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HABITAT MODELING FOR LOCAL ABUNDANCE ESTIMATING. THE RED PARTRIDGE IN AN AGROSYSTEM IN TOLEDO (CENTRAL SPAIN)

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I. INTRODUCTION AND OBJETIVES

Local management as hunting, agriculture or rural development need a good knowledge of the ecosystem to guarantee wildlife conservation. Nevertheless, most of the times there are not enough time or resources to do the studies with the required effort. Specifically the fauna populations monitoring is an essential task in any management program (Belda *et al*. 2011), but in general the monitoring works are scarce detailed. Accordingly, the habitat modeling methods are a useful tool to predict fauna distribution or abundance with a scarce sampling data (Guisan & Zimmermann 2000 y Nielsen *et al*. 2005).

Usually habitat models are used to predict the distribution of rare or threatened species, or to predict the potential dispersion of invasive species (Engler *et al*. 2004), when populations or suitable habitats are small. In the same way, these models are usually used to predict species distributions for regional or continental scales using topographic and climatic variables (Araújo & Louto 2007). Nonetheless, there are only few studies about huge range species and about predictions at local scales. Hunting management is a particular example of local management where is necessary an exhaustive monitoring programs of fauna populations, and where the use of this kind of modeling methods can be useful.

In this context, the aims of this study are to determine if the habitat modelling at local scale is useful to estimate fauna abundance, to find out the contribution that have been the land use changes to the *Alectoris rufa* populations, and to deepen the ecological requirements of *Alectoris rufa* in the study area.

II. SPECIES AND STUDY AREA

As study case we selected the space surrounded by the hunting preserve of Valmojado village (Toledo). It is located in the NW of Toledo province, and its total surface is 6.758 hectares. The geomorphology is undulating with slight slopes, the altitudes vary between 550 and 680 m.a.s.l., and the climate is homogeneous in the whole territory. The landscape is a good representation of the traditional Spanish agriculture landscape, with a mosaic structure of vineyard, cereal crops, small olive groves, and small Mediterranean scrubland plots. However, during last years the farming lands have been abandoned and scrublands surface has been increased, so the mosaic structure is changing.

In the study area the most important hunting species is *Alecotirs rufa* (red partridge), and moreover it is a central species of the Mediterranean food chain (Blanco Aguiar *et al*. 2004). *Alectoris rufa* live preferably in agricultural areas (Fortuna 2002), and the mosaic structure landscape is the most important factor in the habitat selection of *Alectoris rufa* (Blanco Aguiar *et al*. 2004). Consequently their populations are highly affected with the land occupancy changes, and that is the reason why the main threats of *Alectoris rufa* are the intensification or abandonment of agricultural activity (Blanco Aguiar *et al*. 2004). The study area has one of the most *Alectoris rufa* density of Spain, even so, the *Alectoris rufa* populations dropped in general during last decades in whole Spain (Blanco Aguiar *et al*. 2004).

III. METHODS

To sample *Alectoris rufa* presence we used 11 transects which total length was 37 km. In each transect we recorded all *Alectoris rufa* sighted in a buffer of 100 meters in both sides, and for each contact we noted the UTM coordinates and the distance to the track. Then, to model the suitable habitat we selected three types of variables: topographic, land use, and various landscape structure indices. The landscape structure indices were created with the software Fragstats® (McGarigal *et al*. 2002) and Esri® Arcmap™ 10.0, and there were created for the year 2009 and for the year 2000. Before we detected the land use changes between 2000 and 2009 using the land registry parcel and aerial photographs to classify the land uses. In total we used 11 variables for each year to model the habitat: 8 landscape structure indices, 2 topographic variables (slope and geomorphology), and the land use. After that, to calculate the suitable habitat we chose an only presence model because we consider that the use and the results interpretations of these methods are simpler than other methods, and the precision and reliability are enough for local management tasks. In particular, we used the Maxent model (Phillips *et al*. 2006), because many comparative studies support that Maxent interpretations are better and simpler than other methods (Sérgio *et al*. 2007, Benito de Pando & Peñas de Giles 2007), and because it is a method rather stable using correlated variables (Elith *et al*, 2011). The *Alectoris rufa* suitability habitat model was created with the actual data, and then the model was projected 10 years ago. Afterward, the abundance of *Alectoris rufa* was calculated with the software Distance 6.0 Release 2 (Thomas *et al*. 2010) by two methods: firstly considering only one stratum, and secondly using two stratums that have been obtained from the classification of the suitability habitat model.

IV. RESULTS

The ecology explanation of the habitat model made supports other results obtained in previous studies about *Alectoris rufa* (Herranz *et al*. 2000; Fortuna 2002; Buenestado *et al*.

2008). In this regard, the ecological requirements that we deduced agree on a positive selection of fragmented farm areas with a high patches density. Inside this structure, we observed a light preference to vineyard patches, and a refusal to pastures. Furthermore, we observed that *Alectoris rufa* select bottom valleys against hills or slopes.

In the other side, the abundance estimating that we obtained using two stratums give lower variation coefficients than using only one stratum, so we can support that abundance estimating accuracy for *Alectoris rufa* was better using the habitat suitability model to create stratums for the estimation. Moreover, this methodology make possible to do projections and predict the potential effects over the abundance variability caused by an ecosystem transformation. Consequently this methodology can be a useful tool for management tasks.

The model projection to year 2000 shows a decrease of the high suitability area surface for *Alectoris rufa*, which would has caused its abundance decrease. We deduce that this abundance decrease is because of the variations produced on the land use during 2000 and 2010, as is just the only variation that we took into account between the two models. Those land use variations observed are mainly consequence of the agriculture abandonment, which affects to the 20 % of the total study area. And this massive abandonment reduces the number of patches and the ecosystem fragmentation, which original mosaic structure compose the best suitable habitat for *Alectoris rufa*.

V. DISCUSSION AND CONCLUSIONS

Some authors agree that the agriculture intensification is the main reason of the general decrease of *Alectoris rufa* populations (Fortuna 2002 y Vargas 2002). However, in this study we assert that another factor -the agricultural abandonment- is the cause of drop populations of *Alectoris rufa*. These contradictory causes point out that the essential to hold the red partridge abundance is to preserve the traditional agricultural landscape, keeping a variety mosaic of crops and vineyard with some scrubland patches mixed (Jiménez-García *et al*. 2006, Buenestado *et al*. 2008 y Belda *et al*. 2011).

Finally, we assert that to preserve the *Alectoris rufa* populations and their associated species is necessary to assume appropriate management tasks that favour the maintenance of traditional farming conditions, which guarantee the mosaic landscape structure.

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