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Restocking white stork *Ciconia ciconia* (L., 1758) population in Biscay: reintroduction in the Urdaibai Biosphere Reserve

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Abstract

Reintroduction of the white stork *Ciconia ciconia* (L., 1758) in the Urdaibai Biosphere Reserve (Biscay, Basque Country) is described. During the study period the white stork population quadrupled in Biscay and spread to several new localities, including the Urdaibai Reserve. A minimum of 36.8% of the released storks died during the first year after releasing. Power lines were the main cause of mortality (50%), affecting 18.4% of the released individuals. The reintroduction program was also used to strengthen awareness on conservation and to promote corrections of the electricity distribution network in order to reduce the mortality of storks and other large birds.

• **Key words:** Translocation, environmental awareness, electrocution, collision, power lines, flagship species.

Resumen

Se describe la reintroducción de la cigüeña blanca *Ciconia ciconia* (L., 1758) en la Reserva de la Biosfera de Urdaibai. Durante el periodo de estudio la población de Bizkaia se cuadruplicó y se extendió a nuevas localidades, incluyendo la propia Reserva de Urdaibai. Un mínimo del 36,8% de los ejemplares murió el primer año tras su liberación. Las líneas eléctricas fueron la causa de mortalidad más importante (50%), afectando al 18,4% de los individuos liberados. El programa de reintroducción fue utilizado también para fortalecer la conciencia medioambiental y para promover la corrección de la red de distribución eléctrica con el objetivo de reducir la mortalidad entre las cigüeñas y otras grandes aves.

• **Palabras clave:** translocación, concienciación ambiental, electrocución, colisión, líneas eléctricas, especie bandera.

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Laburpena

Zikoina zuriaren *Ciconia ciconia* (L., 1758) birsarketa Urdaibai Biosfera Erreserban deskribatzen da. Ikerketa-aldian Bizkaiko populazioa laukoiztu egin zen eta hainbat lokalitate berritan zabaldu zen, Urdaibai Erreserba barne. Gutxienez zikoinen % 36,8a hil zen askatu ondoko lehen urtean. Linea elektrikoak heriotza kausa garrantzitsuena izan ziren (%50) eta zikoinen % 18,4ari eragin zion. Birsartze programa erabili zen, era berean, ingurunekiko kontzientzia sendotzeko eta elektrizitatea banatzeko sarea zuzentzeko, zikoinen eta beste hegazti handien hilkortasuna gutxitzeko asmoz.

• **Gako hitzak:** Translokazioa, ingurugiro-kontzientzia, elektrokuzioa, talka, linea elektrikoak, espezie bandera.

Introduction

Translocation of wildlife species, the intentional release of organisms from one area into another, has become a widely used conservation management tool (IUCN 1998). Three main types of translocations could be distinguished: (1) "introduction", when the release is outside its historically native range, (2) "reintroduction", when the release occurs into a part of species' native range from which it has disappeared and (3) "restocking", when new individuals are added to an existing population (Iucn 1998; Pérez *et al.*, 2012). The main aim of a reintroduction is to re-establish a viable population of an organism that has become globally or locally extinct (Iucn 1998). However, reintroduction programs can be also carried out to achieve other goals, such as maintain or restore biodiversity, increase conservation awareness or promote local or national economy (IUCN 1998).

White stork *Ciconia ciconia* populations declined dramatically in many European countries during early 20th century (Dallinga & Schoenmakers, 1987; Tucker & Heath, 1994). However, many of these populations recovered during the last decades (Schulz, 1999; Thomsen & Hötker, 2006). That is the case of the Spanish breeding population, which increased sharply and reached 33,217 breeding pairs in 2004, after declining dramatically in the mid-1980s (Molina & Del Moral, 2005).

After becoming extinct in 1963, the white stork bred again in Biscay (Northern Spain) in 1991, and by 2004 the population consisted of four breeding pairs located in two localities (Molina & Del Moral, 2005). During the 2003-2008 period a translocation program was carried out in order to strengthen this small population and restore the species in the Urdaibai Biosphere Reserve. The program was also used to promote awareness on biodiversity conservation and to educate the public on the importance of preserving the

Urdaibai Reserve. Another objective of the reintroduction was to detect hazards and hazardous points, and promote corrections that might reduce mortality of the species in the Reserve. Accidents with power lines are the primary cause of death of many large bird species (JANSS 2000; RUBOLINI *et al.,* 2005, TINTÓ *et al.,* 2010), being the white stork one of the species most susceptible to electrocution and collision (GARRIDO & FERNÁNDEZ-CRUZ, 2003; SCHAUB & PRADEL, 2004; KALUGA *et al.,* 2011). The Urdaibai Reserve is a densely populated area, scattered with many small villages and isolated houses that generate an intricate electricity and transport network. Since white storks live in close association with human settlements it was assumed *a priori* that power lines could cause high mortality on released storks. A major conservation objective of the program was to raise public awareness on the negative impact of power lines on birds and, thus, promote correcting or removing dangerous lines and pylons.

Publishing the aims, methods and results of reintroduction programs is a basic contribution to translocation literature that can be used to improve the effectiveness of translocations and to evaluate the necessity and feasibility of future programs (PÉREZ *et al.,* 2012). However, although the IUCN (1998) encourage publishing on reintroduction programs, there is a lack of literature on many of them. Our main aims here were to describe and show the results of the white stork reintroduction program in Urdaibai, determine the rate and main causes of mortality of released individuals and evaluate media impact of the program.

METHOD

The reintroduction program was carried out at the Special Protected Area for Birds (SPA ES0000144) of the Urdaibai Biosphere Reserve (43°20'N, 2°40'W in its central area). This reserve is part of Biscay, a territory belonging to the Basque Country and located on the northern Iberian Atlantic coast. The Urdaibai Reserve covers 220 km^2 and includes an estuary surrounded by agricultural land (4,860 ha) and woodland (14,080 ha). Climate is oceanic, with an averaged annual rainfall of 1,200 mm, and average annual temperatures ranging between 13°C and 14°C. Human population density was of 153 inhabitants per km^2 in 2006.

We used 38 first-calendar year white storks delivered from Vallcalent Wildlife Rescue Centre (Catalonia, Spain). After transport to Urdaibai, these storks were kept in an aviary of 16 m long x 6.5 m wide x 4 m high during 2-3 consecutive winters before releasing in the wild from the aviary. Thirteen individuals were kept in the aviary from 2003 and released in 2005. Twenty-five new individuals were placed in the aviary in 2005, releasing 21 in 2007 and 4 in 2008. All birds were released on the first week of March. No artificial feeding was

carried out after releasing. Each stork was marked with a metal ring and additional engraved PVC rings to allow distance identification. The ringing scheme was registered in the European colour ring birding website. During the 2005-2012 period all the observations of the released storks sent by birdwatchers through the web together with the authors' observations were compiled. During the same period, annual censuses of the breeding population in Biscay were carried out, by locating the nests while visiting all areas with suitable habitat for the species. Data was used to evaluate the success of the reintroduction program and to determine the rate and main causes of mortality. During the project period an environmental campaign in schools and other actions were carried out to promote awareness on conservation. We compiled all news items in local press, radio and television to evaluate media impact of the program on local public.

Results

During the study period the white stork population increased four-fold in Biscay (Fig. 1) and spread to several new localities (Fig. 2). Released storks established two new nests in Biscay: Urdaibai (0 km from the releasing point) and Amorebieta (15 km), another two nests in Cantabria: Bárcena de Cicero (75 km) and Medio Cudeyo (90 km). A fifth nest was established near Dax (Sanbusse, France), the longest distance from the releasing point (125 km). Four of these five pairs bred the next year after releasing, thus in their third-

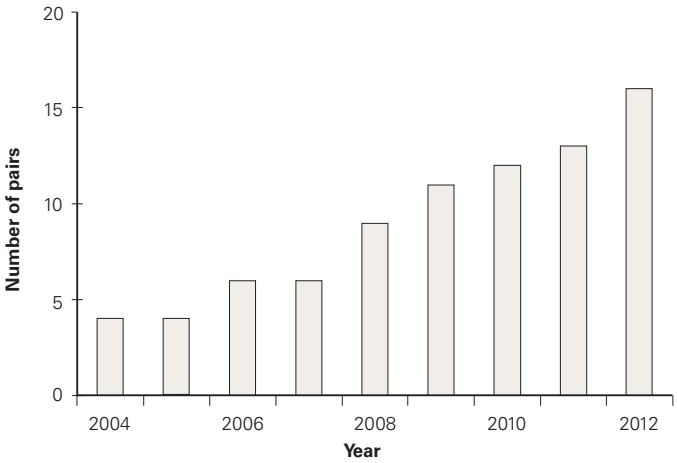

Fig. 1.- Number of white stork breeding pairs in Biscay during the 2004-2012 period.

Fig. 1.- Número de parejas reproductoras de cigüeña blanca en Bizkaia durante el período 2004-2012.

calendar year. In addition another 10 new wild pairs established in Biscay between 2005 and 2012.

We compiled 89 observations on 10 different released storks outside the breeding localities. All these observations were recorded less than 100 km from the releasing point and mainly during the July-December period (84.2%). Sixteen

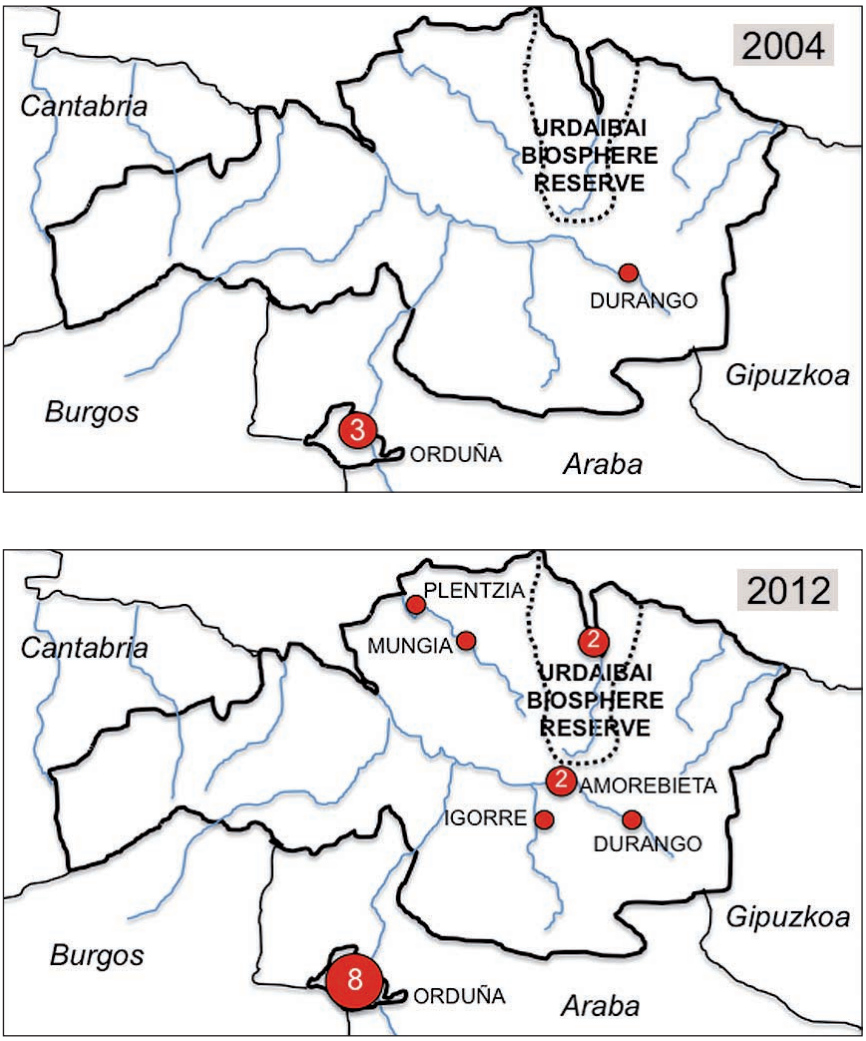

Fig. 2.- Distribution of white stork breeding pairs in Biscay in 2004 (data from Molina & Del Moral 2005) and 2012 (present study). The number of breeding pairs in each locality is shown in circles.

Fig. 2.- Distribución de las parejas reproductoras de cigüeña blanca en Bizkaia en 2004 (datos de Molina & Del Moral 2005) y 2012 (presente estudio). Se indica en los círculos el número de parejas reproductoras en cada localidad.

Year	Released	Observed	Non observed	Dead
2005	13	7	3	3
2007	21	9	5	7
2008	4	-	-	4
	38	16 (42.1%)	8 (21.0%)	14 (36.8%)

Table 1.- Number of storks released, storks observed alive one week or more after release, storks not observed after one week, and storks found dead, according to year of release.

Tabla 1.- Número de ejemplares liberados, ejemplares observados vivos a partir de una semana tras su liberación, ejemplares no observados tras una semana después de su liberación, y cigüeñas muertas, según año de liberación.

individuals (42.1%; Table 1) were observed one week or more after release and six of them were observed feeding in refuse dumps.

A minimum of 14 (36.8%) storks died during the first year following release (Table 1). Most dead storks (71%) were found in the first week after releasing and less than 2.5 km from the releasing point (92.8%). Power lines, due to electrocution or collision with wires, were the main cause of mortality (50% of dead individuals; Table 2), affecting 18.4% of the released storks.

Cause of death	Individuals
Power lines (electrocution)	4
Power lines (collision)	3
Railway (collision)	4
Intoxication	1
Shoot	1
Drowned	1

Table 2.- Causes of death of white storks released in the Urdaibai Biosphere Reserve.

Tabla 2.- Causas de mortalidad de las cigüeñas liberadas en la Reserva de la Biosfera de Urdaibai.

About 450 students of eight primary schools in the Urdaibai Reserve took part in the awareness campaign that included talks in the schools and visits to watch the storks *in situ*. Another 1,800 people participated in the acts organized around the release of the storks. In addition, the reintroduction process generated 83 news items in the local press, television and radio.

Discussion

European white stork populations increased strongly in the last decades, but its distribution range expanded only slightly (Molina & Del Moral, 2005), probably due to the species philopatry and high site-fidelity (Chernetsov *et al.,* 2006). In this scenario, reintroductions have been carried out to restore locally extinct populations in several countries and, thus, to promote the expansion of the species to its historical distribution range (Schaub *et al.,* 2004; Doligez *et al.,*

2004; MOLINA & DEL MORAL 2005; RUBOLINI *et al*., 2005; DUBOIS *et al.,* 2008; OLSON & ROGERS, 2009).

Since the present reintroduction program began, the population in Biscay has increased sharply and nowadays two white stork pairs breed in the Urdaibai Reserve. Therefore, preliminary results of the program confirm that translocation can be a useful tool to reinforce white stork populations and restore the species to a particular area. In many birds, conspecific attraction plays an important role in the colonization of unoccupied areas (STAMPS 1988; SCHLOSSBERG & WARD, 2004). For example, it has been suggested that the presence of conspecifics and their conspicuous treetop nests favours osprey (*Pandion haliaetus Linnaeus, 1758*) recolonization (LÖHMUS, 2001). Most of the new nests in Biscay during the study period were not established by released storks. However, we often observed migratory individuals attracted by released storks and fights were very common around the new founded nests. Therefore, it should be noted the effect of released breeding storks on the establishment of new pairs of wild storks, especially in an area that is fully located on the species migratory flyway.

During the study period no released individuals were observed at more than 100 km from their breeding locations, supporting the view that most manipulated white storks usually do not migrate any more (SCHAUB *et al.,* 2004). Instead, out of the breeding season the released birds tended to concentrate close to refuse dumps. Thus, during the autumn most birds were observed in the Salburua wetland, which located at 7 km from the landfill of the Vitoria-Gasteiz town and 54 km from the releasing point.

White stork is a charismatic bird, a flagship species that has been used very often as an icon to promote public awareness of nature conservation (SCHULZ 1998; CAVALLIN 2000; TRYJANOWSKI *et al.,* 2006). Although difficult to evaluate, results of this study suggest a great local interest in the reintroduction program, which hopefully increased the local concern for the conservation of the species and its habitat.

SCHAUD & PRADEL (2004) estimated that approximately 25% of juvenile and 6% of adult white storks died annually from power-line electrocution or collision. Our results show a severe impact of these infrastructures on the survival of released individuals, as also recorded among the reintroduced white storks in northern Italy (RUBOLINI *et al*., 2005). Because survival of released storks was of high local interest, news on electrocution or collision generated awareness about this impact, thus promoting correction of power lines. Since the release of first storks, 172 pylons have been corrected or removed, 2.5 km of power line have been removed and anti-collision beacons have been installed at 13 km of power line in the Urdaibai Reserve (GOBIERNO VASCO 2008, 2009). OLSSON & ROGERS (2009) suggested that the white stork has the potential to act as an

umbrella species for wetland and grassland species. If so, management of the Urdaibai Reserve for reintroduced white storks could benefit other species. This is the case of the corrections of the electricity distribution network, which also benefit other large birds susceptible to electrocution or collision, such as raptors or herons (Janss 2000, Rubolini *et al.*, 2005).

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