

SEASONAL MOVEMENTS OF MALE GREAT BUSTARDS IN CENTRAL SPAIN

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Abstract.—A sample of 22 radio-tagged male Great Bustards from central Iberian populations was studied from 1996 to 1998. All birds undertook seasonal movements to postbreeding areas located up to 167 km away from their leks. Departures from leks occurred between May and July, with most birds moving northeast to summering areas. Approximately 47% of the males spent only the summer away from their leks, returning to leks between September and December. Other males overwintered in areas located to the southeast, returning to lek sites between January and March.

MOVIMIENTOS ESTACIONALES DE LARGA DISTANCIA DE MACHOS DE AVUTARDA (*OTIS TARDA*) EN EL CENTRO DE ESPAÑA

Síntesis.—Entre 1996 y 1998 se estudió una muestra de 22 machos de avutarda radiomarcadas, procedentes de poblaciones del centro de la Península Ibérica, encontrándose que durante la estación postreproductiva realizaban movimientos migratorios hacia áreas alejadas hasta 167 km de sus leks. La salida del área de lek se produjo principalmente entre los meses de mayo y julio, mostrando una dirección preferencial hacia NE, donde se encontraron las zonas de veraneo. Aproximadamente el 47% de los machos sólo pasaron el verano alejados de sus leks, regresando a los mismos entre septiembre y diciembre. El resto pasaron además el invierno en áreas localizadas al SE de sus áreas de cría, regresando entre enero y marzo.

The Great Bustard (*Otis tarda*) is considered to be migratory in Asia and sedentary or locally dispersive in Iberia, Central Europe, and Eastern Europe (Gewalt 1959; del Hoyo et al. 1996; Snow and Perrins 1998). Studies in Spain recorded the disappearance of males after the mating season, whereas females remained in breeding areas (Alonso and Alonso 1990; Hellmich 1991; Alonso et al. 1995). Seasonal movements of males have been described recently for Great Bustards in northwestern Spain (Morales et al. 2000), the densest population in the world (Alonso et al. 1995). In that study, radio-tagged males moved up to 22 km from the mating areas or leks. Our study presents results from work conducted since 1995 on the Great Bustard population breeding in Madrid Province, Central Spain. Males from this area perform unexpectedly long seasonal movements, not found to date in other Iberian populations, traveling over 200 km to reach postbreeding areas located up to 170 km from their breeding sites. The magnitude of these movements, as well as the location of the areas where these males stay during the postbreeding season, have implications for conservation of Great Bustards, a species listed as Vulnerable by IUCN (Heredia et al. 1996).

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SPECIES AND STUDY AREA

The Great Bustard is a large steppe bird with marked sexual dimorphism and a dispersed lek breeding system (Gewalt 1959; Snow and Perrins 1998). The species has a fragmented distribution throughout the Western Palearctic, with a world population of around 55,000 individuals (del Hoyo et al. 1996; Snow and Perrins 1998). The province of Madrid holds around 1000 individuals (J. A. Alonso et al., unpubl. data), which represents approximately 2% of the estimated world population. Great Bustards are distributed in the eastern and southeastern parts of the province, inhabiting open, flat to slightly undulated areas with an average elevation of 650 m. The main habitat corresponds to extensive cereal cultures (wheat and barley) and, to a lesser extent, other crops such as legumes, olive trees, and vineyards. The major threat for the Great Bustard in Madrid is the loss or fragmentation of suitable habitat due to infrastructure development around the city.

METHODS

During January and February 1996, 1997, and 1998, we captured 22 adult male Great Bustards using rocket nets (one in 1996, five in 1997, and 16 in 1998). Each bird was fitted with a backpack transmitter (Bio-track Ltd., UK) using Teflon as harness material. Additionally, birds were provided with PVC wingtags or a single dorsal PVC plate attached to the transmitter for visual identification in the field. Battery life of the transmitters averaged 3–5 yr. After marking, we located all radio-tagged individuals by triangulation and subsequent visual observation at least once per month. During the postbreeding period we made monthly surveys of an area of ca. 60,000 km² around lek sites looking for radio-tagged males from four-wheel drive vehicles or from aircraft (ca. 200 flight hours in total, E-24 Bonanza, Beechcraft) with radio (Telonics receiving equipment, USA). The UTM coordinates corresponding to each location were recorded using a Global Positioning System (GPS).

RESULTS

Length of seasonal movements.—All 22 radio-tagged males left their leks after the mating season, but only 20 could be located in postbreeding areas (transmitter failure occurred in two). Maximum distances between leks and postbreeding sites varied between 9 and 167 km, averaging 82 km. Eight males (40%) were located farther than 100 km from their lek sites.

Direction of movements.—Sixteen out of the 20 birds with functional transmitters were located during the summer postbreeding period (Fig. 1). The direction of movements from the lek site was not random; most birds moved northeast ($\chi^2_3 = 10.16$, $P < 0.05$). In December, 11 males had not yet returned to their lek sites; nine of them were located in their wintering areas mostly to the southeast of their breeding sites ($\chi^2_3 = 8.16$, $P < 0.05$).

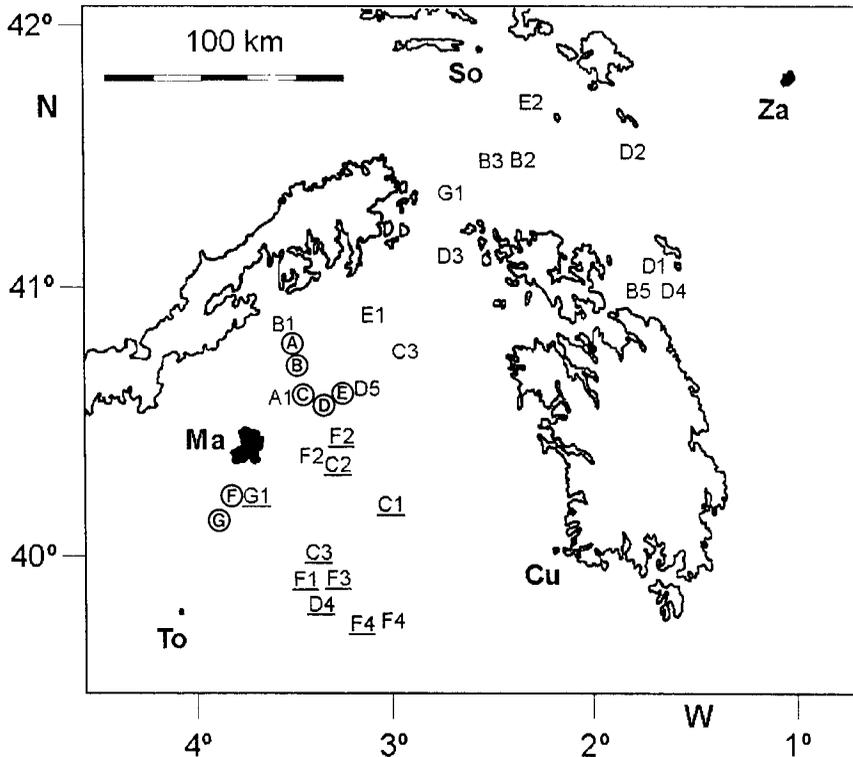


FIGURE 1. Postbreeding dispersal in adult male Great Bustards in central Spain. Encircled letters A to G show the location of the lek sites. Letters A1 to G1 show the locations of the different males in summer (not underlined) and winter (underlined), the letter referring to the lek where each male displays. The main cities are also represented (Cuenca, Cu; Madrid, Ma; Soria, So; Toledo, To; Zaragoza, Za), and mountain chains are indicated by the 1200-m contour.

Timing of departures and returns.—Of the 22 marked males, 19 (86%) left their leks before June, with only 3 (14%) leaving during the months of July and August (Fig. 2). Returns to the lek site could be recorded only for 19 males due to the death of three birds. Nine males (47%) were back in the breeding areas between September and December, and 10 (53%) returned between January and March (Fig. 2).

Lek and postbreeding area fidelity.—Six out of the 19 individuals were tracked during two or three years, all of them showing inter-annual fidelity to their lek sites. All males for which we have data for more than one year also showed fidelity to their postbreeding areas ($n = 4$).

DISCUSSION

In this paper we describe for the first time relatively long-distance seasonal movements by radio-tagged male Great Bustards in the Iberian Pen-

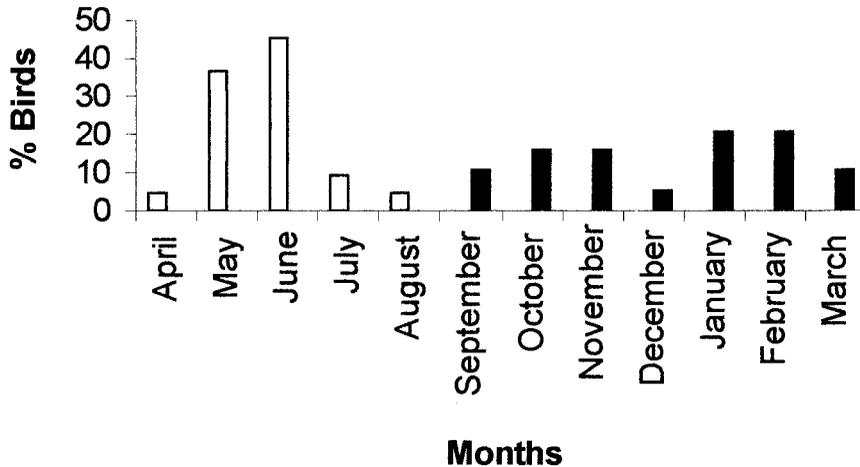


FIGURE 2. Monthly frequency distribution of the dates when males left (white columns, $n = 22$) and returned (black columns, $n = 19$) to their leks in central Spain.

insula. This is in contrast with the previous classification of western Palearctic populations of this species as sedentary. Although a long-term study is still in progress and present results are preliminary, their novelty makes them of great interest for the management and conservation of the species. This is in part due to the identification of some previously unknown areas used during the postbreeding season (summering and wintering areas). Some of these areas were known to hold breeding populations of Great Bustards in the past, but most of them are currently unprotected and need urgent conservation measures to prevent further declines of this globally endangered species. The relatively high mortality detected in our study (three out of 22 males died during the postbreeding period) suggests that the seasonal movements described could represent not only an energetic cost but also a significant mortality risk for these birds.

The movements of the males that are not distributed randomly around the lek sites are probably affected by the mountains around Madrid Province. Birds fly, in summer, to the northeast, probably seeking the lower average summer temperatures of areas that are located generally at higher elevation. All wintering areas were located to the south. This probably represents the general dispersal pattern of the entire male Great Bustard population in Madrid. There seemed to be a unimodal pattern of departures, contrasting with the bimodal pattern of arrivals, which suggests that whereas all males spend the summer away from lek sites, only about half of them remain away during winter. The variability in the distance of these seasonal movements, as well as in the departure and return dates, may simply reflect individual differences between males in this Great Bustard population, as has been shown for other species (Terrill and Able 1988;

Lundberg 1988). More data are needed to know if this variability in dispersal pattern is related to age or social status of individuals or has a genetic basis. There is an important difference, however, between male Great Bustards of the Madrid and Villafáfila populations. In Madrid, all birds seem to undertake seasonal movements, suggesting a differential dispersal pattern, whereas in Villafáfila, only about half of the males abandon the mating areas after the breeding season. Furthermore, the birds from Madrid are located at greater distances than those found for the Villafáfila population (Morales *et al.* 2000). The key to this difference could be the much higher fragmentation and presumably lower carrying capacity of the habitat in Madrid, as compared to the rather uniform, continuous habitat in Villafáfila.

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