(8)

Marais, Wanda

From:	John Geeringh <GeerinJH@eskom.co.za>
Sent:	14 June 2017 02:01 PM
To:	Marais, Wanda
Subject:	RE: NOTICE OF COMMENT PERIOD: PROPOSED INYANDA-ROODEPLAAT WIND ENERGY FACILITY

I do not have any further comments regarding this development. Once final layouts are available, please submit a KMZ file to me indicating all the development footprints and power line connection route, etc.

Regards

John Geeringh (Pr. Sci. Nat.)
Senior Consultant Environmental Management

Eskom GC: Land Development
Megawatt Park
D1Y39
P O Box 1091
Johannesburg
2000

Tel: 011 516 7233
Fax: 086 661 4064
Cell: 083 632 7663

From: Marais, Wanda [mailto:WMarais@srk.co.za]
Sent: 14 June 2017 12:22 PM
Subject: NOTICE OF COMMENT PERIOD: PROPOSED INYANDA-ROODEPLAAT WIND ENERGY FACILITY
Importance: High

Dear Authorities, Stakeholders & Interested and Affected Parties,

NOTICE OF COMMENT PERIOD: PROPOSED INYANDA-ROODEPLAAT WIND ENERGY FACILITY
DEA Reference Number: 14/12/16/3/3/2/464

As per our previous correspondence, SRK Consulting submitted the Final Environmental Impact Report (FEIR) for the proposed Inyanda-Roodeplaat Wind Energy Facility to the Department of Environmental Affairs (DEA) in November 2016. DEA has subsequently rejected the FEIR requiring more details and / or clarity on a number of items. In response to this rejection, SRK has drafted an Addendum to the FEIR addressing the concerns raised by DEA. Each comment in DEA's letter is reproduced in the Addendum and responses are provided per comment. Where relevant, supporting information is included in appendices.

Attached, please find a copy of this Addendum to the FEIR (minus appendices). A copy of the complete Addendum (including appendices) is available in printed form at the Uitenhage Public Library and the Kirkwood Public Library. It can also be accessed in electronic form on the SRK webpage using the link: http://www.srk.co.za/en/page/za-public-documents

The Addendum is open for a 30-day comment period from **14 June 2017** to **17 July 2017**. Should you wish to comment on this Addendum, please submit such comment in writing by **17h00 on 17 July 2017** to:

(9)

Marais, Wanda

From: Alan Lee <alan.tk.lee@googlemail.com>
Sent: 26 June 2017 07:49 AM
To: Marais, Wanda

Subject: Re: NOTICE OF COMMENT PERIOD: PROPOSED INYANDA-ROODEPLAAT WIND ENERGY FACILITY
Attachments: 478867_Roodeplaat WEF FEIR Addendum_20170613.pdf

Dear Wanda,

Thank you for the opportunity to comment on the response document:
478867:Inyanda - Roodeplaat WEF: FEIR Addendum (Draft for comment).

For this response, I restrict my comments to the section on avifauna, being my area of expertise.

I am alarmed to see that the DEA recommendations for further review of the avifauna reports have been brushed off by the applicant, based on what they state to be a DEA misunderstanding of the contents of the report (page 7). It appears to me that the DEA were merely being succinct in their request for more information. The lack of a willingness to cooperate as requested is alarming. If this belligerence is a tone set throughout the document, I would recommend the DEA seriously consider this application based purely on a poor attitude with regards the willingness to cooperate.

The reasons for the brush off for further work to be conducted on the avifauna appear to be both shallow and contradictory. Here I
elaborate:

On page 7, second paragraph you write: "This suggests that the method employed by Percival in this assessment is more robust than is usually the case for four of the species modelled". In otherwords, the consultants agree that the modelled collision rates of the raptors are very high?

The analysis of the Smallie data by Percival shows a lower impact rate, but yet Smallie's conclusion is the impact on avifauna is too great to allow the project to proceed. By contrast, Percival with his higher impact rate on his data suggests it is okay to proceed. These contradictory conclusions warrant further investigation. With collision rates for the Endangered Black Harrier ranging from 0.7 to 7 per year (Table 12), how is this recommendation to proceed justifiable? Even if it is argued that the Percival data is 'better', the conclusion resulting from this analysis does not match the hazard presented to the population of raptors presented by this windfarm.

Furthermore on page 7 it is stated: "The Percival study was originally intended by the Applicant as a review of the Smallie report". In this case, my argument would be: why would the 'review' of the impact of Smallie's report, where the conclusion of the 'review' was favourable to development despite evidence to the contrary, then be submitted as the actual report? Clearly, if there is any misunderstanding, it is on the part of the consultants, which at worst is an attempt to mislead the DEA with favourable conclusions.

It could be further argued that the Percival report was externally
reviewed: by myself, at no expense to the consultants. In my review, in which I flag many issues, I highlight the information buried in the report that expose the great risks of the development to avifauna, but how these are misinterpreted in the executive summary. I note that there was no response to my concerns from this review: poor practise, the consultants have stuck with the final 'no serious impact on avifauna' story despite obvious evidence to the contrary.

In conclusion, there is growing body of data to show that South Africa's avifauna, especially raptors, are extremely prone to mortalities resulting from collision with wind-turbines.

Unfortunately, this information is still in the process of being peer reviewed and published. Regardless: even the 'conservative' avoidance rates based on Scottish raptors used by Percival may be inadequate to explain vulnerability of South Africa's unique set of raptors to turbines through inadequate avoidance rates used in collision risk modelling.

The threat posed by this development to Black Harrier's and Verreaux's Eagle, together with further degradation that would result of the development to a host of other taxa cannot be ignored: The development CANNOT be allowed to take place.

Regards,

Dr Alan Lee

Editor-in-Chief of Ostrich: Journal of African Ornithology & Research Associate at the FitzPatrick Institute of African Ornithology.

23 June 2017

PS contents of this email attached as pdf for your convenience

On 14/06/2017, Marais, Wanda <WMarais@srk.co.za> wrote:
> Dear Authorities, Stakeholders & Interested and Affected Parties,
>
> NOTICE OF COMMENT PERIOD: PROPOSED INYANDA-ROODEPLAAT WIND ENERGY
> FACILITY DEA Reference Number: 14/12/16/3/3/2/464
>
> As per our previous correspondence, SRK Consulting submitted the Final
> Environmental Impact Report (FEIR) for the proposed Inyanda-Roodeplaat
> Wind Energy Facility to the Department of Environmental Affairs (DEA)
> in November 2016. DEA has subsequently rejected the FEIR requiring
> more details and / or clarity on a number of items. In response to
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> concerns raised by DEA. Each comment in DEA's letter is reproduced in
> the Addendum and responses are provided per comment. Where relevant,
> supporting information is included in appendices.
>
> Attached, please find a copy of this Addendum to the FEIR (minus
> appendices). A copy of the complete Addendum (including appendices) is
> available in printed form at the Uitenhage Public Library and the
> Kirkwood Public Library. It can also be accessed in electronic form on
> the SRK webpage using the link:
> http://www.srk.co.za/en/page/za-public-documents
>
> The Addendum is open for a 30-day comment period from 14 June 2017 to
> 17 July 2017. Should you wish to comment on this Addendum, please
> submit such comment in writing by 17h00 on 17 July 2017 to:
>
> Wanda Marais
> SRK Consulting
> PO Box 21842, Port Elizabeth, 6000
> Email: wmarais@srk.co.za<mailto:wmarais@srk.co.za>
> Fax: (041) 509 4850
> Kind Regards,
>

> Wanda Marais B Proc
> Public Participation Practitioner
>
> [cid:image002.jpg@01D051DF.95D92FE0]
>
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> SRK Consulting (South Africa) (Pty) Ltd
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>

> [cid:image005.gif@01CB2FDE.31730DA0]
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Alan Lee

Editor-in-chief @
Ostrich: Journal of African Ornithology

Research Associate @
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10

ZUNGAH SAFARIS

... your very own piece of Africa

Third submission: 12 July 2017

Attention: Ms Milicent Solomons / Mr Muhammad Essop
CC: Ms. Wanda Marais

Comments on the Final Environmental Impact Report: Proposed Inyanda- Roodeplaat Wind Energy Facility, Farm Roodeplaat, Uitenhage, Eastern Cape
DEA Reference: 14/12/16/3/3/2/464

Dear Sir/Madam

1 **Section2.4 (Preferred Layout) page 11 of the Addendum EIAr:**
It is unclear what the EAP means by: "*Recognising that the assessment of alternatives is a requirement of the EIA regulations, it is noted that the assessment of layout alternatives is not prescribed*". According to the NEMA 2010 EIA Regulations, Regulation 31 (2) (g), an EIA report must provide: "*a description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity*"; and (i) "*a description and comparative assessment of all alternatives identified during the environmental impact assessment process*". If one looks at the definition of "alternatives" in these Regulations an alternative is:

"alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to—
(a) the property on which or location where it is proposed to undertake the activity;
(b) the type of activity to be undertaken;
(c) the design or layout of the activity;
(d) the technology to be used in the activity;
(e) the operational aspects of the activity; and
(f) the option of not implementing the activity".

Please clarify this.

2 **Section2.14 (Public Participation) page 18 of the Addendum EIAr:**
[if !supportLists]2.1 [endif]One of the comments made by us on the DEIAr was that we queried whether any public meetings were held during the public participation process. The response was that only one meeting was held to discuss the Draft Scoping Report. This took place on the 23rd of October 2013 in Port Elizabeth. Was no other meetings held? On the Draft EIA even? Information that become available in the EIA phase is generally a lot more detailed and as such one would have thought that a public meeting would have been held discuss these findings with I&APs.
[if !supportLists]2.2 [endif]Progress regarding other applicable licences/permits were requested and we deem the response to us inadequate which states that "*These permits are usually obtained subsequent to the environmental authorisation of a project. The WUL application has been submitted and proof is included in Appendix I6*". I have not approved any access to my property – which I understand is required for the WULA and as such I would like you to please confirm how the WULA process is going to be concluded without my access consent.
[if !supportLists]2.3 [endif]In addition we provided comments on the FEIAr on 8 December 2016 to which we have not seen any responses to? Please note that these comments remain.

Kind Regards

Christopher Bolton

Charles William Bolton

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20 May 2016
Attention: Ms. Wanda Marais

Comments on the Draft Environmental Impact Report: Proposed Inyanda- Roodeplaat Wind Energy Facility, Farm Roodeplaat, Uitenhage, Eastern Cape
DEA Reference: 14/12/16/3/3/2/464

I, the owner of a bordering farm, oppose the erection of the Roodeplaat wind energy facility. The opinions expressed, that follow, is based on personal observation and experience in the Eco-Tourism industry. It also identifies some concerns over the effects of the project in question. As bordering landowner, environmentalist and concerned citizen, I hope my apprehension is noted.

I urge the responsible parties to acknowledge that not all interested persons have the education or background to grasp the vernacular used in the report presented for public viewing, thus making it difficult for public to give viable comment. Was a public meeting held in order for the public to attend and discuss any issues and concerns with the consultants?

In the Draft Environmental Impact Report it was remarked that the study was spearheaded by Coastal and Environmental Services. What are the reasons for the resignation of the company that did the original EIA and why has the EIA process not been restarted by the new consultants? I suggest an external review as chosen by the competent authority.

There are 3 points which are significant to myself and the people I associate with. Firstly, the visual impact of the proposed wind farm will affect a much larger area than studied in the EIA. Secondly, damaging consequences the proposed wind farm will have on fauna and flora therefore our natural environment. Finally, how the project will affect me and my staff, as bordering landowner.

Turbines of this magnitude will be visible from Jefferys Bay, Grahamstown and the Graaff-Reinette Mountains. It will also affect Eco-Tourism on surrounding farms and Reserves, including but not limited to the Groendal Nature reserve, Baviaanskloof conservancy and Elands River Conservancy, negatively. Not to mention The Addo Elephant National Park and The Greater Addo Elephant National park. Mountaineers/outdoorsmen and international travelers who come to the Groot Winterhoek Mountains and surrounds to experience nature and the beauty South Africa's Eastern Cape has to offer will be greatly discouraged. Consequently, a decline in the economic gain tourists offer can be expected. I find it concerning that SANParks has not indicated much concern about the effect of this development on the environment, regardless whether or not the proposed site is within their planning domain or not. Has any other, less sensitive sites been considered?

In Addition to the above, natural habitat that is home to a vast array of species and consisting of delicate eco-systems will, in my opinion, be adversely affected. There are some unresolved issues concerning the fauna and flora that is of concern. These include mammal, reptile and bird species, specifically bats, eagles, chameleons and leopard. Most of these have already been commented on, as is seen in the Executive Summary of the Draft EIA. The outcomes in the EIA is also stated as opinion, thus different outlooks should be considered. It is of concern that the restricting EIA study boundary influence the outcome of the results.

Further to the above, what are the progress of the other authorizations required:

- The Water use License from the Department of Water and Sanitation
- The Surface usage application from Department of Mineral Resources
- Plant permits removal for protected species
- The Destruction permit in terms of the National Heritage Resources Act for the

It has also been noted that the proposed location for the WEF is quite some distance from electrical infrastructure which will ultimately mean that the distribution lines to connect the turbines will need to be extensive, increasing the risk area of birds and bats. I would think it is in the best interest of the bird life, that an external and independent bird specialist as chosen by SANParks or the Competent Authority do an external review of the Avifaunal assessment. What is the likelihood of these populations recovering from this disturbance should any individuals or populations be lost?

As a bordering landowner, with a business that involves Hunting and Eco-Tourism it is disconcerting, to myself and my staff, of the effects the project will have on the future of my company. International clientele makes it possible to employ a team who positively benefit from the aesthetics of the Groot Winterhoek Mountain range – this ultimately provides a sense of place and is the whole point to escaping to such a natural area. What about the impact of noise and disturbance to the wild life on my property (particularly during breeding periods), not only during the construction phase but for the life of this development?

Wind turbines of this scale will not only disrupt my business once erected, but also cause upset during the construction phase as well as the maintenance period during the operational phase. This is due to the fact that part of the access road to the building site, runs through my property. A lot of time and effort has been invested into restoring the property to its original condition, as this land was previously owned by stock farmers who over grazed. Ongoing projects that involve replanting Spekboom, erosion control and Wildlife management has been an investment that will be undermined through this project. Hence, if this land would come up for auction, the property value will be greatly decreased. In addition to this, who will be maintain these roads and who will take responsibility for any losses I incur due to this development?

Please note that I would like to be afforded the opportunity to look at the Final EIA that will be submitted.

I hope the concerns raised will be duly noted and taken into consideration before making a final decision.

Kind Regards
Christopher Bolton & associates

Christopher Bolton

Charles William Bolton

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... your very own piece of Africa

Second submission: 8 December 2016

Attention: Ms Milicent Solomons / Mr Muhammad Essop
CC: Ms. Wanda Marais

Comments on the Final Environmental Impact Report: Proposed Inyanda- Roodeplaat Wind Energy Facility, Farm Roodeplaat, Uitenhage, Eastern Cape
DEA Reference: 14/12/16/3/3/2/464

Dear Sir/Madam

I, the owner of a bordering farm, oppose the erection of the Roodeplaat wind energy facility and our initial comments dated 20 May 2016 submitted to the EAP (SRK) remain. We are of the opinion that our comments were not addressed appropriately in the FEIAR. In addition we would also like to add the following additional comments/concerns:

- In the amended application form dated 10 November 2016 (which we as I&APs have not been notified of or been supplied with) states that: "*Written notices were sent to the owners and/or occupants of land immediately surrounding the site and to numerous organs of state*". Please can you elaborate on how we were notified as we cannot find any such notifications – email, post, fax etc. The first notification received by ourselves was when Mr H Newcombe emailed Mr C Bolton on 12 January 2016 requesting him to sign WUA forms for a proposed river crossing. At no stage were we asked to even provide permission for use of this internal access road? It is understood that DRPW gave the proponent permission to use these minor roads as they are proclaimed, however, in terms of access to our private property, no discussions or agreements have been conducted with us. Should any agreement on access to this property be reached, who will take responsibility for loss of wildlife should gates be left open etc? Who will impose penalties to the contractors and compensate me for any loss?
- We as surrounding landowners were also not notified of the Final Scoping report, submission thereof or the availability of the Draft EIAR. It was bought to our attention by an unrelated person visiting the area. In addition it seems that no public meeting was held to discuss the DEIAR. Is this correct? If a public meeting was indeed held, why have we not been notified of the date of this meeting?
- It has also been noted that the EAP did not assess Site alternatives and the response to not doing this has been stated in the FEIAR as: "*No other site alternatives were considered as part of this EIA. Typically site alternatives would need to be included in the scoping phase of an EIA, however the DEA's acceptance of the Final Scoping report (without site alternatives) seems to suggest that the competent authority did not consider assessment of additional site alternatives to be essential in this case*". Do you as the competent authority and SRK as the EAP deem this appropriate - to not assess site alternatives when there is an outcry from so many I&APs? In addition as mentioned by other I&APs, there are degraded land better suited for such a development. Why has this not been considered?
- Please note that we could not find responses to our comments on the progress of other related authorizations as requested on 20 May 2016. Please can you/the EAP refer us to the applicable section where these comments were addressed/responded to?

As mentioned above, our comments dated 20 May 2016 stands.

I hope the concerns raised will be duly noted and taken into consideration before making a final decision.

Kind Regards
Christopher Bolton & associates

Christopher Bolton

Charles William Bolton

(11)

THE ELANDS RIVER CONSERVANCY

ELANDS RIVER

UITENHAGE

PO BOX 736, UITENHAGE, 6230

COMMENTS BY THE ELANDS RIVER CONSERVANCY (ERC) ON THE ADDENDUM TO THE FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED INYANDA ROODEPLAAT WIND ENERGY FACILITY.

DEA REF: 14/12/16/3/3/2/464

PREPARED BY SRK CONSULTING (SRK) AND PUBLISHED JUNE 2017.

The ERC appreciates the Department of Environmental Affairs' concerns regarding the project and acknowledges SRK's responses to the concerns.

All the concerns, as listed in the ERC's previous comments during the scoping phase, are still valid and the following issues have not been properly addressed:

1. ROADS

On 14 December 2016 (3 working days after the comments on the Final Environmental Assessment report had to be delivered) the ERC received a letter (please see attached) from Rushmere Noach Incorporated (RNI) as instructed by their clients. (The ERC's comments for your information, in italic.)

In the letter RNI suggests on page 2:

1.3 The upgrading of the road, which occurred with the permission of the provincial road engineer, was completed during 2012 and complied with all relevant statutory requirements.

It seems as if RNI was not properly informed by their client with the facts regarding the upgrading of the road as in a letter (dated 22 February 2017) to the Department of Economic Development Environment and Tourism.

In the letter RNI stated that the ERC suggests that the fires are linked to the upgrading of the road. The ERC suggests that RNI visit the area in which the mentioned fires occurred.

RNI continues:

4. The irresistible inference to be drawn from your mail is that you (and the ERFPA, as you write in your representative capacity) are mischievously attempting to undermine the Proposed Wind Energy Facility for some unidentified agenda without any rational basis for doing so.

The Elands River Community are farmers, conservationists and job creators and do not have time for "mischievous" actions. The ERC has been registered as an interested and affected party (IAP) and are merely executing the right to share information and comments relevant to the EIA.

RNI concludes:

6. Our clients will not hesitate to pursue all legal remedies against you and the ERFPA, if you are indeed acting on its behalf, should you unnecessarily interfere (as you are now doing) in the environmental process underway. Their rights in this regard are reserved.

This comment is undermining the right of an IAP and the threatening tone might indicate unnecessary interference on their part in the EIA process.

<u>2. FIRE</u>

The ERC has stated in its comments to the FEIR, that it is concerned about the erection of high structures, like wind turbines, in an area known for fires that have been caused by lightning. This issue has not been addressed.

The 2017 statistics for fires in the area caused by lightning are as follows:

Fire originated in Groendal , burned to the Kwa- Zunga. Duration: 24 February – 06 March 2017.

Fire originated in Kwa-Zunga's North- Western side, burned to Weltevrede in the Elands River Valley. Duration: 21 March – 23 March 2017.

Fire originated at Sand River, burned towards Mountain-to- Ocean's Plantations. 26 April – 29 April 2017.

The impact of fire on a sensitive, biodiverse area is immense.

3. WATER

Under the Water Amendment Act, no 27 of 2014, environmental assessments in terms of the Nature Conservation Act, 1989, can be taken into account by the responsible authority when issuing a water license. The area is currently experiencing a severe drought with the lowest average annual rainfall recorded in 25 years.

Not only is the scarcity of water a concern of national importance, but the pollution of water during and after the construction of industrial developments in a pristine area (such as the study area) a threat to an environment already under pressure.

The Elands River Conservancy maintains its opinion that there are many potential places for wind farms in the Eastern Cape and that this pristine area is definitely not appropriate for a facility as proposed.

Rushmere Noach

ATTORNEYS

Elands River Conservancy

Per email: Llisedodd68@gmail.com

Our ref	Your ref	Date
Mr CD Arnold/dr/MAT28157		**14 December 2016**

e-mail: christophera@rushmere.co.za
Direct Telephone: (041) 399 6727
Fax No : (041) 374 3107
Direct Fax : 086 632 2248

Dear Sirs

RE: ROAD/FIRE – PROPOSED INYANDA ROODEPLAAT WIND ENERGY FACILITY

We represent Inyanda Energy Projects Proprietary Limited and Mr Ronnie Watson.

SRK Consulting ("SRK") delivered a copy of your email dated 28 November 2016 to our clients, who have instructed us to respond thereto as follows:

1. Our clients' position is a matter of record. As objectors to the Proposed Wind Energy Facility you would have received our clients' responses to all comments from interested and affected parties, including those already made by you and the Elands River Fire Protection Association ("ERFPA"). We now pertinently bring the following facts to your attention:

1.1 The road was not newly constructed by our clients but in fact existed as a minor road in the Uitenhage District and was approved and proclaimed as such by the Administrator in terms of section 124(4) of the Divisional Council's Ordinance, 1952.

1.2 No maintenance was carried out on the road for a number of years and it was in urgent need of repair and maintenance which included a measure of upgrading. The road was traversed by Mr Watson as part of his normal farming activities, including for the transport of workers and game. Portions of that road also served as a firebreak from neighbouring farms.

1.3 The upgrading of the road, which occurred with the permission of the provincial road engineer, was completed during 2012 and complied with all relevant statutory requirements.

2. Your mail suggests that the upgrading of the road (which was completed in 2012) is somehow linked to fires on the farm in 2014 and 2016. Not only are your conclusions unsupported by any facts but are also fanciful. The points of origin of the fires chronicled in your email were many kilometres away from the road. There is simply no basis for your attempt to attribute the cause of the fires to either the maintenance of the existing road or the development of the Proposed Wind Energy Facility and it was irresponsible of you to have suggested otherwise to SRK as the Environmental Assessment Practitioner ("EAP").

3. The Final Environmental Impact Report has been submitted to the Department of Environmental Affairs. It deals comprehensively with all material environmental aspects and there is in the view of our clients no need for the EAP to deal with the issues raised in your email. Nevertheless SRK, acting independently, must deal with the matter as it sees fit. A copy of this letter will be sent to SRK.

4. The irresistible inference to be drawn from your mail is that you (and the ERFPA, as you write in your representative capacity) are mischievously attempting to undermine the Proposed Wind Energy Facility for some unidentified agenda without any rational basis for doing so.

5. Mr Watson continually strives to implement fire protection measures on his farms and holds the principles of the ERFPA in high regard. However, fires do occur, particularly in the prevailing climatic conditions, from time to time, through circumstances beyond the control of property owners and notwithstanding the implementation of fire protection measures. Mr Watson is well aware of his statutory obligations with regard to the implementation of fire prevention measures and it is unnecessary for you to lecture him or SRK on the 'legal consequences' of not doing so.

6. Our clients will not hesitate to pursue all legal remedies against you and the ERFPA, if you are indeed acting on its behalf, should you unnecessarily interfere (as you are now doing) in the environmental process underway. Their rights in this regard are reserved.

Yours faithfully,
RUSHMERE NOACH INCORPORATED

12

17th July 2017

Dear Wanda,

Thank you for the opportunity to comment on the DEA's rejection of the avifaunal report contained within the FEIR, and SRK's related response.

The DEA requested the appointment of an independent avifaunal specialist to review all the work undertaken by the two avifaunal specialists because their final conclusions and recommendations differed. SRK responded by saying that this was not necessary, as Steve Percival's report was a review of Jon Smallies' work. However in his executive summary, Steve Percival introduces his report as a specialist avifaunal assessment. To now re-position the assessment as a review seems an opportunistic attempt to justify disregarding the DEA's request.

Steve Percival goes out of his way to discredit every single aspect of Jon Smallie's report, yet he admits that Jon Smallie's collision risk assessment, which predicts a significant impact on the Verreaux's Eagle population, cannot be ruled out, because in his own assessment, a predicted 98% avoidance rate shows an increase of between 1.80and 1.85% over the baseline mortality rate for Verreaux's Eagle, which he admits requires careful consideration as to whether a significant effect on Verreaux's Eagles can be ruled out.

Steve Percival's 98% avoidance rate for Verreaux's Eagle is not based on any empirical data. It's pure guesswork based on the Scottish National Heritage Collision Risk Model which has calculated a 99% avoidance rate for Golden Eagles. Steve hedges his bets and decides Verreaux's Eagles are likely to display a 98% avoidance rate. Information currently available clearly indicates that Verreaux's Eagles, (along with Black Harriers) are vulnerable to collisions with wind turbines. BLSA's recent published report, (attached) "Wind Energy's Impacts on Birds in South Africa" provides a preliminary review of the results of operational monitoring at the first wind farms of the renewable energy independent power producer procurement programme in South Africa. In it, five Verreaux's Eagle fatalities have been recorded, four of which at one wind farm within one year. This reflects a far lower avoidance rate than 98%. In this same report, the number of Black Harrier fatalities also came to five, which also calls Steve Percival's avoidance rate for Black Harriers of 99% into question.

This same BLSA report finds that the risk of collision may be related to particular characteristics of the species present in an area, or topography. This suggests that while international experience can help predict potential risks, it is also important to study the effects of wind energy in a particular area or region. Steve Percival mentioned having spent time in the field during April 2015 but does not quantify the hours. However, based on what he observed, he confidently compares the height he saw Verreaux's Eagles fly at, to the data acquired by Jon Smallie's team who spent over a year in the field monitoring raptor flights. By his own admission, Steve Percival concedes that his field surveys did not continue after January 2016 and therefore assumptions have needed to be made on flight activity between January and July 2016.

Steve has paid no heed to the legitimate concerns by specialists, whose data he has reviewed, about the proposed wind farm's proximity to five Verreaux's Eagle nests and one suspected Martial Eagle nest. Jon Smallie, Andrew Jenkins and Adri Barkhuysen, all of whom have many years of experience monitoring South African raptors, are not confident that effective mitigation measures to protect against collision are possible at this site.

Steve Percival readily draws parallels between large raptor flight densities at wind farm sites in the UK and those at Inyanda Roodeplaat. In his comments on the Beinn an Tuirc wind farm Golden Eagle study in Scotland which has shown that post construction, the pair largely avoided the wind farm, Steve fails to mention that this concerned only one pair of Golden Eagles that had their nest over 6 kilometres away from the wind farm. At Inyanda Roodeplaat we have multiple pairs of Verreaux's Eagles with the wind turbines encroaching into their core areas. In Scotland Golden Eagles are afforded a minimum nest buffer of 2.5kms; however in South Africa he is happy to recommend a 1.5km buffer.

These inconsistencies are troubling and of greater concern is the ease with which Steve persists in comparing raptors across continents, not taking into account that behaviour between species differs and is influenced by topography, weather and the raptor community the target species finds itself in. In my view it is absolutely essential to have the work of the two specialists reviewed by an independent and highly regarded avifaunal specialist.

Regards,

Lucia Rodrigues

Western Cape Black Eagle Project

BirdLife South Africa
Giving Conservation Wings

OCCASIONAL REPORT SERIES: 2

Wind energy's impacts on birds in South Africa:

A preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme in South Africa

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Recommended citation: Ralston Paton, S., Smallie J., Pearson A., and Ramalho R. 2017. Wind energy's impacts on birds in South Africa: A preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme in South Africa. *BirdLife South Africa Occasional Report Series No. 2.* BirdLife South Africa, Johannesburg, South Africa

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Acknowledgements: This document was peer reviewed by the Birds and Renewable Energy Specialist Group (Andrew Jenkins, Andrew Pearson, Alvaro Camiña, Birgit Erni, Chris van Rooyen, Craig Whittington-Jones, David Allan, Hanneline Smit-Robinson, Jon Smallie, Kevin Shaw, Lourens Leeuwner, Michael Brooks, Phoebe Barnard, Peter Ryan, Theoni Photopoulou and Vonica Perold). The input and advice of this group is greatly valued and appreciated. We would also like to thank Department of Environmental Affairs and the Centre for Environmental Rights for facilitating access to the post-construction monitoring reports. We are grateful to the following wind farms for their co-operation: Dorper, Jeffreys Bay (Globeleq), Kouga (Astrum Energy), Dassiesklip (BioTherm Energy), Van Stadens (MetroWind) and Nobelsfontein (Gestamp). We would also like to that South African Wind Energy Association for their support and encouragement. Thank you also goes to Melissa Whitcross for proof reading the document. Lastly, BirdLife South Africa's work towards a renewable energy industry that is developed in harmony with nature is made possible though sponsorship from Investec Corporate and Institutional Banking. We are immensely grateful for their on-going support of our work.

Cover Photo: This Martial Eagle, *Polemaetus bellicosus*, was witnessed being struck by a turbine blade soon after Jackal Buzzards, *Buteo rufofuscus*, had mobbed it.
Image credit: M Martins: Birds & Bats Unlimited

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Samantha Ralston-Paton, Jon Smallie, Andrew Pearson and Ricardo Ramalho

2017

BirdLife South Africa
Giving Conservation Wings

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Foreword

FROM THE SOUTH AFRICAN WIND ENERGY ASSOCIATION (SAWEA)

This post-construction monitoring report is a valuable tool in the ongoing effort to both avoid and successfully mitigate against bird fatalities on operating wind farms in South Africa. The SAWEA is committed to the development and operation of wind farms that function in a responsible manner in order to minimize the impact on avifauna.

The Wind Energy industry is relatively new in this country and the methods and ways of avoiding impacts on birds are still being determined and refined as more information is made available. It is for this reason that the SAWEA Environmental Working Group encourages all members to actively share data that is gathered during the life span of an operating asset. It is this data that will help to avoid fatalities going forward. The data from eight Round 1 wind farms formed the basis of this report and it is hoped that over time, this number will increase. SAWEA understands that it is in the best interests of the industry for there to be a healthy and productive relationship between the industry and groups such as BirdLife South Africa. The work that is done by this organisation is extremely valuable and is absolutely required.

The key factor in the sustainable management of a wind farm is the term "adaptive management" and this is best served through the continuous gathering of data throughout the lifecycle of a plant. To that end, SAWEA supports the sharing of data and the work that BLSA undertakes. As more projects come on line and the cumulative impacts are amplified, it will be increasingly important to work with groups such as BirdLife South Africa to minimize fatalities.

SAWEA agrees that the best mitigation technique is clearly the avoidance of any fatalities, however, this is not always possible and the importance of continuous monitoring during operation is therefore of utmost importance and, if done in a sensible way, supported by the industry.

With thanks
Ben Brimble
Chair of SAWEA Environmental Working Group

Abstract

Wind turbines can have both positive and negative environmental effects, and these impacts are likely to vary according to the lo cal context. This report is the first of its kind for South Africa – it summarises the results of monitoring birds at eight wind farms. Monitoring was largely conducted according to standard procedures outlined in BirdLife South Africa and the Endangered Wildlife Trust's *Best Practice Guidelines for assessing and monitoring the impact of wind-energy facilities on birds in southern Africa (Best Practice Guidelines).* Post-construction phase monitoring was conducted for a minimum of one year, and for no more than two years at all wind farms in the study. No clear evidence for disturbance or displacement was found. However, there were a number of confounding factors – a meta-analysis of the raw data and further research on some species would be of value. The average estimated fatality rate at the wind farms (accounting for detection rates and scavenger removal) ranged from 2.06 to 8.95 birds per turbine per year. The mean fatality rate was 4.1 birds per turbine per year. This places South Africa within the range of fatality rates that have been reported for North America and Europe. The number of fatalities recorded decreased in the winter months, coinciding with the period where lower bird activity levels can be expected. Diurnal raptors accounted for most fatalities (36%), followed by songbirds (26%). Threatened species affected by collisions with wind turbines included Blue Crane (three), Verreaux's Eagle (five), Martial Eagle (two) and Black Harrier (five). A large number of Jackal Buzzard fatalities (24) also were reported. This species is not threatened, but it is endemic to southern Africa. No fatalities were reported for a number of species predicted to be vulnerable to the impacts of wind energy; however, this review is based on data from a limited number of wind farms and a short period of monitoring, and a precautionary approach remains warranted when assessing and mitigating impacts for these species.

Although preliminary, the results of this study point to a number of potential research questions. Recommendations are also made which could help build our understanding around how to minimise the negative effects of wind energy on birds in South Africa.

Glossary

Term	Definition
Birds and Wind Energy Specialist Group	A groups of practicing avifaunal specialists and independent experts who guide, review and advise BirdLife South Africa and the Endangered Wildlife Trust's work towards a renewable energy industry that has minimal impacts on birds. This group has been renamed the Birds and Renewable Energy Specialist Group (BARESG).
Control area	An area that is similar to the development site, but far enough away not to be affected by activities on the site – a key part of any Before (pre-construction) – After (post-construction) – Control – Impact (development) (BACI) study.
Convention on the Conservation of Migratory Species (CMS)	CMS is a treaty of the United Nations Environment Programme (UNEP), which provides a global platform for the conservation and sustainable use of migratory animals and their habitats. South Africa has been a Party State since 1991. The CMS has two Appendices: Appendix I pertains to migratory species threatened with extinction and Appendix II that regards migratory species that need or would significantly benefit from international co-operation. CMS Parties strive towards strictly protecting these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.
Cumulative impact	The sum of impacts on a species, ecosystem or resource associated with actions (e.g. development) in the past, present and foreseeable future (e.g. the sum of the impacts of multiple wind farms, or a wind farm in combination with other developments).
Rotor swept area	The area where birds are at risk of colliding with turbine blades. The area of the circle or volume of the sphere swept by the turbine blades.
Priority species	Threatened or rare birds (in particular those unique to the region and especially those which are possibly susceptible to wind-energy impacts), which occur in the given development area at relatively high densities or have high levels of activity in the area. These species should be the primary (but not the sole) focus of all subsequent monitoring and assessment.
Target species	A list of species defined by the Avian Specialist(s) which, based on their experience, are likely to occur on site and to be affected by the facility. Target species are the focus of some surveys (e.g. vantage point surveys) and subsequent assessment.

Wind energy's impacts on birds in South Africa:
A preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme Wind Farms in South Africa

INTRODUCTION

Wind energy has the potential to play a significant role in reducing greenhouse gas emissions (Intergovernmental Panel on Climate Change 2012), but it can also have negative effects on birds and other biodiversity. Wind farms may cause the displacement of sensitive bird species from development areas, and collisions with the turbines and associated infrastructure can result in mortality. The nature and extent of these impacts is dependent on both site- and species-specific variables (Drewitt & Langston 2006; Drewitt & Langston 2008; Jordan & Smallie 2010; Strickland et al. 2011; Rydell et al. 2012; Gove et al. 2013, American Wind Wildlife Institute (AWWI) 2015 and references therein). The risk of collision, for example, may be related to particular characteristics of the species present in an area, or the topography (De Lucas et al. 2008; Ferrer et al. 2012). This suggests that while international experience can help predict potential risks, it is also important to study the effects of wind energy in a particular area or region.

The wind-energy industry is expanding rapidly in South Africa, and to date our experience of wind energy generation and its effects on birds has been extremely limited. Prior to the completion of the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in 2014, only eight wind turbines had been constructed in South Africa - three turbines at a demonstration facility at Klipheuwel in the Western Cape (2002 – 2003), four turbines at a site near Darling (Western Cape) and one at Coega (near Port Elizabeth, Eastern Cape). Only limited monitoring of the impacts on birds was conducted at Klipheuwel and Coega. Monitoring at Klipheuwel found two bird collisions and estimated a fatality of one bird per turbine per year (Küyler 2004). The single turbine at Coega was monitored for a year (three searches per week); one Little Swift (*Apus affinis*) collision victim was found during that period (Doty & Martin 2013).

With the introduction of the REIPPPP the South African Birds and Wind Energy Specialist Group (BAWESG) (now the Birds and Renewable Energy Specialist Group), convened by BirdLife South Africa and the Endangered Wildlife Trust, recognised the need to measure wind energy's effects on birds as quickly as possible, in order to identify and mitigate any detrimental impacts, particularly on threatened or potentially threatened species. *Best-practice guidelines for assessing and monitoring the impact of wind- energy facilities on birds in southern Africa* (Jenkins et al. 2011) were developed, with the intention of promoting the collection of data in a structured, methodical and scientific manner. The guidelines propose a multi-tiered approach, with the overarching aims of a) informing current environmental impact assessment processes; b) developing our understanding of the effects of wind energy on southern African birds; and c) identifying the most effective means to mitigate these impacts. These guidelines were updated in 2012 and then again in 2015, with the latter providing a more detailed framework to assess the operational phase impacts of projects.

At least one year of post-construction (operational-phase) monitoring of birds has now been completed at all eight wind farms constructed under the first phase of the REIPPPP. The surveys and data analyses were commissioned by the wind farms and undertaken by independent avifaunal specialists, either in accordance with the conditions of the Environmental Authorisation, as recommended in the impact assessment report, or voluntarily. Survey methods used largely followed the recommendations of the best-practice guidelines (Jenkins et al. 2011, 2012 and 2015). This report summarises the findings of these studies to help improve predictions made in impact assessments, provide an early warning of potential cumulative effects, and highlight the need for mitigation, additional conservation action and/or further research. It presents an overview of the key findings based on pre- and post-construction surveys, and makes some preliminary recommendations based on a preliminary analysis of the data. The studies were conducted over a limited period and thus conclusions should be treated as tentative.

METHODS

DATA SOURCES AND METHODS USED

The eight wind farms surveyed were all selected in the first window of the REIPPPP and are in the Western, Eastern and Northern Cape Provinces of South Africa. The wind farms are located in a range of biomes and habitats (see Figure 1 and Table 1 for further details). Together these wind farms have 294 turbines with a combined nameplate capacity of 625 MW. The two smallest wind farms had just nine turbines (total installed capacity of 27 and 30 MW), while the largest had 66 turbines and a capacity of 138 MW (Table 1). The nameplate capacity of individual turbines ranged from 1.8 to 3.3 MW (average 2.4 MW). The average hub height of the turbines was 87.8 metres (range: 80 - 115 m), and average rotor diameter was 102.4 m (range: 88 – 113).

Figure 1. *Location of wind farms included in this study.*

Table 1. *REIPPPP Round 1 wind farms included in this report. The table provides details on the range of different biomes in which the wind farms are located, as well as the total capacity, number of turbines, turbine capacity, hub height and rotor diameter of the wind turbines specific to each wind farm.*

Wind Farm	Province	Biome*	No. of Turbines	Total Capacity (MW)	Turbine capacity (MW)	Hub height (m)	Rotor diameter (m)	References**
Cookhouse	Eastern Cape	Grassland & Albany Thicket	66	136.6	2.1	80	88	Diamond, 2010, Inkululeko, 2016
Dorper	Eastern Cape	Grassland	40	100	2.5	80	100	Wildskies 2014 Wildskies, 2015
Hopefield	Western Cape	Fynbos	37	66.6	1.8	95	100	Jenkins 2009, Bio3 2013, Arcus 2016
Jeffreys Bay	Eastern Cape	Fynbos & Albany Thicket	60	138	2.3	80	101	Van Rooyen et al., 2011, Inkululeko 2015b,
Klipheuwel - Dassiesfontein	Western Cape	Fynbos	9	30	3.3	90	113	Jenkins 2013, Inkululeko 2015a
Kouga	Eastern Cape	Fynbos & Azonal	32	80	2.4	80	90	Diamond 2012, Endangered Wildlife Trust. 2014, Wildskies 2016
Noblesfontein	Northern Cape	Nama-karoo	41	73.8	1.8	80	110	Avisense 2012, Bio3/Savannah Environmental 2013, BioInsight 2016
Van Stadens***	Eastern Cape	Albany thicket & Azonal	9	27	3	90	110	Martin 2013, Martin 2015

Information was gleaned from impact assessment reports, as well as pre- and post-construction avifaunal monitoring reports (see Table 1 for a list of references used). Monitoring was generally undertaken in accordance with BirdLife South Africa and the Endangered Wildlife Trust's *Best Practice Guidelines for assessing and monitoring the impact of wind-energy facilities on birds in southern Africa* (Best Practice Guidelines) (Jenkins et al., 2011, 2012 and 2015) – however it is important to note that these guidelines are not fully prescriptive and there is some scope for specialists to use their discretion. It was also not always possible to accommodate some of the changes or more specific recommendations that were included in the later editions of the guidelines.

Displacement, disturbance and avoidance

The eight wind farms listed in Table 1 measured species composition and abundance through walked transects (small birds), driven transects (large terrestrial birds), and focal point surveys. Bird movements were recorded through vantage point surveys. Surveys were conducted at least four times per year and it is assumed that survey effort before and after construction was the same, as is recommended in Jenkins et al. (2011 and updates thereof).

The use of different specialists to undertake pre- and post-construction surveys created some challenges. In many instances the handover of raw data and the details of survey methods appears to have been limited, or lacking entirely. Information pertinent to monitoring, but not to impact assessment, was not always included in pre-construction reports, and in some cases there was uncertainty with regards to survey and data collection methods used. New infrastructure (e.g. roads and fences) also made replicating the "before" surveys challenging during operational-phase monitoring.

There were also some difficulties experienced with control sites. In two instances landowners refused access to the control sites after the wind farms were constructed - apparently the pre-construction team had accessed one of these sites without the landowner's permission. It is not clear what the reasoning was in the other case. At another wind farm the control site that was used during the pre-construction surveys bordered the wind farm. The possibility of localised movement of birds between the two areas could not be excluded and there was therefore a risk that the wind farm could affect birds resident in the "control" site.

Most operational phase monitoring reports dealt with the subject of displacement, disturbance, as well as changes in bird communities very broadly, and while most specialists adopted similar survey methods, they reported on the results very differently, making comparisons across sites difficult. Species-specific data was not routinely supplied in the reports, and confidence intervals were not normally provided. There was little statistical analysis (e.g. of presence, absence, abundance, passage rates or functional groups) and little or no explicit comparison with data from control sites; as a result it is difficult to ascribe any changes that were observed to a wind farm.

Collisions with turbines and other infrastructure

For the most part, carcass surveys were conducted with a search interval of between one and two weeks, and square or circular plots were searched. The smallest search area was a circle with a radius of 80 meters; the largest was a square 210 meters by 210 meters (Table 2). One wind farm reported issues with surveying the area beneath the turbines, as the landowner had concerns about trampling crops. This meant that only hard stands and roads could be surveyed for a period (less than two months). This was eventually resolved with the landowner, and was taken into account in the model used to estimate fatality rates. Fences, woodpiles, and other obstacles also presented an obstacle to surveying the entire search area at some sites.

Table 1. *REIPPPP Round 1 wind farms included in this report. The table provides details on the range of different biomes in which the wind farms are located, as well as the total capacity, number of turbines, turbine capacity, hub height and rotor diameter of the wind turbines specific to each wind farm.*

Wind Farm	Survey area	Turbine Height (m)	Survey interval (days)	Percentage of turbines searched intensively*
Wind Farm B	Circle with 80 m radius	145	7	100
Wind Farm C	Circle with 99 m radius	146.5	7	100
Wind Farm D	200 x 200 m square	135	7	100
Wind Farm E	210 x 210 m square	130	8-13	80
Wind Farm F	200 x 200 m square	130.5	7	66
Wind Farm H	210 x 210 m square	125	8-13	100
Wind Farm I	186 x 186 m square	124	10	90

** The remaining turbines were searched one a month using less rigorous methods*

Surveys included searcher efficiency and scavenger removal trials, except at Van Stadens wind farm where monitoring for carcasses was not an objective of post-construction monitoring and carcass surveys were far less rigorous than recommended in the Best Practice Guidelines. This wind farm was therefore excluded from the analysis of fatality rates.

A landowner stopped scavenger removal trials at a wind farm out of concern for attracting scavengers or spreading disease by placing carcasses on site. This limited the sample size and season of trials, and therefore compromised the accuracy of the subsequent fatality rate estimates. This does not appear to have been resolved.

Obtaining suitable carcasses for scavenger removal and searcher efficiency trials was also a challenge; it was not always possible to find carcasses of large-bodied birds and raptors. Plastic decoys were sometimes used for searcher efficiency trials, and surrogate carcases (e.g. domestic species such as chickens) were used in some scavenger removal and searcher efficiency trials. This may compromise estimates as the detectability of decoys may differ from real birds, and certain bird species are also more palatable to scavengers than others, and may therefore be removed faster. Raptors, for example, appear to be scavenged less than other species (Smallwood 2007, Urquhart et al. 2015) and thus fatality rates for raptors may be overestimated. Given the number of wind farms and the requirement to conduct these trials at each site this is likely to remain a challenge.

At times, carcass searches were initiated some time after the first turbines had begun turning. It was therefore necessary for specialists to first sweep the wind farm for carcasses, or discard the results of the first carcass searches when estimating fatality rates. Fatality rates (both unadjusted and corrected for searcher efficiency and scavenger removal) were calculated based on the first, complete year of monitoring. These calculations excluded carcasses found during construction, carcasses found outside of formal searches, and carcasses found during an initial sweep of the wind farm. All additional fatalities (e.g. recorded during ad hoc surveys, construction, or during surveys in the second year) have been included in the analysis and discussion of species affected, as well as the table in Appendix 1, but should not be used to infer fatality rates.

Note on confidentiality

Most wind farms submitted monitoring reports to BirdLife South Africa voluntarily, or as a condition of their environmental authorisation. The reports for Cookhouse and Hopefield Wind Farms were obtained through the Promotion of Access to Information Act (Act No. 2 of 2000). There are different opinions regarding whether post-construction monitoring reports should be in the public domain. Some wind farm operators and developers are of the view that this information is sensitive and are concerned that the results may be taken out of context. Although BirdLife South Africa is of the opinion that the information can, and should be freely available, we also believe that there is little benefit to detailing specifics associated with each wind farm. In order to promote on-going cooperation with developers, our approach is therefore to summarise the results and pertinent details, without linking specific impacts to particular wind farms, unless the information is already in the public domain.

In order to respect this confidentially, we have not directly credited authors where results for individual wind farms are presented in this report.

RESULTS AND DISCUSSION

DISPLACEMENT, DISTURBANCE AND AVOIDANCE

Different species are likely to respond to wind farms in different ways. It is therefore not too surprising that no clear pattern was evident across wind farms when considering the total number of species, abundance of small or large birds, or passage rates of all priority species before and after construction.

Five of the eight wind farms studied did report an increase in the total number of species on site after construction (Figure 2), but this difference was not statistically significant (Wilcoxon-signed-ranks test, $p = 0.117$). It is possible that construction activities have increased the diversity of habitats on sites (e.g. roads, hard stand and disturbed areas), leading to an increase in the number of species. It is also possible that in some cases pre-construction monitoring could have covered a larger area, with a possibly greater diversity of habitats than the final footprint of the wind farm. In addition, the use of different observers may have confounded results as observers' skills and techniques used may vary. Observers' capabilities may also have improved over time.

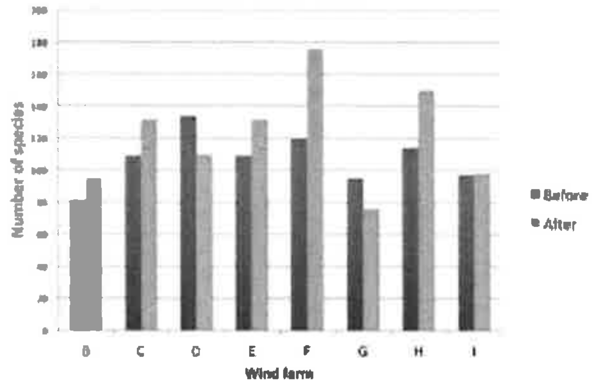


Figure 2: *Total number of species recorded before vs after the construction of the wind farms*

Species-specific responses and changes in functional groups would be more useful indicators of displacement or resilience, than the number of species, overall abundance or total passage rates. This requires more detailed statistical analysis than was available in most reports, and would preferably involve an analysis of data from multiple wind farms and control sites (this data was not available at the time of writing).

Priority species were the focus of most studies, but there would also be value in analysing data on common species, as any trends that are identified could point towards potential threats or possible resilience to effects on similar, rare and/or threatened species.

Although some species observed during pre-construction were not observed during the operational phase, and vice versa, there was little conclusive evidence for displacement of priority species from any sites. The studies were limited to a short period after construction (less than two years), and any effects are likely to change over time (e.g. Stewart et al.

2007). Longer-term studies and better analysis use of control sites would be necessary to confirm effects and shed light on the duration, extent and potential significance of any patterns observed. These limitations must be born in mind when considering the observations summarised below.

Raptors

As a group, it was difficult to identify a particular pattern in abundance and activity for raptors. One wind farm reported lower raptor flight activity and possible displacement. Contrary to this, two reports noted an increase in overall activity of raptors post-construction. One of the latter reports suggested that raptors such as Yellow-billed Kite, Booted Eagle, Rock Kestrel and Black-shouldered Kite might be attracted to the wind farm site, possibly due to some change in prey availability post-construction. This hypothesis requires further study.

Verreaux's Eagle (Aquila verreauxi)

One wind farm reported an apparent increase in Verreaux's Eagle (Vulnerable, Taylor et al., 2015) activity in the first year of construction, but this decreased during the second year. The same site reported multiple Verreaux's Eagle fatalities during the first year (see below). The results of a Generalized Linear Model for the occurrence of Verreaux's Eagle at another wind farm indicated that the species was recorded more frequently before operation of the wind farm (GLM: estimate= 0.042, standard error = 0.003, z = -14.59; p-value = 0.001). In the latter case, eagles continued to use the wind farm site, which suggests that if displacement did occur, it was not complete. It is possible the presence and activity levels of eagles varies between years and longer term studies would therefore be of value.

Martial Eagle (Polemaetus bellicosus)

No displacement or disturbance effects were recorded for Martial Eagles (Endangered, Taylor et al., 2015). One wind farm reported a nest located within the wind farm where Martial Eagles bred successfully. The birds were recorded frequently at this site, with multiple flights recorded close to active turbines. No displacement or disturbance effects were apparent. Another wind farm reported higher passage rates for Martial Eagle post-construction although the passage rates were low in both cases (10.5 passages per year compared to 4 pre-construction - this was not tested for significance).

Large terrestrial birds

Blue Crane (Anthropoides paradiseus)

The endemic and Near Threatened Blue Crane (Taylor et al. 2015) was present at most wind farms in this study, albeit in varying numbers. There was no clear evidence of displacement for this species. A wind farm with a high abundance of Blue Cranes reported that passage rates for the species decreased after construction (301 vs 157 passages per year). A visual comparison of the spatial location of flights at this site suggests the possible avoidance of the wind turbines by birds in flight, but this was not conclusive. Despite the apparent lower passage rates, there was no evidence of displacement of Blue Cranes at this wind farm. Given their affinity for agricultural areas (Taylor et al. 2015) and their apparent tolerance for disturbance in these areas, this finding is not too surprising.

Blue Cranes do not appear to be displaced by wind farms and have been recorded breeding near to wind turbines.

At least three pairs of Blue Crane were recorded with small chicks at this wind farm and it is likely they bred within 500 m of a turbine. One nest was approximately 120 m from a turbine, and although successful fledging could not be confirmed, the pair raised two chicks to at least eight weeks of age.

Denham's Bustard (Neotis denhami)

The risk of disturbance and/or displacement of Denham's Bustards (Vulnerable, Taylor et al. 2015) from wind farm sites has been raised as a concern in impact assessments. Possible displacement was noted in reports for two wind farms. Post-construction monitoring at one of these sites found 0.03 birds per km of driven transect, compared to 0.11 birds per km before the wind farm was built. At the other wind farm a small number of birds (one to two) was recorded during most (three out of four) pre-construction surveys, but this species was not recorded at all during post-construction surveys. Longer-term studies and comparison with control site data is required before displacement can be confirmed.

The post-construction monitoring report for a third wind farm reported that there was no displacement with 0.35 birds/km recorded pre-construction and 0.51 birds/km during the first year of operation. A lek site was present at this wind farm (but not the other two wind farms), and this may have been the reason behind this pattern. Few bustards were observed at the lek site during operational-phase monitoring, which was attributed to a significant amount of heavy truck activity in the vicinity of the lek (not related to the wind farm), which may have temporarily displaced displaying males from the lek, but not the broader area.

It is conceivable that the birds' greater affinity to the historic lek site reduces likelihood of displacement. Great Bustards *Otis tarda*, a species similar to Denham's Bustard in size and behaviour, have high fidelity to their lek and breeding sites (Alonso et al. 2000). It is therefore important to identify and protect these areas from land use change. Where leks were not present, inter-annual variation in abundance of the species may have been the reason for the decreases, but this warrants further investigation.

SAMANTHA RALSTON-PATON

COLLISIONS WITH TURBINES AND OTHER INFRASTRUCTURE

Minimum (unadjusted) fatality rates

In the first year of operation, 271 bird fatalities were recorded at the seven wind farms (285 turbines) that were regularly surveyed in accordance with the BirdLife South Africa/EWT Best Practice Guidelines. This represents an average of 0.95 birds per turbine per year (range 0.2 – 2 birds per turbine per year; Table 4). The actual number of fatalities is likely to be higher given that although all 285 turbines should have been checked, not all were subject to intensive surveys (Table 2). This estimate also does not take into account that scavengers may remove carcasses and searchers may not find all of the carcasses.

Estimated Fatality Rates

Using estimators developed by Jaine (2007), Huso et al. (2012) and/or Korner-Nievergelt et al. (2015), fatality rates were calculated, taking into account factors such as scavenger removal, searcher efficiency (detection rate), visibility class, carcass size and season. Table 3 summarises results of the scavenger removal and searcher efficiency trials.

Table 3. *Summary of the results of scavenger removal and searcher efficiency trials*

Wind Farm	Detection rate	Carcass persistence (avg. days)	Survey interval (days)
Wind Farm B	Average: 39.58% (n=48)	8.5 (n=18)	7
Wind Farm C	Average: 80% (n=42) Small: 47%. (n=15) Medium: 71% (n=14) Large: 85% (n=13)	10.1 (n=17)	7
Wind Farm D	Small: 12% Medium 21% Large. 58% (n=36)	1-2 (n=117)	7
Wind Farm E	Small: 24%, Medium 65%, Large: 91% (n=72)	8.65 (n=72)	8-13
Wind Farm F	24% (n=73)	7.93 (n=59)	7
Wind Farm H	Small 28% Medium: 83% Large: 39% (n=54)	8.82 (n=60)	10
Wind Farm I	Average 47% (n=54)	4.74 (n=60)	7

	UNADJUSTED		ADJUSTED			
	Fatalities/ turbine/ year	Fatalities/ MW/year	Fatalities/turbine/year Average	Range (95% confidence)	Fatalities/ MW/year (average)	Estimator used
Wind Farm B	1.95	1.09	3.7	2.4-8.5	2.07	K
Wind Farm C	2	0.6	4	2.1-7.6	1.2	H
Wind Farm D	0.2	0.11	5.5 11.1	not provided	3.0 5.9	H K
Wind Farm E	0.97	0.39	4.68	3.15-17.85	1.87	H
Wind Farm F	0.49	0.23	3.72	2.03 - 7.43	1.62	H
Wind Farm H	1.78	0.74	8.59	5.25-22.62	3.75	H
Wind Farm I	0.68	0.3	3.32 2.06	2.33-4.95 not provided	1.59 0.95	H J
Average	0.95		4.11			

Table 4. *Adjusted and unadjusted fatality rates for year one at 7 REIPPPP round one wind farms. The MW is nameplate capacity, not realised capacity. Esitimators: H=Huso et al. 2012, J=Jaine 2007, K= Korner-Nievergelt et al. 2015.*

Among the wind farms assessed, estimated fatality rates ranged from 2.1 to 8.6 birds per turbine per year, with a mean of 4.1 (Table 4). Correction factors between observed and estimated fatality rates varied greatly among wind farms (Figure 3). The wind farm with the highest rate of reported fatalities, was ranked fourth once scavenger removal and searcher efficiency was taken into account. The explanation for this may be in the methods employed on site. Sites where all turbines are searched regularly, where turbines are searched at a search interval lower than the rate of carcass removal, and where detection rates are high should show a smaller difference between observed and estimated fatality.

The models used to estimate fatality rates are sensitive to small changes in detection and scavenger removal rates, and there are a number of potential biases in these trials (discussed above). These limitations should be born in mind when comparing results between wind farms, and between regions. However, the figures do place South Africa within the range observed in Europe and North America. Rydell et al. (2012) reviewed studies from 31 wind farms in Europe and 28 in North America and found a range between 0 and 60 birds killed per turbine per year, with a median value of 2.3 (adjusted for detection and scavengers). European average bird fatality rates were 6.5 birds per turbine per year compared to 1.6 birds per turbine per year for North America.

SAMANTHA RALSTON-PATON

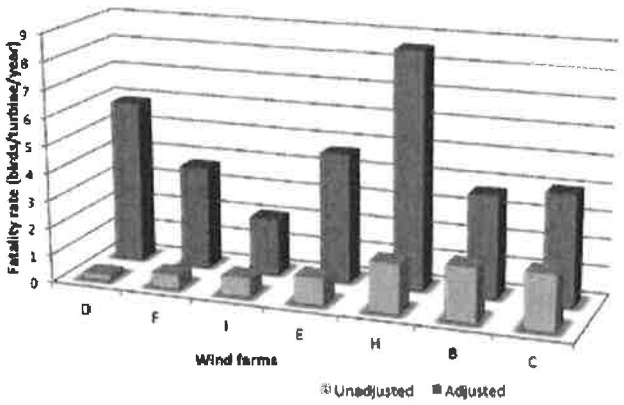


Figure 3: *The relationship between the adjusted and unadjusted fatality rates is not straightforward and is influenced by searcher efficiency, scavenger removal rates, proportion of turbines searched and search interval. (Where two fatality estimates were used, the lower estimate is represented here).*

It is also important to note that high fatality rates do not necessarily equate to a high number of threatened species affected. Wind Farm H, for example, has the highest estimated fatality rate, and third highest unadjusted fatality rate, but only one threatened species fatality was found.

SAMANTHA RALSTON-PATON

Location of carcasses

Most reports contained little detailed analysis of the location of carcasses. Table 5 summarises the data that was available. In all cases where the data were presented, the average distance from the turbine base was less than 60 m. However, the distribution of carcasses is likely to be skewed and the average tells little about the likely position of fatalities. Carcases were found as far as 152 m away. There would be benefit in analysing the exact locations of carcasses more rigorously as this would help inform the appropriate size of search areas in the future.

Table 5: *The location of carcasses relative to the base of the turbines.*

Wind Farm	Average distance from turbine (m)	Range
Wind Farm B	(<40)*	0-110
Wind Farm C	39.9	5 to 97
Wind Farm E	58.9	2-116
Wind Farm H	47.2	1 - 152
Wind Farm I	34.4	0 to 109**

** Most carcasses were < 40 m from turbine base.*
*** 80% of carcasses were found within 54 m of the turbine base.*

Relationship between turbine height, rotor swept area and fatality rates

No relationship between fatality rates (unadjusted or estimated) and the diameter of the rotor swept area or hub height was found. However, there was limited variation in the size of turbines - five wind farms had turbines with a hub height of 80 m and the difference between the smallest and largest rotor diameter was just 25 m.

Table 6: *Fatality rates, hub height of turbines and diameter of rotor swept area*

	Fatality rate (birds/turbine/year)		Hub height (m)	Diameter (m)
	Unadjusted	Estimated		
Wind farm I	0.68	2.06	80	88
Wind farm H	1.78	8.59	80	90
Wind farm E	0.97	4.68	80	100
Wind farm B	1.95	3.7	95	100
Wind farm F	0.49	3.72	80	101
Wind farm D	0.2	5.9	80	110
Wind farm C	2	4	90	113

Season

The number of fatalities recorded decreased in the winter months (Figure 4), coinciding with the period where lower bird activity levels and fewer species can be expected to be present. The number of fatalities recorded dipped in December, but rose sharply in January and peaked in February. This decrease in December is probably more likely to be due to the availability and work ethic of searchers over the festive season, rather than ecological factors.

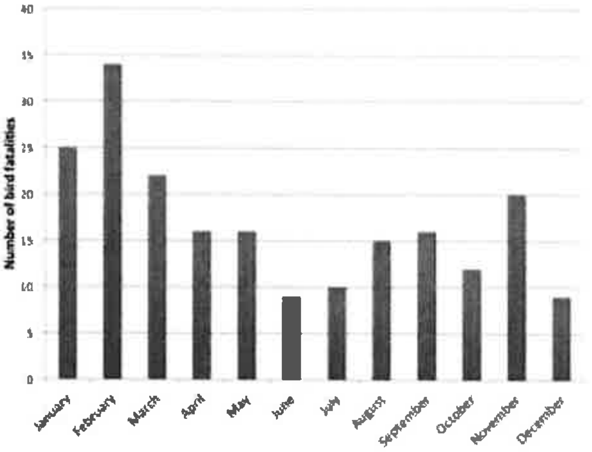


Figure 4: *Number of bird fatalities recorded each month at 6 wind farms (one report did not indicate the date carcasses were found, and was excluded from this analysis).*

Species affected

While fatality rates are of interest, it is perhaps more important to understand which groups of species have been affected, which have not, and what the conservation significance of impacts might be now and into the future. This is particularly important as wind energy is set to expand its footprint in South Africa and predicting and avoiding cumulative impacts will be crucial. A full list of fatalities can be found in Appendix 1. Species were divided into broad groups and the number affected by collisions in each group is summarised in Figure 5. Raptors and passerines are two groups most affected, echoing patterns observed elsewhere (Rydell et al., 2012). It is important to note that the figures listed in Appendix 1 should be interpreted with care. Not all turbines were searched regularly and rigorously. Results may therefore be skewed to larger species, which are likely to persist longer and are more visible than smaller species.

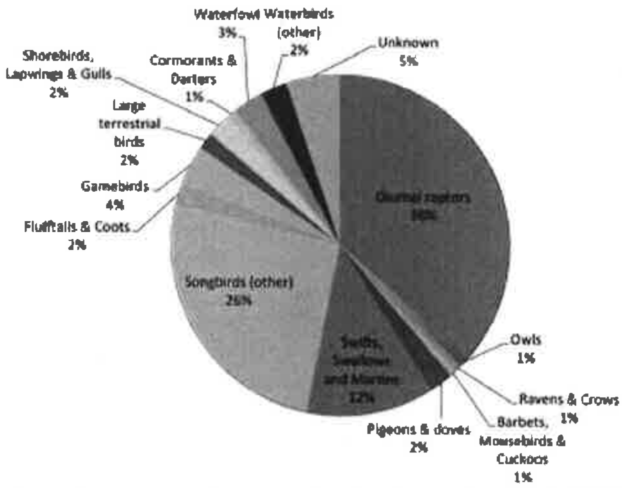


Figure 5: *Summary of species killed by wind turbines at REIPPPP Round 1 Wind Farms in South Africa*

Note: The results presented above include fatalities found during construction, the initial sweep for carcasses, ad hoc finds, and the first year monitoring, additional (year 2 interim) monitoring results, but excludes fatalities as a result of power lines and causes other than wind turbine collisions.

J MUCHAXO (CC BY-NC 2.0, "APUS APUS / COMMON SWIFT", 2007, FROM FLICKER.COM).

While raptors are usually the focus of impact assessments, a wide range of species including swifts, swallows, doves, larks and other songbirds were also recorded as turbine fatalities.

Threatened species affected by collisions with wind turbines include Cape Cormorant (*Phalacrocorax capensis*, regionally Endangered), Blue Crane (*Anthropoides paradiseus*, Near Threatened), Martial Eagle (*Polemaetus bellicosus*, Endangered), Verreaux's Eagle (*Aquila verreauxii*, Vulnerable), Lanner Falcon (*Falco biarmicus*, Vulnerable), Striped Flufftail (*Sarothrura affinis*, Vulnerable) and Black Harrier (*Circus maurus*, Endangered) (Taylor et al. 2015). Although not currently threatened, the high number of Jackal Buzzard (*Buteo rufofuscus*) fatalities is also of note. This species is near endemic to South Africa.

All wind farms reported at least one fatality of a threatened species during the first year of monitoring. The highest number of threatened species mortalities at a single wind farm during this period was four (all Verreaux's Eagle). Additional monitoring and mitigation has been implemented at this site.

Using methods outlined in Retief et al. (2011) the Birds and Renewable Energy Specialist Group has identified a suite of "priority species", species that were assessed to be collision-prone and likely to be vulnerable to the impacts of wind energy. The species were scored according to their conservation status, distribution, behaviour and size (Appendix 2 contains a list of the top 107 priority species and their assigned scores). This list of species is used to help screen potential wind farm sites and helps focus of avifaunal impact assessments and monitoring. The top 20 of these are listed in Table 7, alongside notes about their apparent vulnerability to impacts. Again, it must be emphasised that these results should be considered preliminary, and it is recommended that the list be reviewed once more data is made available.

Table 7. *The top 20 species assessed as likely to be vulnerable to the impacts of wind energy compared to the observed impacts.*

Species	Ranking	Fatalities likely?	Comments
Cape Vulture	1	?	Recorded at several wind farms, and two collisions reported. The risk of future collisions cannot be excluded.
Bearded Vulture	2	NA	Wind farms in this study are outside of the species' range.
Verreaux's Eagle	3	✓	Appears to be vulnerable to collisions.
Martial Eagle	4	✓	Recorded at several wind farms, and two collisions reported. The risk of future collisions cannot be excluded.
Wattled Crane	5	NA	Wind farms in this study are outside of the species' range.
Black Harrier	6	✓	An occasional visitor to many of the wind farms. Appears to be vulnerable to collisions
Great White Pelican	7	?	An occasional visitor to a few of the wind farms. No collisions recorded to date, but the risk cannot be excluded.
Southern Bald Ibis	8	NA	Wind farms in this study are outside of the species' range.
Yellow-billed Stork	9	NA	Not recorded at any of the wind farms assessed.
Black Stork	10	?	Uncommon and only recorded at a few of the surveyed wind farms.
Blue Crane	11	✓	Found regularly at most wind farms in this study. Although collisions have occurred, there are indications of possible flight avoidance.
White-headed Vulture	12	NA	Wind farms in this study are outside of the species' range.
Secretarybird	13	?	Occasional visitor to some sites, no collisions reported to date. The risk cannot be excluded.
Ludwig's Bustard	14	?	Limited overlap with wind farms in this study. Collisions with powerlines associated with wind farms likely.
Grey Crowned Crane	15	NA	Not recorded at any of the wind farms in this study.
Taita Falcon	16	NA	Wind farms in this study are outside of the species' range.
Southern Ground-Hornbill	17	NA	Not recorded at any of the wind farms in this study.
Cape Cormorant	18	✓	One fatality recorded, not regularly recorded at wind farms
Lappet-faced Vulture	19	NA	Wind farms in this study are outside of the species' range.
Pink-backed Pelican	20	NA	Wind farms in this study are outside of the species' range.

RAPTORS

Many raptors (for example eagles and vultures) are long-lived, with low reproductive rates, which make them vulnerable to increased mortality rates. As predators they also play an important role in many ecosystems, and the loss of raptors could have ecological effects. As has been observed in other parts of the world (e.g. Langston and Pullan, 2003; Rydell et al. 2012, Gove et al. 2013), a large proportion (37%) of fatalities recorded were nocturnal and diurnal raptors (Figure 5). A minimum (i.e. unadjusted) fatality rate of 0.3 raptors per turbine per year was calculated for the first year of monitoring. While the actual number is likely to be greater than this figure, raptors do appear to be scavenged less than other groups (Smallwood 2007; Urquhart et al. 2015) and all turbines were searched at least a few times a year. The observed fatality rates are therefore likely to be relatively close to actual fatality rates

KOSHY KOSHY (CC BY 2.0, AMUR FALCON, 2014, FROM FLICKER.COM)

*Raptors accounted over a third of the bird carcasses found beneath turbines. Approximately one quarter of the raptor fatalities recorded during the first year of monitoring were Amur Falcon (*Falco amurensis*).*

when compared to smaller species. Carcasses of nineteen raptor species were found, including buzzards, eagles, falcons, kestrels and kites (Appendix 1). Some of the more important incidents are discussed below.

*Amur Falcon (*Falco amurensis*)*

Amur Falcon was the most commonly affected raptor, with 22 fatalities recorded in the first year of monitoring. Four wind farms reported Amur Falcon fatalities (two of the wind farms which reported no fatalities are located outside of the range of the species). The two wind farms with the highest number of fatalities also reported large numbers (hundreds to thousands) of birds near the wind farms. A temporary roost of 1500 birds was reported at one of the sites. One study noted that approximately 35% of Amur Falcon flights were at the height of the rotor swept area. Not accounting for the number of turbines outside the species' range, the unadjusted (i.e. minimum) fatality rate for this species was 0.08 birds per turbine per year.

Given that the population of this migratory species is large (a national census on 2009 recorded approximately 111 000 individuals in South Africa (Symes & Woodborne, 2010) and the species is not currently threatened (BirdLife International, 2016) the impact on the species' population is unlikely to be significant at this stage. However, Amur Falcon is listed under the Convention of Migratory Species and its flocking behaviour may present a risk of multiple fatalities in a short space of time. The species may also provide valuable ecosystem services and impacts should therefore be monitored, and where possible mitigated. Where large numbers of birds are

PIM STOUTEN (CC BY-NC 2.0, SOARING JACKAL BUZZARD #1, 2010 FROM FLICKER.COM)

Jackal Buzzard, Buteo rufofuscus, *accounted for approximately 20% of raptor fatalities attributed to collisions with wind turbines.*

JESSIE WALTON

Although the results are preliminary, conservationists' concern that Verreaux's Eagles, Buteo rufofuscus, *are at risk of colliding with turbines appear to have been confirmed.*

recorded near a wind farm (or proposed wind farm), consideration should be given to operational phase mitigation (e.g. shutdown on demand during risk periods) to reduce the probability of collisions.

*Jackal Buzzard (*Buteo rufofuscus*)*

The second most commonly affected raptor was Jackal Buzzard. High fatality rates have been reported for other *Buteo* species including Common Buzzard (*B. buteo*) in Europe (Hötker et al. 2006), White-tailed Hawk (*B. albicaudatus*) in Latin America (Ledec et al., 2011) and Red-tailed Hawks (*B. jamaicensis*) in the United States (Smallwood and Thelander, 2008). Seventeen Jackal Buzzard fatalities were recorded in the first year of surveys (a minimum of 0.06 birds per turbine per year). Fatalities occurred at 5 of the 7 wind farms, reflecting the species wide distribution. A large proportion of this species' flights (66-77% according to two monitoring reports) are located at the risk height (i.e. at the height of the rotor swept area). The population in southern Africa is estimated to number in the tens of thousands (BirdLife International, 2016) and while this species is not threatened, it is endemic to southern Africa (Taylor et al. 2015). Impacts at the population level are unlikely to be significant at this stage, monitoring, mitigation, and further research is recommended to help ensure that this common species remains common, and that the ecological implications of any losses are understood.

*Rock Kestrel (*Falco rupicolus*)*

Rock Kestrel fatalities were also recorded with some frequency, with 14 fatalities recorded in the first year (0.05 fatalities per turbine per year). Rock Kestrel fatalities were recorded at five out of the seven wind farms assessed. Like the Jackal Buzzard, while these impacts may not be of immediate concern, further study is encouraged.

*Verreaux's Eagle (*Aquila verreauxii*)*

Verreaux's Eagle is ranked third on the South African Birds and Renewable Energy Specialist Group's priority list and concerns that this species is vulnerable to collisions appear to have been confirmed. One wind farm recorded four Verreaux's Eagle fatalities in the first year of operation. Three of these were adults and one was a juvenile. Two of the fatalities (one adult and one juvenile) occurred at the same turbine. These collisions probably took place 10-12 days apart and all the fatalities at the wind farm occurred in autumn. This period coincides with the time that the highest levels of flight activity were recorded, possibly relating to prey abundance (passage rates peaked to around 1.45 birds per hour in autumn, with most activity occurring in the afternoon). Prior to the construction of the wind farm, low flight activity of Verreaux's Eagle was recorded and the assessment did not predict that the species was particularly at risk at this site. The fatalities occurred a considerable distance (at least 3.5 km) from suitable Verreaux's Eagle breeding habitat, and on relatively flat ground (Smallie, 2015). In response to these fatalities additional research and monitoring activities were initiated, including a thorough survey for Verreaux's Eagle nests in the vicinity of the wind farm. This found nine confirmed and occupied eagle territories within a 15 km radius of the wind farm (ranging from 3.7 to 13.6 km from nearest turbine). A full time eagle monitor was employed on site with the aim of mitigating collision risk for eagles and other priority species, through the collection of additional data, assessment of collision risk, and if required, the monitor can advise shutdown on demand. No further incidents at the site have been reported, and flight activity appears to have reduced in the second year.

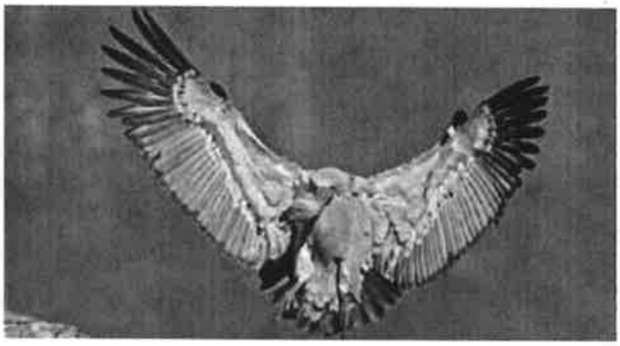
A single adult fatality occurred at another wind farm in August. The carcass was located 65 m from the nearest turbine. Again the fatality occurred some distance from a nest - a pair was reported to be breeding on a nest 3.8 km away. Additional monitoring was also initiated in response to the incident.

Eagle mortalities at wind farms are not unexpected. Fatalities at wind farms have been reported for Golden Eagle (*Aquila chrysaetos*) (e.g. Smallwood & Thelander, 2008; Smallwood, 2013), White-tailed Sea Eagle (*Haliaeetus albicilla*) (e.g. Hötker et al., 2006), Bald Eagle (*Haliaeetus leucocephalus*) (Pagel et al., 2013) and White-bellied Sea Eagle (*Haliaeetus leucogaster*) (Smales & Muir, 2005).

Verreaux's Eagle has recently been up-listed to Vulnerable and rough estimates of the population size are between 3500 and 3750 mature individuals (Taylor et al., 2015). Based on the limited information available, it does appear that a more precautionary approach to mitigating impacts is warranted,

WESSEL ROSSOUW

Just 500 to 1000 breeding pairs of Black Harrier, Circus maurus, *are thought to remain. Although only a small number of Black Harrier fatalities have been recorded thus far at wind turbines, the long-term effect of wind energy on this species is a potential cause for concern.*



CHRIS VAN ROOYEN

Although no fatalities of Cape Vulture, Gyps coprotheres, *were reported during the study period, it is anticipated that longer-term monitoring will confirm that this species is at risk of colliding with poorly located wind turbines.*

particularly when the cumulative risk of multiple wind farms within the species range is considered. Fortuitously, BirdLife South Africa had recognised the potential risk to the species and the need for more consistent and defensible mitigation measures and is finalising guidelines for impact assessment and mitigation for the species. It will be important to continue to study the species behaviour and risk factors.

*Black Harrier (*Circus maurus*)*

Ranked sixth on the priority list, concerns about the risk wind turbines pose to this species also appear to have been confirmed. A total of three Black Harrier fatalities were recorded in the first year of operational-phase monitoring (including one carcass found incidentally). One wind farm recorded a single fatality in January. The pre-construction monitoring report did not highlight collision risk for this species as of particular concern and relatively low flight activity (6 flights) for the species was recorded during the first year of post-construction monitoring. One third of the flights recorded were at the height of the rotor swept area.

Two fatalities were recorded at another wind farm during the first year of post-construction monitoring, with another two fatalities found during subsequent surveys. Again, the risk of collisions was not assessed to be high during preconstruction monitoring as the species was recorded infrequently and all flights were recorded below the height of the rotor swept area. After construction 47 flights were recorded during the first year of monitoring, with 34% of flight duration occurring at the height of the rotor swept area. A roost site was subsequently reported approximately 5 to 10 km from this wind farm. The significance of this roost in relation to wind farm fatalities is being investigated further and the wind farm is investigating options for operational phase mitigation.

Harriers elsewhere in the world do not appear to be particularly collision-prone (Hötker et al., 2006, Whitfield & Madders, 2006, Rydell et al., 2012) and while the current number of fatalities for Black Harrier may seem to be low, this near-endemic species is the most range restricted continental raptor in the world. It is classified as Endangered globally and regionally, and it is estimated that just 500 to 1000 breeding pairs remain, with further declines expected (Taylor et al., 2015). If the trend of wind farm mortalities continues, the proliferation of wind farms within the core breeding habitat and local migration routes could pose a significant threat to this species and must be mitigated. In response to this concern, BirdLife South Africa and the Endangered Wildlife Trust are developing guidelines to promote improved impact assessment and mitigation for this species.

*Martial Eagle (*Polemaetus bellicosus*)*

Ranked fourth on the priority list, Martial Eagle (Endangered, Taylor et al., 2015) was recorded regularly at two of the wind farms studied and was an occasional visitor to the rest of the sites. A breeding pair of Martial Eagles was found located within the footprint of one wind farm and the pair appears to have co-existed with the turbines for two years. However, a sub-adult Martial Eagle (approximately 3 years old) was subsequently struck by a turbine. Bird specialists working at the site witnessed the collision and reported that Jackal Buzzards had mobbed the eagle shortly before the incident occurred (Simmons & Martins, 2016). Another fatality was recorded at the same site later that year. The wind farm is investigating operational phase mitigation options.

*Cape Vulture (*Gyps coprotheres*)*

The Endangered Cape Vulture (Taylor et al., 2015) was ranked at the top of the priority list of species potentially vulnerable to the impacts of wind energy, but to date there have been no Cape Vulture fatalities reported. This species was recorded at two of the wind farms in this study, with a temporary roost with about 50 birds located approximately 12 km from one of these sites. Monitoring at both wind farms in question recorded relatively infrequent flights of small groups of birds (less than 8 birds at a time). Livestock carcass management plans are in place at both sites to limit food availability (and therefore the risk of collisions). Although this is encouraging, the risk of collisions cannot be eliminated as evidence from vultures and wind farms elsewhere suggests that vultures are vulnerable to colliding with turbines and associated infrastructure (García-Ripollés & López-López, 2011; de Lucas et al., 2012). At one of the wind farms mentioned above, 53.5% of flight duration was within the height of the rotor swept area. BirdLife South Africa had recognised the potential risk to the species and the need for more consistent and defensible mitigation measures recommended in impact assessments. Guidelines for impact assessment and mitigation for the species are being developed.

LARGE TERRESTRIAL BIRDS

Carcasses of large species are likely to be more obvious (resulting in high detection rates) (Table 3) and are likely to persist longer than smaller species (Ponce et al., 2010; Shaw et al., 2010; Schutgens et al., 2014). As with raptors, the number of large terrestrial species carcasses recorded is likely to be relatively close to actual fatality rates when compared to smaller species.

Blue Crane (Anthropoides paradiseus)

Ranked 11 on the priority list, Blue Cranes were recorded at all of the wind farms in this study, although abundances varied. This species was recently downgraded to Near Threatened (Taylor et al., 2015). No Blue Crane fatalities were recorded in the first year of monitoring. However, 3 fatalities (all adults) were reported at a wind farm in January/February 2016, after 21 months of monitoring (Smallie, 2016). Two of the cranes were found at the same turbine and it is suspected that they were killed in the same event, (i.e. they were flying together). The incident occurred in a field of cereal crop, and the area had high abundance of cranes. Cranes were regularly seen on site and were also breeding in the area. Coarse collision risk modelling in the pre-construction assessment predicted a possible fatality rate of 15 Blue Cranes per year. Less than this number of fatalities occurred across all wind farms during the period.

Operational phase monitoring of bird movements at the same wind farm suggested possible avoidance behaviour - some birds in flight appeared to avoid turbines several hundred meters away, while other birds seemed to show no sign of avoidance. The behaviour of Blue Cranes in and around turbines warrants further study.

Korhaans and bustards

One Karoo Korhaan (*Eupodotis vigorsii*) (Near Threatened - Taylor et al. 2015) and two Blue Korhaan (*E. caerulescens*) fatalities were reported. The Karoo Korhaan fatality was associated with a powerline (this had no bird flight diverters installed), while the Blue Korhaan carcasses were found near turbines.

Encouragingly no bustard fatalities were reported as a result of collisions with turbines. This may be due to the predominantly low flight height of this group. However, one Denham's Bustard carcass was found during preconstruction surveys - apparently killed in a collision with the supporting cables of the wind monitoring mast. The marking of guy wires is strongly encouraged to prevent similar incidents.

SHOREBIRDS, WATERFOWL AND WATERBIRDS

Shorebirds, waterbirds and waterfowl made up a small percentage of the fatalities. Most of the collision incidents for this group occurred at one wind farm, located a few kilometres from the coast. Impact assessment predictions of high collision rates for waterfowl at another wind farm did not materialise during the monitoring period.

CHRIS VAN ROOYEN

Although fatalities of Blue Crane, Anthropoides paradiseus, *have been recorded, preliminary results suggest that Blue Cranes may avoid flying near turbines.*

Cape Cormorant (Phalacrocorax capensis)

One Cape Cormorant fatality was reported at a wind farm located a few kilometres from the coast. The species was not recorded during pre- or post construction monitoring of live birds, suggesting that the species is only an occasional visitor to the site. A few fatalities of other cormorants (Reed Cormorant *Microcarbo africanus* and an unidentified cormorant species) were also reported (see Appendix 1).

OTHER GROUPS

While raptors and large-bodied birds generally receive the most attention at wind farms, a large proportion of fatalities recorded at wind farms are of passerines and other small birds (AWWI 2015). A similar pattern has emerged here, with passerines accounting for approximately one third of reported fatalities. Species affected included larks, finches, bushsrikes, warblers and cisticolas. Red-capped Lark (*Calandrella cinerea*) fatalities appear to have been associated with species' breeding display in the summer months. Although no threatened species in this group were affected, this does highlight the need for caution when considering developing wind farms within habitats of range-restricted, threatened or endemic passerines.

Pied Crows (*Corvus albus*) were regularly reported at wind farms, yet no fatalities were reported. Corvids do not appear to be immune to impacts though - two Cape Crow (*Corvus capensis*) fatalities were recorded.

Passage rates and collision risk

It was not possible to assess whether high passage rates correlated with an increase in fatalities (both between sites and between species), as the data were presented in such a way that made comparisons difficult. A more detailed analysis of flight activity and collision risk is required. However, it does appear that different species may be affected differently. Some species, for example Pied Crow, had no fatalities reported, despite high passage rates. This question warrants further investigation as high passage rates are often assumed to imply high fatality rates.

EMPLOYMENT BENEFITS AND SKILLS DEVELOPMENT

Often-overlooked benefits of avifaunal monitoring at wind farms are the employment and skills development opportunities this brings to the local community (particularly important in the South African context). Carcass surveys do not require specialised skills or expertise, and this has presented an opportunity for local employment, and semi-skilled staff (farm labourers or residents from surrounding communities within 50 km of the wind farm) have been employed to conduct the surveys. This has resulted in the creation of 27 full time positions (at least for the duration of monitoring) at the first window REIPPPP wind farms. These positions are in addition to the bird specialists and their field staff who are employed on a contractual basis. Further opportunities to develop birding skills and expand job opportunities in this field could be explored.

CONCLUSIONS AND RECOMMENDATIONS

The findings and recommendations contained in this report are based on monitoring over a short period, at a limited number of wind farms. Environmental systems are inherently variable and the wind farms in the study are distributed over a wide range of environmental conditions, but they do fall outside of the range of many priority species. While we encourage stakeholders to consider the results of this review during site screening and impact assessments, we also caution against drawing firm conclusions at this stage.

In terms of fatality rates, the study results suggest that South Africa falls within the range experienced in the United States and Europe. However, there is a wide range of potential values associated with the estimated fatality rates and further monitoring would allow for more accurate estimates. Sourcing a suite of carcasses more representative of the natural bird population for the carcass persistence trials would also be of benefit.

It is encouraging that many of species assessed to be most vulnerable to the impacts of wind energy have not been recorded, or have been recorded at low numbers at the wind farms in this study. This could suggest avoidance of high-risk sites through site screening and impact assessment, but could also be as a result of the small sample size. Steps would (or at least should) have been taken to minimise risk to birds through amendments to the wind farm location and layout during the impact assessment process, and subsequent refinement of the turbine layout in response to additional surveys. A precautionary approach therefore remains warranted for all priority species, including those seemingly unaffected so far.

The preliminary data do appear to confirm that raptors, including threatened species such as Martial Eagle, Verreaux's Eagle and Black Harrier are vulnerable to collisions. Extra care should therefore be taken when considering developing a wind farm within the habitat of these species. Further monitoring, research, and where necessary, adaptive management and operational phase mitigation, is encouraged at existing wind farms within their range.

Displacement effects are particularly challenging to assess. Any differences in presence, absence and abundance of species at an individual wind farm before and after construction could have been due to various factors including environmental variation on site, differing survey methodologies and/or skill differences between the teams. More detailed analysis of data, including from the control sites, would help establish if there were any changes in the bird communities associated with the development of wind farms. While none of the studies yielded conclusive results with regards to displacement or changes in the abundance and species composition, some possible trends were identified that warrant further interrogation.

A large amount of data is collected during pre- and post-construction monitoring, yet only a small portion of this was available, analysed in any detail and presented in the reports. A meta-analysis of the raw data is therefore recommended along with monitoring over a longer period. Data could be made available to students for more rigorous analysis, but ownership and usage rights would need to be resolved. Co-operation of wind farm operators and partnering with academic institutes is therefore strongly encouraged. More intensive academic research into specific questions could also complement existing approaches to monitoring.

RE SIMMONS: BIRDS & BATS UNLIMITED

Black Harriers were not expected to be particularly vulnerable turbine collisions. Operational-phase monitoring is an opportunity to test our assumptions and improve decision-making in the future. It is therefore important that the results of monitoring are shared with the conservation community.

While there is no immediate cause for alarm, we encourage all wind farms to strive to minimise negative impacts and maximise the environmental benefits, rather than wait for a pre-defined level of impact to be exceeded. This approach is critical if the intention is to expand wind energy in South Africa without cumulative negative impacts becoming a major obstacle to development, and without wind energy presenting a serious threat to bird conservation in the long term.

RECOMMENDATIONS FOR WIND FARMS OPERATORS AND DEVELOPERS

- Early consultation with NGOs and bird specialists is encouraged, particularly where a proposed wind farm may affect priority species.
- Wind farm developers/operators should ensure that the landowner understands the implications of monitoring throughout the lifespan of the wind farm, and should ensure the necessary arrangements and agreements are in place to allow monitoring to be conducted.
- Meteorological masts' guy wires and powerlines associated with wind farms should be fitted with bird flight diverters.
- If different specialists are used for monitoring pre- and post- construction, wind farms should ensure that there is adequate handover of raw data and that survey methods are clearly described.
- By making monitoring reports and data available, wind farms can make a major contribution to our understanding of the interactions between wind energy and birds. Wind farms could facilitate further analysis of existing data by academic institutes if raw data is also made available.
- Wind farms should also encourage and facilitate further academic research at their sites to investigate specific questions that standard monitoring protocols cannot address.

- As our understanding develops, wind farms (including existing and approved projects) are encouraged to revisit their mitigation strategies to ensure impacts are minimised as far as possible.

RECOMMENDATIONS FOR BIRD SPECIALISTS

- Although the data in this study are preliminary, the results of this review should be considered during avifaunal impact assessments, and when developing mitigation strategies.
- Specialists should ensure that their data and survey methods are clearly captured and easily handed over and interpreted by another specialist.
- Specialists should encourage the wind farm to have the necessary permissions in place to allow access to sites for monitoring throughout the life cycle of the project (including the control site).
- Specialists should endeavour to identify appropriate control sites that are beyond the influence of any wind farm.
- Statistical analysis of species abundance data could generally be improved, and should include comparisons with the control site. Specialists could consider working with university students to analyse data.
- Specialists should endeavour to use a suite of carcasses representative of the natural bird population for carcass persistence trials, as this will improve the accuracy of the results.

SAMANTHA RALSTON-PATON

Wind energy is a welcome alternative to coal, but its impacts on birds must be adequately assessed and mitigated. This report is the first of its kind for southern Africa and aims to help achieve this goal.

RECOMMENDATIONS FOR POLICY AND DECISION-MAKERS

- Monitoring provides valuable information that should feed back into impact assessments and mitigation strategies, including for projects that already have environmental authorisation.
- It would be useful if reporting key measures (including survey effort and confidence intervals) could be standardised across sites to facilitate comparisons across multiple wind farms.
- Issues around access to and use of raw data need to be resolved. Similarly a clear position regarding whether post-construction monitoring reports should be in the public domain is required.
- There are a number of questions that warrant further study, but are beyond the scope of monitoring and assessment at individual wind farms. Funding needs to be secured to facilitate this.

TOPICS THAT WARRANT FURTHER STUDY INCLUDE:

- How is the abundance and composition of small bird communities affected by the development of wind energy, and how does this change with time? Long-term studies are required to investigate if there are displacement effects on species, particularly priority species.
- Are small, endemic passerines with narrow distributions (e.g. larks) likely to be vulnerable to the impacts of wind energy (displacement, habitat loss and collisions) and can these impacts be mitigated?
- How is raptor activity affected by the construction of wind farms, and what is driving any observed changes?
- How does the presence of turbines affect the breeding, movement and flight activity of priority species (e.g. Blue Crane, Denham's Bustard, Verreaux's Eagle, Martial Eagle, Black Harrier and Jackal Buzzard)?
- How do landscape features, topography, abundance and passage rates influence collision-risk, and how does this differ between species?
- What is the most effective way to predict and minimise the collision risks for Black Harrier? Should the harrier roost influence the location of additional wind turbines in the area?
- What are potential ecological implications of the apparently high fatality rates for Jackal Buzzard? Is the location of territories affected by the presence of wind turbines?
- Based on the location of carcasses and primary purpose of surveys, what is an appropriate size of the search area?

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APPENDIX 1. BIRD FATALITIES AT REIPPPP 1 WIND FARMS

	Scientific name	Red Data Book Status	Endemism	Turbines Year 1	Turbine (other)	Other/ unknown	Grand Total
Diurnal raptors				**84**	**30**	**1**	**115**
Buzzard, Common (Steppe)	*Buteo buteo*			5	1		6
Buzzard, Jackal	*Buteo rufofuscus*		(*)	17	6	1	24
Eagle, African Fish	*Haliaeetus vocifer*				1		1
Eagle, Booted	*Hieraaetus pennatus*		3	1			4
Eagle, Martial	*Polemaetus bellicosus*	EN, VU			2		2
Eagle, Verreaux's	*Aquila verreauxii*	VU, LC		4	1		5
Falcon, Amur	*Falco amurensis*			22	5		27
Falcon, Lanner	*Falco biarmicus*	VU, LC			1		1
Falcon, Peregrine	*Falco peregrinus*			1			1
Goshawk, Pale Chanting	*Melierax canorus*			2	2		4
Harrier, Black	*Circus maurus*	EN, VU	(*)	2	3		5
Hawk, African Harrier-	*Polyboroides typus*			1	1		2
Kestrel, Lesser	*Falco naumanni*			2			2
Kestrel, Rock	*Falco rupicolus*			14	5		19
Kite, Black-shouldered	*Elanus caeruleus*			6	1		7
Kite, Yellow-billed	*Milvus aegyptius*			1			1
Osprey, Western	*Pandion haliaetus*				1		1
Unknown				4	1		5
Owls				**1**	**2**		**3**
Owl, Spotted Eagle-	*Bubo africanus*			1	1		2
Owl, Western Barn	*Tyto alba*				1		1
Ravens & Crows					**2**		**2**
Crow, Cape	*Corvus capensis*				2		2
Barbets, Mousebirds & Cuckoos				**2**			**2**
Barbet, Black-collared	*Lybius torquatus*			1			1
Cuckoo, Great Spotted	*Clamator glandarius*		1			1	
Mousebird, Speckled	*Colius striatus*			1			1
Pigeons & doves				**4**	**3**	**2**	**9**
Dove sp.					1		1
Dove, Cape Turtle	*Streptopelia capicola*		1	1		2	
Dove, Red-eyed	*Streptopelia semitorquata*				1	1	
Dove, Rock	*Columba livia*					1	1
Pigeon, Speckled	*Columba guinea*			3	1		4
Swifts, Swallows and Martins				**27**	**11**		**38**
Swallow, Barn	*Hirundo rustica*			2			2
Swallow, Greater Striped	*Cecropis cucullata*			2			2
Swallow, Lesser Striped	*Cecropis abyssinica*				1		1
Swift sp.				10	1		11
Swift, Alpine	*Tachymarptis melba*		2			2	
Swift, Common	*Apus apus*			1	7		8
Swift, Horus	*Apus horus*			2			2
Swift, Little	*Apus affinis*			4			4
Swift, White-rumped	*Apus caffer*			4	2		6

	Scientific name	Red Data Book Status	Endemism	Turbines Year 1	Turbine (other)	Other/ unknown	Grand Total
Songbirds (other)				**64**	**16**	**3**	**83**
Bokmakierie	*Telophorus zeylonus*			8	5		13
Bulbul, Cape	*Pycnonotus capensis*	*	1			1	
Canary, Cape	*Serinus canicollis*			3			3
Chat, Ant-eating	*Myrmecocichla formicivora*		1			1	
Cisticola sp.				6			6
Cisticola, Lazy	*Cisticola aberrans*				1		1
Fiscal, Southern (Common)	*Lanius collaris*					2	2
Lark sp.				4	1		5
Lark, Cape Long-billed	*Certhilauda curvirostris*	*	1			1	
Lark, Red-capped	*Calandrella cinerea*			8	3		11
Lark, Spike-heeled	*Chersomanes albofasciata*		2			2	
Longclaw, Cape	*Macronyx capensis*			2			2
Pipit sp.				1			1
Pipit, African	*Anthus cinnamomeus*		3			3	
Pipit, Plain-backed	*Anthus leucophrys*			1			1
Quail-finch, African	*Ortygospiza fuscocrissa*		1			1	
Robin-chat, Cape	*Cossypha caffra*			1			1
Sparrow, Cape	*Passer melanurus*			2			2
Starling, Common	*Sturnus vulgaris*					1	1
Starling, Pied	*Lamprotornis bicolor*	SLS	1			1	
Stonechat, African	*Saxicola torquatus*			2			2
Sunbird, Malachite	*Nectarinia famosa*			1			1
White-eye, Cape	*Zosterops virens*		(*)	1			1
Whydah, Pin-tailed	*Vidua macroura*				1		1
Unknown				14	5		19
Flufftails & Coots				**5**	**1**		**6**
Coot, Red-knobbed	*Fulica cristata*				1		1
Flufftail, Buff-spotted	*Sarothrura elegans*			2			2
Flufftail, Red-chested	*Sarothrura rufa*			2			2
Flufftail, Striped	*Sarothrura affinis*	VU, LC		1			1
Gamebirds				**11**	**1**	**15**	**27**
Guineafowl, Helmeted	*Numida meleagris*			2		4	6
Quail, Common	*Coturnix coturnix*			1	1		2
Spurfowl, Cape	*Pternistis capensis*		(*)	7		11	18
Spurfowl, Red-necked	*Pternistis afer*			1			1
Large terrestrial birds				**2**	**3**	**2**	**7**
Bustard, Denham's	*Neotis denhami*	VU, NT				1m	1
Crane, Blue	*Anthropoides paradiseus*	NT, VU			3		3
Korhaan, Blue	*Eupodotis caerulescens*	LC, NT	SLS	2			2
Korhaan, Karoo	*Eupodotis vigorsii*	NT, LC				1p	1
Shorebirds, Lapwings & Gulls				**5**	**2**		**7**
Gull, Kelp	*Larus dominicanus*			1			1
Lapwing sp.				1			1
Lapwing, Crowned	*Vanellus coronatus*			2	2		4
Plover, Kittlitz's	*Charadrius pecuarius*		1			1	
Cormorants & Darters				**2**	**1**		**3**
Cormorant sp.				1			1

	Scientific name	Red Data Book Status	Endemism	Turbines Year 1	Turbine (other)	Other/ unknown	Grand Total
Cormorant, Cape	*Phalacrocorax capensis*	EN, EN		1			1
Cormorant, Reed	*Phalacrocorax africanus*			1		1	
Waterfowl				**6**	**3**		**9**
Duck, White-faced Whistling	*Dendrocygna viduata*		1			1	
Goose, Egyptian	*Alopochen aegyptiaca*		3	2		5	
Teal, Cape	*Anas capensis*				1		1
Teal, Red-billed	*Anas erythrorhyncha*		2			2	
Waterbirds (other)				**6**	**2**	**2**	**10**
Egret, Western Cattle	*Bubulcus ibis*					1	1
Egret, Yellow-billed	*Egretta intermedia*			4			4
Grebe, Black-necked	*Podiceps nigricollis*				1		1
Ibis sp.					1		1
Ibis, African Sacred	*Threskiornis aethiopicus*				1	1	
Ibis, Hadeda	*Bostrychia hagedash*		1			1	
Unknown				1			1
Unknown				**12**	**4**	**1**	**26**
Grand Total				**232**	**81**	**35**	**344**

Red Data book status: Regional, Global. CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern.
Endemism: (in South Africa): * = endemic, SLS = endemic to South Africa, Lesotho and Swaziland (*) = near endemic (i.e. ~70% or more of population in RSA). Threatened species are highlighted in red.
Turbines Year 1: indicates bird fatalities found at 7 REIPPPP 1 wind farms that conducted rigorous carcasses searches, largely in accordance with the BirdLife South Africa and the Endangered Wildlife Trust's Best Practice Guidelines (Jenkins et al., 2012 & 2015) and includes data from a full year of monitoring. These fatalities were likely as a result of collisions with wind turbines.
Turbines (other): indicates carcasses found during pre-construction monitoring, preparatory sweeps to clear the site of fatalities, incidental finds, carcasses found during the second (incomplete) year of monitoring, and fatalities at Van Stadens Wind Farm (where regular carcass searches where not conducted). These fatalities were also likely as a result of collisions with wind turbines.
Other/unknown: Fatalities that could not be ascribed to turbines collisions are. m=meteorological mast, p=powerline collisions.

Common Names	Scientific Names	Regional Threatened Status	Global Threatened Status	Conservation Status Score	Endemic	Near-Endemic	Endemic Score	Range Size	Conservation Score	Size	Soaring	Predatory	Ranging Behaviour	Flocking	Night Flying	Aerial Display	Habitat Preference	Sensitivity to Disturbance	Overlap with Wind Farms	Risk Score	Overall Prioity Score	Rank
Cape Vulture	*Gyps coprotheres*	90	70	90	0	15	15	0	105	30	20	5	15	5	0	0	40	5	30	150	405	1
	Gypaetus barbatus	90	0	90	0	0	0	15	105	30	20	5	15	0	0	0	40	5	30	145	395	2
Verreaux's Eagle	*Aquila verreauxii*	70	0	70	0	0	0	0	70	30	15	10	5	0	0	10	40	5	30	145	360	3
Martial Eagle	*Polemaetus bellicosus*	90	50	90	0	0	0	0	90	30	15	10	15	0	0	0	20	10	30	130	350	4
Wattled Crane	*Bugeranus carunculatus*	100	70	100	0	0	0	15	115	30	5	0	5	5	2	0	30	10	30	117	349	5
Black Harrier	*Circus maurus*	90	70	90	0	15	15	0	105	15	10	10	5	0	5	10	30	5	30	120	345	6
Great White Pelican	*Pelecanus onocrotalus*	70	0	70	0	0	0	0	70	30	15	0	10	10	0	0	30	5	30	130	330	7
Southern Bald Ibis	*Geronticus calvus*	70	70	70	20	0	20	0	90	15	5	0	10	10	5	0	40	5	30	120	330	8
Yellow-billed Stork	*Mycteria ibis*	90	0	90	0	0	0	0	90	30	10	0	5	10	0	0	30	5	30	120	330	9
Black Stork	*Ciconia nigra*	70	0	70	0	0	0	0	70	20	20	0	15	0	0	0	40	5	30	130	330	10
Blue Crane	*Anthropoides paradiseus*	50	70	70	20	0	20	0	90	20	5	0	10	10	5	0	30	5	30	115	320	11
White-headed Vulture	*Aegypius occipitalis*	90	70	90	0	0	0	0	90	30	10	5	15	10	0	0	30	5	10	115	320	12
Secretarybird	*Sagittarius serpentarius*	70	70	70	0	0	0	0	70	30	10	10	5	0	0	5	30	5	30	125	320	13
Ludwig's Bustard	*Neotis ludwigii*	90	90	90	0	0	0	0	90	20	0	0	15	10	5	0	30	5	30	115	320	14
Grey Crowned Crane	*Balearica regulorum*	90	90	90	0	0	0	0	90	20	5	0	10	10	2	0	30	5	30	112	314	15
Taita Falcon	*Falco fasciinucha*	100	50	100	0	0	0	30	130	2	10	10	5	0	5	5	40	5	10	92	314	16
Southern Ground-Hornbill	*Bucorvus leadbeateri*	90	70	90	0	0	0	0	90	30	0	0	10	5	5	0	20	10	30	110	310	17
Cape Cormorant	*Phalacrocorax capensis*	90	90	90	20	0	20	0	110	15	0	0	10	10	5	0	30	0	30	100	310	18
Lappet-faced Vulture	*Aegypius tracheliotus*	90	70	**90**	**0**	**0**	**0**	**0**	**90**	**30**	**15**	**5**	**15**	**0**	**0**	**0**	**30**	**5**	**10**	**110**	**310**	**19**
Pink-backed Pelican	*Pelecanus rufescens*	70	0	70	0	0	0	0	70	30	15	0	5	10	5	0	30	10	10	115	300	20
Denham's Bustard	*Neotis denhami*	70	50	70	0	0	0	0	70	30	0	0	5	10	5	0	30	5	30	115	300	21
Bateleur	*Terathopius ecaudatus*	90	50	90	0	0	0	0	90	20	15	10	15	0	0	5	20	10	10	105	300	22
White-backed Vulture	*Gyps africanus*	90	90	90	0	0	0	0	90	30	15	5	15	5	0	0	20	5	10	105	300	23
Lanner Falcon	*Falco biarmicus*	70	0	70	0	0	0	0	70	15	10	10	5	0	0	5	40	0	30	115	300	24
African Marsh-Harrier	*Circus ranivorus*	70	0	70	0	0	0	0	70	15	10	10	5	0	0	10	30	5	30	115	300	25
African Crowned Eagle	*Stephanoaetus coronatus*	70	50	70	0	0	0	0	70	20	10	10	5	0	0	10	20	5	30	110	290	26
White-winged Flufftail	*Sarothrura ayresi*	100	90	100	0	0	0	30	130	0	0	0	5	0	15	0	20	10	30	80	290	27
Lesser Flamingo	*Phoenicopterus minor*	50	50	50	0	0	0	0	50	20	0	0	10	10	15	0	30	5	30	120	290	28

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Greater Flamingo	*Phoenicopterus ruber*	50	0	50	0	0	0	0	50	20	0	0	10	10	15	0	30	5	30	120	290	29
Tawny Eagle	*Aquila rapax*	90	0	90	0	0	0	0	90	20	15	10	5	0	0	5	30	5	10	100	290	30
African Fish-Eagle	*Haliaeetus vocifer*	0	0	0	0	0	0	0	0	30	15	10	15	0	0	10	30	5	30	145	290	31
African Grass-Owl	*Tyto capensis*	70	0	70	0	0	0	15	85	2	0	10	5	0	15	0	30	10	30	102	289	32
Bat Hawk	*Macheiramphus alcinus*	90	0	90	0	0	0	15	105	15	5	10	10	0	15	0	20	5	10	90	285	33
Damara Tern		100	50	100	0	0	0	0	100	2	0	0	10	5	0	5	30	5	30	87	274	34
Blue Korhaan	*Eupodotis caerulescens*	0	50	50	20	0	20	0	70	20	0	0	5	10	0	0	30	5	30	100	270	35
White-bellied Korhaan	*Eupodotis senegalensis*	70	0	70	0	0	0	0	70	30	0	0	5	10	0	0	20	5	30	100	270	36
Southern Black Korhaan	*Afrotis afra*	70	70	70	20	0	20	0	90	15	0	0	5	0	0	5	30	5	30	90	270	37
Blue Swallow	*Hirundo atrocae-rulea*	100	70	100	0	0	0	30	130	0	0	10	0	5	2	0	30	10	10	67	264	38
Kori Bustard	*Ardeotis kori*	50	50	50	0	0	0	0	50	30	0	0	5	5	0	0	30	5	30	105	260	39
Red Lark	*Calendulauda burra*	70	70	70	20	0	20	30	120	0	0	0	0	0	0	5	30	5	30	70	260	40
Pallid Harrier	*Circus macrourus*	50	50	50	0	0	0	0	50	15	5	10	5	0	0	0	30	10	30	105	260	41
Cape Eagle-Owl	*Bubo capensis*	0	0	0	0	0	0	0	0	20	0	10	5	0	10	0	40	10	30	125	250	42
Jackal Buzzard	*Buteo rufofuscus*	0	0	0	0	0	0	0	0	15	15	10	5	0	0	10	40	0	30	125	250	43
Hooded Vulture	*Necrosyrtes monachus*	90	90	90	0	0	0	0	90	20	10	5	15	0	0	5	20	5	0	80	250	44
Botha's Lark	*Spizocorys fringillaris*	90	90	90	20	0	20	30	140	0	0	0	0	0	0	10	30	5	10	55	250	45
Yellow-breasted Pipit	*Anthus chloris*	70	70	70	20	0	20	15	105	0	0	0	0	0	0	5	30	5	30	70	245	46
Saddle-billed Stork	*Ephippiorhyn-chus senega-lensis*	90	0	90	0	0	0	0	90	30	5	0	0	0	0	0	30	0	10	75	240	47
Marabou Stork	*Leptoptilos crumeniferus*	50	0	50	0	0	0	0	50	30	15	0	5	5	0	0	30	0	10	95	240	48
Peregrine Falcon	*Falco peregrinus*	0	0	0	0	0	0	0	0	15	10	10	5	0	5	5	40	0	30	120	240	49
Sclater's Lark	*Spizocorys sclateri*	50	50	50	0	15	15	15	80	0	0	0	5	10	0	0	30	5	30	80	240	50
Karoo Korhaan	*Eupodotis vigorsii*	50	0	50	0	0	0	0	50	20	0	0	5	5	0	0	30	5	30	95	240	51
Caspian Tern		70	0	70	0	0	0	0	70	15	0	0	10	0	0	0	30	0	30	85	240	52
Hottentot But-tonquail	*Turnix hottentot-tus*	90	0	90	20	0	20	15	125	0	0	0	0	0	0	0	20	5	30	55	235	53

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Agulhas Long-billed Lark	*Certhilauda brevirostris*	50	0	50	20	0	20	15	85	0	0	0	0	0	0	10	30	5	30	75	235	54
Chestnut-banded Plover		50	50	50	0	0	0	0	50	0	0	0	10	10	5	0	30	5	30	90	230	55
Rudd's Lark	*Heteromirafra ruddi*	90	70	90	20	0	20	30	140	0	0	0	0	0	0	0	30	5	10	45	230	56
Osprey	*Pandion haliaetus*	0	0	0	0	0	0	0	0	20	10	10	5	0	0	0	30	10	30	115	230	57
Mountain Pipit	*Anthus hoeschi*	50	0	50	20	0	20	30	100	0	0	0	0	0	0	5	30	0	30	65	230	58
Booted Eagle	*Aquila pennatus*	0	0	0	0	0	0	0	0	15	15	10	5	0	0	5	30	5	30	115	230	59
Black-chested Snake-Eagle	*Circaetus pectoralis*	0	0	0	0	0	0	0	0	20	15	10	5	5	0	5	20	5	30	115	230	60
White Stork	*Ciconia ciconia*	0	0	0	0	0	0	0	0	20	10	0	5	10	0	0	30	5	30	110	220	61
Black Kite	*Milvus migrans*	0	0	0	0	0	0	0	0	15	15	10	15	5	0	0	20	0	30	110	220	62
Southern Banded Snake-Eagle	*Circaetus fasciolatus*	70	50	70	0	0	0	15	85	20	10	10	5	0	0	5	0	5	10	65	215	63
Lesser Kestrel	*Falco naumanni*	0	0	0	0	0	0	0	0	2	5	10	10	10	5	0	30	5	30	107	214	64
Verreaux's Eagle-Owl	*Bubo lacteus*	0	0	0	0	0	0	0	0	30	0	10	0	0	10	0	20	5	30	105	210	65
Amur Falcon	*Falco amurensis*	0	0	0	0	0	0	0	0	0	5	10	10	10	5	0	30	5	30	105	210	66
Steppe Buzzard	*Buteo vulpinus*	0	0	0	0	0	0	0	0	15	15	10	5	0	0	5	20	5	30	105	210	67
Montagu's Harrier	*Circus pygargus*	0	0	0	0	0	0	0	0	15	5	10	5	0	0	0	30	10	30	105	210	68
Burchell's Courser	*Cursorius rufus*	70	0	70	0	0	0	0	70	0	0	0	0	5	0	0	30	5	30	70	210	69
Barlow's Lark	*Calendulauda barlowi*	50	0	50	0	0	0	30	80	0	0	0	0	0	0	5	30	0	30	65	210	70
Cape Parrot		90	0	90	20	0	20	15	125	2	0	0	10	10	0	0	0	10	10	42	209	71
Double-banded Courser	*Rhinoptilus africanus*	50	0	50	0	0	0	0	50	2	0	0	0	0	5	0	30	10	30	77	204	72
Black-winged Pratincole	*Glareola nord-manni*	50	50	50	0	0	0	0	50	0	0	0	10	10	1	10	30	5	10	76	202	73
Black-bellied Bustard	*Lissotis melano-gaster*	50	0	50	0	0	0	0	50	30	0	0	5	0	0	5	20	5	10	75	200	74
Southern Pale Chanting Goshawk	*Melierax canorus*	0	0	0	0	0	0	0	0	20	5	10	5	0	0	5	20	5	30	100	200	75
Knysna Warbler		70	70	70	20	0	20	30	120	0	0	0	0	0	0	0	0	10	30	40	200	76
Drakensberg Rock-jumper	*Chaetops aurantius*	0	0	0	20	0	20	30	50	0	0	0	0	0	0	0	40	5	30	75	200	77
African Rock Pipit	*Anthus crenatus*	50	0	50	20	0	20	0	70	0	0	0	0	0	0	5	30	0	30	65	200	78
Marsh Owl	*Asio capensis*	0	0	0	0	0	0	0	0	15	0	10	0	0	5	0	30	5	30	95	190	79
Grey-winged Francolin	*Scleroptila africanus*	0	0	0	20	0	20	0	20	15	0	0	5	0	0	0	30	5	30	85	190	80
Woolly-necked Stork	*Ciconia epis-copus*	0	0	0	0	0	0	0	0	30	5	0	5	10	0	0	30	5	10	95	190	81

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Wahlberg's Eagle	*Aquila wahlbergi*	0	0	0	0	0	0	0	0	15	10	10	5	5	0	5	30	5	10	95	190	82
Striped Flufftail		70	0	70	0	0	0	0	70	0	0	0	0	0	0	0	20	10	30	60	190	83
Long-crested Eagle	*Lophaetus occipitalis*	0	0	0	0	0	0	0	0	15	10	10	5	0	0	0	20	5	30	95	190	84
African Harrier-Hawk	*Polyboroides typus*	0	0	0	0	0	0	0	0	15	5	10	5	0	0	5	20	5	30	95	190	85
Short-tailed Pipit	*Anthus brachyurus*	70	0	70	0	0	0	15	85	0	0	0	0	0	0	5	30	5	10	50	185	86
Buff-streaked Chat	*Oenanthe bifasciata*	0	0	0	20	0	20	15	35	0	0	0	0	0	0	0	40	5	30	75	185	87
African Hawk-Eagle	*Aquila spilogaster*	0	0	0	0	0	0	0	0	20	15	10	5	0	0	5	20	5	10	90	180	88
Rosy-throated Longclaw	*Macronyx ameliae*	50	0	50	0	0	0	30	80	0	0	0	0	0	0	0	30	10	10	50	180	89
Northern Black Korhaan	*Afrotis afraoides*	0	0	0	0	0	0	0	0	15	0	0	5	0	0	5	30	5	30	90	180	90
Melodious Lark	*Mirafra cheniana*	0	50	50	20	0	20	0	70	0	0	0	5	5	0	10	20	5	10	55	180	91
Brown Snake-Eagle	*Circaetus cinereus*	0	0	0	0	0	0	0	0	20	10	10	5	0	0	0	30	5	10	90	180	92
Yellow-throated Sandgrouse	*Pterocles gutturalis*	50	0	50	0	0	0	15	65	0	0	0	5	10	5	0	30	5	0	55	175	93
Black-shouldered Kite	*Elanus caeruleus*	0	0	0	0	0	0	0	0	2	0	10	0	5	5	5	30	0	30	87	174	94
Greater Kestrel	*Falco rupicoloides*	0	0	0	0	0	0	0	0	2	0	10	5	0	0	5	30	5	30	87	174	95
Red-footed Falcon	*Falco vespertinus*	50	50	50	0	0	0	0	50	2	10	10	5	0	0	0	20	5	10	62	174	96
Black-winged Lapwing	*Vanellus melanopterus*	0	0	0	0	0	0	0	0	2	0	0	5	10	0	5	30	5	30	87	174	97
Spotted Eagle-Owl	*Bubo africanus*	0	0	0	0	0	0	0	0	15	0	10	0	0	10	0	20	0	30	85	170	98
African Pygmy-Goose	*Nettapus auritus*	70	0	70	0	0	0	0	70	0	0	0	5	5	0	0	20	10	10	50	170	99
Victorin's Warbler	*Cryptillas victorini*	0	0	0	20	0	20	30	50	0	0	0	0	0	5	0	20	5	30	60	170	100
Rufous-chested Sparrowhawk	*Accipiter rufiventris*	0	0	0	0	0	0	0	0	15	10	10	5	0	5	5	0	5	30	85	170	101
Black Sparrowhawk	*Accipiter melanoleucus*	0	0	0	0	0	0	0	0	15	10	10	5	0	5	5	0	5	30	85	170	102
Palm-nut Vulture	*Gypohierax angolensis*	0	0	0	0	0	0	30	30	20	5	5	5	0	0	0	20	5	10	70	170	103
Lesser Spotted Eagle	*Aquila pomarina*	0	0	0	0	0	0	0	0	15	10	10	5	5	0	5	20	5	10	85	170	104

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Half-collared Kingfisher		50	0	50	0	0	0	0	50	0	0	0	0	0	0	0	20	10	30	60	170	105
Forest Buzzard	*Buteo trizonatus*	0	0	0	0	0	0	0	0	15	10	10	5	0	0	10	0	5	30	85	170	106
Black-rumped Buttonquail		70	0	70	20	0	20	0	90	0	0	0	0	0	0	0	20	10	10	40	170	107

For further details on the rationale and approach to the species prioritisation, please see Retief et al. 2011.

Scoring used in species prioritisation:

Conservation Value (Global and Regional)	Ranking
Near-threatened	50
Vulnerable	70
Endangered	90
Critical	100
Endemic Status	
Endemic	20
Near-Endemic	15
Range Size	
Limited range	15
Very limited range	30
Population trend	
Marked decrease in SABAP reporting rates	20
Susceptibility (Structural)	
Size	
Very large birds	30
Large	30
Medium	15
Small	2
Very Small	0
Susceptibility (Behaviour)	
Soaring	
always, including slope soaring	20
always	15
usually	10
regularly	5
never	0
Predatory	
highly	10
partially	5
never	0

Ranging Behaviour	
very wide	15
long, daily commuter	10
wide	5
sedentary	0
Flocking Behaviour	
always	10
sometimes	5
never	0
Night Flying	
nocturnal commuter	15
nocturnal	10
crepuscular	5
sometimes crepuscular	2
diurnal	1
Aerial Display	
frequent	10
occasional	5
never	0
Habitat Preference	
open with relief	40
open	30
semi-open	20
closed	0
Sensitivity to disturbance	
high	10
medium	5
low	0
Overlap with Wind Farms	
Major Overlap	30
Minor Overlap	10
No Overlap	0

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BirdLife
SOUTH AFRICA
Giving Conservation Wings

Verreaux' Eagle and Wind Farms

Guidelines for impact assessment, monitoring, and mitigation

March 2017

Contents

Cover image: Verreauxs' Eagle by Marietjie Froneman

Summary and key recommendations

VERREAUXS' EAGLE ALBERT FRONEMAN

These guidelines summarise the current state of knowledge with regards to the potential effects of wind energy on Verreauxs' Eagle, and outline the steps necessary to ensure that negative effects are adequately assessed and minimised.

Verreauxs' Eagle has been listed as regionally Vulnerable in the latest Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor et al. 2015). There is evidence to suggest that this species is vulnerable to colliding with wind turbines. Eagles may also be affected by disturbance and displacement related to wind farm activities, particularly around nests. Opportunities to avoid and minimise these impacts lie largely within the planning phase (i.e. before construction).

Where a wind farm is proposed within potentially important Verreauxs' Eagle habitat, BirdLife South Africa recommends the following:

- **Wind turbines should be placed outside of the core territory of eagles** to reduce the risk of collisions.
- **Areas associated with increased flight activity and/or risky behaviour should also be avoided**, for example the edge the escarpment, ridge tops, cliffs, steep slopes and particularly slopes that are perpendicular to the prevailing wind direction.
- **Dedicated surveys must be conducted to identify potential nest sites**. Cliff-lines should be surveyed for evidence of nesting. These surveys should extend beyond the development footprint to include the likely territory of any pair that may regularly use the site.
- **A buffer of 3 km is recommended around all nests** (including alternate nests). This is intended to reduce the risk of collisions and disturbance. This is a precautionary buffer and may be reduced (or increased) based on the results of rigorous avifaunal surveys, but nest buffers should never be less than 1.5 km.
- Vantage point surveys should be conducted for a **minmum of 72 hours per vantage point per year**.
- Fieldwork must include surveys during the **breeding season.**
- Surveys (including vantage point monitoring) should **extend beyond the developable area**.
- The relative **extent and type of use** of the site by eagles must be assessed.
- Steps should be taken to avoid **increasing the prey population** (and thereby attracting eagles to the wind farm). For example excavated rocks and animal carcasses should be removed.
- If it is suspected that a proposed wind farm may pose a significant risk to Verreauxs' Eagles, **the duration of pre-construction monitoring should be extended to two years,** particularly where alternate nests are some distance apart and/or turbines are proposed in areas that may be associated with increased flight activity and/or risky behaviour.
- **No construction activities (e.g. new roads) should be allowed within 1 km of nests during the breeding season.**
- Nests should be **monitored for breeding activity** throughout the lifespan of the wind farm (including during construction), but care must be taken to ensure that monitoring activities do not disturb breeding birds.

Verreauxs' Eagle and Wind Farms: Guidelines for impact assessment, monitoring, and mitigation

1. INTRODUCTION

Renewable energy has the potential to play a significant role in mitigating global climate change and can therefore make a positive contribution to the conservation of birds and other biodiversity. However, renewable energy can also have negative environmental impacts. Wind-farms can cause mortality, disturb and/or displace of birds (Drewitt & Langston 2006; Strickland et al. 2011; Rydell et al. 2012; Gove et al. 2013).

The iconic Verreauxs' Eagle (*Aquila verreauxii*; previously known as the Black Eagle) is found across much of Africa, including South Africa (BirdLife International, 2015) and a number of wind farms have been proposed within its range (out of a total of 57 impact assessment and monitoring reports for wind farms that BirdLife South Africa analysed, 65% reported the presence of Verreauxs' Eagles at, or near to, a proposed wind farm).

Its conservation status, behaviour and distribution, together with experiences with eagles and wind farms in other parts of the world, suggest that poorly planned wind farms could negatively affect the species. It is therefore not surprising that Verreauxs' Eagle is considered to be a priority for impact assessment and monitoring at wind energy facilities in South Africa (e.g. Retief et al., 2010, and updates thereof). If wind energy is to be developed in South Africa without adding further stressors to the species, steps must be taken to minimise risks throughout the lifecycle of a wind farm (i.e. from screening to operation).

This document provides an overview of our current understanding of the likely impact of wind energy faculties on Verreauxs' Eagle, and offers guidance on how the impacts should be assessed, avoided, mitigated and monitored.

2. SPECIES DESCRIPTION

Verreauxs' Eagle is an apex predator and plays an important ecological role (Davies, 1994). Due to its wide range, the global population of Verreauxs' Eagle is not considered to be threatened (BirdLife International, 2015). However, there has been a marked decline in reporting rates for the species in the South African Bird Atlas Project, which suggests that the species may be decreasing in numbers, at least in some areas. Verreauxs' Eagle has therefore been listed as regionally **Vulnerable** in the latest Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor et al., 2015). Verreauxs' Eagle is a long-lived species and a slow breeder (Simmons 2005).

Verreauxs' Eagle are predominantly found in mountainous, rocky habitat (Davies & Allan, 1997). The regional population of Verreauxs' Eagle (i.e. for South Africa, Lesotho and Swaziland) has been estimated to be between 3500 and 3750 mature individuals, but confidence in these figures is low (Taylor et al., 2015). Davies (1994) estimated there to be 2000 breeding pairs in what was then the Western Cape Province (later divided into Western Cape, Eastern Cape, Northern Cape and part of the North West). The density of the species varies across the landscape (Davies & Allan, 1997), with the highest densities found in the south-western Cape to KwaZulu-Natal. Densities of 1 pair per 24 km^2 (4.2 pairs per 100km^2) have been recorded in the Karoo (Davies, 1994). Murgatroyd et al. (2016) report densities of 1.2 pairs per 100 km^2 in the Sandveld, and 3 pairs per 100 km^2 in the Cederberg.

Verreauxs' Eagles are territorial. Their territories surround their nest sites, but their nests are not necessarily in the centre of their territory (Gargett, 1990). Nests are usually built on cliffs and ledges (Gargett, 1990), although they have been recorded nesting on power lines and occasionally in trees. Resident pairs can have up to and exceeding five alternate nest sites within a territory, although one site may be preferred (Davies, 1994). Alternate nests may be some distance apart – in the Karoo alternative nests have been recorded up to 2.39 km away from the most active nest, although most alternate nest sites are closer (with a mean distance of 0.49km) (Davies, 1994).

The distance between nests of different pairs also varies. In the Karoo Davies (1994) recorded an average distance of 2.72 between nests of neighbouring pairs. In the Cederberg mean Nearest Nest Distance is 4.0 km (range=1.3-7.3km, n=24); while in the Sandveld the mean is 5.3 km (range=1.1-12.8, n=31) (Murgatroyd pers. comm.).

Area (Biome)	Nearest Nest Distance (km)			No. of nests	Reference
	Mean	SD	Range		
Nuweveld (Nama-Karoo)	2.72	0.95	1.34-4.51	20	Davies 1994
Wind Farm (Nama-Karoo)	3.84	0.49	3.29-4.25	4	*
Cederberg (Fynbos)	4.0		1.3-7.3	24	Murgatroyd pers comm.
Nuweveld (Nama-Karoo)	4.25	1.39	3.0-7.5	12	Boshoff & Palmer 1988
Wind Farm (Nama Karoo)	4.91	3.95	0.89-9.2	8	*
Drakensberg (Grassland)	5		4.8-8.9	8	Brown 1988
Sandveld (Fynbos)	5.3		1.1-12.8	31	Murgatroyd pers comm.
Wind Farm (Nama-Karoo/Grassland)	6.40	2.15	4.88-7.93	3	*
Soutpansberg (Savanna)	6.8	4.0	2.0-14.5	8	Tarboton & Allan 1984
Wind Farm (Fynbos/ Succulent Karoo)	6.88	1.91	4.2-9.2	7	*
Magaliesberg (Savanna)	9.5	4.5	3.0-19.5	12	Tarboton & Allan 1984
Magaliesberg (Savanna)	14.4	11.4		8	Whittington-Jones et al. 1994
Wind Farm (NamaKaroo)	6.1		0.6-12.0	21	*
Waterberg (Savanna)	13.3	6.5	5.0-21.0	9	Tarboton & Allan 1984
Gaap Plateau (Savanna/Nama-Karoo)	41.1			5	Anderson & Hohne, 2007

Table 1. *Nearest Nest Distances for Verreauxs' Eagles, as reported in various studies in South Africa.*

3.1. COLLISION WITH WIND TURBINES

Bird fatalities as a result of collision with wind turbines (as well as associated infrastructure) is a well-documented risk associated with wind farms (Drewitt & Langston, 2006; Hötker, Thomsen & Jeromin, 2006). While many wind farms have reported low collision rates (Erickson et al., 2001; Drewitt & Langston, 2006), some wind farms have had a high number of incidents. Most of the high-profile cases have involved large, soaring birds of prey (Barrios & Rodríguez, 2004; Hötker, Thomsen & Jeromin, 2006; Smallwood & Thelander, 2008). Eagle mortalities at wind farms have been experienced in many parts of the world. Golden Eagle (*Aquila chrysaetos*) (e.g. Smallwood & Thelander, 2008; Smallwood, 2013), White-tailed Sea Eagle (*Haliaeetus albicilla*) (e.g. Hötker, Thomsen & Jeromin, 2006), Bald Eagle (*Haliaeetus leucocephalus*) (Pagel et al. 2013) and White-bellied Sea Eagle (*Haliaeetus leucogaster*) (Smales and Muir, 2005) have all been reported to collide with wind turbines. It is therefore not unlikely that Verreauxs' Eagles could face a similar risk in South Africa.

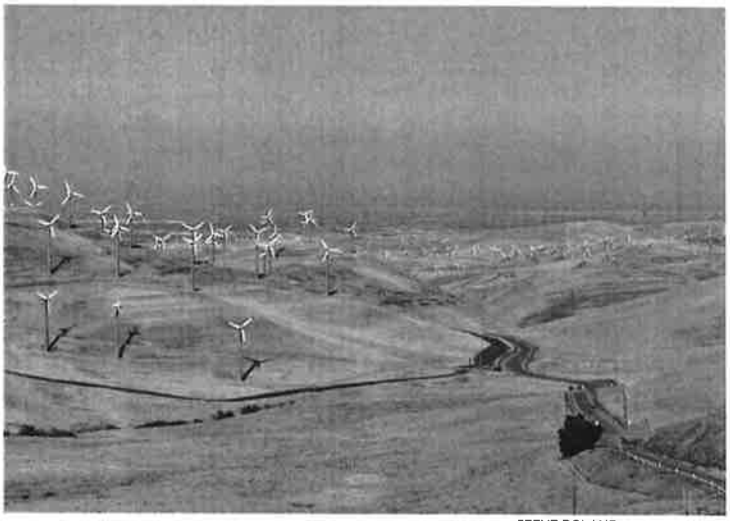
Although Taylor et al. (2015) suggests that wind farms present a potentially significant new threat to the species, up until recently no wind farms had been constructed within the range of Verreauxs' Eagle and there has been limited opportunity to document the impacts. A review of the first six wind farms to share post-construction monitoring data with BirdLife South Africa indicates that Verreauxs' Eagle mortalities have occurred at two of those wind farms. A total of five Verreauxs' Eagles collisions have been reported; four fatalities occurred at one wind farm within a three-month period (Smallie, 2015a). These preliminary data do suggest that this species is vulnerable to collisions, and points to the need for a precautionary approach for wind farms within the species' range.

While it is dangerous to extrapolate fatality rates from studies at a particular wind farm, or from a particular area, to a specific site (Fielding & Haworth, 2010), lessons may be learned from experiences with wind farms and other species of eagle, for example Golden Eagle (*Aquila chrysaetos*), Verreauxs' Eagle's ecological counterpart in the northern hemisphere.

Golden Eagles

Altamont Pass in California is a well-studied and well-publicised example of a wind farm where there have been significant raptor mortalities, particularly Golden Eagles. Fatality rate estimates for Altamont Pass vary, partly as a result of different monitoring protocols (Smallwood & Thelander, 2008; Smallwood & Karas, 2009). There is also inter-annual variation in fatality rates (Smallwood, 2013). Accounting for several potential biases in the data, Smallwood and Thelander (2008) estimated that 1127 raptors are killed annually, including 67 Golden Eagles (0.11 golden eagle collisions per MW per year).

Although the number of fatalities at Altamont Pass is high, the annual fatality rate per turbine is not exceptional. Part of what makes this situation stand out is the large number of turbines involved (Drewit and Langston, 2006) – there are approximately 5400 wind turbines at Altamont Pass, covering an area of 165km^2 (Smallwood & Thelander, 2008)



STEVE BOLAND

With a high density of raptors, combined with the large number of turbines, Altamont Pass has become infamous for Golden Eagle fatalities.

Some authors suggest that Altamont Pass is a unique situation and the high fatality rates are as a result of the particular characteristics of the site (Hunt, 2002). The population of raptors, including Golden Eagles at Altamont Pass is particularly dense (Hunt, 2002; Hunt & Hunt, 2006; Smallwood, Lourdes & Morrison, 2009). Prey are abundant, which attracts and supports the high numbers of raptors. The area is also topographically varied, with deep valleys and mountain ridges (Smallwood & Thelander, 2008). It has also been suggested that design of the wind turbine (e.g. lattice towers) and the layout of turbines (more closely spaced turbines than modern layouts) at Altamont Pass may influence fatality rates (Bright et al., 2008).

Despite the high levels of mortality at Altamont Pass, the breeding population remains intact (all territories that were occupied in 2000 were still occupied in 2005). This suggests that even though the number of fatalities is high, there are enough "floaters" to fill territories (Hunt & Hunt, 2006; Smallwood & Thelander, 2008). Sub-adults and non-territorial adults (floaters) have also been reported to be far more vulnerable to collisions at Altamont Pass than juveniles and breeding adults (Hunt, 2002). While this may seem reassuring, there are concerns that Altamont Pass is a population "sink"; the influx of birds from the surrounding area may have effects on the broader population (Hunt & Hunt, 2006; Smallwood & Thelander, 2008).

Golden Eagle fatalities have not only occurred at Altamont Pass. Fatalities of this widespread species have been reported at wind farms in the USA as well as in Europe. Fatality rates vary and there seems to be a marked difference in reported mortality rates in the USA versus Europe. There have been few reported collisions in Europe (Hötker, Thomsen & Jeromin, 2006).

Despite a large number of wind energy projects in Spain, a review of the European literature found only one reported casualty of a Golden Eagle due to collision with a wind

JESSIE WALTON

Topography influences the flight behaviour of eagles and therefore the risk of collisions.

turbine (Hötker et al., 2004). Camiña (2015) has collated a total of 15 fatalities.

Wind farms in the United Kingdom also appear to pose a low risk of collision to Golden Eagles. This may, however, be because most wind farms are located in areas of low Golden Eagle activity (Madders & Whitfield, 2006). By 2010 only two operational wind farms had an active Golden Eagle range within six kilometres of wind farm (although many more have been approved) (Fielding & Haworth, 2010). There has also been little post-construction monitoring, and data from monitoring is not always accessible. While it is does seem that mortality rates are much lower than those observed at Altamont Pass, it may be to soon to conclude that wind farms pose a low risk to golden eagles in the United Kingdom (Fielding & Haworth, 2010).

White-tailed Sea Eagle

White-tailed Sea Eagle (*Haliaeetus albicilla*) is another species that appears to be vulnerable to collision with wind turbines. In Germany at least 13 White-tailed Sea Eagle mortalities at wind farms have been reported (Hötker, Thomsen & Jeromin, 2006).

The Smøla Archipelago in Norway is an Important Bird Area, largely due to its unusually high breeding density of White-tailed Sea Eagles (BirdLife International, 2015). Despite the IBA status, 68 turbines were erected on Smøla. Between 2005 and 2010 at least 39 eagle mortalities occurred as a result of turbine collisions (Bevanger et al., 2010; May et al., 2012), an average of 0.11 eagles mortalities, per turbine, per year. These fatalities were not evenly distributed through the wind farm, and a higher number of adults than sub-adults and juveniles were killed (Bevanger et al., 2010). The eagles were most vulnerable during spring (May et al., 2010), coinciding with early part of the breeding season (i.e. brooding or with newly hatched chicks) (Dahl et al. 2012). Eagles breeding within or close to the turbines appear to be most vulnerable (May et al., 2012). Fatalities as a result of collisions account for more than half the detectable adult mortality at Smøla. However, despite the high collision rate, the population of White-tailed Sea Eagles at Smøla appears to be stable; the number of young eagles born on Smøla and reproductive success increased between 2002-2010 (May et al., 2012). Again, while reassuring, the long-term implications of the impacts remain a concern.

3.2. FACTORS THAT INFLUENCE THE RISK OF COLLISIONS

Several factors may influence the vulnerability of eagles to collisions with wind turbines. However, the relative importance of these factors, and how they interrelate, remains poorly understood (Strickland et al. 2011). Below are just some factors that may have relevance.

Abundance and flight activity

It is often assumed that collision risk is related to bird abundance and/or passage rates (e.g. (Smallwood & Karas, 2009), however evidence to support this is equivocal (Ferrer et al. 2012, U.S. Fish and Wildlife Service, 2013, Gove et al., 2013, Marquesa et al. 2014). At Smøla, the season with the most White-tailed Sea Eagle fatalities coincides with the breeding season, when flight activity is the greatest (Dahl et al., 2012). While flight activity may influence collision risk, a number of other factors are also likely to play a role (de Lucas et al., 2008; Ferrer et al., 2012). Collision risk may, for example, be reduced if birds are susceptible to being displaced (U.S. Fish and Wildlife Service, 2013).

Results are preliminary, but at the wind farms where Verreauxs' Eagle collisions occurred activity rates measured before construction did not suggest a particularly high risk, although there was a slight peak in autumn (the season when the incidents occurred)(Smallie, 2015b). This the time of year when juveniles disperse along escarpments (Rob Davies, pers. comm.) Avifaunal monitoring reports that have included observations of Verreauxs' Eagles report a range of passage rates that can vary markedly according to location of the vantage point and the season. An analysis of monitoring reports suggest that passage rates, averaged across a study area, can range from less than 0.1 birds per hour to approximately one bird per hour, with a median of 0.12 birds per hour. These figures should be treated with caution as data collection and reporting methods vary, and results may therefore not be directly comparable. Bearing these constraints in mind, the majority of reported flights (approximately 55%) occurred at a height that could put birds at risk of collisions (i.e. between 30 and 160 meters).

Topography and wind

The underlying landscape can influence the extent to which an area is used by eagles (Madders & Whitfield, 2006), how an area is used (Katzner et al. (2012), and collision risk (Ferrer et al., 2012). Some raptors, including Golden Eagles show a preference for flying along ridges (McLeod, Whitfield & McGrady, 2002). Katzner et al. (2012) found that Golden Eagles tend to fly lower when they are over steep slopes and cliffs, when compared to flatter areas. Golden Eagles are also more likely to fly within the rotor swept area of turbines on mountaintops, ridge-tops, cliffs and steep slopes, placing them at greater risk of collision. Thelander, Smallwood & Rugge (2003) report that Golden Eagle fatality rates are higher for turbines located on slopes and in canyons at Altamont Pass. The aspect of a slope may also influence collision risk (Thelander, Smallwood & Rugge, 2003); this may be as a result of a combination of factor that affecting flight behaviour including topography, wind direction and wind speed (U.S. Fish and Wildlife Service, 2013).

Verreauxs' Eagles are mountain specialists with a wing design suited to slope soaring. They often hunt in pairs and soar along ridges (Davies, 1994). Davies (1994) reports that flight activity of Verreauxs' Eagle is influenced by wind direction. Eagles preferentially use slopes that are perpendicular to the wind direction and amphitheatres facing the wind are particularly favoured. Modelling of Verreauxs' Eagle movements suggests that thermalling flight behaviour is more likely to occur over relatively flat topography and in low wind conditions (conditions conducive to the formation of thermals). The average altitude above ground of thermalling birds is not yet known, but this behaviour may place birds within the rotor swept area and thus present an additional risk of collision (Murgatroyd, pers comm.).

Behaviour

Collision risk may also be influenced by behaviour that causes birds to be distracted in flight (e.g. hunting, mating, territorial displays, and inter-species interactions) (U.S. Fish and Wildlife Service, 2013). At Altamont Pass Wind Resource Area birds appear to be at greater risk when foraging (thus prey availability too may affect collision risk) (Thelander, Smallwood & Rugge, 2003). Camiña (per comm.) also reports that most collisions in Spain occurred while Golden Eagles were hunting and it has been hypothesised that birds may go into a "hunting trance" which renders them unaware of obstacles such as spinning turbines (Sinclair and DeGeorge, 2016).

Verreauxs' Eagles have been observed to hang in the air, almost motionless, for extended periods of time when hunting (Davies, 1994). They have a habit of flying at low heights and at speed over rocky terrain during surprise attacks on sun-basking rock hyrax (Rob Davies, pers. comm.). Verreauxs' Eagles also engage in aerial displays during courtship and "cartwheeling" is usually associated with the defence of territories (Gargett, 1990). It is therefore possible that they could be risk when hunting, and during mating and territorial displays.

3.3. HABITAT LOSS, DISPLACEMENT AND DISTURBANCE

Wind farms may affect birds through causing the loss or degradation of habitat (Madders & Whitfield, 2006; U.S. Fish and Wildlife Service, 2013). The implications of habitat loss can be challenging to assess and study, particularly for non-breeders/floaters (Fielding & Haworth, 2010).

In addition to direct habitat loss, activities relating to the construction and operation of wind farms may lead to displacement of birds (effective habitat loss) (Madders & Whitfield, 2006; U.S. Fish and Wildlife Service, 2013), and disturbance relating to wind farm activities could affect breeding success and productivity of nearby eagle nests (U.S. Fish and Wildlife Service, 2013).

Displacement effects have been reported for White-tailed Eagles at Smøla where fewer occupied and successful breeding territories were recorded after the wind farm was constructed (Bevanger et al. 2010, Nygård et al., 2010, Dahl et al., 2012). It is not clear if the reduced number of occupied territories was as a result of collision mortality, or due to displacement of birds, or both (Dahl et al., 2012). In the USA there is equivocal evidence of displacement in Golden Eagles (Madders & Whitfield, 2006). There are, for example, no Golden Eagles nesting in the Altamont Pass Wind Resource Area (Hunt & Hunt, 2006). However, it is not clear if this is as a result of displacement of eagles, or if it reflects the baseline condition, as research only really began after the wind farm was constructed (U.S. Fish and Wildlife Service, 2012). Although there are few examples of wind farms close to Golden Eagle territories in Scotland, there is some evidence to suggest that eagles may be displaced, or partially displaced (Fielding & Haworth, 2010). The lack of before-after-control-impact studies (Drewitt & Langston, 2006) and the low density of raptors has limited the number of conclusive studies (Dahl et al., 2012).

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The risk of displacement and disturbance is possibly greatest during the construction of a wind farm, when noise and activity levels are highest.

Birds may respond differently to different types of disturbance and under different circumstances (Ruddock & Whitfield, 2007) and it is unclear to what extent Verreauxs' Eagle will be affected by habitat loss, displacement and disturbance associated with wind farms. Human disturbance does appear to be an important problem for Verreauxs' Eagles (Whittington-Jones et al., 2013). There is evidence that Verreauxs' Eagles can become habituated; the breeding pair at the Walter Sisiulu Botanical Gardens in Johannesburg being a case in point (Symes and Kruger 2012), although it is not clear if this example is typical of the species. At this stage, there is no evidence of displacement at any operational wind farm in South Africa; on the contrary, there are preliminary indications that activity rates may increase post-construction although further research and analysis is required to confirm this. It is too early to determine if there has been any effect on breeding.

4. MITIGATION

Opportunities to avoid and minimise impacts on eagles lie largely within the planning phase of a project (i.e. before construction).(U.S. Fish and Wildlife Service, 2013). The mitigation hierarchy also dictates that impacts should first be avoided, then minimised, and only then mitigated. It is therefore important that risk factors are taken into account as early as possible in the project development cycle. Emphasis should be placed on avoiding impacts though the careful location of wind farms and wind turbines, before considering curtailment and habitat management.

4.1. WIND FARM LOCATION AND TURBINE LAYOUT

Various studies have highlighted the importance of careful siting of wind farms in reducing the risk of collisions (e.g. Drewitt & Langston, 2006, Dahl et al. 2012, Marquesa et al. 2014). The most cost effective approach to mitigating impacts is to study the area and identify landscape and biological features that may be associated with risk (U.S. Fish and Wildlife Service, 2013). For Verreauxs' Eagle, such sites could include breeding sites (recent or historical), physical features (e.g. topography) or other areas of high use.

Avoid areas of high use and risky flight behaviour

To reduce the risk of collisions and displacement **wind turbines should be placed outside of the core territory of eagles** (e.g. the area where 90% of the eagle activity occurs). Other **areas associated with increased flight activity and/or risky behaviour should also be avoided** (e.g. Hötker 2008, Katzner et al. 2012). These include **ridge tops, cliffs, steep slopes** (Katzner et al., 2012, Gove et al., 2013), **escarpment edges** and particularly **slopes that are perpendicular to the prevailing wind direction** (Davies 1994). These areas should be assumed to represent areas of high flight activity, unless monitoring data demonstrates otherwise.

Avoid nests and important breeding areas

Important breeding areas should be avoided (Dahl et al., 2012). The risk of impacts associated with disturbance, as well the risk of collision for foraging and fledging birds can be reduced by avoiding placing turbines within certain distance of known raptor nests (Gove et al., 2013) and it is common practice to recommend buffer zones (Ruddock & Whitfield, 2007, Rydell et al., 2012).

In South Africa there has been some debate around appropriate extent of nest buffers for Verreauxs' Eagles. This may in part be due to the lack of clarity about the purpose of the buffer, and uncertainly around how much flexibility there is to amend recommended buffer widths in response to site-specific data.

Buffers around nests are proposed for various reasons including:

1. To limit disturbance during the breeding season,
2. To protect what is assumed to be the core activity area of the territory, and therefore reduce risk of both collision and displacement,
3. To protect recently fledged birds from collision risk during the first few months after fledging (when flights are generally restricted to close to the nest).

The extent of nest buffers recommended for eagles elsewhere in the world appears to vary according to the context (e.g. spatial planning vs. wind turbine layout), the purpose of the buffer (e.g. to reduce collision risk vs. reduce displacement and disturbance), and whether the buffer is intended as a guideline or is intended to be strictly implemented across the board.

Where the sole intention is to protect eagles from disturbance (e.g. forestry, roads and tourist activities), recommended buffers can be as little as 200-500 meters (Bright et al., 2008; Kaisanlahti-Jokimäki & Jokimäki, 2008). The distance at which a bird might be affected by disturbance is likely to vary, possibly influenced by the quality of the site, availability of other suitable areas, and the investment an individual has made in the site (Gill, Norris & Sutherland, 2001).

In terms of collision-risk, the assumption is that the probability of collisions decreases with increasing distance from the nest. Where buffers are intended to indicate an area of potential risk, proposed buffers can be as much as 6 km for Golden Eagles (Bright et al., 2008; Hötker, 2008). In Scotland, a buffer of 2.5 km around Golden Eagle nests is considered to be of 'high sensitivity" (Bright et al., 2008). The US Fish and Wildlife Service (2013) assumes that wind farms that fall within half an areas mean inter-nest distance present a high risk to eagles and that the potential to avoid or mitigate impacts is low.

It is recognised that concentric nest buffers are a crude approach, and may not reflect the actual use of a territory or sensitivity to disturbance. It is unlikely that birds will use all areas within the circular buffer to the same extent (Rydell et al. 2012). It is therefore generally recognised that the width of the appropriate buffers may change in accordance with the local topography, the nature of the disturbance, and sensitivity of the birds in question (Bright et al., 2006; Ruddock & Whitfield, 2007, Rydell et al. 2012, U.S. Fish and Wildlife Service, 2013).

Recommended nest buffers for Verreauxs' Eagle

There have been few empirical studies on disturbance distances for Verreauxs' Eagles and to date, specialists in South Africa have relied on expert opinion when recommending buffers. For Verreauxs' Eagles proposed buffers have ranged from 500 m up to 3 km; 68% of reports analysed recommended buffers of 1.5 km or more. Few specialist reports have provided empirical justification for the buffer extent, although an analysis of activity around eagle nests in the Karoo found that activity was generally higher within 1 km of the nest sites, marginally higher between 1 and 1.5 km, with no clear pattern beyond that (Percival 2013).

BirdLife South Africa recommends a **3 km buffer around nest sites**. This figure is the radius of the mean 90% utilisation distributions, based on data from eagles tracked using GPS during the pre-breeding season in the Cederberg and Sandveld (Murgatroyd pers comm.). It is also roughly half the mean inter-nest distance averaged across sites in South Africa (excluding the Gaap plateau)(see Table 1). In the absence of further evidence it should be assumed these buffers indicate areas where the risk of **collisions and displacement is high, and no turbines should be placed within this area**. This buffer may be reduced (or increased) should the results of rigorous monitoring (as outlined below) indicate that this is appropriate and desirable (i.e. it must be clearly demonstrated that there is a low risk). **Under no circumstances should the buffer be less than 1.5 km around all nests**. This will help minimise the risk of disturbing breeding birds, and reduce the risk of collisions, particularly of juveniles (after fledging, the young usually spend 3-4 months exploring the area close to the to the nest before leaving their parental territory (Gargett, 1990; Davies, 1994)).

In order to protect areas around alternate nests and reduce any incentive to disrupt nesting and/or breeding, **nest buffers should be applied to all alternate nests**. Potential nest sites should also be mapped and buffered as a precautionary approach, subject to monitoring data.

It is important to be aware that a nest buffer alone is unlikely to be adequate to mitigate potential impacts on Verreauxs' Eagles. Birds may move great distances away from the nest and may regularly use habitat and perform risky flight behaviour may kilometres away. In South Africa fatalities have occurred more than 3.5 km from suitable Verreauxs' Eagle breeding habitat (Smallie, 2015b). It is therefore important to also consider the spatial extent and relative use of an area by birds.

4.2. CURTAILMENT

Turbine operation may be restricted to certain times of the day, season, or in specific weather conditions that are associated with a high risk of collisions (Smallwood & Karas, 2009). In order to ensure this approach is effective and efficient, a detailed understanding of the risk factors is required. This is a precautionary approach and relies on modelled risk, not the actual presence of birds at risk (Marquesa et al. 2014) and may result in a turbines being shut down for lengthy periods.

Shut-down-on-demand (i.e. stopping the movement of the rotors during high risk periods), has been demonstrated to be an effective mitigation measure for reducing Griffon Vulture mortalities in Spain (de Lucas et al. 2012). Shut-downs can be triggered by human observers, or by using automated devices (e.g. radar or camera) (Marquesa et al. 2014). It is important to note that automated devices do not eliminate the need for human oversight.

The hunting behaviour of Verreauxs' Eagle (i.e. tendency to conduct surprise attacks) is such that it may be a challenge to anticipate their behaviour and shut down turbines in time to avoid a collision (Rob Davies, pers. comm.). The effectiveness and feasibility of shut-down-on-demand for species such as Verreauxs' Eagle, that may be resident and active through the year, remains to be tested. Shut-down-on-demand should therefore not be relied on as the primary mitigation measure, although it should be seriously considered at sites where mortalities have occurred.

4.3. HABITAT MANAGEMENT

Hunting behaviour may be associated with increased collision risk (Hunt, 2002) and some studies have suggested that the high number of raptor mortalities at wind farms could be due to raptors being attracted to the wind farm. The addition of perching sites (e.g. fences, lattice-towers or other structures) may attract raptors (Hötker, Thomsen & Jeromin, 2006) and construction activities could cause prey numbers, and therefore raptor numbers, to increase (Hunt, 2002; Hötker, Thomsen & Jeromin, 2006).

Steps should be taken to ensure that Verreauxs' Eagle's primary prey (e.g. hyrax or mole rat) (Murgatroyd et al, 2016b), does not become more abundant as a result of the wind farm construction, by ensuring that excavated rocks are removed from site, and any animal carcasses found on site should be promptly removed. However, attempts to actively manage prey should be carefully considered and the secondary environmental costs of prey management should always be assessed (Hunt, 2002).

In Scotland, mitigation against habitat loss and collision risk has included attempts to draw Golden Eagles away from a wind farm site though creating suitable foraging habitat away from a wind farm area (Walker et al. 2005, Fielding & Haworth, 2010). Supplementary feeding has also been mooted as mitigation for the loss of foraging habitat (Fielding & Haworth, 2010). Steps to enhance previously degraded landscapes may be beneficial, but supplementary feeding is a complex issue. Any management interventions should be carefully thought out and include consideration of the broader ecological consequences and demonstrate clear conservation benefits.

Habitat management does not negate the need for careful siting of wind turbines and the mitigation hierarchy must always be applied.

Nest removal and/or relocation of birds

The relocation of Verreauxs' Eagle nests away from proposed wind farm areas is not considered an effective or desirable solution. Nest relocation has been attempted in the past for both Golden and Verreauxs' eagle, but there is mounting evidence that this is not a satisfactory solution. A significant percentage return to their original territories, and non-breeding birds may re-occupy vacated areas (Phillips et al. 1991).

There is a risk that some individuals may view the presence of the eagles and eagle nests as an obstacle to the development of wind farm. There is already evidence that Verreauxs' Eagle nests have been intentionally removed from at least one proposed wind farm site in South Africa. Such action is both illegal and futile. It is also more likely to hinder the development of a proposed wind farm, than to facilitate it. Precautionary buffers must be applied where a nest site is suspected, particularly when birds may be temporarily displaced from an area. Specialists and developers are encouraged to take care when communicating with landowners and other stakeholders with a vested interest in a proposed wind farm to ensure these risks are understood.

4.4. ADAPTIVE MANAGEMENT

Adaptive management is an iterative decision-making process, used in the face of uncertainty, where management policies and practices are continually improved through monitoring and learning from the outcomes of previous approaches. It relies heavily on pre- and post-construction monitoring data from individual projects (U.S. Fish and Wildlife Service, 2013). With the limited options available for mitigation once a wind farm is operational, the increased burden of post-construction monitoring, and the potential risk of unforeseen costs associated with operational-phase mitigation, adaptive management should not be relied on as a mitigation measure during the impact assessment process. The mitigation hierarchy (i.e. first seek to avoid and then minimise) must be adhered to. Adaptive management is, however, a critical approach to manage unforeseen negative impacts. Developers and avifaunal specialists are encouraged to consult widely and share experiences with adaptive management.

Note: these recommendations are intended to supplement the BirdLife South Africa / EWT Best Practice Guidelines for Birds and Wind Energy (Jenkins et al. 2015). A tiered approach to development should be adopted. This should start with desktop screening where areas likely to be associated with high risk (e.g. core habitat, potential breeding areas, and topographical features associated with risky behaviour) are earmarked as sensitive, and preferably eliminated from the proposed development area.

5. RECOMMENDATIONS FOR IMPACT ASSESSMENT AND MONITORING

5.1. STUDY AREA

The half the mean inter-nest distance for Verreauxs' Eagle in the area should be used to help define the study area/broader impact zone (e.g. the area surveyed should extend approximately 3 km, preferably more, from the nearest proposed turbine).

5.2. DURATION AND FREQUENCY OF MONITORING

The BirdLife South Africa / EWT 's Best Practice Guidelines for Birds and Wind Energy (Jenkins et al., 2015) recommend that avifaunal impact assessments should cover a minimum of 12 months. Monitoring should span all seasons, and should preferably span several years to account for seasonal variation in flight activity and inter-annual variation in the relative abundance of species (Smallwood, Lourdes & Morrison, 2009). Species with alternative nest sites may exhibit different levels of activity, depending on the location and use of the different nests (Gove et al., 2013). The U.S. Fish and Wildlife Service therefore recommend sampling be extended for two years where wind turbines are proposed within Golden Eagle territories (U.S. Fish and Wildlife Service, 2012). Similarly, Scottish Natural Heritage (2010) also recommend that the duration of monitoring be extended to capture years when alternate nests are used. **BirdLife South Africa therefore suggests that the duration of monitoring should be extended to two years, where a wind farm may pose a significant risk to Verreauxs' Eagles,** particularly where alternate nests are some distance apart and/or turbines are proposed in areas that may be associated with increased flight activity and/or risky behaviour (see the decision tree, Figure 1, page 14).

If monitoring does not include years where alternate nests are used, the impace assessment should consider how territory use might change if the alternate nests are occupied. (Scottish Natural Heritage, 2010). Surveys of the habitat and prey availability in surrounding areas may help provide an indication of the relative importance of the wind farm site compared to other available habitat, and may also provide an indication of the likely significance of displacement, should this occur (Scottish Natural Heritage, 2010).

5.3. FOCAL POINT SURVEYS (NESTS)

If a wind farm is proposed within potential Verreauxs' Eagle habitat, **it is critical that dedicated surveys are conducted to identify potential nest sites. Cliff-lines should be surveyed for evidence of nesting,** taking care not to disturb breeding birds. Malan (2009) details appropriate survey protocols, but BirdLife South Africa strongly recommends that suitably experienced and qualified specialists and field staff undertake these surveys. Surveys should include the potential development area, **but must extend beyond the development footprint** to include the likely territory of any pairs observed regularly on site (U.S. Fish and Wildlife Service, 2013) (e.g. approximately 3km from the nearest proposted turbine). If access to neighbouring properties is not possible, a desktop analysis should be conducted to identify potential nesting areas.

5.4. VANTAGE POINT SURVEYS

Where wind turbines are proposed within Verreauxs' Eagle

JESSIE WALTON

Cliff-lines must be carefully surveyed for evidence of nesting and any nests found within the broader impact zone of the wind farm should be treated as focal points during following site visits.

territory, it is strongly recommended that the **duration of vantage point monitoring be increased from the minimum recommended in BirdLife South Africa and EWT 's Best Practice Guidelines for Birds and Wind Energy** (2015) to ensure that a representative sample of bird movements is sampled. Douglas et al. (2012) found that increasing number of hours at vantage point markedly reduced the variability in the predicted collision-rate for White-tailed Eagle in Smøla. Scottish Natural Heritage recommends a minimum or 72 hours per vantage point per year if a wind farm is may affect Golden Eagles (Scottish Natural Heritage, 2010). However, the asymptote in variability (i.e. the point at which it levels off) is likely to be different for different levels of flight activity. Douglas et al. (2012) therefore suggest that collision risk assessments should include a consideration of the likely variability in the predictions, and acceptable levels of uncertainty.

In the absence of statistical analysis of monitoring time versus the variability in collision risk predictions for Verreauxs' Eagles, BirdLife South Africa suggests that 72 hours of vantage point per year should be considered the minimum, where impacts on Verreauxs' Eagle are likely (see Figure 1).

Where possible, monitoring should be conducted three to five consecutive days, as this should help overcome variability in flight behaviour related to weather and/or when the birds last fed (Rob Davies, pers. comm.) Extra caution should be implemented where turbines are considered on ridge tops and near steep slopes (Katzner et al., 2012) and/or near nests. While there are benefits to monitoring flight activity around nests, the risk of disturbing breeding birds should always be considered when determining the appropriate location of vantage points.

Analysis of vantage point data should account overlapping viewsheds, areas that are not visible as a result of topography, and detectability of birds.

Fieldwork must include the breeding season; flight activity is likely to increase during this time. Particular note should be made of breeding display flights, as well as the flight behaviour of dispersing young, as these behaviours may be associated with an increased risk of collisions (Scottish Natural Heritage, 2010). Interactions between neighbouring pairs may also give an indication of territory occupancy and available

ANDREW PEARSON

With rigorous studies and careful placement of wind turbines, it should be possible to minimise negative effects on Verreauxs' Eagle.

habitat in the surrounding area. This implies that the frequency of surveys should also be increased from the minimum of four surveys recommended in the Best Practice Guidelines.

5.5. TERRITORY USE

The risk of collisions and displacement of eagles can be minimised if wind turbines are not placed within their core territory (Fielding & Haworth, 2010) or areas heavily used by eagles (U.S. Fish and Wildlife Service, 2013). While the focus of vantage point monitoring is usually limited to the developable area, **extending monitoring to include the entire territory of a pair of eagles may be of significant benefit**. This will allow data to be gathered on the relative importance of the wind farm site for the eagles, determine the potential significance of displacement, and may point to areas that are more suitable for development (Scottish Natural Heritage, 2010).

The U.S. Fish and Wildlife Service's (2013) approach is to define "important eagle-use areas" – "*eagle nest, foraging area, or communal roost site that eagles rely on for breeding, sheltering, or feeding, and the landscape features surrounding such nest, foraging area, or roost site that are essential for the continued viability of the site for breeding, feeding, or sheltering eagles*". Wind energy projects that overlap or are close to these areas are presumed to pose a risk to eagles (U.S. Fish and Wildlife Service, 2013). The U.S. Fish and Wildlife Service (2013) suggests that the relative extent and type of use of the site by eagles must be assessed if a proposed wind farm has eagle nests within half the mean inter-nest distance for eagles in the broader project area (they suggest that if necessary mean inter-nest distance should be determined though surveys during the study). This distance can be used to delineate territories and assess the associated breeding eagles at risk of mortality or disturbance. A more precautionary approach would be to use the maximum inter-nest distance for an area, as this does not assume that the available foraging habitat is equally valuable and that there is an equitable allocation of resources amongst pairs.

Core territories of Golden Eagle can be identified through Predicting Aquila Territory (PAT) modelling (Mcleod et al. 2002). PAT models provide an indication of the percentage use of an area by eagles by modelling factors such as distance from the nest, topography, elevation, habitat and regional eagle density (McLeod et al., 2002). They require detailed information on habitat and topography, and necessitate observations across a large part of the birds range (Fielding & Haworth, 2010). PAT models give an indication of the potential importance of an area for breeding eagles and can therefore be used to assess the likely impact of developments. If a wind farm is proposed within an occupied golden eagles range, Scottish Natural Heritage (2010) reccommends that PAT modelling is conducted. Similar models could be developed for Verreauxs' Eagle in South Africa.

Tracking devices

The use of tracking devices (e.g. satellite/GSM devices) can be valuable in helping provide a better understanding of the flight behaviour and habitat usage of individual birds. However, only individual birds can be monitored, which means that there is a risk that not all birds using an area may be assessed. There is also risk that birds fitted with devices may move out of the area of interest. Handling birds and attaching devices to them carries an inherent risk to study animals. There is some evidence of negative impact on birds fitted with tracking devices (Marzluff et al., 1997; Gregory, Gordon & Moss, 2003; Phillips, Xavier & Croxall, 2003) and for this reason the U.S. Fish and Wildlife Service discourages the use of tracking devices for wind farm assessments. They rather recommend that alternative approaches to studying birds should be used (U.S. Fish and Wildlife Service, 2013).

Murgatroyd et al. (in prep.) recorded what appears to be high a mortality rate of adult Verreauxs' Eagles fitted with transmitters. However, it is not clear if this was as a result of the transmitters, or due to natural causes (e.g. driven by a large 'floater' population). BirdLife South Africa therefore also suggests that a precautionary approach should be adopted. The costs and benefits of tracking must be carefully considered alongside alternative survey methods. BirdLife South Africa also strongly recommends that ethical clearance should be obtained before embarking on a project that involves tracking birds. For more information please see BirdLife South Africa's position statement on the tracking of birds, available at *www.birdlife.org.za*.

In order to maximise the benefits of tracking and avoid duplication, tracking data should be housed in a central repository (e.g. Movebank) and the results of the project should be published in a peer review journal. Tracking projects should include a study of the effects of transmitters on the breeding, longevity and behaviour. Studies should therefore include visual observations of the behaviour of tagged eagles and the breeding productivity of tagged birds should also be monitored. It is also recommended that only tags that will facilitate locating birds should they die be used, so that the carcass can be retrieved and a post mortem examination conducted (Murgatroyd pers comm.).

5.6. ESTIMATING COLLISION RISK

Models to predict fatality rates can provide a useful indication of the relative risk of collisions (U.S. Fish and Wildlife Service, 2013), but care should be taken to not to over-interpret the results (Whitfield 2009). Collision-risk models make a number of assumptions, including predictions of species-specific bird behaviour (Madders & Whitfield, 2006). They assume that the risk of mortality increases with flight activity and bird abundance, although evidence to support this assumption is equivocal (Gove et al., 2013). While these models may be useful for comparing sites and layouts, they should be interpreted with caution. Literature verifying fatality rate predictions for eagles is limited and collision risk models would almost certainly not have predicted the Verreauxs' Eagle collision incidents in South Africa (Smallie pers. comm. 2015). It is not clear if additional data collection (as recommended in these guidelines) would have yielded different results.

5.7. SIGNIFICANCE OF IMPACTS

Significance of collision risk

Bearing in mind the limitations of collision risk modelling, potential (and actual) mortalities could be contextualised in terms of the percentage of the population that may be lost. The U.S. Fish and Wildlife Service (2013) suggests that if annual mortality is between 1 and 5 % of the total estimated local-area eagle population, these impacts should be considered significant. A project is considered to be of high risk, and development is not recommended, if the average annual number of mortalities is greater than 5% of the total estimated local-area eagle population. Projects that will cause the cumulative eagle mortality to reach this level are also not recommended.

BirdLife South Africa recommends a more precautionary approach when assessing the significance of potential impacts on Verreauxs' Eagles. Confidence in predicted fatality rates is low, and up-to-date, accurate data to contextualise predicted fatality rates is not always available. Furthermore, even apparently low collision rates have the potential to cause significant population declines for raptors (Carrete et al., 2009; Dahl et al., 2012; Rushworth & Krüger, 2014). **BirdLife South Africa is of the opinion that any turbines placed within an area regularly used by Verreauxs' Eagle should be deemed to pose a significant risk of collisions and should be relocated.**

SAMANTHA RALSTON-PATON

If wind energy is to be rolled-out on a large scale in South Africa, a precautionary approach must be adopted to minimise cumulative negative impacts on Verreauxs' Eagle and other birds.

BirdLife South Africa suggests that wind farms should aim for a target of zero Verreauxs' Eagle mortality. Bearing this in mind, we strongly encourage the inclusion of thresholds in the Environmental Management Programmes for wind farms; if annual mortality rates exceed a pre-defined limit, operational-phase mitigation should be non-negotiable.

Significance of displacement

Displacement may reduce collision risk, but it also effectively reduces the available habitat for a species (Fielding & Haworth, 2010). The cumulative impacts of displacement can be complex to unravel (Gill, Norris & Sutherland, 2001; Fielding & Haworth, 2010). For example, the value of the habitat from which the birds are displaced and to what extent their foraging requirements could be met elsewhere will affect the significance displacement (Gill, Norris & Sutherland, 2001). At this stage it is unclear to what extent Verreauxs' Eagle will be vulnerable to displacement (effective habitat loss), but again a precautionary approach should be adopted when assessing impacts.

Significance of disturbance

Much like displacement, it can be hard to quantify the significance disturbance related impacts. However, the impacts of disturbance will be important if it affects survival and fecundity, and can ultimately cause a population to decline (Gill, Norris & Sutherland, 2001). **BirdLife South Africa would consider any impacts that affect breeding success of Verreauxs' Eagle as significant and should be avoided.**

5.8. CONSTRUCTION-PHASE AND POST-CONSTRUCTION MONITORING

There are high levels of uncertainty with regards to the potential effects of wind energy on Verreauxs' Eagle. Before : after studies, including vantage point surveys (Fielding & Haworth, 2010) will therefore be very valuable to record to what extent displacement occurs and whether impacts are permanent or short-term. Monitoring should continue through construction, as this intense period of disturbance may trigger changes in eagle presence and behaviour. In particular, where nests are located near a wind farm, **no construction activities (e.g. roads) should be permitted within 1 km of a nest during the bredding season**. If a breeding pair's territory overlaps with the wind farm, or if nesting may otherwise be affected by activities related to the wind farm, the nest should be monitored for breeding activity through the lifespan of the project. Where possible the number of pairs and breeding success (productivity and fledgling rates) should be recorded each year, but care must be taken to ensure that monitoring activities do not disturb breeding birds.

6. RESEARCH

There are many gaps in our knowledge with regards to how Verreauxs' Eagles might be affected by wind energy facilities, and how these impacts could be managed. Students, academics and specialists are encouraged to investigate the following topics:

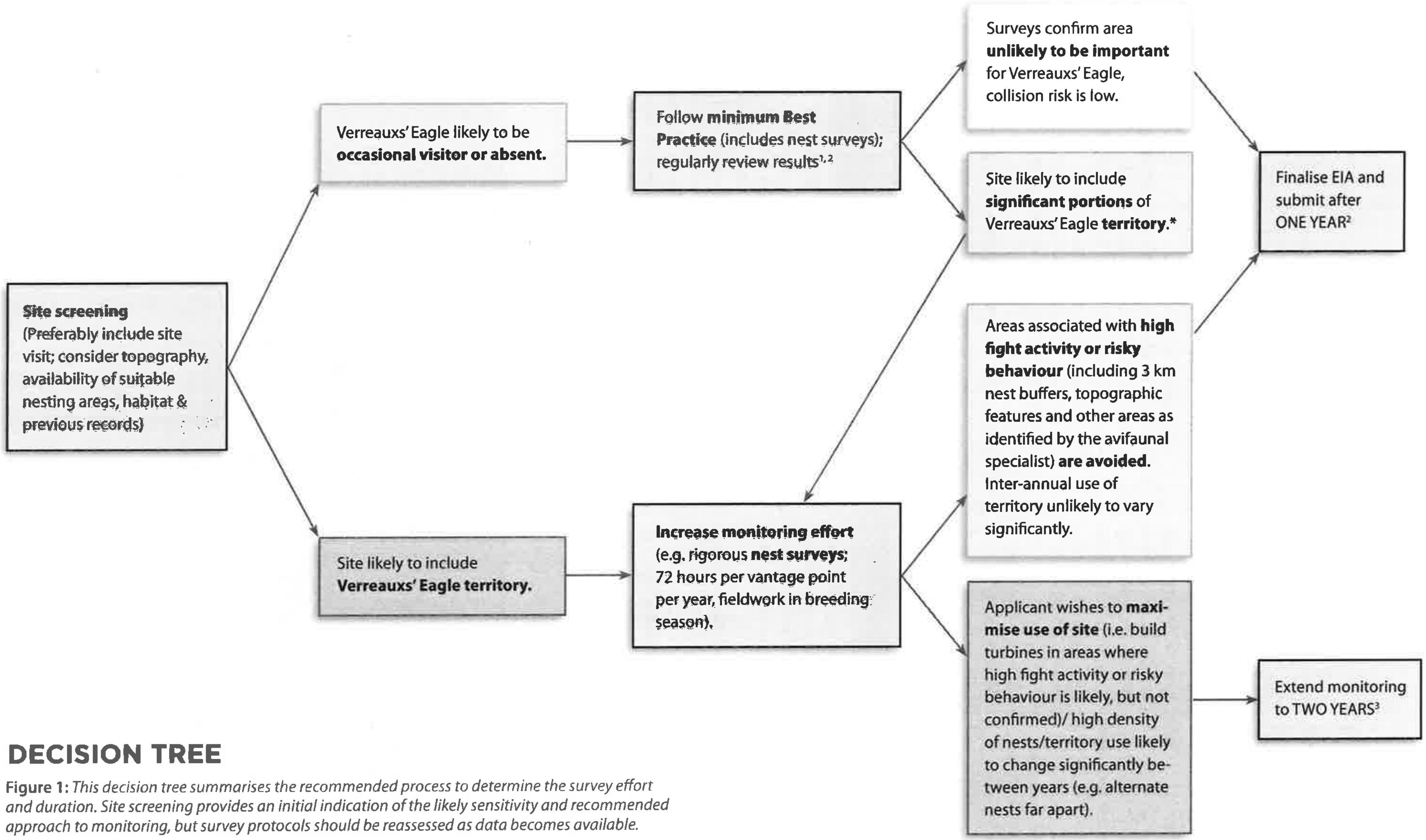
- Factors that affect the risk of collision. For example: how do topography, environmental conditions, and prey availability influence collision risk?
- Do dispersing juveniles and non-breeding adults use specific passage-ways (e.g. the escarpment)?
- What is the best model to predict core territories for Verreauxs' Eagle?
- What range of passage rates have been recorded, what influences this, and do passage rate influence collision risk?
- Does tracking affect breeding productivity, longevity and behaviour?
- Population trends and sensitivity of local and regional populations to additional mortality.
- Ecological and economic significance of the species. What are the ecological and economic implications if the species is lost from an area?
- Detectability of birds in vantage point surveys. Is the 2 km survey radius adequate?
- Sensitivity of Verreauxs' Eagle to disturbance. What are appropriate buffers for nests to reduce disturbance?
- Does Verreauxs' Eagles activity in the vicinity of a wind farm change after construction?
- How effective and feasible are mitigation measures (e.g. curtailment and shut-down on demand)?

BirdLife South Africa encourages wind farm developers and operators to help address these knowledge gaps. Research at wind farms should be supported and encouraged, and avifaunal specialists working on projects should be permitted to share lessons learned through short notes, reports and scientific publication.

7. CONCLUSION

Initial indications are that Verreauxs' Eagles and wind turbines are not compatible, at least not at a fine-scale. The presence of eagles at a proposed wind farm site may not be a fatal flaw to development, but it does suggest that significant effort is required to ensure that risks to this iconic, threatened species are minimised and mitigated. The declining conservation status of Verreauxs' Eagle, and lack of data on the effects of wind energy on the species, necessitates a precautionary approach. These guidelines are intended to be a living document; as our knowledge grows, recommendations may be amended to reflect our improved understanding of how best to ensure a future where renewable energy and eagles can flourish.

ALBERT FRONEMAN



DECISION TREE

Figure 1: *This decision tree summarises the recommended process to determine the survey effort and duration. Site screening provides an initial indication of the likely sensitivity and recommended approach to monitoring, but survey protocols should be reassessed as data becomes available.*

Footnotes:

[1] The results of monitoring should be regularly reviewed to ensure that survey effort is adequate. Site screening and early identification of likely issues can help ensure a smooth EIA process.

[2] This assumes that there are no other reasons to increase the duration of pre-construction monitoring. This also does not imply that a positive environmental authorisation will be issued.

[3] Applicants should not assume that a positive environmental authorisation will be issued after two years monitoring. Regular engagement with BirdLife South Africa and the Department of Environmental Affairs is encouraged to ensure the risks are understood.

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ACKNOWLEDGEMENTS

Compiled by Samantha Ralston-Paton, Birds and Renewable Energy Manager, BirdLife South Africa. Many thanks to the following individuals who provided input and advice towards the development of these guidelines: Alvaro Camiña, Andrew Jenkins, Andrew Pearson, Chris van Rooyen, Craig Whittington-Jones, David Allan, Hanneline Smit-Robinson, Kevin Shaw, Lourens Leeuwner, Lucia Rodrigues, Megan Murgatroyd, Michael Brooks, Mmatjie Mashao, Phoebe Barnard and Rob Davies.

BirdLife South Africa's work towards bird-friendly renewable energy is made possible through the sponsorship from Investec Corporate and Intuitional Banking.

CONTACTS

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(13)

COMMENTS ON ADDENDUM TO THE FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT: PROPOSED INYANDA-ROODEPLAAT WIND ENERGY FACILITY
DEA Reference: 14/12/16/3/3/2/464

Thank you for the opportunity to comment on the Addendum to the FEIR. I submitted comprehensive comments dated 12 May 2016 on the Draft EIR - those comments remain valid and were generally conceded to by the EAP.

1. **General:** I am disappointed that DEA appears to be reluctant to issue a non-approval notice for this project, despite being provided with sufficient information in the Final EIR (if it is read carefully), together with the numerous informed comments from I&APs and the obvious Fatal Flaws (visual impact being an obvious one).
2. **Section 2.1 Avifauna:**
   a. In rejecting the request for Peer Review, the Applicant is clearly concerned that a reviewer will provide different recommendations than S Percival (who, it appears was sourced directly by the Applicant to replace J Smallie. The latter indicated that risks to avifauna were unacceptably high at this location – direct quote from Smallie's Executive Summary: "We believe the overall risk to avifauna to be high and in most cases not easy to mitigate fully. We would therefore recommend against the construction of this facility").
   b. S Percival also found high risks but is relying on turbine shutdown on demand and habitat modification and supplementary feeding off-site to reduce the presence of at-risk species on the site. The details of the latter mitigation methodology have still not been provided and will be developed post-consent (see answer to my original comment on p156 of the FEIR).
   c. The development hierarchy is to Avoid, Minimise and Mitigate impacts – it is clear that this site cannot avoid high risk to avifauna and substantial mitigation (largely un-tested in South Africa) will be required.
3. **Section 2.2 Status of Road**: The Correspondence in Appendix D seems to indicate that the road was illegally commenced with and that a resolution has not yet been reached with DEDEAT.
4. **Section 2.3(m):** DEA should make sure they read this response (letter Noach to ECPTA dated 15 Aug 2016, item 4 pp5-6). The original EAP warned that the project was "doomed from the start".
5. **Section 2.9 Bats**: Last paragraph. DEA should note that the Applicant has opted not to amend the turbine layout to reduce impacts on bats.
6. **Section 2.12 Need & Purpose.** As an I&AP I find it worrying that a WEF of this nature with high negative impacts is being considered when there are many WEFs with positive Environmental Authorisations that have not yet been constructed, largely due to "market demand" problems. Yet the Applicant refuses to divulge where the energy will be sold. The need for this facility, given those with existing authorisations in the region that are closer to the main power distribution networks and with lower negative impacts, has not been adequately demonstrated.

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Date: 16 July 2017

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ADVENTURE PROVINCE
Eastern Cape
PARKS & TOURISM AGENCY

SRK Consulting
PO Box 21842
Port Elizabeth
6000

DEA reference: 14/12/16/3/3/2/464
SRK reference: 478867/4
ECPTA reference: EIA/2015/001
Date: 14 July 2017

ATTENTION: WANDA MARAIS

Delivered: By email wmarais@srk.co.za

RE: ECPTA COMMENTS ON THE DRAFT ADDENDUM TO THE FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED INYANDA – ROODEPLAAT WIND ENERGY FACILITY

The Eastern Cape Parks and Tourism Agency (ECPTA) has reviewed SRK Consulting's response to the rejection letter dated 20 February 2017 from the Department of Environmental Affairs (DEA) for the Final Environmental Impact Assessment Report (FEIAr) for the above-mentioned proposed development. The ECPTA's concerns in relation to the addendum are laid out below. It should however be noted that the addendum to the FEIAr does not adequately address ECPTA's comments and objections against the project, which have been raised in previous communications (dated 20 November 2013, 07 April 2015, 20 May 2016 and 9 December 2017). These still stand, and the ECPTA remains opposed to the proposed development.

Page 7: Avifauna

Item *b* of the rejection letter from DEA states that "*this Department requests that the Applicant appoint an independent avifaunal specialist to externally peer review all work undertaken by the two avifaunal specialists and make final conclusions and recommendations on the avifaunal impacts.*" This request was dismissed by the proponent.

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The dismissal by the proponent of the DEA's request for an external review of the avifauna specialist studies shows disregard for the potential serious negative impacts that the proposed facility will have on avifauna. In our previous comments, the inadequacies of the Percival study were highlighted. These inadequacies were echoed by other stakeholders, including a number of local ornithological experts and BirdLife South Africa (see their comment dated 9 December 2016). While we appreciate that additional data were collected, our concerns with regard to the Percival study relate to 1) the methodology employed and the associated assumptions, 2) the interpretation of the data in a way that deliberately minimizes impacts, 3) the insufficiently conservative impact ratings, especially considering the uncertainty associated with potential impacts, and 4) the lack of appropriate mitigation measures and the reliance on impractical and ecologically unsound mitigation options to reduce the significance of the impacts. In particular, the continued reliance on habitat management (effectively changing the distribution of food resources in the landscape), which is ecologically inappropriate, is concerning. Given the significance of the area for avifauna, the precautionary principle should be applied and an independent review should be conducted, and stakeholders should be afforded the opportunity to comment on this. The reluctance of the proponent to accede to DEA's request for external review is in itself an indication of the poor quality of the Percival study. If this study is truly robust, then it should stand up to the scrutiny of an independent expert. The instruction by the proponent to the EAP is quite alarming as the EIA process should be independent and the developer should not have this level of influence over the process.

Page 13: Section 2.5 Ecology

Item *t* of the rejection letter notes that *"Based on the recommendations of the current ecological specialist, the applicant must enter into a Conservation Management Agreement with the relevant authority to allow for assurance of the conservation of the site. This agreement must be finalized and included in the amended EIAr. Should the applicant not be willing to enter into any agreement, then the mitigation hierarchy must be considered."*

SRK notes that *"this was listed as an optional mitigation measure in the ecological report"*. It should be clear that, as the ECPTA raised in previous communication, the possibility for a biodiversity stewardship agreement or any other type of "Conservation Management Agreement" should not influence the decision-making around the proposed wind energy facility. Relating to the minutes of the meeting held on 13 May 2016, it is noted that "*Mr. Reeves indicated that any stewardship agreement proposed between the applicant and ECPTA should be dealt with subsequent to the environmental authorization process, and should not influence decision making in that regard. It was also further noted that a stewardship agreement, or any other condition relating to ECPTA's responsibilities, could not form a part of the conditions of the EA as this could potentially be at odds with ECPTA's mandate*". The ECPTA opposes the proposed wind energy facility but would be prepared to discuss potential biodiversity stewardship options with the landowners, should they wish to conserve their land; and such an application would need to follow due process for stewardship and would need to be assessed on its own merits. Any engagement from the ECPTA with regard to biodiversity stewardship should not be construed as support for the proposed wind energy facility; indeed stewardship and development such as the wind energy facility may well be mutually exclusive.

Page 14: World Heritage Site

Item *x* of the rejection letter notes that "*the EAP must obtain comments from the Directorate: World Heritage Management, Biodiversity and Conservation, and Protected Areas Management within the DEA as well as Birdlife South Africa. These comments must be included in the amended EIAr.*" In addition to the response from SRK to the assumption of DEA requesting comments internally from these Directorates it is noted that it is "*assumed that other government conservations bodies would have similar concerns/comments to those raised by the ECPTA and DEDEAT.*" It should be noted that comments from the ECPTA are only from the perspective of ECPTA and SRK should not assume that other government entities would not have concerns beyond those raised by the ECPTA.

Appendix D: DEDEAT correspondence regarding illegal road

In Appendix D to the addendum, the proponent's attorneys have composed a compliance notice on behalf of the DEDEAT with regard to the illegal road that was constructed. It is highly inappropriate for a proponent to attempt to influence the DEDEAT's decision-making in this regard and it is irregular for them to be drafting the compliance notice on behalf of the DEDEAT.

CONCLUSION

Having reviewed the Draft Addendum for the FEIAr, the ECPTA acknowledges the priority to reduce the consumption use of fossil fuel and the motives behind the project to contribute to strengthening the existing electricity grid for the area. However, such developments should be appropriately situated and should not compromise other legitimate national and provincial programmes. Aas the management authority for the Groendal Wilderness Area, which is part of the Cape Floral Region Protected Areas World Heritage Site, and as the implementer of the Eastern Cape Biodiversity Stewardship Programme, ECPTA believes that the project will have a significant negative impact on the environment of the proposed area and that environmental authorization should not be granted.

Should you wish to discuss the above comments please do not hesitate to contact the ECPTA. The ECPTA reserves the right to request further information and to revise comments based on any additional information that may be received. It would be appreciated if the ECPTA could be included in all future correspondence relating to this application.

Yours sincerely

Vuyani Dayimani

Chief Executive Officer

EASTERN CAPE PARKS AND TOURISM AGENCY