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Influence of the resolution of forest cover maps in evaluating fragmentation and connectivity to assess habitat conservation status

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ABSTRACT

The analysis of fragmentation and habitat connectivity is important in determining their conservation status and ensuring their long-term survival. However, the reliability of assessments on habitat conservation status may depend on the resolution of forest cover maps used as inputs. The aim of this paper is to quantify differences in the results of habitat fragmentation and connectivity analysis found when using three different forest cover maps of various resolutions, and discusses their effect in the assessment of habitat conservation status. The study was conducted in a Natura 2000 habitat (9120:Atlantic acidophilous beech forests) in Spain. To measure fragmentation, we carried out a morphological spatial pattern analysis (MSPA) which provided a very detailed spatial landscape description (core, islet, bridge, loop, branch and perforation elements). We compared the habitat total area (Hta) with the habitat area without edge width (Hwe), which correspond to the obtained previous cores. To measure connectivity, we used the probability of connectivity index (PC). We used three different forest cover maps with different spatial resolutions: (1) a 2 m map derived from remote sensing using very high resolution satellite imagery (GeoEye) processed with object-based image analysis (OBIA_layer); (2) a 10 m map derived from fieldwork and aerial photo-interpretation at 1:10,000 scale (Forest_layer); and (3) a 50 m map obtained by a similar method at 1:50,000 scale (Atlas_layer). Our results confirm results obtained by previous studies showing that the resolution of input forest cover maps substantially influences MSPA results. The habitat area proportion classified as core decreased as the resolution of input forest cover maps increased, whereas the amount of islets, bridges, loops, branches and perforations increased. The spatial resolution of forest cover maps influences the assessment of habitat conservation status. Habitat conservation status was assessed as being 'unfavourable inadequate' (the middle rank out of three) with the coarse Atlas_layer, and as 'unfavourable bad' (the bottom rank out) when using the higher resolution Forest_layer and OBIA_layer. This can be critical for European environmental funding. Results obtained also show that resolution of input forest cover maps influence the calculated values of PC index. The use of high-resolution forest cover maps is critical to study habitat connectivity, since otherwise the outcome presents no appreciable result. We conclude that using remote sensing techniques together with OBIA is the most appropriate and cost-effective method for analyzing forest fragmentation and connectivity for habitat conservation status assessments. The source and/or the method of generation of the habitat data layer used (also the spatial resolution) as well as the connectivity analysis method applied must at all times be reported in such analyses.

1. Introduction

Forest loss and fragmentation produce a progressive change in spatial landscape configuration, affecting species survival (Telleria and Santos, 2001). Forest loss refers to the clearing of forests for pasture, harvesting, cultivation or urban development (Liu et al., 2016) and fragmentation refers to the breaking up of a habitat, ecosystem, or land-use type into smaller parcels (Forman, 1995). Considering the continuous anthropogenic land use, both loss and fragmentation are serious threats to the conservation of biodiversity (Turner, 1996). The degree of fragmentation is important as it may determine whether a patch of habitat is large enough to support survival of a population of some species. The degree of fragmentation can be described using four variables: size of fragments, number of fragments, distance between

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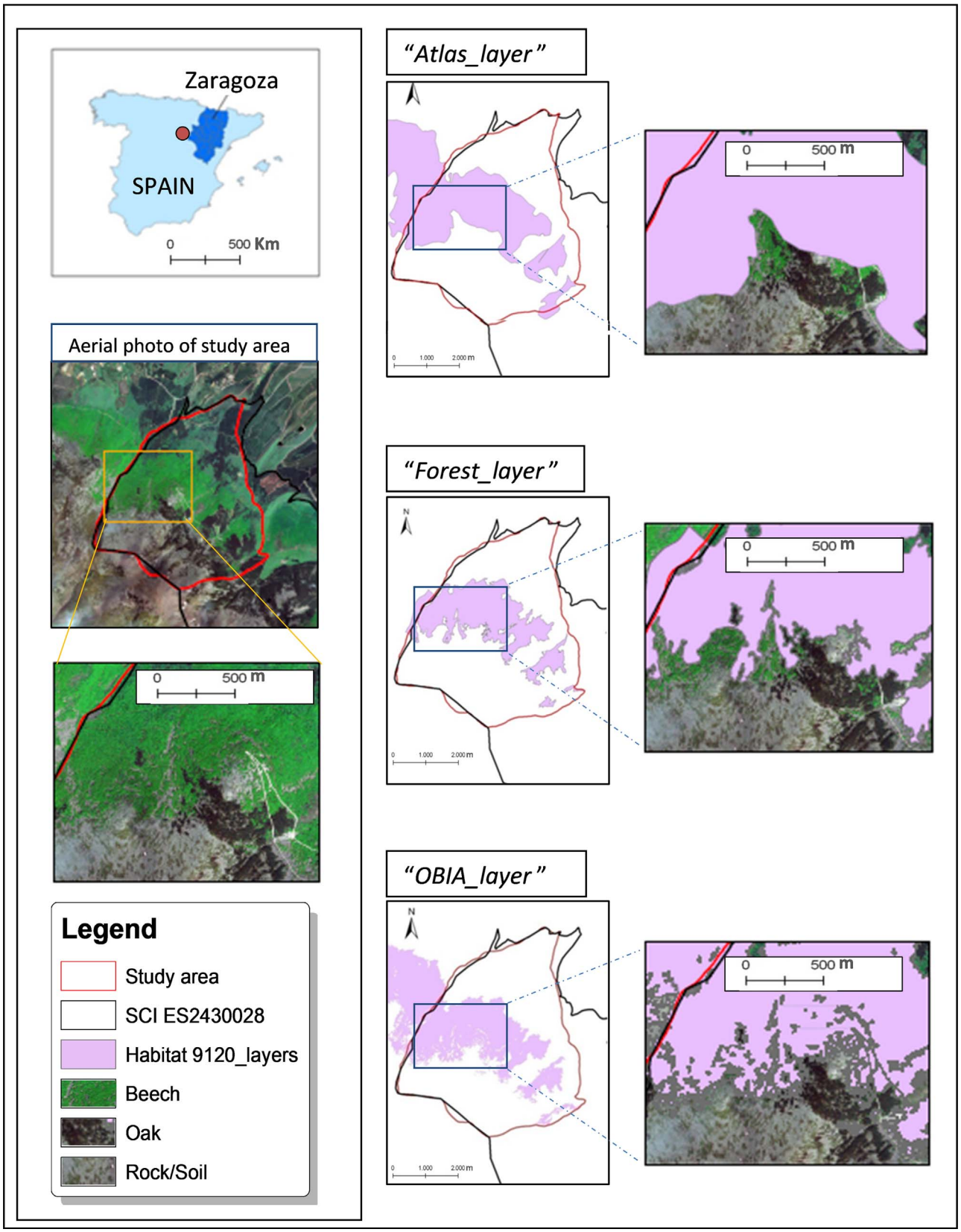

Fig. 1. The three mapping resolutions used for the study: *Atlas_layer* (50 m), *Forest_layer* (10 m) and *OBIA_layer* (2 m). In detail, we show the same area at different resolutions.

fragments, and edge width (Santos and Telleria, 2006). One strategy to mitigate the effects of severe forest fragmentation is to maintain or increase connectivity between habitat fragments (Saura et al., 2011). Connectivity is defined as the degree to which the landscape facilitates the species movement between fragments (Vogt et al., 2009). Connectivity is a functional parameter; it depends not only on the landscape structure, but also on the behavior of the organisms and their dispersal capacity (King and Width, 2002).