Electrocution and collision of birds with power lines in Saudi Arabia

(Aves)

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Abstract. A power line located 100 km south of Jeddah was monitored for four years (2008-2011) and the results show that collision and electrocution of birds by power lines are of conservation concern in Saudi Arabia. The White Stork (*Ciconia ciconia*), Common Quail (*Coturnix coturnix*), Corncrake (*Crex crex*) and Willow Warbler (*Phylloscopus trochilus*) were the most affected species in the study area. However, the Common Quail seems to be more susceptible than other species and was found in high numbers. Although the number of species affected is probably low, the increases in energy demands and the introduction of new power lines will lead to an increase in bird deaths by electrocution and collision unless a conservation measure is applied to minimize the effect of power lines especially among the migratory species.

Key words. Bird collision, electrocution, migration, threats, Saudi Arabia, Middle East.

Introduction

Electrocution and collision with power lines are considered to be a major cause of death for some avian species (CRIVELLI et al. 1988, MORKILL & ANDERSON 1991, SHAW et al. 2010, PRINSEN et al. 2011). Electrocution can occur when a bird perches on a cross-arm and completes an electrical circuit with two or more body parts. Electrocution can also happen when the bird comes between two energized components or an energized and an earthed (also called 'grounded') component of the pole structure. Collisions, on the other hand, happen when birds fly directly into electrical lines, poles and pylons and the bird is typically killed when it collides with such obstructions and the subsequent impact with the ground, or it dies from the resulting injuries (LEHMAN et al. 2007, BEVANGER 1994, BAYLE 1999, APLIC 2006, MARTIN 2011). However, birds die either from the impact of hitting the line or from electrocution when they contact two lines simultaneously and complete the electrical circuit (HARNESS et al. 2008). Several studies have shown that electrocution from power lines is a serious conservation problem and is one of the principal causes of mortality among many threatened species of birds (BEVANGER 1998, BAYLE 1999, REAL et al. 2001). In some areas, it is considered to be the main reason for the decline of endangered species (FERRER et al. 1991, BEVANGER & OVERSKAUG 1998, REAL et al. 2001). Collisions may kill anything between hundreds of thousands to 175 million birds annually, and power lines electrocute tens to hundreds of thousands more birds annually, but these utilities are poorly monitored for both strikes and electrocutions (MANVILLE 2005).

The death rate is low at the population level for most species involved in collisions (BROWN & DREWIEN 1995, FAANES 1987, HUGIE et al. 1993), but power line mortality can be an important concern for rare or declining species. In certain cases it can have significant negative effects on the local scale or even at the population level, such as has been

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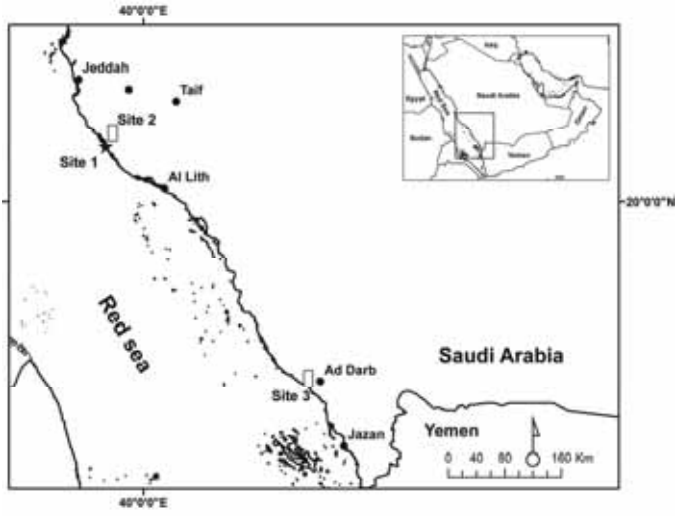

Fig. 1. Map showing the location of the survey sites.

documented for the Saker Falcon, *Falco cherrug* (HARNESS et al. 2008), Golden Eagle, *Aquila chrysaetos* (LASCH et al. 2010, MANVILLE 2005), and Eagle Owl, *Bubo bubo* (BEVANGER & OVERSKAUG 1998; RUBOLINI et al. 2005).

Avian electrocution is not only a conservation issue, but it can also involve financial losses due to the power interruptions and repairs. The studies of ANTAL (2010) in Hungary showed that at least US$7 million is spent annually in retrofitting existing power poles to mitigate electrocution. Moreover, electrical currents running through power lines generate electric and magnetic fields which have been known to affect human health, including increasing the risks of life-threatening illnesses such as leukaemia, brain cancer, amyotrophic lateral sclerosis, clinical depression, suicide and Alzheimer's disease (BRAINARD et al. 1999, HARRINGTON et al. 1997, SOBEL et al. 1996).

PRINSEN et al. (2011) reviewed the conflict between migratory birds and electricity power grids in the African-Eurasian region. Although collision and electrocution has been reported in Saudi Arabia by EVANS (1994) at Sabkat Al Fasal in the eastern province, and by SHOBRAK et al. (2009), who recorded the death of 236 White Storks (*Ciconia ciconia)*, no information was reported from the Arabian Peninsula in PRINSEN et al. (2011). I therefore present here the results of four years of monitoring bird electrocution at a selected site in Saudi Arabia. The main objectives are to document this effect in Saudi Arabia for future conservation planning and to determine the species affected by the power line in the Kingdom.

Methodology and study area

Two types of survey were carried out during the study period at three sites with a high voltage power line 380-400 kV and mid voltage power lines 110-170 kV (Fig. 1). The first type was a semi-systematic survey at site 1 and one general survey at sites 2 and 3. The semi-systematic surveys were made between 2008 and 2011 at site 1, which is located 100 km south of Jeddah near ash Shuibah desalination station (20°44'N, 39°32'E). The length of the monitored area was 6 km. This site was selected after a local web group called Makshat

Table 1. Number of species carcasses recorded during the survey. * = Probably died at the same time as the other White Stork in 2008. Red List species according to IUCN (2011): NT (Near Threatened); LC (Least Concern).

	Red List	Years				To-tal
		2008	2009	2010	2011	
Common Quail *Coturnix coturnix*	LC	88	15	20	47	170
Ferruginous Duck *Aythya nyroca*	NT		1			1
White Stork *Ciconia ciconia*	LC	242	13*			254
Squacco Heron *Ardeola ralloides*	LC			1		1
Purple Hiron *Ardea purpurea*	LC	1		1		2
Goliath Heron *Ardea goliath*	LC	1				1
March Harrier *Circus aeruginosus*	LC			1		1
Common Buzzard *Buteo buteo*	LC	1				1
Corncrake *Crex crex*	NT	13	5	8	18	44
Spotted Crake *Porzana porzana*	LC	1		2		3
Little Crake *Prozana parva*	LC				1	1
Common Moorhen *Gallinula chloropus*	LC	1			1	2
European Turtle Dove *Streptopelia turtur*	LC	2			1	3
Namaqua Dove *Oena capensis*	LC	1			1	2
Rufous-tailed Shrike *Laniusisabillinus*	LC		1			1
Red-backed Shrike *Lanius collurio*	LC	1			1	2
Brown-necked Raven *Corvus ruficollis*	LC	1				1
Willow Warbler *Phylloscopus trochilus*	LC	7	3	2	5	19
Whitethroat *Sylvia communis*	LC	2	1		13	16
Barred Warbler *Sylvia nisoria*	LC	1			2	3
Great Reed Warbler *Acrocephalus arundinaceus*	LC				1	1
Unknown warbler	?	2			2	3
Total		**365**	**39**	**35**	**92**	**532**

reported 150 carcasses of White Storks on 29 August 2008. The surveys were started in September 2008 and continued once a month in October and December. In 2009, two surveys were carried out at this site during January and October. In 2010 two surveys were made in October and November. In 2011, only one survey was made on 23 September 2011.

The general surveys (sites 2 & 3) were carried out in two areas under power lines of high voltage, once each during December 2008 for site 2 and January 2009 for site 3. The first area was located at the power lines from the ash Shuibah desalination station and covered a distance of 56 km. The second area was under the power lines from the ash Shuqaiq desalination station located in the south-west of the country, and covered a distance of 43 km.

The method of searching during the semi-systematic surveys was to drive slowly at 15-20 km/hour under the power line at site 1 with frequent stops every 500 m to walk around the site searching for any evidence of bird carcasses. When a carcass was found, it was identified and the site was checked for carcasses of other species. The general surveys were made by driving slowly at a speed of 20-30 km/hour. Regular stops were made every 4 km to check the surroundings for any carcasses.

The habitat at site 1 consisted of open sandy areas with cultivated trees on the roadside located between the power lines. However, the majority of the terrain was open and sandy with scattered ground cover, whereas sites 2 and 3, where general surveys were carried out, are open with sand and sandy gravels and cross several wadis and rocky areas. Both power lines start moving east then change direction to north-east and south-east.

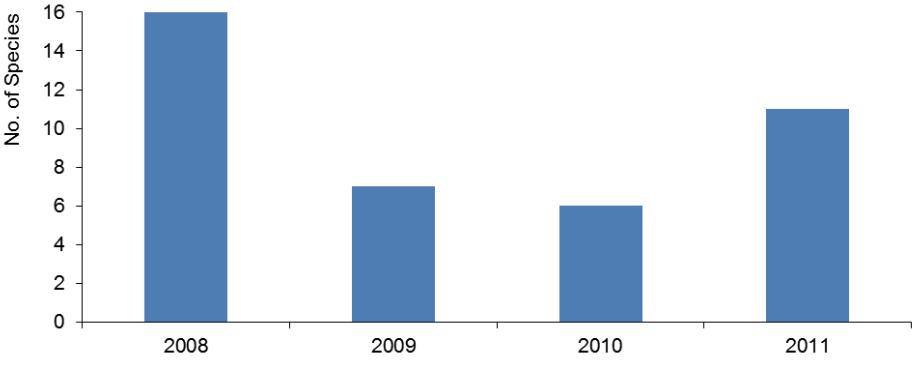

Fig. 2. Number of species affected by the power lines in the study area during 2008-2011.

Results and discussion

The total number of species found affected by power lines during the four years of the study area was 20 species and two unidentified warblers, with a total number of 532 individuals (Table 1).The majority were migratory species with only two resident species, the Namaqua Dove, *Oena capensis*, and the Brown-necked Raven, *Corvus ruficollis*. Fig. 2 shows the total number of species reported during the 4-year survey. Although this number probably does not represent the actual bird mortality due to electrocution or collision with the power lines, the nature of the terrain and the occurrence of predators, where tracks of a large number of foxes and domestic cats were seen along the power lines, could explain the low number of bird carcasses found in the study area. Several studies have already mentioned the importance of counting bird carcasses by the power lines even if this does not represent the actual number or the actual species affected by the power lines, especially the small species (CURRY & KERLINGER 2002, DIETER et al. 2000, RUGGE et al. 2003). However, the number of large species found during this study is probably close to the actual numbers affected by the power lines at the study sites, as the remains of the carcasses of these large birds were observed during the period of the study. Among these large species was the White Stork, which represents the highest percentage of individuals of one species affected by electrocution or collision recorded in this study (Fig. 3). The species is known to be susceptible to electrocution by power lines in other parts of the world, along with passerines and raptors (KEIL 2005, PRINSEN et al. 2011). The large number of individuals of this species affected is probably due to their behaviour during migration, as they fly in flocks. JANSS (2000) suggested that the size and length of the wings of these birds makes them more susceptible to collision. In addition, the weather may also play a role in this high mortality as sand storms are known to be common in this type of habitat.

Among the greatly affected species observed during this study were: Common Quail (*Coturnix coturnix)*, Willow Warbler (*Phylloscopus trochilus)* and the near-threatened Corncrake (*Crex crex*). 88 Quails were found in 2008 and 47 in 2011 (Table 1). This high number is probably related to the presence of trees along the tarmac road between the power line poles, which give shade, food and water for the species. These trees probably also attract other species in this type of habitat.

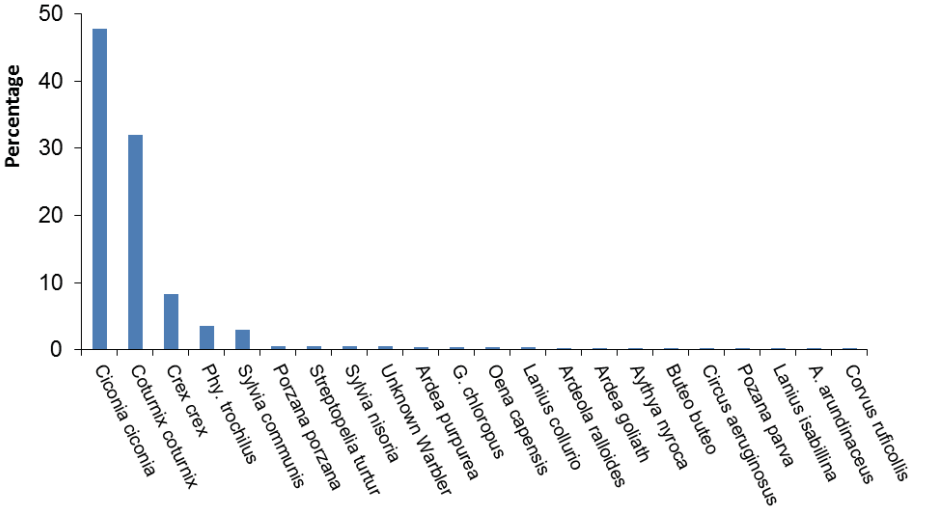

Fig. 3. Percentage of the recorded species affected byelectrocution or collision in the study area.

The issue of collision and electrocution probably needs more investigation, as some could argue that the size, length of wing and position of the carcasses do not always indicate the actual cause of death. JENKINS et al. (2010) suggested that the vulnerability of a species to collision with power lines is defined by a combination of the exposure to collision risk and the susceptibility of the species to collision. Studies from other areas suggested that large birds are more susceptible to collision along with the vegetation cover, density of predators, the size of the bird and the terrain of the area (CURRY & KERLINGER 2002, DIETER et al. 2000, RUGGE et al. 2003). MATHIASSON (1993) proposed that a bird is susceptible to collision if it has a poor lift capacity. This may explain the relatively high number of collisions involving the Common Quail and Corncrake. The results of this study are in line with other research work which showed that there are species which are more susceptible to electrocution and collision by power lines than others (KEIL 2005, LEHMAN 2001, JANSS & FERRER 1998, 1999). The study of JANSS & FERRER (1998) showed that the Great Bustard (*Otis trada*) was still affected by collision with power lines even after implementing certain conservation measures.

The concentration of bird carcasses found in the length of two kilometres at site 1 probably shows that this area is an important pathway for several species of migratory birds. NEWTON (2008) showed that birds migrating along a narrow front tend to follow natural linear features such as coastlines and mountain ranges, and to be channeled into corridors where they may encounter topographic bottlenecks, such as when they move down peninsulas or cross narrow straits of open water. Studies in other parts of the world showed that birds are more susceptible to power line collisions if lines cross flight paths or movement corridors (THOMPSON 1978, BEVANGER 1994). In the Arabian Peninsula the majority of migratory water and soaring birds use the coastline as a corridor to reach the narrow area of Bab Al Mandab whilst crossing to Africa (SHOBRAK 2011). With recent developments on the coastline along the pathway for migratory species, conservation measures should be

Fig. 4. Carcasses of White Storks under a power line.

considered at the stage of coastal planning. Although there no threatened species were recorded during this study, the majority were included in different wildlife agreements such as Convention of the Migratory Species (CMS) and African Eurasian WaterBirds Agreement.

To reduce the effect of power lines on bird populations, especially migrants, the problem has to be raised at the level of both environmental agencies and electricity and energy companies. TUCKER & TREWEEK (2008) explored methods used to reduce the effect of power lines on the bird species. For example, burying electricity line wires underground in coastal areas should be considered, at least for the first 10 kilometres. Burying power lines is practised in some areas in Europe (APLIC 2006, PRINSEN et al. 2011). However, if this is not possible, then other methods can be used such as reflective balls or a moving tag with different colours to attract the birds' attention. These modifications are very important for reducing mortality, especially among the nocturnal migrants species such as Quails and Corncrake.

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