

Status and habitat use of a population of Great Bustard in southern Spain.

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The European populations of the Great Bustard (*Otis tarda*) have greatly decreased during this century due to the destruction of their natural habitats (Goriup 1987). Nowadays the Spanish population is the most important in Europe, estimated to be about 10.000-11.000 birds (Hidalgo and Carranza 1990). The original habitat of Great Bustards was natural grassy steppes (Cramp and Simmons 1980) although they eventually adapted to some artificial environments such as agricultural lands in West Germany or Hungary where Great Bustards now use extensive agricultural or pasture areas (Dornbusch 1983). The Spanish population is very fragmented and the main areas are located in extensive pastures and herbaceous crops in the mid-west of Spain. At present in Southern Spain there are only a few groups totalling less than 100-120 birds (Hidalgo and Carranza 1990). One of the largest groups in Andalucía is located in the Campiña, in the province of Córdoba. In 1987 this group of Great Bustards was composed of less than 30 birds which use the herbaceous cultivation fields and the border of the olive groves in winter (Redondo 1990). This is unusual because the Bustards' habitats are open areas as seen above and not tree-covered ground. Field work was carried out from October 1990 to June 1993 in an area of 177 km² in the Campiña of the province of Córdoba (Southern Spain) (Figure 1). We considered the following classes of land use: herbaceous crops, arable and stubble plots and olive groves which have a density of 100 trees/ha. We also defined an olive grove border as an arbitrary 50 m wide band, including 25 m outside and 25 m inside the first line of olive trees. We made two monthly visits early in the morning by car at a constant speed of 20 km/h. For each bird or flock sighted we recorded the date, flock size, location on a 1:50.000 scale map, type of land used and distance to the nearest olive grove. Because of the importance to the Great Bustards of visibility in their use of each

plot, we calculated the lowest visibility as the minimum distance to the nearest horizon or object which restricts visibility (Martinez 1991). We calculated four levels of core area by the harmonic mean method (Dixon and Chapman 1980), using the Space Ecological Analysis System (SEAS 1989) personal computer software package. The core areas were defined by contour lines (isopleths) enclosing areas in which Bustards were observed in 30, 50, 75 and 90 % of all records.

Table 1 shows the number of Great Bustards located in the study area in each month. The highest number was sighted in December 1990 (24 birds), a similar number to that detected by Redondo (1990) in 1987, which suggests that this population has not increased despite their protection after 1985. Nevertheless, and taking into account the vast area of the Campiña, we cannot be sure we have detected all the birds. Great Bustards probably disperse into small groups in the Campiña between May and October, as occurs in other regions (Lucio and Purroy 1987, Hidalgo and Carranza 1990). Bustards were sighted more frequently from October to April. In April 1991 and 1992, we watched some groups performing a lek-like behaviour. In addition, we located in June 1992 a female with two chicks, thus confirming that Great Bustards breed in this area.

Figure 1 shows the core area in which Great Bustards could be found with a probability of 30 % (129.4 ha), 50 % (340.6 ha), 75 % (872.5 ha) and 90 % (4, 445.1 ha). These results imply that Bustards have a high preference for an area near the olive groves. Nevertheless birds were only sighted in the border band and never completely within the olive groves. As summarized in figure 2, this preference for the border of the olive groves was stronger in winter, when there many olives on the ground. The distance from the olive grove border increased after April and decreased again when the olives were ripe at

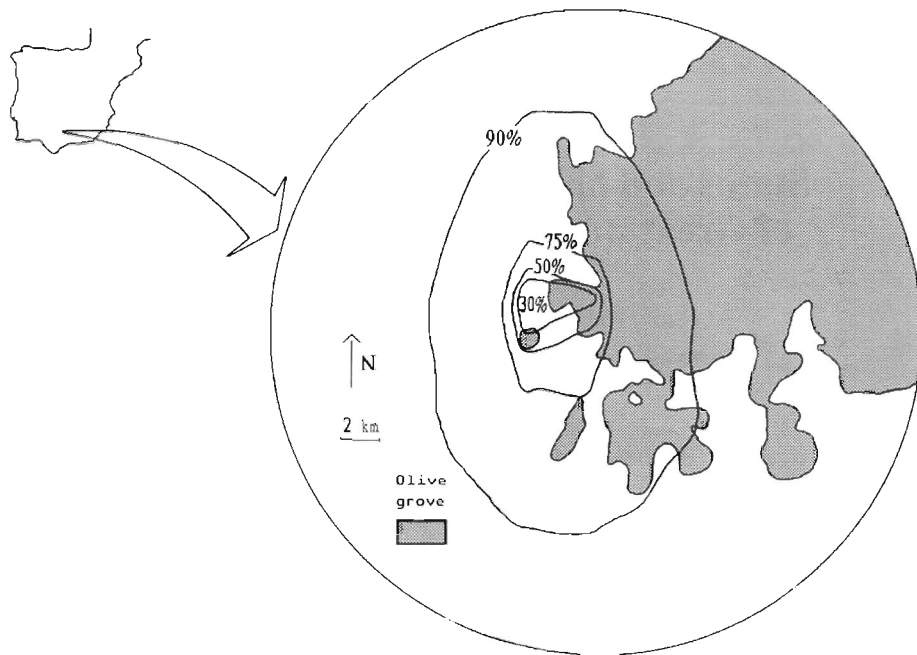


Figure 1 -Study area and core areas at 30 %, 50 %, 75% and 90 % of probability.

the end of autumn (one way ANOVA, $F=37.2$, $d.f.=64$, $p<0.001$) (figure 3). The analysis of excrement collected in winter (December to March) shows that 70.3 % of sample had olive pits (range 0-22 pits, $mean=3.7$, $SD=5.21$, $N=47$) which suggests that olives were an important part of the winter diet of Great Bustards. We also found beetle and plant remains.

The lowest visibility of plots used by Great Bustards changed during the year in a manner similar to the

distance to the olive groves (figure 3). The visibility was lower in winter when Bustards moved close to the olive grove. On the contrary, in spring and summer, birds used high visibility patches (one way ANOVA, $F=17.7$, $d.f.=65$, $p<0.001$). When Bustards were near the border of the olive grove the flock size tended to be higher than in those groups sighted far away (partial correlation between flock size and distance to the olive trees, after controlling for the date, $r=-0.32$, $N=65$, $p<0.05$).

Table 1 - Monthly maximum number of Great Bustards, mean flock size, standard error (S.E.) and sample size (N). July and August are not included because no bird was sighted during these months.

Month	Maximum Sighted				Flock Size		
	1990	1991	1992	1993	Mean	S.E.	N.
I	-	18	9	6	12.2	2.7	6
II	-	14	13	12	7.9	0.8	15
III	-	5	12	5	7.3	1.2	11
IV	-	8	20	5	10.7	2.3	7
V	-	0	12	0	7	0.5	2
VI	-	0	3	0	3	0	1
IX	-	1	0	-	1	0	1
X	7	5	8	-	7.5	1.7	4
XI	12	7	7	-	8.3	2.5	4
XII	24	7	8	-	9.2	1	15

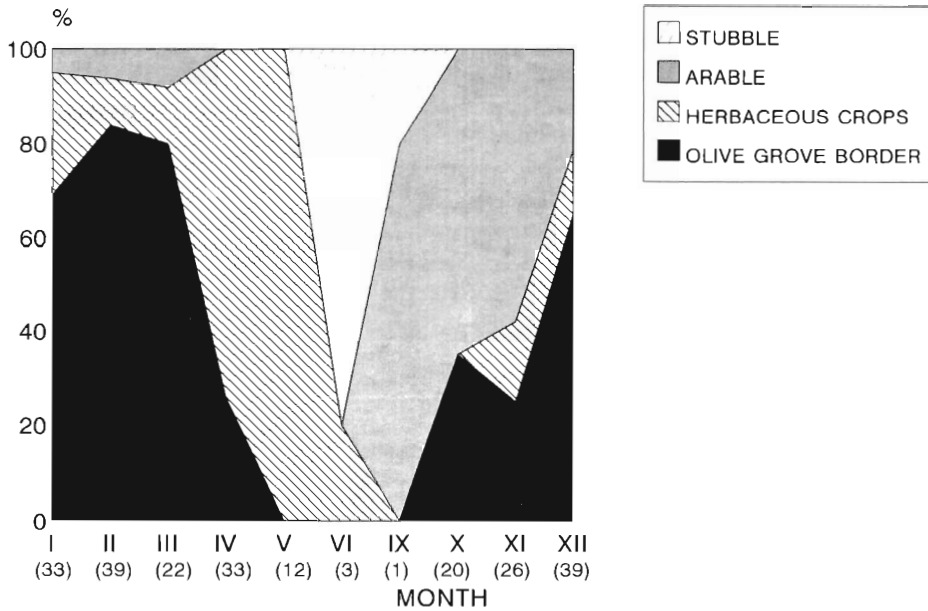


Figure 2 - Monthly habitat use of Great Bustards in the study area. The percentages are calculated from the number of birds sighted in every patch. Months VII and VIII are not included because no bird was sighted (Sample size in brackets).

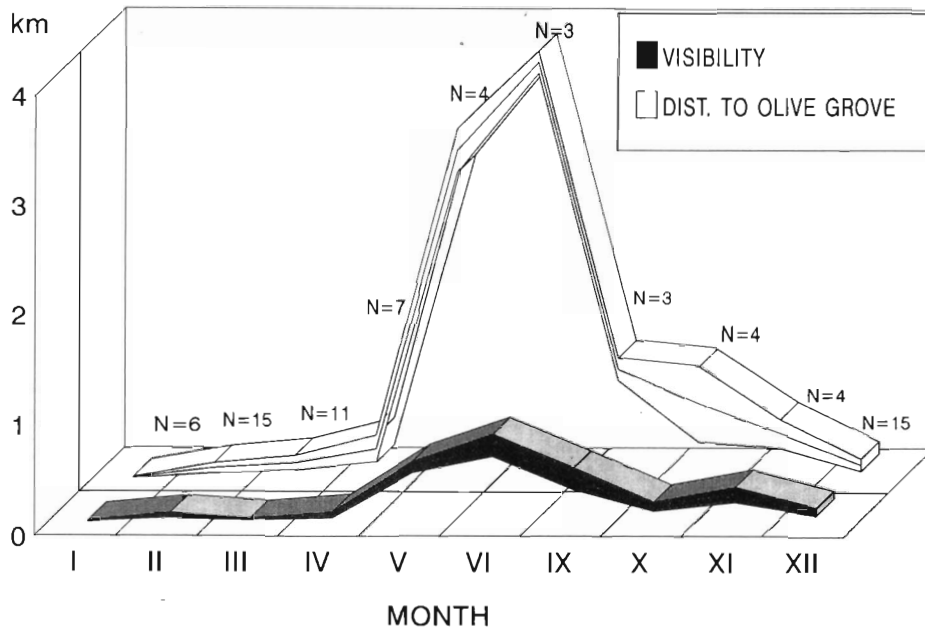


Figure 3 - Monthly distance to the nearest olive grove and the lowest visibility of each bird or flock sighted.

Results of core areas which show a high preference for an area near the olive groves are unexpected since the original habitats of Great Bustards are open fields and grassy steppes, or some open agricultural environments because of their adaptability in colonizing these new habitats (Cramp and Simmons

1980). To our knowledge, this is the only study in which Great Bustards have been detected with regularity in the surroundings of a tree-covered area. The abundant food supply in the olive grove, due to the many olives on the ground in winter (Munoz-Cobo 1987), could explain the use of this habitat, as

suggested also by the high frequency of olive pits found in the excrement. In addition, food in olive groves is seasonally predictable as a consequence of human management. According to Schluter (1982), in predictable conditions birds will use patches with high food supply whereas habitat structure or predation risk will not be so important. As a matter of fact, Bustards use the olive grove border in winter when it is possible a high food intake despite the predation risk due to the lower visibility. In contrast, when olives were not available, birds used high visibility patches in the herbaceous crops, arable or stubble fields, far from the olive grove. Increasing flock size when Great Bustards came close to the olive grove may be explained as a response to the higher predation risk because of the negative relationship between vigilance time and flock size (Pulliam 1973, Elcavage and Caraco 1983, Sullivan 1984).

Riassunto - Sono presentati i risultati di censimenti di Otarda effettuati tra l'ottobre 1990 e il giugno 1993 nella Campiña, provincia di Cordoba. Un massimo di 24 individui fu rilevato nel dicembre 1990. I dati fanno ritenere che la locale popolazione di Otarda non si sia incrementata dopo la protezione accordata nel 1985. La maggior parte dei soggetti è stata avvistata tra ottobre ed aprile, in un'area inferiore ai 900 ha. Nonostante la minor visibilità e l'aumentato rischio di predazione, le Otarde frequentano in inverno i margini di uliveti, in relazione all'abbondante disponibilità alimentare. I gruppi tendono ad essere più consistenti proprio in vicinanza degli uliveti.

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