ANNEX-A

BAT ASSESSMENT REPORT

HİLAL-2 WIND POWER PLANT PROJECT

BAT ASSESSMENT REPORT

JUNE, 2016

ANKARA

HİLAL-2 WIND POWER PROJECT

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1 INTRODUCTION

Wind power is a clean and renewable energy resource. Though, several fatalities of birds and bats have been recorded world wide all over the world (Erickson et al. 2002, Durr and Bach 2004, Kunz, et al. 2007, Arnett et al. 2008, Baerwald 2008). Bat fatalities caused by wind power plants have gained significance along with the death of 1400 to 4000 bats at the Mountaineer Wind Power Plant located in North America in 2003 (Kerns and Kerlinger 2004). This has been followed by fatality of a large number of bats at the same power plant, in Pennsylvania (Arnett 2005) and in Tennessee in 2004 (Fiedler 2004, Fiedler et al. 2007). Hence these evidences have brought about increased concerns on potential impacts of wind power plants on bat populations (Racey and Entwistle 2003, Winhold et al. 2008).

According to Rydell et al (2012) the average number of bat killings because of wind mills in Europe and North America is higher than that for birds (2.9 bats/turbine/year vs 2.3 birds/turbine/year). Parameters related with turbines differ significantly. While no fatalities are recorded at some turbines, several bats have been killed at several others. This difference is associated with geographical location of turbines (EKOenergy, 2015).

Past data recorded at wind power plants show that a significant part of bat fatalities have taken place during spring-summer migration periods when wind speed is relatively lower (Arnett et al. 2008). As a possible measure, limited operation of the power plants have been accepted as a reasonable solution at times of such weather conditions and time periods (Kunz et al. 2007, Arnett et al. 2008). According to results of researches in Canada and Germany, lowered turbine speeds down to 5.5 m/s has accomplished a 50% decrease in bat fatalities as compared to turbines operating at normal speed (Baerwald et al. 2009; O. Behr, University of Erlangen, unpublished data). Despite that it is done for a limited time, lowering of turbine speed has caused operators to manage technical and financial difficulties. Yet such measures are recommended as feasible for mitigating impacts of power generation companies on bat populations at minimal costs and to decrease fatality rates relatively.

In the 2014 Report of EUROBAT (Agreement on the Conservation of Populations of European Bats), five species of bats have been identified that are most affected by turbines in Lithuania. The Report states that two particular species (*P. nathusii, N. noctula*) are impacted by wind mills during their migrations. 40 individual bats from 4 different species have been identified at 6 different turbine locations in Lithuania in 2013.

Bats are impacted by wind turbines as their perching locations, feeding areas and migration routes coincide greatly with siting of wind farms. In general, these are places like lake sides and river sides, hills and mountains at forest areas. Turbines are also attractive for bats for a number of reasons as assumed below:

- With the change in landscape, flying insects find new habitats, which attract bats. Furthermore, some turbine give light at night, attracting insects, which in turn appeal bats.
- Sounds from the turbines attract bats.

- Bats can not visually distinguish turbines from trees.
- Bats resemble air circuits around turbines to those around long trees (Cryan P. et al., 2014).
- Bats generally die by colliding with sharp edges of turning turbine blades, thereby long blades cause more bat fatalities. Internal bleeding may be another reason of fatality as a results of sudden pressure drop behind the blades.
- Tree cutting at construction stages may also cause bat fatalities.

Bats generally migrate during summer months (between August and October). Fewer bats fly in July as it is the month when they are pregnant. According to Rydell et al. (2012), 10% of bat fatalities are in May and early June, while 90% is in August and early November.

Meteorological data can be used in order to estimate bat activities in smaller time periods. Bats generally fly at night and when the wind speed is lower than 6 m/s. They do not fly at rainy weather or when wind speed is higher than 8 m/s (EKOenergy, 2015).

2 STUDY AREA

The Project Area of Hilal 2 WPP is located within the boundaries of Karaman province. Elmadağı and Bademli villages lie to the south of the Project site, and Cerit village to the north. The general vegetation is comprised of juniper trees that define main characteristics of the region, and rare black pine trees (See Photo 1 below).

Photo 1. Juniper Trees around the Project Area

A total of three turbines are present, each with 3300 kWm power generation capacity. Turbine hub height is 84 m blade diameter is 112 m. Project site location is given in Figure 1.

Figure 1. Geographical Location of the Project

3 RESEARCH METHODOLOGY

During the site study on 14 - 15 April 2016 the study team focused on water resources, forest habitats and assessment of bat types and their bio-ecological status. Visual observations have been supported with the use "time expansion" type of bat detection equipment, as well as literature review and discussions with local people.

Bat detection equipment used during the site study include detectors recording bat sounds at night time (BatBox Griffin and Pettersson D500X), detection equipment that converts bat sounds to audible frequency (BAtBox Duet) and another type of bat detector that records in the forms of time expansion (Petersen D 240X).

Photo 2. Installation of Bat Dedectors by the 2U1K Team

BatBox Griffin and Pettersson D500X are full-spectrum equipment and recording time can be set. Recording times have been set to record between sunset and sunrise. Recording periods are shown in Table 1.

Table 1. Recording Equipment and Recording Periods

Bat Dedector	Station No	Date	Recording Period
Pettersson D500X	1	14-15 April 2016	19:30 – 06:30
BatBox Griffin	2	14-15 April 2016	19:30 – 06:30

Special software has been used for showing graphical and sonogram presentations of recorded sounds (BatSound real-time spectrogram analysis software, version 4.2; BatScan version 9.8). Analysis of recorded sounds with these software are shown in Figure 2 and Figure 3.

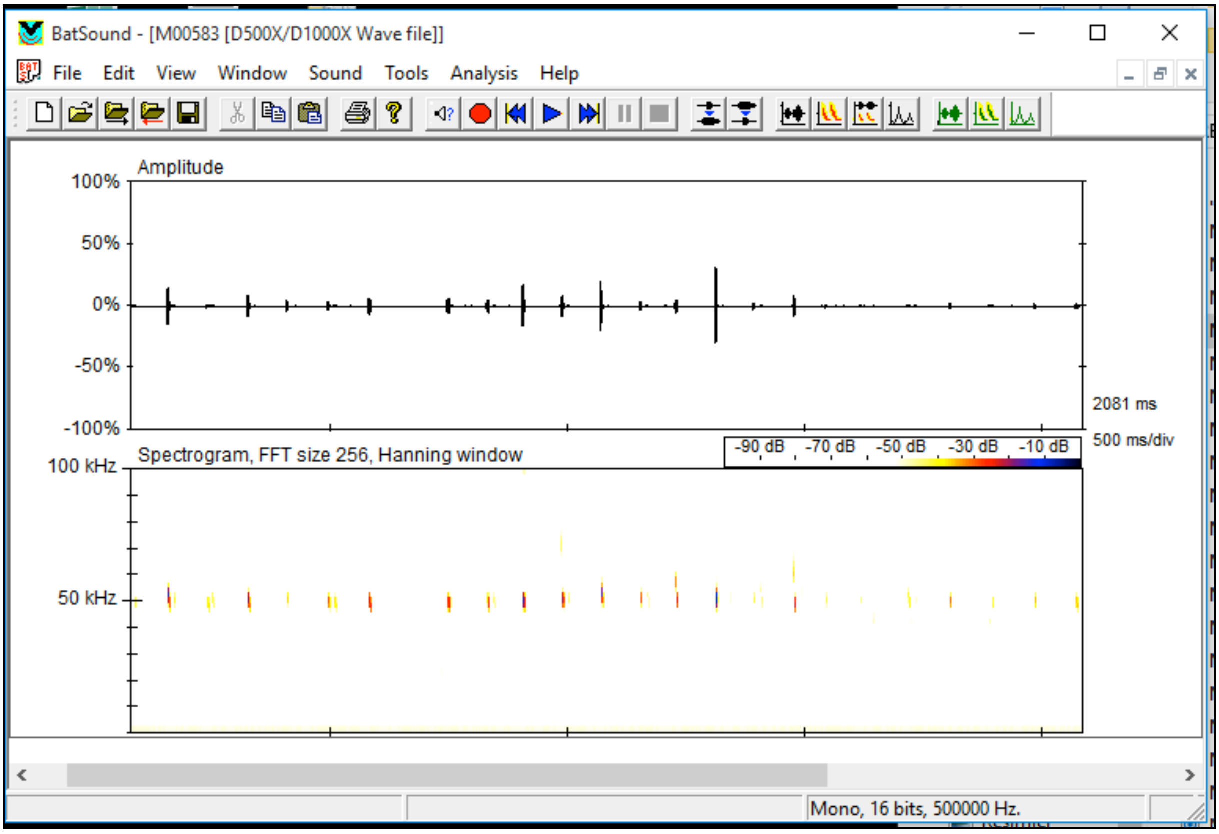

Figure 2. Batsound Software Version 4.2 Used in Analysis of Recorded Sounds

Monitoring Stations

Selection of sound recording stations is significant to represent the impact area of the Project and cover all areas where bat activities can be heard during the transect recording. Transect recording has been made only to understand the general bat fauna of the region.

Table 2. Coordinates of Bat Monitoring Stations

Station No.	Coordinates (UTM)		Elevation (m)	Turbine No.
1	36S 515396 D	4087749 K	1624	1-2
2	36 S 515686 D	4087635 K	1627	2-3

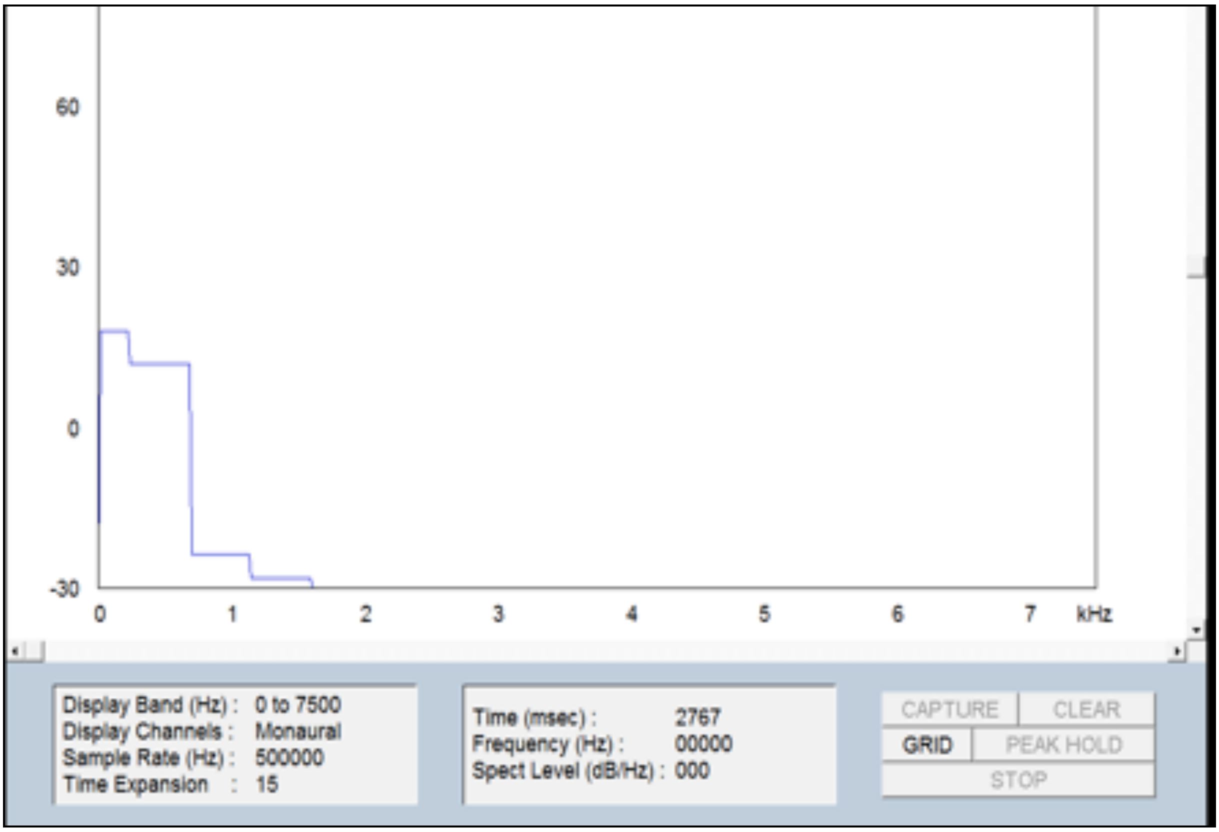

Figure 3. BatScan Version 9.8

4 FINDINGS

The Study Area is comprised of three wind turbines along 500 meters. The study area is small, hence sound recording equipment have been installed between two turbines: one between T1 and T2, and another between T2 and T3. Sonogram graphics of detected bat species are provided in Appendix.

Pipistrellus pipistrellus (Common Pristerelle) has been recorded and other bat types identified from literature and from past experience on the basis of habitat types are *Myotis cf. mystacinus* (Whiskered Bat) and *Nyctalus noctula* (Common Noctule). Table 3 gives EUROBATS' bat species at risk for the Year 2014 in terms of level of collision risk with wind turbines. The shaded cells designate species identified at the Study Area.

Table 3. Level of Collision Risk with Wind Turbines for European and Mediterranean Bat Species

High risk	Medium risk	Low risk	Unknown
Nyctalus sp.	Eptesicus spp.	Myotis sp.	Rousettus aegyptiacus
Pipistrellus sp.	Barbastella spp.	Plecotus sp.	Taphozous nudiventris
Vespertilio murinus	Myotis dasycneme	Rhinolophus sp.	Otonycteris hemprichii
Hypsugo savii			Miniopterus pallidus
Miniopterus schreibersii			
Tadarida teniotis			

Source: EUROBATS, 2014

During the site assessments, conversations with local people have led to identification of caves and rock deposits (See Figure 4). The cave that is located at about 6 km to the Project area is not within impact zone of the Project. Furthermore, no bat colonies or species or feces have been identified in the cave (See Photo 3).

Figure 4. Location of the Cave and the Project Area

Photo 3. Site Observations at a Cave near the Project Area

Carcass Searches

Carcasses have been searched in order to see dead bats from fatalities due to possible collisions and pressure changes. However; raptors, carnivorous mammals and necrophagous reptiles make it difficult to find any carcasses. Thereby it is more possible to see carcasses on concrete grounds at early times of the day.

In this respect, early morning searches on concrete grounds have been performed. Yet no carcasses were found. Site personnel was also interviewed and no carcasses were seen.

Photo 4. Carcass Search (Turbine No: 1 and Surroundings)

Species Sonogram Data

Full spectrum bat recording equipment have been used for a night time assessment. As a result of 22-hours recording, only one bat specie was detected: *Pipistrellus pipistrellus detected at 01:28, possibly attracted by the lighting at the switch yard.*

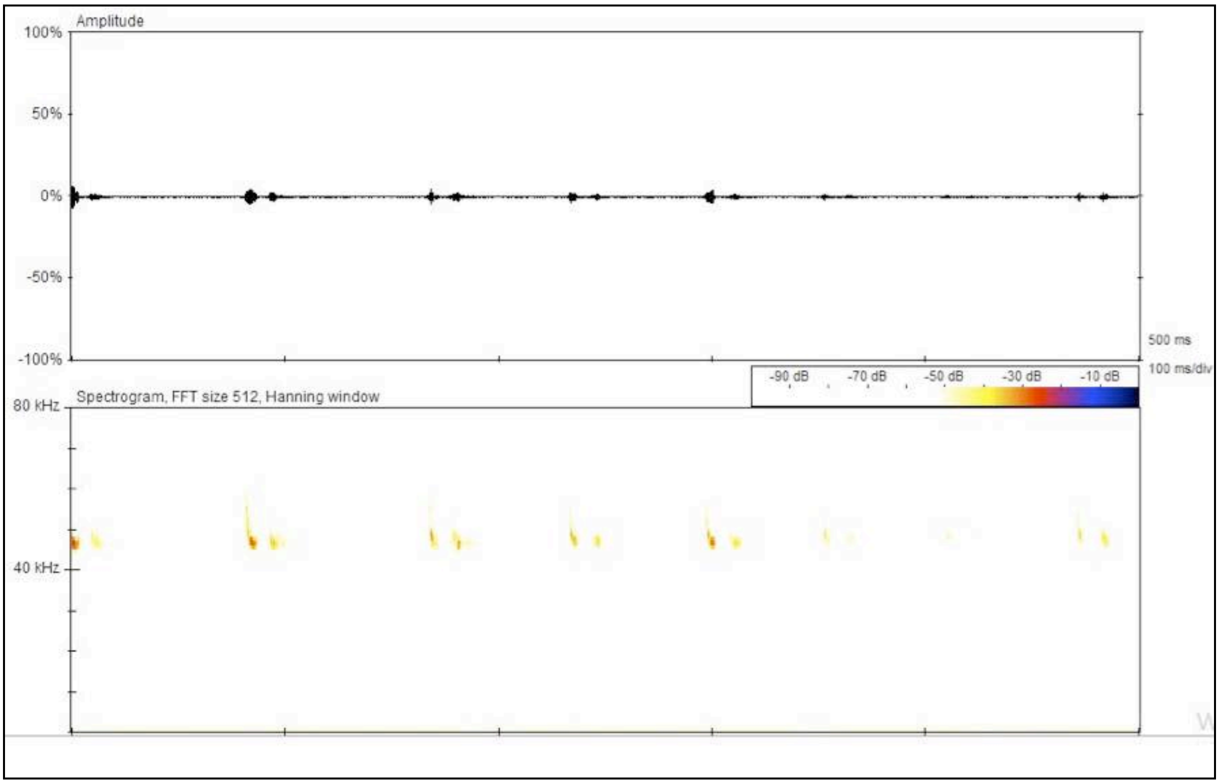

Figure 5. Sonogram Belonging to *Pipistrellus pipistrellus* (Common Pristerelle)

5 CONCLUSIONS AND RECOMMENDATIONS

The number flying bats recorded at the Study Area is considerably low for the season. This is due to the wind speed above 9 m/s. Bats fly at warm nights when at times of wind speed lower than 6 m/s. They do not fly at rainy weather and when the wind speed is above 8 m/s (EKOenergy, 2015). The site study has proven the strong correlation between the wind speed data and bat activities (r= 0,9763). Table 4 shows bat activities at different wind speeds.

Table 4. Bat Activities Predicted at Different Wind Speeds

Turbine Speed (m/s)		Wind Speed (m/s)			
		<3.5 m/s	3.5-5.0 m/s	5.1-6.5 m/s	>6.5
5.0 m/s	Activity	High	Medium	Medium	Low
	Fatality	None	None	Medium	Low
6.5 m/s	Aktivite	High	Medium	Medium	Low
	Fatalite	None	None	None	Low
6.5 >	Aktivite	High	Medium	Medium	Low*
	Fatalite	None	High	Medium	Low*

** Shaded cells comply with the situation at Project Site.*

According to the study above, it can be seen that there are no fatalities when the wind speed is higher than 3,5 m/s and bat activities are high. However, given the very high wind speed at the Project area, number of bat activities are low, accounting for low number of fatalities (Table 5).

Table 5. Average Wind Speeds at the Project Area

Year	Months	Wind Speed Recorded	Wind Speed Calculated
2015	October	11.03	11.04
	November	9.77	9.80
	December	9.94	10.01
2016	January	11.38	11.41
	February	10.23	10.28
	March	9.51	9.56
Averages		10,31	10,35

Table 5 above indicates the very high speed at the Project area, thereby it is anticipated that bat activities are considerably low.

No bats were identified during the carcass search as well. 90% of bat fatalities occur during migrations. Siting of wind turbines should take into account bat migration routes at planning stage, based on studies by bat specialists during migration periods. However, bat migration routes are not known in the country yet. It can be stated that no mass fatalities occurred around the site. The Site personnel should continue with carcass search and at migration periods and low wind speeds, and site personnel should be trained on carcass search.

Carcass search should be performed within a diameter of 50 m around each turbine early autumn during the migration period and for 5 days, as suggested by EUROBAT.

Bat fatalities should be monitored at the Project area. In case of rapid fatalities identified due to migration or another reason, turbine speed should be lowered to 5 m/s. This speed will decrease bat fatalities to a rate of 44-93%. This will contribute to loss in power generation at only about 0.3-1%.

The cave shown in Photo 3 above should be checked during summer months as well and searched for possible locations for perching of bats. In addition, monitoring should be performed from May to September for a minimum of two nights per month, which would be significant to generate data about bats around the Project site.

It is recommended to record wind data during summer months and to conduct a monitoring study during months with low wind speeds.

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Annex-1: Bat Species Identified at Project Area

Cluster	Family	***Species***	**Species Name in Turkish**	**Species Name in English**	**DANGER/PROTECTION CATEGORIES**					
					INTERNATIONAL			**NATIONAL**		
					IUCN	**BERN**	**CITES**	**MAK**	**T-RDB**	**ENDEMİSM**
CHIROPTERA	RHINOLOPHIDAE	*Rhinolophus euryale* Blasius, 1853	Akdeniz Nalburunlu Yarasası	Mediterranean Horseshoe Bat	NT	EK-II	-	EK-1	V	-
CHIROPTERA	VESPERTILIONIDAE	*Myotis mystacinus* (Kuhl, 1817)	Bıyıklı Yarasa	Whiskered Myotis	LC	EK-II	-	EK-1	V	-
CHIROPTERA	VESPERTILIONIDAE	*Pipistrellus pipistrellus* (Schreber, 1774)	Adi Yarasa	Common Pipistrelle	LC	EK-III	-	EK-1	V	-
CHIROPTERA	VESPERTILIONIDAE	*Nyctalus noctula* (Schreber, 1774)	Akşamcı Yarasa	Noctule	LC	EK-II	-	EK-1	V	-
CHIROPTERA	MINIOPTERIDAE	*Miniopterus schreibersii* (Kuhl, 1817)	Uzunkanatlı Yarasa	Schreiber's Bent-winged Bat	NT	EK-II	-	EK-1	V	-