

GEOGRAPHICAL ORIGIN, RETURN RATES,  
AND MOVEMENTS OF THE NEAR-THREATENED  
BLACK-TAILED GODWITS *LIMOSA LIMOSA* STAYING  
AT A MAJOR STOPOVER SITE OF IBERIA

ORIGEN GEOGRÁFICO, TASAS DE RETORNO Y MOVIMIENTOS  
DE LA CASI AMENAZADA AGUJA COLINEGRA *LIMOSA LIMOSA*  
EN UNA IMPORTANTE ZONA DE PARADA DE IBERIA

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SUMMARY.—*Geographical origin, return rates, and movements of the near-threatened black-tailed godwits Limosa limosa staying at a major stopover site of Iberia.*

Most black-tailed godwits *Limosa limosa* en route from West Africa to breeding grounds cross Iberia (Spain and Portugal), but there are fundamental aspects of the stopover ecology of black-tailed godwits in Iberia which remain unknown. Geographical origin, return rates, and movements of the near-threatened black-tailed godwits staying at Extremadura's rice fields, a major Iberian stopover site, was investigated. Godwits were captured with mist-nets from January to early March (2005 - 2008), and individually marked with a combination of colour rings and lime flag (see codes in [www.cr-birding.be](http://www.cr-birding.be)). Most black-tailed godwits staying in Extremadura's rice fields belonged to the declining subspecies *limosa*, with Extremadura probably being a crucial final take-off site for most of them. A significant percentage (3 - 14 %) of subspecies *islandica* staying in Extremadura was also found. Return rates averaged 35.9 %, and godwit movements between Iberian stopover sites were documented. The movements of colour-ringed godwits showed that the main SW Iberian sites probably function as a single functional unit, and therefore the loss of some of these Iberian sites may put at risk the long-term viability of the Western European population of black-tailed godwit.

*Key words:* black-tailed godwit, rice fields, shorebirds, stopover ecology.

RESUMEN.—*Origen geográfico, tasas de retorno y movimientos de la casi amenazada aguja colinegra Limosa limosa en una importante zona de parada de Iberia.*

Aunque la mayoría de las agujas colinegras *Limosa limosa* que migraron desde el oeste de África a las áreas de reproducción cruzan Iberia (España y Portugal), existen aspectos fundamentales de su ecología en las áreas de parada en Iberia que permanecen desconocidos. Se ha investigado el origen geográfico, tasas de retorno y movimientos de la "casi amenazada" aguja colinegra que se detiene en los arrozales de Extremadura, un área importante de escala ibérica. La mayoría que se detienen en dichos campos de arroz pertenecieron a la subespecie en declive *limosa*, siendo probablemente Extremadura el último y

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crucial área de tránsito. Se encontró también en Extremadura un porcentaje significativo (3 - 14 %) de la subespecie *islandica*. La tasa de retorno promedió un 35.9 % y se documentaron movimientos de agujas entre los principales lugares ibéricos de escala. Los movimientos de agujas, con marcas individuales de color, mostraron que las mencionadas localidades ibéricas funcionan probablemente como una única unidad funcional y, por lo tanto, la pérdida de alguna de ellas podría poner en riesgo la viabilidad de la población de agujas de Europa occidental.

*Palabras clave:* aguja colinegra, aves limícolas, arrozales, ecología de áreas de parada.

## INTRODUCTION

The near-threatened black-tailed godwit *Limosa limosa* is a long-distance migratory shorebird with two populations present in coastal and inland habitats of Western Europe, the nominal subspecies and *L. l. islandica* (e.g. Hoglund *et al.*, 2009). The population size of the latter is 47,000 birds (Gunnarsson *et al.*, 2005a), and exhibits a positive population trend (Stroud *et al.*, 2004; Gunnarsson *et al.*, 2005a; Gill *et al.*, 2007). However, despite the large amounts of financial resources invested in improving the main breeding areas (8 million euros is planned in 2008 - 2009 in The Netherlands) (Jensen *et al.*, 2008), the Western European breeding population of *L. l. limosa* has declined dramatically, by more than 50 % over the last 20 years (Stroud *et al.*, 2004; Gill *et al.*, 2007). Recent updates indicate a total population of 50,000 breeding pairs (Birdlife International, 2004), which mainly winter in West Africa to South of the Sahara, as well as in Portugal and Spain (Stroud *et al.*, 2004; Masero *et al.*, 2010). A key research priority for the declining Western European population of black-tailed godwits is to improve understanding of the location of stopover sites in Europe and Africa (Gill *et al.*, 2007; Jensen and Perennou, 2007; Jensen *et al.*, 2008).

Large numbers of black-tailed godwits use rice fields as foraging habitats during the non-breeding season (e.g. Kuijper *et al.*, 2006; Piersma *et al.*, 1996; Lourenço and Piersma, 2008; Masero *et al.*, *in press*). In Extremadura, inland Spain, large expanses of rice fields have

been created since the 1970s. At present around 20,000 godwits en route from West Africa to the breeding grounds stay for long periods in Extremadura (Kuijper *et al.*, 2006; Sánchez-Guzmán *et al.*, 2007; Masero *et al.*, 2008; Masero *et al.*, 2010), but the proportions of *limosa* and *islandica* birds staying in this major stopover site are unknown. Most godwits staying in Extremadura are thought to be the nominal subspecies (Kuijper *et al.*, 2006). However, Gunnarsson *et al.* (2005a) estimated recently that about 15,000 Icelandic black-tailed godwits winter in areas (mostly in Portugal, Spain and Morocco) where the races overlap. Accordingly, a significant number of Icelandic birds could use Extremadura as a stopover site. Further research on these aspects of the stopover ecology of black-tailed godwit migrating through Extremadura and other main stopover sites of Iberia is required to provide a basis for informed decision making when considering management options for this species (Jensen and Perennou, 2007; Jensen *et al.*, 2008; Lourenço and Piersma, 2008).

Here, we determined the geographical origin, return rates, and movements of the near-threatened black-tailed godwits staying in Extremadura rice fields during spring migration, based on individually colour-marked birds.

## STUDY AREA AND METHODS

Extremadura's rice fields (25,000 - 30,000 ha) are located in inland Spain, in the southwest of the Iberian Peninsula (39° 01' N, 5° 58'

W). Harvesting is in October-early November. From then until the end of December, farmers roll the rice straw left after the harvest into the mud under flooded conditions, leaving large expanses of shallow water which usually remain throughout the winter (Sánchez-Guzmán *et al.*, 2007). Large numbers of black-tailed godwits consistently use Extremadura rice fields during spring migration (late January-early March), with an average number of 24,214 birds during February 2004 - 2007 (Masero *et al.*, 2010). Black-tailed godwits feed on rice seeds left on the ground after harvest (e.g. Santiago-Quesada *et al.*, 2009), and most of them have long lengths of stay in the rice fields (2 - 6 weeks; unpublished data from radio-tagged godwits).

#### *Geographical origin, return rates, and movements*

To determine the geographical origin, return rates, and movements of black-tailed godwit populations using Extremadura, from 2005 to 2008 a sample of birds was captured with mist-nets from January to early March, and individually marked with a combination of colour rings and lime flag. The international ringing scheme for godwits was provided by the International Wader Study Group and this information was placed in a web-site ([www.cr-birding.be](http://www.cr-birding.be)) that promotes dissemination of colour-ringing schemes.

We looked regularly for colour-ringed godwits marked with our ringing scheme and other schemes outside of Extremadura. The percentage of the total Icelandic population marked with colour-rings (1 - 2 %) is high in comparison to Western European population (Gunnarson *et al.*, 2006). Therefore, population estimates derived from sightings of colour-ringed godwits marked outside Extremadura are not directly comparable. In an attempt to resolve this issue, we also quantified the percentage of *islandica* birds by checking during ringing ac-

tivities (mid February 2005 - 2007) each male godwit with full (> 90 %) breeding plumage, since it possible to distinguish the males of both subspecies in full breeding plumage (Cramp, 1983).

To calculate return rates we revisited the study area over four consecutive years (2005 - 2008). This parameter was estimated by dividing the number of resighted colour-ringed godwits that returned each year by the total number of colour-ringed birds present during the previous winter period (Koronkiewicz *et al.*, 2006).

#### RESULTS

A total of 341 godwits were individually colour-ringed over the four study seasons, ranging from 70 birds in 2005 to 108 birds in 2008 (95.1 % were adults, showed no traces of wing and tail moult). Of these, 161 individuals were observed outside Extremadura during the breeding season, almost of all them in Western Europe (96.9 %) and Iceland (3.1 %) (table 1). The closest stopover site with sightings of colour-ringed birds that departed from the study area during February-early March was Maine-et-Loire, West France (approximately 900 km away).

In the study area, we identified 117 codes of godwits ringed outside Extremadura. Of these, 85.5 %, 10.2 % and 4.3 % were birds ringed in The Netherlands, Iceland, and United Kingdom, respectively. The birds from Iceland and United Kingdom were subspecies *L. l. islandica*, so that 14.5 % (95 % confidence interval: 9.3 % - 22.0 %) of the black-tailed godwits identified in Extremadura belonged to this subspecies. However, from the examination of male godwits with full breeding plumage in mid-February, we estimated the percentage of Icelandic population to be 7.7 % (95 % confidence interval: 2.7 % - 20.3 %) ( $n = 39$  males checked).

Return rates ranged from 31.4 % to 39.7 % annually, averaging 35.9 % for the four con-

TABLE 1

Resightings ( $n = 161$ ) during the breeding season (roughly from late March to June) of black-tailed godwits *Limosa limosa* colour-ringed in Extremadura rice fields in January-early March 2005-2008. Total numbers per country are different individuals resighted at least once during the breeding season. [*Controles visuales (n = 161) durante la estación reproductiva (en sentido amplio desde últimos de marzo a junio) de agujas colinegras Limosa limosa anilladas con colores en los arrozales de Extremadura desde enero a primeros de marzo de 2005-2008. El número total por área son diferentes individuos controlados al menos una vez durante la estación reproductiva.*]

Country	Total number of re-sightings	Percentage (%)
France	21	13.0
Belgium	10	6.2
Netherlands	112	69.6
Denmark	3	1.9
Germany	10	6.2
Iceland	5	3.1

secutive seasons. Movements between Iberian stopover sites in consecutive winters were documented in this study. About 6 % of the birds ringed in Extremadura during 2005 - 2008 were observed in Portuguese stopover sites (4 % in Sado and Tagus estuaries, and 2 % in Ria Formosa) in the following winters. On the other hand, about 31 % of black-tailed godwits colour-ringed on February 2006 at Cádiz Bay Natural Park (SW Spain;  $n = 29$ ) by GEAM ringing group (Frias, 2007) were sighted later in Extremadura during the same migration season or in the following spring migrations.

## DISCUSSION

Most black-tailed godwits staying in Extremadura's rice fields belonged to the declin-

ing subspecies *L. l. limosa*, with Extremadura probably being a crucial final take-off site for most of them (in Iberia there are no significant stopover sites for the Western European population of black-tailed godwit north of the study area; Martí and del Moral, 2003). We also found a significant percentage of Icelandic birds staying in Extremadura, ranging from 3 % to 14 %. The *islandica* percentage is probably lower than the value estimated from resightings in Extremadura (14 %), since the percentage of the total Icelandic population marked with colour-rings is high in comparison with the Western European population (Gunnarson *et al.*, 2006; see methods). On the other hand, the intensity of resighting effort may vary geographically, being lower in Iceland than in Western Europe (in the Netherlands, for example, there are a large number of birdwatchers looking for colour-ringed godwits), so the *islandica* percentage (3 %) derived from resightings in the breeding areas is underestimated. The actual percentage of Icelandic birds using the Extremadura rice fields is probably close to the value estimated during ringing activities (8 %), at least during the peak of migration (mid February).

The occurrence of Icelandic birds in Extremadura contrasts with distribution patterns found previously for this subspecies. At the south end of the winter range, including Spain and Portugal, most Icelandic birds are assumed to winter on 'soft coasts', mainly estuaries and areas of intertidal mud (e.g. Jensen *et al.*, 2007). The Icelandic population has recently been rapidly increasing, during which time godwits have been occupying new areas at the both ends of the range (Gunnarsson *et al.*, 2005b). Our findings suggest that substantial numbers of *islandica* are occupying freshwater habitats at the southern end of the non-breeding range.

The intensity of resighting effort in SW Iberia is low. Doñana and surroundings (36° 51' N, 6° 20' W), for example, support the largest godwit population of Iberia during

winter (Barbosa, 1997; Kuijper *et al.*, 2006; Masero *et al.*, 2010), but we did not receive any information from this region. Probably a significant proportion of godwits leaving Doñana and near coastal sites fly directly to Extremadura during spring migration, as is suggested by the re-sighting in the study area of colour-ringed birds in Cadiz Bay Natural Park (< 45 km from Doñana). Also, our results suggest that godwits staying at Portuguese coastal sites move to Extremadura and vice versa. Such godwit movements link the main SW Iberian sites into what is probably a single functional unit, meaning that so the loss of some of them may put at risk the long-term viability of the Western European population of black-tailed godwit.

ACKNOWLEDGEMENTS.—P. M. Lourenço, J. Hooijmeijer and J. Shroeder made useful comments on the first draft of the manuscript. Project PRI 2PR03A010 provided financial support for this study.

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[Recibido: 03-06-09]  
[Aceptado: 20-10-09]