

# Power line design and raptor protection in Bulgaria

Stoycho Stoychev and Tzezar Karafeisov

## ABSTRACT

There are no existing studies on raptor electrocutions and collisions in Bulgaria. This paper analyzes different types of power lines used in Bulgaria and their potential risks to raptors. A few cases of electrocutions and collisions are presented. High voltage lines (220 and 400kV) are considered to be safe for electrocutions. 110kV lines are constructed with suspended insulators and are also relatively safe. There is small electrocution risk if a large bird defecates on the wire while perched on a grounded surface. In these cases, several types of devices are used to prevent perching above the wire. Most dangerous lines in Bulgaria are 20kV distribution power lines. The most dangerous distribution poles are constructed with upright pin-type insulators mounted on one support (7-8% of all structures). Less dangerous are distribution structures with upright pin-type insulators mounted in three levels (70% of all structures). The safest configuration employs suspended insulators and comprises about 20% of all structures. Poles with jumper wires are designed in a way that the jumpers can be routed either over or under the arms. About 5-6% of all structure types are with jumpers above the crossarm, which are very dangerous for perching birds. Also dangerous are switch poles.

## INTRODUCTION

There are no existing studies on the effects of power lines on raptors in Bulgaria. The country harbors significant raptor populations and the Bulgarian ornithofauna includes thirty-seven species of diurnal raptors and nine species of owls. There are data that electrocutions and collisions with power lines are a threat, as dead birds have been recorded by conservationists, electricity companies and ordinary people. This paper makes an attempt to assess the degree of danger of several different power line configurations.

## METHODS

Data on bird fatality due to collision or electrocution were gathered from literature, personal communications and our own observations. Information on the power line network was collected from the national electricity company. Pictures were taken of the poles and towers in use. The potential risk for certain type of design was assessed using data on the fatalities and electrocution publications (Olendorff et al., 1996; Ferrer et al., 1996; Haas and Nipkow, 2002).

## RESULTS AND DISCUSSION

### *Fatalities*

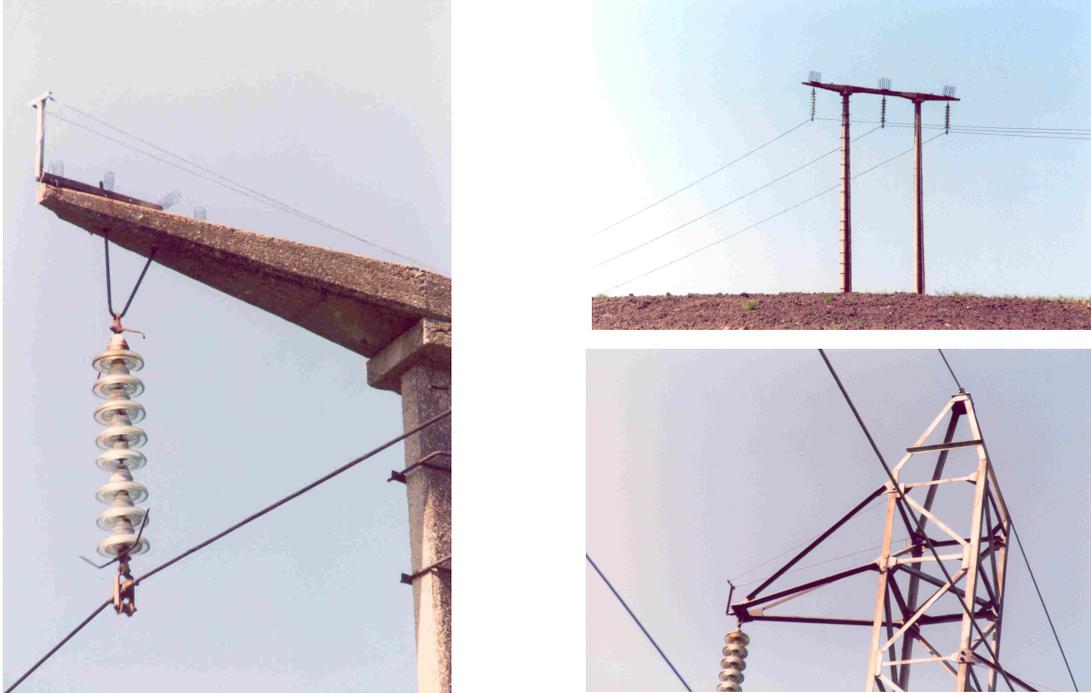
Seven species of raptors were established as victims of electrocution or collision: Griffon vulture (*Gyps fulvus*), Egyptian vulture (*Neophron percnopterus*), Golden eagle (*Aquila chrysaetos*), Common buzzard (*Buteo buteo*), Marsh harrier (*Circus aeruginosus*), Barn owl (*Tyto alba*), Eagle owl (*Bubo bubo*). Since all the data are collected without systematic approach it is not possible to draw any conclusions concerning the level each species is affected. However, collisions and possibly electrocutions seem to be important mortality factors for Griffon vultures (16% of all dead birds) (Iankov & Profirov, 1992).

### *Power line network in Bulgaria*

The power line network in Bulgaria consists of 400kV, 220kV and 110kV transmission lines and 20kV distribution lines. The highest voltage transmission lines (400kV and 220kV) are considered to be safe due to large clearances between conductors, and between conductors and grounded hardware. Although these transmission lines are not an electrocution risk, they do pose a collision risk.

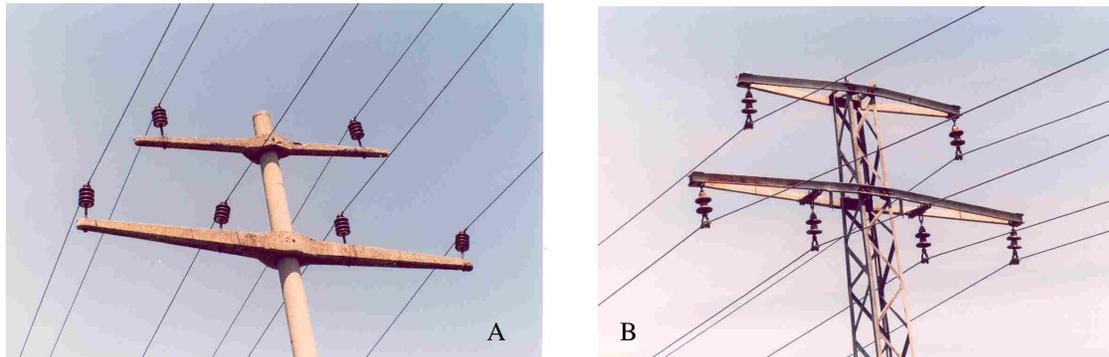
The total length of 110kV transmission lines in the country is about 8000 km. They are considered to be relatively safe in terms of electrocutions. Some problems have been noted when large birds defecate on conductors while perched on grounded surfaces. To prevent bird streamer problems, electricity

companies use several types of devices (Figure 1) that prevent perching above the wires. In some areas on migration routes or in bottleneck sites (Bourgas lakes) 110kV transmission lines cause significant mortality among a large number of species including raptors (N. Petkov, personal communication). Especially vulnerable are storks and pelicans. Nineteen dead and injured White pelicans (*Pelecanus onocrotalus*) were found under such a line in a single collision accident on 21 November 2002 (Stoyan Mihov, personal communication).



**Figure 1: 110kV transmission lines with devices that prevent perching above the wires**

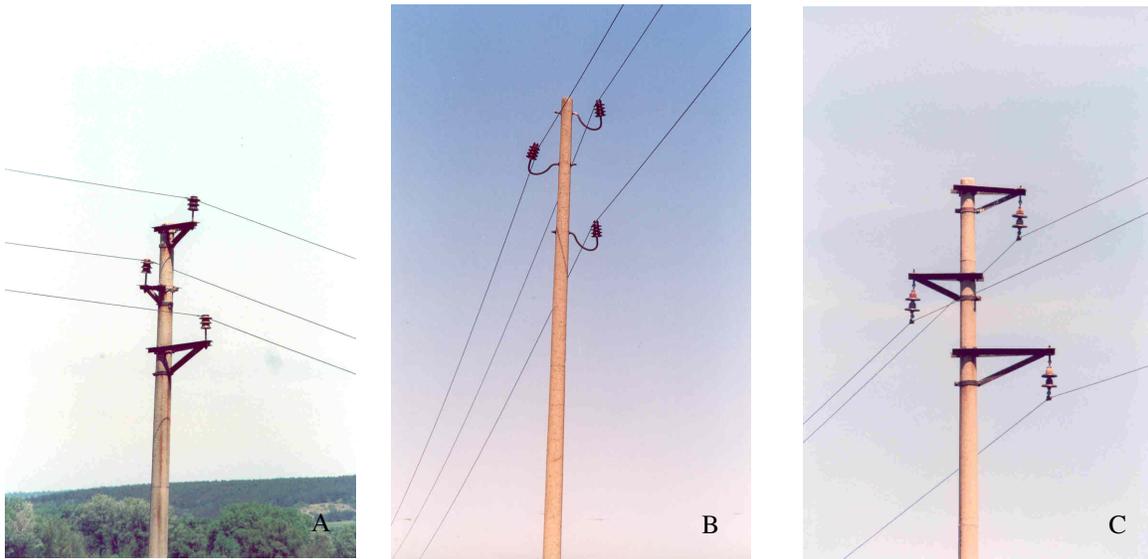
The total length of 20kV distribution lines in the country is about 45,000 km. Several types of configurations and insulators are used. One of the most dangerous is so called “old type poles” with upright pin-type insulators mounted on a single support (Figure 2 A). These units comprise 7-8% of all poles. Such configurations are not used in new construction but many older units persist. This design is considered to be especially hazardous for eagles (Harness 1996). There is a new type of configuration with a similar design that is much safer because it uses suspended insulators (Figure 2 B).



**Figure 2: 20kV distribution line structures**

Concrete poles with short crossarms are the most widely used materials in 20kV construction. These units comprise about 70% of all 20kV power lines. There are several types of configurations according to the position of the insulators and conductors (Figure 3) thus presenting different levels of electrocution hazard. Most risky are two configuration types employing upright pin-type insulators (Figures

3A and 3B). Especially lethal are configurations providing suitable perching places close to the conductors (refer to Figure 3A). Poles of a similar type have been recorded to be dangerous in Spain (Ferrer et al., 1991).



**Figure 3: Concrete poles with short crossarms**

Metal towers are typically designed with jumper wires underneath crossarms, which makes them relatively safe. However, approximately 5-6% of these structures are constructed with jumper wires above the crossarm which are very dangerous. Similar types are considered dangerous in Spain and Germany. (Ferrer et al. 1991; Haas & Nipkow 2002). Switch towers also present a high electrocution hazard. They are not fitted with any devices to prevent perching between wires.

#### *Legislation*

The Biodiversity Act prohibits only deliberate killing of raptors. No legislation exists on the protection of birds from risks associated with utility structures and power lines.

#### *Conservation*

The most dangerous lines to raptors are 20kV lines. Although Bulgaria has approximately 45 000 km of these lines, there are no existing protective devices to prevent electrocutions of large birds. Similarly, there are no devices installed to prevent collisions. However, first steps have been undertaken by Bulgarian Society for the Protection of Birds (BSPB). Recently BSPB established good contacts with some of the Bulgarian electricity companies and are forging working partnerships. BSPB provides information on the rare species breeding and hunting grounds, migration routes, and possible solutions to mitigate the problems. In the Eastern Rhodopes, in an important for raptors area, underground cable was recently installed instead of overhead power lines. The electricity company in the Haskovo district also prepared special guidance for its staff not to disturb vultures and eagles near their nests and not to destroy the nests on towers.

## CONCLUSIONS

1. High voltage transmission lines (400kV, 220kV, 110 m kV) are relatively safe in terms of electrocution, but in some areas collisions are a problem.
2. Distribution lines of 20kV present electrocution hazards. Large numbers of 20kV poles are dangerous and no protective devices have been applied until now.
3. It is necessary for a special study on electrocutions to be carried out. Protective devices should be applied on risky poles. This will have economical effect also reducing outages.
4. In areas where high mortality of collision is known anti-collision devices should be applied.
5. The Biodiversity Act should be amended so that all new power lines have to be designed to protect birds and the lines that are already in use have to be fitted with protective devices within a certain

period of time. This will eliminate unnecessary bird deaths while also improving the service reliability of the power lines by reducing costly power outages.

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## REFERENCES

- FERRER, M., M. DE LA RIVA, AND J. CASTROVIEJO. 1991.** Electrocutation of raptors on power lines in southwestern Spain. *J. Field Ornithol.* 62: 181-190. 125 pp.
- HAAS, D. AND M. NIPKOW. 2002.** Caution: electrocution! Suggested practices for birds protection on power lines. NABU. Bon. Germany. 24 pp.
- HARNES, R. E. 1996.** Raptor electrocution on electric utility distribution overhead structures. Pages B4-1 – B4-7 in Proc. of the 1996 Rural Electric Power Conference. Institute of Electrical and Electronic Engineers, New York, N.Y.
- IANKOV, P. L. PROFIROV. 1991.** Contemporary state of the Griffon Vulture (*Gyps fulvus* Habilizl) population in Bulgaria, *Ecology*, 24:44-52 (in Bulgarian)
- OLENDORFF, R. R., A. ANSELL, M. GARRET, R. LEHMAN, AND A. MILLER. 1996.** Suggested Practices for Raptor Protection on Power Lines. – The State of the Art in 1996. A report prepared in the public interest, published and distributed for the Edison Electric Institute by Raptor Research Foundation, c/o Department of Veterinary Biology, University of Minnesota, S t. Paul, Minnesota.

Stoycho Stoychev and Tzezar Karafeizov  
BSPB\BirdLife Bulgaria; Haskovo 6300, P.O.Box 130, BG; tel/fax +359 38 622964; e-mail:  
[sakarbg@mbox.digsys.bg](mailto:sakarbg@mbox.digsys.bg) ; [www.bspb.org](http://www.bspb.org)

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