First bird-mortality figures from telephone line collisions in open grassland areas of Lanzarote and Fuerteventura (Canary Islands, Spain)

Primeiros dados de mortalidade de aves por colisão com linhas telefónicas em áreas estepárias de Lanzarote e Fuerteventura (Ilhas Canárias, Espanha)

Juan Antonio Lorenzo[1]*

1 Delegación Territorial de Canarias de SEO/BirdLife, Ctra. General del Sobradillo, nº 30B, 38107, El Sobradillo, S/C de Tenerife, Tenerife, islas Canarias, España.

***Corresponding author:** jalorenzo@seo.org

ABSTRACT

This article gives the first quantitative and qualitative findings on bird mortality from telephone-line collisions in open grassland areas on the islands of Fuerteventura and Lanzarote in the east of the Canary archipelago. A first ground search along 115.2 km of telephone lines on the two islands found the carcasses/remains of 107 birds belonging to 16 different species, corresponding to a mortality rate of 0.8 birds/km. The most frequent species were Eurasian Stone-curlew (*Burhinus oedicnemus*, 34.6%), Barbary Partridge (*Alectoris barbara*, 15.0%), Rock Dove (*Columba livia*, 14.0%) and Houbara Bustard (*Chlamydotis undulata*, 10.3%). When later patrols and other complementary findings are also taken into account, total bird deaths along these lines amount to a minimum of 175 birds belonging to 21 species. Once more the main species in the total findings are Eurasian Stone-curlew (34.9%), Houbara Bustard (22.3%), Rock Dove (9.7%) and Barbary Partridge (9.1%). These results suggest a high bird mortality rate from telephone-line collisions. From a conservation point of view, the negative impact of telephone lines on bird communities in the Canary archipelago is exacerbated by the fact that these are island environments and, as such, frequently more vulnerable than mainland areas.

Keywords: Bird mortality, collision, telephone lines, Lanzarote, Fuerteventura, Canary Islands.

RESUMO

Este estudo apresenta os primeiros dados quantitativos relativos à mortalidade de aves por colisão com linhas telefónicas em áreas estepárias das ilhas de Lanzarote e Fuerteventura, no extremo oriental do arquipélago das Canárias. Numa primeira prospecção que cobriu 115.2 kms de linhas telefónicas nas duas ilhas foi registada a morte de 107 aves pertencentes a 16 espécies, o que corresponde a uma mortalidade de 0.8 aves/km. As espécies com frequências relativas de mortalidade mais elevadas foram o Alcaravão (*Burhinus oedicnemus*, 34.6%), a

Perdiz-moura (*Alectoris barbara*, 15%), o Pombo-das-rochas (*Columba livia*, 14%) e a Abetarda-moura (*Chlamydotis undulata*, 10.3%). Quando foram considerados dados de prospecções complementares, o número de aves mortas foi estimado num mínimo de 175 indivíduos pertencentes a 21 espécies. De acordo com os resultados anteriores, as espécies mais atingidas foram o Alcaravão (34.9%), a Abetarda-moura (22.3%), o Pombo-das-rochas (9.7%) e a Perdiz-moura (9.1%). Estes resultados sugerem uma elevada mortalidade por colisão com linhas telefónicas. Do ponto de vista da conservação, o impacto negativo das linhas telefónicas na comunidade de aves das ilhas Canárias é exacerbado pelo facto dos ambientes insulares serem em geral mais vulneráveis do que áreas similares continentais.

Palavras-chave: mortalidade de aves, colisão, linhas telefónicas, Lanzarote, Fuerteventura, ilhas Canárias.

Introduction

By now an appreciable amount of information has been built up on bird mortality from collision with power lines (Tinto et al. 2010, Prinsen et al. 2011, Demerdzhiev 2014, Guil et al. 2015). In marked contrast few information is available on bird deaths into other structures like transmission pylons, telephony antennae, etc. (see Ferrer & Janss 1999, Ferrer 2012, Tellería 2012).

Among these structures, the telephone lines have not been studied, but there is no doubt that they are part of the current landscape of natural environments, and they share the landscape with the power lines. Therefore, it is expected some effect on the mortality of the birds. Telephone lines are smaller and have a much simpler design than power lines. Furthermore, they do not present a risk of electric mortality for birds. However, the telephone lines represent a collision threat to birds, in particular those whose flight altitude is lower than the power lines. Precisely, the scenario of this study is dominated by open environments and birds adapted to such landscapes, for instance birds like bustards, stone-curlews, larks, that flight at low altitude (Bota et al. 2005) and might be thus more susceptible to collision with lines compared to species from other environments. In fact, waterfowl (gulls, ducks, waders, etc.) and steppe birds (bustards, cranes, etc.) are those more heavily affected by collision with overhead wires (Bevanger 1998, Alonso & Alonso 1999, Janss 2000, Ferrer 2012, Tellería 2012).

In an attempt to start filling this gap, this study gives the first qualitative and quantitative findings on insular bird mortality from telephone line collisions. Also, the island character of these bird communities should never be overlooked, since this makes them potentially more vulnerable than their mainland counterparts (Gorman 1991, Fernández-Palacios & Martín-Esquivel 2001, Fernández-Palacios & Morici, 2004).

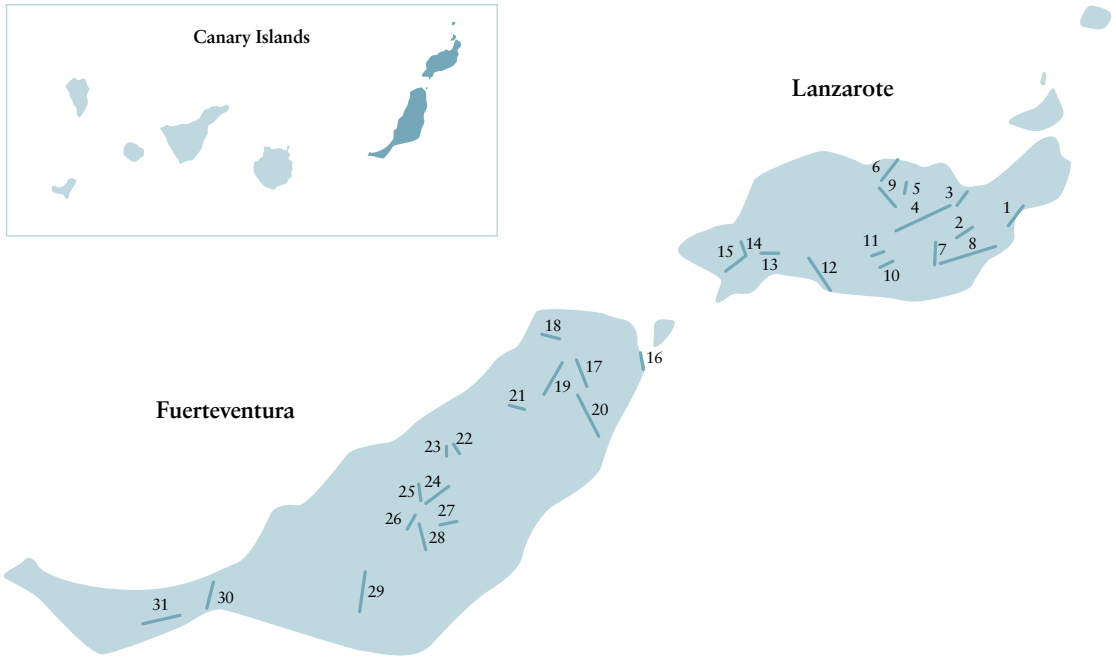
Methods

Study area

These study was conducted on the islands of Lanzarote (846 km^2 in area and maximum height above sea level of 670 m) and Fuerteventura (1660 km^2 and 807 m), the two eastern islands of Canary archipelago, lying only 127 and 95 km, respectively, off the African coast (Figure 1). The predominant habitat on both islands is xeric shrubland and grassland. Telephone lines were sampled in areas dominated by volcanic sand and thin-soiled and

Figure 1 - Map of the islands of Lanzarote and Fuerteventura in the Canary Islands, detailing the transects on both islands.

Figura 1 - Mapa das ilhas de Lanzarote e Fuerteventura no arquipélago das Canárias com a localização dos transectos efectuados em cada ilha.



stony plains both inland and along the coastline of the two islands, the typical habitat for grassland bird communities in this islands (Martín & Lorenzo 2001, Lorenzo 2007). The main mountain chains, urban areas and *malpaíses* ("badlands" of dry volcanic rock) were not surveyed.

Data collection

Fieldwork was carried out mainly in November and December 2005 on the two islands, although complementary surveys were also conducted in December 2011 and April and September 2012. A total of 115.2 km of telephone lines was patrolled in 2005, 51.9 km on Fuerteventura and the remaining 63.3 km on Lanzarote (Table 1). These distances were divided into 31 transects, 16 of them on Fuerteventura and the remaining 15 on Lanzarote (Figure 1). All transects were visited once in November-December 2005. One transect (2.8 km) on Fuerteventura and 5 transects on Lanzarote (14.1 km) were re-visited in subsequent dates (December 2011, April 212 and September 2012; Table 1). A further analysis includes additional data of species and numbers of birds from other studies that have included some of the same telephone lines between 1993 and 2008 (Table 5).

The dominant telephone wire arrangement throughout the whole study area consist of wooden poles from 8-9 m high and about 45-55 m apart, holding up between them a steel-wire braided only telephone line covered with an insulating material adding up to a total diameter of 45-65 mm. This conventional telephone line network connects all towns and cities in each of the islands. Also, this is the telephone network owned by the former national company, but is now owned by a multinational company responsible for its maintenance. All sections of this line through open grassland areas of Fuerteventura and Lanzarote have been included in this study.

Table 1 - Number and total length (km) of telephone lines transects prospected in the islands of Lanzarote and Fuerteventura from 2005 to 2012.

Tabela 1 - Número e comprimento total dos transectos de linhas telefónicas prospectados nas ilhas de Lanzarote e Fuerteventura entre 2005 e 2012.

SURVEY PERIODS	FUERTEVENTURA		LANZAROTE		TOTAL		
	Nº of transects	Lenght (km)	Nº of transects	Lenght (km)	Nº of transects	Length (km)	Length (%)
November/ December 2005	16	63.3	15	51.9	31	115.2	87.2
December 2011	-	-	3	7.4	3	7.4	5.6
April 2012	1	2.8	-	-	1	2.8	2.1
September 2012	-	-	2	6.7	2	6.7	5.1
Total	**17**	**66.1**	**20**	**66.0**	**37**	**132.1**	-

The ground-search methodology involved patrols of three people walking abreast about 20 m apart, one directly under the line and one to either side, each covering 20 m transects, as a fixed band census. The band patrolled by the three observers was therefore about 60 m wide. In these 60 m, each observer prospected its 20 m (10 m on each side). When any carcasses or bird remains were found, we recorded the distance from the line, the bird species, the decomposition status of the remains, any signs of collision and predator activity, etc. Most of the remains were collected and then donated to scientific collections; in the case of protected species, the pertinent authority was informed on the location of the bird. Importantly, the remains were removed once recorded, to avoid duplication in subsequent visits.

Results

Survey results, during the main and most intensive ground search carried out in November and December 2005, show a mortality of at least 107 birds of 16 different species, 62 of them on Fuerteventura and the remaining 45 on Lanzarote (Table 2). At least two remains, representing 1.9% of the total, were unidentifiable at species level; one seemed to correspond to a dove species, Streptopelia sp., while the other was unidentifiable even down to genus level but was definitely a different species from the 16 identified ones (Table 2). Moreover, it is interesting to note that, according to their preservation status, most of these remains belonged to animals that died in less than one year before detection date.

In decreasing order of abundance, the most frequent recorded species were Eurasian Stone-curlew Burhinus oedicnemus (34.6%, 0.3 birds/km), Barbary Partridge Alectoris barbara (15.0%, 0.1 birds/km), Rock Dove Columba livia (14.0%, 0.1 birds/km), Houbara Bustard Chlamydotis undulata (10.3%, 0.1 birds/km) and Yellow-legged Gull Larus michahellis (6.5%, 0.1 birds/km). Together these species represent over 80.0% of the total remains found in the main ground search on the two islands (Table 2).

Although more bird remains were found on Fuerteventura than Lanzarote (62 and 45, respectively), when the extension of lines surveyed was considered (63.3 and 51.9 kms,

Table 2 - Number of specimens (n), relative percentage (%) and relative abundance (dead birds per km) of bird species killed by collision with telephone lines on the islands of Lanzarote and Fuerteventura during the November and December 2005 survey.

Tabela 2 - Número de exemplares (n), percentagem relativa (%) e abundância relativa (aves mortas por km) de espécies de aves mortas por colisão com linhas telefónicas nas ilhas de Lanzarote e Fuerteventura durante o período de prospecção de Novembro e Dezembro de 2005.

SPECIES	FUERTEVENTURA			LANZAROTE			TOTAL		
	n	%	Birds/km	n	%	Birds/km	n	%	Birds/km
Burhinus oedicnemus	19	30.7	0.3	18	40.0	0.4	37	34.6	0.3
Alectoris barbara	9	-	-	7	15.6	0.1	16	15.0	0.1
Columba livia	9	-	-	6	13.3	0.1	15	14.0	0.1
Chlamydotis undulata	3	-	-	8	17.8	0.2	11	10.3	0.1
Larus michahellis	6	-	-	1	2.2	0.0	7	6.5	0.1
Pterocles orientalis	4	6.5	0.1	0	0.0	0.0	4	3.7	0.0
Falco tinnunculus	3	4.8	0.1	0	0.0	0.0	3	2.8	0.0
Upupa epops	3	4.8	0.1	0	0.0	0.0	3	2.8	0.0
Lanius meridionalis	2	3.2	14.5	0.1	2.2	0.0	3	2.8	0.0
Cursorius cursor	2	3.2	14.5	0.1	0.0	0.0	2	1.9	0.0
Calonectris diomedea	0	0.0	4.8	0.1	2.2	0.0	1	0.9	0.0
Bubulcus ibis	0	0.0	9.7	0.1	2.2	0.0	1	0.9	0.0
Coturnix coturnix	1	1.6	0.0	0	0.0	0.0	1	0.9	0.0
Pluvialis squatarola	0	0.0	0.0	1	2.2	0.0	1	0.9	0.0
Streptopelia sp.	0	0.0	0.0	1	2.2	0.0	1	0.9	0.0
Not identified	1	1.6	0.0	0	0.0	0.0	1	0.9	0.0
Total	**62**	-	**0.9**	**45**	-	**0.7**	**107**	-	**0.8**

respectively), the results do not differ so appreciably, with mortalities of 0.7 birds/km on Lanzarote and 0.9 birds/km on Fuerteventura (Tables 1 and 2). Excluding unidentified remains, a slightly higher variety of species was found on Fuerteventura than on Lanzarote: 11 and 9 species, respectively (Table 2). Furthermore, on Fuerteventura the most frequent findings were Eurasian Stone-curlew (30.6%), Barbary Partridge (14.5%),

Table 3 - Number of specimens (n), relative percentage (%) and relative abundance (dead birds per km) of bird species killed by collision with telephone lines on the islands of Lanzarote and Fuerteventura during complementary surveys (see methods).

Tabela 3 - Número de exemplares (n), percentagem relativa (%) e abundância relativa (aves mortas por km) de espécies de aves mortas por colisão com linhas telefónicas nas ilhas de Lanzarote e Fuerteventura durante visitas complementares (ver métodos).

SPECIES	FUERTEVENTURA April 2012			LANZAROTE December 2011			LANZAROTE September 2012			TOTAL		
	n	%	Birds/ km	n	%	Birds/ km	n	%	Birds/ km	n	%	Birds/ km
Chlamydotis undulata	0	0.0	0.0	11	64.7	1.5	4	66.7	0.6	15	65.2	0.9
Burhinus oedicnemus	0	0.0	0.0	4	23.5	0.5	2	33.3	0.3	6	26.1	0.4
Columba livia	0	0.0	0.0	1	5.9	0.1	0	0.0	0.0	1	4.3	0.1
Lanius meridionalis	0	0.0	0.0	1	5.9	0.1	0	0.0	0.0	1	4.3	0.1
Total	**0**		**0.0**	**17**		**2.3**	**6**		**0.9**	**23**		**1.4**

Rock Dove (14.5%) and Yellow-legged Gull (9.7%), whereas on Lanzarote they were Eurasian Stone-curlew (40.0%), Houbara Bustard (17.8%), Barbary Partridge (15.6%) and Rock Dove (13.3%).

These main figures have been fleshed out by other visits made to the same lines in subsequent years (Table 1), although in this case only some sections of the lines were checked and dead birds were recorded only on Lanzarote (Table 3). These surveys revealed a minimum of 23 bird deaths: Houbara Bustard (65.2%), Eurasian Stone-curlew (26.1%), Rock Dove (4.3%) and Southern Grey Shrike *Lanius meridionalis* (4.3%). Other finds were also made during casual visits in different sites of both islands, for example a Northern Raven *Corvus corax* underneath a Fuerteventura telephone line in March 2009 (M. Cabrera, pers. com.).

Discussion

Bird mortality by collision with telephone lines had previously been reported in the study area (Table 4), where some telephone lines were mistakenly counted as part of the power line network (see, for example, Ramos & Padrón 2008). A total of 68 bird deaths from 21 species were recorded in previous studies, with mortality rates ranging between zero and 2.3 birds/km (Table 4). Comparisons with other studies should be performed with due caution because the number of recorded dead birds from this study cannot be reliable attributed to a particular time period. Also, and despite the differences between these studies, such as the period of the annual cycle, number of observers, prospection methodologies, etc. (Table 5), cumulative figures from all studies give an idea of the conservation problem both from the point of view of its persistence over time and from the number of species impacted. Although both the present study and most of the previous studies were carried out during migration and wintering periods (Table 5), amongst recorded bird deaths there is a notably high proportion of species that breed in the islands, when compared with passage migrants or winter visitors (Martín & Lorenzo 2001, Lorenzo 2007). In quantitative terms these figures affect 20.4% of the total species nesting on Lanzarote and 21.8% of the total of Fuerteventura nesters (Martín & Lorenzo 2001, Lorenzo 2007).

Table 4 - Number of specimens (n) and relative percentage (%) by species of birds killed by collision with telephone lines on the islands of Lanzarote and Fuerteventura in surveys conducted between 1995 and 2012 (results from this study and previous research). Legend of the sources, arranged chronologically: (1) Lorenzo 1995, (2) Lorenzo et al. 1998, (3) present study, (4) Ramos & Padrón 2008 and (5) other non-systematic data obtained in the two islands between 2006 and 2010 (unpublished).

Tabela 2 - Número de exemplares (n), percentagem relativa (%) e abundância relativa (aves mortas por km) de espécies de aves mortas por colisão com linhas telefónicas nas ilhas de Lanzarote e Fuerteventura em transectos efectuados entre 1995 e 2012 (resultados deste estudo e estudos prévios). As fontes bibliográficas por ordem cronológica são: (1) Lorenzo 1995, (2) Lorenzo et al. 1998, (3) presente estudo, (4) Ramos & Padrón 2008 e (5) dados não sistemáticos obtidos nas mesmas ilhas entre 2006 e 2010 (não publicado).

SPECIES	FUERTEVENTURA	LANZAROTE	TOTAL		SOURCE
	n	n	n	%	%
Burhinus oedicnemus	20	41	61	34.9	3 and 4
Chlamydotis undulata	3	36	39	22.3	3 and 4
Columba livia	9	8	17	9.7	3 and 4
Alectoris barbara	9	7	16	9.1	3
Larus michahellis	6	2	8	4.6	3 and 4
Lanius meridionalis	2	2	4	2.3	3
Pterocles orientalis	4	0	4	2.3	3
Indeterminate birds	2	2	4	2.3	3 and 4
Calonectris diomedea	0	3	3	1.7	3 and 4
Falco tinnunculus	3	0	3	1.7	3
Upupa epops	3	0	3	1.7	3
Bubulcus ibis	0	2	2	1.1	3 and 4
Cursorius cursor	2	0	2	1.1	3
Larus sp.	0	2	2	1.1	4
Bulweria bulwerii	0	1	1	0.6	4
Calandrella rufescens	0	1	1	0.6	4
Corvus corax	1	0	1	0.6	5
Coturnix coturnix	1	0	1	0.6	3
Pluvialis squatarola	0	1	1	0.6	3
Streptopelia sp.	0	1	1	0.6	3
Tyto alba	0	1	1	0.6	4
Total	**65**	**110**	**175**	-	-

Table 5 - Detailed information of the surveys conducted between 1995 and 2012: source, island, date of fieldwork, survey methodology, number of observers and band length (meters). Both aerial lines (power and telephone) and only for telephone lines, length of the transects (km), number

Tabela 5 - Informação detalhada sobre os estudos efectuados entre 1995 e 2012: fonte, ilha, data, metodologia de prospecção, número de observadores e largura das bandas de prospecção. É apresentada ainda informação sobre o comprimento dos transectos (km) e o número total e a abundância relativa de aves mortas para as linhas aéreas (energia e telefone) e linhas telefónicas separadamente.

SOURCE	Island	Date	Search metho-dology	Nº of observers	Census band (m)	Aerial lines			Phone lines		
						Lenght (km)	Phone lines	Dead birds/km	Lenght (km)	Nº of dead birds	Dead birds/km
Lorenzo, 1995	Fuerte-ventura	November 1993	Three fixed bands	3	40-60	48	1.1	3.6	0	0.0	0.9
Lorenzo et al, 1998	Lanzarote	April and May 1994	Three fixed bands	3	40-60	160	1.5	0.7	0	0.0	0.4
Lorenzo & Ginovés, 2007	Fuerte-ventura	November 2005	Three fixed bands	3	60	343	1.2	63.3	62	1.0	0.1
Lorenzo & Ginovés, 2007	Lanzarote	December 2005	Three fixed bands	3	60	266	1.4	51.9	45	0.9	0.1
Lorenzo, 1995	Fuerte-ventura	November 1993	Multiple fixed bands	3	40-60	48	1.1	3.6	0	0.0	0.9
Lorenzo et al, 1998	Lanzarote	April and May 1994	Multiple fixed bands	3	40-60	160	1.5	0.7	0	0.0	0.4
Lorenzo & Ginovés, 2007	Fuerte-ventura	November 2005	Multiple fixed bands	3	60	343	1.2	63.3	62	1.0	0.1
Lorenzo & Ginovés, 2007	Lanzarote	December 2005	Multiple fixed bands	3	60	266	1.4	51.9	45	0.9	0.1
Lorenzo, 1995	Fuerte-ventura	November 1993	Three fixed bands	3	40-60	48	1.1	3.6	0	0.0	0.9
Lorenzo et al, 1998	Lanzarote	April and May 1994	Three fixed bands	3	40-60	160	1.5	0.7	0	0.0	0.4
Lorenzo & Ginovés, 2007	Fuerte-ventura	November 2005	Three fixed bands	3	60	343	1.2	63.3	62	1.0	0.1

Some of the fatal telephone-line collisions might be related to the line's maintenance. The deaths of some species seem to be especially bounded up with breakage of the steel support cable. The abovementioned Northern Raven found dead on Fuerteventura, for example, was found in an area where the cable was frayed and hence thinner and much less visible to flying birds. The same applies for power lines with a ground line, which is thought to be responsible for larger number of collisions than the thicker conductor wires (Ferrer & Janss 1999, Ferrer 2012). However, there have also been recorded many cases of bird impacts with telephone lines

in a perfect state of maintenance, for example of Houbara Bustard and Stone-curlew.

The lower height of the telephone lines in comparison with electrical lines may be the cause of increased occurrence of species with lower flying heights, such as the Barbary Partridge or Hoopoe *Upupa epops*. However, more detailed research is needed to affirm this assumption rigorously. In other continental areas studied, the design (especially the existence of ground line) and the location of the line, as well as the type of bird and its flight performance, and the visibility conditions, influence collisions of birds (Bevanger 1994, Janss 2000, Ferrer 2012).

It should be pointed out here that, estimates of bird mortality based exclusively on ground searches below telephone lines might underestimate the real problem. Data from carcass search are biased by several factors such as observer acuity, bird detectability, the type of terrain the line runs through and scavenger removal (Bevanger 1999, Ferrer 2012). For example, if the Fuerteventura and Lanzarote findings under aerial (telephone and power) lines in November and December 2005 are corrected by the Bevanger formula (1995a and b, 1999), the 351 and 263 carcasses found, respectively, in each island actually represent a bird mortality rate of 3000 a year (Lorenzo & Ginovés 2005). According to these authors, the total number of dead birds (N) under lines can be estimated as N = tam / pae x pne x pp x pam, where tam is the total number of dead birds found, pae is the percentage of dead birds not removed by scavengers in an experimental study, pp is the proportion of lying that can prospect, and pam is the percentage of dead birds in the area prospected being detected by the team (Bevanger 1995a and b, 1999).

From these findings no strong conclusions can be drawn about the percentage of bird populations affected by this type of mortality. Reliable species counts close to the study area are scarce. The Houbara Bustard counts carried out in the same year as this fieldwork (2005), suggest that 0.86-1.41% of the population was affected in that year, 1.00-2.10% for Lanzarote and 0.65-0.80% for Fuerteventura (Lorenzo et al. 2007). Also, in the case of Stone-curlew, deaths account for 0.70-4.85% on both islands, 0.45-3.71% for Lanzarote and 1.41-6.83% for Fuerteventura, according to the estimated population in spring 2005 (Carrascal & Alonso 2005). Houbara Bustard and Stone-curlew, are the most affected species in the two islands (Table 4).

An analysis of the conservation status of the various species involved in these telephone line deaths at regional, national and international level brings out the importance of this bird mortality from a conservation point of view. Many of these species are not only protected but are also listed as endangered, such as the Canarian Houbara Bustard *C. undulata fuertaventurae*, Canary Northern Raven *C. corax canariensis*, Cream-coloured Courser *Cursorius cursor*, Black-bellied Sandgrouse *Pterocles orientali*s and Eastern Islands Barn Owl *Tyto alba gracilirostris* (Madroño et al. 2004). Other species with lower conservation status are still of considerable value, such as the Barbary Partridge, as a game species, and the Rock Dove, raised for racing activities (a considerable proportion of the dead birds found had been ringed by the Real Federación Española de Colombofilia, i.e., the Spanish Pigeon-Racing Federation).

These findings point out the need to implement mitigation measures to reduce bird mortality on both islands. This would involve preliminary studies to ascertain the black spots, i.e., areas with higher mortality rates, followed by the implementation of dissuasive devices (as spirals, firefly diverters, etc.), as a first attempt to reduce bird deaths to the minimum. Similar schemes have already been carried out on power lines in these same islands (Lorenzo et al. 2012) and there is also a host of examples at national and international scale (see, for example Ferrer & Janss 1999, Ferrer 2012). The island character of these bird communities should be considered, since are much more vulnerable than their mainland counterparts (Gorman 1991, Fernández-Palacios & Martín-Esquivel 2001, Fernández-Palacios & Morici 2004).

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