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# Status and trends of the Common Crane *Grus grus* on the western route

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## Summary

The evolution of 40 wintering areas of *Grus grus* in the south-west of the Iberian Peninsula has been studied, including the traditional wintering places of this species on its western route. Eight of these areas harboured 50% of the whole population using this route, and none of the 40 areas showed a decline in the number of birds during the study period. At present the number of cranes in each area is much greater than in the 1979–1980 winter. No geographical trends have been observed regarding the magnitude of the increase, which is closely related to that observed for the whole Spanish and Palearctic populations. Despite the emergence of some new wintering areas, the magnitude of the increase is greater in more southerly parts of the range. This may be a consequence of greater diversity and availability of food in these latitudes. The influence of enhanced international protection and agricultural food sources on the appearance of new wintering areas is discussed.


## Introduction

The Common Crane *Grus grus* is a migratory species with a wide Palearctic distribution, breeding in the northern half of the Palearctic region and wintering north of the Sahara Desert (Cramp and Simmons 1980). Notable changes occurred in its breeding zone between the end of the last century and the middle of the present one (Johnsgard 1983). Initially it bred all over Europe but from the turn of the century, the breeding population has become more concentrated in the most northern region of the Palearctic. This breeding population has two migratory routes, one eastern and the other western. The latter route once took the cranes, or at least the majority of them, to the other side of the Straits of Gibraltar (Irby 1895, Bede 1926, Heim de Balzac 1962). However, from the middle of this century onwards, a large contingent of the population on the western route has wintered in the dehesas of the south-western region of the Iberian Peninsula (Bernis 1960). It has since been shown that this region harbours the largest wintering contingent of the whole of the Western Palearctic (Fernández-Cruz 1981, Alonso *et al.* 1986a, Muñoz-Pulido *et al.* 1988, Sánchez *et al.* 1993).

The number of cranes wintering in the countries around the Mediterranean has been estimated on numerous occasions, for example in Morocco (Thevenot 1985a, b, Thevenot and Salvi 1987), Spain (Fernández-Cruz 1981, Alonso *et al.* 1986a, Muñoz-Pulido *et al.* 1988, Sánchez *et al.* 1993, Alonso and Alonso 1996a), Portugal (Almeida 1996), and France (Salvi 1987, Salvi *et al.* 1996a, b). Data on cranes wintering outside this zone are also available, for example in Germany (Mewes 1996), and to a lesser extent Belgium (Symens 1984) and Finland (Glutz *et al.* 1973, Symens 1984). Several authors have attempted to make calculations based on these data, which are frequently partial and divergent in time, of the total number of cranes which use the western route. Alonso *et al.* (1986a) estimated a total of 32,000 cranes using this route, a number later increased by Alonso and Alonso (1988) to 50,000, coinciding with the figure given by Prange and Mewes (1991). Muñoz-Pulido *et al.* (1988) and Dupuy and Hippolyte (1991) reported a figure of 60,000 for this population and Alonso and Alonso (1990) estimated 60,000–70,000. Most of these estimates are based on winter counts but some of them relate to migrating birds (Prange and Mewes 1991, Dupuy and Hippolyte 1991). Prange (1996) estimated 74,000 cranes on the western route.

The discrepancies among many of these studies show that neither the true size of the population nor its trends have been clearly determined. Where some authors report an increase in the total population (Prange 1991) or in some wintering areas (Salvi 1996, Alonso and Alonso 1996a), others suggest that these variations are the result of more effective censusing or of a redistribution of wintering areas (Bautista *et al.* 1992, Sánchez *et al.* 1993).

This paper analyses the present status of the crane population wintering in Extremadura which contains the greatest number of cranes on the western route. A study is made of the trends of the different wintering areas within this region, comparing them with those of other wintering areas. Those estimates of the western Palearctic population which we consider reliable are included, together with the trends observed in other wintering areas.

## Methods

In the period 1986–1992 a total of 40 wintering areas in the south-western Iberian Peninsula were censused (for more details of these areas see Sánchez *et al.* 1993). Three winter censuses were made but for the purposes of this study the second of these, carried out in January (second week), was chosen as an indication of the number of cranes wintering in each area (Fernández-Cruz 1981, Sánchez *et al.* 1993). The censuses were made at the roosting sites of each area, both at nightfall and at dawn. Of these two censuses, the one which gave the greater number was chosen, this generally being the second of the two, since many groups of birds remain feeding after sunset (Sánchez *et al.* 1993, Alonso *et al.* 1985). All the areas were censused within a maximum period of four days in order to minimize the possibility of movement between areas; areas in close proximity were censused simultaneously.

The estimate of the western wintering population of the Common Crane and its trend observed in our study period was made from the compilation of population census data from East Germany (Mewes 1996), France (Salvi *et al.* 1996b), Portugal (Almeida 1996), Morocco (Thevenot *et al.* 1987) and Spain (Sánchez *et al.* 1993, Alonso and Alonso 1996a). Sporadic individual sightings in Belgium (Symens 1984) and Finland (Glutz *et al.* 1973, Symens, 1984) were not included, since these occurred in years of exceptionally mild weather, or were sick or injured birds (Alonso and Alonso 1988).

From these data the average number of cranes for each of the wintering areas was obtained, together with the coefficient of variation, which has been used to compare oscillations between areas. The mean value of the percentage of cranes with respect to the total Palearctic population in each of the wintering areas allowed us to determine the relative importance of each area in relation to the calculated western Palearctic population. For 22 of the 40 areas censused, the development of the population over the past 25 years can be determined because of data collected in the winter of 1979–1980 (Fernández-Cruz 1981).

The trends in population over time were determined by correlating (Spearman rank) the number of birds counted each winter against the year of the count (Fowler and Cohen 1995). The slopes of those regression lines (b) of counts against year which were statistically significant were used to show the magnitude of the population trend.

## Results

Table 1 shows the results of the variables obtained from the censuses of the wintering areas in Extremadura from 1986 to 1992. The average population on each wintering area during this period was 1,159 ± 2,203 cranes; the mean contribution of each as a percentage of the Palearctic total was 1.8 ± 3.4%. The mean slope of the regressions averaged 93.8 ± 782.4 cranes. Eight of the wintering zones contained 50% of the population which used the western route in this period.

### *Population trends*

Only eight of the areas, with a total of 2,958 cranes and an average of 5.6% of the western wintering population, showed a decreased trend in the number of cranes during the study period and in only one area was this trend statistically significant. The magnitude of the decrease was low in all cases and significant in none (Table 1). Three areas showed no time trend. The remaining 25 showed a trend of increase, 12 of them significant (Table 1). The magnitude of this trend was statistically significant in 10 wintering areas.

Compared with the data collected in the winter of 1979–1980 (Fernández-Cruz 1981), 21 of the 23 areas showed increased populations in 1986–1992. The average number of cranes per area recorded in 1986–1992 was significantly greater (1159 ± 2203) than in 1979–1980 (459 ± 481) ($U$=437, $df$=1, $P$<0.05).

No significant variations were observed in the average latitudinal distribution of the wintering zones between 1981 and the present study. The number of wintering areas increased in the Guadiana Basin (South Extremadura) while in the Tajo basin (North Extremadura) they decreased. The average number of cranes in the two basins was greater, however, in this study than in 1979–80 (Table 2).

The coefficient of variation (CV) was independent of the number of years in which censuses were made for each area and of the average number of cranes in each one ($r$=0.219; $P$>0.05; $n$=40 and $r$=–0.033; $P$>0.05; $n$=40, respectively).

### *The western population of* Grus grus *and its trends*

Table 3 shows the results of the censuses and population parameters of Common Crane in the countries on the western route, and the estimated total number of

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Table 1. Mean number of Common Cranes at wintering sites in Extremadura, percentage of the total population and population growth rate (X/ 1979–1980 survey)

| Area | (X) | Mean percentage of estimation | *r* | *b* | Growth rate (*Grus* Project) | CV | *n* |
|---|---|---|---|---|---|---|---|
| Azuaga | 5442 | 8.52 | 0.64 | 628.8 | 13.24 | 0.37 | 7 |
| Orellana | 13454 | 20.31 | 0.39 | 1835.8 | 7.67 | 0.45 | 7 |
| Valdecaballeros | 819 | 1.27 | 0.82* | 179.3** | 2.06 | 0.54 | 7 |
| Valdehornillos | 1200 | 1.58 | 0.87 | 1350 | | 1.29 | 3 |
| Cornalvo | 25 | 0.07 | 1 | 50 | | 1.41 | 2 |
| Villar del Rey | 339 | 0.67 | −0.29 | −65.2 | 2.46 | 0.82 | 7 |
| La Roca | 194 | 0.32 | 0.20 | 4.1 | | 0.39 | 7 |
| Esparragalejo | 789 | 1.20 | 0.81* | 140.1 | 14 | 0.53 | 7 |
| La Albuera | 613 | 0.99 | 0.78* | 68.5 | 2.33 | 0.34 | 7 |
| Merinillas | 373 | 0.48 | | | | | 1 |
| V. del Fresno | 1589 | 2.64 | 0.43 | 217.8 | 1.31 | 0.64 | 6 |
| Don Benito | 538 | 0.96 | −0.4 | −45.6 | 2.30 | 0.23 | 4 |
| Guareña | 340 | 0.55 | 0.77 | 93.8* | | 0.63 | 6 |
| Alange | 648 | 0.93 | 0.78* | 216.3 | | 0.98 | 7 |
| Retamal | 713 | 0.84 | 0.60 | 139.6 | | 0.56 | 6 |
| Los Molinos | 644 | 0.92 | 0.93* | 246.9* | | 0.96 | 7 |
| Usagre | 670 | 1.32 | −0.31 | −118.9 | 0.75 | 0.60 | 6 |
| La Guarda | 4836 | 0.71 | 0 | 4.29 | | 1.08 | 7 |
| Guadalefra | 1659 | 2.67 | 0.32 | 171.9 | | 0.61 | 7 |
| Cabeza del Buey | 2368 | 4.08 | 0 | −60.6 | 1.37 | 0.28 | 7 |
| Zarzacapilla | 407 | 0.63 | 0.86* | 73.0** | 2.59 | 0.44 | 7 |
| Capilla | 482 | 0.62 | 0.50 | 191 | 0.51 | 3 | |
| Siruela | 777 | 1.33 | 0 | 13.0 | | 0.44 | 7 |
| Ahillones | 414 | 0.81 | −0.43 | −50.8 | 1.17 | 0.53 | 6 |
| Villagarcia | 200 | 0.25 | | | | | 1 |
| Gabriel y Galán | 855 | 1.41 | 0.93** | 86.4** | 4.64 | 0.25 | 7 |
| Borbollón | 962 | 1.49 | 0.79* | 191.5* | 5.76 | 0.50 | 7 |
| Rosarito | 847 | 1.42 | 0.93* | 137.8* | | 0.37 | 6 |
| Casatejada | 500 | 0.99 | −0.60 | −40.6 | 8.49 | 0.17 | 5 |
| Valdecañas | 1842 | 2.62 | 0.70 | 644.6** | 1.98 | 0.88 | 7 |
| Serrejón | 50 | 0.16 | | | | | 5 |
| Talaván | 1558 | 2.57 | 0.64 | 161.9 | 2.75 | 0.38 | 7 |
| Tozo | 361 | 0.59 | 0.4 | 43.4 | 2.07 | 0.67 | 5 |
| Torrecillas | 331 | 0.61 | −0.1 | −7.8 | | 0.45 | 5 |
| Brozas | 2157 | 3.61 | 0.71* | 145.2 | 3.31 | 0.22 | 7 |
| Membrío | 503 | 0.84 | 0.89* | 86.7* | 4.74 | 0.46 | 6 |
| Herreruela | 84 | 0.16 | −0.76 | −7.71 | 0.67 | 0.39 | 6 |
| Aldea del Cano | 973 | 1.37 | 0.88* | 263.7* | 4.69 | 0.75 | 7 |
| Monesterio | 79 | 0.08 | −1* | −65.5 | | 0.83 | 3 |
| Salorino | 88 | 0.001 | | | | | 1 |
| Extremadura | 43115 | 66.58[a] | 0.82* | 4426* | 3.35 | 0.19 | 7 |

*r* = Spearman's correlation coefficient (*r*) and *b*, slope of the line of numbers in relation to year; CV, coefficient of variation of counts over *n* years. * $P<0.05$; ** $P<0.01$.

[a] The mean of the annual percentage for the Extremaduran population has been calculated only between 1987 and 1992. For the wintering of 1986 an estimation of the whole population using the western route was not made (see Table 2).

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Table 2. Number of wintering areas, number of Common Cranes and percentage of the Extremaduran population in the Tajo and Guadiana river basins in 1979 and this study

| | Tajo | | Guadiana | |
|---|---|---|---|---|
| | 1979 | 1986–1992 | 1979 | 1986–1992 |
| No. of wintering areas | 15 | 13 | 18 | 27 |
| No. of birds per basin | 3,950 | 11,031 | 11,808 | 35,346 |
| In Extremadura (%) | 25.06 | 23.79 | 74.93 | 76.21 |

Table 3. Annual estimated number of Common Cranes wintering in the western Palearctic based on recent censuses; mean number of birds (X), Spearman correlation coefficient (*r*), slope of the line (*b*), coefficient of variation (CV)

| | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | X | *r* | *b* | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| Spain | 39,579 | 63,563 | 57,071 | 71,362 | 65,818 | 67,080 | 60,760 | 0.771 | 4,522.80 | 0.187 |
| Gallocanta | 2,757 | 4,500 | 3,338 | 6,828 | 4,098 | 6,613 | 4,689 | 0.600 | 616.14 | 0.360 |
| Extremadura | 29,515 | 48,692 | 43,272 | 54,073 | 51,259 | 50,008 | 43,115 | 0.714 | 3,456.20 | 0.180 |
| Portugal | 2,609 | 2,019 | 3,001 | 1,930 | 2,389[a] | 2,389[a] | 2,389 | −0.40 | −105.00 | 0.212 |
| France | 3,500 | 2,200 | 3,000 | 2,750 | 3,200 | 12,200 | 4,475 | 0.371 | 1,321.00 | 0.851 |
| East Germany | 747 | 27 | 264 | 972 | 841 | 575 | 571 | 0.314 | 65.43 | 0.635 |
| Morocco | 1,000[b] | 1,000[b] | 1,000[b] | 1,000[b] | 1,000[b] | 1,000[b] | 1,000 | | | |
| Whole estimation | 47,435 | 68,899 | 64,336 | 78,014 | 73,248 | 83,246 | 68,196 | 0.886 | 5,879.43 | 0.168 |

[a] The counts in Portugal for 1987–1990 inclusive were averaged to provide an estimate for 1991 and 1992. This is considered reasonable given the low CV of the counts.
[b] For Morocco we used the maximum number of cranes given by Thevenot and Salvi (1985) in the best years. Statistical parameters were not calculated.

cranes which used this migratory passage in the period 1987–1992. A statistically significant trend of increase was observed, and in 1992 the number of cranes migrating on this route reached 83,000.

The trend in the number of cranes wintering north of the Pyrenees bears no relation to the evolution in the traditional wintering areas of the Iberian Peninsula, nor to the Palearctic population which uses the western route. Nevertheless, the number of wintering cranes in Extremadura is significantly related to the number of cranes wintering in Gallocanta ($r$=0.829; $P$<0.05; $n$=6), and both of these to cranes wintering in Spain ($r$=0.829; $P$<0.05; $n$=6 and $r$=0.943; $P$<0.05; $n$=6, respectively) and in the western Palearctic ($r$=0.829; $P$<0.05; $n$=6 and $r$=0.886; $P$<0.05; $n$=6, respectively). There is also a positive relation between the number of cranes that use the western route and those which winter in Spain ($r$=0.943; $P$<0.05; $n$=6).

A significant inverse relation existed between the extent of the increase in the number of cranes and the latitude of the six main wintering zones of the western crane population ($P$<0.05; $r$=−0.886; $n$=6) (Figure 1).

## Discussion

The results support the view, as do the partial censuses and estimates made earlier, that Extremadura is the area of greatest importance for wintering cranes

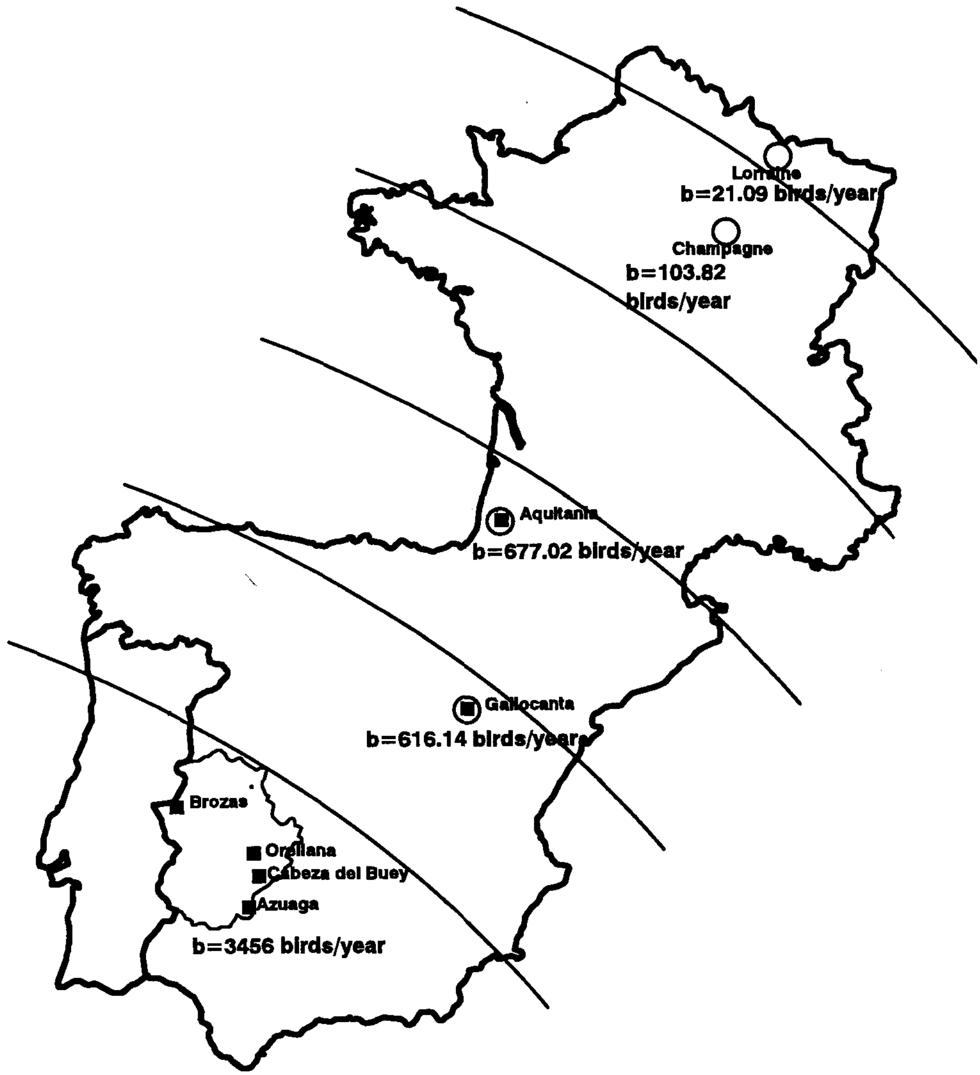


Figure 1. Distribution of wintering areas in the western route with more than two thousand birds (K). The wintering areas with a circle appeared in the last twenty years. The magnitude of increase in each area is expressed as numbers of birds/year.

on the western route (Figure 1). The increases both in the number of wintering areas within the study zone and in the number of cranes present over the past 15 years corroborate the suggestion of Bernis (1960) of a redistribution of the cranes' wintering areas, i.e. that fewer cranes cross the Straits of Gibraltar today than at the beginning of the century (Irby 1895, Verner 1909, Bedé 1926, Heim de Balzac *et al.* 1962, Moreau 1967). These changes involve both winter colonization of more northern latitudes (Petit 1986, J. Hippolyte unpublished 1988, Gerard *et al.* 1991, Salvi *et al.* 1996b), and an increase in the number of areas and in the number of cranes wintering in the traditional areas of the Iberian Peninsula

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(Pérez-Chiscano and Fernández-Cruz 1971, Alonso and Alonso 1990). Breeding and wintering areas are becoming closer. This could be due to improved habitat in the most northern areas rather than to loss of habitats in the south, as Bautista *et al.* (1992) suggested in the case of the occupation of the Gallocanta lagoon. Improved habitat suitability may result in a diminishing of migratory stimulus (Gwinner 1986) leading the birds to settle in more northern regions. This has been described as habitual in migratory species (Therrill and Omart 1984, Therrill 1990).

Diverse factors are responsible for this improved habitat suitability, not least being the increased availability of food in Western Europe as a result of intensified farming practices (Alonso *et al.* 1986b). This is a major determinant in the increase in the number of cranes in many of the traditional wintering areas (J. M. Sánchez *et al.* unpublished data), as well as in the colonization of new zones (Petit 1986, Salvi 1987). Another important factor is an increase in protection measures for numerous areas within Europe, especially along the migratory route (Bautista *et al.* 1992, Salvi *et al.* 1996a). This has no doubt enhanced feeding possibilities in the surrounding territory. The relation between the appearance or increase of cranes in certain areas and the creation of wetlands which are used as roosting sites has been highlighted for the wintering areas of Extremadura (authors' unpublished data).

The combination of these factors has led to a decrease in wintering mortality (Bautista *et al.* 1992) as has been shown, for example, in geese (Owen 1990, Ebbinge 1991). The population increase averages 6,000 cranes per year. It is likely that this trend is the factor that has determined the increase in the number of cranes to be found in the different wintering areas, rather than a differential occupation of areas throughout Western Europe. The latitudinal gradient shows the size of the increase is highest in Extremadura, indicating that this region is still the most propitious for the cranes. This may be due to the presence of holm oaks *Quercus ilex* in this region, the birds feeding on the acorns which have been traditionally a component of their diet. The population of cranes in this area, therefore, is one of the few whose feeding is not based entirely on agricultural products.

These factors, together with the reported enlargement of the total population, have led to the emergence of four large wintering areas between the breeding zones of Northern Europe (Prange 1996) and the traditional wintering areas in the western Iberian Peninsula (Bernis 1960, Fernández-Cruz 1981). One of them is in Spain (the Gallocanta lagoon) and three in France (Aquitaine, Champagne and Lorraine) all of which have increased both in size and stability in recent years (Alonso and Alonso 1996a, Salvi *et al.* 1996b). This chain of favourable areas (Figure 1) along the migratory route must have a positive influence on the cranes' survival on their migration south, since the possibility of travelling in stages must make the journey less arduous, a factor fundamental for the survival of the young.

In addition to the appearance of these new zones, it has been observed that the number of cranes wintering in the western Iberian Peninsula has increased and that, according to the data presented here, certain wintering patterns have varied. In the case of the traditional areas of Extremadura, the wintering groups were in the past relatively small (Bernis 1960, 1966) and the cranes roamed the stands of holm oaks feeding on acorns (Pérez-Chiscano and Fernández-Cruz 1971, Soriguer and Herrera 1978). The asynchronies of acorn production and the retention of oaks in areas without livestock, such as in cultivated dehesas, made it possible for the cranes to spend the winter here. These small wintering groups roosted in swampy areas, or in the many ponds which provide water for livestock in the region. This heavy dependence on acorn production (Fernández-Cruz 1981) had an influence on the cranes' wintering phenology in past decades and has been shown to coincide with the phenology of acorn production (authors' unpublished data). Nowadays, however, the number of cranes wintering in each area is much greater than in the past, as is the number of areas. The population now alternates its consumption of acorns with that of cereals which are widely cultivated in the region. Food supply is no longer likely to limit the size of each population in each area. A further influence on the increased numbers of wintering areas and of cranes per area is the construction of several reservoirs (Sánchez *et al.* 1993) which have become habitual roosting sites.

The factors which determine occupation of the newly colonized areas seem to be the same as those which have brought about increased numbers in the traditional areas. Extremadura is an area with a great diversity of available food. In addition to traditional foods such as acorns (Soriguer and Herrera 1978, González *et al.* 1981) which are abundant and easily procured (Sánchez *et al.* 1993), there are cereals which, like acorns, have a high energy value (Clark and Sudgen 1986) but lack important proteins and minerals (Baldassarre *et al.* 1983, Jorde *et al.* 1983). Others, such as bulbs and large quantities of invertebrates, compensate for the lack of proteins and mineral salts (Reinecki and Krapu 1986). The existence of these food sources is a consequence of the type of farming practised in the region, where each plot of land cultivated in one year is left uncultivated for the next two years. This extensive management is essential for the continuance of the invertebrate populations (Díaz *et al.* 1996). This diversity of food has proved to be a determining factor in the choice of foraging places of family groups of cranes (Alonso *et al.* 1996b).

Inter-annual variations observed may have different origins. On the one hand, the cranes' sensitivity to climate (Bautista *et al.* 1992) may lead to a redistribution of wintering areas, making accurate censuses more difficult (Sánchez *et al.* 1993). On the other hand, ringing results indicate that some individual birds use different routes (eastern, western) in different years (Alonso and Alonso 1996b, Lozano *et al.* 1996), although more data are needed to confirm this. However, if this is a habitual practice, it would be a new source of variation to be considered when assessing the populations which use the different routes.

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