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Bird collisions with power lines in Nakhchivan Autonomous Republic

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The article summarizes the results of research in four selected sites (observations) on the impact of surface power lines on bird death in the area of Nakhchivan Autonomous Republic in 2016-2017. Studies show that electrical wires have a major impact on bird death during the spring migration and nesting period. We determined that 225 individual of 27 species were killed by electric shock in selected areas, while 16 individuals belonging to 3 predator bird species were exposed to this threat. Two of these species are in the World Red List. The next plot with high mortality rate was the Cananbar well - Shikhmahmud plain (2 km), although we did not make a research here for the first two months. An average mortality rate of birds here were 2.72 individuals/km. The electric poles in the selected Nakhchivan - Shikhmahmud road (4 km) consisted mainly of wooden material and were sometimes replaced with reinforced concrete. We attribute the fact that the percentage of deaths in this area is lower than other stations because of the poles are more wooden. Among the dead birds some species belonging to the Red List of the World *(Falco naumanni* and *Coracias garrulus*). As we already mentioned, beside the overhead electric wires were mainly dangerous to *Ciconia ciconia, Buteo rufinus* and eagles. The dead and wounded species were recorded only one to four km from the electric line. Among the most common species exposed electric shocks were*: Columba livia, Merops apiaster, Corvus frugilegus, Sturnus vulgaris* and *Passer domesticus*. A total of 3,225 birds from 26 species were killed by the private electric shock during the study, four birds could not be identified (unknown species). When looking at the process from a landscape-species perspective, bird species - those most exposed to the electric wires are: less open, open space (loos); forest landscape (fl); residential areas (ra) and less grove areas (lga).
Keywords: power lines, insulator, power poles, biotope, migration, nesting.

Introduction

The electricity now has outstanding importance in level of human life. Due to the lower cost, the transmission of electricity through overhead wires expands and covers large areas. Nevertheless, electric wires start to pose a serious threat to the wild animals. Among them the birds are the most susceptible to death by power lines (Erickson et al., 2005; Barrientos et al., 2012; Dwyer et al., 2014; Bernardino et al., 2018). These threats are particularly dangerous for large birds such as *Ciconia ciconia* and birds of prey (Brown & Drewein, 1995; Garrido & Fernández-Cruz, 2008; Levashkin, 2008; Shaw et al., 2010; Karyakin, 2012; Karyakin et al., 2013; Rioux et al., 2013; Dranga et al., 2016), because sich birds use electric poles that pass through arid areas for sitting (perching and observation) and nesting (Fig. 1).

The most common reason of bird deaths is the passing over electrical wires on the migration route (Ferrer, 1990; Jenkins et al., 2010). The collision with electrical wires, as well as the use of overhead electrical wires, transformers, and towers (rail infrastructure) caused the death of many migratory species worldwide and in Europe (Fig. 2) (Mattsina, 2008; McIntyre, 2012; Longcore et al., 2012; 2013; Smalwood, 2013; Loss et al., 2014).

Fig. 1 White stork nests on electric poles

Fig. 2 Electric lines caused the bird death

To deal with the bird deaths, the Bonn Convention (Seventh Meeting, Bonn, 18-24 September 2002) was adopted towards the ways of preventing birds death being affected by electrical wires during bird migration (Mammadov., 2006). Construction of modern electrical transmitters and minimization of hazardous projects have become one of the most pressing problems of the day to minimize the risk of bird death (Lehman, 2001; Lehman et al., 2007). We have also worked on this issue in the autonomous republic during 2016-2017.

Material and methods

Three different sites (Cheshmabasar - Babak road, Cananbar well - Shikhmahmud road, Nakhchivan - Shikhmahmud plain), different types of poles (A, P, E ...) and material (iron, concrete and wood) were selected for the survey. A total of 14 electric poles with a adjacent area at the distance of 1-4 km from each pole were taken as a research object (Fig. 3).

P-shaped poles were selected for *Chesmebasar - Babak* road, the only one column was repaired and replaced with concrete A-shaped poles. On each pole there were three aluminum wires with three insulators. The distance between the poles was 60 m.

E-shaped poles were selected for the *Cananbar well - Shikhmahmud road*, the foundation of poles consist of concrete material. On each pole crosses four electrical wires with four insulators. The distance between the poles was 110 m.

P-shaped wooden poles were selected for the *Nakhchivan - Shikhmahmud plain* and as repairing a pole in the middle it was replaced by an iron E-shaped pole.

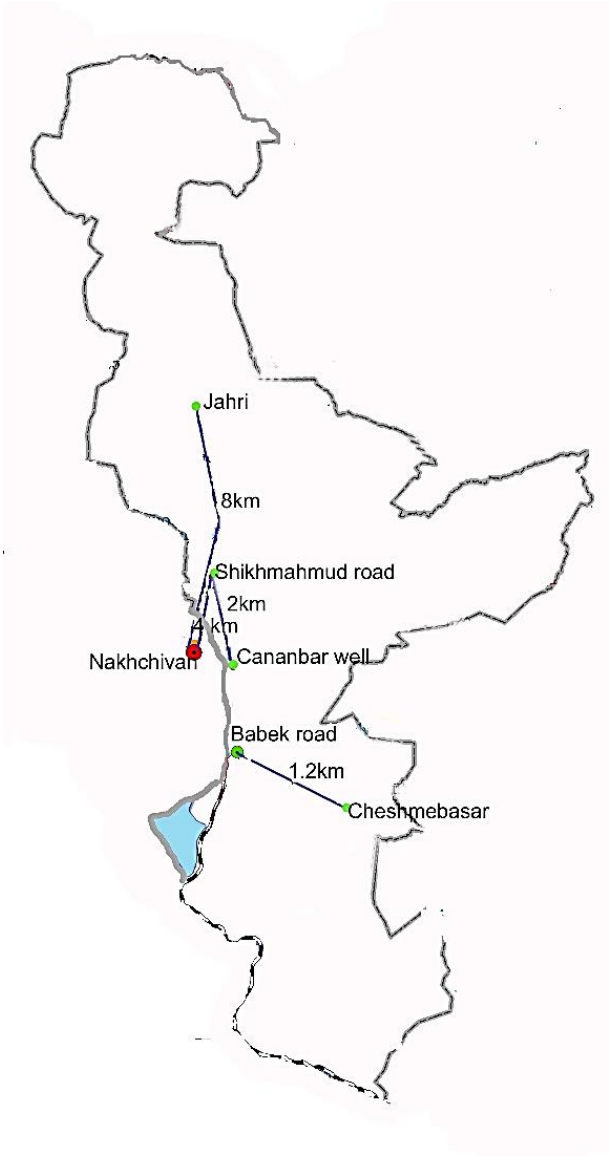

Fig. 3 The study area

We performed regular observations during migratory and breeding periods; on other days we surveyed the birds four times a month in each site. Every selected site including surrounding areas had approximately 14 km round. We used some methods previously reported by Mattsina (2008) and Ferrer et al. (1990). We need to mention that to find the birds hitted by electric shock was rather difficult because they were rapidly consumed by carnivores. The identification of the registered species was done according to Mammadov (2006) and Talibov (1999).

Results and discussion

During the survey, 225 individuals of 27 species were found to be killed by electric shock in the selected areas. The majority of bird death from the electric wires was during the brooding, hatching, and migration (VI, VIII, and IX months) (Table 1).

Table 1. Number of birds killed by electric shock

Area	Months												Total
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Cheshmebasar – Babek road	-	-	2	4	7	10	7	13	11	6	5	5	70
Nakhchivan – Shikhmahmud road	5	3	1	3	14	12	6	14	31	2	2	1	94
Cananbar well – Shikhmahmud plain	-	-	1	5	6	10	4	10	9	4	3	3	55
Nakhchivan – Jahri road	5	1	-	-	-	-	-	-	-	-	-	-	6
Total by sites (individual)	10	4	4	12	27	32	17	37	51	12	10	9	225

Bird mortality was most common in the Nakhchivan - Shikhmahmud road (4 km) point. The number of killed birds in Nakhchivan–Shikhmahmud road were 94, while 70 birds were killed in Cheshmabasar-Babak road (1.2 km), 55 individual for the Cananbar well - Shikhmahmud plain (2 km). Because of point was not suitable, studies were postponed after February the

in selected site for the Nakhchivan - Jahri road (8 km). The death number for the first two months were six. The highest mortality rate were also registered from May to September. May, June, July, and August is the season of hatching, feeding of infants, and flight of inexperienced birds; September should be associated with the onset of migration. While the lenght of Cheshmabasar-Babak (1.2 km) road is less than others, the number of monthly deaths here were higher than in other areas (5.8 individuals/km). This may be explained by the fact that the electrical poles are made of iron and iron-concrete material (Table 2).

Table 2. Average density of birds killed by electric shock in selected areas (birds per km in numbered month)

Area	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Monthly
Cheshmebasar – Babek road	-		1.66	3.3	5.8	8.3	5.8	10.8	9.16	5.0	4.1	4.1	58.02
Nakhchivan – Shikhmahmud road	1.25	0.75	0.25	0.75	3.5	3.0	1.5	3.5	7.75	0.5	0.5	0.25	23.5
Cananbar well – Shikhmahmud plain	-		0.5	2.5	3.0	5.0	2.0	5.0	4.5	2	1.5	1.2	27.2
Nakhchivan – Jahri road	0.62	0.12	-	-	-	-	-	-	-	-	-	-	0.75
Total density	1.87	0.87	2.41	6.55	12.3	16.3	9.3	19.3	21.41	7.5	6.1	5.55	109.46

The next plot with high mortality rate was the Cananbar well - Shikhmahmud plain (2 km), although we did not make a research here for the first two months. An average mortality rate of birds here were 2.72 individuals/km. The electric poles in the selected Nakhchivan - Shikhmahmud road (4 km) consisted mainly of wooden material and were sometimes replaced with reinforced concrete. We attribute the fact that the percentage of deaths in this area is lower than other stations because of the poles are more wooden (Table 2).

Table 3. Species subject to electric shock

Species	WRL	H	G	S	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Σ
Bubulcus ibis		WS	(-)	O/y								2				4	6
Ciconia ciconia		WS	(-)	Y/k						1			2				3
Accipiter nisus		FG		O/q									1				1
Buteo rufinus		FM	(-)	Y/ q					1		1	2					4
Falco naumanni	VU	OS		Y/k										3			3
Falco tinnunculus		RA	(-)	O/y				2				5			2	2	11
Larus cachinnas		WS	(-)	O/y					3	1	3		1				8
Columba liva		RA	(+)	O/y	3	1		1	1	1	2	1		6	3	3	22
Streptopelia decaocta		RA	(-)	O/y					1				1				2
Streptopelia turtur		OS; FG	(-)	Y/k	2								1				3
Upupa epops		DA	(-)	Y/k				1					1				2
Merops apiaster		OLOA	(-)	Y/k				1	8	11	8	2	6				36
Merops superciliosus		DA		Y/k								1					1
Coracias garrulus	NT	DA	(-)	Y								2					2
Alauda arvensis		OA	(-)	O/y									1				1
Motacilla alba		OA	(-)	O/ y						1							1
Lanius minor		Bos	(-)	Y/k								1					1
Lanius collurio		FB	(-)	Y/k									1				1
Pica pica		FL	(-)	O/y	1	1			1		1		1	2			7
Corvus frugilegus		FCL and lgoa	(-)	O/q	3	1	1	1	1	1	1	1	21				31
Corvus c. cornix		D/A	(-)	O/y						4		3	3	3	1		14
Corvus mondeula		F	(-)	O/y	1	1			2	1	2	4	2	1	1	1	16
Sturnus vulgaris		FL	(-)	O/q				3	4	8	4	12	3	1			35
Passer domesticus		FL	(-)	O/y				1?	4	3	4	1	4	2	2		21
Emberizia cia		M	(-)	O/y				1	1		1						3
Emberiza melanosephalus		OA		Y/k									1				1

Note: WRL - World Red List; VU - Vulnerable; NT-Near Threatened; G (game species) + game species, – non-hunting species; H (habitat); ws – water swamp; f - forest; fm – field/mountainous; ra – residential areas; os - open space; fg - forest garden; da - different areas; oloa open and less open areas; fb - forest bush; fl - forest landscape; m - mountainous; mrl - mountainous, rocky, landslide; fcl - forest, cultivated landscape and lgoa – less grove open areas; S (status): sn - nesting; nm- migratory; sw - wintering; nw – wintering; unknown species

Among the dead birds some species belonging to the Red List of the World *(Falco naumanni* and *Coracias garrulus*). As we already mentioned, beside the overhead electric wires were mainly dangerous to *Ciconia ciconia, Buteo rufinus* and eagles. The dead and wounded species were recorded only one to four km from the electric line. Among the most common species exposed electric shocks were*: Columba livia, Merops apiaster, Corvus frugilegus, Sturnus vulgaris* and *Passer domesticus*. A total of 3,225 birds from 26 species were killed by the private electric shock during the study, four birds could not be identified (unknown species). When looking at the process from a landscape-species perspective, bird species - those most exposed to the electric wires are: less open, open space (loos); forest landscape (fl); residential areas (ra) and less grove areas (lga).

According to habitat analysys we registered three wetland species, two - forest–garden; one field–mountainous; four - open area species; three residential; one open area and forest garden; three from different areas; one - open and less open areas; one - bushy and open area; one - forest bush; one forest, forest landscape and less grove open area; one forest area species; one - forest; three from cultivated landscape and one from mountainous landscape. One of these species (*Columba livia*) is important for hunting.

Although the discovery of birds killed by electric posed enormous difficulty because they were eaten by Carnivores. We found that the most affected were the individuals of *Columba livia*, *Merops apiaster*, *Corvus frugilegus*, *Sturnus vulgaris*, and *Emberizia cia*.

Our result proved that the death of birds occurs for several reasons caused by non-standard fitted electric transmissions:

1. **Death by short-circuit:** If the distance between the electric wires is less than 130 cm, when the bird was rising, the wings touching the different voltages of wires would create short-circuit. Such cases were most often caused by large birds such as *Ciconia ciconia* and birds of prey. However, depending on the type of installation, smaller-sized species, such as the *Passer domesticus*, could also damage from this when they rising in a flock.

One of the main reasons of birds death was the temporal perching at the electric poles and biulding the nestswhen their wings were short-circuited by touching the electric wires. However, birds were endangered even when they were just sitting (when they cleaned their beaks and wings).

2. **Death by dampness.** When the distance between the conductors is small, the humid air would increase the electric sparks (even the bird faeces could cause their death). This could also have been caused by an electrical circuit between the electric transmitter connected to the ground and the electric wires.

Conclusions

Although finding the electric shocked birds during survey period posed enormous difficulty because they were eaten by carnivores, when looking at bird death by months, it was revealed that: 10 individuals in January, four individuals in February, four individuals in March, 12 individuals in April, 27 individuals in May, 32 individuals in June, 17 individuals in July, 32 individuals in August, 51 individuals in September, 12 individuals in October, 10 individuals in November and nine individuals died in December.

The bird density was 1.87 in January, 0.87 in February, 3.41 in March, 6.55 in April, 12.3 in May, 16.3 in June, 9.3 in July, 19.3 in August, 21.41 in September, 7.5 in October, 6.1 in November, and 5.55 in December (birds/km).

We suggest some measure in order to minimize the mortality rate of birds from the surface electric transmitters.

All new medium-voltage substations should be constructed in accordance with technical standards and electric wires must be setted up on the basis of new technologies to ensure the birds constantly presence (if the wires are constructed above ground, there should be prepared special places for birds to be sitting and nesting at the end of the electric poles, etc.). In particular, the installation structure of electrical poles should not cause the the death of migratory birds (the migration route must be considered).

Wherever possible, electric wires must be replaced by cables, as they are one of the most important bird protection measures. Electrical wires should be constructed at a distance the regular flight lines of a large groups of birds, areas of colonies and narrow passages (“bottle neck”).

Bird mortality should be effectively reduced as a result of the collaborative efforts of conservationists, ornithologists, energy experts, officials, and other stakeholders.

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