

# The way towards more effective conservation practices: Understanding *Lullula arborea* and *Lanius collurio* occurrence patterns in the National Park of Lakes Koronia-Volvi and the Macedonian Tempe

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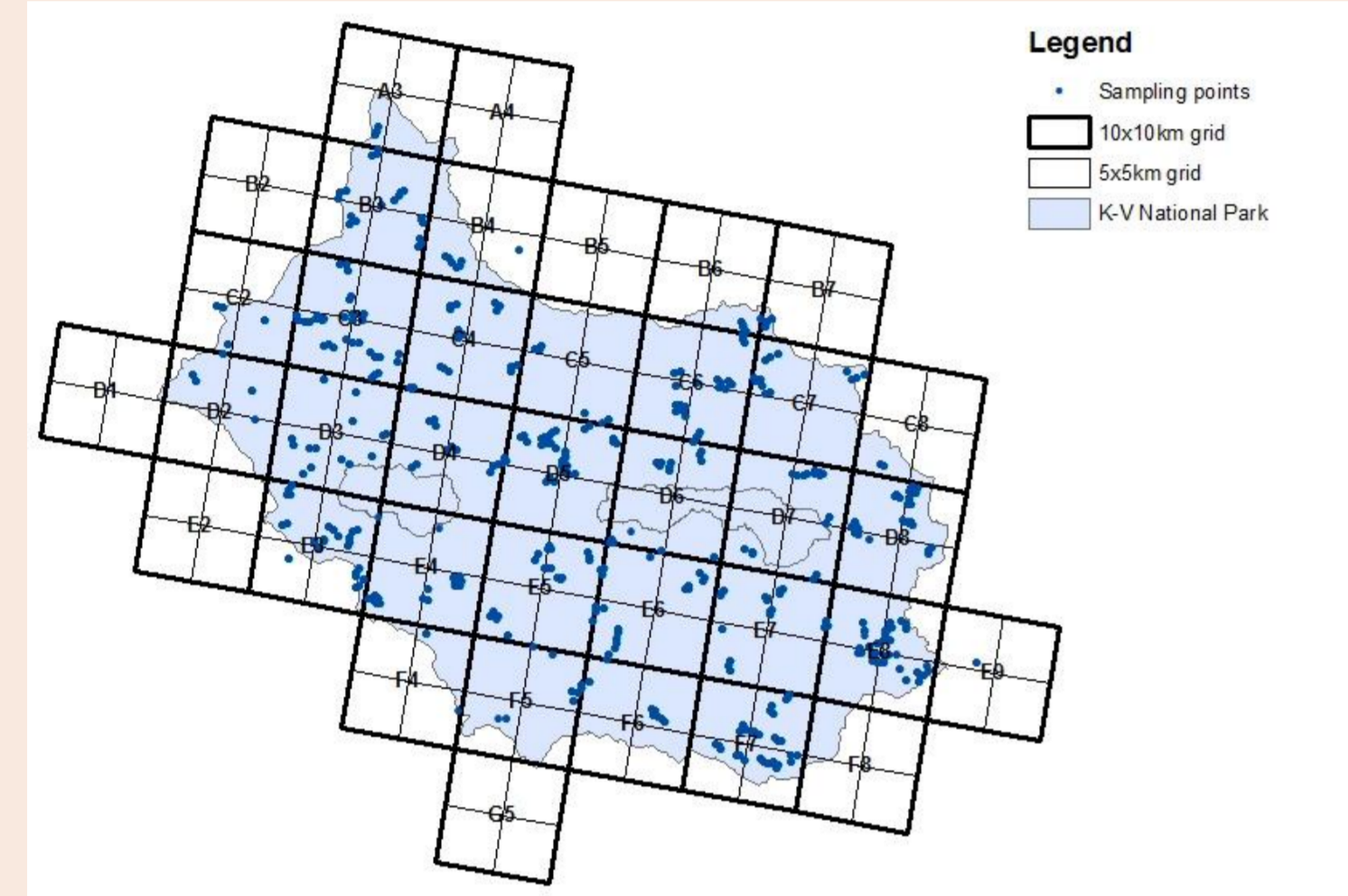


## Introduction

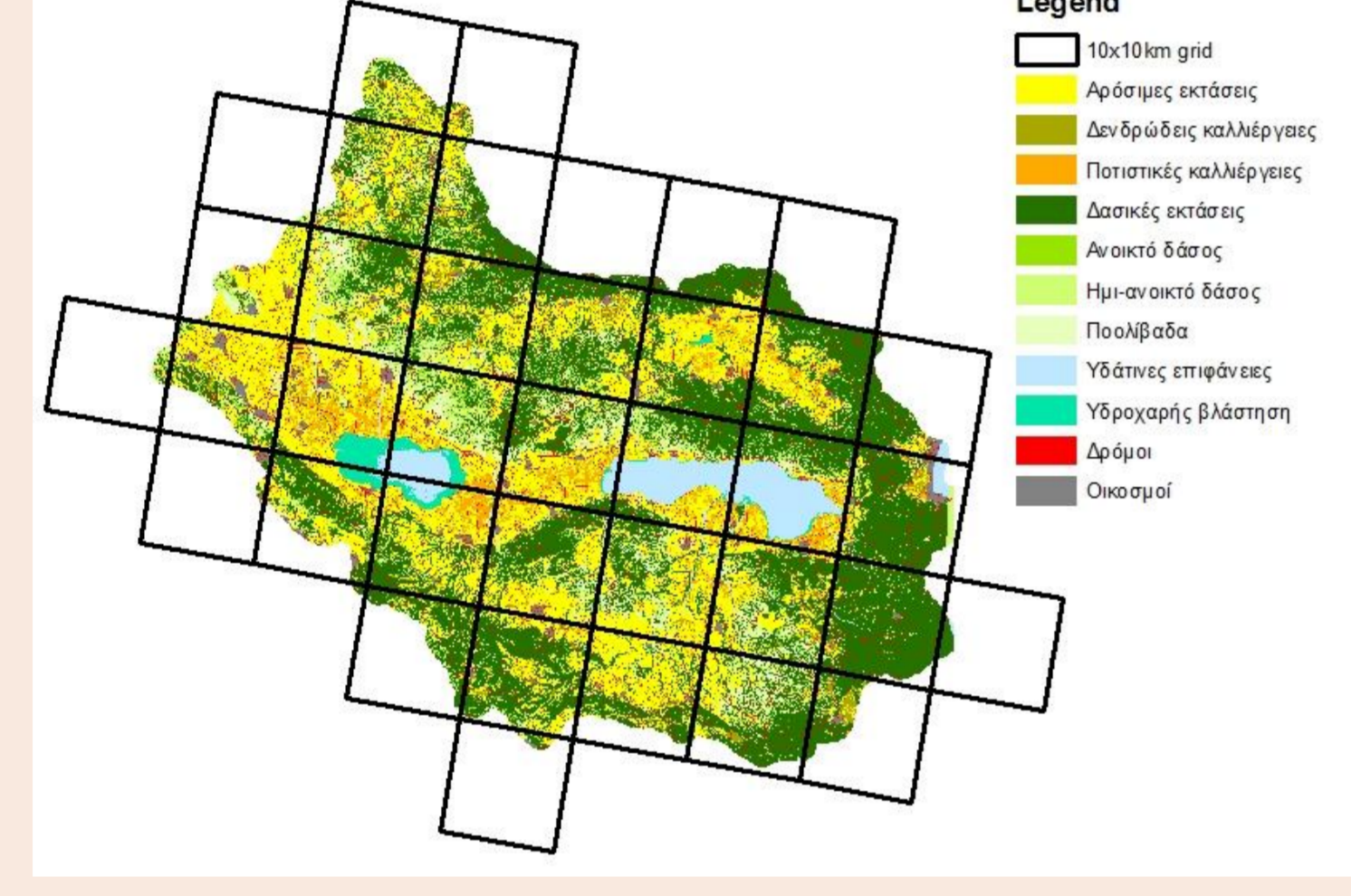
The need to preserve biodiversity in constantly changing landscapes in Europe has led to the designation of the Natura 2000 network and the need for a closer examination of species distributions and requirements within each site for the implementation of effective conservation measures. Heterogeneity in agricultural landscapes is a key feature for preserving farmland bird species, many of which are listed as threatened<sup>1</sup>. However, different habitat requirements sometimes pose a challenge for multiple species conservation. In this study we examine habitat suitability for two passerine species, *L. arborea* and *L. collurio*, listed in Annex I of Dir.2009/147, in the National Park of Lakes Koronia-Volvi and the Macedonian Tempe (SPA GR1220009).

## Methods

We sampled 477 points, with 100m radius, from 2013 to 2015 and recorded 217 and 30 individuals of *L. arborea* and *L. collurio*, respectively:



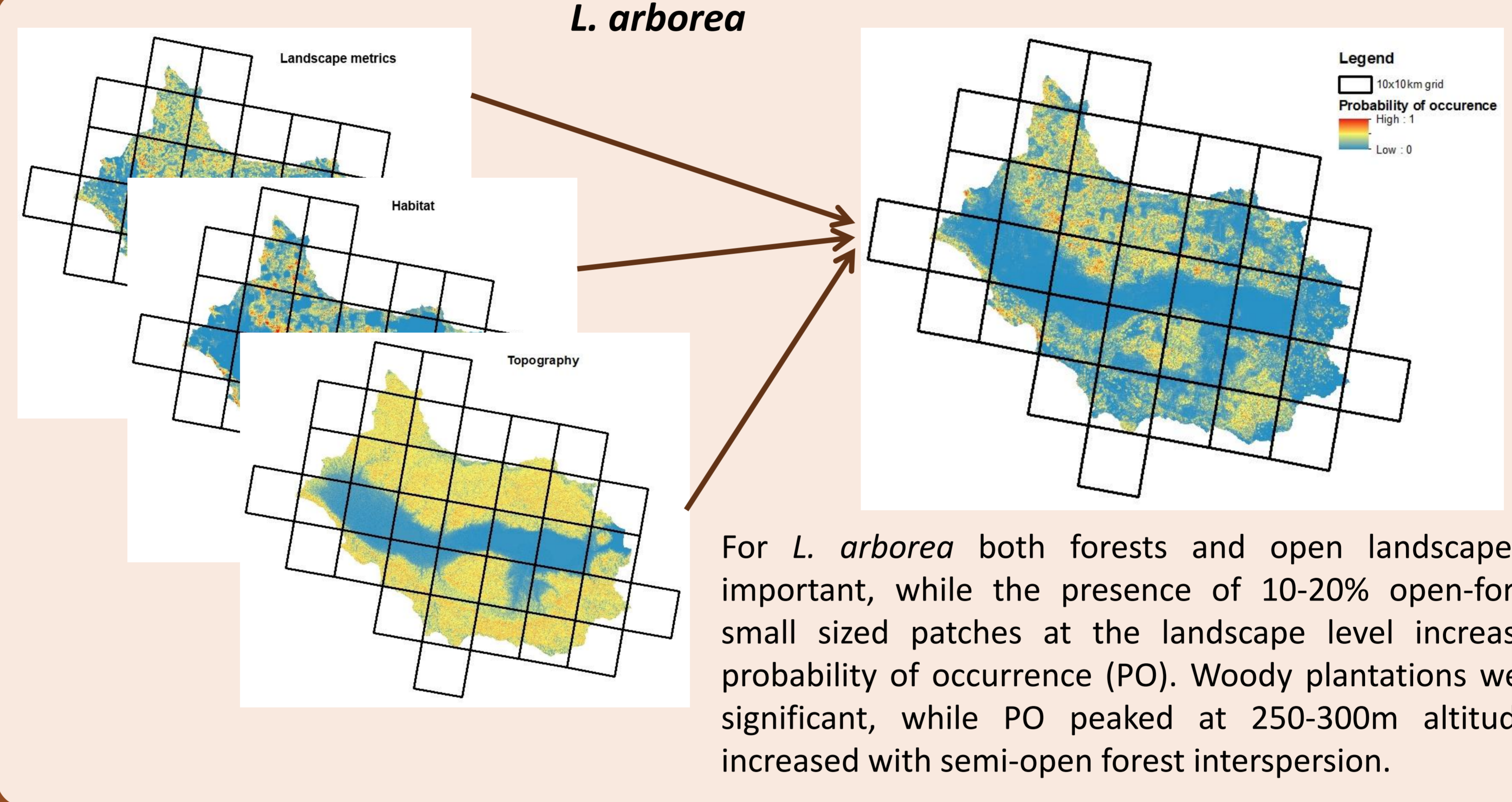
We mapped landscape features and classified them into 11 classes and 26 sub-classes:



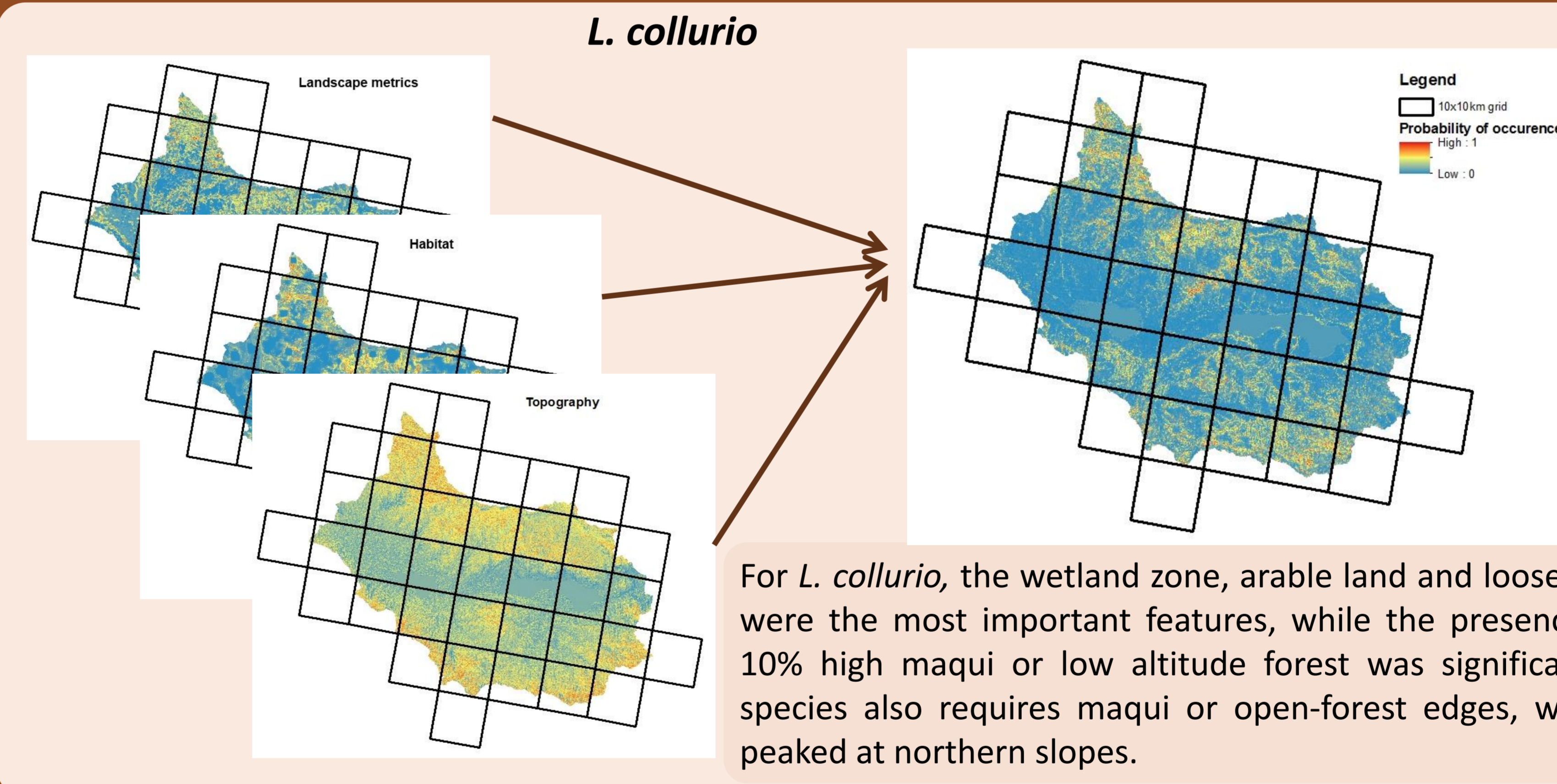
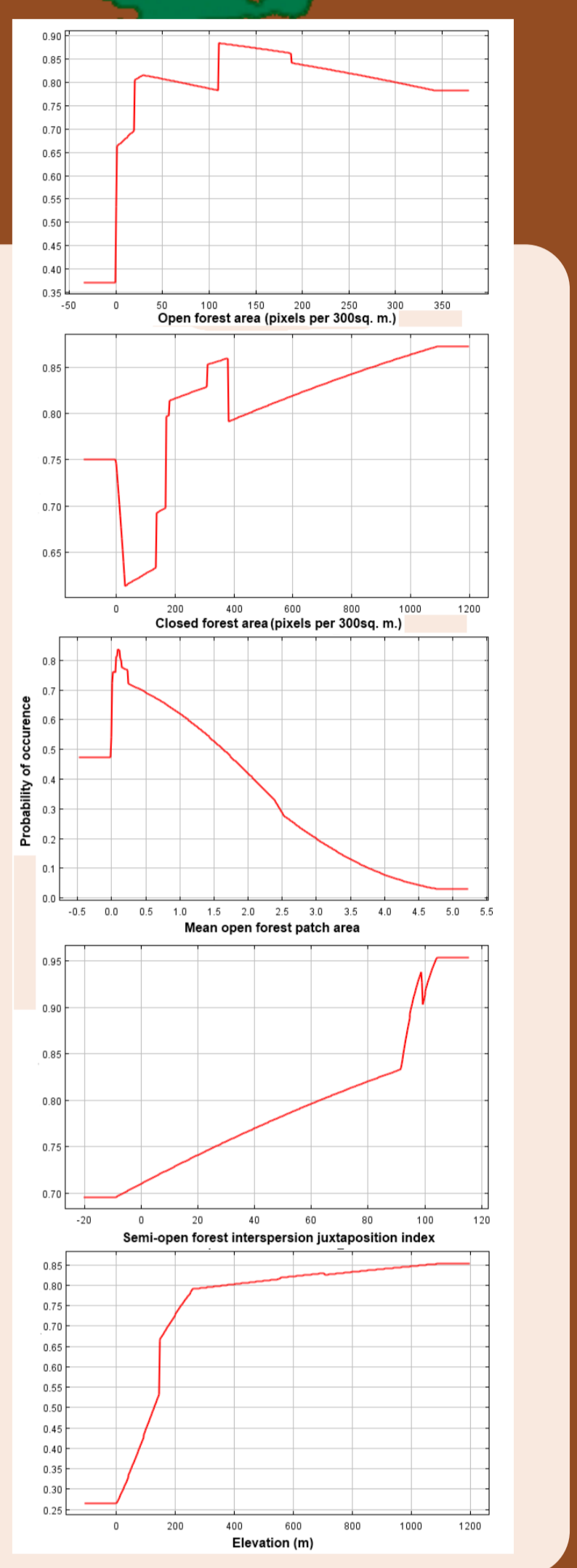
We extracted a set of landscape metrics, using Fragstats 4.2<sup>2</sup>, which we imported to Maxent 3.3.3<sup>3</sup>, along with a set of other variables regarding habitat and topographic attributes:

<b>Landscape metrics</b>	1. Mean patch area
	2. Patch cohesion index
	3. Contagion
	4. Edge density
	5. Mean radius of gyration
	6. Interspersion juxtaposition index
	7. Largest patch index
	8. Landscape shape index
	9. Effective mesh size
	10. Number of patches
	11. Patch density
	12. Shannon's diversity index
	13. Shannon's evenness index
<b>Habitat attributes</b>	14. Area of each habitat type at a 300m radius around each point
	15. Habitat classification
<b>Topographic attributes</b>	16. Aspect
	17. Elevation
	18. Slope

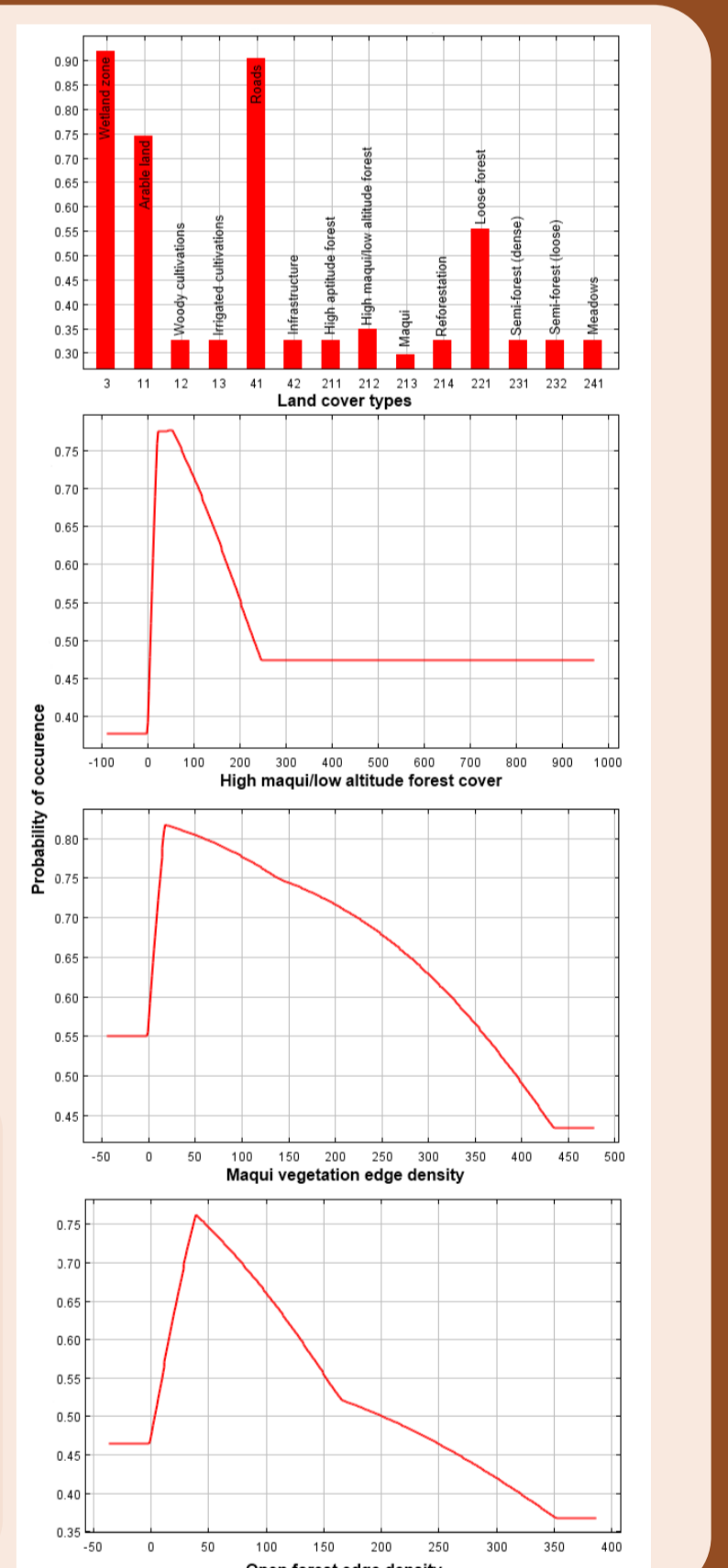
## Results



For *L. arborea* both forests and open landscapes were important, while the presence of 10-20% open-forests as small sized patches at the landscape level increased the probability of occurrence (PO). Woody plantations were also significant, while PO peaked at 250-300m altitude, and increased with semi-open forest interspersion.



For *L. collurio*, the wetland zone, arable land and loose forests were the most important features, while the presence of 5-10% high maqui or low altitude forest was significant. The species also requires maqui or open-forest edges, while PO peaked at northern slopes.



## Discussion

When it comes to habitat selection, *L. arborea* and *L. collurio* seem to share many common characteristics. However, differences is what makes their conservation challenging within a certain area, as satisfying the requirements of both may not be an easy task<sup>4</sup>. *L. arborea* is a species using both forest and open habitat, positively affected by forest edges<sup>5</sup>. It is mainly threatened by agricultural land intensification, while land abandonment seems to have a positive effect, as the expansion of shrubland, up to a threshold benefits it<sup>6</sup>. At the same time, *L. collurio* is an ecotone species, long known for its sensitivity to agricultural land use changes, including both intensification, through the destruction of hedges, and abandonment, through forest expansion<sup>7,8,9</sup>. In an attempt to best serve the needs of both species we suggest the establishment of large areas of traditional, mild agricultural use, mixed with scattered shrubland and open forest patches, within the study area. However, given the importance of a great variety of bird species in the National Park, the necessity to better serve the needs of as many as possible, renders further studies critical, so that other species-specific needs are also evaluated.

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