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Short Communications

WINTERING HABITAT SELECTION BY EURASIAN WRYNECKS *JYNX TORQUILLA* IN THE WEST OF THE IBERIAN PENINSULA

SELECCIÓN DE HÁBITAT EN INVIERNO POR EL TORCECUELLO EUROASIÁTICO *JYNX TORQUILLA* EN EL OESTE DE LA PENÍNSULA IBÉRICA

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SUMMARY.—The Iberian Peninsula is a wintering area for an estimated 300 million birds. Most insectivorous birds winter in the southern half of the Peninsula, where mild mid-winter temperatures ensure the availability of insects. However, case studies of habitat use by specific species during winter are still rare. A species of particular interest is the Eurasian wryneck *Jynx torquilla*, the only long-distance migratory woodpecker in Europe that feeds almost exclusively on ants. Its European populations have declined throughout Europe over recent decades. Wrynecks are known to winter in the Iberian Peninsula but it has only recently been shown that at least some of these birds originate from Central European breeding populations. Hitherto, the habitats they select in winter have remained unknown although it is plausible to think that they are habitat specific given the birds' strong reliance on ants as their main food source. We studied the wintering habitat selection by wrynecks in northern Extremadura, Spain, with MaxEnt models. We found that they chose diverse, extensive, agricultural (irrigated) croplands. Our findings highlight the importance of these threatened landscapes for wintering birds.

Key words: Extremadura, Maxent, presence data, species distribution modelling, wintering distribution, wintering habitat.

RESUMEN.—La península Ibérica es una conocida área de invernada con unos 300 millones de aves que pasan el invierno cada año. La mayor parte de las aves insectívoras invernan en la parte sur de la Península, donde unas temperaturas suaves e inviernos benignos aseguran la disponibilidad de los insectos. Sin embargo, los estudios sobre uso del hábitat en invierno específicos para una determinada especie son todavía raros. Una especie de particular interés es el torcecuello eurasiático *Jynx*

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torquilla. Es el único pájaro carpintero migrador de Europa que se alimenta casi exclusivamente de hormigas y ha sufrido declives poblacionales en toda Europa durante las últimas décadas. Se conoce que los torcecuellos invernan en la península Ibérica, pero solo recientemente se ha demostrado que al menos algunas de estas aves proceden de poblaciones reproductoras centroeuropeas. Aún así, se desconoce exactamente qué habitats prefieren estas aves durante el invierno, aunque es plausible plantear que deben ser específicos dada su fuerte preferencia por las hormigas como principal fuente de alimento. El objetivo de este trabajo fue estudiar las preferencias de hábitat de los torcecuellos en el oeste de la península Ibérica durante el invierno con modelos MaxEnt. Nuestros resultados muestran que los torcecuellos seleccionaron heterogeneos y extensivos cultivos de regadío. Los resultados subrayan la importancia de preservar este mosaico paisajístico, hoy en día en retroceso, para las aves invernantes.

Palabras clave: datos de presencia, distribución invernal, Extremadura, hábitat invernal, Maxent, modelo de distribución de la especie.

Introduction

Some 300 million birds winter every year in the Iberian Peninsula (Santos and Telleria, 1985), especially within the Meso- or Thermomediterranean zones of the southern half. Such habitats are characterised by low annual precipitation (~200-500 mm) and relatively high mean temperatures during mid-winter (4-11 °C) which ensures the availability and activity of insects throughout the winter months (Santos and Telleria, 1985). In addition, there are many irrigated croplands in this region, which are presumed to be the habitat of choice for birds that are not specialists of dense oak forests (Tellería *et al*., 1988).

A species of particular interest is the Eurasian wryneck *Jynx torquilla*. Wrynecks are migratory woodpeckers whose populations from Central, Northern and Eastern Europe have been presumed to be long-distance sub-Saharan migrants, whereas birds from southern Europe and northern Africa have been regarded as mostly short-distance migrants or residents (Cramp *et al*., 1985). As early as 1956, however, it was suggested that some birds found in winter in the Iberian Peninsula could actually be migrants from Central European populations (Moreau, 1956). It has only recently been confirmed that some of the nominate race of wrynecks wintering in Iberia originate from Central European populations (van Wijk *et al*., 2013). Where exactly they occur in winter has hitherto remained unclear but central European wrynecks feed almost exclusively on ants during the breeding season and occur in ant-rich habitat such as orchards and fallow land with sufficient bare ground for foraging (Mermod *et al*., 2009; Weisshaupt *et al*., 2011). Given these specific habitat requirements during the breeding season, we expected wrynecks to occur in similar, specific ant-rich habitats within the Iberian Peninsula in winter. The present study aimed to provide insights into habitat selection by wrynecks in winter in the west of the Iberian Peninsula.

Material and methods

We sampled 68 random locations throughout Northern Extremadura in January 2014 and January 2015 (fig. 1). The study area was selected based on geolocator findings (van Wijk *et al*., 2013) and distribution predictions from the Spanish wintering bird atlas (SEO/BirdLife, 2012). Specific sampling locations were chosen by driving for a fixed period on roads distributed throughout the territory. At each of these locations song

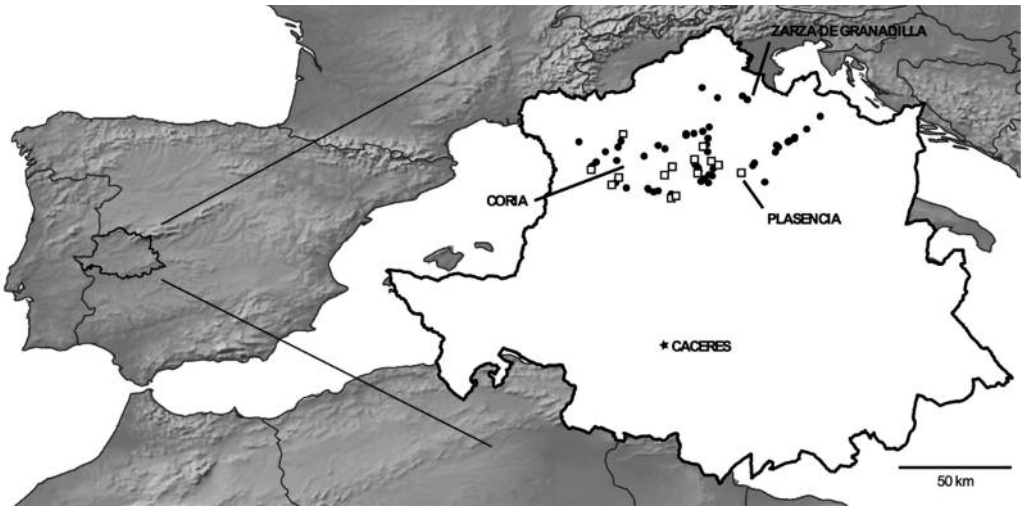

FIG. 1.—Overview of the study area and the locations sampled for the presence of wrynecks in Extremadura. Open squares show locations with confirmed presence and black dots depict locations where wrynecks were not detected.
[Muestra del área de estudio y las localidades muestreadas para la presencia del torcecuello en Extremadura. Los recuadros huecos muestran localidades con presencia confirmada y los puntos negros localidades donde los torcecuellos no fueron detectados.]

playback was used for three minutes using a Foxpro® Wildfire 2 (~100dB) speaker followed by a five-minute wait for any response. Wrynecks are known to respond strongly to the songs of conspecifics, at least during spring and summer (Coudrain *et al*., 2010).

To describe the habitats within this region, both in terms of bioclimate and environment, we used data of a wide range of variables (table 1) acquired via a free source, the "*Catálogo del Ministerio de Agricultura y Medio Ambiente*". Raster layers of 45,000 km^2 were created for each variable with a pixel size of 60 m^2 using QGIS (Quantum GIS Development Team, 2015). Only altitude was analysed as a climatic variable since altitude is highly correlated with temperature and precipitation in the Iberian Peninsula (Lautensach, 1967; Sa-Sousa, 2000).

Subsequently we developed a model in MaxEnt using the 14 points where wrynecks were present (fig. 1), all available environmental layers (described in table 1) and 10,000 random points throughout the 45,000 km^2 area (Phillips *et al*., 2006). All environmental layers that did not contribute to the model (lambda = 0) were excluded, after which each selected categorical layer was transformed into different predictor variables, as many as categories the layer had, with a presence-absence format (1-0) (e.g. presence of sclerophyllous forest). These categorical variables and the altitude layer were tested for colinearity and layers with a correlation ≥ 0.70 or ≤ -0.70 were excluded. The selection of variables used in the final MaxEnt model, is described in table 2. Variables were considered relevant for the interpretation of the model based on the outcomes of the jack-knife test as part

TABLE 1

Environmental variables used in the initial MaxEnt model, their general description, the number of categories within the variable layer (#Cat.), whether the layer was preselected in the initial MaxEnt model (Presel.), the number of categories of each environmental variable that were kept in the final model (#Cat. Kept) and the source of each environmental variable (Source). MAGRAMA: Catálogo de Metadatos del Ministerio de Agricultura y Medio Ambiente de España (http://www.magrama.gob.es/ide/metadatos/). IGN: Centro Nacional de Información Geográfica. Instituto Geográfico Nacional (http://centrodedescargas.cnig.es/).
[Variables ambientales usadas en el modelo inicial MaxEnt, sus decripciones generales, el numero de categorías dentro de la variable "layer" (capa) (#Cat.), si "layer" fue preseleccionado en el modelo inicial MaxEnt (Presel.), el número de categorías de cada variable ambiental que fue guardado en el modelo final (#Cat.Kept) y la fuente de cada variable ambiental (Source).]

Layer	Description	#Cat.	Presel.	#Cat. kept	Source
aguassub	underground water	1	no		MAGRAMA
altitude	altitude (metres above sea level)	NA	yes	NA	Ninyerola *et al*. (2005)
cauces	water course	1	no		MAGRAMA
corinegeneral	generic land use, e.g. agriculture	4	yes	0	IGN
corine	specific land use, e.g, dry farming	26	yes	3	IGN
geopb	geological soil type	24	yes	1	MAGRAMA
mfe50def	dominant vegetation	26	yes	2	MAGRAMA
mfe50nomforarb	forest structure	33	yes	1	MAGRAMA
mfe50usos	habitat management	7	yes	2	MAGRAMA
seriep	specific phytoclimatic classification of the vegetation	11	no		MAGRAMA
seriepgeneral	generic phytoclimatic classification of the vegetation	7	no		MAGRAMA

of the MaxEnt output: when their percentage contribution or permutation importance was at least > 1%. These variables were used to discuss the biological implications of the results (table 2). The area under the ROC curve (AUC) determined the predictive power of the model and was used to evaluate it.

RESULTS

Wrynecks were found at 14 of the 68 locations sampled. The highest probability of wryneck occurrence according to the final MaxEnt model (fig. 2) is associated with habitats characterised by irrigated crops

TABLE 2

The categories that were kept in the final MaxEnt model, description, lamba values, relative contribution and permutation importance are shown.
[Se muestran las categorías que fueron guardadas en el modelo final MaxEnt, descripción, valores lambda, contribución relativa y permutación.]

Layer	Description	Lambda	Percent contribution	Permutation importance
corine20	irrigated crops, e.g. rice fields	2.36	54.9	15.9
geopb24	geomorphological alluvial plain with gravel, clay	0.89	10.7	1.6
altitude	altitude (meters above sea level, range 7 – 232 meters)	–26.87	10.3	64.4
mfeusos6	cultivated areas	1.29	8.3	4.2
mfeusos2	forest	0.56	5.0	0.7
corine10	natural water bodies, e.g. rivers or ponds	3.74	3.4	2.3
corine13	sclerophyllous vegetation, e.g. *Quercus ilex*	1.80	2.2	2.0
mfe12	woodland, e.g. patches of forest	1.05	1.7	0.2

close to water bodies, with sparse woodland nearby (table 2). This is locally represented by extensive crops in soils characterised as sandy riverbeds, where sclerophyllous vegetation adds structural diversity to the landscape. Other habitat features present in the areas highlighted in the final MaxEnt model are crops such as meadows or rice fields, as well as olive groves.

There was a strong influence of altitude on the probability of wryneck occurrence. Wrynecks selected lower altitudes which can be interpreted as warmer, drier locations with Mediterranean vegetation. It is interesting that at least some wrynecks did respond to playback in mid-winter and thus seemed to show some degree of territorial behaviour.

DISCUSSION

Based on the interpretation of the final MaxEnt model, we argue that wintering wrynecks in northern Extremadura select a mix of Meso- and Thermomediterranean habitats corresponding to diverse croplands under extensive management. The presence of sparse woodland provides shelter and presumably deep sandy soils, such as those found in riverbeds, that provide optimal habitats for foraging (Tagmann-Ioset *et al*., 2012). Overall, wrynecks are likely to occur in winter in floodplain habitats cultivated with irrigated crops and that offer some woody elements such as scattered oaks, olive trees or large shrubs. These results indicate that wrynecks in winter use similar habitats

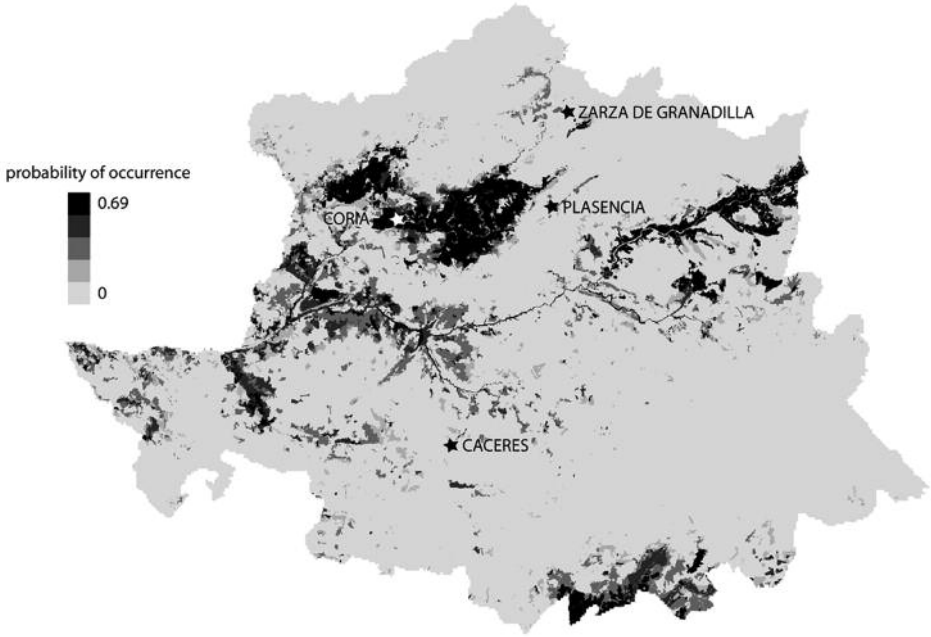

FIG. 2.—Predicted probability of occurrence of wrynecks in Cáceres Province, Northern Extremadura, according to the final MaxEnt model.
[Probabilidad predecida de aparición de torcecuellos en la provincia de Cáceres, norte de Extremadura, de acuerdo con el modelo final MaxEnt.]

as in their breeding grounds (Martí and del Moral, 2004; Weisshaupt *et al*., 2011). Our results suggest that wrynecks are dependent on agricultural landscapes year-round.

The use of spatial distribution models to inform and predict the occurrence probability and habitat preference of a wide range of animals has increased dramatically since the introduction of MaxEnt (Phillips and Dudík, 2008; Dormann *et al*., 2012). It is easy to use and interpret and results can be generated with few data. Nonetheless, the method has its drawbacks, most notably that it only uses presence points (Yackulic *et al*., 2013) and, in this case, disregards information from locations where wrynecks were not found. Information on absence points is routinely incorporated into other modelling approaches such as occupancy modelling (Beale and Lennon, 2012). For such models, however, two observations per point are necessary since an observation probability has to be calculated. Thus, they are more data demanding and require additional effort on the ground. In our study area, it seems unlikely that another methodology would give a different result, due to the apparent specific habitat requirements of wrynecks. However, such an approach may allow for a more robust predictive assignment of the distribution of wintering wrynecks on a broader scale such as across the whole Iberian Peninsula.

Another question is whether the observed wintering wrynecks were migrants or residents. Such matters may be resolved using wing morphology measurements (van Wijk *et al*., 2013) or isotopes (Hobson *et al*., 2009) or a combination of both. Given that

the birds responded to playback in winter, such a result could suggest that the birds observed were resident. However, it is known that some migrating birds sing on their wintering grounds in Africa (Sorensen *et al*., 2016) and thus it is yet unclear whether these responding birds consist of migrants or residents.

In line with previous findings on wintering birds in the Iberian Peninsula, our findings highlight the importance of extensive agricultural landscapes for bird conservation in Extremadura (Navedo *et al*., 2015). These landscapes are under severe threat of disappearance due to agricultural intensification. Future conservation efforts should be directed to the sustainable maintenance of these habitats. Such conservation actions would favour not only wintering birds but also many other breeding species of international conservation concern that use these habitats.

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BIBLIOGRAPHY

BEALE, C. M. and LENNON, J. J. 2012. Incorporating uncertainty in predictive species distribution modelling. *Philosophical Transactions of the Royal Society B: Biological Sciences,* 367: 247-258.

COUDRAIN, V., ARLETTAZ, R. and SCHAUB, M. 2010. Food or nesting place? Identifying factors limiting Wryneck populations. *Journal of Ornithology*, 151: 867-880.

CRAMP, S., BROOKS, D. J., DUNN, E. and GILLMOR, R. 1985. *Handbook of the birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic, Vol. IV: Terns to woodpeckers*. Oxford University Press. Oxford.

DORMANN, C. F., SCHYMANSKI, S. J., CABRAL, J., CHUINE, I., GRAHAM, C., HARTIG, F., KEARNEY, M., MORIN, X., RÖMERMANN C. and SCHRÖDER, B. 2012. Correlation and process in species distribution models: bridging a dichotomy. *Journal of Biogeography*, 39: 2119-2131.

HOBSON, K. A., LORMEE, H., VAN WILGENBURG, S. L., WASSENAAR, L. I. and BOUTIN, J. M. 2009. Stable isotopes (δD) delineate the origins and migratory connectivity of harvested animals: the case of European woodpigeons. *Journal of Applied Ecology*, 46: 572-581.

LAUTENSACH, H. 1967. *Geografía de España y Portugal*. Editorial Vicens-Vives.

MARTÍ, R. and DEL MORAL, J. C. 2004. *Atlas de las aves reproductoras de España*. Dirección General de Conservación de la Naturaleza-Sociedad Española de Ornitología. Madrid.

MERMOD, M., REICHLIN, T. S. and ARLETTAZ, R. 2009. The importance of ant-rich habitats for the persistence of the Wryneck *Jynx torquilla* on farmland. *Ibis,* 151: 731-742.

MOREAU, R. E. 1956. The Iberian Peninsula and Migration. *Bird Study,* 3: 1-25.

NAVEDO, J. G., HAHN, S., PAREJO, M., ABAD-GÓMEZ, J. M., GUTIÉRREZ, J. S., VILLEGAS, A., SÁNCHEZ-GUZMÁN, J. M. and MASERO, J. A. 2015. Unravelling trophic subsidies of agroecosystems for biodiversity conservation: food consumption and nutrient recycling by waterbirds in Mediterranean rice fields. *The Science of the total environment*, 511: 288-97.

NINYEROLA, M., PONS, X. and ROURE, J. M. 2005. *Atlas Climático Digital de la Península Ibérica. Metodología y aplicaciones en bioclimatología y geobotánica*. Universidad Autónoma de Barcelona. Bellaterra.

PHILLIPS, S. J., ANDERSON, R. P. and SHAPIRE, R. E. 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modelling,* 190: 231-259.

PHILLIPS, S. J. and DUDÍK, M. 2008. Modeling of species distribution with Maxent: new extensions and a comprehensive evalutation. *Ecograpy,* 31: 161-175.

QUANTUM GIS DEVELOPMENT TEAM 2015. *Quantum GIS Geographic Information System*. Open Source Geospatial Foundation Project.

SANTOS, T. and TELLERÍA, J. L. 1985. Patrones generales de la distribucion invernal de passeriformes en la península Iberica. *Ardeola,* 32: 17-30.

SA-SOUSA, P. 2000. A predictive model for the Iberian wall lizard (*Podarcis hispanicus*) in Portugal. *Herpetological Journal,* 10: 1-11.

SEO/BIRDLIFE. 2012. *Análisis preliminar del banco de datos de anillamiento de aves del Ministerio de Agricultura, Alimentación y Medio Ambiente, para la realización de un atlas de migración de aves de España*. Madrid.

SORENSEN, M. C., JENNI-EIERMANN, S. and SPOTTISWOODE, C. N. 2016. Why do migratory birds sing on their tropical wintering grounds? *The American naturalist*, In press.

TAGMANN-IOSET, A., SCHAUB, M., REICHLIN, T. S., WEISSHAUPT, N. and ARLETTAZ, R. 2012. Bare ground as a crucial habitat feature for a rare terrestrially foraging farmland bird of Central Europe. *Acta Oecologica*, 39: 25-32.

TELLERÍA, J. L., SANTOS, T. and CARRASCAL, L. M. 1988. *La invernada de los passeriformes (O. Passeriformes) en la Península Ibérica*. In, Invernada de aves en la peninsula Ibérica, pp. 153-166. Sociedad Española de Ornitología. Madrid.

WEISSHAUPT, N., ARLETTAZ, R., REICHLIN, T. S., TAGMANN-IOSET, A. and SCHAUB, M. 2011. Habitat selection by foraging Wrynecks *Jynx torquilla* during the breeding season: identifying the optimal habitat profile. *Bird Study*, 58: 111-119.

VAN WIJK, R. E., SCHAUB, M., TOLKMITT, D., BECKER, D. and HAHN, S. 2013. Short-distance migration of Wrynecks *Jynx torquilla* from Central European populations. *Ibis*, 155: 886-890.

YACKULIC, C. B., CHANDLER, R., ZIPKIN, E. F., ROYLE, J. A., NICHOLS, J. D., CAMPBELL GRANT, E. H. and VERAN, S. 2013. Presence-only modelling using MAXENT: when can we trust the inferences? *Methods in Ecology and Evolution*, 4: 236-243.

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