

Stopover ecology of Black-tailed Godwits *Limosa limosa limosa* in Portuguese rice fields: a guide on where to feed in winter

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Capsule Conservation management of rice fields may be necessary to guarantee the availability of high quality stopover habitats.

Aims To analyse habitat selection and quantify the diet composition of birds.

Methods Using water level and agricultural management of the fields as variables, habitat selection was analysed by compositional analysis. Godwit diet composition was quantified by faecal analysis, and food abundance was sampled to explain the observed habitat selection.

Results We found evidence of higher use of flooded and ploughed paddies than expected from their relative abundance. These fields have the highest densities of buried rice kernels, which seem to be the main food source for Black-tailed Godwits.

Conclusion Currently, godwits find good foraging areas in Portuguese rice fields, feeding primarily on rice kernels that are mostly found in flooded ploughed fields. Changes in rice farming, late ploughing and predicted decreases in rainfall may lead to loss of this habitat. However, because of the man-made nature of their requirements, it should be possible to install relevant land-use practices that guarantee the availability of high quality stopover habitats.

In the course of a long migration, birds need to stop a number of times for refuelling before continuing their journeys. The migratory journey is characterized by an alternation between flights, when distance is covered and energy is consumed, and stopover periods, when energy for the next flight stage is accumulated (Gudmundsson *et al.* 1991, Alerstam & Hedenström 1998). Most of the time and energy expenditure during an entire migration episode is actually spent on the ground (Hedenström & Alerstam 1997). Migratory stopovers are very important periods in the yearly cycle of migrant birds, with downstream consequences for survival, breeding success and demographics (Newton 2006). As a consequence, knowledge of habitat requirements of migrants during stopover is crucial for their conservation (Piersma & Baker 2000, Chernetsov 2006). Despite this, stopover ecology has remained one of the least studied aspects of avian migration (Lindström 1995).

Black-tailed Godwits *Limosa limosa* are long-lived

migratory birds. The continental European race *L. limosa limosa* mostly breeds in agricultural grasslands in northern and eastern Europe, where it faces a serious population decline (Birdlife International 2004), leading to the recent classification of the species as 'Near Threatened' on the IUCN Red List (IUCN 2007). Although this decline is mostly blamed on habitat loss and changes in agricultural practices in the breeding areas (Beintema *et al.* 1985, Beintema & Müskens 1987), the failure of most conservation programmes (Kleijn *et al.* 2001, Kleijn & Van Zuijlen 2004) suggests that this subspecies could be facing additional problems at other times during its annual cycle. Black-tailed Godwits winter in west Africa in marshes, flooded plains and rice fields (Cramp & Simmons 1983) and an important part of this population performs an extended stopover in the Iberian Peninsula, during the prenuptial migration, where they mostly use rice fields as foraging habitat (Beintema *et al.* 1995, Kuiper *et al.* 2006). Little is known about their ecology in these areas other than that they seem to forage on rice kernels (Kuiper *et al.* 2006).

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