IMPORTANCE OF ECOSYSTEM SERVICES FROM AGROFORESTRY FOR LOCAL PEOPLE

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Introduction

Agroforestry systems provide great potential for environmental conservation and sustainable rural development, but the ecosystem services of European agroforestry and their contributions to human well-being have not been scrutinized from a social-cultural perspective. In this study, our aim is to understand the importance of ecosystem services from agroforestry for local people in a spatially explicit way at the landscape scale, and to reveal the contribution of agroforestry landscapes to subjective well-being. We present a first social-cultural assessment of ecosystem services provided by a European type of agroforestry through participatory GIS methods. The particular focus of this paper is the Spanish dehesa a traditional, low-input, extensive agroforestry system composed of open, heterogeneous canopies of holm oak (*Quercus ilex*) and cork oak (*Q. suber*) with a shrub or annual herbaceous understorey. Dehesas are estimated to cover about 2.3 million ha in Spain (Moreno & Pulido, 2009).

Material and methods

The study was carried out within the Llanos de Trujillo plains in Cáceres Province, south-western Spain (**Figure 1**). We conducted a participatory GIS survey with 219 local residents in Spanish agroforestry (dehesa) landscapes and analysed the spatial patterns of mapped ecosystem services and in particular their relation to land cover.

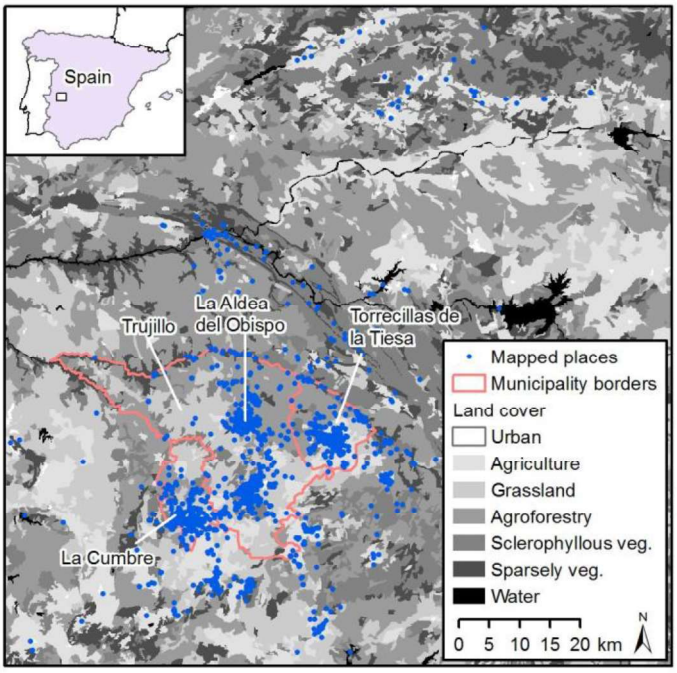

Figure 1: Study areas, the four neighbouring municipalities of Trujillo, Torrecillas de las Tiesas, La Cumbre and La Aldea del Obispo. La Aldea del Obispo is a small enclave within Trujillo.

Results

A total of 2594 places were mapped in the survey as significant sites of ecosystem service provision with a mean amount of 12 places per informant (min 3, max 30, SD 4.2). The majority (58%) was related to cultural services. Places for outdoor activities (17%), mainly for walking, were the most mapped.

Well-mapped cultural services were also sites of beautiful landscapes, social interaction and culture and heritage values (12%, 10% and 10% of mapped places respectively). Beautiful landscapes were related to oak trees and the dehesa, to views of the mountains and rivers, and to the panoramic view from the old castle of Trujillo. Sites for social interaction were especially

related to places where people gathered for a picnic with family or friends, or for the town festivities mainly in the vicinity of settlement areas (mean distance to home 5.6 km, max 0.59 points/ha). Culture and heritage values were mainly related to the town of Trujillo, historical bridges in the landscape and other (ruined) monuments (**Figure 2**). Inspirational, spiritual and religious values (5% of mapped places) and sites for intrinsic value of nature (4%) were among the lowest mapped among cultural services.

Provisioning services totaled to 24% of all mapped places. Provision of farm products, mainly meat and eggs, represented 11% of mapped places. Places for harvesting wild products, such as asparagus and fish, had a share of 13%. Harvesting was much more scattered around the landscape (**Figure 2**) compared with sites for farm products located closer to settlement with a higher spatial intensity (mean distance to home 8.5 vs. 4.7 km, max 0.35 vs. 0.66 points/ha).

Out of regulating and supporting services sites for appreciation of plants, animals and ecosystems were identified more than sites for appreciating environmental capacities such as water regulation (10% vs. 5% of all mapped sites). Special places presented 3% of all mapped places with the smallest spatial extent (4384 ha) and the most scattered pattern, most likely due to the limited number of these places.

When looking at the relationship to land cover, most of the mapped places were distributed in grasslands (27%), and the rest on agricultural (21%) and agroforestry (18%) areas, urban surfaces (17%), sclerophyllous vegetation or forest (11%), sparsely vegetated areas (6%), and water (1%). Almost half (45%) of all sites for provisioning services were found on grasslands and agroforestry areas. Farm products were also especially related to urban areas, where people commonly had chicken and home gardens. Cultural services were also most prevalent in grassland (28% of the mapped cultural services), urban areas (22%) and agroforestry areas (18%). Sites for outdoor activities, social interaction and beautiful places were especially found on grasslands and agroforestry areas. The sites for appreciation of local culture, cultural heritage or history dominated in urban areas. Grasslands and agroforestry areas (23% and 20% of mapped sites respectively) were the most typical for regulating and supporting services.

Comparison of these figures to the spatial extent of different land covers in the extended study area showed that sclerophyllous vegetation/forest (11% of places vs. 19% of land), agroforestry areas (18% of places vs. 25% of land), and water (1% of places vs. 2% of land) were less represented than the extent of the land cover. Agricultural areas, grasslands and sparsely vegetated areas showed slight overrepresentation.

Discussion

The starting point of our study was the assumption that, based on evidence from biophysical assessments (Smith et al., 2013; Torralba et al., submitted), agroforestry systems would generally provide higher levels of ecosystem services than other land use systems. Indeed, our respondents allocated multiple ecosystem services to agroforestry lands within our study area. However, the intensity was not higher than for the surrounding agricultural or semi-natural areas. These areas clearly differ from agroforestry land in their vegetation structure and visual appearance. But they are also managed by low-input land-use systems, have a high share of semi-natural habitats and are of overall high nature value (Veen et al., 2009). Moreover, grasslands are also culturally relevant to local people (Stenseke, 2006). We find that it is less individual land-use systems, but rather our study landscape as a whole that provides ecosystem services to people, though agroforestry is an important part of this landscape with long traditions and historical roots. The fact that people working in agriculture and forestry and those with a better knowledge of the area had a higher appreciation for the ecosystem services in agroforestry areas, point to a second explanation: the dehesas of our study area are mostly in large private ownership and usually do not offer access to the public. Many people simply may not have physical access to these lands and are therefore unable to allocate ecosystem services to them as discussed above.

Acknowledgements

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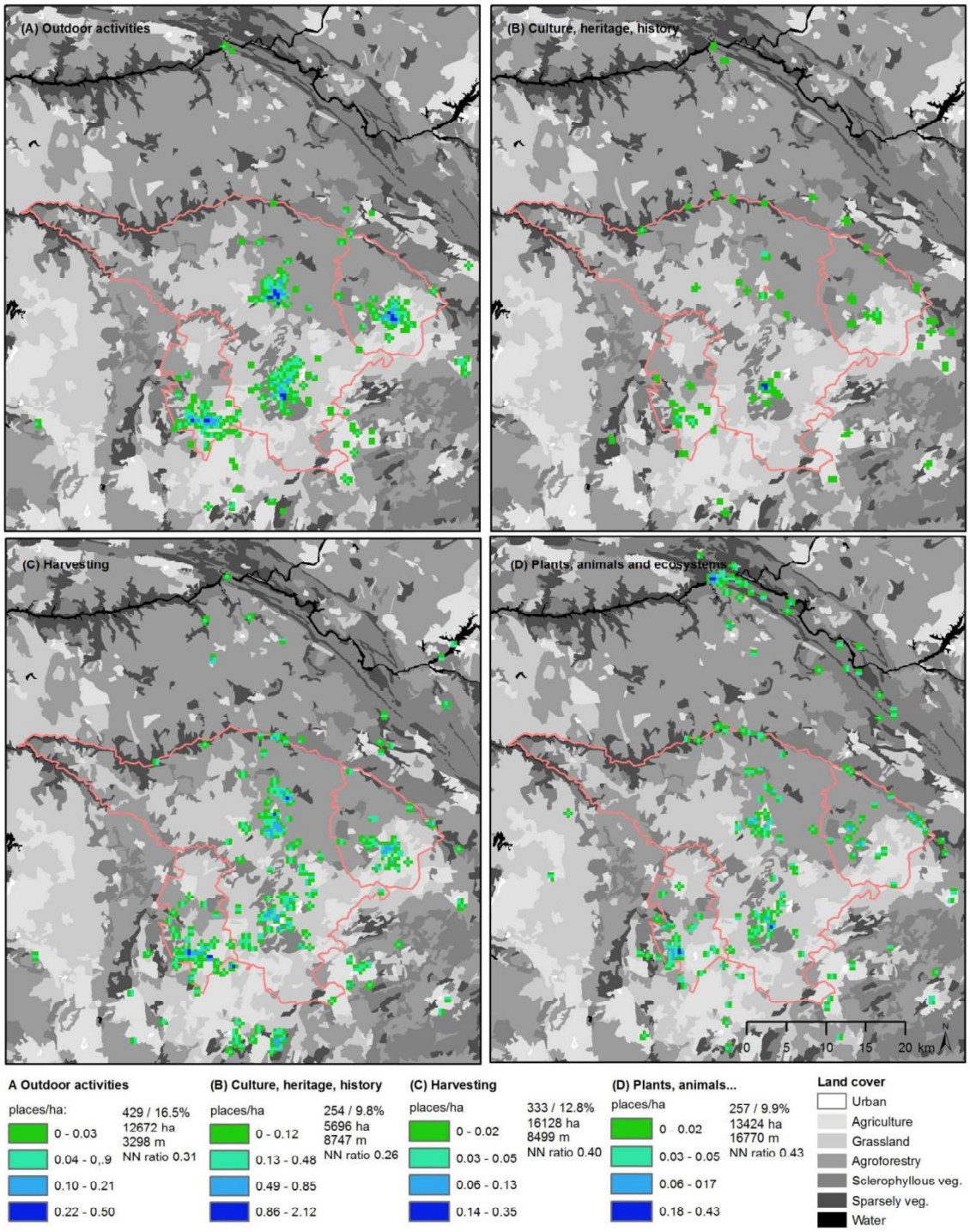

Figure 2: Spatial intensity (points/ha) for four ecosystem service indicators of outdoor recreation (A), appreciation of local culture, cultural heritage or history (B), harvested products (C) and appreciation of plants, animals and ecosystems (D). Descriptive data indicate the number of mapped points and relative proportion of all mapped points per indicator, area (ha), average distance (m) from informant home to mapped point locations, and nearest neighbour ratio.

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