WHITE STORK POPULATIONS ACROSS THE WORLD

Results of the 6th International White Stork Census in Spain

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Zusammenfassung

Im Frühjahr 2004 nahm SEO/BirdLife am 6. Internationalen Weißstorchzensus teil und organisierte die Erfassungen in Spanien. Neben der Zählung der gesamten Population wurden zum ersten Mal die Standorte aller Kolonien und Einzelnester georeferenziert. Dies eröffnete eine ganze Reihe neuer Möglichkeiten, um die Art großräumig zu erforschen. Die gesammelten Ergebnisse bestätigen die Bedeutung der spanischen Weißstorchpopulation innerhalb Europas. Seit dem ersten nationalen Zensus in Spanien (14.500 Paare), der 1948 durch Professor Francisco Bernis organisiert wurde, ging die Zahl der Weißstorchpaare über einen langen Zeitraum zurück (1984: 6.700 Paare) und die Art wurde auf der Roten Liste geführt. Erfreulicherweise kehrte sich nach 1984 der Trend um. Seit zwei Jahrzehnten nahm der Bestand wieder stetig zu, um 2004 den bisherigen Höchstbestand von 32.217 Paaren zu erreichen. Die meisten Paare brüten in der Extremadura (mehr als 11.000 Paare) und in den westlichen Provinzen von Castilla y León, Castilla-La Mancha, und Andalucía. Jedoch wurden in den nördlichen Regionen, die kleinere Populationen des Weißstorchs beherbergen, die deutlichsten Bestandsanstiege verzeichnet (Navarra, Catalonia and Galicia).

Summary

During the spring of 2004, SEO/Birdlife took part in the 6th International White Stork Census, by organising the work in Spain. As well as counting the whole population, all colonies and isolated pairs were georeferenced for the first time, thus opening a new range of possibilities for the study of the species over a wide area. The data collected have confirmed the importance of the Spanish breeding population within Europe. Following the first census in Spain, organised by Professor Francisco Bernis in 1948 (14,500 pairs), White Stork numbers were on the decrease for a long time (to 6,700 pairs in 1984) and the species was even red listed. Fortunately, 1984 proved to be a turning point and the trend over the last two decades has been one of steady increase, to record levels (32,217 pairs in 2004), clearly confirming the recovery of the species in Spain. The largest breeding grounds are in Extremadura (more than 11,000 pairs) and in the westernmost provinces of the communities of Castilla y León, Castilla-La Mancha, and Andalucía. However, it is in northern regions supporting smaller numbers of White Storks where the most marked population increases have been recorded (Navarra, Catalonia and Galicia).

Introduction

The Census of the White Stork is one of the most frequent and long-standing bird surveys in our country. It enjoys great popularity and the participation is massive; because of this, the surveys are highly successful. Spain has one of the most important populations of White Stork in Europe, together with those of Poland and Ukraine (SCHULZ 1999). In Spain, population size has been estimated on several occasions; the three first times using postal polls (1948, 1957 and 1974), the fourth census (1984) combined a poll with direct surveys, while in the census of 1994 data were obtained by means of direct observation or fieldwork (BERNIS 1981; LÁZARO *et al.* 1986; SEO/BIRDLIFE 1995). In addition, CHOZAS (1984) undertook a census of the species for the period 1979-1981 using postal polls and direct observations, and two other estimates were made in 1990 and 1992 (GÓMEZ-MANZANEQUE 1992).

Method of the census and amount data obtained

The census carried out during the spring of 2004 took place within the framework of the 6th International White Stork Census. This was the first time in Spain that the population has not only been counted, but the location of each nest or colony has also been mapped. To do this, a network of regional coordinators with experience of previous White Stork censuses was established. They were in charge of allocating the territory among volunteer surveyors so as to ensure coverage of all areas while avoiding duplication. The territory was divided into sampling units of 10x10 km UTM squares. Each volunteer received a map of their square, together with a data sheet to take note of the information of the area.

The minimum effort required was one visit, although at least two visits were recommended, with timings adapted to the phenology of the species. If a third visit was made, it was recommended to schedule this between the end of May and the middle of June, in order to count young White Storks flying from each nest. In parallel to the census, 4-5 visits were made to obtain the breeding parameters; a detailed data sheet was completed for those nests in which productivity data were taken.

All the information was then summarized on a data sheet for each 10x10 km UTM square, and the exact location of the point where the specimens were recorded was marked in the corresponding

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map. Other data collected included: coordinate, time of the census and situation (N.- Nest, B.- Landfill, D.- Roosting site, O.- Other).

Results of the census 2004/05: population, distribution, breeding density, breeding performance

During 2004, 33,217 breeding pairs (HPa) were located, the highest number ever recorded in Spain (Fig. 1, Fig. 2). This represents an increase of 99.6% compared with the 1994 census, with 16,574 new pairs (SEO/BIRDLIFE, 1995). Most of the population is situated in the west of the Iberian Peninsula. The autonomous communities of Extremadura and Castilla & Leon are particularly important, having between them 69.9% of the total.

Numbers are lower to the east, decreasing until the species disappears in most of the eastern half of the peninsula, although some individuals can be found along the Ebro Valley. Their general absence in these regions corresponds to the appearance of lime-rich substrates, decrease in rainfall and a more varied relief, none of which are ideal for breeding White Storks. The species is also absent from the north of the peninsula, this time due to the Atlantic climate, with only small numbers in Cantabria, the Basque Country, Galicia and Asturias. However, in some of these areas, the population trend is upward. The species is absent from wide areas of the Cantabrian mountains and from the Pyrenees, as well as from other areas of rugged landscapes. In addition, in contrast to the population increase in other Spanish provinces, the small population that used to be present in the province of Cuenca in the middle of the last century has not recovered; White Storks were not reported from here in either the census of 1994 (SEO/BIRDLIFE, 1995) or during the field surveys for the last Atlas of the Breeding Birds of Spain (MARTÍ & DEL MORAL 2003). Asturias is newly colonised, with only one successfully breeding pair each year.

The species' range is centred on Extramadura, which holds a high proportion of large colonies. The province of Cáceres has 27 of the 100 largest colonies (ten with more than 80 nests), which demonstrates the importance of this province for the species. There are only 11 colonies with more than 100 nests; three of these are located in Cáceres, three in Seville and one in each one of the following provinces: Badajoz, Huelva, La Rioja, Madrid and Segovia.

The population density per 100 km^2 (StD) was calculated for each province, using the same surface area data as for the 1984 and 1994 censuses (SEO/BIRDLIFE; 1995; LÁZARO *et al.*, 1986). The highest values were found in the west of the Iberian Peninsula (Figure 3) and the pattern is very similar to that obtained in the earlier censuses. The highest density is in the province of Cáceres (35.27 pairs/100 km^2). Segovia and Salamanca also have high values. The lowest values were found on the edge of the species' range.

Breeding parameters were monitored for 14.7% of the 33,217 pairs recorded (Table 1). The value obtained for the productivity (JZa) was 1.67 young fledged per pair, the same as that estimated for the census of 1994 (SEO/BIRDLIFE 1995), but higher than the 1.39 estimated in 1984 (LÁZARO *et al.* 1986). Mean fledged brood size (JZm) was 2.06, lower than in 1994 (2.5; SEO/BIRDLIFE 1995) and slightly lower than 1984, which was considered as a 'bad' year (2.12; LÁZARO *et al.* 1986).

It should be noticed that comparing the results of the 2004 census with previous records is rather complicated because these use inconsistent and sometimes vague terminologies (*e.g.* "partial", "real" and "total" productivity), and also because the breeding outcome is not known for a large number of pairs.

The highest breeding values were obtained in areas where close monitoring is carried out following reintroduction programmes, such as in the province of Girona, while the poorest breeding performance was recorded in the provinces of Guadalajara, Ciudad Real and Segovia.

Development of the breeding population

Numbers of White Storks in Europe and in Spain declined significantly between the middle of the 20th century and the 1980s (Fig. 1) (BERNIS 1981; BIBER *et al.* 1995; Schulz, 1999). The smallest population size recorded for Spain was 6,753 pairs, in the 1984 census (LÁZARO *et al.* 1986), since when numbers have increased. From the 1990s onwards, the population began to recover. GÓMEZ-MANZANEQUE (1992) recorded about 10,000 pairs in 1992, and later, in 1993, the *Grupo Ibérico de Cigüeñas* (SEO/BIRDLIFE) estimated a population of between 12,000 and 14,000 pairs (MARTÍ 1999). The 1994 census confirmed an important increase (16,643 pairs; SEO/BIRDLIFE 1995). The population estimate obtained by the present census (33,217 pairs) is double that of the previous one, representing an increase of 99.6%; and the total population at the time of writing may now be more than 34,000 pairs. It should be borne in mind that survey coverage and methodologies have been different in the several national censuses to date, and therefore the population trajectory should not be taken exactly as indicated over the whole period. The 1994 and 2004 censuses used direct observations and resurveys in the field, while the four previous censuses were carried out indirectly, by means of postal questionnaires and polls (BERNIS 1981; LÁZARO *et al.* 1986). In general, the rate of increase between 1994 and 2004 was more than 100% in all the autonomous communities except Extremadura, where the increase was below 50%.

Nest locations

Nests are found most frequently in trees (44.5%; Fig. 4), which are also much the commonest supports for nests in colonies (93.4%; Tab. 2). The commonest nest-tree species is the holm oak, followed by poplar and ash. Exceptions to this general pattern have been observed in Jaén, where most nests (28) are on buildings and none have been recorded on trees; and in Huesca, where the use of trees as habitat is very limited (0.6%).

The second commonest type of nest support is buildings, with only a slightly lower proportion of the total than trees. More than 4,000 nests have been found on electricity poles, most of which (85.5%; Tab. 2, Tab. 3) are clustered in colonies. There has been a tendency for more nests to be positioned on poles, at the expense of natural tree nest sites; this phenomenon had already been noted in the census of 1984 (LÁZARO *et al.* 1986). In Extremadura alone, 1,700 nests on power lines have been recorded, with Cáceres holding more of this type of nest than any other province. In

other autonomous communities, power lines are also starting to be used for nest building. Power lines were the commonest type of nest support in only one province, Huelva (47.8%).

There has also been a significant increase in the number of platforms located on mobile phone masts, as these have become widespread in our landscapes, as well as on artificial nesting posts that are often put up in places where nest building would otherwise create problems. This type of support has compensated for the current lack of trees or other suitable supports in areas where tree cover has been lost, including riparian woodland in some areas.

Conservation

Various schemes have been undertaken in locations with particularly dangerous power lines, high nest densities or close to suitable White Stork feeding areas, in order to prevent electrocution and collision of storks with power lines, while simultaneously avoiding negative effects on power transmission. Some of these schemes have consisted of: wire marking with buoys or other bird-friendly devices to prevent bird collision; changes in the layout of wires and posts; the use of isolation material; and the installation of deterrent devices. These have been developed by power companies to prevent incidents in foraging, breeding and roosting areas, although some studies have shown that they are not completely effective in preventing all stork electrocutions (GARRIDO & FERNÁNDEZ-CRUZ 2003).

In addition, the widespread use of artificial nest platforms in locations where the riparian woodland has disappeared, or as an alternative nest support to prevent damage to buildings or power lines, has boosted the population of the species in some areas, often assisting the establishment of a new colony or population (*e.g.* Malaga).

Discussion

A number of factors have been identified that are likely to have contributed to the population increase, and which could also have an effect on future trends. It is necessary to be prudent about the results obtained and to continue population monitoring, since some threats remain in place (*e.g.* agricultural intensification and power lines), while new ones arise as a result of human activity, such as the effects of climate change and, possibly, of the electromagnetic fields from telecommunications masts, closing up of landfills, and rural abandonment (CONTRERAS 2001, SANZ 2002, BALMORI 2004).

Feeding in urban refuse dumps

Although refuse dumps provide an additional source of food for White Storks, partly compensating for habitat loss, wetlands, dehesas, and other wild habitats remain vital for successful breeding. The role of dumps is thought to be one of the main reasons behind the population increase (BIBER *et al.*, 1995; TORTOSA *et al.*, 2002). Some important colonies are located around very large urban dumps (*e.g.* Cáceres, Mérida, Badajoz, Madrid and Zamora), and the food that White Storks find in dumps can be the main supply during the breeding season. In addition, many juveniles also visit dumps, which provide a continuous source of food requiring minimum foraging effort, and this in turn contributes to increasing survival rates. In fact, dumps are used by storks throughout the year (*i.e.* breeding, migration and wintering). Feeding on dumps might also be responsible for new migration strategies observed for White Storks, which now winter closer to the breeding sites or do not migrate at all. Nevertheless, the ingestion of items such as plastic, wire, nylon, rubber or cords, frequently produces many deaths (GARRIDO & SARASA 1999, PERIS 2003).

Changes in agricultural practices

Agricultural changes have affected White Stork populations in different ways. On the one hand, intensification of arable farming has led to the loss of habitat and traditional foraging and breeding areas. On the other hand, the increase in the extent of rice-fields has provided an important source of food, both during migration and in the breeding period (*e.g.* rice crops in the Guadalquivir Marshes, the Ebro Valley, and the Tajo Basin). During the past few decades, the red swamp crayfish (*Procamburus clarkii*) introduced from North America has become abundant, and storks now catch them in rice fields, irrigation channels and other wetlands (MÁÑEZ *et al.* 1994).

Meteorological conditions

Between 1994-2000, weather conditions have been favourable for the ecological needs of the White Stork, with springs generally rather humid, in contrast to the periods of drought that had occurred in previous decades, and which coincided with the lowest population levels during the 1970s and 1980s. Moreover, there has been no repeat of the persistent droughts in the wintering sites of sub-Saharan Africa, mainly in the Sahel, that also took place in the 1970s and 1980s.

Conservation measures

The implementation of various conservation measures may also have supported the population increase over the last 30 years. These measures include the modification of power lines, the construction of artificial nests, and the careful scheduling of construction works to take place outside the breeding period.

Reintroduction programme

Some reintroduction programmes have also contributed to the expansion and increase of the population, like the one implemented in the province of Girona, in Aiguamolls de l'Empordà Natural Park, where an important increase of the population was recorded between 1988 and 2004 (from one to 39 breeding pairs; SARGATAL pers. comm.).

Changes in behaviour

Changes in migratory patterns, covering shorter distances and occupying less time (HERNÁNDEZ-CARRASQUILLA & GÓMEZ MANZANEQUE 2001), together with an increase in the number of storks not crossing the Strait of Gibraltar to wintering grounds in Africa, contribute to an important reduction in the energetic costs associated with migration, and thus probably also to an increase in survival rates.

Others

Another factor that could have an effect might be the degradation of African wetlands used by White Storks for resting and thermoregulation on their wintering grounds. This seems linked to changes in rainfall patterns and the increase of human pressure. The impacts of hunting and pesticide use have not yet been studied, and consequently the effects of locust control programmes in Africa are not well known. (BROUWER *et al*. 2003).

Other activities around the census

A monograph showing the results of the wintering and breeding surveys has been produced (MOLINA & DEL MORAL 2005). It includes a detailed chapter devoted to White Stork migration over the Strait of Gibraltar, written by Manuel Fernández Cruz, with descriptions of the routes in and out of Iberia. Our magazine, *La Garcilla*, published a summary for our members. Several interviews in the media such as newspapers, radio and TV were made to disseminate the results to the general public.

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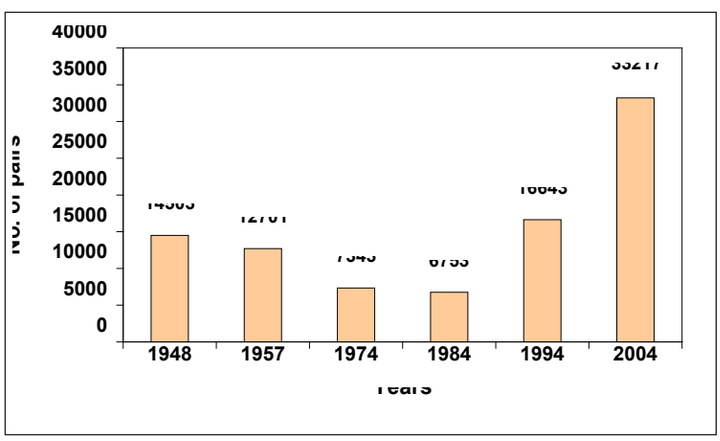

Fig. 1. Development of the White Stork population in Spain (1948–2004).

Entwicklung der Weißstorchpopulation in Spanien (1948-2004).

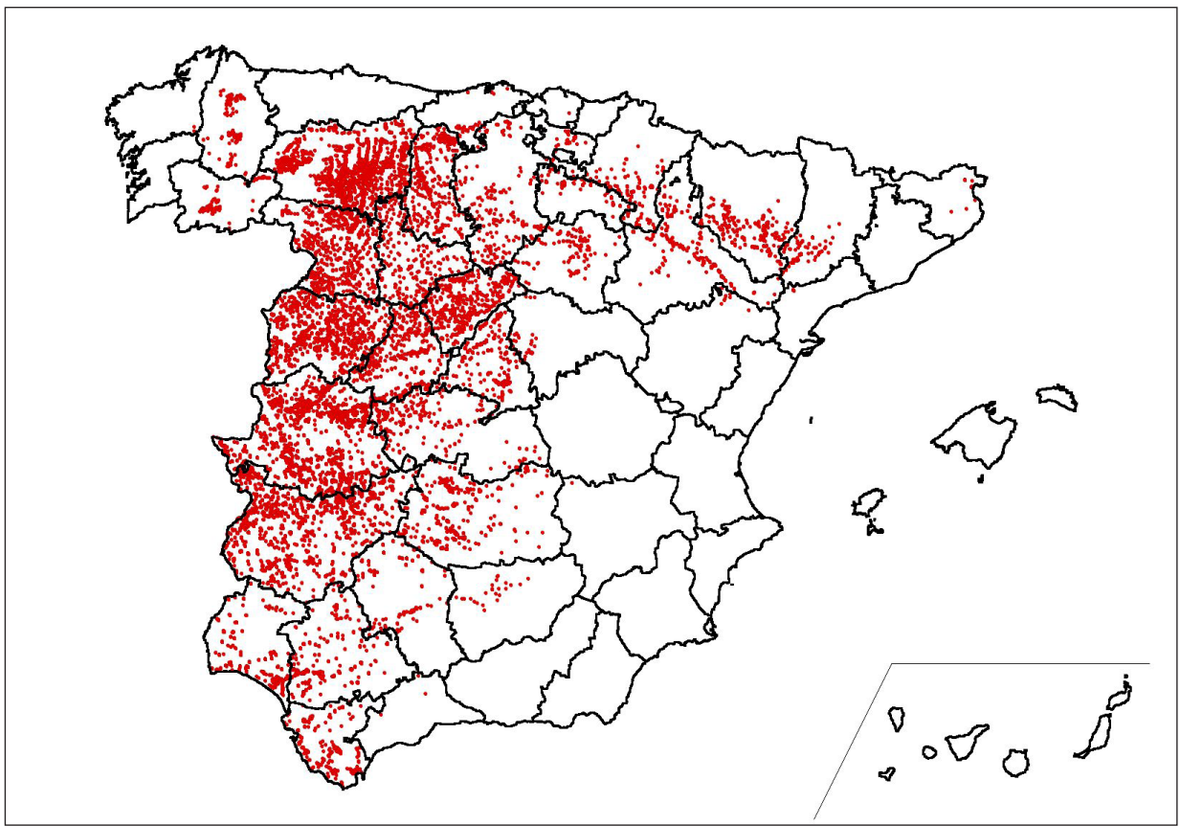

Fig. 2. Distribution of the White Stork in Spain 2004.
Verbreitung des Weißstorchs in Spanien 2004.

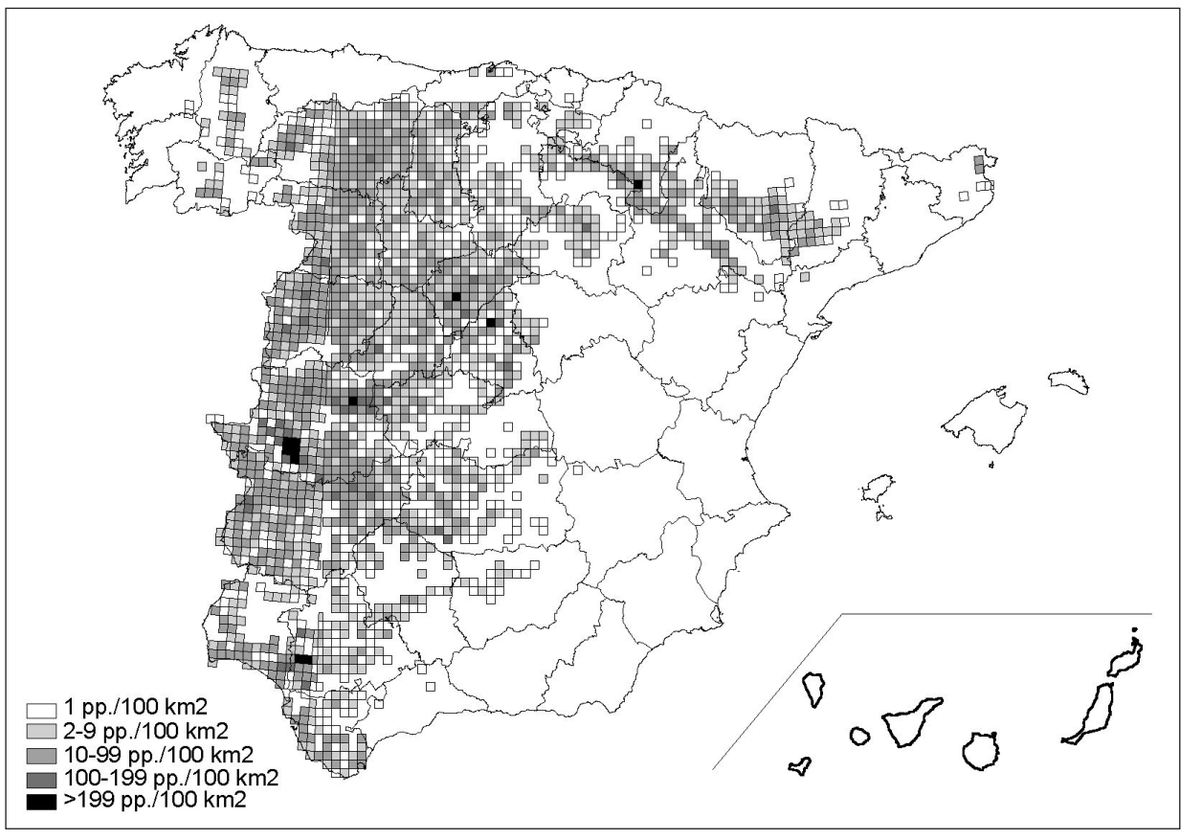

Fig. 3. Population density of the White Stork (StD) in Spain within 10x10 km UTM squares.
Populationsdichte des Weißstorchs (StD) in Spanien innerhalb der 10x10 km, UTM Gitter.

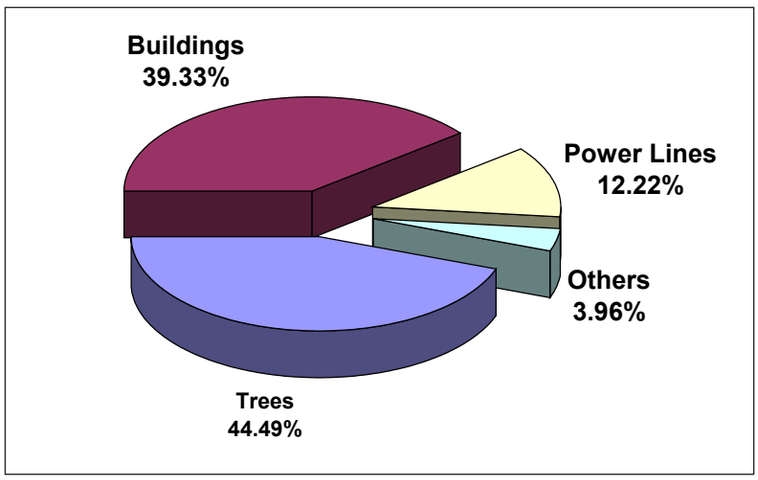

Fig. 4. Percentages of different nest locations of the White Stork in Spain 2004.
Häufigkeit verschiedener Neststandorte in Spanien 2004.

Tab. 1. Results of the 6th International White Stork Census in Spain 2004.
Ergebnisse des 6. Internationalen Weißstorchzensus 2004.

REGION	1948	1957	1974	1984	1994	2004	%	% Acumulated	N.° new breeding pairs	% Increment
CASTILLA Y LEÓN	4.953	4.500	2.375	2.043	5.197	12.017	36,18	36,18	6.820	131,23
EXTREMADURA	4.936	4.400	2.775	3.022	7.508	11.190	33,69	69,87	3.682	49,04
ANDALUCÍA	2.512	1.798	985	666	1.551	3.409	10,26	80,13	1.858	119,79
CASTILLA- LA MANCHA	1.333	1.200	779	525	1.005	2.315	6,97	87,10	1.310	130,35
MADRID	250	280	151	215	582	1.221	3,68	90,78	639	109,79
ARAGÓN	140	164	117	145	339	1.205	3,63	94,40	866	255,46
NAVARRA	82	77	35	41	95	621	1,87	96,27	526	553,68
LA RIOJA	122	110	57	46	168	499	1,50	97,77	331	197,02
CATALUÑA	5	8	8	19	55	270	0,81	98,59	215	390,91
GALICIA	26	16	6	4	56	256	0,77	99,36	200	357,14
CANTABRIA	114	126	49	26	79	177	0,53	99,89	98	124,05
PAÍS VASCO	30	22	6	1	8	36	0,11	100	28	350,00
ASTURIAS	0	0	0	0	0	1	0,00	100	1	-
BALEARES	0	0	0	0	0	0	0,00	100	0	0
CANARIAS	0	0	0	0	0	0	0,00	100	0	0
MURCIA	0	0	0	0	0	0	0,00	100	0	0
VALENCIA	0	0	0	0	0	0	0,00	100	0	0
TOTAL	**14.503**	**12.701**	**7.343**	**6.753**	**16.643**	**33.217**	**100**		**16.574**	**99,59**

Tab. 2. Distribution of different nest locations of the White Stork in Spain 2004 breeding solitary or in colonies.
Verteilung verschiedener Neststandorte von Weißstörchen in Spanien 2004, die einzeln oder in Kolonien brüten.

	TREES		CONST-RUCTION		POWER LINES		OTHERS		TOTAL	
	No. NESTS	%	No. NESTS	%	No. NESTS	%	No. NESTS	%	No. NESTS	%
COLONIES	13.806	93,42	10.310	78,93	3.471	85,49	987	75,06	28.574	86,02
SOLITARY NESTS	975	6,60	2.752	21,07	589	14,51	327	24,87	4.643	13,98
TOTAL	**14.779**	**44,49**	**13.063**	**39,33**	**4.060**	**12,22**	**1.315**	**3,96**	**33.217**	**100,00**

Tab. 3. Number and percentage of White Stork nests on powerlines.
Anzahl und prozentualer Anteil von Nestern auf elektrischen Masten.

Province	No. PAIRS (HPa) 2004	NEST ON THE POWER LINES	NEST ON THE POWER LINES (%)
A CORUÑA	2	2	100,00
ÁVILA	1.261	57	4,52
BADAJOZ	4.155	747	17,98
BURGOS	383	11	2,87
CÁCERES	7.035	953	13,55
CÁDIZ	692	215	31,07
CANTABRIA	177	3	1,69
CIUDAD REAL	1.493	145	9,71
CÓRDOBA	391	64	16,37
GIRONA	56	1	1,79
HUELVA	904	432	47,79
HUESCA	670	237	35,37
JAÉN	28	2	7,14
LA RIOJA	499	5	1,00
LEÓN	2.799	371	13,25
LLEIDA	208	3	1,44
LUGO	142	10	7,04
MADRID	1.221	135	11,06
NAVARRA	621	26	4,19
OURENSE	112	6	5,36
PALENCIA	860	53	6,16
SALAMANCA	2.627	93	3,54
SEGOVIA	1.582	25	1,58
SEVILLA	1.391	65	4,67
SORIA	261	25	9,58
TARRAGONA	6	1	16,67
TOLEDO	777	19	2,45
ZAMORA	1.581	246	15,56
ZARAGOZA	526	108	20,53
TOTAL	**32.460**	**4.060**	**12,51**

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