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Impact of Power Lines on Bird Mortality in Southern Bulgaria

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Abstract: Bird mortality on 20 kV power lines was reported in four IBAs in Southern Bulgaria. In the period between September-December 2004, 139.3 km of power lines and a total of 1418 electric poles of different designs were monitored. As a result, 105 bird carcasses representing 22 species were detected. Electrocution was suspected for 77.1% (n=81) of the detected carcasses, while 22.9% (n=24) were suspected power line collisions. Most of the suspected bird collisions (59%) were small Passeriformes. Crows, storks, and raptors were some of the most common victims to electrocution. The number of suspected electrocutions per lethal pole ranged from 1 to 9. Thirteen percent of these lethal pylons accumulated approximately 30% of the victims. Mortality differed with poles of different design and habitat types. Five types of pole configurations and a switch tower were recorded during the study. Metal towers with jumper wires underneath the crossarms proved to be the most dangerous configuration; accounting for 54.3% of total detected electrocution mortality. Detected mortality caused by suspected electrocution was significantly higher in cultivated lands, providing less suitable perch sites compared to natural areas. A significant part of the power line network consisted of dangerous poles. Insulating protective devices should be applied on risky poles.

Key words: electrocution, collision, birds, raptors, power lines

Introduction

Electric power supply networks are responsible for causing mortality of birds, and raptors in particular. There is published data on bird mortality caused by power line systems from all over the world (Markus 1972, Haas 1980, Ledger, Annegarn 1981, Ferrer, Hiraldo 1991, Ferrer *et al*. 1991, Bayle 1999, Janss 2000, Van Rooyen 2000, Kruger,Van Rooyen 2000, Arhipov 2000, Guyonne *et al*. 1999, Guyonne *et al*. 2001, Adamec 2004, Karyakin *et al*. 2005, Karyakin, Barabashin 2005, Kariakin, Novikova 2006, Mastina 2005, Medzhidov *et al*. 2005; Pestov 2005, Cartron *et al*. 2006, Lehman *et al*. 2007, Harness 1998, 2000, 2008). Bird mortality caused by power lines in Bulgaria has been treated in an article on Stork mortality (Nankinov 1992). Also, dead birds have been recorded by conservationists, power

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supply companies, and ordinary people. In 2004 Stoychev and Karafeizov analysed the Bulgarian power line network and estimated a significant portion of 20 kV lines pose an electrocution hazard. This paper presents the preliminary results of a four-month study on bird mortality on a 20 kV power line network located in southern Bulgaria. This is the first attempt at a quantitative assessment of mortalities and the first attempt to compare mortality on different pole types.

Material and Methods

Four Important Birding Areas (IBAs) in southern Bulgaria were selected as study areas (Fig. 1). A considerable part of the national population of the globally threatened Imperial Eagle (*Aquila heliaca)* (13 pairs) is concentrated in 'Sakar' and 'Western Strandzha' IBAs. These areas also harbour significant populations of Short-toed Snake-eagles (*Circaetus gallicus*) - 6-8 pairs, Black Kites (*Milvus migrans*) - 11 pairs, Lesser Spotted Eagles (*Aquila pomarina*) - 26-28 pairs, Booted Eagles (*Hieraaetus pennatus*) - 9-10 pairs, Long-legged Buzzards (*Buteo rufinus*) - 25-30 pairs, and other raptors (Stoychev *et al*. 2004, Stoychev *et al*. 2007, Demerdzhiev 2007). In spring and autumn, during migration, these regions represent important stopover areas for many raptors and thousands of storks. The two other IBAs – 'Kamenski bair' and 'Besaparski hills' are temporary settlement areas for Imperial Eagles. Twelve breeding raptor species, including Long-legged Buzzards - 14 pairs and Kestrels (*Falco tinnunculus*) – 20 pairs, have been recorded in 'Besaparski hills' area. Species such as the Short-toed Snake-eagle, Booted Eagle, Golden Eagle (*Aquila chrysaetos*), Saker Falcon (*Falco cherrug*), and Peregrine Falcon (*Falco peregrinus*) use this region to forage (Demerdzhiev 2007).

The study focused on 20 kV power lines within the IBAs totaling a length of 139.3 km with a sum of 1418 power poles of different design. The studied power lines ran across two main habitat types - cultivated fields and pastures with scattered bushes (*Paliurus spina-cristi*), groups of oak trees (*Quercus*), and small coppices.

The power lines were monitored once a month during the period September 2004 - December 2004. Inspections were carried out by walking along the power lines. During each visit all carcasses and remains were collected in order to avoid double recording. All birds found within a radius of 5 m under the poles were considered to be suspected electrocuted. Birds found under the conductors were considered to be suspected collisions. The inspections recorded bird remains found within 10 m on either side of the

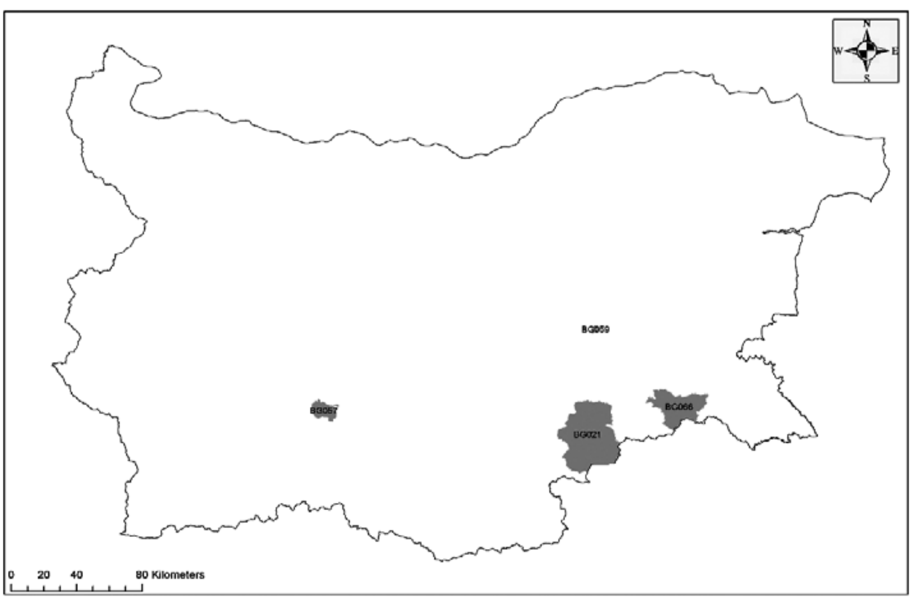

Fig. 1. Study areas.

power lines. The condition of the remains was also taken into account – i.e. considering any traces of singing or burning. Fresh remains found during the inspections were submitted for toxicological analyses to detect possible poisoning.

Results and Discussion

Monitoring of the power lines

105 birds comprising 22 species (Table 1) were found dead along the 20 kV power lines. Six dead raptors were also found with confirmed pesticide poisoning. Whether they died as a result of poisoning or the poison affected the coordination of their movements, thus contributing to a wire collision or electrocution, could not be determined with certainty. Therefore, these raptors were excluded from further analysis. The study was carried out in the autumn of 2004. That year, there was a calamity of rodents in the study areas, followed by a mass spread of pesticides to control rodent numbers. Therefore, raptor mortality might be overestimated due to secondary poisoning.

The number of birds scavenged by predators and not discovered during the visits was not assessed. There are high densities of jackals (*Canis aureus*) in the studied areas, so high ratio of losses can be assumed. In Spain, the loss of electrocuted raptors was about 51% to 70% (Ferrer *et al.* 1991, Guyonne *et al.* 1999, Guyonne *et al.* 2001). Presumably, the actual mortality rate is twice or even more times higher than recorded. Songbirds, due to their small size, are often eaten by scavengers, while there are usually parts of bodies, bills, and primaries left of larger raptors and storks. Therefore, the number of detected songbird carcasses is probably underestimated too.

Suspected collisions and electrocutions

Suspected collusions comprised 22.9% (n=24) of all detected carcasses (see Fig. 2). Suspected collisions were greatest with flocking birds consisting mostly of small Passeriformes (59%). Birds from the family Corvidae are separated from the other Passeriformes. Storks colliding with power lines mainly during migration, when big flocks try to roost were also recorded (21%). Strong winds in the area may have contributed to collisions with power lines. The percentage of raptors colliding with power lines was small compared to electrocuted individuals.

Suspected electrocutions comprised 77.1% (n=81) of all detected fatalities. Among pylons associated with electrocutions, 68.4% (n=39) had at least one carcass upon first inspection. Fig. 3 shows the mortality by different systematic groups. Corvids and raptors regularly use poles for roosting or hunting. Not surprisingly, these two groups made

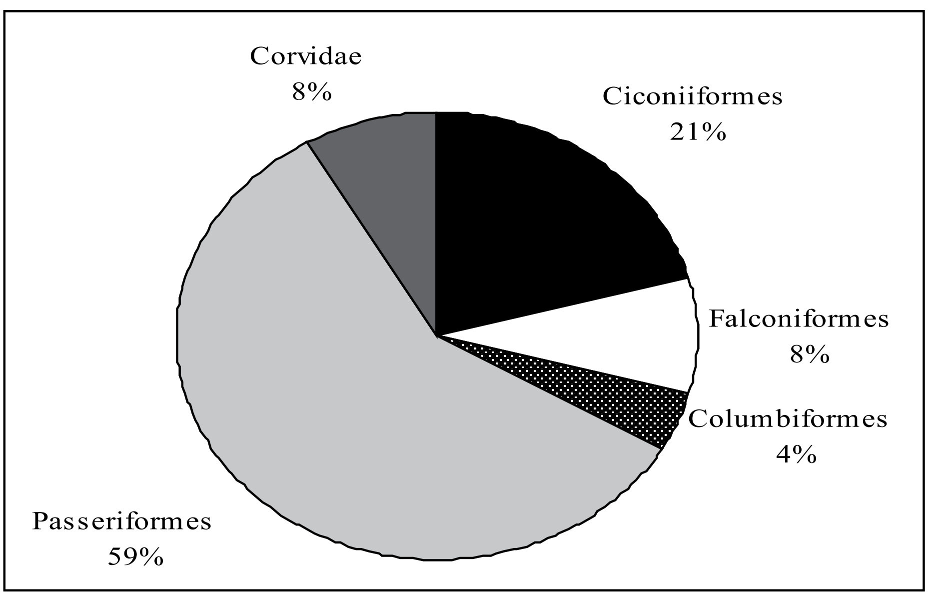

Fig. 2. Suspected collisions by different systematic groups.

Table 1. Distribution of detected dead birds by species.

N	Species	Dead birds from suspected electrocution	Dead birds from suspected collision
1	*Ciconia ciconia* (Linnaeus, 1758)	14	1
2	*Ciconia nigra* (Linnaeus, 1758)	3	4
3	*Falco tinnunculus* (Linnaeus, 1758)	4	-
4	*Buteo buteo* (Linnaeus, 1758)	12	2
5	*Buteo rufinus* (Cretzchmar, 1827)	1	-
6	*Accipiter nisus* (Linnaeus, 1758)	1	-
7	*Circaetus gallicus* (Gmelin, 1788)	1	-
8	*Coracias garrulus* (Linnaeus, 1758)	6	-
9	*Streptopelia turtur* (Linnaeus, 1758)	-	1
10	*Corvus corax* (Linnaeus, 1758)	4	1
11	*Corvus frugilegus* (Linnaeus, 1758)	4	-
12	*Corvus cornix* (Linnaeus, 1758)	7	-
13	*Corvus monedula* (Linnaeus, 1758)	1	1
14	*Pica pica* (Linnaeus, 1758)	7	-
15	*Garrulus glandarius* (Linnaeus, 1758)	1	-
16	*Sturnus vulgaris* (Linnaeus, 1758)	11	5
17	*Miliaria calandra* (Linnaeus, 1758)	-	2
18	*Alauda arvensis* (Linnaeus, 1758)	-	2
19	*Galerida cristata* (Linnaeus, 1758)	-	1
20	*Anthus pratensis* (Linnaeus, 1758)	-	1
21	*Turdus merula* (Linnaeus, 1758)	1	-
22	*Passer* sp.	-	1
23	*Passeriformes* (Non – corvidae)	3	2
	TOTAL	81	24

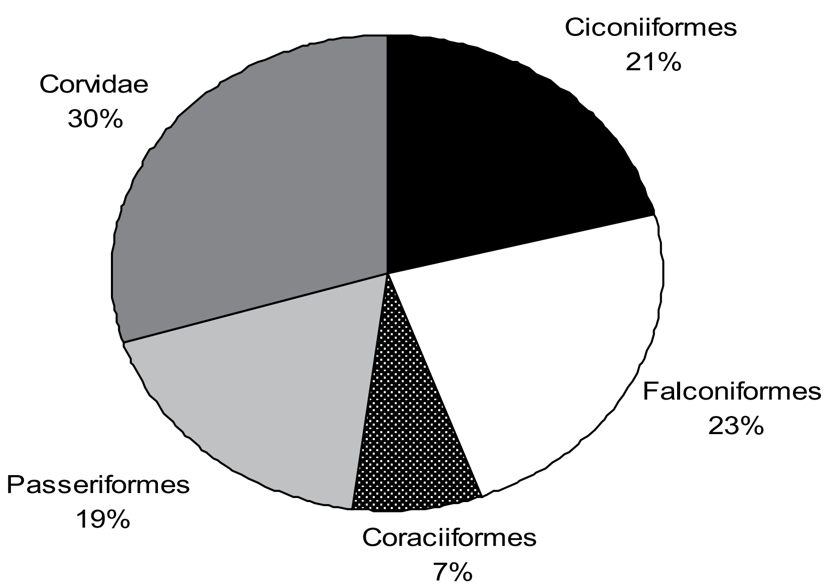

Fig. 3. Suspected electrocutions by different systematic groups

up 53% of suspected electrocutions. In SW Spain crows and raptors make up more than 80% of detected electrocutions (Guyonne *et al.* 2001), while in NE Spain this percentage is even higher – up to 96% (Manosa 2001). In Southeastern France corvids and raptors consist 85% of electrocutions (Bayle 1999). In our study, the Common Buzzard *(Buteo buteo)* was the most common raptor detected and was associated in 63% of all suspected raptor electrocutions. Considering the unfavorable conservation status of many raptors, preventing electrocutions would have important conservation effects. Mortality of storks is high, too. During migration big flocks roost on dangerous poles and fall victims to electrocution. In most cases, electrocution of small Passeriformes occurs only when flocks of birds perch on insulators.

Effect of pole design and habitat type on mortality rates

The percentage of electrocutions on poles of different design is of particular interest. Five types of poles and one switch tower were recorded during the study (Fig. 4).

We found 81 suspected electrocuted birds, concentrated at 65 (4.6%) pylons. The carcasses found under a single pylon ranged from 1 to 9 (Fig. 5). Thirteen percent of the lethal pylons accumulated approximately 30% of all carcasses.

The metal switch tower was excluded from analysis because of the small numbers of poles (1.3 % of all poles respectively). However, this pole type works as a circuit-breaker and is rarely used in the electric circuit. It is particularly dangerous since its insulators are turned upwards in a leveled position, and when birds perch on them they often die from electrocution. Most electrocutions were recorded on pole type 1 (p=0.166), a metal tower with jumper wires. Although the outer jumpers run underneath the crossarms, the top jumper wire is located where a large perching bird can easily contact it. This configuration accounted for 54.3% of total detected electrocution mortality. Second in terms of electrocution hazard was type 5 (p=0.044), a metal lattice structure with pin-type insulators. These are followed by type 2 (p=0.033), concrete poles with pin-type insulators. This type was assumed as dangerous in the work of STOYCHEV, Karafeizov (2004). Poles of a similar type have been recorded as dangerous in Spain (Ferrer *et al.* 1991, Guyonne *et al.* 2001). Suspended insulators are more favourable for power lines constructed with steel and concrete pylons/poles (Harness 1998). Structure types 3 and

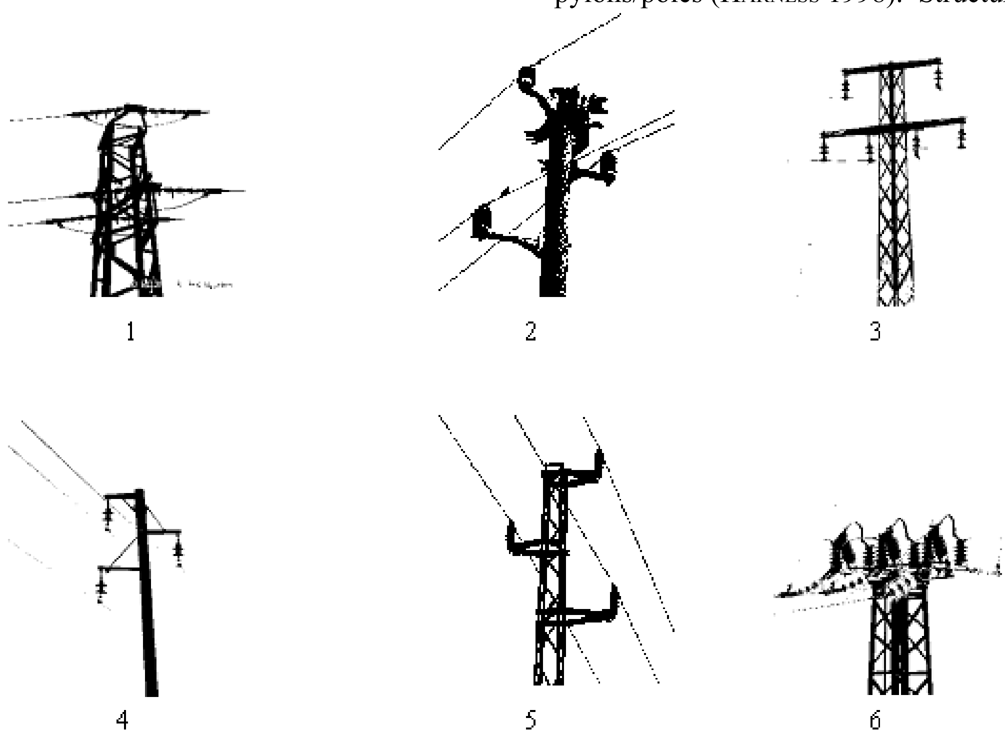

Fig. 4. Different 20 kV pole configurations.

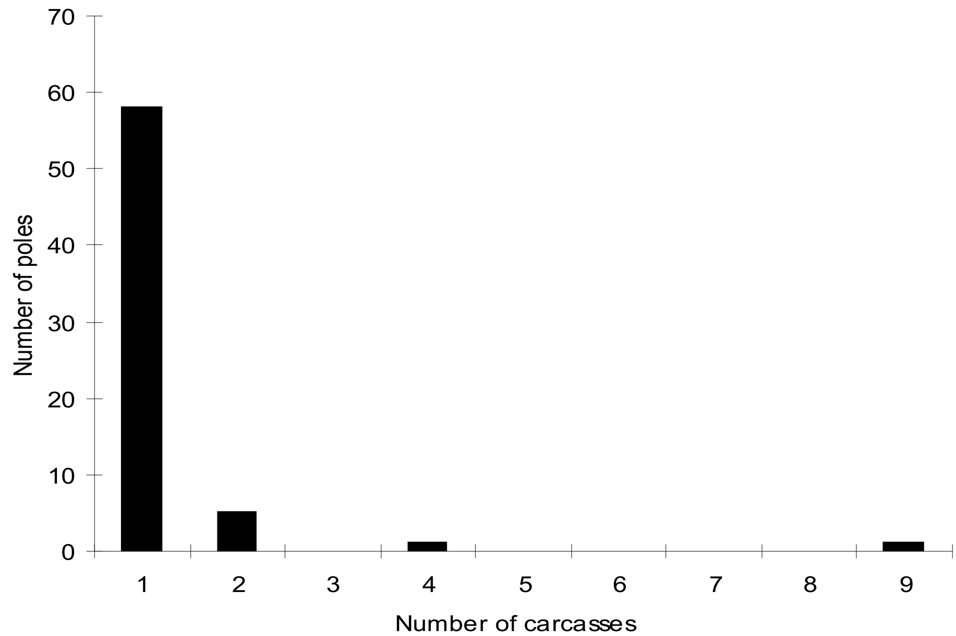

Fig. 5. Frequency distribution of carcasses detected under pylons.

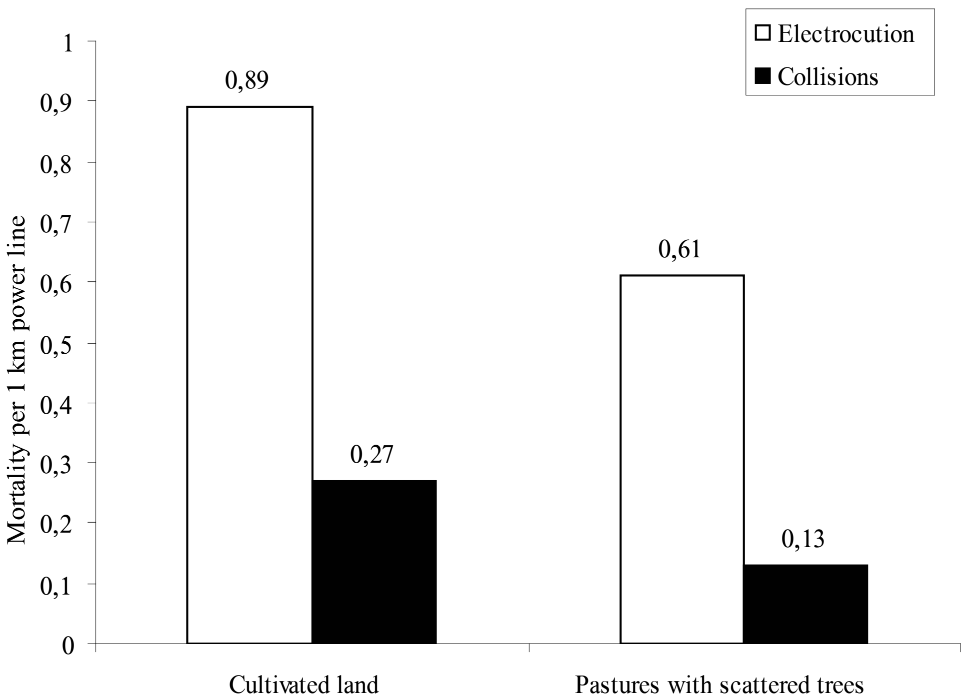

Fig. 6. Electrocutions and collisions in different habitat types.

4 utilized suspension insulators and two electrocuted birds were found under power line type 3 (p=0.018), a metal tower with suspended insulators. No victims were recorded on type 4, another configuration with suspended insulators.

There are approximately 45 000 km of 20 kV power lines in Bulgaria. Unfortunately, configurations type 1 and type 2 are most common ones, comprising at least 50% of the network. Accordingly, it is suspected bird mortality caused by the power supply network is considerable all over the country.

Habitat characteristics (vegetation type, pray density) also influence the detected mortality rate (Ferrer et al. 1991, Guyonne et al. 2001). Two main habitat types were noted in this study- cultivated land with a total length of 46 km, as well as pastures with scattered bushes (*Paliurus spina-cristi*), groups of oak trees (*Quercus*), and small coppices, with a total length of 93.3 km. Fig. 4 presents the mortality per 1 km of power line in these two habitat types. The higher detected mortality in cultivated land is likely explained by the lack of suitable perches in the cultivated land, so electric poles are most often used.

Conservation measures

In order to evaluate bird mortality caused by the power-supply network, studies of this kind need to be carried out in other regions throughout the country, especially those harbouring significant bird populations or located on migration routes. The duration of these studies is also important. In order to mitigate the hazard of collision, the power lines in the most risky regions need signal marking. The Spanish experience shows that after marking with color spirals in an area of high collision mortality, collision rates decreased by 60% (Negro 1999). Modification of dangerous pylons to prevent electrocutions would also have a significant conservation impact. Studies carried out in Spain (Guyonne *et al*. 1999) show that mounting perch guards on the cross arms and the top of the most dangerous pine type poles is not effective, because birds perch on the insulators. Therefore, insulating exposed contact pints is the most efficient measure. As it is evident from the implemented study, all victims of electrocution were found fewer than 4.6% of the total of 1418 inspected pylons. Therefore, with concentrated efforts at such preferred perching locations, power supply companies could most economically prevent these preventable bird deaths.

Conclusions

Mortality depends on the pole design and the habitat type. Large portions of Bulgarian line network consist of dangerous poles. Detected mortality in cultivated lands is higher.

Similar studies need to be carried out in other parts of the country.

Protective insulating devices should be installed on risky poles. This will prevent electrocutions and reduce outages.

In areas where high collisions have been documented, spans should be marked with anti-collision devices should be applied.

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Влияние на електропреносната мрежа върху смъртността при птиците в южна България

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(Резюме)

Отчетена бе смъртността при птиците, причинявана от 20 kV електропроводни линии в четири Орнитологично важни места в южна България. През периода септември-декември 2004 г. бе проведено изследване на 139,3 km електропроводни линии и общо 1418 електрически стълба от различни типове. В резултат на изследването бяха открити 105 мъртви птици от 22 различни вида. За 77,1% (n=81) от откритите мъртви птици предполагаемата причина за смъртността бе електрическото напрежение, докато при 22,9% (n=24) от жертвите предполагаемата причина за смъртта бе сблъсък с електропреносната мрежа. Повечето от предполагаемите жертви на сблъсък с електропреносната мрежа (59%) бяха дребни видове от разред Passeriformes. Вранови, щъркели и хищни птици бяха сред най-често срещаните жертви на електрическото напрежение. Броят на предполагаемите случаи на смъртност, причинена от електрическото напрежение за смъртоносен стълб варираше от 1 до 9. Тринадесет процента от тези смъртоносни стълбове бяха причината за приблизително 30% от жертвите. Смъртността при различните типове електрически стълбове и хабитати бе различна. По време на изследването бяха регистрирани пет типа стълбове с различна конфигурация и един стълб-прекъсвач. Металните стълбове със съединителни проводници под изолаторите се оказаха най-опасната конфигурация, причина за 54,3% от всички смъртни случаи в резултат на електрическото напрежение. Отчетената смъртност, предполагаемата причина за която бе електрическото напрежение, бе значително по-висока в обработваеми земи, които осигуряват по-малко подходящи места за кацане в сравнение с природните местообитания. Голяма част от електропреносната мрежа се състоеше от опасни стълбове. Изолиращи защитни съоръжения трябва да бъдат прилагани при рисковите електрически стълбове за предотвратяване на смъртността при птиците.