framework contributes to the aim of achieving territorial cohesion and promoting the balanced development of the territories. Specific land-use regulation projects, such as the system of infrastructures for slow mobility, can have a regional scope or refer to these landscape areas.

The project for a system of infrastructures for slow mobility in the territory of the lower Guadalquivir (Figure 8) refers to the identified landscape area. This kind of project could be included in land-use or landscape plans to promote visual access to the landscape while also contributing to the polycentric and balanced development of the territory. Using a methodology similar to that employed in Puglia's landscape plan, the information from the analysis of urban morphology is synthesised graphically in order to define the future uses of the roads and livestock trails identified as structural elements of the settlement systems.

Figure 8. Project for a system of infrastructures for slow mobility in the territory of the lower Guadalquivir, 2023.

Source: Elaborated by the author in collaboration with Geomalandar S.L.

The system is made up of networks of connections for road traffic, for hikers and cyclists, railways, and waterways. Roads and livestock tracks identified as structural elements of the settlement systems are re-qualified according to their nature and that of neighbouring networks. On the one hand, the structuring provincial, regional, and national roads comprise the network of roads of landscape interest destined for road traffic. They offer panoramic views and provide visual access to valuable landscapes and historic settlements. On the other hand, livestock tracks that are passable or perceptible along most of their length and which cross or connect landscapes and assets of great value, are identified. These comprise a network of cycling and pedestrian routes, functional in terms of the continuity of slow connections. In addition to these cycling and pedestrian connections, there are potential service road connections along the main high-capacity roads which have replaced livestock tracks and which could be re-qualified for pedestrian or cycling use.

Urban centres founded in historical times are incorporated into the system as the nodes of the network of structuring roads and paths. Depending on the networks and services which converge at each node, the nature and scope of a modal interchange is determined to ensure the network of structuring roads and paths is continuously accessible to the public. Four modes of access are determined: airport access, through the regional railway network, via the bus service (which implicitly entails private road access by car), and pedestrian or cycle access. Where different networks or services converge, the modal interchange should facilitate the change from one form of transit to the other.

## **Final considerations**

The application of the method to interpret the polycentric and reticular nature of the settlement systems in the lower Guadalquivir has revealed some differences with respect to the two cases taken as references. From the morphotypological analysis of the settlement systems in the lower Guadalquivir, we have extracted a smaller number of morphotypes than those identified at a regional level in the landscape plans of Tuscany and Puglia. This is logical if we take into account the smaller extension considered. While most of the component figures of the morphotypes identified for the area of the lower Guadalquivir are also included in the reference examples, we have established other specific figures, such as the reticular system of the Tartesian or Turdetan plateau matrix. The different natural and cultural factors make it necessary to carry out a preliminary review of the component figures and morphotypes and their adaptation to the different places, as we noted in the description of the method.

There is a risk that, when applying this interpretation to urban and regional planning and design, the definition of the component figures and morphotypes of the settlements may not achieve an adequate degree of precision, either due to the lack

of preliminary studies or due to their meagre content. When this happens, the definition of the quality objectives and specific use rules may end up being based on abstract archetypal schemes that do not represent the place identity. To avoid the consequences of poor practice, it is essential that both the catalogue of component figures and that of morphotypes emerge from an interpretation that takes into account the specificities of each place, that is, the natural and human factors that have contributed throughout history to the consolidation of settlements following specific patterns. By adapting the description of both the component figures and the morphotypes to the place, the degree of abstraction to which, by definition, they aspire is reduced and the degree of concreteness is increased.

The method is applied at a sub-regional level in this paper to illustrate how it works and to evaluate its performance. The elaboration of a comprehensive morphotypological analysis of urban and infrastructural settlement systems at regional level by interdisciplinary teams following the proposed method and its consideration during the preparation of future land-use or landscape plans can help to define quality objectives and specific use rules in such a way as to promote a more polycentric and balanced development of the Andalusian territory.

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