# TSITSIKAMMA WIND ENERGY FACILITY

Avian impact assessment

- Scoping Phase -

AVISENSE CONSULTING

**EXECUTIVE SUMMARY**

This study contains an extensive review of relevant literature on the impacts of wind energy developments on local avifauna, and identifies potential impacts of the proposed Tsitsikamma Wind energy facility on the avifauna of that 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, and mortality in collisions with the blades of the wind turbines and/or other associated infrastructure.

The impact zone of the proposed wind energy facility probably features a mixture of Fynbos, Renosterveld and grassland habitats, with extensive tracts of cultivated lands, set in an area of undulating relief, traversed by the, and with scattered patches of forest (including stands of alien trees) and artificial impoundments of various sizes. The area is likely to support over 240 bird species, including 19 red-listed species, 41 endemics, and four red-listed endemics. Priority species – i.e. those of greatest conservation significance which may be impacted by the wind energy facility, in terms of the collision and disturbance impacts of the facility itself, and/or of the disturbance and mortality risks posed by its peripheral infrastructure – include (i) seasonal influxes (and/or resident populations) of Denham's Bustard *Neotis denhami*, Ludwig's Bustard *Neotis ludwigii* and Whitebellied Korhaan *Eupodotis senegalensis*, (ii) flocks or breeding pairs of Blue Crane *Anthropoides paradiseus*, (iii) a range of raptors, including Martial Eagle *Polemaetus bellicosus*, African Crowned Eagle *Stephanoeatus coronatus*, African Marsh Harrier *Circus ranivorus*, Black Harrier *Circus maurus*, Peregrine Falcon *Falco peregrinus* and Lanner Falcon *F. biarmicus* foraging or moving through the area, (iv) flocks of wetland species commuting between resource areas, and (v) a suite of smaller, restricted range endemics, including Knysna Woodpecker *Campethera notata* and Knysna Warbler *Bradypterus sylvaticus*.

The scale and likelihood of impacts on these and other affected species 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 importance of this impact will depend mainly on the relative abundance of certain key species, the distribution of their respective microhabitats or key resource areas, and the resulting patterns of movement by these birds through the development area. The EIA study will include a more detailed assessment of all impacts, recommended mitigation where necessary, and a comprehensive programme to fully monitor the actual impacts of the wind energy facility throughout construction and into its operational phase.

**CONSULTANT'S DECLARATION OF INDEPENDENCE**

Andrew Jenkins (*AVISENSE* Consulting cc) is an independent consultant to Savannah Environmental Pty (Ltd) and Exxaro Resources / Watt Energy. 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

Exxaro Resources and Watt Energy are proposing to establish a commercial wind energy facility (WEF) (project name 'Tsitsikamma wind energy facility'), as well as associated infrastructure, on a site located approximately 20 km south-west of Humansdorp, Eastern Cape Province (Fig. 1). Savannah Environmental Pty (Ltd) was appointed to compile the EIA report for this proposed development, 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 METHODS

## 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: 3424AB Clarkson and 3424BA Kruisfontein) or pentads (SABAP 2: 3400_2425, 3405_2425, 3400_2430, 3405_2430). 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 and EMP reports for other developments in the same area (Jenkins 2010, 2011).
- 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).

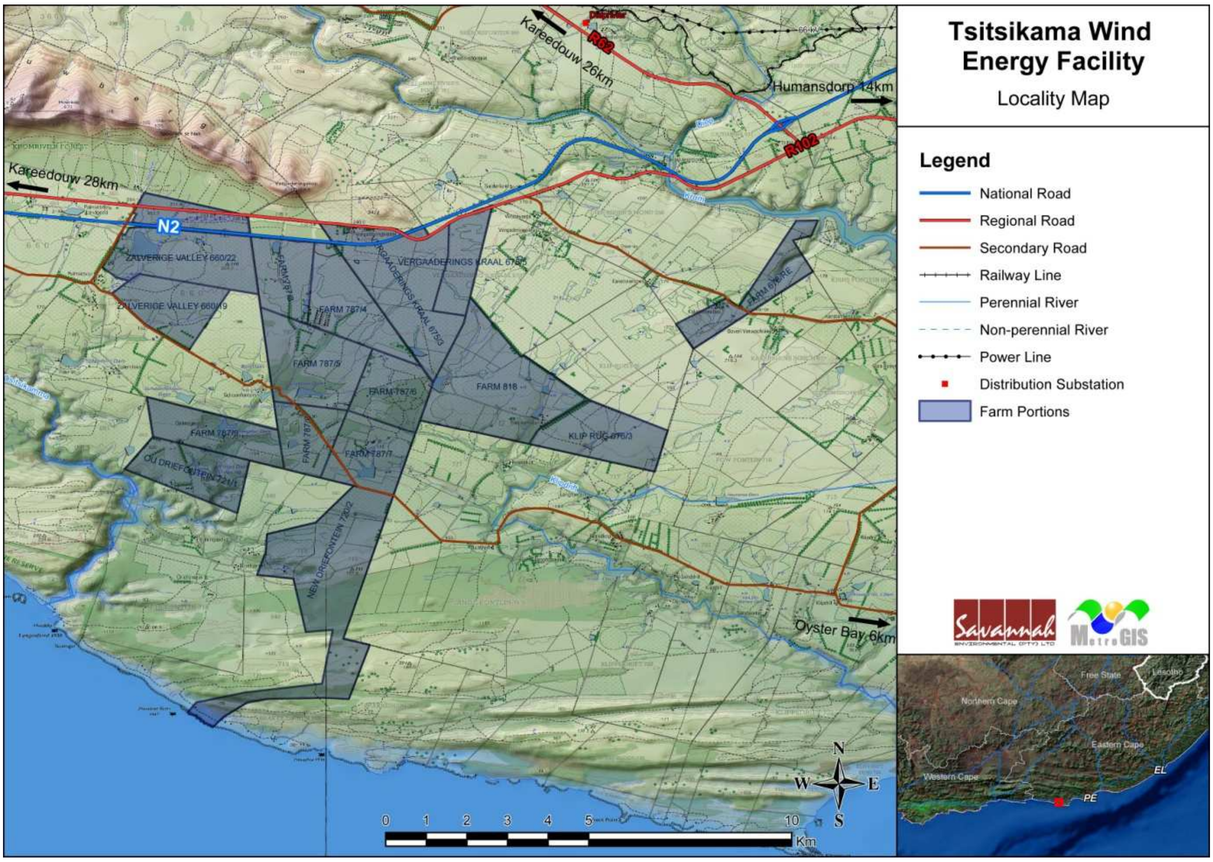


FIGURE 1. Location of the proposed Tsitsikamma Wind Energy Facility.

### 3.3. Limitations & assumptions

Any inaccuracies in the above sources of information could limit this study. The SABAP 1 data for this area was reasonably comprehensive (125 cards submitted for the two relevant quarter-degree squares combined) but it is now is now >15 years old (Harrison *et al.* 1997), and there are presently only 13 cards submitted for the ongoing SABAP 2 initiative for the four 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 Klipheuwel and Darling in the Western Cape (van Rooyen 2001, Jenkins 2001, 2003) and, more recently, in the first phase of a bigger development at Coega in the Eastern Cape. An avian mortality monitoring program was established at the Klipheuwel 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) 9-57% of the birds recorded per observation period within 500m of the turbines were flying at blade height, and (ii) 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 height, exponentially increasing collision risk (Drewitt & Langston 2006, 2008).

All other variables being equal, larger wind energy facilities, with more turbines, are more likely to incur significant numbers of bird casualties, simply because they present greater aggregate risk (Kingsley & Whittam 2005). Also, 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 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). A recent study found no significant difference in nocturnal collision rates by small passerines at unlit turbines *vs* turbines with regulation aviation safety lighting (small, flashing red lights) (Kerlinger *et al.* 2010).

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 a single collision incident).

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 (Pennycuick 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.

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

| Location | *n* wind farm/s assessed | Turbine hub height (m) | *n* 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 *et al.* 2008 |
| East Anglia, UK | 2 | 60 | 8 | Croplands | Gamebirds, corvids, larks and see-eaters | Minimal, only gamebirds significantly affected | N/A | Devereaux *et al.* 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 *et al.* 2009 |
| Netherlands | 3 | 67-78 | 7-10 | Farmland | Various | N/A | 27.0-39.0 | Krijgsveld *et al.* 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 *Circus cyaneus* sightings, other species also decreased | N/A | Pearce-Higgins *et al.* 2009 |

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 *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, 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 (Egyptian Vulture *Neophron percnopterus*) 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 conspicuousness 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 behavior, (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 renewable 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. Note that (i) each radar installation of this type has a maximum effective range of 10-15 km depending on topography, (ii) that maximum efficacy on any one site can only be achieved through trial and error, and a considerable amount of specialized analysis and software refinement, and (iii) that radar deployment is an expensive exercise, with each unit retailing at about ZAR 2.5-4.2 m.

#### *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 renewable 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), where the affected avifauna already have a degree of habituation to and tolerance of anthropogenic environmental change. Either way, displacement effects on birds by WEF's are highly species-specific in operation.

### 4.2 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).

### 4.3. Description of the proposed wind energy facility

The project is proposed for portions of the following Farms: portions 19 and 22 of Zalverige Valley 660, portions 3 and 5 of Vergaaderingskraal 675, portion 1 of Ou Driefontein 721, portion 2 of New Driefontein 720, portions 3-9 of Wittekleibosch 787, Farm 818, the remainder of Farm 678 and portion 3 of Kliprug 676, all of which lie about 20 km west of Humansdorp, in the Eastern Cape Province, South Africa (Fig. 1).

The broader development site, within which the turbines and infrastructure will be built, covers an area of about 75 $km^2$. The proposed wind energy facility will generate up to 100 MW of power, and will comprise up to 50-60 wind turbines. Other infrastructure associated with the facility will include a small, on site substation, foundations to support the turbine towers, cabling between the project components, to be lain underground where practical, an overhead power line (132kV) feeding into the Eskom electricity network at the existing Melkhout Substation, a network of internal access roads, and a workshop area for maintenance and storage (Fig. 1).

## 5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

### 5.1 Vegetation of the study area

The natural vegetation is probably dominated by Tsitsikamma Sandstone Fynbos (low montane or undulating proteoid shrubland with an ericoid understorey and interspersed with fynbos thicket) in the central part of the proposed development area, with Humansdorp Shale Renosterveld (medium dense shrubland dominated by renosterbos) in the lower areas in the north-east (Mucina & Rutherford 2006), Southern Cape Dune Fynbos (Fynbos heath covered dune slopes, with a strong restio component) adjacent to the coast, and patches of Southern Afrotemperate Forest along the watercourses.

### 5.2 Avian microhabitats

These will be defined more accurately after a site visit during the EIA phase of the project, but will probably comprise a mix of (i) quite degraded, rocky Fynbos (or Renosterveld) covered ridgeline and slopes, (ii) flat, grassy old pastureland, with small areas of active cultivation, (iii) patches of indigenous/alien forest, and (iv) various forms of wetlands (including the major and minor river courses, and a scattering of natural vleis and small artificial impoundments.

### 5.3 Avifauna of the impact area

The study area is located about 30 km south-east of the Kouga-Baviaanskloof Complex, 25 km east of the Tsitsikamma National Park, and about 50 km west of the Maitland-Gamtoos Coast – all of which are recognized as national Important Bird Areas (Barnes 1998), and are likely to support a diverse avifauna, including some significant populations of rare, threatened and/or endemic species. Over 240 bird species may occur with some regularity within the anticipated impact zone of the wind energy facility (Appendix 1), including 41 endemic or near-endemic species, 19 red-listed species, and four species – Knysna Woodpecker *Campethera notata*, Blue Crane *Anthropoides paradiseus*, Black Harrier *Circus maurus* and Knysna Warbler *Bradypterus sylvaticus* - which are both endemic and red-listed (Barnes 1998, 2000, Table 1).

**Table 1.** Red-listed bird species considered likely to occur within the impact zone of the proposed Tsitisikamma 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 endemicity | Relative importance of local population[1] | Susceptibility to collision | Susceptibility to electro-cution | Susceptibility to distur-bance |
|---|---|---|---|---|---|---|
| Knysna Woodpecker | Near-threatened | Endemic | Moderate? | - | - | Moderate |
| Half-collared Kingfisher | Near-threatened | - | Moderate? | - | - | Moderate |
| Denham's Bustard | Vulnerable | - | High | High | - | High |
| Ludwig's Bustard | Vulnerable | Near-endemic | Low? | High | - | High |
| Kori Bustard | Vulnerable | - | Low? | High | - | High |
| White-bellied Korhaan | Vulnerable | - | High? | Moderate | - | High |
| Blue Crane | Vulnerable | Endemic | Moderate? | High | - | High |
| Greater Painted Snipe | Near-threatened | - | Low? | - | - | - |
| African Black Oystercatcher | Near-threatened | Endemic | Low? | - | - | - |
| Chestnut-banded Plover | Near-threatened | - | Low? | - | - | - |
| Black-winged Lapwing | Near-threatened | - | Moderate? | - | - | Moderate |
| Caspian Tern | Near-threatened | - | Low? | Moderate | - | - |
| African Marsh Harrier | Vulnerable | - | Moderate? | High | - | Moderate |
| Black Harrier | Near-threatened | Endemic | Moderate? | High | - | Moderate |
| Pallid Harrier | Near-threatened | - | Low? | High | - | - |
| Martial Eagle | Vulnerable | - | Moderate? | High | High | Moderate |
| African Crowned Eagle | Near-threatened | - | Moderate? | High | High | Moderate |
| Secretarybird | Near-threatened | - | Moderate? | High | - | Moderate |
| Lesser Kestrel | Vulnerable | - | Low? | High | - | - |
| Lanner Falcon | Near-threatened | - | Moderate? | High | Moderate | - |
| Peregrine Falcon | Near-threatened | - | Moderate? | High | Moderate | - |
| Greater Flamingo | Near-threatened | - | Low? | High | - | - |
| Lesser Flamingo | Near-threatened | - | Low? | High | - | - |
| Yellow-billed Stork | Near-threatened | - | Low | Moderate | Moderate? | - |
| Black Stork | Near-threatened | - | Moderate? | High | Moderate | - |
| Knysna Warbler | Vulnerable | Endemic | Moderate? | - | - | Moderate |

[1]Relative to the national/global population; the use of a '?' indicates insufficient existing data, to be clarified in the EIA Phase.

The coastal plain between Tsitsikamma and Port Elizabeth is arguably the most important area for Denham's Bustard *Neotis denhami* in the country (Young *et al.* 2003), and also supports important numbers of Blue Crane and White-bellied Korhaan *Eupodotis senegalensis*. Large wetlands flanking the development area, including at least two large impoundments on the Krom River, the Krom River Estuary, and the Krom, Diep and Klipdrif Rivers themselves, may support some wetland birds, while areas of high relief along the valleys of the larger rivers may provide habitat for cliff-nesting raptors, including Lanner Falcon *Falco biarmicus* and possibly Peregrine Falcon *Falco peregrinus* (Jenkins 1994). Forest patches may attract African Crowned Eagle *Stephanoaetus coronatus*, and possibly support at least one pair of breeding Martial Eagle *Polemaetus bellicosus* in the near vicinity. Vlei areas along the river courses may attract African Marsh Harrier *Circus ranivorus*, and the Fynbos slopes and/or grassy Renosterveld flats will support Black Harrier as a seasonal visitor (Curtis *et al.* 2004).

The birds of greatest potential relevance and importance in terms of the possible impacts of the proposed wind energy facility are likely to be:

(i) Seasonal influxes and/or resident populations of Denham's Bustard *Neotis denhami,* White-bellied Korhaan *Eupodotis senegalensis* and possibly Ludwig's Bustard (Young *et al.* 2003, Hockey *et al.* 2005) foraging in and commuting over open veld.
(ii) Flocks or breeding pairs of Blue Crane commuting between roosting sites and feeding areas in the open renosterveld or in cultivated lands.
(iii) A range of locally resident or visiting raptors, including Martial Eagle, African Crowned Eagle, African Marsh Harrier, Black Harrier, Peregrine Falcon and Lanner Falcon, foraging in or moving through the area.
(iv) Flocks of wetland species commuting between resource areas (especially in relation to the Krom River Estuary and its impoundments and the coastline to the west).
(v) A suite of smaller, restricted range and/or endemic species, probably including Knysna Woodpecker and Knysna Warbler (see Table 1, Appendix 1).

## 6. PROVISIONAL ASSESSMENT OF IMPACTS

Of the conservation priority, red-listed species, 19 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 14 species are considered to be at risk of being disturbed and/or losing habitat during construction and possibly in the longer term (Table 1).

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. 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 **collision mortality, displacement and disturbance are possible, may be significant, and could 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, a 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.

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

| Impact | Cause | Affected taxa | Likeli-hood | Duration | Extent | Signifi-cance | Mitigation |
|---|---|---|---|---|---|---|---|
| Disturbance | Construction & maintenance | Ground-nesting and/or terrestrial spp. and raptors, smaller endemic | High | Short | Local | Low | 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 | *Cannot be specified at this stage* | Minimise noise output of facility? |
| Habitat loss: habitat destruction | Construction footprint | Small endemics | High | Life of the facility | Local | Low | Minimise construction footprint |
| Habitat loss: displacement | Operation - noise and movement | Nesting or foraging large terrestrial spp., foraging or nesting raptors, commuting wetland spp., smaller endemics | Moderate | Life of the facility? | Local | *Cannot be specified at this stage* | Minimise prominence in landscape and noise output |
| Mortality | Electrocution on associated infrastructure | Raptors and storks | High | Life of the facility | Local | *Cannot be specified at this stage* | 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 endemic passerines, | Moderate | Life of the facility | Local | *Cannot be specified at this stage* | Turbine and power line siting, mark turbine blades/power lines, limit operational times or conditions, radar–sensitive management of turbine operation |

AVISENSE CONSULTING

## 8. REFERENCES


Acha, A. 1997. Negative impact of wind generators on the Eurasian Griffon *Gyps fulvus* in Tarifa, Spain. *Vulture News* 38:10-18.

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

Allan, D.G. & Jenkins, A.R. 1990. West Coast heavy mineral sands project: Birdlife on the proposed mining site. Unpublished report. University of Cape Town, Cape Town.

Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.

Avian Powerline Interation Committee (APLIC). 1994. Mitigating bird collisions with power lines: the state of the art in 1994. Edison Electric Institute. Washington DC.

Barclay, R.M.R, Baerwald, E.F. & Gruver, J.C. 2007. Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. *Canadian Journal of Zoology* 85: 381-387.

Barrios, L. & Rodríguez, A. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. *Journal of Applied Ecology* 41: 72-81.

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.

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

Bevanger, K. 1995. Estimates and population consequences of Tetraonid mortality caused by collisions with high tension power lines in Norway. *Journal of Applied Ecology* 32: 745-753.

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

Boshoff, A., Piper, S. & Michael, M. 2009. On the distribution and breeding status of the Cape Griffon *Gyps coprotheres* in the Eastern Cape, province, South Africa. *Ostrich* 80: 85-92.

Boshoff, A., Barkhuysen, A., Brown, G. & Michael, M. 2009. Evidence of partial migratory behavior by the Cape Griffon *Gyps coprotheres*. *Ostrich* 80: 129-133.

Bright, J., Langston, R., Bullman, R. Evans, R., Gardner, S., & Pearce-Higgins, J. 2008. Map of bird sensitivities to wind farms in Scotland: A tool to aid planning and conservation. *Biological Conservation* 141: 2342-2356.

Crawford, R.J.M., Cooper, J. & Dyer, B.M. 1995. Conservation of an increasing population of Great White Pelicans *Pelecanus onocrotalus* in South Africa's Western Cape. *S. Afr. J. Mar. Sci.* 15:33-42.

Crawford, R.J.M. & Taylor, R.H. 2000. White Pelican. *In:* Barnes, K.N. (ed.). The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Cape Town. pp. 136.

Crockford, N.J. 1992. A review of the possible impacts of wind farms on birds and other wildlife. Joint Nature Conservation Committee. JNCC Report number 27. Peterborough, United Kingdom.

Curry, R.C., & Kerlinger, P. 2000. Avian mitigation plan: Kenetech model wind turbines, Altamont Pass WRA, California. In: Proceedings of the National Avian-Wind Power Planning Meeting III, San Diego California, May 1998.

Curtis, O., Simmons, R.E. & Jenkins, A.R. 2004. Black Harrier *Circus maurus* of the Fynbos biome, South Africa: a threatened specialist or an adaptable survivor? *Bird Conservation International* 14: 233-245.

De Lucas, M., Janss, G.F.E., Whitfield, D.P. & Ferrer, M. 2008. Collision fatality of raptors in wind farms does not depend on raptor abundance. *Journal of Applied Ecology* 45: 1695-1703.

Devereaux, C/L., Denny, M.J.H. & Whittingham, M.J. 2008. Minimal effects of wind turbines on the distribution of wintering farmland birds. *Journal of Applied Ecology* 45: 1689-1694.

Drewitt, A.L. & Langston, R.H.W. 2006. Assessing the impacts of wind farms on birds. *Ibis* 148: 29-42.

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

Erickson, W.P., Johnson, G.D., Strickland, M.D., Young, D.P., Sernka, K.J., Good, R.E. 2001. Avian collisions with wind turbines: a summary of existing studies and comparison to other sources of avian collision mortality in the United States. National Wind Co-ordinating Committee Resource Document.

Erickson, W.P., Johnson, G.D., Strickland, M.D., Kronner, K. & Becker, P.S. 1999. Baseline avian use and behaviour at the CARES Wind Plant Site, Klickitat County, Washington. Unpublished report to the National Renewable Energy Laboratory. NREL, Colorado.

Everaert, J. 2003. Wind turbines and birds in Flanders: Preliminary study results and recommendations. *Natuur. Oriolus* 69: 145-155.

Farfán, M.A., Vargas, J.M. & Duarte, J. 2009. What is the impact of wind farms on birds. A case study in southern Spain. *Biodiversity Conservation* 18: 3743-3758.

Gill, J.P., Townsley, M. & Mudge, G.P. 1996. Review of the impact of wind farms and other aerial structures upon birds. *Scottish Natural Heritage Review* 21.

Hanowski, J.M., & Hawrot, R.Y. 2000. Avian issues in development of wind energy in western Minnesota. In Proceedings of the National Avian-Wind Power Planning Meeting III, San Diego California, May 1998.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V & Brown, C.J. (eds). 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa, Johannesburg.

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

Hodos, W. 2002. Minimization of motion smear: Reducing avian collisions with turbines. Unpublished subcontractor report to the National Renewable Energy Laboratory. NREL/SR 500-33249.

Howell, J.A. 1995. Avian mortality at rotor sweep areas equivalents Altamont Pass and Montezuma Hills, California. Prepared for Kenetech Wind Power, San Francisco, California.

Janss, G. 2000a. Bird behaviour in and near a wind farm at Tarifa, Spain: Management considerations. In: Proceedings of National Avian-Wind Power Planning Meeting III, San Diego California, May 1998.

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

Jaroslow, B. 1979. A review of factors involved in bird-tower kills, and mitigation procedures. In: G.A. Swanson (Tech co-ord). The Mitigation symposium. A national workshop on mitigation losses of Fish and Wildlife Habitats. US Forest Service General Technical Report. RM-65.

Jenkins, A.R. 1994. The influence of habitat on the distribution and abundance of Peregrine and Lanner Falcons in South Africa. Ostrich 65: 281-290.

Jenkins, A. 1998. Site evaluation for Namakwa Sands heavy minerals sands mine. Unpublished report to the Environmental Evaluation Unit. University of Cape Town, Cape Town.

Jenkins, A.R. 2001. The potential impact of a demonstration wind farm facility on the birds of the Darling / Yzerfontein area, Western Cape Province, South Africa. Unpublished report to the Environmental Evaluation Unit, University of Cape Town, Cape Town.

Jenkins, A.R. 2003. Populations and movements of priority bird species in the vicinity of the proposed Darling Demonstration Wind Farm facility. Unpublished report to the Environmental Evaluation Unit, University of Cape Town, Cape Town.

Jenkins, A.R. 2008a. A proposed new list of the threatened raptors of southern Africa. Gabar 19 (1): 27-40.

Jenkins, A.R. 2008b. Eskom generation wind energy facility – Western Cape: Avifaunal impact assessment. Report to Savannah Environmental Pty (Ltd).

Jenkins, A.R. 2011. Winds of change: birds and wind energy development in South Africa. *Africa – Birds & Birding* 15(6): 35-38.

Jenkins, A., Gibbons, B. & Visagie, R. 2009. Long-term fixed site monitoring of wildlife interactions with power lines across a range of biomes: establishment and maintenance of a long-term bird;power line interaction monitoring site in the De Aar (Hydra) area of the eastern Karoo, Northern Cape. Unpublished report to Eskom.

Jenkins, A.R., Smallie, J.J. & 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.

Kemper, C.A. 1964. A tower for TV: 30 000 dead birds. *Audubon Magazine* 66: 86-90.

Kerlinger, P. & Dowdell, J. 2003. Breeding bird survey for the Flat Rock wind power project, Lewis County, New York. Prepared for Atlantic Renewable Energy Corporation.

Kerlinger, P., Gehring, J.L., Erickson, W.P., Curry, R., Jain, A. & Guarnaccia, J. 2010. Night migrant fatalities and obstruction lighting at wind turbines in North America. *The Wilson Journal of Ornithology* 122: 744-754.

King, D.I. & Byers, B.E. 2002. An evaluation of powerline rights-of-way as habitat for early-successional shrubland birds. *Wildlife Society Bulletin* 30: 868-874.

Kingsley, A. & Whittam, B. 2005. Wind turbines and birds – A background review for environmental assessment. Unpublished report for Environment Canada/Canada Wildlife Service.

Krijgsveld, K.L., Akershoek, K., Schenk, F., Dijk, F. & Dirksen, S. 2009. Collision risk of birds with modern large wind turbines. *Ardea* 97: 357-366.

Küyler, E.J. 2004. The impact of the Eskom Wind Energy Demonstration Facility on local avifauna – Results from the monitoring programme for the time period June 2003 to Jan 2004. Unpublished report to Eskom Peaking Generation.

Kuvlevsky, W.P. Jnr, Brennan, L.A., Morrison, M.L., Boydston, K.K., Ballard, B.M. & Bryant, F.C. 2007. Wind energy development and wildlife conservation: challenges and opportunities. *Journal of Wildlife Management* 71: 2487-2498.

Larsen, J.K. & Guillemette, M. 2007. Effects of wind turbines on flight behaviour of wintering common eiders: implications for habitat use and collision risk. *Journal of Applied Ecology* 44: 516-522.

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

Madders, M. & Whitfield, D.P. 2006. Upland raptors and the assessment of wind farms impacts. *Ibis* 148: 43-56.

Masden, E.A., Fox, A.D., Furness, R.W., Bullman, R. & Haydon, D.T. 2009. Cumulative impact assessments and bird/wind farm interactions: Developing a conceptual framework. *Environmental Impact Assessment Review* 30: 1-7.

McIsaac, H.P. 2001. Raptor acuity and wind turbine blade conspicuity. Pp. 59-87. National Avian-Wind Power Planning Meeting IV, Proceedings. Prepared by Resolve, Inc., Washington DC.

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

National Wind Co-ordinating Committee. 2004. Wind turbine interactions with birds and bats: A summary of research results and remaining questions. Fact Sheet, Second Edition.

Newton, I. & Little, B. 2009. Assessment of wind-farm and other bird casualties from carcasses found on a Northumbrian beach over an 11-year period. *Bird Study* 56: 158-167.

Noguera, J.C., Pérez, I. & Mínguez, E. 2010. Impacts of terrestrial wind farms on diurnal raptors: developing a spatial vulnerability index and potential vulnerability maps. *Ardeola* 57: 41-53.

Pennycuick, C.J. 1989. Bird flight performance: a practical calculation manual. Oxford University Press, Oxford.

Pierce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. 2009. The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, Published Online, September 24, 2009.

Richardson, W.J. 2000. Bird migration and wind turbines: Migration timing, flight behaviour and collision risk. In Proceedings of the National Avian-wind Power Planning Meeting III, San Diego, California, May 1998.

Scottish National Heritage. 2005. Survey methods for use in assessing the impacts of onshore windfarms on bird communities. Unpublished Report.

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

Shaw, J., Jenkins, A.R., Ryan, P.G. & Smallie, J. 2010b. A preliminary survey of avian mortality on power lines in the Overberg, South Africa. *Ostrich* 81: 109-113.

Stewart, G.B., Pullin, A.S. & Coles, C.F. 2007. Poor evidence-base for assessment of windfarm impacts on birds. *Environmental Conservation* 34: 1-11.

Smallwood, K.S. & Thelander, C. 2008. Bird mortality in the Altamont Pass Wind Resource Area, California. *Journal of Wildlife Management* 72: 215-223.

Smallwood, K.S., Rugge, L. & Morrison, M.L. 2009. Influence of behavior on bird mortality in wind energy developments. *Journal of Wildlife Management* 73: 1082-1098.

Sovacool, B.K. 2009. Contextualizing avian mortality: a preliminary appraisal of bird and bat fatalities from wind, fossil-fuel, and nuclear electricity. *Energy Policy* 37: 2241-2248.

Tapia, L., Dominguez, J. & Rodriguez, L. 2009. Using probability of occurrence to assess potential interaction between wind farms and a residual population of golden eagle *Aquila chrysaetos* in NW Spain. *Biodiversity & Conservation* 18: 2033-2041.

Van Rooyen, C. 2001. Bird Impact Assessment Study – Eskom Wind Energy Demonstration Facility, Western Cape South Africa. Prepared for Eskom Enterprises, TSI Division.

Van Rooyen, C.S. 2004a. The Management of Wildlife Interactions with overhead lines. In The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.

Van Rooyen, C.S. 2004b. Investigations into vulture electrocutions on the Edwardsdam-Mareetsane 88kV feeder, Unpublished report, Endangered Wildlife Trust, Johannesburg.

Van Zyl, A.J, Jenkins, A.R. & Allan, D.G. 1994. Evidence for seasonal movement by Rock Kestrels *Falco tinnunculus* and Lanner Falcons *F. biarmicus* in South Africa. *Ostrich* 65:111-121.

Weir, R. D. 1976. Annotated bibliography of bird kills at manmade obstacles: a review of the state of the art and solutions. Canadian Wildlife Services, Ontario Region, Ottawa.

Walker, D., McGrady, M., McCluskie, A., Madders, M. & McLeod, D.R.A. 2005. Resident Golden Eagle ranging behavior before and after construction of a windfarm in Argyll. *Scottish Birds* 25: 24-40.

Winkelman, J.E. 1995. Bird/wind turbine investigations in Europe. In Proceedings of the National Avian- wind Power Planning Meeting 1994.

Young, D.J., Harrison, J.A., Navarro, R.A., Anderson, M.D. & Colahan, B.D. (eds). 2003. Big birds on farms: Mazda CAR report 1993-2001. Avian Demography Unit, Cape Town.

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 Tsitsikamma Wind energy facility.

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| Common Ostrich | *Struthio camelus* | | | X | X | | |
| Red-necked Spurfowl | *Pternistes afer* | | | X | X | X | |
| Common Quail | *Coturnix coturnix* | | | X | X | | |
| Helmeted Guineafowl | *Numida meleagris* | | | X | X | | |
| Egyptian Goose | *Alopochen aegyptiaca* | | | | X | | X |
| South African Shelduck | *Tadorna cana* | | Endemic | | | | X |
| Spur-winged Goose | *Plectropterus gambensis* | | | | X | | X |
| Cape Teal | *Anas capensis* | | | | | | X |
| African Black Duck | *Anas sparsa* | | | | | | X |
| Yellow-billed Duck | *Anas undulata* | | | | | | X |
| Cape Shoveler | *Anas smithii* | | Endemic | | | | X |
| Red-billed Teal | *Anas erythrorhyncha* | | | | | | X |
| Scaly-throated Honeyguide | *Indicator variegatus* | | | | | X | |
| Greater Honeyguide | *Indicator indicator* | | | | | X | |
| Lesser Honeyguide | *Indicator minor* | | | | | X | |
| Knysna Woodpecker | *Campethera notata* | Near-threatened | Endemic | | | X | |
| Ground Woodpecker | *Geocolaptes olivaceus* | | Endemic | X | | | |
| Cardinal Woodpecker | *Dendropicos fuscescens* | | | | | X | |
| Olive Woodpecker | *Dendropicos griseocephalus* | | | | | X | |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | | | | | X | |
| Acacia Pied Barbet | *Tricholaema leucomelas* | | Near-endemic | | | X | |
| Crowned Hornbill | *Tockus alboterminatus* | | | | | X | |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| African Hoopoe | *Upupa africana* | | | | | X | |
| Green Wood-Hoopoe | *Phoeniculus purpureus* | | | | | X | |
| European Roller | *Coracias garrulus* | | | | X | | |
| Half-collared Kingfisher | *Alcedo semitorquata* | Near-threatened | | | | | X |
| Malachite Kingfisher | *Alcedo cristata* | | | | | | X |
| Brown-hooded Kingfisher | *Halcyon albiventris* | | | | | X | |
| Giant Kingfisher | *Megaceryle maximus* | | | | | | X |
| Pied Kingfisher | *Ceryle rudis* | | | | | | X |
| European Bee-eater | *Merops apiaster* | | | X | X | | |
| Speckled Mousebird | *Colius striatus* | | | X | X | | |
| Red-faced Mousebird | *Urocolius indicus* | | | X | X | | |
| Jacobin Cuckoo | *Clamator jacobinus* | | | X | | X | |
| Great Spotted Cuckoo | *Clamator glandarius* | | | X | | X | |
| Red-chested Cuckoo | *Cuculus solitarius* | | | | | X | |
| Black Cuckoo | *Cuculus clamosus* | | | | | X | |
| Klaas's Cuckoo | *Chrysococcyx klaas* | | | X | | X | |
| Diderick Cuckoo | *Chrysococcyx caprius* | | | X | | X | |
| Burchell's Coucal | *Centropus burchellii* | | | | | | X |
| Alpine Swift | *Tachymarptis melba* | | | X | | | |
| Common Swift | *Apus apus* | | | X | | | |
| African Black Swift | *Apus barbatus* | | | X | | | |
| Little Swift | *Apus affinis* | | | X | | | |
| Horus Swift | *Apus horus* | | | X | | | |
| White-rumped Swift | *Apus caffer* | | | X | | | |
| Barn Owl | *Tyto alba* | | | X | X | | |
| Spotted Eagle-Owl | *Bubo africanus* | | | X | X | | |
| African Wood-Owl | *Strix woodfordii* | | | | | X | |
| Marsh Owl | *Asio capensis* | | | | | | X |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| Fiery-necked Nightjar | *Caprimulgus pectoralis* | | | X | | | |
| Rock Dove | *Columba livia* | | | X | X | | |
| Speckled Pigeon | *Columba guinea* | | | | X | | |
| African Olive-Pigeon | *Columba arquatrix* | | | | | X | |
| Laughing Dove | *Streptopelia senegalensis* | | | X | X | | |
| Cape Turtle-Dove | *Streptopelia capicola* | | | X | X | | |
| Red-eyed Dove | *Streptopelia semitorquata* | | | | X | X | |
| Emerald-spotted Wood-Dove | *Turtur chalcospilos* | | | | | X | |
| Tambourine Dove | *Turtur tympanistria* | | | | | X | |
| Namaqua Dove | *Oena capensis* | | | X | | | |
| Denham's Bustard | *Neotis denhami* | Vulnerable | | X | X | | |
| Southern Black Korhaan | *Afrotis afra* | | Endemic | X | X | | |
| White-bellied Korhaan | *Eupodotis senegalensis* | Vulnerable | | X | | | |
| Blue Crane | *Anthropoides paradiseus* | Vulnerable | Endemic | X | X | | |
| Buff-spotted Flufftail | *Sarothrura elegans* | | | | | X | |
| Red-chested Flufftail | *Sarothrura rufa* | | | | | | X |
| African Rail | *Rallus caerulescens* | | | | | | X |
| Black Crake | *Amaurornis flavirostris* | | | | | | X |
| Baillon's Crake | *Porzana pusilla* | | | | | | X |
| African Purple Swamphen | *Porphyrio madagascariensis* | | | | | | X |
| African Finfoot | *Podica senegalensis* | Near-threatened | - | | | | X |
| Common Moorhen | *Gallinula chloropus* | | | | | | X |
| Red-knobbed Coot | *Fulica cristata* | | | | | | X |
| African Snipe | *Gallinago nigripennis* | | | X | | | X |
| African Jacana | *Actophilornis africanus* | | | | | | X |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| Water Thick-knee | *Burhinus vermiculatus* | | | | | | X |
| Spotted Thick-knee | *Burhinus capensis* | | | X | X | | |
| Black-winged Stilt | *Himantopus himantopus* | | | | | | X |
| Pied Avocet | *Recurvirostra avosetta* | | | | | | X |
| Kittlitz's Plover | *Charadrius pecuarius* | | | | | | X |
| Three-banded Plover | *Charadrius tricollaris* | | | | | | X |
| Blacksmith Lapwing | *Vanellus armatus* | | | | | | X |
| Black-winged Lapwing | *Vanellus melanopterus* | Near-threatened | | X | X | | |
| Crowned Lapwing | *Vanellus coronatus* | | | X | X | | |
| Whiskered Tern | *Chlidonias hybrida* | | | | | | X |
| White-winged Tern | *Chlidonias leucopterus* | | | | | | X |
| African Cuckoo Hawk | *Aviceda cuculoides* | | | X | | X | |
| Black-shouldered Kite | *Elanus caeruleus* | | | X | X | | |
| Black Kite | *Milvus migrans* | | | X | X | | |
| African Fish-Eagle | *Haliaeetus vocifer* | | | | | | X |
| African Marsh-Harrier | *Circus ranivorus* | Vulnerable | | | X | | X |
| Black Harrier | *Circus maurus* | Near-threatened | Endemic | X | X | | X |
| Pallid Harrier | *Circus macrourus* | Near-threatened | | X | | | |
| African Harrier-Hawk | *Polyboroides typus* | | | | | X | |
| African Goshawk | *Accipiter tachiro* | | | | | X | |
| Little Sparrowhawk | *Accipiter minullus* | | | | | X | |
| Rufous-chested Sparrowhawk | *Accipiter rufiventris* | | | | | X | |
| Black Sparrowhawk | *Accipiter melanoleucus* | | | | | X | |
| Steppe Buzzard | *Buteo vulpinus* | | | | X | X | |
| Forest Buzzard | *Buteo trizonatus* | | Endemic | | X | X | |
| Jackal Buzzard | *Buteo rufofuscus* | | Endemic | X | X | X | |
| Verreaux' Eagle | *Aquila verreauxii* | | | X | | | |
| Booted Eagle | *Aquila pennatus* | | | X | X | | |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| Martial Eagle | *Polemaetus bellicosus* | Vulnerable | | X | | | |
| Long-crested Eagle | *Lophaetus occipitalis* | | | | | X | X |
| African Crowned Eagle | *Stephanoaetus coronatus* | Near-threatened | | | | X | |
| Secretarybird | *Sagittarius serpentarius* | Near-threatened | | X | X | | |
| Lesser Kestrel | *Falco naumanni* | Vulnerable | | X | X | | |
| Rock Kestrel | *Falco rupicolus* | | | X | X | | |
| Amur Falcon | *Falco amurensis* | | | X | X | | |
| Eurasian Hobby | *Falco subbuteo* | | | X | | X | |
| Lanner Falcon | *Falco biarmicus* | Near-threatened | | X | X | | |
| Peregrine Falcon | *Falco peregrinus* | Near-threatened | | X | X | | |
| Little Grebe | *Tachybaptus ruficollis* | | | | | | X |
| Great Crested Grebe | *Podiceps cristatus* | | | | | | X |
| African Darter | *Anhinga rufa* | | | | | | X |
| Reed Cormorant | *Phalacrocorax africanus* | | | | | | X |
| White-breasted Cormorant | *Phalacrocorax lucidus* | | | | | | X |
| Little Egret | *Egretta garzetta* | | | | | | X |
| Yellow-billed Egret | *Egretta intermedia* | | | | | | X |
| Great Egret | *Egretta alba* | | | | | | X |
| Grey Heron | *Ardea cinerea* | | | | | | X |
| Black-headed Heron | *Ardea melanocephala* | | | X | X | | X |
| Purple Heron | *Ardea purpurea* | | | | | | |
| Cattle Egret | *Bubulcus ibis* | | | | X | | X |
| Squacco Heron | *Ardeola ralloides* | | | | | | X |
| Little Bittern | *Ixobrychus minutus* | | | | | | X |
| Hamerkop | *Scopus umbretta* | | | | | | X |
| Hadeda Ibis | *Bostrychia hagedash* | | | | X | X | X |
| African Sacred Ibis | *Threskiornis aethiopicus* | | | | X | | X |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| African Spoonbill | *Platalea alba* | | | | | | X |
| Yellow-billed Stork | *Mycteria ibis* | Near-threatened | | | | | X |
| Black Stork | *Ciconia nigra* | Near-threatened | | X | | | X |
| White Stork | *Ciconia ciconia* | | | X | X | | X |
| Black-headed Oriole | *Oriolus larvatus* | | | | | X | |
| Fork-tailed Drongo | *Dicrurus adsimilis* | | | | | X | |
| Blue-mantled Crested-Flycatcher | *Trochocercus cyanomelas* | | | | | X | |
| African Paradise-Flycatcher | *Terpsiphone viridis* | | | | | X | |
| Black-backed Puffback | *Dryoscopus cubla* | | | | | X | |
| Southern Tchagra | *Tchagra tchagra* | | Endemic | X | | X | |
| Southern Boubou | *Laniarius ferrugineus* | | Endemic | X | | X | |
| Bokmakierie | *Telophorus zeylonus* | | Near-endemic | X | | | |
| Grey-headed Bush-Shrike | *Malaconotus blanchoti* | | | | | X | |
| Cape Batis | *Batis capensis* | | Endemic | X | | X | |
| Cape Crow | *Corvus capensis* | | | X | X | X | |
| Pied Crow | *Corvus albus* | | | X | X | | |
| White-necked Raven | *Corvus albicollis* | | | X | X | | |
| Red-backed Shrike | *Lanius collurio* | | | X | X | | |
| Common Fiscal | *Lanius collaris* | | | X | X | | |
| Black Cuckooshrike | *Campephaga flava* | | | | | X | |
| Southern Black Tit | *Parus niger* | | | X | | X | |
| Brown-throated Martin | *Riparia paludicola* | | | | | | X |
| Banded Martin | *Riparia cincta* | | | X | X | | X |
| Barn Swallow | *Hirundo rustica* | | | X | X | | X |
| White-throated Swallow | *Hirundo albigularis* | | | | | | X |
| Pearl-breasted Swallow | *Hirundo dimidiata* | | | X | X | | X |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| Greater Striped Swallow | *Hirundo cucullata* | | | X | X | | |
| Lesser Striped Swallow | *Hirundo abyssinica* | | | X | X | | |
| Rock Martin | *Hirundo fuligula* | | | X | | | |
| Common House-Martin | *Delichon urbicum* | | | X | X | | X |
| Black Saw-wing | *Psalidoprocne holomelaena* | | | | | X | |
| Cape Bulbul | *Pycnonotus capensis* | | Endemic | X | | X | |
| Sombre Greenbul | *Andropadus importunus* | | | | | X | |
| Fairy Flycatcher | *Stenostira scita* | | Endemic | X | | | |
| Cape Grassbird | *Sphenoeacus afer* | | Endemic | X | | | |
| Victorin's Warbler | *Cryptillas victorini* | | Endemic | X | | | |
| Little Rush-Warbler | *Bradypterus baboecala* | | | | | | X |
| Knysna Warbler | *Bradypterus sylvaticus* | Vulnerable | Endemic | | | X | |
| African Reed-Warbler | *Acrocephalus baeticatus* | | | | | | X |
| Lesser Swamp-Warbler | *Acrocephalus gracilirostris* | | | | | | X |
| Yellow-throated Woodland-Warbler | *Phylloscopus ruficapilla* | | | | | X | |
| Willow Warbler | *Phylloscopus trochilus* | | | | | X | |
| Cape White-eye | *Zosterops virens* | | Endemic | X | | X | |
| Lazy Cisticola | *Cisticola aberrans* | | | X | | | |
| Grey-backed Cisticola | *Cisticola subruficapilla* | | Near-endemic | X | | | |
| Wailing Cisticola | *Cisticola lais* | | | X | | | |
| Levaillant's Cisticola | *Cisticola tinniens* | | | | | | X |
| Neddicky | *Cisticola fulvicapilla* | | | X | | | |
| Zitting Cisticola | *Cisticola juncidis* | | | | X | | |
| Cloud Cisticola | *Cisticola textrix* | | Near-endemic | | X | | |
| Karoo Prinia | *Prinia maculosa* | | Endemic | X | | X | |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| Bar-throated Apalis | *Apalis thoracica* | | | | | X | |
| Yellow-breasted Apalis | *Apalis flavida* | | | | | X | |
| Green-backed Camaroptera | *Camaroptera brachyura* | | | | | X | |
| Rufous-naped Lark | *Mirafra africana* | | | X | X | | |
| Cape Clapper Lark | *Mirafra apiata* | | Endemic | X | X | | |
| Eastern Long-billed Lark | *Certhilauda semitorquata* | | Endemic | X | X | | |
| Red-capped Lark | *Calandrella cinerea* | | | X | X | | |
| Cape Rock-Thrush | *Monticola rupestris* | | Endemic | X | | | |
| Olive Thrush | *Turdus olivaceus* | | | | | X | |
| Southern Black Flycatcher | *Melaenornis pammelaina* | | | | | X | |
| Fiscal Flycatcher | *Sigelus silens* | | Endemic | X | | X | |
| Spotted Flycatcher | *Muscicapa striata* | | | | | X | |
| African Dusky Flycatcher | *Muscicapa adusta* | | | | | X | |
| Cape Robin-Chat | *Cossypha caffra* | | | | | X | |
| White-browed Scrub-Robin | *Cercotrichas leucophrys* | | | | | X | |
| African Stonechat | *Saxicola torquatus* | | | X | X | | |
| Capped Wheatear | *Oenanthe pileata* | | | X | X | | |
| Familiar Chat | *Cercomela familiaris* | | | X | X | | |
| Ant-eating Chat | *Myrmecocichla formicivora* | | Endemic | X | | | |
| Red-winged Starling | *Onychognathus morio* | | | X | | | |
| Cape Glossy Starling | *Lamprotornis nitens* | | | | | X | |
| Pied Starling | *Spreo bicolor* | | Endemic | X | X | | |
| Wattled Starling | *Creatophora cinerea* | | | X | X | | |
| Common Starling | *Sturnus vulgaris* | | | | X | | |
| Cape Sugarbird | *Promerops cafer* | | Endemic | X | | | |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| Orange-breasted Sunbird | *Anthobaphes violacea* | | Endemic | X | | | |
| Amethyst Sunbird | *Chalcomitra amethystina* | | | | | X | |
| Malachite Sunbird | *Nectarinia famosa* | | | X | | X | |
| Collared Sunbird | *Hedydipna collaris* | | | | | X | |
| Southern Double-collared Sunbird | *Cinnyris chalybeus* | | Endemic | X | | X | |
| Greater Double-collared Sunbird | *Cinnyris afer* | | Endemic | X | | X | |
| Cape Sugarbird | *Promerops cafer* | | Endemic | X | | | |
| Spectacled Weaver | *Ploceus ocularis* | | | X | | X | X |
| Cape Weaver | *Ploceus capensis* | | Endemic | X | | X | X |
| Southern Masked-Weaver | *Ploceus velatus* | | | X | | X | X |
| Red-billed Quelea | *Quelea quelea* | | | X | X | | |
| Southern Red Bishop | *Euplectes orix* | | | | X | | X |
| Yellow Bishop | *Euplectes capensis* | | | | | | X |
| Thick-billed Weaver | *Amblyospiza albifrons* | | | | | | X |
| African Quailfinch | *Ortygospiza atricollis* | | | | X | | |
| Swee Waxbill | *Coccopygia melanotis* | | Endemic | | | X | |
| Common Waxbill | *Estrilda astrild* | | | | | | X |
| African Firefinch | *Lagonosticta rubricata* | | | | | X | |
| Bronze Mannikin | *Spermestes cucullatus* | | | | | | X |
| Pin-tailed Whydah | *Vidua macroura* | | | X | X | | |
| Dusky Indigobird | *Vidua funerea* | | | | | X | |
| House Sparrow | *Passer domesticus* | | | X | X | | |
| Cape Sparrow | *Passer melanurus* | | Near-endemic | X | X | | |
| Southern Grey-headed Sparrow | *Passer diffusus* | | | | X | X | |
| African Pied Wagtail | *Motacilla aguimp* | | | | | | X |
| Cape Wagtail | *Motacilla capensis* | | | X | X | | X |

| Common name | Scientific name | Conservation status | Regional endemicity | Habitat | | | |
|---|---|---|---|---|---|---|---|
| | | | | Fynbos / Renosterveld slopes | Old pastures and cultivated lands | Indigenous and alien forest | Wetlands |
| Cape Longclaw | *Macronyx capensis* | | Endemic | X | X | | |
| African Pipit | *Anthus cinnamomeus* | | | X | X | | |
| Plain-backed Pipit | *Anthus leucophrys* | | | X | X | | |
| Long-billed Pipit | *Anthus similis* | | | X | X | | |
| Cape Canary | *Serinus canicollis* | | Endemic | X | X | | |
| Brimstone Canary | *Crithagra sulphuratus* | | | | | X | |
| White-throated Canary | *Crithagra albogularis* | | Near-endemic | X | | | |
| Streaky-headed Seedeater | *Crithagra gularis* | | | X | | | |
| Cape Bunting | *Emberiza capensis* | | Near-endemic | X | X | | |