ARIES 50KV POWER LINE

AVIFAUNAL IMPACT ASSESSMENT

October 2014

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EXECUTIVE SUMMARY

The Sishen-Saldanha line, Transnet Freight Rail's (TFR) iron ore export corridor, forms the backbone of the company's growth strategy. As part of the Transnet Orex expansion, TFR will be replacing the 9E Electrical Locomotives and Diesel Locomotives with the new energy efficient 15E Electrical Locomotives. Eskom Holdings SOC Limited (Eskom) was therefore requested by TFR to provide advice and the necessary provisions in this regard. Eskom recommended a new 15 kilometre 50KV power line be built.

Nsovo Environmental Consultants were appointed as the environmental consultants for the projects and they in turn appointed Wildskies Ecological Services as the avifaunal specialists for this project.

A site visit was conducted during the week of the 8th to the 12th September 2014 to assess the project from an avifaunal perspective.

A combined (Southern African Bird Atlas Project 1 and 2) total of 224 bird species occur across a wide study area that encompasses the proposed site itself. Of these a total of 14 species are Red List species, with 4 classified as Endangered, 4 classified as Vulnerable and 6 Near-threatened. In addition there are 2 species listed as Bonn species.

The proposed project can proceed with acceptable levels of impact on avifauna if the recommendations in this report are followed.

Electrocutions can be mitigated by using the steel monopole design for any new towers required for this power line. It must be noted that there is a far greater risk of electrocutions from the neighbouring substation and from the railway line towers themselves. Therefore the impact of electrocutions on this project is acceptable should the steel monopole be used.

Collisions are certainly possible on the new power line but this can be mitigated by placing the new line adjacent to the existing power line as well as by marking the line with anti-collision bird flappers. The exact spans requiring marking must be subject to an avifaunal walk down once the line has been surveyed and pegged. If this is done the impact of collisions is seen as acceptable for this project.

The impact of bird induced faulting, while not really a conservation issue, can be mitigated by using the steel monopole. This is generally a safe design for faulting and is immune to this impact.

Habitat destruction and disturbance can both be mitigated by following a strict construction EMP and taking care to disturb the local environment as little as possible during construction.

There were no alternatives to consider and in the specialists' opinion this was also not necessary for this project.

SPECIALIST DETAILS

Professional registration and experience

The Natural Scientific Professions Act of 2003 aims to "Provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP) and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith." "Only a registered person may practice in a consulting capacity" – Natural Scientific Professions Act of 2003 (20(1)-pg 14)

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Declaration of independence

The specialist investigators declare that:

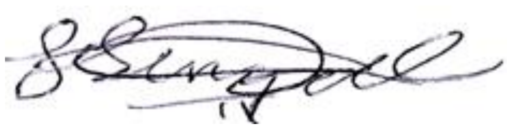
- We act as independent specialists for this project.
- We consider ourselves bound by the rules and ethics of the South African Council for Natural Scientific Professions.
- We do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2006.
- We will not be affected by the outcome of the environmental process, of which this report forms part of.
- We do not have any influence over the decisions made by the governing authorities.
- We do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- We undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2006.

Terms and Liabilities

- This report is based on a short term investigation using the available information and data related to the site to be affected. No long term investigation or monitoring was conducted.
- The Precautionary Principle has been applied throughout this investigation.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.

- The specialist investigator reserves the right to amend this report, recommendations and conclusions at any stage should additional information become available, particularly from Interested and Affected Parties.
- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

Signed on the 1st October 2014 by Luke Strugnell in his capacity as specialist investigator.



1. INTRODUCTION

1.1 Background to the current study

The Sishen-Saldanha line, Transnet Freight Rail's (TFR) iron ore export corridor, forms the backbone of the company's growth strategy. As part of the Transnet Orex expansion, TFR will be replacing the 9E Electrical Locomotives and Diesel Locomotives with the new energy efficient 15E Electrical Locomotives. Eskom Holdings SOC Limited (Eskom) was therefore requested by TFR to provide advice and the necessary provisions in this regard. Consequently, to enable TFR to expand their operations without overloading and interruption of supply, Eskom proposes the following:

- Construction of approximately 15 kilometres of 50kV power line in parallel to the existing line from Helios substation to the proposed new Transnet Traction Feeder Substation. The new line will have three single phase supplies each rated at 60MVA;
- Installation of a 1x60MVA 400/50kV transformer; and
- Connect in parallel existing 2x40MVA 400/50kV transformers and make them to feed north of the substation.

Although an approximately 31 meter wide servitude is required for the proposed power lines, the environmental assessment will earmark a 200 meter corridor.

Nsovo Environmental Consultants where appointed as the environmental consultants for the projects and they in turn appointed Wildskies Ecological Services as the avifaunal specialists for this project.

A site visit was conducted during the week of the 8th to the 12th September 2014 to assess the project from an avifaunal perspective.

1.2 Terms of reference

The terms of reference used for this project were as follows:

- Provide status of bird habitats in the area and any endangered species;
- Identification of areas where bird interactions may play a major role;
- Classification of potential bird impacts, if any, on the proposed infrastructure and infrastructure impacts on bird species in the area;
- Provide recommendations on how to mitigate potential impacts on both birds and the proposed infrastructure

1.3. Description of proposed development

The proposed power line is 15 kilometres long and a 200 meter corridor was assessed. The site map is presented below in Figure 1.

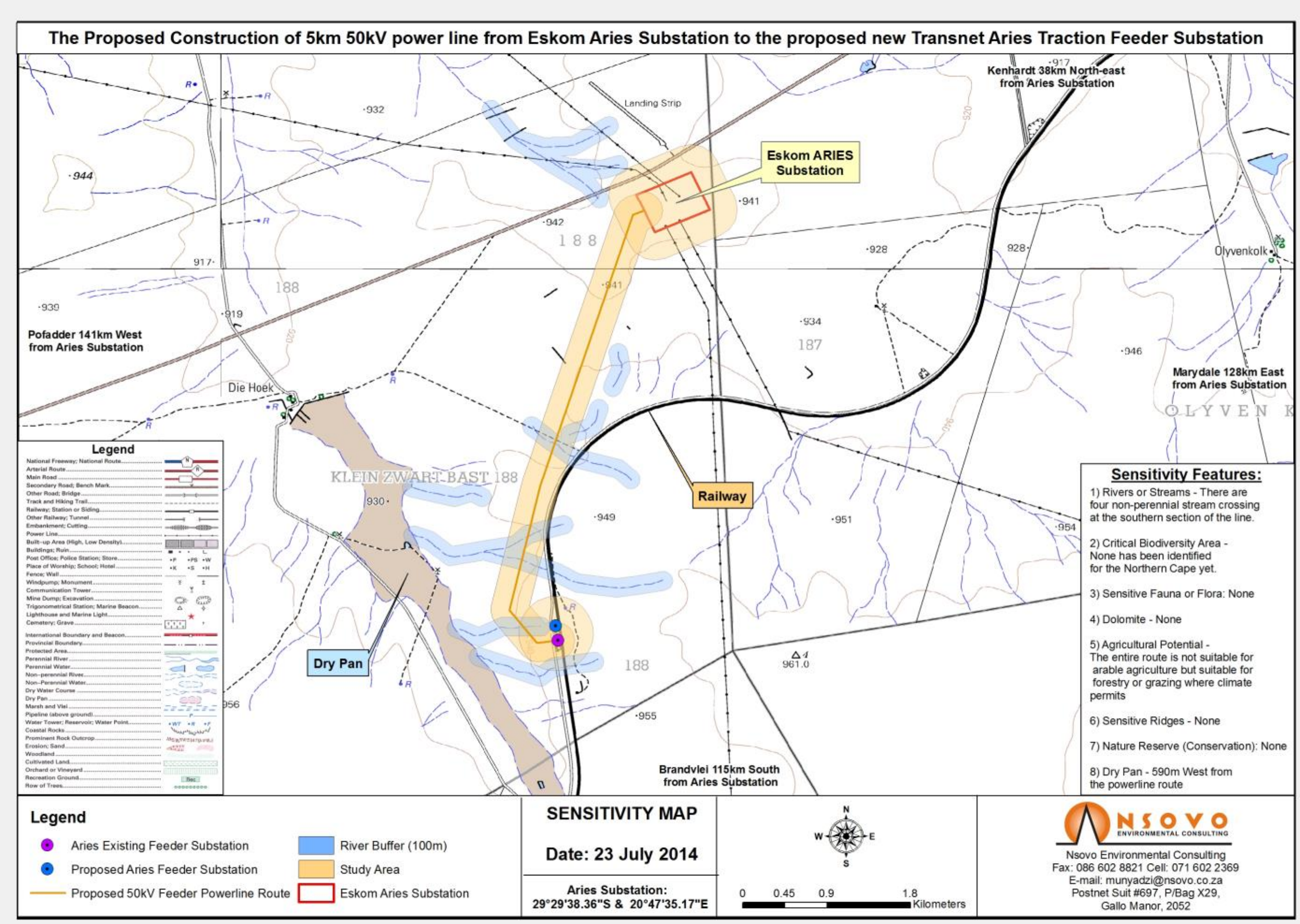


Figure 1. The layout of the proposed 50KV Aries substation and power line.

1.4. Sources of information

The following information sources were consulted:

- Bird distribution data from the South African Bird Atlas Projects 1 and 2 (SABAP 1 and SABAP 2) were obtained to ascertain which bird species occur in the study area (Harrison *et al.* 1997, SABAP 2 2013).
- The conservation status of all bird species occurring in the study area was determined using The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor, 2014) and the IUCN Red List for Birds (BirdLife International 2013).
- A description of the vegetation types occurring in the study area was obtained from The Vegetation of South Africa, Lesotho and Swaziland (Bredenkamp, G., Granger, J.E. & van Rooyen, N., 1996).
- The Important Bird Area programme of BirdLife South Africa was consulted (Barnes 1998, and recent updates of the Important Bird Areas Directory downloaded from http://www.birdlife.org.za; BirdLife South Africa 2013).
- Through a field investigation (conducted during September 2014), information at the micro-habitat level was obtained first hand by driving the proposed route, as close to the alignment as roads would allow, and examining sections of particular concern.
- The author has extensive field experience in the study area and significant expertise in the field of power line collisions affecting large South African birds.

1.5. Assumptions and limitations

This study made the assumption that the sources of information discussed above are reliable, but the following factors may potentially detract from the accuracy of the predicted results. The Atlas of Southern African Birds (Harrison *et al.* 1997) data is quite old now (covering the period 1986-1997), and bird distribution patterns fluctuate continuously according to availability of food and nesting substrate, and environmental conditions. While data is available from both SABAP 1 and SABAP 2, it is probably not comprehensive because this area of Bushmanland is amongst the least surveyed areas of the country due to its remoteness from large settlements where birders reside (SABAP 2 2013). Various other inaccuracies could exist in this atlas data; for a full discussion of these see Harrison *et al.* (1997).

The EIA process for power lines of this type in South Africa relies heavily on existing information, and this avifaunal study is no different. Field work was conducted in order to examine specific areas and ground truth information, but by necessity much of the information used is obtained from various existing sources (see 1.4) in order to make an educated assessment. Invariably, the existing information on birds is obtained over a far longer period and far more representative conditions than the short term EIA study.

2. DESCRIPTION OF BASELINE CONDITIONS

2.1 Vegetation description

It is widely accepted that vegetation structure is more important in determining bird habitat than the actual plant species composition (Harrison *et al.* 1997). The description of vegetation presented in this study therefore concentrates on factors relevant to the bird species present, and is not an exhaustive list of plant species present. The following description of the vegetation types occurring in the study area makes extensive use of information presented by Bredenkamp, G., Granger, J.E. & van Rooyen, N. (1996).

The vegetation in the study area is Bushmanland Nama Karoo and is described as follows "The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. Grazing rapidly increases the relative abundance of shrubs. Most of the grasses are of the C_4 type and, like the shrubs, are deciduous in response to rainfall events.

The amount and nature of the fuel load is insufficient to carry fires and fires are rare within the biome. The large historical herds of Springbok and other game no longer exist. Like the many bird species in the area - mainly larks - the game was probably nomadic between patches of rainfall events within the biome. The Brown Locust and Karoo Caterpillar exhibit eruptions under similarly favourable, local rainfall events, and attract large numbers of bird and mammal predators*."* (Bredenkamp, G., Granger, J.E. & van Rooyen, N. 1996).

From an avifaunal perspective this type of vegetation is very uniform and there is a general absence of water bodies outside of an unusual rainy period. From an avifaunal perspective the micro-habitats discussed below are of more value to this assessment.

2.2. Bird micro-habitats

Whilst much of the distribution and density of bird species in the study area can be explained in terms of the above broad vegetation description, there are differences that correspond to variations in habitat at the micro level. These "bird micro-habitats" are evident at a much smaller spatial scale than the broader vegetation types or biomes, and can generally only be identified through a combination of field investigation and experience. It is therefore important to visit the study area first hand.

The following bird micro-habitat was identified during the field investigation (Figure 2-5). Since the study area is so uniform this was the only micro-habitat identified in the area that is relevant to this study.

Plains

Much of the broader area within which this small study area is located is composed of irregular rolling plains, covered with dwarf shrubland and/or grasses, with occasional small trees. This habitat is preferred by large terrestrial birds because they are relatively cumbersome when taking off, so need to be able to see for a distance in order to maintain vigilance from predators. Birds like bustards, cranes, storks and Secretarybirds spend much of their time on the ground in such areas foraging and resting. Prey items such as insects and seeds are associated with this vegetation and visibility for foraging is good in the open habitat. A host of other species also favour these areas, including raptors and small passerines. After good rains, lower lying areas can become waterlogged, increasing their appeal to more water-dependent birds, as well as increasing insect abundances.

Figure 2. Example of the plains in the study area.

Figure 3- Example of the open plains with very limited vegetation in the area.

Figure 4- The existing power line present in the study area.

Figure 5- Closer view of the vegetation in the area

2.3. Bird species present in the study area

The first Southern African Bird Atlas Project (SABAP 1 – Harrison *et al*. 1997) and the second atlas project (SABAP 2 – www.sabap2.adu.org.za) recorded a combined total of 224 bird species across a wide study area that encompasses the proposed site itself. This does not mean that all of these species do occur on the alignment of the proposed power line, but it does give an indication of what could occur in the area. The full species list is shown in Appendix 2. Table 1 is an extract of the Red-listed species. A total of 16 species are included in Table 1, with 4 classified as Endangered, 4 classified as Vulnerable and 6 Near-threatened. In addition there are 2 species listed as Bonn species.

For each species the preferred micro-habitat, likelihood of occurring on site and relative importance of site have been assessed. An indication of the ways in which the species could interact with the proposed power line has also been presented.

Table 1. Summary of Red data species in the project area.

Common name	Scientific name	SABAP 1	SABAP 2	Regional conservation status	Preferred micro habitat in this study area	Likelihood of occurring on site	Relative importance of site for national population of species	Likely interactions with proposed power line
Bustard, Kori	*Ardeotis kori*	X	X	NT	Open Karoo and *Acacia* watercourses	Definite	High	C, HD, D
Bustard, Ludwig's	*Neotis ludwigii*	X	X	EN	Open Karoo	Definite	High	C, HD, D
Crane, Blue	*Anthropoides paradiseus*	X		NT	Open Karoo, pans	Possible	Low	C, HD, D
Eagle, Martial	*Polemaetus bellicosus*	X	X	EN	Open Karoo	Definite	High	C, HD, D, N, P
Flamingo, Greater	*Phoenicopterus ruber*	X	X	NT	Pans	Possible	Medium	C, D
Flamingo, Lesser	*Phoenicopterus minor*	X		NT	Pans	Possible	Medium	C, D
Harrier, Black	*Circus maurus*	X		EN	Any	Possible	Medium	C, HD, D, P
Lark, Red	*Calendulauda burra*	X	X	VU	Open Karoo	Possible	Medium to high	HD, D
Lark, Sclater's	*Spizocorys sclateri*	X	X	NT	Open Karoo	Possible	Medium to high	HD, D
Marsh-harrier, African	*Circus ranivorus*			EN	Any close to water	Possible	Low	C, HD, D
Plover, Chestnut-banded	*Charadrius pallidus*	X		NT	Pans	Possible	Low to medium	C, D
Secretarybird	*Sagittarius serpentarius*	X		VU	Open Karoo	Definite	Medium to high	C, HD, D
Stork, Abdim's	*Ciconia abdimii*	X		Bonn	Any close to water	Possible	Low	C, P
Stork, Black	*Ciconia nigra*	X	X	VU	Any close to water	Possible	Medium	C, P
Stork, White	*Ciconia*	X		Bonn	Any close to water	Possible	Low	C, P
Verreauxs' Eagle	*Aquila verreauxii*	X		VU	Open Karoo	Definite	Medium	C, HD, D,N, P

En= Endangered; VU = Vulnerable; NT = Near-threatened; Bonn= Protected by the Bonn Convention. C = Collision with overhead cables; E= Electrocutions; HD = Habitat destruction; D = Disturbance of birds during construction; N = Nesting on towers; P = Perching on power line towers (this has relevance for the impacts discussed elsewhere in this report).

The most important bird species for this study area are discussed below in more detail.

Ludwig's and Kori Bustards

These physically large species are highly vulnerable to collision with overhead power lines, and are also likely to be affected by disturbance and habitat destruction. Ludwig's Bustard is a wide-ranging bird endemic to the south-western region of Africa (Hockey *et al.* 2005). This species was listed as globally Endangered in 2010 because of potentially unsustainable collision mortality, exacerbated by the current lack of proven mitigation and the rapidly expanding power grid (Jenkins *et al.* 2011, BirdLife International 2013). Ludwig's Bustards are both partially nomadic and migratory (Allan 1994, Shaw 2013), with a large proportion of the population moving west in the winter months to the Succulent Karoo. In the arid and semi-arid Karoo environment, bustards are also thought to move in response to rainfall, so the presence and abundance of bustards in any one area are not predictable. Therefore, collisions are also largely unpredictable, and vary greatly between seasons and years (Shaw 2013). While there is no evidence yet of population-level declines resulting from collision mortality, detailed range-wide power line surveys estimate that tens of thousands of bustards (from a total South African population of approximately 114,000 birds) die annually on the existing power grid in this country, which is of grave concern given that they are likely to be long-lived and slow to reproduce. It seems likely that there will be a threshold power line load at which population declines will become apparent, but it is not possible to accurately predict what this will be, and such effects will probably only be noticed when it is too late to do anything about it (Shaw 2013). Therefore, extreme caution is necessary in the planning of any new power lines in the range of this species.

Kori Bustards are classified as regionally Near-threatened (Taylor 2014), with an estimated population of 2,000 – 5,000 birds in South Africa (Hockey *et al.* 2005). There are also worries for the population consequences of power line mortality for this species, given that some 14% of the population are estimated to die annually on Karoo transmission lines alone (Shaw 2013). Kori Bustards in the Karoo are thought to be locally nomadic (Hockey *et al.* 2005) and thus likely suffer greater collision rates than more sedentary populations in other areas (e.g. the Kalahari; Senyatso 2011). If this is the case, the Karoo could be acting as a population sink for Kori Bustards, at a time when Kori numbers are thought to be decreasing throughout southern Africa (Taylor 2014, Senyatso *et al.* 2012).

Secretarybirds

This species is classified as regionally Vulnerable (Taylor 2014), but has recently been uplisted to globally Vulnerable on the basis of population declines (BirdLife International 2013). While there is no current population estimate in South Africa, there has been a reduction of sightings in the areas it previously occupied (SABAP 2 c.f. SABAP 1 data). This is probably mainly due to habitat loss, but power line collisions may also be a significant factor. The physical attributes of Secretarybirds mean that they are highly vulnerable to collision, and data from Karoo transmission lines (Shaw 2013) and the Central Incident Register (Eskom-EWT 2012) indicate that these birds do indeed collide across their range. However, as the population is sparsely distributed it is probably underrepresented in available collision data, and further research would be necessary to better understand potential population impacts of this source of unnatural mortality. Unfortunately, the species' movement is not well understood so BirdLife South Africa have recently placed satellite transmitters on Secretarybirds in order to track their movements, but this data is not useful for the current study.

Martial and Verreaux's Eagles

The Martial Eagle is classified as globally Near-threatened, and regionally Endangered (Taylor 2014, BirdLife International 2013), whilst Verreaux's Eagle is currently regionally Vulnerable. Both species are locally common, the Karoo being an area with a relatively high density of breeding pairs and therefore an important area for these species. They are well known to have adapted to using Eskom transmission line towers for perching, roosting and nesting. Although this appears at face value to be a positive impact (allowing the birds to expand their range into areas previously unsuitable for breeding due to a lack of trees) residing on a power line also increases the risk of collision that the birds face, particularly for young birds recently fledged (who can also become entangled and die in the tower lattice when fledging; J. Shaw pers. obs.). This new power line may pose a new collision risk within existing territories, and a possible disturbance of breeding if construction of the new line takes place during breeding season.

3. EVALUATION OF IMPACTS

3.1. General description of bird interactions with power lines

Because of its size and prominence, electrical infrastructure constitutes an important interface between wildlife and man. Wildlife interactions with power lines are almost all negative, with the two main problems caused by electrocution of birds (and other animals) and birds colliding with power lines (Ledger & Annegarn 1981, APLIC 1994, Bevanger 1998, Kruger 1999, van Rooyen & Ledger 1999, Lehman *et al.* 2007, Jenkins *et al.* 2010, Shaw *et al*. 2010, Prinsen *et al.* 2011, APLIC 2012, Shaw 2013). Other issues are electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure (van Rooyen & Ledger 1999), and disturbance and habitat destruction during construction and maintenance activities (e.g. Silva *et al.* 2010, Raab *et al.* 2011a).

Electrocutions

Electrocution of birds on overhead lines is an important cause of unnatural mortality of raptors and storks, and has been a focus of much attention in Europe, USA and South Africa (APLIC 1994, Alonso & Alonso 1999, van Rooyen & Ledger 1999, Lehman 2001, Lehman *et al.* 2007). Electrocution can occur when a bird is perched or attempts to perch on electrical structure and causes a short circuit by physically bridging the air gap between live components and/or live and earthed components.

Mitigation for Electrocutions starts by selecting a bird safe tower structure. For a line of this size the best tower design is the steel monopole as it is an inherently safe design for birds from an electrocution perspective. Where other designs are used insulation may be added to reduce the chances of electrocutions. This should be seen as a distant second option to building the preferred tower design from the start.

Collisions

Collision with power lines is a well-known conservation problem for many birds, and for some species can be a significant source of mortality (Bevanger 1998, Erickson *et al.* 2005, Drewitt & Langston 2008, Shaw *et al.* 2010, Jenkins *et al.* 2011). The reasons for collisions are complex, with each case involving a variety of biological, topographical, meteorological and technical factors (Bevanger 1994). Although all birds have the potential to be affected by collisions, those most heavily impacted are generally large, flocking species which fly often, with waterfowl, gamebirds, cranes, bustards and storks usually among the most frequently reported casualties (Bevanger 1998, Janss 2000, Jenkins *et al.* 2010). The large body size of such species mean that they have limited manoeuvrability in the air and are less able to take necessary evasive action to avoid colliding with power lines (Bevanger 1998).

Mitigating bird collisions with power lines typically involves the installation of line marking devices on the cables in order to make them more visible to approaching birds. Worldwide, a variety of marking devices are used, but very few have been adequately field-tested (Jenkins *et al.* 2010). Great uncertainty remains about which are best, as they vary enormously in effectiveness between species and in different conditions (van Rooyen & Ledger 1999, Anderson 2002). Generally though, marking seems to be fairly effective, with a recent meta-analysis showing a 78% decrease in mortality rates on marked lines (Barrientos *et al.* 2011). However, bustards are particularly difficult to mitigate for. Janss & Ferrer

(1998) found no evidence of a decrease in Great Bustard *Otis tarda* mortality following line marking in Spain, although markers did seem to be effective for Little Bustards *Tetrax tetrax*. Raab *et al.* (2011b) suggested that Great Bustards benefitted from line marking in Austria and Hungary, but the effect was minimal compared to the reduction in mortality resulting from burying power lines. Most recently, Barrientos *et al.* (2012) demonstrated a slight reduction in collision rates for Great and Little Bustards following marking in Spain, but rates remained high even after marking.

Habitat destruction and disturbance

During the construction phase and maintenance of power lines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors, and to minimise the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity.

Nesting

Raptors, large eagles, crows, Hadeda Ibises and Egyptian Geese have learnt to nest on transmission towers, and this has allowed them to breed in areas of the country where breeding would not previously have been possible due to limited nesting substrates (van Rooyen & Ledger 1999, de Goede & Jenkins 2001). This has probably resulted in a range expansion for some of these species, and large eagles such as Tawny, Martial and Verreaux's are now quite common inhabitants of transmission towers in the Karoo (e.g. de Goede & Jenkins 2001). Cape Vultures *Gyps africanus* and White-backed Vultures have also taken to roosting on power lines in certain areas in large numbers, while Lappet-faced Vultures are also known to using power lines as roosts, especially in areas where large trees are scarce (J. Smallie pers. obs.). At face value this appears a positive contribution that power lines can make to these species. However the situation is more complex in that nesting on the tower places the adults and young at much greater risk of collision with the overhead cables than would otherwise be the case. Due to the electrical faulting that these birds can cause on transmission towers, Eskom also sometimes wishes to remove nests in order to manage the risk of faulting, with negative effects for the birds if not correctly handled. In the study area Sociable Weavers also use power lines to create large nests. These nests can become very large and have an impact on the quality of supply of the new power line.

Electrical faulting caused by birds

Birds are able to cause electrical faults on transmission lines in the following ways: nest material can intrude into the air gap and cause a short circuit (this is particularly so for eagles with large stick nest material and crows with conductive wire nest material), bird faeces can drop through onto insulator strings until the build-up renders the insulator ineffective and a fault occurs, or birds can produce a long continuous streamer of faeces which bridges the air gap as it falls. None of these mechanisms necessarily result in the death of the bird, but they can cause an electrical fault which affects line performance. This is typically managed for by installing perch deterrents (Bird Guards) on the steel work to manipulate where birds can perch, reducing perching directly above the live conductors. This is very dependent on the tower structure used. If the recommended steel monopole is used it is unlikely that this would be a significant impact in this study.

3.2. Evaluation of expected impacts of the proposed power line on birds in study area

Generally speaking, it is inevitable that birds will be killed through interaction with power infrastructure, despite the best possible mitigation measures. It is therefore important to direct risk or impact assessments and mitigation efforts towards species that have a high biological significance, in order to achieve maximum results with the available resources at hand. While society places other values on certain species, e.g. aesthetic or commercial, this impact assessment is primarily aimed at assessing the potential threat to important or Red-listed species that occur or potentially occur along the proposed power line routes.

The impacts have been assessed according to the criteria in Appendix 1. The impact tables for each of the identified impacts above are presented below (The significance rating is a number out of a total of 100, the lower the number, the lower the impacts rating):

Table 2. Electrocution of birds with proposed power line

Nature: **Electrocutions of birds with earth and live wires on power line**		
	Without mitigation	With mitigation
Extent	1-site bound	1-site bound
Duration	4-long term	4-long term
Magnitude	3-moderate	2-low
Reversibility	5-irreversible	5-irreversible
Probability	3-can occur	1-extremely remote
Significance	**39-moderate**	**12-low**
Status	negative	Negative
Irreplaceable loss of resources	Yes-birds killed	Yes-birds killed
Can impacts be mitigated	yes	yes
Mitigation: Mitigation is required in order to reduce the impact of electrocutions to low significance. The most effective mitigation will be to build the new power line using the steel monopole design. This is an inherently safe structure for avifauna and if this is used the impact of electrocutions will be negligible. It is also advised that when the steel monopole is used that a bird perch be added to the top of the pole. This will further reduce the chances of electrocutions on the new power line.		

Table 3. Collision of birds with proposed power line

Nature: **Collision of birds with earth wires and conductors – key species being Ludwig's Bustard, Kori Bustard**		
	Without mitigation	With mitigation
Extent	2-local	2-local
Duration	4-long term	4-long term
Magnitude	3-moderate	2-low
Reversibility	5-irreversible	5-Irriversible
Probability	3-can occur	2- Unusual but possible
Significance	**42-moderate**	**26-low**
Status	Negative –birds killed	Negative –birds killed
Irreplaceable loss of resources	Yes-birds killed	Yes-birds killed
Can impacts be mitigated	Yes	Yes
Mitigation: The most important mitigation measure for this line is to place the new line adjacent to the existing power line. Generally infrastructure placed together has a lower impact when it comes to collisions as the visual signature increases. It is further recommended that the line be marked with anti-collision bird flappers to further reduce the impact of collision. If this is done the impact of collisions reduces to low and is acceptable.		

Table 4. Impact of habitat destruction on avifauna

Nature: **Destruction of bird habitat during construction of the power line, and to a lesser extent maintenance**		
	Without mitigation	With mitigation
Extent	1-site bound	1-Site bound
Duration	4- long term	4- long term
Magnitude	2-low	1-minor
Reversibility	3- reversible with human intervention	3- reversible with human intervention
Probability	3-can occur	2-unusual but possible
Significance	**30-moderate**	**18-low**
Status	negative	negative
Irreplaceable loss of resources	Yes - habitat lost	Yes - habitat lost
Can impacts be mitigated	Yes	Yes
Mitigation: On the site visit no sensitive bird habitat was observed, however care must still be taken to reduce the impact of habitat destruction to an absolute minimum. This can be achieved by following a strict construction EMP. In particular use must be made of the already disturbed servitude and all existing roads must be used if possible. Construction activities must be limited to the site and surroundings and not be allowed to spill over to adjacent habitat.		

Table 5. Impact of disturbance on avifauna

Nature: **Disturbance of birds, during construction and to a lesser extent maintenance**		
	Without mitigation	With mitigation
Extent	1-site bound	1-site bound
Duration	2-short term	2-short term
Magnitude	2-low	1-minor
Reversibility	5-irreversible	5-irreversible
Probability	3-can occur	2-unusual but possible
Significance	**30-moderate**	**18-low**
Status	negative	Negative
Irreplaceable loss of resources	yes-breeding success could be impacted	yes-breeding success could be impacted
Can impacts be mitigated	yes	yes
Mitigation: As with habitat destruction, care should be taken during construction and a strict construction EMP should be followed. If this is done the impact of disturbance will decrease to low and be acceptable to avifauna.		

Table 6. Nesting of birds on the towers

Nature: **Nesting on towers**		
	Without mitigation	With mitigation
Extent	1-site bound	1-site bound
Duration	4-long term	4-long term
Magnitude	1-minor	1-minor
Reversibility	3-reversible with human intervention	3-reversible with human intervention
Probability	2-unusual but possible	2-unusual but possible
Significance	**18-low**	**18-low**
Status	negative	Negative
Irreplaceable loss of resources	no	No
Can impacts be mitigated	Not required	Not required
Mitigation: It is possible that birds will nest on the new power line but mitigation can be retrofitted should it be required in the future.		

Table 7. Impact of birds on faulting of the lines

Nature: **Electrical faulting on lines, caused by birds**		
	Without mitigation	With mitigation
Extent	1-site bound	1-site bound
Duration	4-long term	4-long term
Magnitude	2-low	1-minor
Reversibility	3-reversible with human intervention	3-reversible with human intervention
Probability	2-unusual but possible	1-extremely remote
Significance	**20-low**	**9-low**
Status	Negative for business	Negative for business
Irreplaceable loss of resources	No - business risk	No - business risk
Can impacts be mitigated	Yes	Yes
Mitigation: The most effective mitigation measure is to build the new line using the steel monopole design. This is generally a design that is immune to bird induced faulting. In addition a bird perch should be fitted to the towers further reducing the risk of faulting. This impact will be negligible should these recommendations be followed.		

4. MITIGATION

In order to mitigate for the impacts summarised above, the following recommendations need to be implemented:

- **The steel monopole design should be used for the new power line towers. This will mitigate for the impact of electrocutions as well as the impact of bird induced faulting. In addition all poles should be fitted with a Bird Perch on top to provide safe perching space for large birds.**
- **The new power line must be built adjacent to the existing power line to mitigate for the impact of collisions. In addition the new line must be marked with anti-collision flappers to further reduce the impact of collision. An avifaunal walk down should be commissioned once the line has been surveyed and pegged to indicate the exact spans requiring marking.**
- **A general construction environmental management plan (EMP) should be followed to mitigate for the general habitat destruction and disturbance when building the new line.**
- **No other impacts require any mitigation.**

5. RELEVANT LEGISLATION

Various sets of legislation and policy frameworks are relevant to this specialist study and development, including the following:

- The Convention on Biological Diversity is dedicated to promoting sustainable development. The Convention recognises that biological diversity is about more than plants, animals and micro-organisms and their ecosystems. It is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live. It is an international convention signed by 150 leaders at the Rio 1992 Earth Summit, and South Africa is a signatory.
- An important principle encompassed by the CBD is the precautionary principle, which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used a reason for delaying management of these risks. The burden of proof that the impact will not occur lies with the proponent of the activity posing the threat.
- The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe and Oceania. South Africa is a signatory.
- The African-Eurasian Waterbird Agreement: the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is the largest of its kind developed so far under the CMS. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguins. The agreement covers 119 countries from Europe, parts of Asia and Canada, the Middle East and Africa.
- National Environmental Management – Biodiversity Act - Threatened or Protected Species list (TOPS): the following relevant species for this study are on the list: Vulnerable – White-backed Vulture; Kori Bustard; Ludwig’s Bustard; Martial Eagle.

6. CONCLUSIONS

It is concluded that the proposed project can proceed with acceptable levels of impact on avifauna if the recommendations in this report are followed.

Electrocutions can be mitigated by using the steel monopole design for any new towers required for this power line. It must be noted that there is a far greater risk of electrocutions from the neighbouring substation and from the railway line towers themselves. Therefore the impact of electrocutions on this project is acceptable should the steel monopole be used.

Collisions are certainly possible on the new power line but this can be mitigated by placing the new line adjacent to the existing power line as well as by marking the line with anti-collision bird flappers. The exact spans requiring marking must be subject to an avifaunal walk down once the line has been surveyed and pegged. If this is done the impact of collisions is seen as acceptable for this project.

The impact of bird induced faulting, while not really a conservation issue, can be mitigated by using the steel monopole. This is generally a safe design for faulting and is immune to this impact.

Habitat destruction and disturbance can both be mitigated by following a strict construction EMP and taking care to disturb the local environment as little as possible during construction.

There were no alternatives to consider and in the specialists' opinion this was also not necessary for this project.

7. REFERENCES

Allan, D.G. 1994. The abundance and movements of Ludwig's Bustard *Neotis ludwigii*. Ostrich 65: 95-105.

Alonso, J.A. and Alonso, J.C. 1999. Collision of birds with overhead transmission lines in Spain. In: Ferrer, M. and Janss, G.F.E. (Eds.) Birds and Power Lines. Collision, Electrocution and Breeding: pages 57-82. Servicios Informativos Ambientales/Quercus, Madrid.

Anderson, M.D. 2002. Karoo large terrestrial bird power line project: Report No 1. Eskom, Johannesburg.

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating bird collisions with power lines: the state of the art in 1994. Edison Electrical Institute, Washington D.C.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing avian collisions with power lines: the state of the art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Barnes, K.N. (Ed.) 1998. The Important Bird Areas of southern Africa. BirdLife South Africa, Johannesburg.

Barnes, K.N. (Ed.) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Barrientos, R., Alonso, J.C., Ponce, C., and Palacín, C. 2011. Meta-analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25: 893-903.

Barrientos, R., Ponce, C., Palacín, C., Martín, C.A., Martín, B. and Alonso, J.C. 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: a BACI designed study. PLoS ONE 7: 1-10.

Bevanger, K. 1994. Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. Ibis 136: 412-425. 184

Bevanger, K. 1998. Biological and conservation aspects of bird mortality caused by electricity power lines: a review. Biological Conservation 86: 67-76.

Bevanger, K. 1999. Estimating bird mortality caused by collision and electrocution with power lines; a review of methodology. In: Ferrer, M. and Janss, G.F.E. (Eds.) Birds and Power Lines. Collision, Electrocution and Breeding: pages 29-56. Servicios Informativos Ambientales/Quercus, Madrid.

BirdLife International. 2013. IUCN Red List for Birds. Downloaded from http://www.birdlife.org in April 2013.

BirdLife South Africa. 2013. Important Bird Areas Programme. Downloaded from http://www.birdlife.org.za/conservation/iba in April 2013.

De Goede, K. 2011. Monitoring large eagle nest sites on Eskom power lines in the south-western Karoo – Progress report 2011. Unpublished report, Endangered Wildlife Trust, Johannesburg.

De Goede, K. and Jenkins, A. 2001. Electric eagles of the Karoo. Africa - Birds & Birding 6: 62-67.

Dean, W.R.J. 1997. The distribution and biology of nomadic birds in the Karoo, South Africa. Journal of Biogeography 24: 769-779.

Drewitt, A.L. and Langston, R.H.W. 2008. Collision effects of wind-power generators and other obstacles on birds. Annals of the New York Academy of Sciences 1134: 233-266.

Erickson, W.P., Johnson, G.D. and Young Jr., D.P. 2005. A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. General Technical Report PSW-GTR-191. United States Department of Agriculture Forest Service, Washington D.C.

Eskom-Endangered Wildlife Trust Strategic Partnership (Eskom-EWT). 2012. Central Incident Register. Wildlife & Energy Programme, Endangered Wildlife Trust, Johannesburg.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. and Brown, C.J. (Eds.) 1997. The Atlas of Southern African Birds. BirdLife South Africa, Johannesburg.

Hockey, P.A.R., Dean, W.R.J. and Ryan, P.G. (Eds.) 2005. Roberts Birds of Southern Africa, 7th edn. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Janss, G.F.E. 2000. Avian mortality from power lines: a morphological approach of a species-specific mortality. Biological Conservation 95: 353–359.

Janss, G.F.E. and Ferrer, M. 1998. Rate of bird collision with power lines: effects of conductor-marking and static wire-marking. Journal of Field Ornithology 69: 8-17.

Jenkins, A.R., Smallie, J.J. and Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 20: 263-278.

Jenkins, A.R., Shaw, J.M., Smallie, J.J., Gibbons, B., Visagie, R. and Ryan, P.G. 2011. Estimating the impacts of power line collisions on Ludwig's Bustards *Neotis ludwigii*. Bird Conservation International 21: 303 – 310.

Kruger, R. 1999. Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa. M.Phil. mini-thesis. University of the Orange Free State. Bloemfontein.

Ledger, J.A. and Annegarn, H.J. 1981. Electrocution Hazards to the Cape Vulture *(Gyps coprotheres)* in South Africa. Biological Conservation 20: 15-24.

Lehman, R.N. 2001. Raptor electrocution on power lines: current issues and outlook. Wildlife Society Bulletin 29: 804-813.

Lehman, R.N., Kennedy, P.L. and Savidge, J.A. 2007. The state of the art in raptor electrocution research: a global review. Biological Conservation 136: 159-174.

Martin, G.R. and Shaw, J.M. 2010. Bird collisions with power lines: failing to see the way ahead? Biological Conservation 143: 2695-2702.

Martin, G.R., Portugal, S.J. and Murn, C.P. 2012. Visual fields, foraging and collision vulnerability and *Gyps* vultures. Ibis 154: 626-631.

Mucina, L. and Rutherford, M.C. (Eds.) 2006. The Vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Prinsen, H.A.M., Boere, G.C., Píres, N. and Smallie, J.J. (Eds.) 2011. Review of the conflict between migratory birds and electricity power grids in the African-Eurasian region. CMS Technical Series/AEWA Technical Series, Bonn.

Raab, R., Spakovszky, P., Julius, E., Schütz, C. and Schulze, C.H. 2011a. Effects of power lines on flight behaviour of the West-Pannonian Great Bustard *Otis tarda* population. Bird Conservation International 21:142-155.

Raab, R., Schütz, C., Spakovszky, P., Julius, E. and Schulze, C.H. 2011b. Underground cabling and marking of power lines: conservation measures rapidly reduced mortality of West-Pannonian Great Bustards *Otis tarda*. Bird Conservation International 22: 299-306.

Schutgens, M., Shaw, J.M. and Ryan, P.G. In review. Estimating scavenger and search bias for collision mortality surveys of large birds on power lines in the Karoo, South Africa. Journal of Field Ornithology.

Senyatso, K.J. 2011. Conserving widely distributed wildlife species in an African savannah: parks, cattle-grazing and community-managed areas. PhD thesis, University of East Anglia, Norwich.

Senyatso, K.J., Collar, N.J. and Dolman, P.M. 2012. Assessing range-wide conservation status change in an unmonitored widespread African bird species. Diversity and Distributions 19: 106-119.

Shaw, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. PhD Thesis, University of Cape Town, Cape Town.

Shaw, J.M., Jenkins, A.R., Smallie, J.J. and Ryan, P.G. 2010. Modelling power-line collision risk for the Blue Crane *Anthropoides paradiseus* in South Africa. Ibis 152: 590-599.

Shaw, J.M., van der Merwe, R., van der Merwe, E. and Ryan, P.G. In prep. Camera traps reveal high winter scavenging rates under power lines in the Karoo.

Silva, J.P., Santos, M., Queirós, L., Leitão, D., Moreira, F., Pinto, M., Leqoc, M., and Cabral, J.A. 2010. Estimating the influence of overhead transmission power lines and landscape context on the density of Little Bustard *Tetrax tetrax* breeding populations. Ecological Modelling 221: 1954-1963.

South African Bird Atlas Project 2 (SABAP 2). 2013. Downloaded from http://sabap2.adu.org.za/ in April 2013.

South African National Biodiversity Institute (SANBI). 2011. National Freshwater Ecosystem Priority Areas Map. CSIR, Stellenbosch.

Taylor, P.B., Navarro, R.A., Wren-Sargent, M., Harrison, J.A. and Kieswetter, S.L. 1999. TOTAL CWAC Report: Coordinated Waterbird Counts in South Africa, 1992 – 1997. Avian Demography Unit, Cape Town.

van Rooyen, C.S. and Ledger, J.A. 1999. Birds and utility structures: developments in southern Africa. In: Ferrer, M. and Janss, G.F.E. (Eds.) Birds and Power Lines. Collision, Electrocution and Breeding: pages 205-230. Servicios Informativos Ambientales/Quercus, Madrid.

Young, D.J., Harrison, J.A., Navarro, R.A., Anderson, M.D. and Colahan, B.D. (Eds.) 2003. Big Birds on Farms: Mazda CAR Report 1993-2001. Avian Demography Unit, University of Cape Town, Cape Town.

APPENDIX 1. Criteria against which impacts are assessed

To determine the significance ranking, the following ranking (or similar) should be applied to each impact identified:

SIGNIFICANCE RANKING MATRIX

RANKING	MAGNITUDE	REVERSIBILITY	EXTENT	DURATION	PROBABILITY
5	Very high/ don't know	Irreversible	International	Permanent	Certain/inevitable
4	High		National	Long term (impact ceases after operational life of asset	Almost certain
3	Moderate	Reversibility with human intervention	Provincial	Medium term	Can occur
2	Low		Local	Short term	Unusual but possible
1	Minor	Completely reversible	Site bound	Immediate	Extremely remote
0	None		None		None

Significance= Consequence (Magnitude+ Duration+ Extent + Reversibility) X Probability wherein the following meaning applies:

- The **Magnitude** of the impact, which will be quantified as either:
  - Low: Will cause a low impact on the environment;
  - Moderate: Will result in the process continuing but in a controllable manner;
  - High: Will alter processes to the extent that they temporarily cease; and
  - Very High: Will result in complete destruction and permanent cessation of processes.

- The **Probability,** which shall describe the likelihood of impact occurring and will be rated as follows:
  - Extremely remote: Which indicates that the impact will probably not happen;
  - Unusual but Possible: Distinct possibility of occurrence;
  - Can Occur: there is a possibility of occurrence;
  - Almost Certain: Most likely to occur; and
  - Certain/ Inevitable: Impact will occur despite any preventative measures put in place.

- The duration **(Exposure)**, wherein it will be indicated whether:
  - The impact will be immediate;
  - The impact will be of a short tem (Between 0-5 years);
  - The impact will be of medium term (between 5-15 years);
  - The impact will be long term (15 and more years); and
  - The impact will be permanent.

- **Reversibility/ Replaceability,** which is the degree at which the impact can be reversible or the lost resource can be replaced.

APPENDIX 2. SABAP 1 and SABAP 2 bird lists.

Common name	Scientific name	SABAP1	SABAP2
Avocet, Pied	*Recurvirostra avosetta*	X	X
Barbet, Acacia Pied	*Tricholaema leucomelas*	X	X
Batis, Pririt	*Batis pririt*	X	X
Bee-eater, European	*Merops apiaster*	X	X
Bee-eater, Swallow-tailed	*Merops hirundineus*	X	X
Bishop, Southern Red	*Euplectes orix*	X	X
Bokmakierie, Bokmakierie	*Telophorus zeylonus*	X	X
Brubru, Brubru	*Nilaus afer*	X	
Bulbul, African Red-eyed	*Pycnonotus nigricans*	X	X
Bunting, Cape	*Emberiza capensis*	X	X
Bunting, Lark-like	*Emberiza impetuani*	X	X
Bustard, Kori	*Ardeotis kori*	X	X
Bustard, Ludwig's	*Neotis ludwigii*	X	X
Buzzard, Jackal	*Buteo rufofuscus*	X	X
Buzzard, Steppe	*Buteo vulpinus*	X	X
Canary, Black-headed	*Serinus alario*	X	X
Canary, Black-throated	*Crithagra atrogularis*	X	X
Canary, White-throated	*Crithagra albogularis*	X	X
Canary, Yellow	*Crithagra flaviventris*	X	X
Chat, Anteating	*Myrmecocichla formicivora*	X	X
Chat, Familiar	*Cercomela familiaris*	X	X
Chat, Karoo	*Cercomela schlegelii*	X	X
Chat, Sickle-winged	*Cercomela sinuata*	X	X
Chat, Tractrac	*Cercomela tractrac*	X	X
Cisticola, Desert	*Cisticola aridulus*	X	
Cisticola, Grey-backed	*Cisticola subruficapilla*	X	X
Cisticola, Levaillant's	*Cisticola tinniens*	X	
Cliff-Swallow, South African	*Hirundo spilodera*	X	
Coot, Red-knobbed	*Fulica cristata*	X	X
Cormorant, Reed	*Phalacrocorax africanus*	X	
Cormorant, White-breasted	*Phalacrocorax carbo*	X	
Courser, Burchell's	*Cursorius rufus*	X	X
Courser, Double-banded	*Rhinoptilus africanus*	X	X
Crane, Blue	*Anthropoides paradiseus*	X	
Crombec, Long-billed	*Sylvietta rufescens*	X	X
Crow, Cape	*Corvus capensis*	X	X
Crow, Pied	*Corvus albus*	X	X
Cuckoo, Diderick	*Chrysococcyx caprius*	X	

Cuckoo, Jacobin	*Clamator jacobinus*	X	
Darter, African	*Anhinga rufa*	X	
Dove, Laughing	*Streptopelia senegalensis*	X	X
Dove, Namaqua	*Oena capensis*	X	X
Dove, Red-eyed	*Streptopelia semitorquata*	X	X
Dove, Rock	*Columba livia*	X	X
Drongo, Fork-tailed	*Dicrurus adsimilis*	X	
Duck, Maccoa	*Oxyura maccoa*	X	
Duck, Mallard	*Anas platyrhynchos*		X
Duck, Yellow-billed	*Anas undulata*	X	X
Eagle, Booted	*Aquila pennatus*	X	X
Eagle, Martial	*Polemaetus bellicosus*	X	X
Eagle, Tawny	*Aquila rapax*		
Eagle, Verreaux's	*Aquila verreauxii*	X	
Eagle-Owl, Cape	*Bubo capensis*	X	
Eagle-Owl, Spotted	*Bubo africanus*	X	X
Egret, Cattle	*Bubulcus ibis*	X	
Egret, Little	*Egretta garzetta*	X	
Eremomela, Karoo	*Eremomela gregalis*	X	X
Eremomela, Yellow-bellied	*Eremomela icteropygialis*	X	X
Falcon, Lanner	*Falco biarmicus*	X	X
Falcon, Pygmy	*Polihierax semitorquatus*	X	X
Finch, Red-headed	*Amadina erythrocephala*	X	X
Finch, Scaly-feathered	*Sporopipes squamifrons*	X	X
Fiscal, Common	*Lanius collaris*	X	X
Fish-Eagle, African	*Haliaeetus vocifer*	X	
Flamingo, Greater	*Phoenicopterus ruber*	X	X
Flamingo, Lesser	*Phoenicopterus minor*	X	
Flycatcher, Chat	*Bradornis infuscatus*	X	X
Flycatcher, Fairy	*Stenostira scita*	X	X
Flycatcher, Fiscal	*Sigelus silens*	X	X
Flycatcher, Spotted	*Muscicapa striata*	X	X
Francolin, Grey-winged	*Scleroptila africanus*	X	
Goose, Egyptian	*Alopochen aegyptiacus*	X	X
Goose, Spur-winged	*Plectropterus gambensis*	X	X
Goshawk, Gabar	*Melierax gabar*	X	
Goshawk, Southern Pale Chanting	*Melierax canorus*	X	X
Grebe, Black-necked	*Podiceps nigricollis*	X	
Grebe, Little	*Tachybaptus ruficollis*	X	X
Greenshank, Common	*Tringa nebularia*	X	X
Guineafowl, Helmeted	*Numida meleagris*	X	X
Gull, Grey-headed	*Larus cirrocephalus*	X	
Hamerkop, Hamerkop	*Scopus umbretta*	X	
Harrier, Black	*Circus maurus*	X	

Harrier-Hawk, African	*Polyboroides typus*	X	
Heron, Black-headed	*Ardea melanocephala*	X	X
Heron, Goliath	*Ardea goliath*	X	
Heron, Grey	*Ardea cinerea*	X	X
Hoopoe, African	*Upupa africana*	X	X
Ibis, African Sacred	*Threskiornis aethiopicus*	X	X
Ibis, Glossy	*Plegadis falcinellus*	X	
Ibis, Hadeda	*Bostrychia hagedash*	X	X
Kestrel, Greater	*Falco rupicoloides*	X	X
Kestrel, Lesser	*Falco naumanni*		
Kestrel, Rock	*Falco rupicolus*	X	X
Kite, Black-shouldered	*Elanus caeruleus*	X	
Kite, Yellow-billed	*Milvus aegyptius*		X
Korhaan, Karoo	*Eupodotis vigorsii*	X	X
Korhaan, Northern Black	*Afrotis afraoides*		X
Lapwing, Blacksmith	*Vanellus armatus*	X	X
Lapwing, Crowned	*Vanellus coronatus*	X	X
Lark, Benguela Long-billed	*Certhilauda benguelensis*	X	
Lark, Cape Clapper	*Mirafra apiata*	X	X
Lark, Cape Long-billed	*Certhilauda curvirostris*	X	
Lark, Clapper	*Mirafra apiata*	X	
Lark, Eastern Clapper	*Mirafra fasciolata*	X	
Lark, Eastern Long-billed	*Certhilauda semitorquata*	X	
Lark, Fawn-coloured	*Calendulauda africanoides*	X	X
Lark, Karoo Long-billed	*Certhilauda subcoronata*	X	X
Lark, Large-billed	*Galerida magnirostris*	X	X
Lark, Longbilled	*Mirafra curvirostris*	X	
Lark, Red	*Calendulauda burra*	X	X
Lark, Red-capped	*Calandrella cinerea*	X	X
Lark, Sabota	*Calendulauda sabota*	X	X
Lark, Sclater's	*Spizocorys sclateri*	X	X
Lark, Spike-heeled	*Chersomanes albofasciata*	X	X
Lark, Stark's	*Spizocorys starki*	X	X
Lovebird, Rosy-faced	*Agapornis roseicollis*	X	X
Marsh-harrier, African	*Circus ranivorus*		
Martin, Brown-throated	*Riparia paludicola*	X	X
Martin, Rock	*Hirundo fuligula*	X	X
Masked-Weaver, Southern	*Ploceus velatus*	X	X
Moorhen, Common	*Gallinula chloropus*	X	X
Mousebird, Red-faced	*Urocolius indicus*	X	X
Mousebird, White-backed	*Colius colius*	X	X
Neddicky, Neddicky	*Cisticola fulvicapilla*		X
Nightjar, Fiery-necked	*Caprimulgus pectoralis*	X	
Nightjar, Rufous-cheeked	*Caprimulgus rufigena*	X	X

Ostrich, Common	*Struthio camelus*	X	
Owl, Barn	*Tyto alba*	X	
Paradise-Flycatcher, African	*Terpsiphone viridis*	X	
Penduline-Tit, Cape	*Anthoscopus minutus*	X	X
Pigeon, Speckled	*Columba guinea*	X	X
Pipit, African	*Anthus cinnamomeus*	X	X
Plover, Chestnut-banded	*Charadrius pallidus*	X	
Plover, Grey	*Pluvialis squatarola*	X	
Plover, Kittlitz's	*Charadrius pecuarius*	X	
Plover, Three-banded	*Charadrius tricollaris*	X	X
Pochard, Southern	*Netta erythrophthalma*	X	
Prinia, Black-chested	*Prinia flavicans*	X	X
Prinia, Karoo	*Prinia maculosa*	X	X
Quail, Common	*Coturnix coturnix*	X	
Quelea, Red-billed	*Quelea quelea*	X	X
Raven, White-necked	*Corvus albicollis*		X
Reed-Warbler, African	*Acrocephalus baeticatus*	X	X
Robin-Chat, Cape	*Cossypha caffra*		X
Rock-Thrush, Short-toed	*Monticola brevipes*	X	
Roller, European	*Coracias garrulus*	X	
Ruff, Ruff	*Philomachus pugnax*	X	
Sanderling, Sanderling	*Calidris alba*	X	
Sandgrouse, Namaqua	*Pterocles namaqua*	X	X
Sandpiper, Common	*Actitis hypoleucos*	X	
Sandpiper, Curlew	*Calidris ferruginea*	X	
Sandpiper, Marsh	*Tringa stagnatilis*	X	
Sandpiper, Wood	*Tringa glareola*	X	X
Scimitarbill, Common	*Rhinopomastus cyanomelas*	X	
Scops-Owl, Southern White-faced	*Ptilopsus granti*	X	
Scrub-Robin, Kalahari	*Cercotrichas paena*		X
Scrub-Robin, Karoo	*Cercotrichas coryphoeus*	X	X
Secretarybird, Secretarybird	*Sagittarius serpentarius*	X	
Shelduck, South African	*Tadorna cana*	X	X
Shoveler, Cape	*Anas smithii*	X	
Shrike, Lesser Grey	*Lanius minor*	X	X
Shrike, Red-backed	*Lanius collurio*	X	
Snake-Eagle, Black-chested	*Circaetus pectoralis*	X	X
Sparrow, Cape	*Passer melanurus*	X	X
Sparrow, House	*Passer domesticus*	X	X
Sparrow-Weaver, White-browed	*Plocepasser mahali*	X	X
Sparrowlark, Black-eared	*Eremopterix australis*	X	X
Sparrowlark, Chestnut-backed	*Eremopterix leucotis*	X	
Sparrowlark, Grey-backed	*Eremopterix verticalis*	X	X
Spoonbill, African	*Platalea alba*	X	X

Spurfowl, Cape	*Pternistis capensis*	X	
Starling, Cape Glossy	*Lamprotornis nitens*	X	
Starling, Common	*Sturnus vulgaris*	X	X
Starling, Pale-winged	*Onychognathus nabouroup*	X	X
Starling, Pied	*Spreo bicolor*	X	X
Starling, Wattled	*Creatophora cinerea*	X	
Stilt, Black-winged	*Himantopus himantopus*	X	X
Stint, Little	*Calidris minuta*	X	
Stonechat, African	*Saxicola torquatus*	X	X
Stork, Abdim's	*Ciconia abdimii*	X	
Stork, Black	*Ciconia nigra*	X	X
Stork, White	*Ciconia ciconia*	X	
Sunbird, Dusky	*Cinnyris fuscus*	X	X
Sunbird, Malachite	*Nectarinia famosa*	X	X
Sunbird, Southern Double-collared	*Cinnyris chalybeus*	X	X
Swallow, Barn	*Hirundo rustica*	X	X
Swallow, Greater Striped	*Hirundo cucullata*	X	X
Swallow, Pearl-breasted	*Hirundo dimidiata*	X	
Swallow, White-throated	*Hirundo albigularis*	X	X
Swamp-Warbler, Lesser	*Acrocephalus gracilirostris*	X	
Swift, Alpine	*Tachymarptis melba*	X	
Swift, Bradfield's	*Apus bradfieldi*	X	
Swift, Common	*Apus apus*	X	X
Swift, Little	*Apus affinis*	X	X
Swift, White-rumped	*Apus caffer*	X	X
Teal, Cape	*Anas capensis*	X	X
Teal, Hottentot	*Anas hottentota*	X	
Teal, Red-billed	*Anas erythrorhyncha*	X	X
Tern, White-winged	*Chlidonias leucopterus*	X	
Thick-knee, Spotted	*Burhinus capensis*	X	X
Thrush, Karoo	*Turdus smithi*	X	X
Thrush, Olive	*Turdus olivaceus*	X	
Tit, Ashy	*Parus cinerascens*	X	X
Tit, Grey	*Parus afer*	X	X
Tit-Babbler, Chestnut-vented	*Parisoma subcaeruleum*	X	X
Tit-Babbler, Layard's	*Parisoma layardi*	X	X
Turnstone, Ruddy	*Arenaria interpres*	X	
Turtle-Dove, Cape	*Streptopelia capicola*	X	X
Vulture, Lappet-faced	*Torgos tracheliotos*		
Vulture, White-backed	*Gyps africanus*		
Wagtail, African Pied	*Motacilla aguimp*	X	
Wagtail, Cape	*Motacilla capensis*	X	X
Warbler, Cinnamon-breasted	*Euryptila subcinnamomea*	X	
Warbler, Namaqua	*Phragmacia substriata*	X	X

Warbler, Rufous-eared	*Malcorus pectoralis*	X	X
Warbler, Willow	*Phylloscopus trochilus*	X	
Waxbill, Common	*Estrilda astrild*	X	
Weaver, Cape	*Ploceus capensis*	X	X
Weaver, Sociable	*Philetairus socius*	X	X
Wheatear, Capped	*Oenanthe pileata*	X	X
Wheatear, Mountain	*Oenanthe monticola*	X	X
White-eye, Cape	*Zosterops pallidus*	X	
White-eye, Cape	*Zosterops virens*	X	
White-eye, Orange River	*Zosterops pallidus*	X	
Whydah, Pin-tailed	*Vidua macroura*	X	
Woodpecker, Cardinal	*Dendropicos fuscescens*	X	