

SPIITSKOP WIND ENERGY FACILITY

Avian impact assessment

- Scoping Phase -



EXECUTIVE SUMMARY

This study contains an extensive review of relevant literature on wind energy facility impacts on avifauna, and identifies potential impacts of the proposed Spitskop Wind Energy Facility on the avifauna of the area. These expected impacts are: habitat destruction by construction of the facility itself and any associated power lines or substation/s, disturbance by both activities and possible displacement or disturbance of sensitive species by the operation of the facility, collision with blades of the wind turbines and other associated infrastructure.

From the desk-top study undertaken, it is expected that the impact zone of the proposed wind energy facility features hilly, lightly wooded, grassy Karoo vegetation, with tall thicket on the slopes of the Little and Great Fish Rivers which traverse the site, and various wetlands, including the rivers themselves and their tributaries. The area is likely to support over 290 bird species, including 21 red-listed species, 72 endemics, and six red-listed endemics. Seasonal influxes of Ludwig's Bustard *Neotis ludwigii*, Denham's Bustard *Neotis denhami* and Kori Bustard *Ardeotis kori*, flocks or breeding pairs of Blue Crane *Anthropoides paradiseus* and Grey-crowned Crane *Balearica regulorum*, and a range of locally resident or visiting raptors (possibly including Cape Vulture *Gyps coprotheres*, Martial Eagle *Polemaetus bellicosus*, African Crowned Eagle *Stephanoeatus coronatus*, Secretarybird *Sagittarius serpentarius*, Black Harrier *Circus maurus*, Lesser Kestrel *Falco naumanni*, Peregrine Falcon *Falco peregrinus* and Lanner Falcon *F. biarmicus*) foraging or moving through the area, and a suite of smaller, restricted range endemics, possibly including Knysna Woodpecker *Campethera notata* and Melodius Lark *Mirafra cheniana*, are the species of greatest conservation significance which may be impacted by the wind energy facility, both in terms of the collision and disturbance impacts of the facility itself, and of the disturbance and mortality risks posed by its peripheral infrastructure.

These issues will be investigated in more detail during the EIA phase. In particular the significance of bird collisions with the wind turbines will be assessed in order to determine whether the risk warrants mitigation. The significance of this impact will depend mainly on the relative abundance of certain key species, and the distribution of their respective microhabitats. The result of the EIA phase will be a more detailed assessment of all impacts, recommended mitigation where necessary, and the outline for a recommended, comprehensive programme to fully monitor the actual impacts of the wind energy facility throughout construction and well into its operational phase.

CONSULTANT'S DECLARATION OF INDEPENDENCE

Andrew Jenkins (*AVISENSE* Consulting cc) is an independent consultant to Savannah Environmental Pty (Ltd) and Renewable Energy Systems Southern Africa (RES SA). He has no business, financial, personal or other interest in the activity, application or appeal in respect of which they were appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work.

1. INTRODUCTION

Renewable Energy Systems Southern Africa (RES SA) is proposing to establish a commercial wind energy facility (WEF) (project name 'Spitskop Wind Energy Facility') as well as associated infrastructure on a site located approximately 6 km north-west of Riebeek-East, and 15 km north-west of Alicedale, in the Eastern Cape Province, South Africa (Fig. 1). Savannah Environmental Pty (Ltd) was appointed to compile the Environmental Impact Assessment (EIA) report for this project, and subsequently appointed *AVISENSE* Consulting to conduct the specialist avifaunal assessment. The study was conducted by Dr Andrew Jenkins, an ornithologist with over 20 years of experience in avian research and impact assessment work. He has been involved in the design and/or execution of many of the completed EIA and EMP studies for wind energy facilities in South Africa to date, including the only two operational facilities at Darling and Klipheuwel, Western Cape Province.

2. TERMS OF REFERENCE

The terms of reference for the scoping phase, as supplied by Savannah Environmental (Pty) Ltd, were to provide:

- A description of the affected environment and the manner in which it may be affected.
- A description and evaluation of the avian issues and impacts identified, including detail on the nature and extent of any potential direct, indirect and cumulative impacts.
- A statement on the potential significance of identified issues based on the above evaluation.
- A comparative evaluation of any identified, feasible alternatives.
- Identification of any potentially significant impacts which will require particular attention in the EIA phase, with recommendations on the methodology to be adopted in assessing such, expressed as a Plan of Study for the EIA.

3 STUDY METHODOLOGY

3.1. Approach

This desktop study included the following steps:

- A review of available published and unpublished literature pertaining to bird interactions with wind energy facilities is provided summarising the issues involved and the current level of knowledge in this field. Various information sources (listed below), including data on the birdlife of the area and previous studies of bird interactions with wind energy facility and electricity infrastructure, were examined.
- An inclusive, annotated list of the avifauna likely to occur within the impact zone of the proposed wind energy facility was compiled using a combination of the existing distributional data and previous experience/knowledge of the avifauna of the general area.
- A short-list of priority bird species (defined in terms of conservation status and endemism) which could possibly be impacted by the proposed wind energy facility was extracted from the total bird list. These species were subsequently considered as adequate surrogates for the local avifauna generally, and mitigation of impacts on these species was considered likely to accommodate any less important bird populations that may also potentially be affected.
- A summary of more likely and significant impacts of the wind energy facility on the local avifauna was drawn up, and a brief methodology was devised for the EIA phase for confirming these impacts and developing an effective mitigation strategy.

3.2. Data sources used

The following data sources and reports were used in the compilation of this report:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP – Harrison *et al.* 1997) were obtained from the Animal Demography Unit website (<http://sabap2.adu.org.za/index.php>) for the relevant quarter-degree squares (SABAP 1: 3325BB Kommadagga and 3326AA Riebeek-Oos) or pentads (SABAP 2: 3300_2540, 3300_2545, 3300_2550, 3300_2555, 3300_2600, 3300_2605, 3300_2610, 3305_2540, 3305_2545, 3305_2550, 3305_2555, 3305_2600, 3305_2605 and 3305_2610). A composite list of species likely to occur in the impact zone of the wind energy facility was drawn up as a combination of these data, refined by a more specific assessment of the actual habitats affected, based on general knowledge of the avifauna of the region (APPENDIX 1).
- Conservation status and endemism of all species considered likely to occur in the area was determined as per the most recent iteration of the national Red-list for birds (Barnes 2000), and the most recent and comprehensive summary of southern African bird biology (Hockey *et al.* 2005).
- Data from the Animal Demography Unit's Coordinated Avifaunal Roadcount project (CAR: <http://car.adu.org.za/>, Young *et al.* 2003).

- EIA reports and any subsequent monitoring reports on the potential impacts on birds of other proposed and/or constructed and operational wind energy facilities in South Africa (van Rooyen 2001, Jenkins 2001, 2003, Küyler 2004, Jenkins 2008a, 2009).

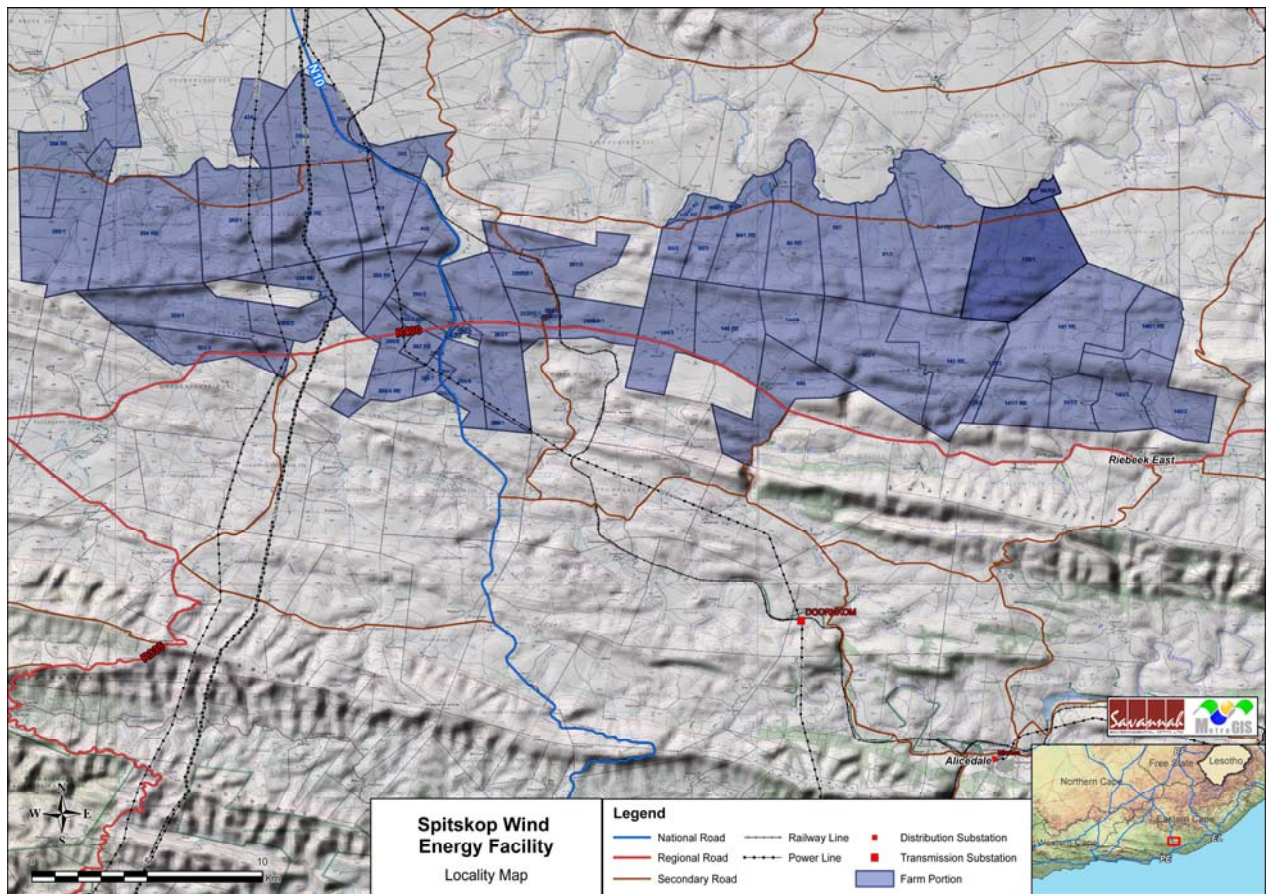


FIGURE 1. Location of the proposed Spitskop Wind Energy Facility.

3.3. Limitations & assumptions

Any inaccuracies in the above sources of information could limit this study. The SABAP 1 data for this area was quite sparse (only 76 cards submitted for the two relevant quarter-degree squares combined) and is now >15 years old (Harrison *et al.* 1997), and there is presently only seventeen SABAP 2 cards available for the 14 relevant pentads. This deficiency will be rectified to some extent in a visit to the site as part of the EIA phase of this study.

Given that there are currently only three, very small wind energy facilities operative in South Africa (Coega, Klipheuwel and Darling, currently numbering only 1, 3 and 4 operational turbines respectively), practical experience of the environmental effects of wind energy facilities in this country is extremely limited, and we must base our estimates of the possible impacts of new facilities farms largely on lessons learnt

internationally. While many of the established, general principles can probably be usefully applied here, care should be taken in adapting international knowledge and experience to uniquely South African birds and conditions.

4. BACKGROUND TO THE STUDY

4.1 Interactions between wind energy facilities and birds

Recent literature reviews (www.nrel.gov), Kingsley & Whittam 2005, Drewitt & Langston 2006, Kuvlevsky *et al.* 2007, Stewart *et al.* 2007, Drewitt & Langston 2008, Krijgsveld *et al.* 2009, Sovacool 2009) are essential summaries and sources of information in this field. While the number of comprehensive, longer-term analyses of the effects of wind energy facilities on birds is increasing, and the body of empirical data describing these effects is rapidly growing, scientific research in this field is still in its infancy (Madders & Whitfield 2006, Stewart *et al.* 2007), and much of the available information originates from short-term, unpublished, descriptive studies, most of which have been carried out in the United States, and more recently across western Europe, where wind power generation is a more established and developed industry.

Concern about the impacts of wind facilities on birds first arose in the 1980s when numerous raptor mortalities were detected at facilities at Altamont Pass Wind Resource Area (California, USA) and Tarifa (southern Spain). More recently, there has been additional concern about the degree to which birds avoid or are excluded from the areas occupied by wind energy facilities – either because of the visible action of the turbine blades or because of the noise they generate - and hence suffer a loss of habitat (Larsen & Guillemette 2007, Stewart *et al.* 2007, Devereaux *et al.* 2008, Pearce-Higgins *et al.* 2009). With a few important exceptions, most studies completed to date suggest low absolute numbers of bird fatalities at wind energy facilities (Kingsley & Whittam 2005), and low casualty rates relative to other existing sources of anthropogenic avian mortality on a per structure basis (Crockford 1992, Colson & associates 1995, Gill *et al.* 1996, and Erickson *et al.* 2001).

4.1.1 Collisions with turbines

Collision rates

As more monitoring has been conducted at a growing number of sites, some generic standards and common units have been established, with bird collisions with turbine blades generally measured in mortalities/turbine/year, mortalities/Mega-Watt/year, or mortalities /Giga-Watt Hour (Smallwood & Thelander 2008, Sovacool 2009). Wherever possible, measured collision rates should allow for (i) casualty remains which are not

detected by observers (searcher efficiency - Newton & Little 2009), and (ii) casualties which are removed by scavengers before detection, and the rate at which this occurs (scavenger removal rate). Also, although collision rates may appear relatively low in many instances, cumulative effects over time, especially when applied to large, long lived, slow reproducing and/or threatened species (many of which are collision-prone), may be of considerable conservation significance.

The National Wind Co-ordinating Committee (2004) estimates that 2.3 birds are killed per turbine per year in the US outside of California – correcting for searcher efficiency and scavenger rates. However, this index ranges from as low as 0.63 mortalities/turbine/year in Oregon, to as high as 10 mortalities/turbine/year in Tennessee (NWCC 2004), illustrating the wide variance in mortality rates between sites. Curry & Kerlinger (2000) found that only 13% of the >5000 turbines at Altamont Pass, California were responsible for all Golden Eagle *Aquila chrysaetos* and Red-tailed Hawk *Buteo jamaicensis* collisions, but the most recent aggregate casualty estimates for Altamont run to >1000 raptor mortalities/turbine/year, and nearly 3000 mortalities/turbine/year overall (Smallwood & Thelander 2008), including >60 Golden Eagles, and at a mean rate of about 2-4 mortalities/MW/year.

At the Tarifa and Navarre wind energy facilities on the Straits of Gibraltar, southern Spain, about 0.04-0.08 birds are killed per turbine/year (Janss 2000a, de Lucas *et al.* 2008), with relatively high collision rates for threatened raptors such as Griffon Vulture *Gyps fulvus*, of particular concern (Table 1). At the same sites, collisions have also been found to be non-randomly distributed between turbines, with >50% of the vulture casualties recorded at Tarifa being killed by only 15% of the turbine array at the facility (Acha 1997). Collision rates from other European sites are equally variable, with certain locations sporadically problematic (Everaert 2003, Newton & Little 2009, Table 1).

To date, only eight wind turbines have been constructed in South Africa at two pilot wind energy facilities at Klipheuvel and Darling in the Western Cape (van Rooyen 2001, Jenkins 2001, 2003) and, more recently, one turbine in the first phase of a proposed bigger development at Coega in the Eastern Cape. An avian mortality monitoring program was established at the Klipheuvel facility once the turbines were operational, involving regular site visits to monitor both bird traffic through the area and detect bird mortalities (Küyler 2004). This study found that (i) 30% (range 9-57%) of the birds observed within 500m of the turbines were flying at blade height, and (ii) 6% (range 0-32%) of birds sighted were flying either between the turbines or within the arc of the rotors of the outermost turbines. Five bird carcasses were found on the three-turbine site during the 8-month monitoring period, of which two, a Horus Swift *Apus horus* and a Large-billed Lark *Galerida magnirostris*, were thought to have been killed by collision with turbine blades, indicating a net collision rate for birds of about 1.00 mortality/turbine/year. It is important to note here that simple estimates of aggregate

collision rates for birds are not an adequate expression of biodiversity impact. Rather, consideration must be given to the conservation status of the species affected or potentially affected, and the possibility that even relatively low collision rates for some threatened birds may not be sustainable in the long term.

Causes of collision

Multiple factors influence the number of birds killed at wind energy facilities. These can be classified into three broad groupings: (i) avian variables, (ii) location variables, and (iii) facility-related variables. Although only one study has so far shown a direct relationship between the abundance of birds in an area and the number of collisions (Everaert 2003), it would seem logical to assume that the more birds there are flying through an array of turbines, the higher the chances of a collision occurring. The nature of the birds present in the area is also very important as some species are more vulnerable to collision with turbines than others, and feature disproportionately frequently in collision surveys (Drewitt & Langston 2006, 2008, de Lucas *et al.* 2008). Species-specific variation in behaviour, from general levels of activity to particular foraging or commuting strategies, also affect susceptibility to collision (Barrios & Rodríguez 2004, Smallwood *et al.* 2009). There may also be seasonal and temporal differences in behaviour, for example breeding males displaying may be particularly at risk.

Landscape features can potentially channel birds towards a certain area, and in the case of raptors, influence their flight and foraging behaviour. Ridges and steep slopes are important factors in determining the extent to which an area is used by gliding and soaring birds (Barrios & Rodríguez 2004). High densities of prey will attract raptors, increasing the time spent hunting, and as a result reducing the time spent being observant. Poor weather affects visibility. Birds fly lower during strong headwinds (Hanowski & Hawrot 2000, Richardson 2000), so when the turbines are functioning at their maximum speed, birds are likely to be flying at their lowest, exponentially increasing collision risk (Drewitt & Langston 2006, 2008).

Table 1. Results of recent published studies of the effects of wind energy facilities on local avifauna.

Location	<i>n</i> wind farm/s assessed	Turbine hub height (m)	<i>n</i> turbines	Habitat	Bird groups assessed	Evidence of displacement?	Collision rate (birds/turbine/year)	Reference
Tarifa, Southern Spain	2	18-36	66-190	Hilly woodland	Raptors	N/A	Raptors = 0.27, Griffon Vultures = 0.12	Barrios & Rodríguez 2004
Tarifa, Southern Spain	2	28-36	66-190	Hilly woodland	Raptors	N/A	0.04-0.07, mostly Griffon Vultures	de Lucas <i>et al.</i> 2008
East Anglia, UK	2	60	8	Croplands	Gamebirds, corvids, larks and see-eaters	Minimal, only gamebirds significantly affected	N/A	Devereaux <i>et al.</i> 2008
Altamont Pass, California	1	14-43	5400	Hilly grassland	Various	N/A	4.67, raptors = 1.94	Smallwood & Thelander 2008
Southern Spain	1	44	16	Hilly woodland	Various	Yes, >75% reduction in raptor sightings	0.03	Farfán <i>et al.</i> 2009
Netherlands	3	67-78	7-10	Farmland	Various	N/A	27.0-39.0	Krijgsveld <i>et al.</i> 2009
Northumberland, UK	1	30	9	Coastal	Seabirds	N/A	16.5-21.5, mostly large gulls	Newton & Little 2009
N England & Scotland	12	30-70	14-42	Moorland	Gamebirds, shorebirds, raptors, passerines	Yes, 53% reduction in Hen Harrier <i>Circus cyaneus</i> sightings, other species also decreased	N/A	Pearce-Higgins <i>et al.</i> 2009

Larger wind energy facilities, with more turbines, are almost by definition more likely to incur significant numbers of bird casualties (Kingsley & Whittam 2005), and turbine size may be proportional to collision risk, with taller turbines associated with higher mortality rates in some instances (e.g. de Lucas *et al.* 2009, but see Howell 1995, Erickson *et al.* 1999, Barclay *et al.* 2007), although with newer technology, fewer, larger turbines are needed to generate equivalent or even greater quantities of power, possibly resulting in fewer collisions per Megawatt of power produced (Erickson *et al.* 1999). Certain turbine tower structures, and particularly the old-fashioned lattice designs, present many potential perches for birds, increasing the likelihood of collisions occurring as birds land at or leave these perch or roost sites. This generally is not a problem associated with more modern, tubular tower designs (Drewitt & Langston 2006, 2008), such as those proposed to be used for this project.

Illumination of turbines and other infrastructure is often associated with increased collision risk (Winkelman 1995, Erickson *et al.* 2001), either because birds moving long distances at night do so by celestial navigation, and may confuse lights for stars (Kemper 1964), or because lights attract insects, which in turn attract birds. Changing constant lighting to intermittent lighting has been shown to reduce nocturnal collision rates (Richardson 2000, APLIC 1994, Jaroslow 1979, Weir 1976) and changing flood-lighting from white to red can reduce mortality rates by up to 80% (Weir 1976).

Spacing between turbines at a wind facility can have an effect on the number of collisions. Some authors have suggested that paths should be left between turbines to allow free passage through the turbine strings (Drewitt & Langston 2006, Kuvlevsky *et al.* 2007, Drewitt & Langston 2008). This approach tallies well with wind energy generation principles, which require relatively large spaces between turbines in order to avoid wake and turbulence effects. An alternative perspective suggests that all attempts by birds to fly through wind energy facilities, rather than over or around them, should be discouraged to minimise collision risk (Drewitt & Langston 2006, Kuvlevsky *et al.* 2007, Drewitt & Langston 2008). This approach effectively renders the entire footprint of the facility as lost habitat (see below).

Collision prone birds

Collision prone birds are generally either (i) large species and/or species with high ratios of body weight to wing surface area (wing loading), which confers low maneuverability (cranes, bustards, vultures, gamebirds, waterfowl, falcons), (ii) species which fly at high speeds (gamebirds, pigeons and sandgrouse, swifts, falcons), (iii) species which are distracted in flight - predators or species with aerial displays (many raptors, aerial insectivores, some open country passerines), (iv) species which habitually fly in low light conditions, and (v) species with narrow fields of forward binocular vision (Drewitt & Langston 2006, 2008, Jenkins *et al.* 2010, Noguera *et al.* 2010). These traits confer high levels of *susceptibility*, which may be compounded by high levels of *exposure* to man-made obstacles such as overhead power lines

and wind turbine areas (Jenkins *et al.* 2010). Exposure is greatest in (i) very aerial species, (ii) species inclined to make regular and/or long distance movements (migrants, any species with widely separated resource areas - food, water, roost and nest sites), (iii) species that regularly fly in flocks (increasing the chances of incurring multiple fatalities in single collision incidents).

Soaring species may be particularly prone to colliding with wind turbines where the latter are placed along ridges to exploit the same updrafts favoured by such birds - vultures, storks, cranes, and most raptors - for cross-country flying (Erickson *et al.* 2001, Kerlinger & Dowdell 2003, Drewitt & Langston 2006, 2008, Jenkins *et al.* 2010, Noguera *et al.* 2010). Large soaring birds – for example, many raptors and storks - depend heavily on external sources of energy for sustainable flight (Pennycuik 1989). In terrestrial situations, this generally requires that they locate and exploit pockets or waves of rising air, either in the form of bubbles of vertically rising, differentially heated air – thermal soaring - or in the form of wind forced up over rises in the landscape, creating waves of rising turbulence – slope soaring.

Certain species are morphologically specialised for flying in open landscapes with high relief and strong prevailing winds, and are particularly dependent on slope soaring opportunities for efficient aerial foraging and travel. South African examples might include Bearded Vulture *Gypaetus barbatus* and Cape Vulture *Gyps coprotheres*, Verreaux's Eagle *Aquila verreauxii*, Jackal Buzzard *Buteo rufofuscus*, Rock Kestrel *Falco rupicolus*, Peregrine Falcon *Falco peregrinus*, Lanner Falcon *Falco biarmicus* and Black Stork *Ciconia nigra* and, to a lesser extent, most other open-country raptors. Such species are potentially threatened by wind energy developments where turbines are situated to exploit the wind shear created by hills and ridge-lines. In these situations, birds and industry are competing for the same wind resource, or a similar wind resource in the same general area (turbine arrays are generally positioned just off steep slopes to avoid turbulent, rising air and rather intercept accelerated, smooth, lateral flow; slope soaring raptors seek out and use both turbulent and smoothly flowing air to their advantage) and the risk that slope soaring birds will collide with the turbine blades, or else be prevented from using foraging habitat critical for their survival, is greatly increased. Evidence of these effects has been obtained from several operational wind energy facilities in other parts of the world – for example relatively high mortality rates of large eagles, buzzards and kestrels at Altamont Pass, California (>1100 raptors killed annually or 1.9 raptor casualties/MW/year, Smallwood & Thelander 2008), and of vultures and kestrels at Tarifa, Spain (0.15-0.19 casualties/turbine/year, Barrios & Rodríguez 2004, de Lucas *et al.* 2008, Table 1), and displacement of raptors generally in southern Spain (Farfán *et al.* 2009) and of large eagles in Scotland (Walker *et al.* 2005) – and one study has shown that the additive impact of wind farm mortality on an already threatened raptor could theoretically cause its localised extinction (Carrete *et al.* 2009).

Mitigating collision risk

The only direct way to reduce the risk of birds colliding with turbine blades is to make the blades more conspicuous and hence easier to avoid. Blade conspicuity is compromised by a phenomenon known as 'motion smear' or retinal blur, in which rapidly moving objects become less visible the closer they are to the eye (McIsaac 2001, Hodos 2002). The retinal image can only be processed up to a certain speed, after which the image cannot be perceived. This effect is magnified in low light conditions, so that even slow blade rotation can be difficult for birds to see.

Laboratory-based studies of visual acuity in raptors have determined that (i) visual acuity appears superior when objects are viewed at a distance, suggesting that the birds may view nearby objects with one visual field and objects further away with another, (ii) moderate motion of the visual stimulus significantly influences acuity, and kestrels may be unable to resolve all portions of an object such as a rotating turbine blade because of motion smear, especially under low contrast or dim lighting conditions, (iii) this deficiency can be addressed by patterning the blade surface in a way which maximises the time between successive stimulations of the same retinal region, and (v) the easiest, cheapest and most visible blade pattern for this purpose, effective across the widest variety of backgrounds, is a single black blade in an array of white blades (McIsaac 2001, Hodos 2002). Hence blade marking may be an important means to reduce collision rates by making the rotating turbine blades as conspicuous as possible under the least favourable visual conditions, particularly at facilities where raptors are known or likely to be frequent collision casualties.

Even if the turbine rotors are marked in this way, many species may still be susceptible to colliding with them, especially during strong winds (when the rotor speed is high and birds tend to fly low and with less control) and when visibility is poor (at night or in thick mist). All other collision mitigation options operate indirectly, by reducing the frequency with which collision prone species are exposed to collision risk. This is achieved mainly by (i) siting farms and individual turbines away from areas of high avifaunal density or aggregation, regular commute routes or hazardous flight behaviour, (ii) using low risk turbine designs and configurations, which discourage birds from perching on turbine towers or blades, and allow sufficient space for commuting birds to fly safely through the turbine strings, and (iii) carefully monitoring collision incidence, and being prepared to shut-down problem turbines at particular times or under particular conditions.

Effective mitigation can only be achieved with a commitment to rigorous pre- and post-construction monitoring (see below), ideally using a combination of occasional, direct observation of birds commuting or foraging through and around the wind energy facility, coupled with constant, remote tracking of avian traffic using specialised radar equipment (e.g.

see <http://www.detect-inc.com/wind.html>). Such systems can be programmed to set the relevant turbines to idle as birds enter a pre-determined danger zone around the turbine array, and to re-engage those turbines once the birds have safely passed.

4.1.2 Habitat loss – destruction, disturbance and displacement

Although the final, destructive footprint of most wind energy facilities is likely to be relatively small, the construction phase of development inevitably incurs quite extensive temporary damage or permanent destruction of habitat, which may be of lasting significance in cases where wind energy facility sites coincide with critical areas for restricted range, endemic and/or threatened species. Similarly, construction, and to a lesser extent ongoing maintenance activities, are likely to cause some disturbance of birds in the general surrounds, and especially of shy and/or ground-nesting species resident in the area. Mitigation of such effects requires that generic best-practice principles be rigorously applied - sites are selected to avoid the destruction of key habitats, and construction and final footprints, as well as sources of disturbance of key species, must be kept to an absolute minimum. Some studies have shown significant decreases in the numbers of certain birds in areas where wind energy facilities are operational as a direct result of avoidance of the noise or movement of the turbines (e.g. Larsen & Guillemette 2007, Farfán *et al.* 2009, Table 1), while others have shown decreases which may be attributed to a combination of collision casualties and avoidance or exclusion from the impact zone of the facility in question (Stewart *et al.* 2007). Such displacement effects are probably more relevant in situations where wind energy facilities are built in natural habitat (Pearce-Higgins *et al.* 2009, Madders & Whitfield 2006) than in more modified environments such as farmland (Devereaux *et al.* 2008), and are highly species-specific in operation.

Note that the only post-construction monitoring that has been done at a wind energy facility in South Africa located a successful Blue Crane *Anthropoides paradiseus* nest only 400 m from the operating turbine array at Klipheuwel (Küyler 2004).

4.1.3 Impacts of associated infrastructure

Infrastructure commonly associated with wind energy facilities may also have detrimental effects on birds. The construction and maintenance of substations, power lines, servitudes and roadways causes both temporary and permanent habitat destruction and disturbance, and overhead power lines pose a collision and possibly an electrocution threat to certain species (Van Rooyen 2004a, Lehman *et al.* 2007, Jenkins *et al.* 2010).

Construction and maintenance of power lines and substations

Some habitat destruction and alteration inevitably takes place during the construction of power lines, substations and associated roadways. Also, power line service roads or servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, and to prevent vegetation from intruding into the legally prescribed clearance gaps between the ground and the conductors. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, and retention of cleared servitudes can have the effect of altering bird community structure along the length of any given power line (e.g. King & Byers 2002).

Collision with power lines

Power lines pose at least an equally significant collision risk to wind turbines, probably affecting the same suite of collision prone species (Bevanger 1994, 1995, 1998, Janss 2000b, Anderson 2001, van Rooyen 2004a, Drewitt & Langston 2008, Jenkins *et al.* 2010). Mitigation of this risk involves the informed selection of low impact alignments for new power lines relative to movements and concentrations of high risk species, and the use of either static or dynamic marking devices to make the lines, and in particular the earthwires, more conspicuous. While various marking devices have been used globally, many remain largely untested in terms of their efficacy in reducing collision incidence, and those that have been fully assessed have all been found to be only partially effective (Drewitt & Langston 2008, Jenkins *et al.* 2010).

Electrocution on power infrastructure

Avian electrocutions occur when a bird perches or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004b, Lehman *et al.* 2007). Electrocution risk is strongly influenced by the voltage and design of the power lines erected (generally occurring on lower voltage infrastructure where air gaps are relatively small), and mainly affects larger, perching species, such as vultures, eagles and storks, easily capable of spanning the spaces between energised components. Mitigation of electrocution risk involves the use of bird-safe structures (ideally with critical air gaps >2 m), the physical exclusion of birds from high risk areas of live infrastructure, and comprehensive insulation of such areas (van Rooyen 2004b, Lehman *et al.* 2007).

4.2. Description of the proposed wind energy facility

The project is proposed on portions of the following properties (See Fig. 1): Farm Steenkampsberg 590; the Remainder of Farm Buffels Drift 61; Farm 597; Portion 1 of Farm 61 Junction Drift; Portion 2, 3, the remainder of Portion 1 and the remaining extent of Farm 60; Portion 2 and 3 of Farm Groot Fontein 138; Portion 1 and the remaining extent of Farm Bosch Fontein 143; Portion 2, 3 and the remainder of Portion 1 of Farm Groot Fontein 140; Portion 2, the remainder of Portion 1 and the remaining extent of Farm Ebenezer 141; Portion 3, 4 and the remaining extent of Farm 144; Portion 3 of Farm Modderfontein 302; Portion 1 and the remaining extent of Farm Bothas Hoop 358; the remaining extent of Farm Draai Van Klein Visch Rivier 254; Portion 1 and the remaining extent of Farm Gras Fonteyn 258; Farm Springbok Vlakte 434; Portion 3 and the remaining extent of Farm Driefontein 259; the remainder of Portion 1, the remainder of Portion 6 and Portion 11 of Farm Witte Poort 262 ; Portion 1 and Portion 2 of Farm Varkens Kuil 269; The remaining extent of Farm Brand Rug 268; Portion 1 of Farm Commadagga 264; Farm 369; Portion 2 and the remainder of Portion 1 of Farm Brakfontein 261; Portion 1 and Portion 3 of Farm Commadagga 263; Portion 2, Portion 6, Portion 7, Portion 8, the remainder of Portion 3, the remainder of Portion 4 and the remaining extent of Farm Commadagga 266; Farm Driefontein 436; the remaining extent of Farm 267; Portion 1, Portion 2 and the remaining extent of Farm 145. The site proposed for the facility falls within the Blue Crane Route and Makana Local Municipalities.

The site under investigation for the proposed Spitskop Wind Energy Facility covers an approximate area of 247 km². The facility is proposed to accommodate up to 420 MW which could comprise up to 200 wind turbines, each with a generating capacity of 1.8 - 3 MW (number of turbines is depending on the size of turbines; the bigger the installed capacity per turbine the smaller the number of turbines to be installed). Other infrastructure associated with the facility will include a substation/s to facilitate the connection between the wind energy facility and the Eskom electricity grid, foundations to support the turbine towers, cabling between the project components, to be laid underground where practical, an overhead power line possibly feeding into the Eskom electricity network at the existing Poseidon Substation, a network of internal access roads, and a workshop area for maintenance and storage.

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

5.1 Vegetation of the study area

The affected environment is located at an interface of the Lower Karoo and Albany Thicket Bioregions, within the Albany Thicket Biome (Mucina & Rutherford 2006). The natural vegetation is dominated by Albany Broken Veld (low mountain ridges with open, grassy karroid shrubland and low trees), with Kowie Thicket (tall thicket dominated by euphorbias) on the slopes south of the Fish River, Great Fish Thicket (short-tall thicket, with a tall tree component) on the slopes north of the river, and Southern Karoo Riviere (narrow, riverine flats with woody thicket, fringed with shrubs) along the river floodplain (Mucina & Rutherford 2005).

5.2 Avian microhabitats

These will be defined more accurately after a site visit during the EIA phase of the project, but are expected to comprise (i) extensive tracts of degraded, lightly wooded **grassland**, (ii) areas of thicker, thornveld **thicket**, including riparian strips, and (iii) a network of **wetlands**, including vleis, rivers and artificial impoundments. The course of the Fish Rivers, either within the study area or close to it, is likely to include small lines of cliffs that may support cliff-nesting species.

5.3 Avifauna of the impact area

Over 290 bird species are considered likely to occur within the anticipated, broader impact zone of the WEF (APPENDIX 1), including 72 endemic or near-endemic species, 21 red-listed species, and six species – Knysna Woodpecker *Campethera notata*, Ludwig's Bustard *Neotis ludwigii*, Blue Crane *Anthropoides paradiseus*, Cape Vulture *Gyps coprotheres*, Black Harrier *Circus maurus* and possibly Melodius Lark *Mirafra cheniana* which are both endemic and red-listed (Barnes 1998, 2000, Young *et al.* 2003). The site is located approximately 60 km south-west of the Katberg-Readsdale Forest Complex (Barnes 1998), approximately 60 km south of the Agieskloof Cape Vulture *Gyps coprotheres* roost (Boshoff *et al.* 2009a), and about 20 km north-east of the Addo Elephant National Park and the Sunday's River Valley.

The birds of greatest potential relevance and importance in terms of the possible impacts of the WEF are likely to be:

- (i) Large terrestrial birds – including Ludwig's Bustard, Denham's Bustard *Neotis denhami* and Kori Bustard *Ardeotis kori*, White-bellied Korhaan *Eupodotis senegalensis*, Blue Crane and Grey-crowned Crane *Balearica regulorum*, breeding and/or foraging in and commuting across the open uplands of the study site.
- (ii) Raptors (and possibly storks) nesting either on the cliffs along the river, in the larger trees along the river valleys, or in the mountains to the north – including Cape Vulture, Verreaux's Eagle *Aquila verreauxii*, Martial Eagle *Polemaetus bellicosus*, African Crowned

Eagle *Stephanoaetus coronatus*, Black Harrier, Secretarybird *Sagittarius serpentarius*, Lesser Kestrel *Falco naumanni*, Peregrine Falcon *Falco peregrinus*, Lanner Falcon *Falco biarmicus*, and possibly Black Stork *Ciconia nigra*.

- (iii) Waterbirds living on and/or commuting along the Great Fish River and its tributaries, especially Black Stork.
- (iv) Populations of smaller, threatened endemics (Knysna Woodpecker and Melodius Lark).

The threatened species most likely to occur on the site (Table 1) are the focus of the remainder of this report, and all potential impacts of the WEF on the local avifauna, as well as all required mitigation, are deemed to be adequately covered by catering only for these species, as effective surrogates for the entire avian assemblage.

Table 1. Red-listed bird species considered likely to occur within the impact zone of the proposed wind energy facility, with estimates of their relative susceptibility to the environmental impacts of the construction and operational phases of the development. *Red-listed endemic species are highlighted in grey.*

Common name	Conservation status	Regional endemism	Relative importance of local population ¹	Susceptibility to collision	Susceptibility to electro-cution	Susceptibility to disturbance
Knysna Woodpecker	Near-threatened	Endemic	Low?	-	-	Moderate
Ludwig's Bustard	Vulnerable	Near-endemic	Low?	High	-	Moderate
Denham's Bustard	Vulnerable	-	Low?	High	-	Moderate
Kori Bustard	Vulnerable	-	Low?	High	-	Moderate
White-bellied Korhaan	Near-threatened	Endemic	Moderate	Moderate	-	Moderate
Blue Crane	Vulnerable	Endemic	High	High	-	Moderate
Cape Vulture	Vulnerable	Endemic	Moderate?	High	High	-
Martial Eagle	Vulnerable	-	High	Moderate	High	Moderate
African Crowned Eagle	Near-threatened	-	Moderate?	High	High	Moderate
Secretarybird	Near-threatened	-	High	High	-	Moderate
Black Harrier	Near-threatened	Endemic	Low	High	-	Moderate
Lesser Kestrel	Vulnerable	-	High	Moderate	-	Moderate
Lanner Falcon	Near-threatened	-	Moderate	High	Moderate	-
Peregrine Falcon	Near-threatened	-	Low	High	Moderate	-
Black Stork	Near-threatened	-	Low	High	Moderate	-
Melodius Lark	Near-threatened	Endemic	Low	Moderate?	-	Moderate

¹Relative to the national/global population, ? indicates insufficient existing data, to be clarified in the EIA Phase.

6. PROVISIONAL ASSESSMENT OF IMPACTS

Of the conservation priority, red-listed species, nearly all are considered to be at some risk of colliding with the blades of the turbines or associated power lines, six species are considered to be at risk of electrocution on any bird-unfriendly power infrastructure associated with the wind energy facility, and 12 species are considered to be at risk of being disturbed and/or losing habitat during construction and possibly in the longer term (Table 1).

Table 2. Provisional bird impacts matrix for the Spitskop Wind Energy Facility.

Impact	Cause	Affected taxa	Likelihood	Duration	Extent	Significance	Mitigation
Disturbance	Construction & maintenance	Ground-nesting terrestrial spp. and raptors, smaller endemics	High	Short	Local	Low-medium	Optimize timing and minimise duration of construction activity
	Operation - noise and movement	Nesting or foraging large terrestrial spp., foraging or nesting raptors, smaller endemics	Moderate	Life of the facility	Local	<i>Cannot be specified at this stage</i>	Minimise noise output of facility?
Habitat loss: habitat destruction	Construction footprint	Smaller endemics	High	Life of the facility	Local	Low-medium	Minimise construction footprint
Habitat loss: displacement	Operation - noise and movement	Nesting or foraging large terrestrial spp., foraging or nesting raptors, smaller endemics	<i>Cannot be specified at this stage</i>	Life of the facility	Local	<i>Cannot be specified at this stage</i>	None
Mortality	Electrocution on associated infrastructure	Raptors and storks	High	Life of the facility	Regional	<i>Cannot be specified at this stage</i>	Use bird friendly hardware and power line designs
Mortality	Collision with turbine blades and associated power lines	Commuting large terrestrial spp., raptors, wetland spp. ibises and some smaller endemics,	<i>Cannot be specified at this stage</i>	Life of the facility	Regional	<i>Cannot be specified at this stage</i>	Turbine and power line siting, mark turbine blades and power lines, limit operational times or conditions

It is not possible at this stage to determine with confidence the relative significance of these various potential impacts, mainly because too little information is available on the relative abundance and movements of local populations of the implicated species (Table 1). The significance of impacts will be investigated in more detail during the EIA phase after spending some field time at the site.

Collision with the turbine blades and power lines is potentially the most significant impact of the proposed development (Table 2), and could negatively affect a variety of collision prone species, most notably individuals or loose flocks of a variety of bustards and cranes, and a suite of raptors present in the area, especially Cape Vulture (which may forage this far south off the mountains to the north and north-east, especially in the summer months when this species is a local migrant to the western half of the Eastern Cape – Boshoff *et al.* 2009b), Martial Eagle, African Crowned Eagle and Verreaux's Eagle, and possibly active pursuit hunters such as Peregrine Falcon and Lanner Falcon. Locally resident large terrestrial birds and raptors may also be displaced from significant areas of foraging or breeding habitat by the action or noise of the turbines.

At present, it is only possible to *speculate* on the biology and possible mitigation of the most likely risk factors (Table 2), an exercise which suggests that (especially given the size and extent of the proposed wind energy development) **collision mortality and displacement disturbance are possible, may well be significant, and will probably require considerable mitigation effort.**

7. CONCLUSIONS AND PLAN OF STUDY FOR EIA PHASE

The scoping phase has identified potential avifaunal issues associated with the proposed wind energy facility and its associated infrastructure. These issues will be investigated in more detail during the full EIA phase. In particular, the significance of bird collisions with the turbines will be assessed in order to determine whether the risk warrants mitigation such as no-go areas for turbines, patterning of turbine blades, or periodic shutting down of the wind energy facility (as discussed above). This will be assessed mainly in terms of (i) the actual or estimated abundance of priority bird species in the area, and (ii) the distribution of relevant microhabitats and food resources, and the way in which the latter is likely to influence aggregation and movement of these birds through the impact zone of the proposed wind energy facility.

The EIA phase will emphasise the outcome of the site visit, which in turn will include:

- (i) Absolute or sample surveys of large terrestrial species, raptors and endemic passerines within the study area to determine the relative importance of local populations of these key taxa.
- (ii) Estimates of the extent and direction of possible movements of these species within/through the anticipated impact zone of the wind energy facility, in relation to the distribution of available resources – nesting or roosting sites (e.g. cliff-lines, wetlands, stands of trees, existing power lines) and foraging areas (e.g. wetlands, rocky screes and ridges).
- (iii) Identification of the least sensitive/lowest risk areas to locate wind turbines within the broader study area, in terms of (i) and (ii) above.

The results will include a more detailed assessment of all impacts, recommended mitigation where necessary (particularly with reference to the siting of turbines) and, perhaps most importantly, the outline for a recommended, comprehensive, long-term programme for monitoring actual impacts from pre- to post-construction phases of the development, and improving our understanding of the long-term effects of wind energy developments on South African avifauna.

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Dr Andrew Jenkins
AVISENSE Consulting cc
Email: Andrew@avisense.co.za
Cell: 082 959 9238
Web: avisense.co.za

APPENDIX 1. Annotated list of the bird species considered likely to occur within the impact zone of the proposed Spitskop Wind Energy Facility.

SPECIES	SCIENTIFIC NAME	CONSERVATION STATUS	ENDEMI SM	HABITAT		
				Grasslands (incl. light <i>Acacia</i> woodland)	Thicket (incl. dense riparian woodland)	Wetlands (incl. vleis, rivers and dams)
Common Ostrich	<i>Struthio camelus</i>			X		
Grey-winged Francolin	<i>Scleroptila africanus</i>		Endemic	X		
Common Quail	<i>Coturnix coturnix</i>			X		
Helmeted Guineafowl	<i>Numida meleagris</i>			X		
Egyptian Goose	<i>Alopochen aegyptiaca</i>					X
South African Shelduck	<i>Tadorna cana</i>		Endemic			X
Spur-winged Goose	<i>Plectropterus gambensis</i>					X
African Black Duck	<i>Anas sparsa</i>					X
Yellow-billed Duck	<i>Anas undulata</i>					X
Cape Shoveler	<i>Anas smithii</i>		Endemic			X
Red-billed Teal	<i>Anas erythrorhyncha</i>					X
Greater Honeyguide	<i>Indicator indicator</i>				X	
Lesser Honeyguide	<i>Indicator minor</i>				X	
Red-throated Wryneck	<i>Jynx ruficollis</i>				X	
Knysna Woodpecker	<i>Campethera notata</i>	Near-threatened	Endemic		X	
Ground Woodpecker	<i>Geocalaptēs olivaceus</i>		Endemic	X		
Cardinal Woodpecker	<i>Dendropicōs fuscescens</i>				X	
Olive Woodpecker	<i>Dendropicōs griseocephalus</i>				X	
Acacia Pied Barbet	<i>Tricholaema leucomelas</i>		Near-endemic		X	
Black-collared Barbet	<i>Lybius torquatus</i>				X	
Red-fronted Tinkerbird	<i>Pogoniulus pusillus</i>				X	
Crowned Hornbill	<i>Tockus alboterminatus</i>				X	
African Hoopoe	<i>Upupa africana</i>				X	
Green Wood-Hoopoe	<i>Phoeniculus purpureus</i>				X	
Narina Trogon	<i>Apaloderma narina</i>				X	
European Roller	<i>Coracias garrulus</i>			X		

SPECIES	SCIENTIFIC NAME	CONSERVATION STATUS	ENDEMIISM	HABITAT		
				Grasslands (incl. light <i>Acacia</i> woodland)	Thicket (incl. dense riparian woodland)	Wetlands (incl. vleis, rivers and dams)
Half-collared Kingfisher	<i>Alcedo semitorquata</i>	Near-threatened				X
Malachite Kingfisher	<i>Alcedo cristata</i>					X
Brown-hooded Kingfisher	<i>Halcyon albiventris</i>				X	
Giant Kingfisher	<i>Megaceryle maximus</i>					X
Pied Kingfisher	<i>Ceryle rudis</i>					X
European Bee-eater	<i>Merops apiaster</i>			X		
White-backed Mousebird	<i>Colius colius</i>				X	
Speckled Mousebird	<i>Colius striatus</i>				X	
Red-faced Mousebird	<i>Urocolius indicus</i>				X	
Jacobin Cuckoo	<i>Clamator jacobinus</i>				X	
Great Spotted Cuckoo	<i>Clamator glandarius</i>				X	
Red-chested Cuckoo	<i>Cuculus solitarius</i>				X	
Black Cuckoo	<i>Cuculus clamosus</i>				X	
Common Cuckoo	<i>Cuculus canorus</i>				X	
Klaas's Cuckoo	<i>Chrysococcyx klaas</i>				X	
Diderick Cuckoo	<i>Chrysococcyx caprius</i>				X	
Burchell's Coucal	<i>Centropus burchellii</i>					X
Alpine Swift	<i>Tachymarptis melba</i>			X		
Common Swift	<i>Apus apus</i>			X		
African Black Swift	<i>Apus barbatus</i>			X		
Little Swift	<i>Apus affinis</i>			X		
Horus Swift	<i>Apus horus</i>			X		
White-rumped Swift	<i>Apus caffer</i>			X		
Knysna Turaco	<i>Tauraco corythaix</i>				X	
Barn Owl	<i>Tyto alba</i>			X	X	
Cape Eagle-Owl	<i>Bubo capensis</i>			X		
Spotted Eagle-Owl	<i>Bubo africanus</i>			X	X	
African Wood Owl	<i>Strix woodfordii</i>				X	
Fiery-necked Nightjar	<i>Caprimulgus pectoralis</i>				X	
Rufous-cheeked Nightjar	<i>Caprimulgus rufigena</i>				X	

SPECIES	SCIENTIFIC NAME	CONSERVATION STATUS	ENDEMIISM	HABITAT		
				Grasslands (incl. light <i>Acacia</i> woodland)	Thicket (incl. dense riparian woodland)	Wetlands (incl. vleis, rivers and dams)
Rock Dove	<i>Columba livia</i>			X		
Speckled Pigeon	<i>Columba guinea</i>			X		
African Olive-Pigeon	<i>Columba arquatrix</i>				X	
Laughing Dove	<i>Streptopelia senegalensis</i>			X	X	
Cape Turtle-Dove	<i>Streptopelia capicola</i>			X	X	
Red-eyed Dove	<i>Streptopelia semitorquata</i>				X	
Emerald-spotted Wood-Dove	<i>Turtur chalcospilos</i>				X	
Tambourine Dove	<i>Turtur tympanistria</i>				X	
Namaqua Dove	<i>Oena capensis</i>			X		
Denham's Bustard	<i>Neotis denhami</i>	Vulnerable		X		
Ludwig's Bustard	<i>Neotis ludwigii</i>	Vulnerable	Near-endemic	X		
Kori Bustard	<i>Ardeotis kori</i>	Vulnerable		X		
Southern Black Korhaan	<i>Afrotis afra</i>		Endemic	X		
Karoo Korhaan	<i>Eupodotis vigorsii</i>		Endemic	X		
White-bellied Korhaan	<i>Eupodotis senegalensis</i>	Vulnerable		X		
Blue Crane	<i>Anthropoides paradiseus</i>	Vulnerable	Endemic	X		X
Grey-crowned Crane	<i>Balearica regulorum</i>	Vulnerable		X		X
African Rail	<i>Rallus caerulescens</i>					X
Black Crane	<i>Amaurornis flavirostris</i>					X
Common Moorhen	<i>Gallinula chloropus</i>					X
Red-knobbed Coot	<i>Fulica cristata</i>					X
Namaqua Sandgrouse	<i>Pterocles namaqua</i>		Near-endemic	X		
African Snipe	<i>Gallinago nigripennis</i>					X
Marsh Sandpiper	<i>Tringa stagnatilis</i>					X
Common Greenshank	<i>Tringa nebularia</i>					X
Common Sandpiper	<i>Actitis hypoleucos</i>					X
African Jacana	<i>Actophilornis africanus</i>					X
Spotted Thick-knee	<i>Burhinus capensis</i>			X		
Black-winged Stilt	<i>Himantopus himantopus</i>					X
Pied Avocet	<i>Recurvirostra avosetta</i>					X

SPECIES	SCIENTIFIC NAME	CONSERVATION STATUS	ENDEMIISM	HABITAT		
				Grasslands (incl. light <i>Acacia</i> woodland)	Thicket (incl. dense riparian woodland)	Wetlands (incl. vleis, rivers and dams)
Kittlitz's Plover	<i>Charadrius pecuarius</i>			X		X
Three-banded Plover	<i>Charadrius tricollaris</i>					X
Blacksmith Lapwing	<i>Vanellus armatus</i>					X
Black-winged Lapwing	<i>Vanellus melanopterus</i>	Near-threatened		X		
Crowned Lapwing	<i>Vanellus coronatus</i>			X		
Double-banded Courser	<i>Rhinoptilus africanus</i>			X		
Grey-headed Gull	<i>Larus cirrocephalus</i>					X
White-winged Tern	<i>Chlidonias leucopterus</i>					X
Black-shouldered Kite	<i>Elanus caeruleus</i>			X	X	
Black Kite	<i>Milvus migrans</i>			X	X	
African Fish-Eagle	<i>Haliaeetus vocifer</i>				X	X
African Marsh-Harrier	<i>Circus ranivorus</i>	Vulnerable				X
Black Harrier	<i>Circus maurus</i>	Near-threatened	Endemic	X		X
Pallid Harrier	<i>Circus macrourus</i>	Near-threatened		X		
African Harrier-Hawk	<i>Polyboroides typus</i>			X	X	
Southern Pale Chanting Goshawk	<i>Melierax canorus</i>		Near-endemic	X	X	
Gabar Goshawk	<i>Melierax gabar</i>				X	
African Goshawk	<i>Accipiter tachiro</i>				X	
Little Sparrowhawk	<i>Accipiter minullus</i>				X	
Rufous-chested Sparrowhawk	<i>Accipiter rufiventris</i>			X	X	
Black Sparrowhawk	<i>Accipiter melanoleucus</i>				X	
Steppe Buzzard	<i>Buteo vulpinus</i>			X	X	
Jackal Buzzard	<i>Buteo rufofuscus</i>		Endemic	X	X	
Verreauxs' Eagle	<i>Aquila verreauxii</i>			X		
Booted Eagle	<i>Aquila pennatus</i>			X		
Martial Eagle	<i>Polemaetus bellicosus</i>	Vulnerable		X	X	
African Crowned Eagle	<i>Stephanoaetus coronatus</i>	Near-threatened			X	
Secretarybird	<i>Sagittarius serpentarius</i>	Near-threatened		X		
Lesser Kestrel	<i>Falco naumanni</i>	Vulnerable		X		
Rock Kestrel	<i>Falco rupicolus</i>			X		

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Greater Kestrel	<i>Falco rupicoloides</i>			X		
Amur Falcon	<i>Falco amurensis</i>			X		
Eurasian Hobby	<i>Falco subbuteo</i>			X	X	
Lanner Falcon	<i>Falco biarmicus</i>	Near-threatened		X		
Peregrine Falcon	<i>Falco peregrinus</i>	Near-threatened		X		
Little Grebe	<i>Tachybaptus ruficollis</i>					X
African Darter	<i>Anhinga rufa</i>					X
Reed Cormorant	<i>Phalacrocorax africanus</i>					X
White-breasted Cormorant	<i>Phalacrocorax lucidus</i>					X
Little Egret	<i>Egretta garzetta</i>					X
Yellow-billed Egret	<i>Egretta intermedia</i>					X
Great Egret	<i>Egretta alba</i>					X
Grey Heron	<i>Ardea cinerea</i>					X
Black-headed Heron	<i>Ardea melanocephala</i>			X		X
Goliath Heron	<i>Ardea goliath</i>					X
Purple Heron	<i>Ardea purpurea</i>					X
Cattle Egret	<i>Bubulcus ibis</i>			X		X
Squacco Heron	<i>Ardeola ralloides</i>					X
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>					X
Little Bittern	<i>Ixobrychus minutus</i>					X
Hamerkop	<i>Scopus umbretta</i>					X
Glossy Ibis	<i>Plegadis falcinellus</i>					X
Hadedda Ibis	<i>Bostrychia hagedash</i>				X	X
African Sacred Ibis	<i>Threskiornis aethiopicus</i>					X
African Spoonbill	<i>Platalea alba</i>					X
Yellow-billed Stork	<i>Mycteria ibis</i>	Near-threatened				X
Black Stork	<i>Ciconia nigra</i>	Near-threatened		X		X
White Stork	<i>Ciconia ciconia</i>			X		X
Eurasian Golden Oriole	<i>Oriolus oriolus</i>				X	
Black-headed Oriole	<i>Oriolus larvatus</i>				X	

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				Grasslands (incl. light <i>Acacia</i> woodland)	Thicket (incl. dense riparian woodland)	Wetlands (incl. vleis, rivers and dams)
Fork-tailed Drongo	<i>Dicrurus adsimilis</i>				X	
African Paradise-Flycatcher	<i>Terpsiphone viridis</i>				X	
Black-backed Puffback	<i>Dryoscopus cubla</i>				X	
Southern Tchagra	<i>Tchagra tchagra</i>		Endemic		X	
Southern Boubou	<i>Laniarius ferrugineus</i>		Endemic		X	
Bokmakierie	<i>Telophorus zeylonus</i>		Near-endemic		X	
Olive Bush-Shrike	<i>Telophorus olivaceus</i>		Near-endemic		X	
Cape Batis	<i>Batis capensis</i>		Endemic		X	
Chinspot Batis	<i>Batis molitor</i>				X	
Pririt Batis	<i>Batis pririt</i>		Near-endemic		X	
Cape Crow	<i>Corvus capensis</i>			X		
Pied Crow	<i>Corvus albus</i>			X	X	
White-necked Raven	<i>Corvus albicollis</i>			X		
Red-backed Shrike	<i>Lanius collurio</i>			X	X	
Lesser Grey Shrike	<i>Lanius minor</i>			X		
Common Fiscal	<i>Lanius collaris</i>			X	X	
Cape Penduline-Tit	<i>Anthoscopus minutus</i>		Near-endemic		X	
Grey Tit	<i>Parus afer</i>		Endemic	X	X	
Southern Black Tit	<i>Parus niger</i>			X	X	
Sand Martin	<i>Riparia riparia</i>			X		X
Brown-throated Martin	<i>Riparia paludicola</i>					X
Banded Martin	<i>Riparia cincta</i>			X		X
Barn Swallow	<i>Hirundo rustica</i>			X		X
White-throated Swallow	<i>Hirundo albigularis</i>					X
Pearl-breasted Swallow	<i>Hirundo dimidiata</i>			X		X
Greater Striped Swallow	<i>Hirundo cucullata</i>			X		X
Lesser Striped Swallow	<i>Hirundo abyssinica</i>			X		X
South African Cliff-Swallow	<i>Hirundo spilodera</i>		Breeding endemic	X		
Rock Martin	<i>Hirundo fuligula</i>			X		
Common House-Martin	<i>Delichon urbicum</i>			X		X

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				Grasslands (incl. light <i>Acacia</i> woodland)	Thicket (incl. dense riparian woodland)	Wetlands (incl. vleis, rivers and dams)
Black Saw-wing	<i>Psalidoprocne holomelaena</i>				X	
Dark-capped Bulbul	<i>Pycnonotus tricolor</i>				X	
African Red-eyed Bulbul	<i>Pycnonotus nigricans</i>		Near-endemic		X	
Cape Bulbul	<i>Pycnonotus capensis</i>		Endemic		X	
Sombre Greenbul	<i>Andropadus importunus</i>				X	
Fairy Flycatcher	<i>Stenostira scita</i>		Endemic	X	X	
Cape Grassbird	<i>Sphenoeacus afer</i>		Endemic	X		
Long-billed Crombec	<i>Sylvietta rufescens</i>				X	
Yellow-bellied Eremomela	<i>Eremomela icteropygialis</i>				X	
Karoo Eremomela	<i>Eremomela gregalis</i>		Endemic	X		
Little Rush-Warbler	<i>Bradypterus baboecala</i>					X
African Reed-Warbler	<i>Acrocephalus baeticatus</i>					X
Lesser Swamp Warbler	<i>Acrocephalus gracillirostris</i>					X
Willow Warbler	<i>Phylloscopus trochilus</i>				X	
Layard's Tit-Babbler	<i>Parisoma layardi</i>		Endemic	X	X	
Chestnut-vented Tit-Babbler	<i>Parisoma subcaeruleum</i>		Near-endemic	X	X	
Garden Warbler	<i>Sylvia borin</i>				X	
Cape White-eye	<i>Zosterops virens</i>		Endemic		X	
Orange River White-eye	<i>Zosterops pallidus</i>		Endemic		X	
Lazy Cisticola	<i>Cisticola aberrans</i>			X		
Grey-backed Cisticola	<i>Cisticola subruficapilla</i>			X	X	
Wailing Cisticola	<i>Cisticola lais</i>				X	
Levaillant's Cisticola	<i>Cisticola tinniens</i>					X
Neddicky	<i>Cisticola fulvicapilla</i>			X		
Zitting Cisticola	<i>Cisticola juncidis</i>			X		
Desert Cisticola	<i>Cisticola aridulus</i>			X		
Cloud Cisticola	<i>Cisticola textrix</i>		Near-endemic	X		
Karoo Prinia	<i>Prinia maculosa</i>		Endemic	X	X	
Namaqua Warbler	<i>Phragmacia substriata</i>		Endemic		X	
Rufous-eared Warbler	<i>Malcorus pectoralis</i>		Endemic	X		

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				Grasslands (incl. light <i>Acacia</i> woodland)	Thicket (incl. dense riparian woodland)	Wetlands (incl. vleis, rivers and dams)
Bar-throated Apalis	<i>Apalis thoracica</i>				X	
Yellow-breasted Apalis	<i>Apalis flavida</i>				X	
Melodious Lark	<i>Mirafra cheniana</i>	Near-threatened	Endemic	X		
Rufous-naped Lark	<i>Mirafra africana</i>			X		
Cape Clapper Lark	<i>Mirafra apiata</i>		Endemic	X		
Eastern Clapper Lark	<i>Mirafra fasciolata</i>		Near-endemic	X		
Sabota Lark	<i>Calendulauda sabota</i>		Near-endemic	X		
Spike-heeled Lark	<i>Chersomanes albofasciata</i>			X		
Eastern Long-billed Lark	<i>Certhilauda semitorquata</i>		Endemic	X		
Grey-backed Sparrowlark	<i>Eremopterix verticalis</i>		Near-endemic	X		
Red-capped Lark	<i>Calandrella cinerea</i>			X		
Large-billed Lark	<i>Galerida magnirostris</i>		Endemic	X		
Cape Rock-Thrush	<i>Monticola rupestris</i>		Endemic	X		
Sentinel Rock-Thrush	<i>Monticola explorator</i>		Endemic	X		
Karoo Thrush	<i>Turdus smithi</i>		Endemic	X	X	
Chat Flycatcher	<i>Bradornis infuscatus</i>		Near-endemic	X		
Fiscal Flycatcher	<i>Sigelus silens</i>		Endemic		X	
Spotted Flycatcher	<i>Muscicapa striata</i>				X	
African Dusky Flycatcher	<i>Muscicapa adusta</i>				X	
Cape Robin-Chat	<i>Cossypha caffra</i>				X	
White-browed Scrub-Robin	<i>Cercotrichas leucophrys</i>				X	
Karoo Scrub-Robin	<i>Cercotrichas coryphoeus</i>		Endemic	X	X	
African Stonechat	<i>Saxicola torquatus</i>			X		
Mountain Wheatear	<i>Oenanthe monticola</i>		Near-endemic	X		
Capped Wheatear	<i>Oenanthe pileata</i>			X		
Sickle-winged Chat	<i>Cercomela sinuata</i>		Endemic	X		
Karoo Chat	<i>Cercomela schlegelii</i>		Near-endemic	X		
Familiar Chat	<i>Cercomela familiaris</i>			X		
Ant-eating Chat	<i>Myrmecocichla formicivora</i>		Endemic	X		

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				Grasslands (incl. light <i>Acacia</i> woodland)	Thicket (incl. dense riparian woodland)	Wetlands (incl. vleis, rivers and dams)
Mocking Cliff-Chat	<i>Thamnolaea cinnamomeiventris</i>			X		
Pale-winged Starling	<i>Onychognathus nabouroup</i>		Near-endemic	X		
Red-winged Starling	<i>Onychognathus morio</i>			X		
Cape Glossy Starling	<i>Lamprotorornis nitens</i>				X	
Pied Starling	<i>Spreo bicolor</i>		Endemic	X		
Wattled Starling	<i>Creatophora cinerea</i>			X	X	
Common Starling	<i>Sturnus vulgaris</i>				X	
Amethyst Sunbird	<i>Chalcomitra amethystina</i>				X	
Malachite Sunbird	<i>Nectarinia famosa</i>			X	X	
Southern Double-collared Sunbird	<i>Cinnyris chalybeus</i>		Endemic	X	X	
Greater Double-collared Sunbird	<i>Cinnyris afer</i>		Endemic	X		
Dusky Sunbird	<i>Cinnyris fuscus</i>		Near-endemic	X		
Scaly-feathered Finch	<i>Sporopipes squamifrons</i>		Near-endemic	X		
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>			X		
Spectacled Weaver	<i>Ploceus ocularis</i>				X	
Cape Weaver	<i>Ploceus capensis</i>		Endemic	X	X	X
Southern Masked-Weaver	<i>Ploceus velatus</i>			X	X	X
Village Weaver	<i>Ploceus cucullatus</i>				X	
Red-billed Quelea	<i>Quelea quelea</i>			X		X
Yellow-crowned Bishop	<i>Euplectes afer</i>					X
Southern Red Bishop	<i>Euplectes orix</i>			X		X
Yellow Bishop	<i>Euplectes capensis</i>			X		X
Long-tailed Widowbird	<i>Euplectes progne</i>			X		X
Red-collared Widowbird	<i>Euplectes ardens</i>			X		
African Quailfinch	<i>Ortygospiza atricollis</i>			X		
Red-headed Finch	<i>Amadina erythrocephala</i>		Near-endemic	X	X	
Sweet Waxbill	<i>Coccyzygia melanotis</i>		Endemic		X	
Common Waxbill	<i>Estrilda astrild</i>			X	X	X
Red-billed Firefinch	<i>Lagonosticta senegala</i>				X	

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African Firefinch	<i>Lagonosticta rubricata</i>				X	
Bronze Mannikin	<i>Spermestes cucullatus</i>			X		X
Pin-tailed Whydah	<i>Vidua macroura</i>			X		
Dusky Indigobird	<i>Vidua funerea</i>				X	
House Sparrow	<i>Passer domesticus</i>			X	X	X
Cape Sparrow	<i>Passer melanurus</i>		Near-endemic	X		
Southern Grey-headed Sparrow	<i>Passer diffusus</i>			X		
Yellow-throated Petronia	<i>Petronia superciliaris</i>				X	
African Pied Wagtail	<i>Motacilla aguimp</i>					X
Cape Wagtail	<i>Motacilla capensis</i>			X		X
Yellow Wagtail	<i>Motacilla flava</i>					X
Cape Longclaw	<i>Macronyx capensis</i>		Endemic	X		
African Rock Pipit	<i>Anthus crenatus</i>		Endemic	X		
African Pipit	<i>Anthus cinnamomeus</i>			X		
Plain-backed Pipit	<i>Anthus leucophrys</i>			X		
Buffy Pipit	<i>Anthus vaalensis</i>			X		
Long-billed Pipit	<i>Anthus similis</i>			X		
Cape Canary	<i>Serinus canicollis</i>		Endemic	X	X	
Black-headed Canary	<i>Serinus alario</i>		Endemic	X		
Yellow-fronted Canary	<i>Crithagra mozambicus</i>			X	X	
Black-throated Canary	<i>Crithagra atrogularis</i>			X		
Forest Canary	<i>Crithagra scotops</i>		Endemic		X	
Yellow Canary	<i>Crithagra flaviventris</i>		Near-endemic	X		
Brimstone Canary	<i>Crithagra sulphuratus</i>			X	X	
White-throated Canary	<i>Crithagra albogularis</i>		Near-endemic	X		
Streaky-headed Seedeater	<i>Crithagra gularis</i>			X	X	
Lark-like Bunting	<i>Emberiza impetuani</i>		Near-endemic	X		
Cinnamon-breasted Bunting	<i>Emberiza tahapisi</i>			X		
Cape Bunting	<i>Emberiza capensis</i>		Near-endemic	X		
Golden-breasted Bunting	<i>Emberiza flaviventris</i>				X	

