Environmental Impact Assessment for the proposed Banna Ba Pifhu Wind Energy Project near Humansdorp, Eastern Cape: Draft Environmental Impact Assessment Report

Chapter 7:

Impact on Bats

Rhinolophus clivosus, Geoffrey's horseshoe bat

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CHAPTER 7. IMPACT ON BATS

The findings of the specialist study on bats that was conducted by Stephanie Dippenaar as part of the EIA for the proposed Banna Ba Pifhu Wind Energy Project are presented in this chapter. Anna Doty, Nelson Mandela Metropolitan University, serves in an advisory capacity as a local bat specialist and Dr. Samantha Stoffberg provides assistance with the identification of bats.

7.1 INTRODUCTION

7.1.1 Approach to the study

The approach adopted for the bat study included the following steps:

- A review of available literature to establish which species occur in the area, including information gathered during previous research conducted in the area;
- Site visits to investigate the environment and availability of suitable bat habitat, and to record echolocation of bats on site;
- Identification and evaluation of potential impacts that the development could have on bats;
- Discussion of possible cumulative impacts;
- Recommending mitigation measures and monitoring requirements.

7.1.2 Terms of reference

The Terms of Reference for the bat specialist study are:

- Identify which species may occur in the area and their relevant conservation status;
- Conduct field work to assess the occurrence of bat species in the vicinity of the proposed turbine sites, the presence of any large bat roosts or maternal colonies, and areas of foraging activity;
- Identify the potential impacts of the wind project on bats and bat mortality; and
- Identify potential management plans to reduce the impact of the wind farm on the local bat community.

According to the relevant bat guidelines the bat specialist will have to determine whether the proposed project area occurs within a migration route for bats. This will only be possible after the data from twelve months monitoring has been analysed and incorporated in the EIA, or a subsequent monitoring report.

7.1.3 Assumptions and limitations

Only one month of monitoring data has been included in this study. A comprehensive bat survey would require monitoring of bats in all habitats, during all seasons, from dusk until dawn. Confirmation of bat occurrence at the proposed site is therefore limited to the time period between 6 and 18 October, 2011, when recordings were done on site. Furthermore, no monitoring has been done during the migration period in spring, and none during autumn, when some species not resident at the proposed site, may migrate through the area. The developer is committed to bat monitoring and12 months monitoring data will be included in the monitoring report.

- Given the lack of comprehensive site monitoring data, the confidence in the general EIA assessment is therefore shown as "low".
- Most research regarding the impacts of wind turbines on bats was conducted in North America, Canada and parts of Europe. As almost no information exists on the impact of wind farms on bats in South Africa, information from international sources is used in this study.
- Bats are less active when wind speeds are high, thus when turbines are operating at higher output rates. Bats are also less active during cold, windy weather, as often occurs during the winter months in the Jeffrey's Bay/Humansdorp vicinity. No data were collected at height. Bat recording equipment will be installed at height when monthly bat monitoring progresses and a wind data monitoring mast has been installed. The ideal is to have data of bat activity in the range of the turbine blades, i.e. at least 30 m above ground level.
- Echolocation operates over ranges of metres so any monitoring based on echolocation samples only a few metres of space, depending on the type and intensity of the call. The accuracy of the species assignation is also dependent on the quality of the calls. Some species put more energy in their echolocation and are therefore more likely to be recorded.
- Bats don't echolocate in a uniform, monotonous way, and when they go into a feeding frenzy, for example, it can be problematic to identify a species from a call. Dr. Samantha Stoffberg, University of Stellenbosch, assists where calls are not easily identifiable.
- Recording distance is influenced by the intensity of the bat call as well as the weather conditions. Furthermore, due to overlap of calls, it is not possible to provide an exact number of bats passing the recorder; therefore only an estimate is provided.
- To comment on bat numbers being low, medium or high for a wind farm development in South Africa is not possible at this stage, since data from various different sites aren't available yet to use as comparison. Essentially what we have at present is an activity index which will be relative to another activity index, after monitoring data is available, so that it can be compared.
- Most fruit bats don't echolocate and therefore cannot be recorded by bat recording equipment.
- No verified information at a micro-habitat level was available on bat occurrence, densities or migration patterns. Until such data are available, the precautionary principle needs to be invoked.

7.1.4 Information sources

Information was gathered from the following sources in order to investigate the existing situation that would be affected by the project:

- Project information as provided by CSIR;
- Sowler, S and S Stoffberg, 2011: *South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments*, Endangered Wildlife Trust;
- Other existing literature, including journal papers and the recently compiled bat atlas for southern and central Africa (Monadjem *et al.,* 2010);
- Bat occurrence data from existing, published and unpublished studies in the Humansdorp/Jeffrey's Bay area;
- Discussions with people staying within the area of the proposed wind farm development; and
- Daytime site visit, including a review of the surrounding areas, on 19 January 2011.

The assessment methodology applied in this chapter is presented in Chapter 4 of this EIA (Approach to the EIA).

7.1.5 Declaration of Independence

DECLARATION OF INDEPENDENCE

In terms of Chapter 5 of the National Environmental Management Act of 1998, I, Stephanie C Dippenaar, do hereby declare that I have no conflicts of interest related to the work of this report. I have no personal financial interest in the proposed development and/or properties and have no personal or financial connections to the relevant property owners, developers, planners, financiers or consultants of the development.

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Stephanie C Dippenaar

7.2 DESCRIPTION OF ASPECTS OF THE PROJECT THAT POTENTIALLY COULD CAUSE IMPACTS ON BATS

For further details on the proposed project components, refer to Chapter 2 of the EIA (Project Description). Only those aspects that could affect bats are described below.

7.2.1 Components of the project which could impact on bats

Components of the wind energy project which could impact on bats, directly through mortality during the operational phase, and indirectly, through the loss of foraging habitat, include the following:

- The proposed turbines;
- Any structures, such as operation and maintenance facilities, storage buildings, and security offices that might provide habitat which attract bats; and
- Clearance of natural vegetation for electrical connections, construction and upgrading of access roads and creating hard standing areas.

The potential impact on bats, related to the project, includes loss of habitat, new roosting sites in the wind farm infrastructure, and collision and barotrauma. These impacts are discussed in the following sections.

7.2.1.1 Loss of habitat

Some of the bat species that might occur on the proposed site are known to roost in culverts, aardvark burrows, rock crevices, buildings, under the bark of trees, in tree trunks, and in tall aloe species (see Table 7.1). The removal of limited natural vegetation during the construction phase of development might alter the foraging and roosting habitat of some species.

Disturbance resulting from construction activities might also deter bats resulting in loss of feeding and roosting habitat.

Bats are habitual animals and often some species, if not all, will still visit the site after the development has been completed. New developments might even attract more bats because of the presence of night lights which tend to attract more insects. Although there has been no research in South Africa as to determine how different species would react to different types of development, bats don’t necessarily move away after development has taken place.

7.2.1.2 New Roosting Habitat amongst Proposed Turbines

The proposed operation and maintenance facility, storage building and security office may provide additional roost sites for species, such as *Neoromicia capensis,* that make use of man-made structures (e.g. roofs of buildings, see Table7.1), especially if roofs are not properly sealed.

New buildings surrounding the wind farm development, such as on the Broadlands farmsteads, could similarly attract bats.

7.2.1.3 Collision and Barotrauma

The most important aspect of the project that would affect bats adversely are the wind turbines themselves, and in particular, the operational turning blades. Bat mortality has been attributed to direct collisions with the turbine blades, but approximately 90% of fatalities involve internal bleeding consistent with barotrauma (Baerwald *et al*., 2008). Barotrauma refers to tissue damage to the lungs and is caused by rapid or excessive changes in pressure (Baerwald *et al.,* 2008). As air moves over the turning turbine blades, an area of low pressure is created. Barotrauma occurs when bats experience a sharp decrease in atmospheric pressure near rotating turbine blades. This pressure drop causes a rapid expansion of the lungs, which is unable to be remedied through proper exhalation (the decompression hypothesis) (Baerwald, *et al*., 2008) thus resulting in haemorrhaged lungs and ultimately mortality. There is evidence, for example, that the cause of death of bat carcasses found at the Coega IDZ experimental wind turbine, close to Port Elizabeth, were all due to barotrauma. It must be noted that bats prefer to fly during nights when there are no wind, when turbines are not operational, and during nights when low wind speeds occur; therefore it is expected that mortality will be at the highest at the start of production, at 3 m/s, and reduces as wind speeds increase, up to approximately 6.5 m/s. At high wind speeds mortality is expected to be low to none, especially if high wind speed is combined with cold and rainy weather conditions.
Bats tend to approach turbines (rotating or not), follow or get trapped in the blade-tip vortices, and make regular and repeated passes close to turbines. However, it is not yet known *why* bats approach moving turbines. Various hypotheses and questions have been established and are being tested to inform researchers, developers and decision makers (Kunz *et al*., 2007). These hypotheses include:

- acoustic attraction (bats are attracted to sounds produced by wind turbines);
- heat attraction (insects are attracted to the heat produced by the nacelles and bats are pursuing the insects);
- echolocation failure (bats cannot acoustically detect moving blades or miscalculate rotor velocity);
- electromagnetic field disorientation (moving turbine blades produce a complex electromagnetic field, causing bats to become disoriented); and
- thermal inversion (thermal inversions create dense fog in cool valleys, concentrating insects, and bats, on ridge tops).

7.3 DESCRIPTION OF AFFECTED ENVIRONMENT

A detailed description of the study area is provided in Chapter 3 of the EIA report (Project Description).

The proposed development area is zoned as agriculture. At present it is mostly used for cattle grazing, either irrigated or fallow, see Figure 7.1. The remnant pockets of natural vegetation that exist along the slopes and drainage lines are away from the proposed turbine positions.

Figure 7.1: Typical environment where the proposed turbines will be situated

Areas surrounding the proposed site consist predominantly of Humansdorp Shale Renosterveld. Gamtoos Thicket occurs along the kloofs, valleys and drainage lines surrounding the proposed site. Limited clumps of small indigenous trees and bushes occur on site, but no tall indigenous trees or aloe species, which are usually preferred by bats as roosts, occur on the proposed site itself. The Seekoei river lies to the north of the proposed site.

Figure 7.2: A typical open water body of which several are present on and around the proposed site

Numerous small to medium sized farm dams of which some contain water throughout the year are present on the site (Figure 7.2). The site is also surrounded by perennial open water bodies, namely the Broadlands Dam and Du Toitsvlakte dam, in the Seekoei River, north of the site, the Geelhout dam north east east, and the Grasmere Big Dam south of the site.

Even though there are a few structures suitable for roosting on the site itself, the surrounding areas and drainage lines have ample habitat for bat roosts. Bats might use the natural vegetation surrounding the site for roosting and then utilise the site itself for foraging at night. Open air foragers make use of the kind of foraging habitat, such as open grassland that is found amongst the proposed turbine locations.

Man-made structures (e.g. houses and sheds) near the proposed project site may provide suitable roosting habitat for some species (e.g. *Neoromicia capensis, Tadarida aegyptiaca* and *Taphozous mauritianus).* Although all the buildings could not be investigated, some of the farmsteads were investigated during the daytime site visit on 19 January 2011, but no bats or remnants of bats were found.

No large caves or derelict mines are situated on or in close vicinity of the site, thus precluding the presence of important maternal colonies. The closest derelict mine populated by bats at present that we are aware of, is situated at Blue Horizon Bay, approximately 76 km from Humansdorp in the direction of Port Elizabeth.

Table 7.1: Review of bat species that have distribution ranges that include the proposed Banna Ba Pifhu Wind Energy Project.

Family	Species	Common Name	SA conservation status	Global conservation status (IUCN)	Roosting habitat	Functional group (type of forager)	Migratory behaviour	Bats confirmed in the Humansdorp / Jeffrey's Bay vicinity
PTEROPODIDAE	*Epomophorus wahlbergi*	Wahlberg's epauletted fruit bat	Least Concern	Least Concern	Dense foliage of large leafy trees	Fruit, nectar, pollen, flowers	Foraging mostly 2 to 4 km from roost site, but foraging trips up to 13 km is known.	
	Rousettus aegyptiacus	Egyptian Rousette (endemic)	Least Concern	Least Concern	Caves	Ficus species, fruit	Up to 24 km from their roosting cave	
RHINOLOPHIDAE	*Rhinolophus capensis*	Cape horseshoe bat (endemic)	Near Threatened	Least Concern	Caves, old mines.	Clutter, insectivorous	Not known, but believe to have seasonal migration	✓
	Rhinolophus clivosus	Geoffroy's horseshoe bat (endemic)	Near Threatened	Least Concern	Caves, old mines. Night roosts used	Clutter, insectivorous	Up to 13 km nightly roost site.	✓
EMBALLONURIDAE	*Taphozous mauritianus*	Mauritian tomb bat	Least Concern	Least Concern	Rock faces, tree trunks, walls	Open air, insectivorous	Not known	✓
NYCTERIDAE	*Nycteris thebaica*	Egyptian slit-faced bat	Least Concern	Least Concern	Cave, Aardvark burrows, road culverts, hollow trees.	Clutter, insectivorous	Average 1.1 km daily migration reported.	
MOLISSIDAE	*Tadarida aegyptiaca*	Egyptian free-tailed bat	Least Concern	Least Concern	Roofs of houses, caves, rock crevices, under exfoliating rocks, hollow trees	Open-air, insectivorous	Not known	✓
MINIOPTERIDAE	*Miniopterus fraterculus*	Lesser long-fingered bat (endemic)	Near Threatened	Least Concern	Caves	Clutter-edge, insectivorous	Probable seasonal migration	
	Miniopterus natalensis	Natal long-fingered bat	Near Threatened	Near Threatened	Caves	Clutter-edge, insectivorous	Seasonal, up to 150 km	✓
VESPERTILIONIDAE	*Eptesicus hottentotus*	Long-tailed serotine (endemic)	Least Concern	Least Concern	Caves, rock crevices, rocky outcrops	Clutter-edge, insectivorous	Not known	

Family	Species	Common Name	SA conservation status	Global conservation status (IUCN)	Roosting habitat	Functional group (type of forager)	Migratory behaviour	Bats confirmed in the Humansdorp / Jeffrey's Bay vicinity
	Glauconycteris variegate	Variegated butterfly bat	Near Threatened	Least Concern	Dense foliage	Clutter-edge, insectivorous	Not known	
	Kerivoula lanosa	Lesser woolly bat	Near Threatened	Least Concern	Not known, although individuals found roosting in weaver and sunbird nests	Clutter, insectivorous	Not known	
	Myotis tricolor	Temminck's myotis	Near Threatened	Least Concern	Caves	Clutter-edge, insectivorous	Seasonal	✓
	Neoromicia capensis	Cape serotine	Least Concern	Least Concern	Roofs of houses, under bark of trees, at basis of aloes	Clutter-edge, insectivorous	Not known	✓
	Pipistrellus hesperidus	Dusky pipistrelle	Least Concern	Least Concern	Rocky Crevices, under back of dead trees, often in proximity of water	Clutter-edge, insectivorous	Not known	
	Scotophilus dinganii	Yellow-bellied house bat	Least Concern	Least Concern	Fabricated stuctures, roofs of houses, holes in trees	Clutter-edge, insectivorous	Not known	✓
Species that might occur in the area, but have not been recorded so far south								
RHINOLOPHIDAE	*Rhinolophus swinnyi*	Swinnyi's horseshoe bat	Endangered	Near Threatened	Caves, old mines.	Clutter, insectivorous	Not known	
	Rhinolophus simulator	Bushveld horseshoe bat	Least Concern	Least Concern	Caves, mines, rocky outcrops	Clutter, insectivorous	Not known	
VESPERTILIONIDAE	*Hypsugo anchietae*	Anchieta's pipistrelle	Near	Least Concern	Not known	Clutter-edge,	Not known	

Family	Species	Common Name	SA conservation status	Global conservation status (IUCN)	Roosting habitat	Functional group (type of forager)	Migratory behaviour	Bats confirmed in the Humansdorp / Jeffrey's Bay vicinity
			Threatened			clutter. insectivorous		
	Kerivoula argentata	Damara woolly bat	Endangered	Least Concern	Weaver's and other bird's nests, under eaves of buildings and amongst leaves.	Clutter-edge, insectivorous	Not known	
	Scotophilus viridis	Green house bat	Least Concern	Not Evaluated	Holes in trees, roofs of houses	Clutter-edge, insectivorous	Not known	

From: Monadjem, et al (2010) and Friedmann and Daly (2004), conservation status according to Monadjem, et al (2010)

7.3.1 Bat Species Potentially Affected by the Proposed Project

Bats can be classified into three broad functional groups on the basis of their wing morphology and echolocation call structure, see Table 7.1. Clutter foragers, such as *Nycteris thebaica,* are bats that have a wing design and echolocation call that enables them to fly slowly and manoeuvre easily within vegetated areas. Clutter-edge foragers, such as *Myotis tricolor*, include bats that fly close to or around vegetation, and it is expected that these species will occur around the drainage lines. Open-air foragers, such as *Tadarida aegyptiaca*, are bats that have a wing design and echolocation call adapted to flying rapidly, high above the vegetation. Some open-air foragers have been recorded foraging 500 m above ground (Monadjem *et al.,* 2010). These species prefer to forage in open spaces and are most likely to be negatively impacted by the turning turbine blades because the blades will be within the range of their foraging altitude. Clutter foragers are less likely to encounter turning turbine blades because they prefer to forage close to the ground and amongst vegetationFurthermore, bats could have a completely different flying pattern when they migrate. As a precaution it is therefore important to note that all species may be negatively impacted by the turning turbines at some stage, e.g. whilst migrating through the proposed site, or moving between foraging sites and open water bodies.

A summary of bat species, distribution, feeding behaviour, preferred roosting habitat, and conservation status is presented in Table 7.1. The proposed turbine site falls within the distributional ranges of 16 species. This follows the most recent distribution maps of Friedmann & Daly (2004) and Monadjem *et al.* (2010). A further five species have been listed in Table 7.1, but it is unlikely that these species' distribution overlaps with the proposed site. Some of the 16 species mentioned prefer vegetated areas and might rather prefer to forage along the drainage lines, but as mentioned above, they might have migration routes crossing the proposed wind farm. Bats that have been recorded by the author or reported in recent published or unpublished studies in the Humansdorp/Jeffrey's Bay vicinity have also been indicated in the table, which confirms their presence in the local area.

According to Monadjem, *et al* (2010), of the 16 species listed in Table 7.1, one species, namely *Miniopterus natalensis,* has a global conservation status of Near Threatened and seven species have a South African conservation status of Near Threatened. Five of the species mentioned are endemic to southern Africa.

The open air forager, *Tadarida aegyptiaca* that occurs at the proposed site, is identified with a conservation status of being of Least Concern. This classification, however, does not mean that less attention should be given to this species.

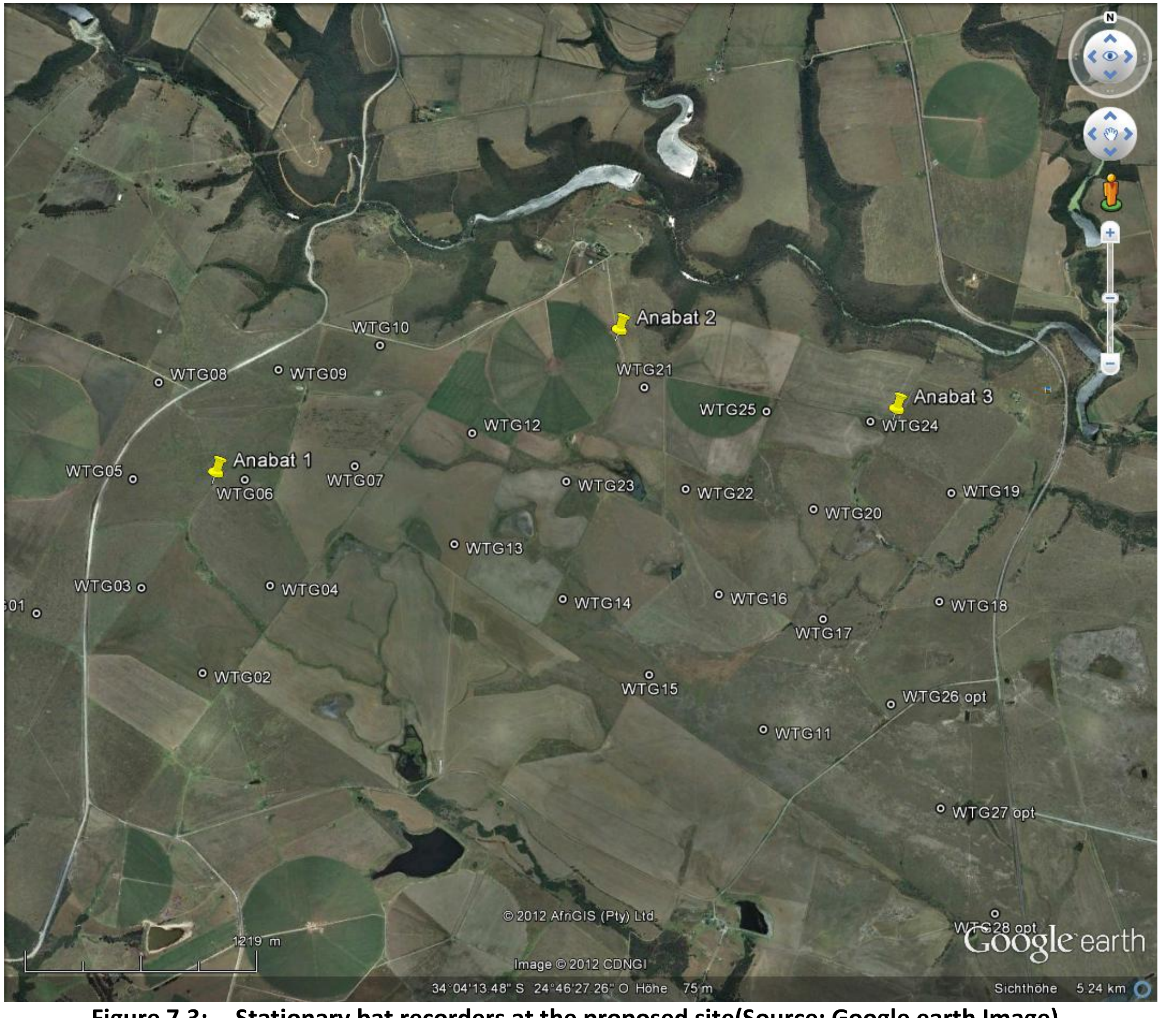

Figure 7.3: Stationary bat recorders at the proposed site(Source: Google earth Image).

7.3.2 Site visit during January and October

On 19 January 2011, a daytime site visit took place and where accessible, the farmstead buildings were investigated. No bats or bat rests were found in the sheds. Bat occurrence at the farmsteads of Broadlands as well as The Glen was discussed with Mr. David Masterson, who indicated that they have never had bats trapped in their houses or sheds or seen any bats in or around the farmsteads. Mr. Masterson has also indicated that during his stay at Broadlands, he had never noticed any particular time of the year that there are bats flying over his property.

Three Anabat SD2 stationary bat detecting recorders were used amongst the proposed turbine positions on the site (see Figure 7.3). The Anabat SD2 is a broadband, real time, frequency division (each bat call is re-synthesises at typically a fraction of its frequency) recorder. Bat calls are recorded and then identified by looking at a sonogram of the bat call afterwards, mainly using Analook software, (see Figure 7.4). Bats were identified from the echolocation frequency at the knee of the call (point where there is a change in the slope of the call), shape of the call and species distribution records.

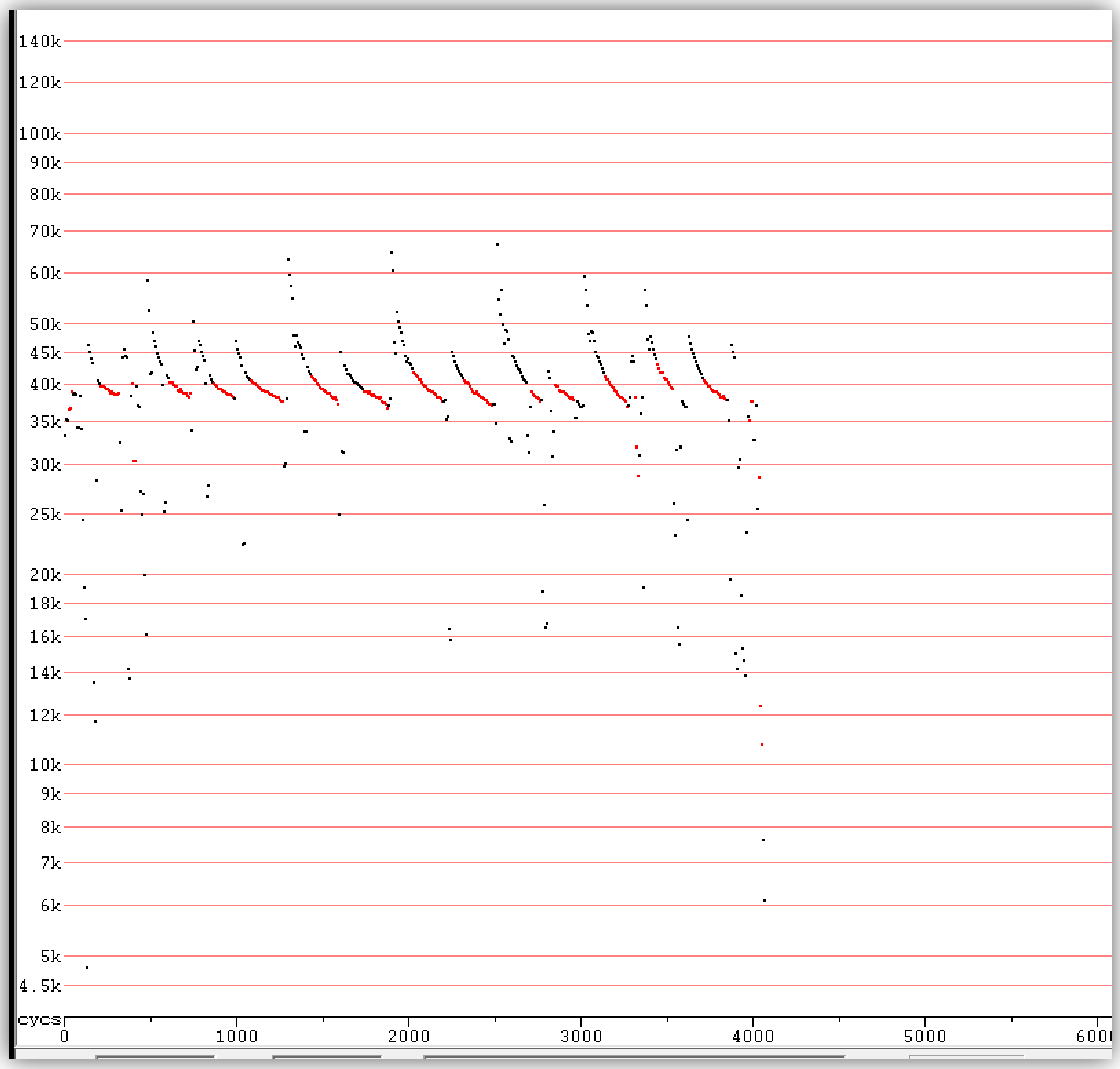

Figure 7.4: A sonogram of *Neoromicia capensis* (Cape serotine bat), recorded on site on 7 October 2011

Bat monitoring started during October 2011 and no transects, making recordings at each turbine base or recording while moving between proposed turbine positions, have been done yet. Monitoring took place between 6 and 18 October 2011. The Anabats were not installed at exactly the same date, but dates overlapped at some point, andwere as close as possible to each other. The recordings took place on the following dates:

- Anabat 1: Between 13 and 18 October 2011
- Anabat 2: Between 6 and 13 October 2011
- Anabat 3: Between 10 and 14 October 2011

The bat detecting recorders were set up in stationary position during these nights. Figure 7.3 indicates the positions of the stationary recorders. Stationary recorders were placed so that bats flying from the Seekoei River situated north of the property, or from the Broadlands, Du Toitsvlakte and Geelhout dams, crossing the proposed site, could be recorded. Possible daily migration routes from the riverbed and overhangs along the Seekoei River would have been covered. Anabat 1 covered the eastern part of the proposed property. These positions will be reviewed before further monitoring progresses and one of the recorders will be installed on the wind monitoring mast which will be erected in the near future.

The results from the three Anabat recorders are presented in Figure 7.5 and Figure 7.6. It must be noted that due to the overlap of calls, it is not possible to provide an exact number of bats passing the recorder. Sets of calls are counted and one set of calls can flow into another set, therefore the bat counts are approximate.

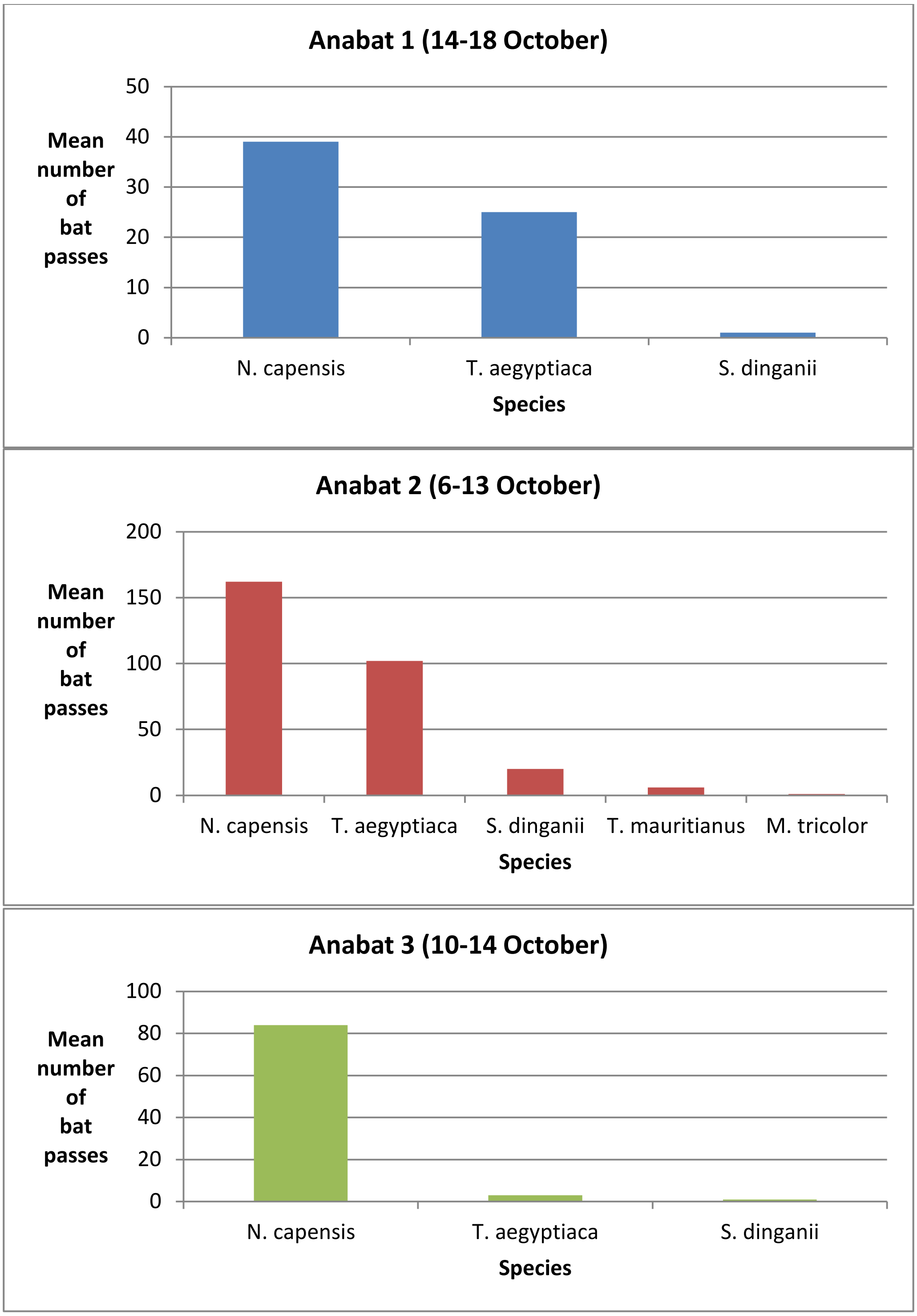

Figure 7.5: Approximate bat passes and species from stationary recordings on the proposed site

Five species of bats were recorded (Figure .7.5). *Neoromicia capensis* and *Tadarida aegyptiaca,* which is dominant on site according to this data, have an overall status of Least Concern. Limited numbers of *Scotophilus dinganii* , *Taphozous mauritianus* and *Myotis tricolor* were also recorded. Except for *M. tricolor*, which has a South African conservation status of Near Threatened, these species have a conservation status of Least Concern. The species noted in Figure 7.5 and 7.6 correlate with species which have distribution ranges covering the proposed site, as well as species that were recorded during the Environmental Impact Assessments for other wind farms in the vicinity.

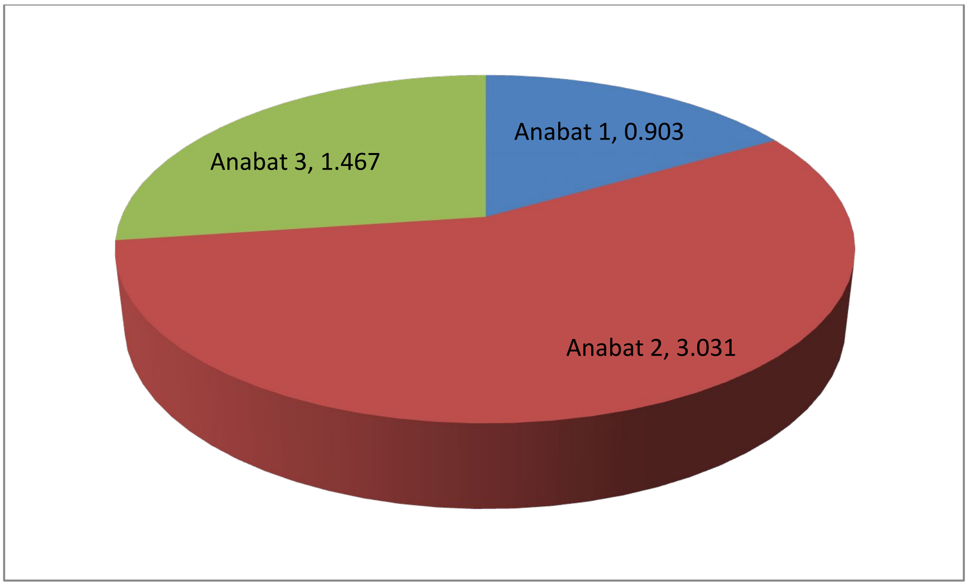

Figure 7.6: Bat index for each of the stationary Anabats during October

According to Sowler and Stoffberg (2011) the volume of data collected from static detectors provides the raw data to estimate bat activity, known as a 'bat activity index' for the site. This is calculated by dividing bat passes by time.

Activity Index = Bat passes / unit time

Data collected are analysed to detail the total number of bat passes for each species or species group (depending on level of identification possible from echolocation recordings)
and total bat activity for each survey location and also the whole site. This information
can then be compared across sites and analysed within site to provide, in this case, relative levels of bat activity at ground level and within the proposed turbine area. Anabat 2 seems to have the highest bat activity during 6 to 13 October 2011. Anabat 1, situated on the eastern side recorded the lowest bat activity. The combined bat activity index for the static recordings on the site as a whole for 6 to 18 October 2011 is 1.947.This will provide a starting point to compare with further monitoring data on site, as well as at other wind farms in South Africa.

7.4 IDENTIFICATION OF ISSUES AND IMPACTS

Direct issues related to wind farms that are of importance to bats include the following:

- The direct loss of roosting, flight paths and foraging habitat;
- Bat mortality through collisions with turbines or barotrauma from turning turbine blades; and
- The cumulative effect of bat fatalities associated with wind farms and the density of wind farms in any particular geographic area. Indirect issues related to wind farms include the consequences of a large scale loss of bats as discussed in Section 7.2.

7.5 PERMIT REQUIREMENTS

No permits are required for removing bats or killing them, unless for the purpose of research. If bats are to be collected, a permit from the Province of the Eastern Cape: Economic Development and Environmental Affairs is required to undertake research or collection of biological material on privately owned land in the Eastern Cape Province.

7.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

The impact assessment applied the standard impact assessment criteria (see Chapter 4: Approach to the EIA), with a summary assessment provided in Table 7.2.

7.6.1 Limitations of Impact Prediction

Methods prescribed by the South African Guidelines were followed, however one month of data collection cannot be extrapolated to reflect 12 months of bat activity. No site-specific data from a full autumn, spring or summer season are available. These are the times when bats migrate and when they would be more active. Therefore confidence in the EIA statements as a whole is low.

The use of a bat detector or recorder confirms bat activity (or non-activity) at the particular time and season of recording. Therefore confidence of species recorded in October 2011 is high. Further monitoring, during other times of the year might confirm the presence of more bat species on site than those that have been recorded up to now. A comprehensive species list of the site will become available once twelve months of monitoring has been completed.

Echolocation operates over ranges of metres, so any monitoring based on echolocation samples only a few metres of space, depending on the type and intensity of the call. One must therefore be cautious when extrapolating data from echolocation surveys over large areas. The accuracy of the species assignation is also very dependent on the quality of the calls. Some species' put more energy into their echolocation and recording distance is influenced by the intensity of the bat call as well as the weather conditions.

Two species of fruit bats have distribution ranges crossing the site. *Epomophorus wahlbergi,* which does not echolocate, and *Rousettus aegyptiacus,* which has a primitive form of echolocation by repetitive tongue clicks. These will not be recorded by the Anabat. Although there are no fruit trees which might attract these species to the site, they might forage along the drainage lines when wild trees are bearing fruit, or they might cross the site during migration.

One bat may pass a recorder more than once. Therefore, the number of calls does not directly correlate with the number of bats passing the recorder. However, more calls do indicate that there are more bats present on site.

7.6.2 Loss of habitat

The proposed site provides good foraging habitat for bats feeding in open airThis foraging habitat will be lost, or at least become dangerous for bats flying at a certain height, after the construction of the turbines.

The main attractions for bats are open water bodies and foraging territory. The site does not have much habitat for bats to roost, so it is assumed that they cross the site from the surrounding areas. Bats may traverse a wide territory when travelling to their primary feeding locations during dusk and dawn. It is probable that bats visiting the proposed development could roost in the kloofs surrounding the proposed site. The indigenous trees, riparian vegetation and cliff overhangs along the drainage lines provide suitable habitat. One could speculate that this might be the reason why the bat index for Anabats 2 and 3 are a bit higher than Anabat 1, as these two recorders were situated in closer proximity to the river valley situated towards the north of the proposed site. This will have to be confirmed by further monitoring.

Figure 7.7: *Neoromicia capensis* (Cape serotine bat), photographed at a derelict mine at Blue Horizon Bay.

Little is known about daily feeding patterns of South African bats. Although open-air foragers were expected on the proposed site, as is the case with the number of *Tadarida aegyptiaca* recorded, some bats which are classified, for example as clutter-edge foragers, such as *Neoromicia capensis* (see Figure 7.7), also utilise the open areas to forage or pass through it. As suspected, species that prefer to forage around denser vegetation, such as *Kerivoula lanosa*, were not recorded on site. The assumption is that if these bats do visit the area, they tend to rather forage along the vegetated drainage lines; but again, these species might cross the proposed site during migration.

Except for the farmsteads, there are no nightlights, which could attract more insects at night, which are present on the property or surrounding properties.

During construction, the impact on bat fauna at the proposed project site is expected to be minimal with mitigation. This impact will be due to some of the natural vegetation, limited clumps of trees, and therefore foraging area for bats, being removed as part of site clearance.

Construction activities themselves will generate noise, which might cause some disturbance to bats and the foraging habitat of some species might be affected.

During operations, as a precautionary measure, the developer must avoid attracting bat colonies to the vicinity of the wind farm site. Any buildings within the study area, as well as the nearby farmsteads, should be investigated for bats. If there are no bats roosting within them, the roofs could be sealed so as to avoid bats being attracted to the area in the future. This will of course have to be discussed with the land owner.

7.6.3 Mortality during the operation of wind turbines

The most important aspect of the project that would affect bats is the turning blades when the turbines are operating. Bat mortality has largely been attributed to direct collisions with turbine blades, but approximately 90% of fatalities involve internal bleeding consistent with barotrauma (Baerwald *et al.* 2008) (see Section 7.2.2.3). Open air foragers visiting the site, such as *Tadarida aegyptiaca* is expected to be the most affected as this species tends to forage in the vicinity of the turning turbine blades. *Tadarida aegyptiac* passed the Anabats more than a 100 times during the recording period. Anabat 2 had a particular high number of this species recorded.

Since little is known about the foraging habitat of bat species in South Africa, it is not improbable out that *Neoromicia capensis, Myotis tricolor* or *Scotophilus dinganii*, which have been recorded during October on site, will forage within the vicinity of the turbine blades. The highest number of bat calls recorded on site, was that of *Neoromicia capensis* and only recordings at height will provide an idea as to whether these species forage or migrate either daily or seasonally in the vicinity of the turning turbine blades.

Weather patterns may influence bat fatalities. Some studies demonstrate that bat fatalities occur primarily on nights with low wind speed and typically increase immediately before and after the passage of storm fronts. Activity increases during spring, summer and the beginning of autumn, and decline as temperature drops towards the middle to end of autumn. During the colder winter months bats tend to be less active; therefore less mortality is expected during nights with high wind speed and colder temperatures, more so if it is combined with rainy conditions. Studies conducted in the USA and Canada indicate that fatalities peak in late summer and early fall which coinciding with the migration of many species (Kunz, et al. 2007; Arnett, et al. 2008). A smaller spike in bat fatalities occurs during spring migration for some species at some facilities (Arnett, et al. 2008). However, the seasonal fatality peaks noted above may change as more facilities are developed and studied and the situation might also differ within the Southern African context.

According to the data available at present, the proposed site has an active bat presence, and mortality is expected in bats flying amongst the turbine blades during operation (under favourable flight conditions as discussed earlier).

7.6.4 Management actions to avoid or reduce negative impact

Management actions are proposed for the following stages of the project:

- Detailed design (pre-construction);
- Construction; and
- Operation.

7.6.4.1 Actions to inform the detailed design (pre-construction)

a) Pre-construction monitoring

At national and project scale, research is needed to provide more information on specific impacts and novel mitigation measures that might reduce impacts of wind turbines on South African species of bats. *The South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments* (Sowler and Stoffberg, 2011) was finalised during May 2011, at which time the EIA for the Banna Ba Pifhu Wind Energy Project had already commenced. The guidelines recommend monitoring of at least "**7 consecutive days (during good weather conditions) per month over a period of 12 consecutive months**." As the EIA commenced before the guidelines were published, the proponent was at that stage not obligated to conduct any bat monitoring. However, the proponent has opted to comply with the guidelines and, accordingly, a full 12 months of pre-construction monitoring will be completed and the monitoring report submitted to DEA before construction commences. If the monitoring data shows high bat activity, and DEA still agrees that the development may proceed, the client and a bat specialist will investigate possible ways to minimise potential bat mortality. The findings of this will be incorporated into the EMP for the project and inform the following actions:

- potential need to seal existing buildings within and close to the study area;
- possible need to refine turbine operational procedures (described below);
- possible need to re-assess at the turbine layout; and
- potential placement of bat roost boxes in safe areas away from turbines as a trade-off.

7.6.4.2 Actions to reduce impacts during construction

a) Protect existing bat habitat

Due to the fact that the area is quite extensive, hidden crevices and aardvark burrows should be approached with care during construction since they might provide roosts for bats. A bat specialist should be contacted immediately if there is a discovery during construction of any structure with a bat roost.

b) Avoid creating bat habitat close to turbines

Care needs to be taken to completely seal roofs of any new buildings within the study area to prevent bats from moving in, thus making them more prone to coming into contact with the turbines in the surrounding area.

The presence of structures in close vicinity of the study area may provide roost sites for species such as *Neoromicia capensis* that make use of man-made structures, particularly if roofs are not properly sealed. Species which use walls and/or roofs for roosting habitats need rough surfaces on which to grip and thus by modifying these surfaces potential bat colonies can be either attracted or deterred. Consideration should be given to this mitigation if, with further investigation, it is found that bats occur at the farmsteads close to construction. If no bats are found to reside in the buildings, roofs of buildings at the wind farm should be carefully sealed so that no bats move into it.

c) Avoid Creating permanent water bodies and structures

Bats visit open water bodies to drink and therefore it is recommended that no new water bodies, such as open dams or reservoirs, are created on the proposed site. The developer does not have authority over farm activities and cannot prevent the land owner from building more dams, but this issue will have to be discussed with the farmer so as to establish if more open water bodies are planned within the nearby future.

d) Setbacks

Setbacks have already been incorporated in the planning phase of the project. This might have to be re-assessed after more monitoring data becomes available. If high bat occurrence is found at any particular area on the proposed development site, or neighbouring the site, the setback areas will have to be reconsidered and discussed with a bat specialist. Although setbacks are believed to at least have some value as a mitigation measure, the effectiveness of setbacks regarding bats and wind turbines is unknown in the South African context, due to the very limited data available on the daily foraging patterns of different bat species.

7.6.4.3 Actions to reduce impacts during operations

a) Operational management of blade speeds (curtailment)

Nights with low wind speeds are associated with increased bat mortalities as bats are most active under these conditions (Hoso and Hayes, 2010). If monitoring indicates high bat occurrence, mitigation measures concerning cut-in speeds of turbines (curtailment) could be applied. Currently this seems to be the only truly effective and tested mitigation measure (Huso and Hayes, 2010). The theory behind curtailment is that there is a negative correlation between bat activity and wind speed, causing bat activity to decrease as the wind speed increases. However, implementing curtailment as mitigation for bat collisions would need to be evaluated against other possible risks, including financial feasibility prior to being undertaken and should be based on discussion and agreement between the project operator and bat specialists. It may also only be applicable at certain times of the year such as during bat migration periods.

b) Turbine size

Research done in North America indicates that bat fatalities per turbine increase exponentially with tower height, suggesting that larger turbines are reaching the airspace of migrating bats (Barclay, *et al*, 2007). Turbines of 65 m and taller had the highest mortality rates for bats. Barclay mentions that in general, regardless off the fact that there will be less turbines with more spacing between turbines, which will provide more airspace for bats, that "fatalities of bats per megawatt of installed energy capacity are greater at some of the new, larger turbines, and overall, bat fatalities increase per megawatt." The increase of rotor-swept area was not a significant factor in the analyses. At present no recordings at height have been incorporated in the study as no wind monitoring masts have been installed on site yet. In theory, from the perspective of existing literature on bat migration, the preference would rather be for the smaller turbines, but this need to be further investigated and discussed with the developer if monitoring data is available.

From a bat perspective it would be preferable if the alternative position 28 is not developed, simply due to the fact that this location is situated close to a fairly large open farm dam and situated on the periphery of the wind development. In general, where there is an alternative position close to open water bodies, it should be avoided if possible. Bats might fly to open water bodies to drink and it would reduce the risk if turbines could be situated as far as possible from these water sources.

c) Attract bats away from turbines as a trade-off for habitat destruction

Even though there is never certainty as to whether bats will move into artificial roost boxes, this could always be used as a trade-off to offset potential mortalities during turbine operation. When more is known of the bat population one could consider roost boxes (to attract bats) to "safe" areas away from any turbine developments. Pre-construction monitoring should inform the potential placement of bat roost boxes. This would require further investigation.

7.6.4.4 Post-construction/operational monitoring

It is recommended that operational monitoring be undertaken to determine the extent of bat fatalities and the species affected. Although, due to the higher level of scavenging, it is not expected to be as successful in South Africa as in European countries, carcass searches are the standard method employed to determine the level of bat mortality. Carcass searches for birds and bats could be done by the same person in order to save costs.

Post-construction monitoring is especially important during the periods April to May and August to September when bats are migrating between summer and winter roosts. Carcass searches should be done early in the morning to minimize the effect of scavengers (which remove carcasses). Carcasses should be frozen and sent to a bat specialist for identification purposes.

This information is critical to improve the understanding of the effect of wind farms on bat populations in South Africa.

7.6.4.5 Cumulative effect of various wind farms in the area

Seven other wind farm developments are proposed in the Humansdorp/Jeffrey's Bay vicinity. Together these developments, if authorisation is received, will result in the installation of more than 350 wind turbines, depending on the size of the turbines. Three of these projects have already received positive environmental authorisation, but no bat monitoring data are available for these projects yet.

Whilst this bat study only focuses on the Banna Ba Pifhu Wind Energy Project, there might be cumulative effects that may significantly change the picture in terms of the negative impact on bats by increasing the risk of fatalities. The Jeffrey's Bay Wind Energy Project is situated approximately 5 km north east of Banna Ba Pifhu Wind Energy Project. The Seekoei River is situated between these two projects, and it is predicted that a higher concentration of bats will reside along the river valley due to denser riverine vegetation. It is expected that daily migration routes of bats that prefer to forage at hub height will be between the river valley and its tributaries and the surrounding hills, where wind developments are proposed.

Miniopterus natalensis is known to undertake migratory flights, up to a 150 km from their roosting site, between bushveld caves and highveld caves in the northern parts of the country. This species had been recorded in the Jeffrey's Bay area, but the locations of roosting caves and migration routes in the Eastern Cape are unknown. *Tadarida aegyptiaca* and *Neoromicia capensis* have already been recorded on four of the potential wind farms in the Humandsdorp/Jeffrey's Bay vicinity. *Tadarida aegyptiaca* is an open air forager and is particularly susceptible to a negative impact from wind turbines. *Neoromicia capensis*, which is known to forage at various heights, occurs widely in southern Africa and has been recorded during the impact assessments of all wind farms that the author is aware of in the Eastern Cape. Little is known about the migratory behaviour of the 16 species that have distribution ranges overlapping the Banna Ba Pifhu Wind Energy Project, but all bats, including fruit bats, are exposed to negative impact by wind turbines when they are migrating.

The review of EIAs for wind farm applications in the Humansdorp/Jeffrey's Bay region should consider the bat situation in order to avoid a localised decline in certain bat species resulting from the cumulative impact of these wind farms.

Bats are habitual animals and the literature suggests that they tend to return to the same area for feeding and roosting. It is therefore expected that bats will still visit the wind turbine sites after construction. At this stage though, with the limited data available, it is not possible to make confident predictions concerning the effect of the cumulative impact of all these proposed wind farms.

7.6.5 Overall assessment of the reversibility and irreplaceability for bat impacts

An overall assessment of the reversibility and irreplaceability for bat impacts is provided on the data available at the time the EIA was submitted. This will need to be reviewed when all the monitoring data is available and should be updated in the monitoring report. Primarily the probability of the wind farm being situated in a migration route for bats should be eliminated. If this is ruled out it is not expected that any singular species will be irreplaceably affected.

7.6.5.1 Assessment of the reversibility of impact

Any bat mortality is non-reversible, but one needs to take into account to which extent a species as a whole will be irreversibly impacted upon by the Banna Ba Pifhu Wind Energy Project. Limited numbers of *Scotophilus dinganii* , *Taphozous mauritianus* and *Myotis tricolor* had been recorded on site. *Neoromicia capensis* and *Tadarida aegyptiaca,* which occurs wide spread in the Eastern Cape, is dominant on site according to data collected for this EIA. The overall status of all species recorded is Least Concern, while *Myotis tricolor*, has a conservation status of Near Threatened in South Africa (Monadjem, et al, 2010). It is expected that a moderate to low reversibility of impacts will occur at the proposed site.

The cumulative effect of several wind farms in the vicinity of Jeffrey's Bay is expected to have an effect on at least the abundance of *Tadarida aegyptiaca* and probably *Neoromicia Capensis* in the area, due to a moderate abundance of these bats on the Banna Ba Pifhu Wind Energy site as well as other proposed wind energy developments in the close vicinity of Jeffrey's Bay and Humansdorp. If all the wind farms go ahead as proposed at present, they could together have a lower cumulative negative reversibility of impacts.

7.6.5.2 Assessment of the degree to which the impact causes irreplaceable loss of resources

As mentioned above, statements regarding irreplaceable loss of a resource will be updated in the monitoring report after 12 months of bat monitoring. Species visiting the site seem to be individual bats feeding at the site as no maternity or hibernations have been encountered in the close vicinity of the proposed farm. *Neoromicia capensis* and *Tadarida aegyptiaca* are common species found widespread in the region. It is therefore expected, with the data available up to now, that there will be a low irreplaceability of the resource. Again, the cumulative effect of a lot of wind farms situated in a linear fashion might have a higher irreplaceable influence on the mentioned bat population.

Table 7.2: Impact assessment

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
CONSTRUCTION PHASE									
Scenario: Construction of Wind Turbines									
1.1 Loss of roosts for bat species using clumps of indigenous trees, crevices and aardvark burrows.	Negative	Localised	Long term	Medium	Definite	Medium	Carefully investigate crevices, clumps of small indigenous trees and aardvark burrows before they are destroyed.	Medium	High
1.2. Loss of roosts for bat species using manmade structures as roosts	Negative	Localised	Permanent	Low	Probable	Medium	Seal all existing buildings within the study area which have not got bat roosts. Seal off all new building structures within the study area.	Low	High
1.3. Construction noise during night time	Negative	Localised	Permanent	Low	Probable	Low	Night time activities and noise on the construction site should be minimised.	Low	High

Nature of impact	Status (Negative or positive)	Extent	Duration	Intensity	Probability	Significance (no mitigation)	Mitigation/Management Actions	Significance (with mitigation)	Confidence level
OPERATIONAL PHASE									
Scenario: Operation of Wind Turbines									
Displacement or exclusion from foraging areas and the loss or shifting of flight paths.	Negative	Localised	Long Term (life of project)	Medium	Highly probable	Medium-High	Pre-construction monitoring to confirm turbines not on a migration pathway.	Medium (depending on pre-construction monitoring results)	Low
Mortality due to collision with turning turbine blades or due to barotrauma.	Negative	Localised and Regional (migratory species)	Permanent	Medium	Highly probable (may be species specific)	Medium-High	Pre-construction monitoring to confirm turbines not on a migration pathway. Optimise turbine rotation speeds to reduce bat fatalities, if needed, and for specific times of year only.	Medium (depending on pre-construction monitoring and mitigation actions)	Low

Table 7.3: Monitoring programme

Impact	Mitigation/Management action	Monitoring		
		Methodology	*Frequency*	*Responsibility*
CONSTRUCTION PHASE				
1.1 Loss of roosts for bat species using clumps of small indigenous trees, aardvard burrows and crevices.	Investigate any features that could house bats before they are demolished.	Protect existing bat habitat.	During construction	Construction manager and ECO, and bat specialist, if necessary.
1.2. Loss of roosts for bat species using manmade structures as roosts	Seal all existing buildings close to the study area which have not got bat roosts. Seal off any new building structures within the study area.	Avoid attracting bats to or creating any new bat habitat on site.	Once off, during construction of turbines	Construction manager and ECO
1.3. Construction noise during night time	Construction activities should as far as possible take place during daytime.	Avoid disturbance of bat activity after sunset as far as possible.	During construction	Construction manager and ECO

OPERATIONAL PHASE				
Mortality due to collision with turning turbine blades or due to barotrauma.	Pre-construction monitoring to confirm turbines are not on a migration pathway.	Try to avoid bat fatalities	Monitor bat activity for 7 days per month for one year	Bat specialist and proponent
	Optimise turbine rotation speeds to reduce bat fatalities, if needed, and for specific times of year only.	Try to avoid bat fatalities	Monitor bat activity for 7 days per month for one year	Client in collaboration with bat specialist
	Avoid creating bat habitat on site and in neighbouring surrounding areas.	Try to avoid attracting bats to proposed site facilities	Once off discussion with landowners so as to try to avoid creating more open water bodies on and in close vicinity of the proposed site.	Client to discuss with landowners
Compensate for possible bat fatalities through trade-offs	Install/build artificial roost sites away from the proposed site.	Attempt to create a trade-off for bat mortality	Once off installation of bat boxes	Proponent and ECO, in collaboration with bat specialist. The ideal would be to do this in collaboration with other wind farm developers in the vicinity.

7.7 CONCLUSION

The main potential impacts of the proposed Banna Ba Pifhu Wind Energy Project on bats are a loss of foraging habitat and mortality during the operational phase of the project. The mortality is attributed predominantly to barotrauma as well as due to direct collisions with turbine blades. Bats are creatures of habit, and their ability to adapt to these changes is uncertain and; therefore, bats will most probably visit the site after the development of the wind farm.

The site visit conducted on 19 January 2011 and recordings of echolocation from 6 to 18 October 2011, as part of this specialist study, identified five bat species present on site. No large caves or maternal colonies were identified in the vicinity of the proposed turbine sites. The majority of species calls are associated with *Tadarida aegyptiaca,* an open air forager, and *Neoromicia capensis,* for which the highest number of calls, was recorded. It is expected that open air foragers will be mostly negatively affected during operation of the turbines

Bats change their flying patterns when they migrate. Consequently, those species which usually forage at a lower elevation might fly, or even forage, in the vicinity of the turbine blades when migrating. Thus the need to investigate the area for a 12 month period covering all four seasons and at height, is important. The proponent has already commenced with monitoring.

The no-go scenario, has the least negative impact from a bat perspective compared to the other option. The literature suggests that bat fatalities may increase exponentially with tower height, suggesting that larger turbines are reaching the airspace of migrating bats. At present no recordings at height have been incorporated in the study. Furthermore, no studies concerning the impact of different sizes of wind turbines on South African bat species are available. The effect of smaller but more turbines to larger but less turbines will have to be estimated and evaluated. Furthermore, it would be preferable if alternative positions, as far as possible, close to open water bodies, such as option 28 could be avoided. Bats that fly to the proposed area to drink water is expected to be more at risk if turbines are situated close to open water bodies.

Although it is not possible to make confident predictions with the limited data available, it is expected that the combined proposed wind developments in the area might have a cumulative negative impact on the bat population, at least through a loss of habitat.

Based on existing available information and the findings of the site visit, the potential impact of the wind turbines on bats at the proposed Banna Ba Pifhu is anticipated to be of **medium** significance with mitigation, and medium – high without mitigation. Although confidence levels for the October recordings are high, overall confidence levels are low as only one month of monitoring data has been incorporated into the study. After the data from additional monitoring has been assessed, the confidence in predictions will be higher. A condition of this assessment is that the pre-construction monitoring be completed.

It is further recommended that post-construction monitoring be undertaken while the turbines are in operation to determine the extent of bat fatalities and the species affected.

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