

The Royal Sites and their importance in the conservation of the soil

Los Reales Sitios y su importancia en la conservación del suelo
Os Sítios Reais e a sua importância na conservação do solo

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ABSTRACT

The Royal Sites have been studied and analysed from many points of view and there is an extensive bibliography regarding their historic, artistic and touristic heritage. However, their importance in the conservation of the environment, namely the conservation of soils and ecological corridors allowing the movement of animals and maintenance of biodiversity, has hardly been studied. Their high levels of protection, both as patrimony of the State and as ecological areas, have helped to preserve these natural landscapes even in areas close to big cities. In this paper we will analyse the importance that the Royal Sites, located in the northwest of the Autonomous Community of Madrid and in areas nearby in the Province of Segovia, have had in the conservation of the soils.

RESUMEN

Los Reales Sitios han sido estudiados y analizados desde muchos puntos de vista y existe una amplísima bibliografía en cuanto a su patrimonio histórico, artístico y turístico. Sin embargo, apenas ha sido estudiada su importancia en la preservación del medio natural: conservación de suelos y de corredores ecológicos que permitan el mantenimiento de la biodiversidad y el movimiento de la fauna. Su alto grado de protección, tanto por Patrimonio Nacional como por las redes de espacios naturales en su entorno, han facilitado la conservación de paisajes naturales aun en las proximidades de grandes ciudades. En este trabajo analizamos la importancia que los Reales Sitios, localizados en el noroeste de la Comunidad de Madrid y en áreas próximas de la provincia de Segovia, han tenido en la preservación de los suelos.

RESUMO

Os Sítios Reais têm sido estudados e analisados sob diversos pontos de vista e existe uma extensa bibliografia acerca do seu património histórico, artístico e turístico. No entanto, a sua importância na conservação do ambiente natural, nomeadamente na conservação dos solos e corredores ecológicos que permitem a circulação de animais e a manutenção da biodiversidade, pouco foi estudada. Os elevados níveis de proteção a que estão sujeitos, tanto como património Nacional, ou como áreas ecológicas, têm facilitado a conservação dessas paisagens naturais mesmo nas áreas próximas das grandes cidades. Neste trabalho analisamos a importância que os Sítios Reais, localizados a noroeste da Comunidade Autónoma de Madrid e em áreas próximas da Província de Segóvia, têm tido na conservação dos solos.

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1. Introduction

Numerous studies done in recent years of soil sealing in the Autonomous Community of Madrid (AEMA CE 2012; García Rodríguez et al. 2014; García Rodríguez and Pérez González 2016; Pérez González and García Rodríguez 2016; Pérez González and García Rodríguez 2017; García-Alvarado et al. 2018; García-Alvarado et al. 2020) demonstrate that urban growth comes with a significant problem for the maintaining of diverse ecosystems and the conservation of the soils. This problem has also been studied in other parts of Spain (Añó Vidal et al. 2005; Ojeda Zújar et al. 2006; Romero Díaz et al. 2017; Caballero Pedraza 2017). However, the presence of protected areas both in the Autonomous Community of Madrid and in neighbouring provinces has allowed for the conservation of much of these habitats (Comunidad de Madrid 2007; Ministerio de Medio Ambiente y Medio Rural y Marino 2010; Rodríguez and Martínez 2019). In this aspect the existence of the Royal Sites belonging to the National Patrimony has played an important role.

The Royal Sites do not solely include royal areas with functions related exclusively to the Royal Court. The farming and use (wood gathering, hunting, fishing, agriculture) of the large natural areas around them have made them important centres of political and economic power which have transformed and restructured adjoining territories (Labrador and Pasquale 2014). In their foundation, apart from their geographic location, they have influenced the use that can be made of natural areas, especially with the case of hunting. This has allowed for the conservation of the soils and with that the conservation of an important biological diversity.

2. Study Objective

Demographic pressure and related urbanization is the most significant problem affecting the soils of Madrid and its surrounds, causing a significant sealing of the soils with the accompanying loss of vital functions. Fortunately the existence of the Royal Sites has considerably mitigated this effect. The objective of the study is to analyse, through the comparison of historic maps with current satellite images, whether the soil surrounding these enclaves has been conserved.

3. Materials and Methods

An image from the satellite Landsat 8 available from the free server <http://glovis.usgs.gov/> can be used to analyse the sealing of the soils. The image has been modified to include spectral enhancements (combinations of spectral bands and Normalized Difference Vegetation Index) with the objective of confirming whether soil sealing has affected the conservation of the natural landscapes of the Royal Sites. The study used the software ERDAS Imagine 2019. The best identification of soils sealed by urban development and

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landscapes.

**PALABRAS
CLAVES**
Patrimonio
Nacional, sellado
del suelo, paisajes
protegidos.

**PALAVRAS-
CHAVE**
Património
Nacional, selagem
dos solos, paisagens
protegidas.

soils that are still unsealed is obtained from false colour images from near and visible infrared bands (6-5-4). To support this information the study has analysed orthophotos of the National Institute of Geography (www.ign.es) and they have carried out observations of the terrain. The entirety of the material has been compared with multi-time aerial photographs and historic maps. Maps of Forteza et al. (1987) and Monturiol and Alcalá (1990) have been used to establish the location and distribution of soils, adapting the FAO classification of 1988 to the WRB of 2015 (IUSS Working Group WRB 2015).

4. Results and Discussion

The majority of the Royal Sites of the Autonomous Community of Madrid and their surrounds forms an important area of natural space that in total comprises more than 22,000 hectares. In the Modern Age, the landholdings of the Royal Sites of El Escorial, La Granja de San Ildefonso, Riofrío, El Pardo and El Soto de Viñuelas were connected to each other, together with the landholdings of the Casa de Campo and El Real Sitio de la Florida that are recorded in historical maps (Urteaga and Camarero 2014). Today these sites have become fragmented and

some have disappeared altogether due to the urban pressure from the city of Madrid, as can be noted in orthophotos and satellite images. There are connections between the National Park of the Sierra of Guadarrama and the Regional Park of Manzanares, given that the protection offered by legislation concerning Royal Sites has impeded the sealing of the soils. This legislative protection has allowed for the conservation of significant treed spaces in the proximity of the city of Madrid, which has preserved important forest areas and their associated soils. These soils correspond, in Monte del Pardo, to Cambisols, Regosols and Arenosols (Monturiol and Alcalá 1990), with a high risk of erosion due to the fragility and lack of consistency of their structures, and for this reason their protection is essential. At the Royal Site of Escorial in the areas with steeper slopes, the Cambisols and Umbrisols predominate, which in general have little depth and a high risk of erosion. Since the construction of the Monastery it has had an important forestry and grazing function, with pasture and forests in the higher zones and a landscape of pastureland (“dehesas”) in the lower lying areas. In the Royal Sites of La Granja and Riofrío the dominant soils are Umbrisols, Cambisols, Leptosols and Gleysols (Forteza et al. 1987; Gallardo et al. 1988). Cambisols are the dominant soils in Valsain (Jiménez Ballesta et al. 1981) and San Ildefonso (Nicolás and Gandullo 1969). These soils also have a high risk of erosion.

Table 1. Soils and vegetation of the Royal Sites

ROYAL SITES	SOILS (IUSS Working Group WRB 2015)	VEGETATION
Monte del Pardo	Cambisols, Regosols, Arenosols	Pastureland (<i>Quercus ilex</i>)
San Lorenzo del Escorial	Cambisols, Umbrisols	Forest (<i>Quercus pyrenaica</i>) and pasturelands (<i>Quercus ilex</i>).
La Granja de San Ildefonso	Cambisols, Umbrisols, Regosols, Gleysols	Forest (<i>Pinus sylvestris</i> , <i>Quercus pyrenaica</i>)
Riofrío	Umbrisols, Cambisols, Regosols, Gleysols	Forest (<i>Quercus pyrenaica</i> , <i>Quercus ilex</i> , <i>Fraxinus angustifolia</i>)

Accordingly, although all these soils have a high risk of becoming degraded, they have been preserved due to the use to which they have

been put, and particularly due to the high level of protection afforded to the Royal Sites as can be observed in **Figure 1**.

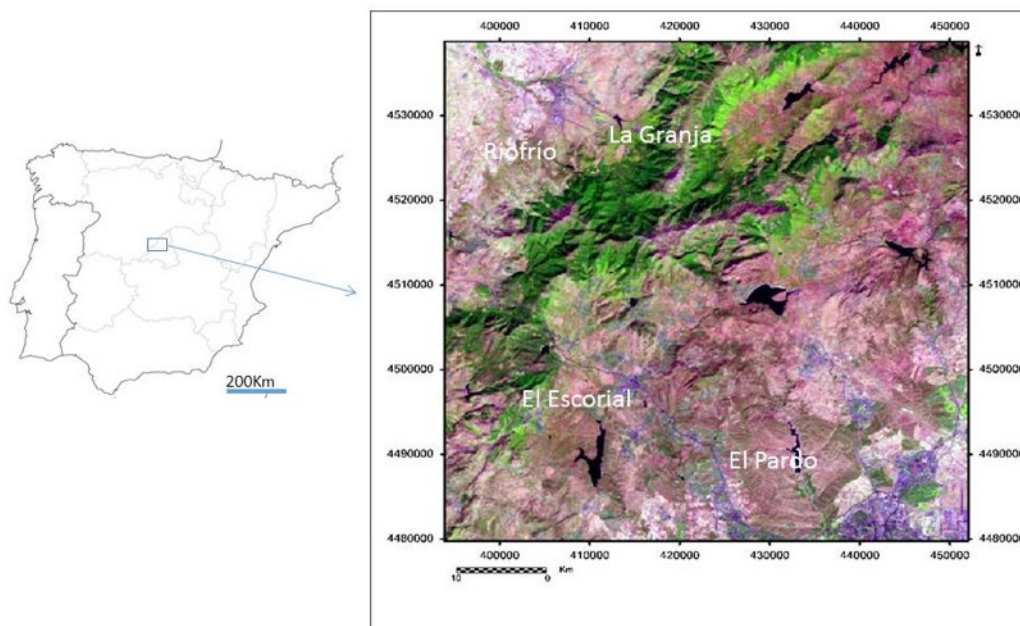


Figure 1. Localization of the Royal Sites. Landsat 8 Image (6-5-4), 3-10-2018.

In this image in false colour (6-5-4 channels, R-G-B), represented in green tones are the natural spaces (deciduous trees in light green and pine trees in dark green) of San Ildefonso, La Granja and Riofrío, which are practically joined. Further, the sites of Cuelgamuros and El Escorial are joined with the peaks of the Central System. However, one can observe in dark purple tones, the fragmentation of the Mediterranean forest between El Pardo and El Escorial due to the presence of various infrastructures and housing developments (marked in a dark blue tone) that separate the two sites that were joined in the past. Although over the centuries the extension of the natural spaces of the Royal Sites has diminished, today these sites are protected which has facilitated the continued existence of these spaces. Although in the Modern Age the natural spaces of the Royal Sites of El Escorial, La Granja de San Ildefonso, Riofrío and El Soto de Viñuelas were joined, today these sites have become fragmented and some have disappeared altogether due to the urban pressure of the City of Madrid which has sealed an important area of soils (García Rodríguez and Pérez González 2011; Pérez González and García Rodríguez 2017). However, given the connections between the National Park of the Sierra de Guadarrama

and the Regional Park of Manzanares, this has permitted the establishment of SCIs (Sites of Community Importance) and Special Protection Areas for Birds (SPABs) which, being protected, have allowed biological interconnections and avoided the urbanization of these areas (García-Alvarado et al. 2020). This legislative protection has allowed for the conservation of significant treed spaces in the proximity of the city of Madrid, which has preserved important forest areas and their associated soils.

5. Conclusions

Apart from the historic, artistic and touristic importance of the Royal Sites, today they are also important for preserving the landscape and impeding the sealing of the soil.

The natural landscape of the Royal Sites constitutes an important ecologic unit that is very well preserved. Its evolution has always been determined by Madrid being the capital city. In

1561 (and once again in 1606) the city became the base of royal power, which resulted in the Royal Sites being established in its surroundings. The result of being the capital was that there was a constant population increase in the city. Over the past four centuries the pressure on these natural sites has been continuous, and the consequences can be seen today.

In addition to their inclusion as a National Park or a Regional Park, the more important protection afforded by National Patrimony for Royal Sites, has allowed for the conservation of natural landscapes. This not only includes the conservation of the soils, but also their acting as important ecological corridors for the movement of fauna between them.

Their protection reduces the degradation of these very fragile soils, which are little evolved and prone to erosion, and further it sustains significant natural spaces in the surrounds of the metropolitan area of the capital. Important forest areas of conifers (*Pinus sylvestris*), deciduous trees (*Quercus pyreniaca*) and Mediterranean ecosystems characterized by formations of holm oaks (*Quercus ilex*) and have been conserved.

Satellite images facilitate the cartography of natural areas and areas of sealed soils and allow for the study of their evolution. By comparing these images with historic maps one can analyse the changes that have occurred in these places since the Modern Age.

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