Eskom Transmission

GUIDELINE

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COMPILED BY	FUNCTIONAL RESP.	AUTHORIZED BY
H.F.Vosloo Servitude Specialist C.S. v Rooyen EWT	E. Shunmangum Primary Plant Support Manager	G.F.Bruce TRANSMISSION TECHNOLOGY MANAGER
DATE: 27/10/03	DATE: 10/11/03	DATE: 6/11/03

This document has been seen and accepted by:

Name	Designation
R. Chinzvende	Line & Servitude Manager
C. Pelser	Line & Servitude Manager
J Correia	Line & Servitude Manager
B Vockerodt	Line & Servitude Manager
S Mohlakoana	Line & Servitude Manager
L Stubbs	Line & Servitude Manager
R Bekker	Line & Servitude Manager

Revision Information

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1. Purpose

The purpose of this document is to provide knowledge of the dynamics of the problem of bird collisions with transmission lines, provide practical solutions and set out procedures for dealing with it.

2. Applicability

This document will apply to all Transmission lines.

3. Normative references

[1] Alonso J A and Alonso J C, Mitigation of bird collisions with transmission lines through groundwire marking. In: Ferrer M and Janss F E (eds), Birds and powerlines, Quercus, Madrid, 1999, pp113 – 124.

[2] ANDERSON, M D, The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Karoo Large Terrestrial Bird Powerline Project, Directorate Conservation & Environment (Northern Cape), Kimberley, 2001.

[3] Alonso J A and Alonso J C, Collision of birds with overhead transmission lines in Spain. In: Ferrer M and Janss F E (eds), Birds and powerlines, Quercus, Madrid, 1999, pp57 - 82.

[4] Van Rooyen C S and Ledger J A, VAN ROOYEN, Birds and utility structures: Developments in southern Africa. In: Ferrer M and Janss F E (eds), Birds and powerlines, Quercus, Madrid, 1999, pp205-230.

[5] Avian Powerline Interaction Committee (APLIC), Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute, Washington D.C. 1994, pp77.

[6] Williams A J and Velasquez C, Greater Flamingo *Phoenicopterus rubber*. In: The atlas of southern African birds, Volume 1: Non-passerines, Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V & Brown, C.J. (eds). BirdLife South Africa, Johannesburg, 1997, pp112 - 113.

[7] C van Rooyen, Nelson P and Kambouris D, Strategic partnerships as a mechanism to address wildlife interactions with powerlines: The South African approach. Session 15, Proceedings of the Cigré Fourth Southern Africa Regional Conference, Somerset-West, Cape Town, 2001, pp1-7.

[8] Koops F B J and De Jong J, Vermindering van draadslachtoffers door markering van hoogspanningsleidingen in de omgeving van Heerenveen. 1982 Electrotechniek 60 (12): pp641 – 645.

4. Definitions

none

5. Abbreviations

EWT Endangered Wildlife Trust

6. BIRD COLLISIONS WITH TRANSMISSION LINES IN SOUTH AFRICA

A bird collision incident happens when a bird physically strikes either the overhead conductor or the overhead ground wire of a powerline. In the case of transmission lines, the overhead ground wire is usually involved. It is generally accepted that birds can usually avoid the highly visible bundled conductors but often fail to see the thin ground wire [1]. In South Africa, bird collisions with transmission lines are a major form of unnatural mortality among several threatened species. Research is ongoing to attempt to gauge the effect of this form of mortality on these species, especially cranes. Preliminary results indicate that the mortality could be unsustainable for regional populations of species such as Blue Cranes in the central Karoo (K. McCann pers.comm).

6.1 COLLISION MECHANISM VERSUS ELECTROCUTION MECHANISM

Bird electrocutions on electrical infrastructure are often confused with bird collisions. Bird electrocution refers to the scenario where a bird is perched or attempts to perch on electrical infrastructure, and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components. In the case of a collision, the incident takes place when a bird fails to see the conductor and/or overhead ground wire while in full flight, and collides with it in mid-air. The primary cause of death or injury is the physical impact with the line. It is important to distinguish between the two mechanisms, as the wrong terminology can cause confusion and even lead to wrong conclusions and recommendations.

6.2 TYPICAL CHARACTERISTICS OF A COLLISION INCIDENT

6.2.1 Locality of Carcass

The dead bird is almost invariably found underneath the powerline conductors in the *centre* of the span. Research established that very few collisions actually happen in the first and last 20% of the span [2]. Depending on the size of the powerline, and the resulting height of the earthwire, and the speed at which the bird was travelling, the carcass may be found up to 50m from the line.

6.2.2 Types of Injury

The typical injuries that result from a powerline collision are impact injuries such as a broken neck, broken wings and legs. Broken legs are a particularly common injury sustained by large terrestrial birds from a powerline collision. When large terrestrial birds approaching an overhead ground wire finally see it, they will usually flare (brake with their wings and drop both their legs to reduce speed). In most of these cases the birds strike the powerline with their legs, resulting in broken legs.

Figure 1: Examples of injuries sustained after collisions with powerlines

6.2.3 Type of Species

The species involved in the incident could give an indication whether the bird was a victim of a powerline collision. See annexure A for a description of species that commonly collide with transmission lines in South Africa.

6.3 FACTORS INFLUENCING THE COLLISION RISK ASSOCIATED WITH TRANSMISSION LINES

6.3.1 Size of Powerlines Involved

Research suggests a correlation between the size of the powerline and its collision risk potential. Research in the Karoo indicates that mortality increases with voltage size [2].

6.3.2 Body Size and Flight Behaviour

Species with a combination of a heavy body and small wing surface relative to their body weight are less manoeuvrable and therefore more prone to collisions. Many of them are terrestrial species, such as cranes, bustards and storks that spend the majority of their time on the ground and therefore have never experienced strong environmental pressures to evolve manoeuvrability as a flight characteristic. Another group is rapid flying gregarious species such as waterfowl [3]. Species that congregate in large flocks are also generally more vulnerable to collisions than solitary species [3]. Flocking reduces the space for negotiating obstacles as well as reducing the visibility ahead for trailing birds.

6.3.3 Flight Height and Habitat Use

The height at which birds fly is an important factor in collision incidents [3]. During migration flights, many larger birds fly at altitudes well above the height of powerlines in order to minimize the energy cost of their long-distance movements. Most collisions probably occur during short distance, low altitude flights, with a high frequency of powerline crossings. These flights are usually between foraging and roosting areas (Van Rooyen unp. Data).

6.3.4 Age of birds

Young birds (inexperienced flyers) are more vulnerable to collisions than experienced adult birds (Van Rooyen unp. data). However, adult birds are also vulnerable, especially migrants moving into unfamiliar territory.

6.3.5 Resident versus Migratory Birds

Most birds are tied to a fixed territory during the breeding season, with an intimate knowledge of this territory which reduces the chances of a powerline collision. However, outside the breeding season individuals tend to flock and become more nomadic, following foraging and roost site availability, and moving into unfamiliar areas. In extreme cases they will undertake long distance migrations. Collisions risks increase when birds move into unfamiliar terrain. This has particularly been noted with storks and bustards in Southern Africa [4] [2].

6.3.6 Weather

Collisions are often associated with inclement weather. High velocity winds increase the collision hazard for species crossing powerlines at low altitudes, by decreasing their flight control and forcing them to fly lower than usual. During periods of heavy fog / mist or precipitation, many birds reduce their flight altitude, bringing them into contact with powerline structures [5]. Clear, full moon nights allow birds to fly after sunset, during which time enough light is available for flight, but powerlines will be invisible.

6.3.7 Time of Day

Many species leave roost sites before sunrise and return well after dark, times at which low light conditions prevail and visibility is poor. In addition to this, some species, notably flamingos, migrate at night, when powerlines are invisible [6].

6.3.8 Land use

Land use can influence the potential for bird collisions with powerlines because it affects the attractiveness of habitats near powerlines for foraging. Cultivated grain and pasture crops are often seasonally attractive to many species and are often bordered or divided by powerlines. This is especially so in arid areas where irrigated crops attract large numbers of birds. Therefore, the close proximity of powerlines to regular feeding areas increases the potential for collisions through the increased daily low-altitude movements across these powerlines between feeding areas. The hazard is further increased in agricultural areas where disturbance from farming activities, hunting or deliberate scaring of birds foraging on crops (or insects in the crops) results in birds flushed into the air with potential for colliding with powerlines.

2.3.8 Topography

Topographical features influence local and migratory movements of birds [5]. Features such as mountains, river valleys and shorelines are commonly used as flight corridors. Topographic features may also influence the visibility of powerlines. Conductors may be obscured against a background, increasing the potential for collisions.

7 SPECIES INVOLVED IN COLLISION INCIDENTS

Countless bird species have been recorded as collision victims with powerlines. However, research has mostly concentrated on the impact of collisions on rare and threatened species, as unnatural mortality could contribute to the decline and eventual extinction of a species. Birds of conservation concern known to be vulnerable to powerline collisions include various species of cranes, bustards, storks, vultures, eagles, flamingos, swans and geese. These species are mostly heavy-bodied birds with limited manoeuvrability, which make it very difficult for them to take the necessary evasive action to avoid colliding with powerlines (see annexure A).

When collision mortality is recorded on transmission lines, the services of a qualified ornithologist should be obtained to assist with the identification of the species. This is vitally important, as the conservation status of the species should influence the decision as to whether mitigation action should be taken.

8 MITIGATION TECHNIQUES

8.1 MARKING POWERLINES

Mitigation techniques have generally focused on making the line more visible to birds [1]. Many marking devices have been used worldwide, showing varying degrees of effectiveness. The two types that are commonly used in South Africa are Bird Flight Diverters and Bird Flappers. A special device for night-time collisions is the Mace Bird Lite.

8.1.1 Bird Flight Diverters

Bird Flight Diverters (BFD's) were developed in Europe. Various studies have proven that the attachment of these devices onto powerline conductors can significantly reduce the collision rate of birds, by increasing the visibility of the powerline [1]. However, recent research in the Karoo involving bustards and cranes has found the contrary. The BFD is therefore not recommended as an anti-collision device on transmission lines in South Africa.

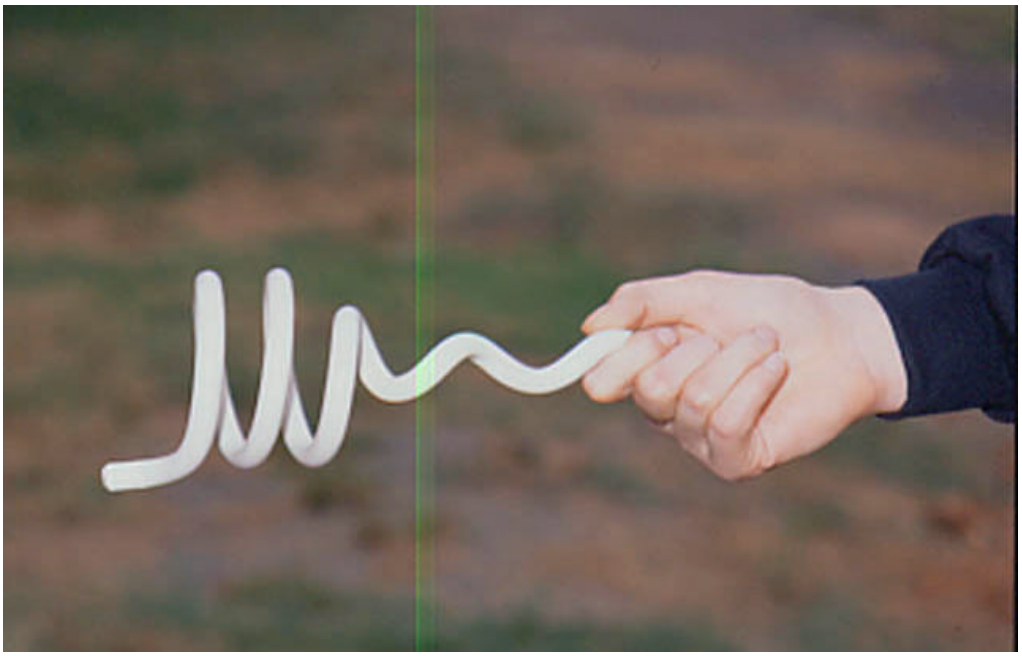


Figure 2: Bird Flight Diverter (Photo: Chris van Rooyen)

8.1.2 Bird Flapper

Bird Flappers are a South African invention and have been used in South Africa since 1995, but only since 2001 has a mechanically acceptable product been commercially available. The Bird Flappers, *if applied correctly*, have proven to be more effective than the Bird Flight Diverter in comparative experiments [7] [2]. It has largely replaced the BFD as a mitigation device for bird collisions with powerlines in South Africa. The Bird Flapper is available from Preformed Line Products in Pietermaritzburg (0333 871520/4).

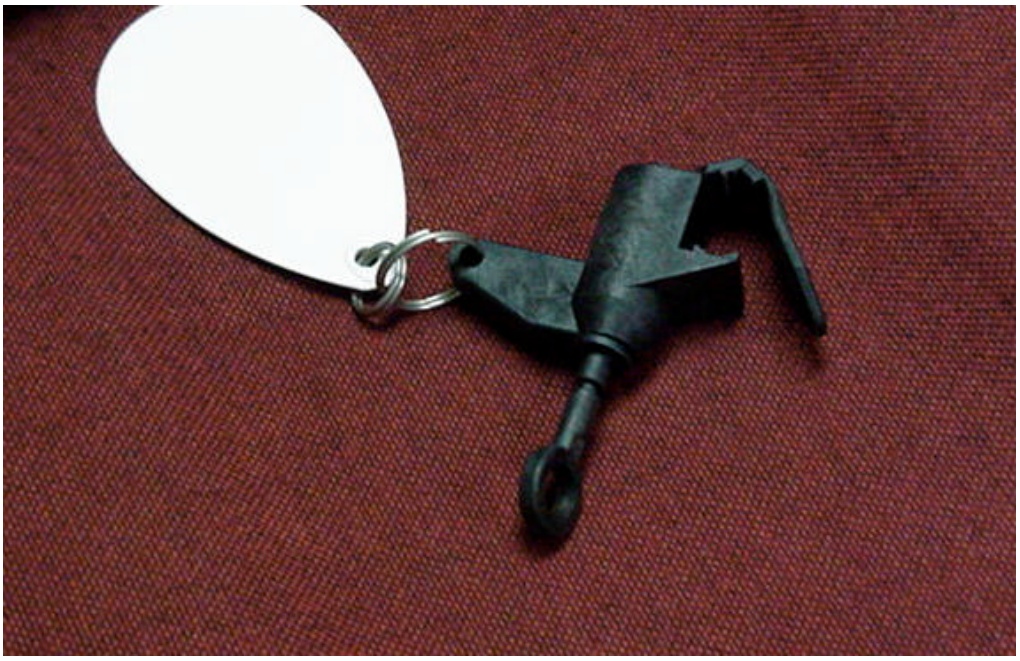


Figure 3: Bird Flapper (Photo: Barry Hill)

8.1.3 Mace Bird Lite

The Mace Bird Lite is a Perspex tube with a fluorescent tube inside. It is mounted on the overhead ground wire and the light is energized by the ambient electrical field generated by the conductors. It has been used in South Africa and Botswana and is reported to have worked well for curbing flamingo mortality on powerlines. No scientific data is available on the effectiveness but it is generally claimed to be effective.

8.1.4 Attachment methods and spacing

Bird Flappers are usually fitted live-line by helicopter. Unfortunately, the huge costs associated with helicopter flying time are a major stumbling block for any initiative that involves large scale fitting of devices to transmission lines. Therefore it is generally combined with other maintenance operations to save costs.

Research in the Netherlands has shown that spacing intervals have a major influence on the effectiveness of anti-collision devices [8]. In South Africa, the same has been found [2]. See figure 3 for a suggested marking method with Bird Flappers.

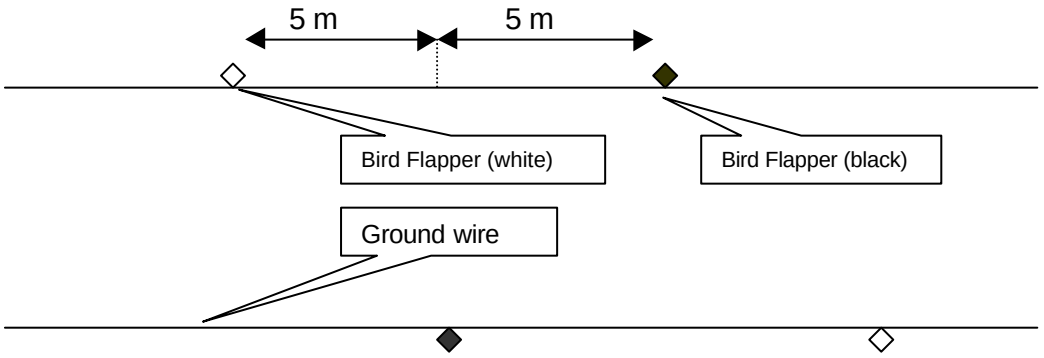


Figure 4: Marking method with Bird Flappers on overhead ground wires (viewed from above)

NB. It is important to alternate the colours (black-white) in order for maximum contrast.

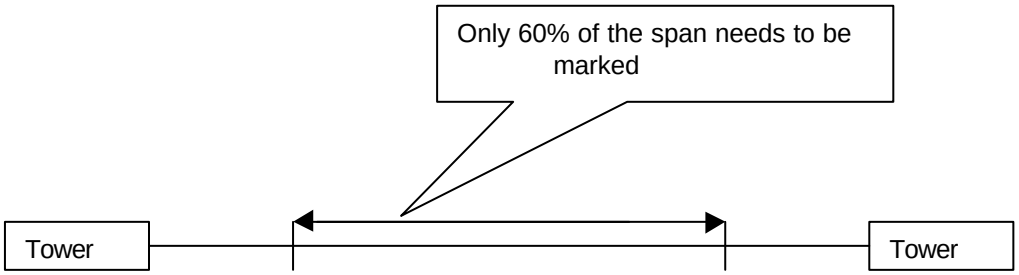


Figure 5: Area of span that must be marked

9. PROCEDURE FOR THE INVESTIGATION BIRD COLLISION INCIDENTS

When a problem is discovered with bird collisions on a transmission line, it must be reported to the Endangered Wildlife Trust (EWT) at 0860-111-535 or (011) 486 – 1102. The EWT will organise for an investigation to be conducted on site, and will generate recommendations for mitigation measures to be taken.

10 LEGAL IMPLICATIONS

The killing of protected bird species can be a criminal offence. The legal position with regard to the protection of birds is governed mainly by various provincial ordinances and nature conservation acts, all of which broadly concur. The situation with regards to birds being killed on powerlines could be summarized as follows:

- All birds are protected by law, except those specifically excluded from this protection.
- No protected bird species (breeding or non-breeding) may be wilfully killed in any way, without a permit from the relevant provincial authority.

- Contravention of these regulations constitute a criminal offence and the offender is subject to a fine or imprisonment if found guilty.

  It could be argued that allowing protected birds to be killed on powerlines, *where the perpetrator was made aware of the problem* is a form of wilful killing. In a recent case in the USA, an electric utility was fined $100 000 for failing to take reasonable measures to prevent the killing of protected eagles on its powerlines, after it was made aware of the problem.

ANNEXURE A

POWERLINE COLLISION SENSITIVE SPECIES IN SOUTHERN AFRICA

Blue Crane *Anthropoides paradisea*
Other names: Bloukraanvoël
Weight and length: 5 kg, 100cm.
Food: Insects, grass seeds, grain, frogs and reptiles.

Commonly use very open habitats, attracted to agricultural pastures and congregating in large flocks to roost in farm dams and shallow water bodies. Highly prone to powerline collisions, especially with large transmission powerlines in close proximity to roost sites. This species often returns to roost after sunset, resulting in a high potential for collisions. Total population approximately 20 100 in South Africa.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Vulnerable

Grey Crowned Crane *Balearica regulorum*
Other names: Mahem
Weight and length: 3.6kg, 100cm
Food: Insects, frogs, lizards, crabs and grain.

Utilize wetland habitats for breeding, and forage extensively in agricultural lands, commonly seen in intensively farmed areas. Highly prone to collisions due to their regular daily low-altitude movements across reticulation powerlines in intensively farmed areas. Grey Crowned Crane numbers approximately 4200 individuals.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Vulnerable.

Wattled Crane *Grus carunculatus*
Other names: Lelkraanvoël
Weight and size : 6 – 8 kg, 120cm
Food : wetland tubers and rhizomes, grain, insects, frogs, small reptiles

A species of very low number in South Africa, highly dependent on wetland and surrounding grassland habitat for survival. They are large slow-flying birds with little maneuverability and high likelihood of collisions. Mortality of Wattled Cranes through powerline collisions are of very high biological significance due to their high potential for collision and significant impact due to their low population numbers. Wattled Crane numbers approximately 250 in South Africa.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Vulnerable.

Stanley's Bustard *Neotis denhami*
Other names: Veldpou
Weight and size: Up to 9kg, 104cm.
Food: Mainly insects, grass seeds, lizards and small rodents.

A large-bodied, low-altitude rapidly flying species, highly susceptible to powerline collisions. Utilize open grassland habitats, easily being flushed resulting in rapid low flight often at powerline height.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Vulnerable.

Ludwig's Bustard *Neotis ludwigi*
Other names: Ludwigse Pou
Weight and size: 3.4 kg, 90 cm.
Food : Insects, seeds, small vertebrates and plant material.

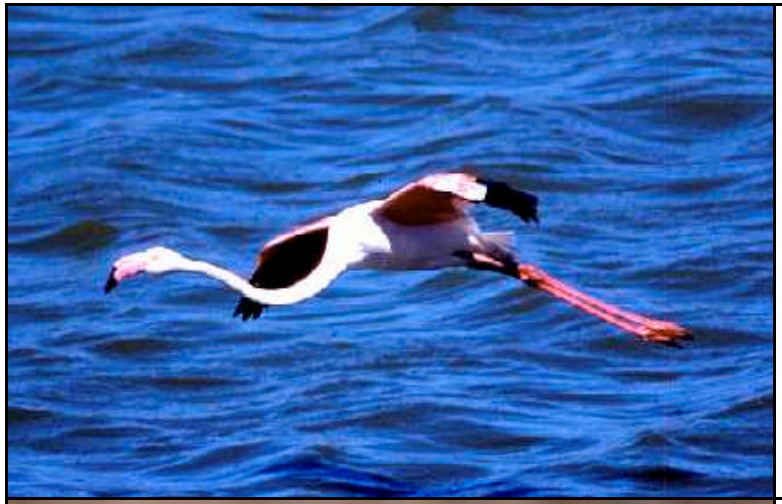
A large-bodied, low-altitude, rapidly flying species highly susceptible to powerline collisions. Utilize open grassland and Karoo scrub habitats, easily being flushed resulting in rapid low flight often at powerline height.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Vulnerable

Kori Bustard *Otis kori*
Other names: Gompou
Weight and size: Up to 19 kg, 132cm.
Food: Insects, small vertebrates, seeds and carrion.

South Africa's largest and heaviest flying bird, with very little maneuverability with a resulting high susceptibility to collisions by virtue of its size and flight characteristics.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Vulnerable



Greater Flamingo *Phoenicopterus ruber*
Other names: Grootflamink
Weight and size: Up to 4kg, 127cm
Food : Small aquatic invertebrates, detritus and algae.

Very susceptible to powerline collisions due to flocking behaviour and nocturnal migration.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Near threatened

Lesser Flamingo *Phoenicopterus minor*
Other names: Kleinflamink
Weight: Up to 1.9 kg, 100cm.
Food: Blue-green algae and diatoms.

Very susceptible to powerline collisions due to flocking behaviour and nocturnal migration

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Near threatened

White Stork *Ciconia ciconia*
Other names: Wit ooievaar, Wit sprinkaanvoël
Weight: Up to 4.4 kg, 100cm
Food: Large insects (locusts), small reptiles and mammals, young ground-nesting birds and frogs. Present in southern Africa from November to May.

Particularly prone to collisions on lines bordering irrigated crops such as lucerne.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Not endangered.

Secretarybird *Sagitarius serpentarius*
Other names: Sekretarisvoël
Weight : Up to 4.3 kg, 140cm
Food: Insects, small amphibians, lizards, rodents, young hares, snakes and young birds and eggs.

This species utilizes open grassland and lightly wooded savanna habitats. The only large raptor that regularly collide with powerlines.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Near threatened.

White Pelican *Pelecanus onocrotalus*
Other names: Witpelikaan
Weight : Up to 15 kg, 180cm
Food: Fish, some crustaceans.

Very large and heavy bird. Prone to collisions near roosts and at regular flight corridors. Flocking behaviour increases risk to collisions.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Vulnerable.

Spurwing Goose *Plectropterus gambensis*
Other names: Wildemakou
Weight: Up to 9kg, size 100cm
Food: Vegetable matter including young grasses, lucerne and grain.

Very common in grain growing areas of the Western Cape. Flocking behaviour increases risk of collision.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Not endangered.

Sacred Ibis *Threskiornis aethiopicus*
Other names: Skoorsteenvëer, Heilige ibis
Weight and size: 2kg, 90cm
Food: Insects, mollusks, frogs and small reptiles.

Roost in large colonies on the fringes of dams. Often collide with powerlines between roosting and foraging sites.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Not endangered

Bald Ibis *Geronticus calvus*

Other names: Kalkoenibis, Wilde Kalkoen
Weight and size: 1kg, 80cm
Food: Worms, grasshoppers, caterpillars on recently burnt fields

Endemic to southern Africa. Breeds and roosts in colonies on cliffs. Vulnerable to powerlines when flying between roosts and foraging sites.

Conservation status (Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland): Vulnerable