

Recent changes on migratory behaviour of the White stork (*Ciconia ciconia*) in Portugal: Towards the end of migration?

Alterações recentes do comportamento migratório da Cegonha-branca (*Ciconia ciconia*) em Portugal: O fim da migração?

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ABSTRACT

Historically, the White stork (*Ciconia ciconia*) was almost entirely migratory in Europe, but recently increasing numbers of individuals started wintering in their Iberian breeding grounds. We performed a survey in 2015 to estimate the number of wintering storks in Portugal and assess the last two-decade trend based on results from seven previous surveys performed between 1995 and 2008. The number of wintering storks increased from 1,187 individuals in 1995 to 14,434 in 2015. Although the breeding population showed a considerable boost during the same period, the proportion of resident individuals increased substantially in the last two decades (from 18% to 62%), suggesting a sound change in the migratory behaviour of this species towards fully residency.

Keywords: census, migration, Portugal, wintering population, White Stork.

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RESUMO

Nas últimas décadas, um número crescente de Cegonhas-brancas (*Ciconia ciconia*) passa o inverno na Península Ibérica, em vez de migrar para África. Em 2015 foi realizado um censo nacional para determinar o número de indivíduos invernantes em Portugal e comparar com a tendência registada nas últimas duas décadas, baseado em sete censos realizados entre 1995 e 2008. O número de Cegonhas-brancas invernantes aumentou de 1,187 indivíduos em 1995 para 14,434 contabilizados em 2015. Embora este aumento seja em parte justificado pelo aumento do efectivo reprodutor nas últimas duas décadas, a proporção de indivíduos residentes aumentou substancialmente no mesmo período (de 18% para 62%), sugerindo uma alteração no comportamento migratório da espécie que poderá, no futuro próximo, tornar-se residente.

Palavras-chave: Cegonha-branca, censo, migração, população invernante, Portugal.

Introduction

The migratory behaviour of birds is changing in response to global environmental change. Many migratory species are modifying their migratory phenology by advancing spring arrival to the breeding areas (Cotton 2003, Jonzén et al. 2006), shifting their breeding and wintering ranges and shortening their migration distances by wintering closer to the breeding grounds (Visser et al. 2009, La Sorte & Jetz 2010). In recent decades, even more profound and fascinating changes to migratory behaviour have occurred, with individuals from migratory species abandoning migration completely (Newton 2008). In southern Europe, particularly in the Iberian Peninsula, previously fully migratory species have recently established non-migratory populations (Berthold 2001, SEO/Birdlife 2012).

The iconic White stork (*Ciconia ciconia*) is a very adaptable, opportunistic species. After a sharp decline of the western European populations recorded in the mid-20th century, likely due to the prolonged Sudaño-Sahelian drought and locust control programs in this area (Dallinga & Schoenmakers 1989), the Iberian population started to

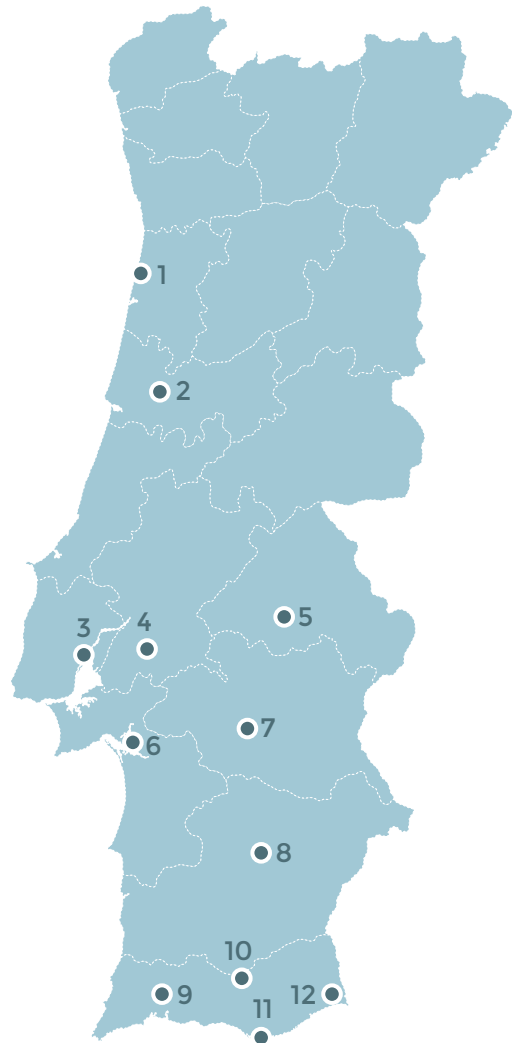
recover in the mid-1980s. Increased food availability and milder temperatures in winter have enabled an increasing number of residents, i.e., individuals that choose to stay in Iberia rather than migrate to Africa. Residency, coupled with changes in drought conditions in the Sahel were thought to be important in reversing the strong population decline in Europe (Tortosa et al. 2002). In Portugal, the recovery of the White stork population also started in the mid-1980s. The breeding population increased continuously from 1,533 pairs in 1984 to 3,302 in 1994, 7,684 in 2004 and 11,691 in 2014 (Encarnação 2015). Although considered traditionally a fully migratory species, some authors refer the presence of small numbers of wintering storks in the first half of the 20th century and the existence of small flocks during the decades of 1960 and 1970 (Tait 1924, Coverley c. 1945, Cary 1973).

This paper aimed at estimating the current number of wintering storks in Portugal and assessing the last two-decade trend of resident storks based on results from seven previous surveys performed between 1995 and 2008.

Figure 1 - Main wintering sites of white storks (*Ciconia ciconia*) in Portugal surveyed between 1995 and 2015 (Rosa et al. 2009 and this study).

Figura 2 - Principais áreas de invernada de Cegonha-branca (*Ciconia ciconia*) em Portugal entre 1995 e 2015 (Rosa et al. 2009 e presente estudo).

- | | |
|--------------------|------------------------|
| 1. Ria de Aveiro | 7. Évora landfill |
| 2. Baixo Mondego | 8. Beja landfill |
| 3. Vale do Tejo | 9. Barlavento landfill |
| 4. Vale do Sorraia | 10. Sotavento landfill |
| 5. Avis landfill | 11. Ria Formosa |
| 6. Sado | 12. Castro Marim |



Methods

A program to monitor the number of wintering white storks was launched in 1995, but the last out of the seven census occurred in 2008 (Rosa et al. 2009). In 2015, between 5 and 10 October, we surveyed the wintering population of white storks in Portugal to describe the trend of the wintering population comparing with data from seven previous surveys (1995 to 2008). The same survey was used to assess the proportion of resident individuals, i.e., individuals that stay in Portugal all year-round. After breeding, most migratory individuals cross the Strait of Gibraltar towards their African wintering grounds till the end of August (Fernández-Cruz 2005). Migratory storks can

start their pre-nuptial migration very early, but not before the end of October (Fundación MIGRES, pers. comm.). From mid September to mid November, the number of emigrants and immigrants is residual (Rosa et al. 1998, pers. obs.). Therefore, we considered the wintering birds counted during the survey period as resident ones, although acknowledging that these figures might be slightly overestimated by the inclusion of birds from northern breeding areas. Surveys included all areas where the species is known to winter regularly, giving special attention to areas with known high winter food availability, such as landfill sites and rice fields, where the birds tend to concentrate (Figure 1).

Table 1 - Number of wintering white storks (*Ciconia ciconia*) counted in each surveyed area in Portugal between 1995 and 2015 (Rosa et al. 2009 and this study).**Tabela 1** - Efectivos de Cegonha-branca (*Ciconia ciconia*) contados em cada área de invernada em Portugal entre 1995 e 2015 (Rosa et al. 2009 e presente estudo).

	1995	1996	1997	1998	1999	2006	2008	2015
Ria Aveiro	nc	14	30	1	nc	79	163	422
Baixo Mondego	22	28	40	53	109	377	763	1342
Vale do Tejo	2	7	100	219	405	308	545	3339
Vale do Sorraia	9	31	19	67	nc	610	1145	1317
Avis Landfill	x	x	x	x	x	245	628	0
Évora Landfill	x	x	x	x	x	135	900	571
Sado	272	520	433	1368	2813	4238	3717	4792
Beja Landfill	x	x	x	x	x	873	1100	550
Sotavento Landfill	95	150	124	340	750	0	0	0
Barlavento Landfill	x	x	x	x	x	585	800	790
Ria Formosa	168	156	197	52	37	30	10	106
Castro Marim	522	266	550	176	45	13	8	13
Other sites	97	253	215	149	42	450	241	1192
TOTAL	1187	1425	1708	2425	4201	7943	10020	14434

(nc) not counted, (x) landfill site not built at survey date

Results

The number of wintering white storks in Portugal has increased significantly from 1,187 individuals in 1995 to 14,434 in 2015 (Table 1, Figure 2). Most birds concentrated in areas of rice fields (68%) and landfill sites (21%) where birds likely rely on the guaranteed year-round food supply, namely Red-swamp Crayfish (*Procambarus clarkii*) and anthropogenic food. The most

important areas for wintering storks were the Tejo, Sorraia and Sado valleys holding approximately 65% of the surveyed storks, followed by Baixo Mondego and Ria de Aveiro (12%) and the Algarve (8%; Table 1). The recorded northward range expansion of breeding birds (Encarnação 2015) seems to also occur during the non-breeding period: the proportion of storks win-

Figure 2 - Population trend of wintering white storks (*Ciconia ciconia*) in Portugal between 1995 and 2015 (Rosa et al. 2009 and this study).

Figura 2 - Evolução do efectivo populacional invernante de Cegonha-branca (*Ciconia ciconia*) em Portugal entre 1995 e 2015 (Rosa et al. 2009 e presente estudo).

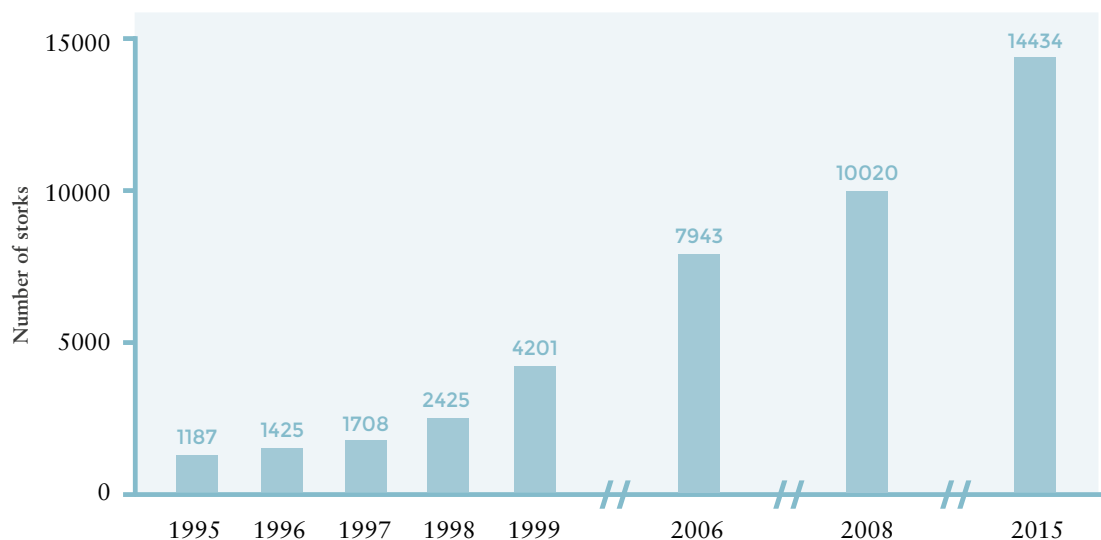
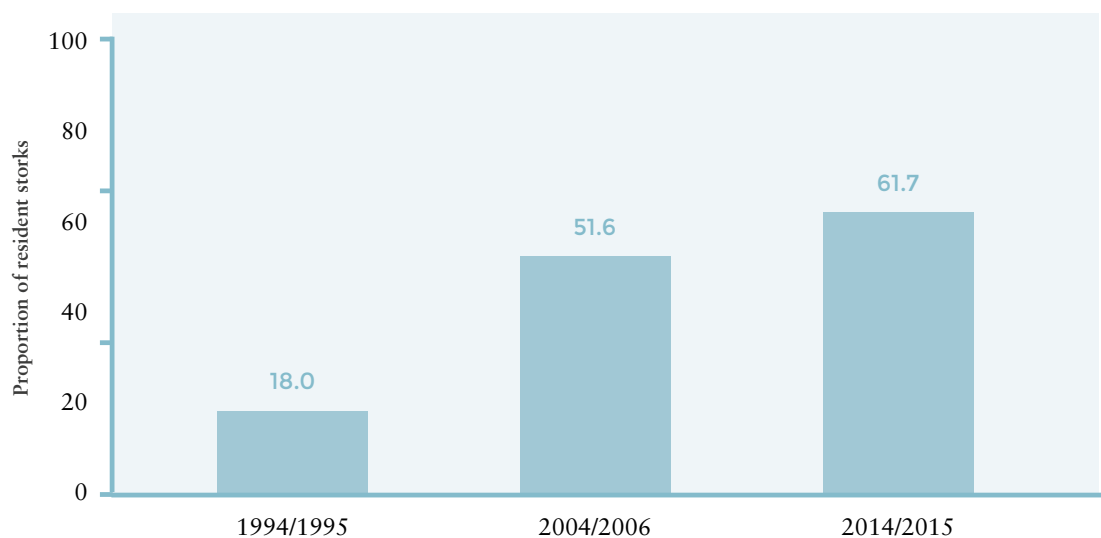


Figure 3 - Evolution of the White stork (*Ciconia ciconia*) resident population in Portugal in the last two decades as estimated by the ratio between the number of breeding and wintering individuals. Breeding and wintering population were assessed in the breeding season of 1994, 2004 e 2014 (n= 3302, 7684 and 11691 breeding pairs, respectively; Encarnação 2015) and during winter surveys in 1995, 2006 (Rosa et al. 2009) and 2015 (this study).

Figura 3 - Evolução da população residente de Cegonha-branca (*Ciconia ciconia*) em Portugal nas últimas duas décadas, estimada como a proporção entre o número de indivíduos reprodutores e o número de indivíduos migradores. As estimativas da população reprodutora e invernante referem-se aos censos nacionais realizados nas primaveras de 1994, 2004 e 2014 (n= 3302, 7684 e 11691 casais reprodutores, respectivamente; Encarnação 2015) e aos censos de inverno realizados em 1995, 2006 (Rosa et al. 2009) e 2015 (presente estudo).



tering north of the Tejo River increased from approximately 2% in 1995 to 14% in 2015. Besides the high increase in the number of wintering storks in coastal areas in the centre of the country (Baixo Mondego and Ria de Aveiro), we should highlight the high number recorded in the Castelo Branco district, where 200 birds were counted at the Fundão landfill site (included in “other sites”, Table 1). Overall, although the long-term positive trend in the number of breeding birds could partially explain the observed increase in the wintering population numbers, our results unveil a change in the migratory behaviour of white storks, as the proportion of resident individuals in the population steeply increased from 18% in 1994/1995 to 62% in 2014/2015 (Figure 3).

Discussion

Bird migratory behaviour can be highly flexible. Migration is likely to be advantageous whenever there is sufficient environmental variation to benefit individuals that move to exploit spatial variation in resource availability or quality (Boyle 2008, Newton 2008). Changes to environmental conditions can thus alter the selection pressures operating on migratory behaviour. If winter conditions improve, species may alter their migratory strategy and stay closer to their breeding areas. This saves them the costs of migration in terms of time, energy and mortality and ensures the benefits of early arrival to the breeding grounds (Visser et al. 2009). Climate change may thus not only result in strong shifts of phenology but also in changes in the primary migratory decision (to migrate or not migrate). A recent study showed that rising winter temperatures in the last decades have promoted an overall increase in climatic similarity between the Iberian Peninsula overwintering areas and African wintering grounds of six bird species with recent established overwintering popula-

tions in Iberia, including the White stork (Correia 2014). Additionally, year-round food availability from anthropogenic sources, including rubbish dumps and landfill sites (Gilbert et al. 2016), and the introduction of the invasive red-swamp crayfish in the 1970s (Ramos & Pereira 1981) likely enabled the establishment of overwintering populations of white storks in Iberia. In Spain, national winter census performed in 1995 and 2004 showed a large increase in the number of wintering storks, from 7,594 to 31,229 individuals (Molina & Del Moral 2005). Comparison with surveys of breeding numbers (1994 and 2004, Molina & Del Moral 2005) suggest an increase in the resident Spanish population from 23% to 47%, matching well the findings recorded for Portuguese resident storks in the same period (18% and 52%, respectively).

The migratory status of the White stork is changing substantially and in the mid-term, if environmental conditions continue to favour non-migratory individuals, the population is likely to change towards full residency.

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