

# Assessing four decades of wintering crane counts in Spain, Portugal and Morocco

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**ABSTRACT**

The Common crane winter counts carried out in Spain, Portugal and Morocco during the last four decades show an extraordinarily increasing trend, from the ca. 40000 birds counted in the mid 1980's to a total of 232298 birds in winter 2013/14. Such a marked increase cannot be explained as an intrinsic demographic growth alone, given juvenile productivity values measured in this species, and reasonable mortality estimates based on values published for other cranes. Additional factors contributing to the trend observed have surely been: (a) an increase in survey coverage; (b) a progressively better knowledge of the surveyed areas, particularly in Spain; (c) a northward shift of the wintering range, from relatively high numbers wintering in unknown sites in Morocco in the past to higher concentrations at present in areas where birds are easier to count, like Gallocanta; (d) a possible shift of an unknown number of cranes from eastern migratory routes to the western route. In sum, an actual demographic increase has unquestionably occurred in the western European population of Common cranes over the last 40 years, which can be explained by a likely reduction in mortality favoured by the shorter migration journey and higher food availability at staging areas, and to a higher availability of nesting sites due to current protection measures at breeding areas. However, here we want to highlight that such increase has not been as pronounced as the available counts suggest. To quantify that population increase more accurately, and to understand its consequences for the species' management, we need to obtain accurate mortality rates from the database of marked birds. Using these marked birds, we can also quantify possible shifts between migratory routes.

**KEYWORDS:** Common crane, *Grus grus*, Morocco, Portugal, Spain, wintering

**Introduction**

During the last decades the numbers of Common cranes counted at many breeding, staging, and wintering areas in Europe have increased (Alonso & Alonso 1996, Bautista et al. 1992, Prieta & Del Moral 2008, Lundgren 2013, Mewes et al. 2013, Salvi 2013, Román et al. 2014). Winter counts are particularly useful to estimate the total size and demographic trends of the population, as cranes aggregate in a number of known wintering areas where counts can easily be carried out each year. However, the demographic increases inferred from series of published counts should be taken with caution, since these counts may be affected by various sources of error. Here we review the winter counts done in Spain, Portugal and Morocco during the last 35 years, and discuss possible factors affecting the tendency observed.

## Censuses in Spain

The first coordinated census including the whole wintering range of the species in Spain was carried out in 1979-80. The resulting count was 14721 cranes (Fernández-Cruz 1981), based on which an estimated figure of ca. 17000 cranes was suggested as the size of the crane population wintering in Spain that year (Fernández et al. 1987). Three decades earlier Bernis (1960a, 1960b, 1966) had estimated the wintering population around 10000-15000 individuals. These first guesses were of great value as a starting point, but they surely underestimated real numbers of cranes, since they were done with limited staff resources and imperfect knowledge of the areas (Table 1).

Only five years later, in February-March 1985, a total of 31945 cranes were counted departing northwards on spring migration from Gallocanta lake, the main staging and wintering area in north-eastern Spain. This count questioned the reliability of counts from earlier years, suggesting that a minimum of 40000-50000 cranes were using the West-European migratory route (Alonso et al. 1986, 1987a). This spring count at Gallocanta showed the urgent need for a new reliable census, which was carried out during the winter 1987-88: the 61 wintering sites known at that moment were surveyed several times throughout that winter, with a maximum simultaneous count of 39579 cranes in January 1988 (Alonso & Alonso 1990, Alonso et al. 1995). On 10th November of that year and on 23rd November 1989, respectively 51466 and 54114 cranes were counted roosting at Gallocanta, where local food abundance on those autumns retained the cranes there for longer than usual staging periods. Allowing for a number of birds that had already left this area south-westwards to their wintering sites in Extremadura, Portugal, western Andalucía and Morocco, and for those that had not yet arrived there on those dates, the above mentioned censuses suggested that the western European route was really used by at least 70000 cranes (Alonso & Alonso 1990, Alonso et al. 1995) (Table 1).

During subsequent years (up to 1992-93) more coordinated counts were made in Extremadura, the main wintering region in south-western Spain (Sánchez et al. 1993), which led again to estimates for the whole population wintering in Spain of 65000-85000 birds (Table 1; see Alonso & Alonso 1996). Adding estimates for Portugal, Morocco and France, a guess for the crane population migrating through the Western route would be ca. 85000-95000 birds in the winter 1992-93 (Alonso & Alonso 1996, Sánchez et al. 1998). The results of these counts showed that ca. 75% of the birds spent the central winter period in Extremadura region, south-western Spain, with large-scale autumn and spring staging periods at Gallocanta, the main staging area in the northeast of the country.

After 1992-93, counts continued in Extremadura and Gallocanta almost every year, but not all of them were done in a coordinated way, i.e. in simultaneous dates in all areas. In Gallocanta cranes were counted every year, but at a larger, regional scale the only coordinated counts were done in Extremadura in 1998-99 (40000 birds, Valiente & Ferrero 1999), 2002 (58150 birds, ADENEX 2002), and 2004 (57000 birds, De la Cruz & Montoya 2004). In this last winter (January 2004), an almost complete, coordinated census was carried out in Spain, resulting in a total of 93241 cranes (De la Cruz & Montoya 2004) (Table 1).

During the winter 2007-08 a new coordinated census was carried out in Spain (at most localities between 21 and 28 December 2007, for some localities between 15 December 2007 and 15 January 2008). The total count was 151423 cranes (Prieta & Del Moral 2008). However, partial counts carried out more recently suggest that real numbers could be even higher. According to a count made in Extremadura in December 2012 (95282 cranes counted, 101000-120000 estimated; Arce et al. 2013, Román et al. 2013), and adding the 27th December 2012 count at Gallocanta (23184 cranes, Gobierno de Aragón 2014) and an estimate for other wintering sites in Spain that year (ca. 40000 cranes), the total number of cranes wintering in Spain in 2012-2013 could have been 160000-190000 cranes.

Finally, in 2013-14 another coordinated census was done in the whole country, with a total of 223639 cranes (Román et al. 2014).



**Table 1. Published censuses (and estimates, in parenthesis) of Common cranes wintering in Spain between 1960 and 2014**

<i>year</i>	<i>number of cranes</i>	<i>reference</i>
1960	(10000-15000)	Bernis 1960a, Bernis 1960b, 1966
1979-80	14721	Fernández-Cruz 1981
1980-81	(17000)	Fernández et al. 1987
1984-85	31945 (40000-50000) <sup>1</sup>	Alonso et al. 1986, 1987a
1987-88	39579 (60000-70000)	Alonso & Alonso 1990, Alonso et al. 1995
1988-89	(63653-71881) <sup>2</sup>	Alonso & Alonso 1996, Sánchez et al. 1998
1989-90	(57071-62986) <sup>2</sup>	Alonso & Alonso 1996, Sánchez et al. 1998
1990-91	(71362-82359) <sup>2</sup>	Alonso & Alonso 1996, Sánchez et al. 1998
1991-92	(65818-74807) <sup>2</sup>	Alonso & Alonso 1996, Sánchez et al. 1998
1992-93	(67082-75597) <sup>2</sup>	Alonso & Alonso 1996, Sánchez et al. 1998
1998-99	(80000)	Valiente & Ferrero 1999
2003-04	93241	De la Cruz & Montoya 2004, Alonso, Alonso & Bautista unpubl. data
2007-08	151423	Prieta & Del Moral 2008
2012-13	> 118466 (160000-190000)	Arce et al. 2013, Román & Gómez 2013, Román et al. 2013, Gobierno de Aragón 2014
2013-14	223639	Román et al. 2014, Gobierno de Aragón 2014

<sup>1</sup> cranes wintering in Portugal and Morocco might be included in these figures

<sup>2</sup> sum of counts in Extremadura (Sánchez et al. 1998) plus estimates for other Spanish regions (Alonso & Alonso 1996)

## Censuses in Portugal

The counts carried out in Portugal since 1985 also show an increasing trend, and numbers are at present two or three higher than four decades ago (Table 2). In spite of interannual fluctuations, current counts suggest a maximum population circa 10000 cranes (recorded in January 2013 and February 2006, the months when higher numbers are censused in the country; Cruz et al., in prep).

We believe that this trend could reflect a real increase of the population wintering in Portugal. The size of the areas to be surveyed and the previous knowledge of most roosts allowed to ensure a wide survey coverage of the winter range of the species since the mid 1980's. The simultaneous counts in most wintering areas and the participation of the same observers since 1996 reinforce our conviction of a real increase.

The crane movements between feeding areas and roosts show that there are five traditional wintering areas in the Alentejo region (southern Portugal), which have been active since the beginning of the coordinated counts, independently of the changes occurred in the use of the roosts.

**Table 2. Published censuses of Common cranes wintering in Portugal between 1985 and 2014**

<i>year</i>	<i>number of cranes</i>	<i>reference</i>
1985-86	2200	Cruz 1986
1986-87	3200	Cruz 1991
1987-88	1611	Cruz 1996
1988-89	3619	Almeida 1992, Cruz 1996
1989-90	3041	Almeida 1992, Cruz 1996
1990-91	5407	Almeida 1992, Cruz 1996
1991-92	2848	Almeida 1992, Cruz 1996
1992-93	2034	Almeida, unpubl.
1993-94	2362	Cruz 1996
1996-97	2901	Cruz et al. in prep.
1997-98	3918	Cruz et al. in prep.
1998-99	5152	Cruz et al. in prep.
1999-00	4402	Cruz et al. in prep.
2000-01	2095	Cruz et al. in prep.
2001-02	6663	Cruz et al. in prep.
2002-03	3686	Cruz et al. in prep.
2003-04	6693	Cruz et al. in prep.
2004-05	7697	Cruz et al. in prep.
2005-06	10609	Cruz et al. in prep.
2006-07	5994	Cruz et al. in prep.
2007-08	7112	Cruz et al. in prep.
2008-09	7919	Cruz et al. in prep.
2009-10	8867	Cruz et al. in prep.
2010-11	8223	Cruz et al. in prep.
2011-12	10306	Cruz et al. in prep.
2013-14	7080	CEAI, LPN, ICNF/PNVG & SPEA, unpubl. data

## Censuses in Morocco

As for Morocco, there are only three censuses covering most of the wintering areas in this country (Table 3). The wintering areas extend from the peninsula of Tangier in the north to the valley of Massa in the south, where birds have been observed in some winters (A. Muñoz, A. Kemp, C. Boix, pers. com.). Annual winter counts have been made at several well-known wintering sites (Table 3) and these reveal that the total wintering population varies markedly between years and is within the range of 1500-3000 (Thevenot et al., 2003; present study).

**Table 3. Censuses or estimates of Common cranes wintering in Morocco between 1980 and 2014. Counts are indicated for five regions, ordered from North to South**

year	number of cranes					Total	reference
	Tangier-Tetouan	Fes-Meknes	L'Oriental-Rif	Haouz	Souss		
1984-85 <sup>1</sup>	400	700	250	150	200	1700	Thévenot & Salvi 1987
1986-87	600						
1990-95							
1994-95	600	2035	230	120	85	8070	Thévenot e al. 2003
2008-09	1078						Onrubia et al. 2009
2013-14	632	663	212	60	13	1580	Onrubia et al. unpubl.

<sup>1</sup> estimates based on local counts made during winter seasons 1980-81 and 1984-85

## Discussion

Numbers of wintering cranes have increased in Spain and Portugal during the last four decades, whereas in Morocco the trends are not clear from the few counts available. The increase in winter numbers has been particularly remarkable in Spain, where the total numbers of cranes would have grown fifteen-fold in only 34 years (1979-2013, if we take the 1979-80 count as the first reliable census), or five-fold in only 26 years (1987-2013, if we take the 1987-88 count as the first reliable census). These increases would imply annual growth rates of, respectively, ca. 9% and 7%, which are not viable with the species' annual productivity rates (ca. 12%, Alonso & Alonso 1987, 1990) and accounting for a realistic mortality. Mortality values are unknown in this species, but assuming 8% as a conservative annual mortality rate (that value is close to the lowest among mortality rates obtained for similar crane species through marked birds: 8-20% for non-juvenile birds in Sandhill Cranes *Grus canadensis*, Whooping Cranes *Grus americana* or Red-crowned Cranes *Grus japonensis*, Bennet 1990, Tacha et al. 1992, Canadian Wildlife Service and U.S. Fish and Wildlife Service. 2007, The Aransas project 2009, Momose 2013), and using the series of counts for Spain which represent the majority of cranes in the western route, we conclude that the guess of 15000 cranes in 1960 could have underestimated the real wintering population by at least some 35000 birds; the count of 1987 would have underestimated the population by 66000 birds, and the count in 2007 by 40000 birds (Fig. 1). For higher mortality rates (e.g., 10%), these underestimates would have been even higher (Fig. 1). The error in estimate has surely been decreasing through these 50 years -in our example, from ca. 200% in 1960 to a ca. 30% in 2007-, mainly due to a better knowledge of the crane wintering areas and the participation of more and better trained observers in the surveys, but we must undoubtedly assume that all historical counts have underestimated the real population size, which means that the increasing trend has been lower than that reflected by the counts in Table 1. Undoubtedly, an increase in numbers of cranes wintering in the Iberian peninsula has taken place during the last five decades, but what we want to highlight here is that we cannot accept such increase as representing only a true demographic increase of the population.



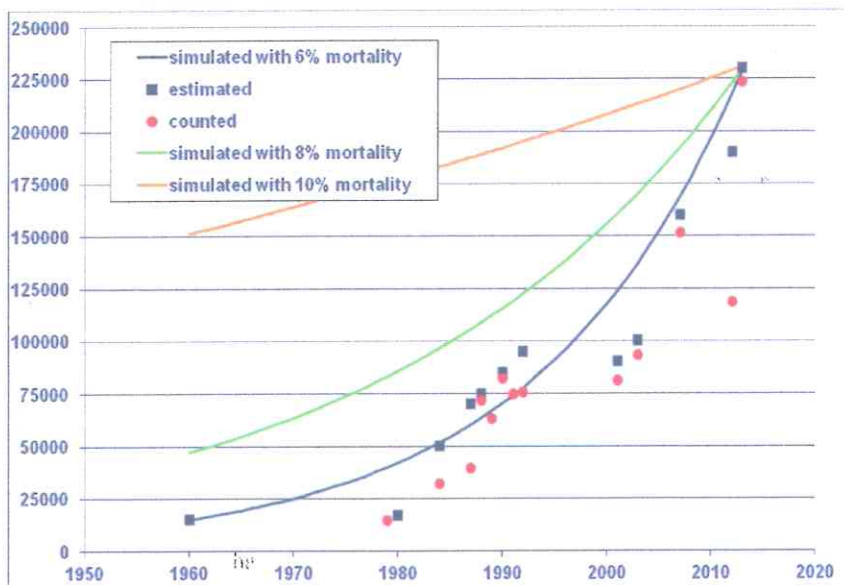


Fig. 1. Counts (red dots) and estimates (blue squares) of the Common crane population wintering in Spain since 1960, and simulated population increases assuming 230000 cranes in 2013-14 (Román et al. 2014), a fixed 12% annual productivity rate (Alonso & Alonso 1987, 1990) and three constant annual mortality rates (6%, blue curve; 8%, green curve; and 10%, orange curve), fixed for all age classes except juveniles in their first calendar-year. In spite of the good fit of counts to the blue curve, it is the green curve, or perhaps one between the green and orange curves, the one that more closely represents the real increase in the population over the last 50 years (see text for explanations).

At least four reasons have contributed to the increase in survey results. The first is the coverage of the survey. In 1987 only 61 sites were surveyed in Spain, whereas in 2007 and 2013, the numbers of sites surveyed were respectively, 144 (114 with positive results) and 176 (107 with positive results). The second factor contributing to the increase, at least in Spain, has certainly been a combination of the progressively better knowledge of the areas, and the higher experience acquired by the observers throughout the years in counting cranes. It is likely that such increase in knowledge and experience was the main factor contributing to the rapid increases in censuses recorded between 1980 and 1990. Even the authors of the count done in winter 2007-08 admit that the marked increase observed between 2002 and 2007 may have been caused by a higher survey coverage and a better census methodology in 2007, as in 2002 some areas were not surveyed, and in some areas counts were made during transects performed during the day at the foraging areas, instead of counting the cranes during flights from or to the roosts (Prieta & Del Moral 2008).

The third reason for the increase observed in the series of historical counts may have been the northward shift of the wintering range that has taken place through the time interval considered (reviewed in Alonso et al. 2003, 2008). This shift to the north has enabled more accurate counts of the birds in areas where cranes are easy to count like Gallocanta, compared to a situation some decades earlier where cranes spent the winter at more remote or less accessible areas in south-western Spain and Morocco. The northward shift has been observed and well described at the northern limit of the wintering range (Riols 1987, Alonso et al. 2003, 2008, Genard et al. 1992, Salvi et al. 1996, Salvi 2013), but there are also some evidences for the southern limit. Ornithologists from the late 19th and early 20th centuries reported high numbers of wintering cranes in Morocco, and these reports were used in later reviews to suggest that north-western Africa was the main wintering area for cranes in the Western route (e.g., Irby 1895, Verner 1909, Hartert 1910-1922, Bedé 1926, Libbert 1936, Hortling 1939, Heim de Balsac & Mayaud 1962, Moreau 1967, Makatsch 1970, Moll 1973, Walkinshaw 1973). Irby (1895) cited over 4000 cranes crossing the Straits of Gibraltar on the 11th of March 1874, i.e. more birds on a single day than the highest count of the last 35 years (see Table 3; Thévenot 1985a, Thévenot 1985b, Thévenot & Salvi 1987, Urban et al. 1986).

Finally, a shift from eastern European migratory routes to west might have also contributed to the increase observed in the western route. A few cases of banded cranes using different routes on different years shows that this

shift is possible, but the magnitude of such shift is probably very small and not necessarily directional from east to west. In addition, numbers of cranes staging at Hortobágy, the main stopover area in Hungary, have not decreased in the last decades, suggesting that there has been no massive shift from that flyway to the western flyway (Z. Vegvari, pers. com.). Shift between routes should be studied in the future with a large number of observations of banded birds.

In conclusion, it is clear that a certain demographic increase has occurred in this crane population, which should probably be attributed to the protected status of the species, as well as to conservation and management measures taken at most areas used by cranes during the breeding, migratory and wintering seasons. However, that demographic increase has unquestionably been lower than that reflected by the series of counts and estimates published in the last five decades. To quantify that population increase, forecast future trends, and build accurate population models that help us understand the species' demography and its management consequences, we need to obtain accurate mortality rates from the database of marked Common cranes.

## Acknowledgments

We thank all voluntary participants in the crane surveys in all three countries, and particularly J.C. del Moral, J. Prieta, J. A. Román and M. Gómez Calzado for sharing details about the censuses they coordinated in Spain, J. Almeida for her data for Portugal, and the CEAI, LPN, ICNF/PNVG and SPEA of Portugal for allowing us to use their unpublished census data.

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