Bat Comparative Assessment for the ZEN Wind Energy Facility Amendment Application, Republic of South Africa

Gouda, Western Cape

Bat Comparative Assessment report – 2019

calidris

expertises environnementales

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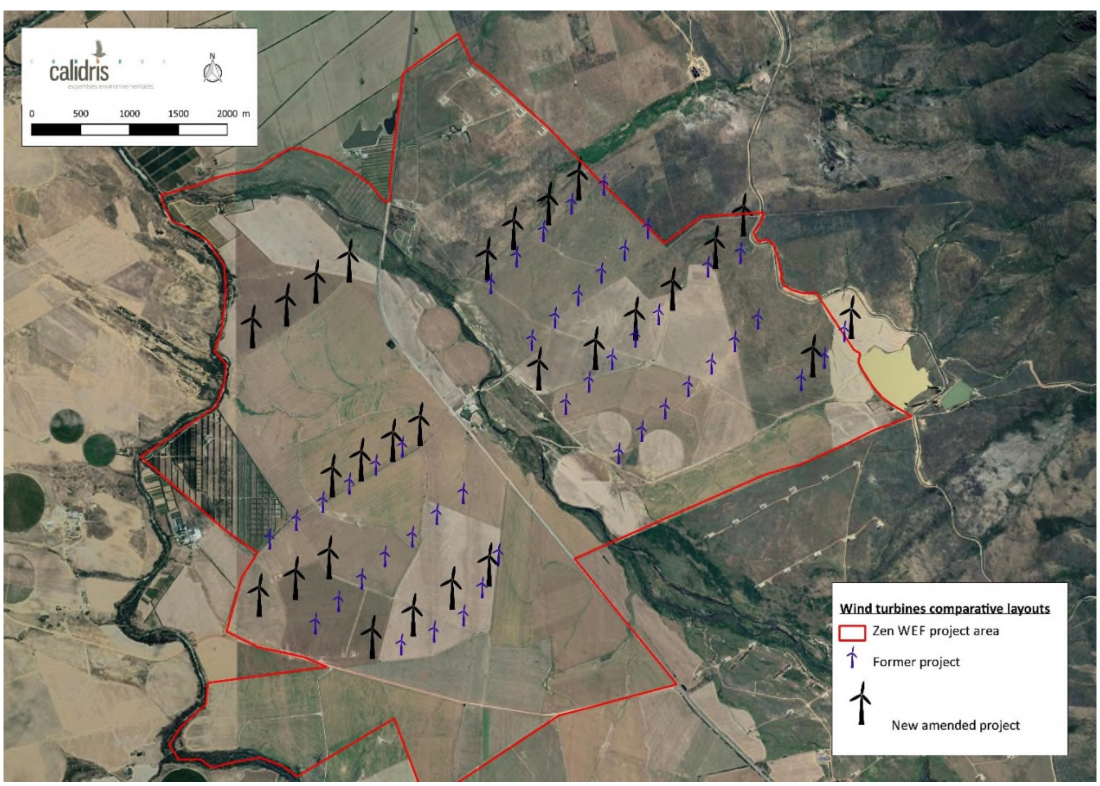
INTRODUCTION

Savannah Environmental is submitting to the Environmental Authorisation (EA) for the Zen Wind Energy Facility (WEF) to the Department of Environment, Forestry & Fisheries (DEFF) an amendment to change the turbine specification and layout as previously assessed in the EIA. The project led by Zenaphan Trading (Pty) Ltd and already known as Zen Wind Energy Facility had already received the Environmental Authorisation in terms of the National Environmental Management Act (act 107 of 1998) on 03 November 2016 (DEA ref: 14/12/16/3/3/2/322, as subsequently amended on 11 February 2019). Of the list of proposed amendments, only the following are relevant to this report and need to be assessed:

- Reduction in the number of turbines from **46** to **27;**
- Increase rotor diameter from **122 m** to up to **165 m**;
- Increase hub height from **110 m** to up to **140 m**.



Map 1 : Comparison between the authorized project layout and the amended project layout

Methodology & Results

1. Bio3, 2013

The pre-construction programme of bat community monitoring was conducted across a 12 months period from September 2012 to August 2013.

Active detection surveys were conducted once a month. 3 transects of 5 km each were established: one in the study area and two others in a similar control area with respectively 31, 25 and 19 sampling points. All of the transects were located on representative biotopes in the study area. Ultrasounds were recorded during a 5-minute period at each sampling point. Contrary to what is recommended in the South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments Pre construction (Sowler, 2017), no detectors were placed at hub height or within the rotor swept area. It was justified by the fact that wind turbines are planned to be installed in open areas, not in forested areas, hence it would not be relevant to record bat activity at rotor height. Moreover, they argued that as the mast existing at the site is located in open areas and away from forested areas, it would not be representative of the main target of the static detection at height, nor the activity present throughout the site area. Passive detection surveys were conducted using 4 detectors set up on 3 m high poles, of which 2 were distributed in the wind facility site and the other 2 within similar control areas. Searches were conducted in the study area to identify any structures that could potentially provide roosts for bats.

Based on several data sources available for the study area (ACR, 2018 ; Monadjem, 2010), 16 species were considered to potentially occur in the vicinity of the site, according to bat species distribution and ecology. The 12-months bat monitoring confirmed the presence of 9 bat species : Natal long-fingered bat (*Miniopterus natalensis*), Long-tailed serotine (*Eptesicus hottentotus*), Temminck's myotis (*Myotis tricolor*), Cape serotine (*Neoromicia capensis*), Cape horseshoe bat (*Rhinolophus capensis*), Geoffroy's horseshoe bat (*Rhinolophus clivosus*), Darling's horseshoe bat (*Rhinolophus darlingi*), Robert's flat-headed bat (*Sauromys petrophilus*) and Egyptian free-tailed bat (*Tadarida aegyptiaca*).

Tadarida aegyptiaca was the most common and active species in the study area, as it was detected in all surveys and throughout the year. *Neoromicia capensis*, *Eptesicus hottentotus* and *Miniopterus natalensis* were the other main species recorded almost all year long. The remaining 5 species were recorded more occasionally : *Rhinolophus clivosus* was detected in November, April and May, *Myotis tricolor* in October and November. *Sauromys petrophilus, Rhinolophus darlingi*, *Rhinolophus capensis* were recorded only in a single month, respectively in February, April and July.

Bat activity varied depending on the season and habitats. It was higher during late winter and early spring, decreased during summer and increased in late summer and autumn. It also appeared to vary according to habitats, with activity higher within the agricultural crops and water-related features.

Concerning roosts prospection, 23 potential roosts sites were identified, exclusively in human infrastructures. Among those 23 roosts, 12 showed evidence of bat occupancy with the observation of traces or individuals.

2. Calidris, 2019

According to the South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments Pre construction (Sowler *et al.,* 2017), field surveys consisted of: active detection sampling points; passive detection at hub height and roosts searches. Bat community monitoring was conducted from January to December 2019, covering all seasons.

Active detection surveys were conducted once a month from 9 sampling points, using 3 recorders per night for 3 nights. The distribution of sampling points was based on vegetation types or land-use to assess bat activity in areas where it was expected to be higher (e.g. water-related features, riparian vegetation, natural rows of trees), but also in areas where bat activity was expected to be lower (e.g. open areas like croplands). Sampling points were chosen instead of transects in order to cover all the various biotopes on the facility site. Moreover, the recorders were scheduled to automatically record bat activity all night long, from 30 minutes before sunset to 30 minutes after sunrise, enabling to get a more accurate idea of how bat species are using the site and the features on site.

For passive detection surveys, a recorder was first set up on the mast located in the south-east part of the area. Nevertheless, as this mast was not secured enough to climb on it, the recorder was set up in July 2019 on another mast northward up to 80 meters above ground.

All structures that could potentially provide roosting locations for bats within the facility area were investigated to assess bats presence and occupation throughout the year, with particular efforts of prospection during birth season.

Bat community monitoring was conducted from January to October 2019. So far, 8 species have been identified: Long-tailed serotine (*Eptesicus hottentotus*), Natal long-fingered bat (*Miniopterus natalensis*), Cape serotine (*Neoromicia capensis*), Cape horseshoe bat (*Rhinolophus capensis*), Geoffroy's horseshoe bat (*Rhinolophus clivosus*), Darling's horseshoe bat (*Rhinolophus darlingi*), Robert's flat-headed bat (*Sauromys petrophilus*) and Egyptian free-tailed bat (*Tadarida aegyptiaca*). Temminck's myotis (*Myotis tricolor*) has not been recorded.

Tadarida aegyptiaca, *Neoromicia capensis* and *Miniopterus natalensis* appear to be the most active species, being recorded almost every months and at all sampling points. The other 5 species presence varies according to the period of the year and sampling points.

Bat activity seems to be higher close to rows of trees, riparian vegetation or water-related features, and to a lesser extent in open-areas like pastures or cereal croplands. On the west part of the study area, a hedgerow extends from east to west and connects the two main rivers, the Berg River and Klein Berg River, bisecting the study area. According to the results of the ongoing monitoring, it seems to be an important feature for bat communities for both foraging and commuting.

Sensitivities

1. Bat sensitvities to wind turbines facilities: a literature review

Bat mortality due to human infrastructures is a well-known phenomenon. Streetlights (Saunders W.E., 1930), roads (Jones et al., 2003 ; Safi, 2004), power lines (Dedon, 1989) and radio towers (Crawford R.L, 1981 ; Van Gelder, 1956) can be responsible for bat injury or death and lead to severe impacts on populations (Carrete, 2009 ; Hunt, 2002). Bat fatalities due to collision with turbines or barotrauma started to be taken into consideration in environmental impact assessments when carcasses were discovered while searching for bird fatalities in wind turbine facilities, mostly in Germany (Lothar Bach, 2001, 1999 ; Brinkmann, 2006 ; Dürr, 2002 ; Rhamel, 1999) and in Spain (Alcalde, 2003 ; Lekuona, 2001). The impact of wind turbines on bats is due to direct mortality caused by collision with blades, but also as a result of barotrauma (Baerwald, 2008).

Regarding bat activity according to altitudinal distributions, sensitivity differs between species as the likelihood of bats encountering wind turbines depends on their ecology or feeding behaviour. High-risk species are those morphologically and physiologically adapted to live in the open-air, with relatively long and narrow wings, for instance bats from the families Molossidae and Emballonuridae. Low-risk species are bats relatively broad-winged that usually forage within vegetation or water-related features (Monadjem *et al.*, 2010 ; Rydell, 2010). Nevertheless, among those species, some can be at risk as they are generally clutter-edge foragers and can use the area surrounding the moving blades to forage, particularly if turbines are located in tall vegetation areas. Numerous studies report that high-risk species were regularly recorded flying near the turbines at rotor height, because they feed on insects attracted by turbines (Ahlén, 2002, 2007 ; L. Bach, 2010 ; Endl, 2004). However, results suggest that on average, bat activity is greater at lower heights but that there are important differences across species. Those adapted to using open air spaces seem to be at greater risk. For instance, when recording bat activity at ground level, 30 m, 50 m, 90 m and 150 m, Sattler and Bontadina, (2005) found more species and higher activity at lower heights.Similarly, two studies in the United Kingdom showed that less activity and fewer species were recorded at heights between 30 m and 80 m than at ground level (COLLINS, 2009 ; MATHEWS, 2016).

In Texas, free-tailed bats activity was recorded from ground level to more than 900 m. Bats were more active between 0 and 99 m, accounting for 28% of activity, between 100m and 199m the activity accounted for 6%, 9% from 200m and 299m, and 57% at 300 m and more (MCCRACKEN, 2008).

Bat mortality also seems to vary with seasons. For instance, Erickson et al. (2002) show that in the USA, mortality is strongly correlated to the period of the year since 90% (n=536) of bat fatalities happen between mid-July and mid-September, with 50% in August. Bach (2005) reports similar figures in Germany, with 85% of mortality (n=100) between mid-July to mid-September with 50% in August. This mortality peak in late summer and autumn for bats of the northern hemisphere seems to indicate that migrating bats are particularly at risk. This can be explained by the fact that they use less, if any, echolocation while migrating in order to avoid energetic waste (CRAWFORD R.L *ET AL.*, 1981 ; GRIFFIN, 1970 ; KEELEY, 2001 ; TIMM, 1989 ; VAN GELDER, 1956), and that blades may move too quickly making it difficult for bats to detect and avoid them in time (RYDELL *ET AL.*, 2010). Little information are available on impacts recorded on operational wind farms in South Africa, but results from (ARONSON, 2013 ; DOTY, 2013) suggest that open-air species such as *Tadarida aegyptiaca* or clutter-edge species as *Neoromicia capensis* are more at risk, which are two migrating species not present in the colder months of the year, mid-April to October.

Several studies have shown that birds and bats mortality increased jointly with the size of rotors (Martin, 2015; Baerwald et Barclay, 2009; Barclay et al., 2007; Johnson et al., 2003). Barclay et al. (2007) showed that bat fatalities increased exponentially with tower height from 65 m high. More recently, in Europe, evidence of a positive correlation between mortality and hub heigh and rotor diameter has been shown, but no significant relationship between bat mortality and the minimum distance between the rotor and the ground has been found (RYDELL *ET AL.*, 2010). Moreover, there was no relationship between the number of turbines and bat fatality. However, the largest wind energy facility in this study only has 18 turbines which is fewer than the Zen Wind Energy Facility. Another study in Europe showed that fatalities were significantly positively correlated with tower height but not with rotor diameter, with maximum being respectively 60 m and 90 m (GEORGIAKAKIS, 2012). They also found that bat fatalities decrease as the distance between the blade tips and the ground increases.

In North America, some authors showed that more bats were killed when turbines were taller (FIEDLER, 2007 ; JOHNSON, 2003), whereas others found no evidence that turbine height influenced bat mortality, neither did the number of turbines (THOMPSON, 2017). Berthinussen et al. (2014) found no evidence that modifying turbine design would reduce bat fatalities.

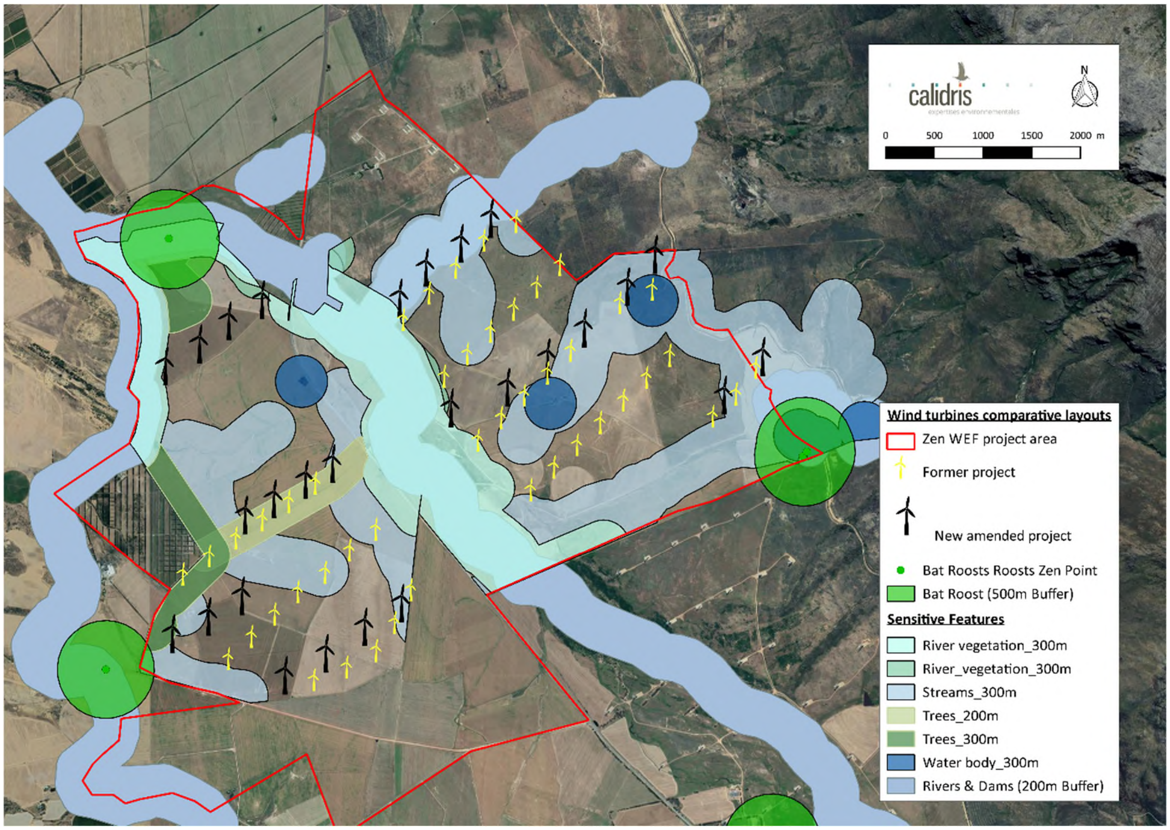
Baerwald & Barclay, (2009) reported that the number of bat fatalities differed partly due to differences in tower height, but the relationship was also influenced by bat activity: bat fatality was low at sites where activity was high and with short turbines as well as sites with low activity and tall towers. Nonetheless, an increase in tower height increased the probability of fatality at sites with high bat activity. Based on literature review, Hein and Schirmacher, (2016) suggest that bat fatality should continue to increase as turbines intrude into higher airspaces because bats are known to fly at high altitudes (McCracken *et al.*, 2008 ; Peurach, 2009 ; Roeleke, 2018).

The relationship between turbine size and bat mortality, or number of turbines at a wind energy facility is therefore unclear. Hence, the impact of turbines of the size proposed for the ZEN Wind Energy Facility cannot be assessed with certainty.

2. Sensitive features

Map 2 targets the main sensitive features onsite such as waterbodies, streams, rivers and tree lines. This map shows that globally, with the new layout, turbines are farther from sensitive zones or in smaller number. According to the analysis of bat activity and environmental features by Bio3 and the results of the ongoing monitoring, sensitive areas for bat communities should be avoided or modified as little as possible. The minimisation and mitigation measures for the layout definition phase has to keep indicated buffers as following:

- No wind turbines should be implemented within the 500 m buffer surrounding bat roosts;
- No wind turbines should be implemented within the 200 m buffer surrounding riparian vegetation and rows of trees.



Map 2: Comparative wind turbines layouts above sensitive features mapping

Impacts

The different type of impacts upon bats mentioned during the first EIA are: habitat loss, mortality through collision with power lines, reduction of ecosystem services provided by bats and direct collision with the turbine blades or barotrauma for bats. However, as the number of turbines will decrease and that part of power lines will be buried were deemed practical, only mortality of species due to collision with turbines blades or due to barotrauma, and cumulative impacts, are relevant to this amendment.

The potential collision impact to bats is currently rated as medium before, and low after mitigation with adherence to the sensitivity buffers being the major mitigation measure proposed. The 27 wind turbines associated with the amended layout will have hub heights of 140 m with a rotor diameter of up to 165m, i.e. the rotor blade arc will be from 57.5 m to 222.5 m above ground (for a surface of a little bit more than 2 hectares per turbine). As the distance between the ground and the blade tips will increase, some bat species foraging in the ground level will be less at risk in the amended project. However, as the hub height and rotor diameter will increase, this would result in a greater rotor swept area and a potentially greater likelihood of bat collision with turbine blades or barotrauma, especially for open-air species like free-tailed bats. Therefore, these impacts would remain medium before and low after mitigation.

Nature of impact: **Mortality of bat species due to collision with wind turbines blades or barotrauma caused by turbines operation.**				
	Authorised		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Local (1)	Local (2)	Local (1)
Duration	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Minor (2)	Low (4)	Minor (2)
Probability	Highly probable (4)	Improbable (2)	Highly probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (16)**	**Medium (44)**	**Low (16)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible

Irreplaceable loss of resources?	Yes	Yes	Yes	Yes
Can impacts be mitigated?	Yes	-	Yes	
Mitigation: The minimisation of deaths caused by wind turbines can be achieved through the avoidance of turbines installation in sensitive areas for bats, particularly in foraging areas or close to riparian vegetation, natural rows of trees or roosting sites. Mitigation measures such as the utilisation of red lights in the turbines instead of white in order to minimise insect attraction and bat foraging behaviours near turbines can be implemented. As curtailment has been shown to be an effective mitigation measure, it should be implemented when appropriate.				
Cumulative impacts: Since there is already an operating wind farm close to the study area, therefore cumulative fatalities of bats can be expected resulting from the operation of all facilities simultaneaously.				
Residual Risks: Some collisions are expected despite the implementation of mitigation. This will result in bat fatalities which have potential to result in residual impacts.				

Curtailment is a measure that can be undertaken in addition to the mitigation measures proposed within the EIA should high collision bat fatalities be recorded during the operational phase, as highlighted within the Bio3 (2013) report. It is defined as the act of limiting the supply of electricity to the grid during conditions when it would be normally be supplied at specific turbines.

Bats activity peaks at the beginning of the night and decreases until dawn. They also significantly reduce their flight activity during periods of rain, low temperatures and strong winds and are less at risk of collision with wind turbines under these conditions (ERICKSON, 2002b ; HORN, 2008 ; REYNOLDS, 2006 ; WELLER, 2012). For instance, Amorim et al. (2012) showed that 94% of mortality induced by wind turbines happen when temperatures are higher than 13°C. Hence, altering turbine operations when bats are most at risk was proposed as a possible means of reducing impacts (ARNETT, 2013 ; KUNZ, 2007b).

Several studies have tested the effect of implementing different curtailment conditions on mortality. Based on information from 10 different operational mitigation studies in North America, Arnett et al., (2013) report that increasing turbine cut-in speed (i.e. wind speed at which at turbines begin producing electricity into the power grid) by 1.5 m/s above the manufacturer's cut-in speed led to a reduction in bat fatalities of at least 50%. Actual power loss and economic costs of operational mitigation have been rarely studied, but some studies suggest that less of 1% of total annual output would be lost if operational mitigation were implemented during high risk periods for bat fatalities (ARNETT *ET AL.*, 2013).

Curtailment will be defined according to the results of bat activity, but also of wind and temperature measurements obtained from the mast, and can be adapted according to seasons and in line with available bibliography. If high collision bat fatalities are recorded, this should be evaluated by the bat specialists as soon as possible. Subsequent mitigation measures, adjusted to the risk situation identified, should be implemented and may include, but not restricted to curtailment at specific turbines or blade feathering (Arnett et al., 2013).

Conclusion

Considering the findings of the bat assessment report, it is unlikely that the amendments to the turbine dimensions, number and layout proposed at Zen Wind Energy Facility would result in an important change in impacts. No new impacts were identified for the proposed amendments; hence no new mitigation measures are recommended and the proposed amendment is deemed acceptable.

Impacts may be slightly lower for some species as the turbines would reach higher above the ground based on the maximum dimensions being applied for, and this is an advantage of the proposed amendments. However, for high flying species, the higher tip height may result in a greater impact, which is a disadvantage. Longer blades will also extend higher into the air and place open air species such as free-tailed bats at greater risk; therefore, ground clearance should be maximized and tip height should be minimized as much as possible. On the other hand, longer blades spin less quickly and can be easier to avoid. Considering that the orchards and rows of trees located west of the study area are important features for bats, the reduction of the number of turbines and the change of location will reduce the risk of collision for bats.

Layouts design should take sensitive areas for bats into consideration and respect buffer distances indicated in order to reduce at most the impacts on bat communities. The implementation of mitigation measures as determined within the bat assessment conducted in November are still applicable and must be implemented in order to reduce the identified impacts.

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