

# ÇAKIL WIND TURBINE FARM Ecosystem Study Report

## INTRODUCTION

An “Ecosystem Assessment Report” for the “Wind Turbine Farm and Other Facilities to be built within the municipal borders of Gemlik borough, Bursa province” was requested from Prof. Dr. Ali Erdoğan, referring to the protocol between Güvenres Enerji Elektrik Üretim A.Ş. and AGM Çevre Enerji AR-GE ve Danışmanlık Sanayi Ticaret Ltd. Şti.

Under the chairmanship of Ornithologist Prof. Dr. Ali ERDOĞAN, the team members Zoologist Prof. Dr. Mehmet Öz (for the assessment of the faunistic structure of the area), Botanist Assoc. Prof. I. Gökhan Deniz (for the assessment of floristic structure of the area) and for the Forest Engineer (MSc) M. Süleyman Kaçar and Biologist Bekir Kabasakal (with regard to wildlife) (Picture 1.) analyzed and assessed the Wind Turbine Farm’s impact on environment and wildlife and prepared this report according to their on site observations during the 2016-spring period (March-April) and by utilizing scientific data acquired from previous observation/researches conducted at the same site (in spring, fall migration periods, and summer season) for different purposes.



Picture 1. (Project Team; left to right Forest Engineer (MSc) M. Süleyman Kaçar, Ornithologist Prof. Dr. Ali ERDOĞAN, Botanist Assoc. Prof. I. Gökhan Deniz, Biologist Bekir Kabasakal, in the background project site)

## 4. STUDY

ÇAKIL Wind Turbine Farm is planned to be built within the municipal borders of Gemlik borough, Bursa province, surrounded by the Çınarcık, Teşvikiye and Termal villages in the north; Narlı, Büyükkumla and Memiris villages in the south; Selimiye village in the west; and Kurtköy and Güneyköy villages in the east, and will contain 14 turbines, a road connecting the turbines, an underground power transmission duct, and a switchgear station.

The impacts which the above mentioned ÇAKIL Wind Turbine Farm project will have on the flora, fauna, landscape, geomorphologic sources and hydrologic sources of this area are

assessed in this report with reference to the observations performed in the area and to relevant literature. The impacts which the turbines, underground and aboveground power transmission cables, switchgear station and road planned to be built in this area and which the maintenance and repair works to be performed on the road will have on local natural resources are assessed in this report (Table 8).

Table 8: Description and surface areas of the ÇAKIL RES structures

Structure	Description	Surface area (m <sup>2</sup> )
Turbines (14 units)	Each turbine will be built on a platform covering 25 m x 25 m (625 m <sup>2</sup> )	8,750
Underground power transmission cable	Approximately 35,000 m long and 0.5 m wide (3500 m x 0,5 m), underground.	17,500
Approximately 35 km road	35.000 m x 6.0 m	210,000
Switchgear station and transformer	500 m <sup>2</sup>	500
TOTAL		236,750

#### 4.1 Floristic assessment

A floristic study performed on the ÇAKIL project site and its surroundings found that eight native plant taxa are living in this area. All of the endemic taxa fall in the Least Concern (LC) category (R7CN 2006). The land surveys performed in this project site and the flora studies performed by other scientists in this area in the past indicate that none of the local taxa is in the list of indigenous or local taxa in danger of extinction (CR), but it is obvious that land surveys to be performed for the whole vegetation period might reveal other taxa. Therefore, the area should be monitored, locations of taxa potentially in risk of extinction should be determined, and similar protective measures should be taken. The above mentioned eight native plant taxa living in the project site and its surroundings are *Eryngium bithynicum* Boiss (milk thistle), *Centaurea consanguinea* DC (bluebottle), *Geropogon hybridus* (L.), Schultz Bip., *Onosma bracteosum* Hausskn. Et Bornm), *Campanula betonici/olia* (bellflower), *Stachys eretica* L. subsp. *anatolica* Rech. (sidentis), *Scrophularia cryptophila* Boiss. Et Heldr. (figwort), *Verbascum parviflorum* Lam. (mullein). All of these taxa are widespread in Turkey and have been recorded in several regions of this country. It is concluded that if the project is built, it will not have an impact on the continuity of these taxa living in the project site and its surroundings.

It is assessed that in general scrub, forest and ruderal types of vegetation are dominant in the ÇAKIL project site. Forest vegetation is dominant in the project site zone where the wind turbines are planned to be built, and is characterized by scrubs, clearings, naturally spread trees and bushes. The dominant taxa forming the coppice scrub-forest character of this area are *Quercus cerris* var. *cerris* (turkey oak) and *Quercus cocci/era* (kermes oak). In various parts of this area the *Cistus creticus* (Cretan rockrose), *Clematis vitalba* (wild bower), *Spartium junceum* (gorse) and *Quercus pubescens* (downy oak) taxa are added in the above mentioned ones. Forest is the dominant vegetation in the central and east parts of the project site. *Fagus orientalis* (eastern beech) is the dominant taxon in said parts. *Fagus sylvatica* (beech), *Carpinus betulus* (hornbeam), *Ostrya carpini/olia* (hop hornbeam) and *Carpinus orientalis* (hornbeam) are added to the above mentioned taxon on the slopes. A sparse group of *Pinus nigra* (black pine) is added to said taxa at the north of Selimiye village. The project

site's parts near Haydariye and Selimiye villages also contain ruderal vegetation due to the previous use of them. Dominant vegetation taxa of the clearings and roadsides of the project site are *Echium italicum* (blue thistle), *Papaver rhoeas* (poppy) and *Convolvulus arvensis* (bindweed).

No local endemic or narrowly spread plant taxon indigenous to this area in floristic terms found. Therefore, it is concluded that the damage to be given to the area by the construction of the project will not put a highly tolerant or cosmopolitan plant taxon in danger of extinction. Therefore, it is concluded that if the project is built, it will have an impact on local flora and habitats only in terms of clearing a small plot of land and will not harm the general vegetation structure of the area.

Diversity and properties of local ecosystem:

Ecosystems present in the project site: Terrestrial (forest, scrub, ruderal) ecosystems.

Sensitivity and rarity of the ecosystems: These ecosystems are wide-spread, and are neither sensitive nor rare.

Protection priority: None of the local vegetation and plant taxa has been given protection priority.

#### **4.2 Faunistic assessment**

The use and preference of habitats by amphibia, reptiles and mammals comprising the faunistic part of wild life depend on an area's properties, especially water and food resources, to meet said animals need of habitation and hiding. The project site and its surroundings are covered with forest stands of such coniferous trees as beech and oak, and said stands are not far from the feeding and dwelling habitats of most of the local active mammals. In this context, the ÇAKIL Wind Turbine Farm project site is located in an area covered by a forest of mixed coniferous trees of beech, oak and hornbeam situated at mountainous topography of a medium elevation (479 to 821 m). There are a number of small perennial brooks within the project site. Local habitats consist of a multi-layered coniferous forest containing bushes and small trees including rhododendron at the bottom and of small clearings covered with bushes and weeds. In this context, it was found that 6 amphibian species, 13 lizard species and 12 snake species, total 31 species live in the project site and its surroundings.

According to the IUCN Convention, 21 of these species are classified LC (Least Concern i.e. the lowest level of danger) and one of them (turtle) is classified VU (Vulnerable i.e. facing the danger of extinction); the remaining 9 species are not classified.

According to the Bern Convention, 17 of these species are classified Annex I (strictly protected) and 9 of them are classified Annex II (protected).

According to CITES, only one of these species (turtle) is protected.

It was found that 34 species of mammal are living in the project site and its surroundings, 33 of them are classified LC (Least Concern i.e. the lowest level of danger) and the remaining one species (lesser mole) is classified DD, but no information is available on said lesser mole.

According to the Bern Convention, 11 of these species are classified Annex II (strictly protected) and 14 of them are classified Annex III (protected); the remaining 9 species are not classified.

According to CITES, only one of these species (grizzly bear) is protected.

The resolutions passed by the Hunting Board in 2015 and 2016 classify weasels and badgers as Annex I (i.e. wild animals selected for protection by the Hunting Board from the list of

game issued by the Ministry of Forest and Water Works), and classify hares, jackals, red foxes and wild hogs as Annex II (i.e. game which may be hunted only in the periods determined by the Hunting Board).

The amphibians living in and around the project site are widely spread species, and the area where the foundations of the turbines and the road are planned to be built are not the habitats preferred by the nocturnal frogs or toads. The area where the foundations of the turbines are planned to be built are included in the habitats preferred time to time by both the local reptiles and mammals for feeding, not for dwelling. The species in question are expected to be disturbed while the turbines and the road are under construction and to leave the area, but the fact that there are plenty of other similar habitats near to and far from the area will minimize the above mentioned negative impact. Water resources, moisty ground and moisty meadows around the project site are also habitats preferred by the local frogs. Some of the local reptiles, especially the snakes, which feed on the local amphibians, are naturally present in this area. Study of the area where the turbines will be built reveals that high winds blow here. The wind in question will cause the body fluids of local animals to vaporize, so that they will lose water fast. Therefore, it is expected that the species directly or indirectly depending on water to survive will not much prefer this area. Taking into consideration that this area is poor in terms of biological diversity because of this fact, the project is not expected to have a negative impact on local amphibians and reptiles if large backwaters are left intact during the construction and operating phases. Considering that the amphibians living in and around the ÇAKIL project site are wide-spread and that only nocturnal frogs and toads live in the area where the foundations of the turbines will be built, said wide-spread and non-endemic species are not expected to suffer a negative impact.

Wild hog is the widest-spread species of local mammals and will not suffer a negative impact due to the towers and rotors of the wind turbines to be built. It is a species having high ecological tolerance and high potential to breed, and its population is quite large. This species is likely to suffer a slight negative impact during the construction phase, but it is expected to tolerate said impact very easy. Although the area where the wind turbines will be built are included in the feeding and dwelling habitats of most of the local active mammals, the area is wide, dense and uniform in terms of structure, and the widest-spread species of them i.e. mice, rats and lesser moles are subterranean species in full contact with earth, so that the towers and the rotors of the wind turbines will not have a negative impact on them. Bother the species in question and the other local small mammals have high ecological tolerance and high potential to breed, and their populations are quite large. These species are likely to suffer a slight negative impact during the construction phase, but they are expected to tolerate said impact very easy.

#### 4.2.1 Bats living in and around the project site and potential dangers

The mammal having the largest impact from wind turbines is the bat. It is known from experience with wind turbines built in this country and other countries that bats die of barotrauma or are killed by directly crashing to them. Data collected by the full-time bat sound recorder installed in Yalova Wind Turbine Farm located 4 to 10 km west of the project site, and the scanning performed by using a hand-held detector in the same farm, as part of the bat-spotting performed there reveal that 9 of the 38 species of bat native to Turkey are living in and around the project site. It is thought that local bats may be active in the Nacakli Brook and the coniferous tree forest located within the project site and may be using especially the old beeches and oaks there to dwell. Furthermore, they may be dwelling in barns, pens and roofs at Haydariye, Selimiye and Hayriye villages located in and around the project site (Figure 57). In terms of basin, the project site does not contain any moisty and deep cave where bats can dwell for among time. Taking these factors into consideration, it is understood whether or the local bats will suffer any negative impact can only be found out by observing them after the turbines are built and unveiled.



Figure 57: An abandoned hut in one of the clearings of the forest located in the project site, where bats may be dwelling.

#### 4.2.2 Ornithological assessment

The turbines to be built in the ÇAKIL Wind Turbine Farm will inevitably have direct and indirect impacts on the local living and non-living things. Industrial facilities having a direct relation with soil, flora and wildlife will have some impact on the local species of bird which use the area as a permanent habitat. It has been found out that 84 species of bird from 33

families from 14 genera live in and around the project site. Most of these species are songbirds. They are observed in and around the project site all year round (Table 5). The project site contains ridges, slight slopes, scrubs, garigue and clearings. Therefore, the songbirds using this area for feeding and resting time to time are not expected to fly up to the blade height of the wind turbines. Only a few bird species live in the project site, including wheatear, butcherbird, hoopoe, crow, pipit and falcon which are wide-spread and have high ecological tolerance. The species of bird living in the sites of the existing wind turbines and in the project site are wide-spread and are not in danger of extinction throughout Turkey. It is observed that such songbird species as towhee, yellowbird, blue paridae, large paridae, bunting, crested lark and jay live at the villages, agricultural fields and orchards located in the south of the project site. The above mentioned species are also observed in the woods located in the west of the project site. Such birds of prey as falcon, red falcon, hawk and kestrel are also observed in the above mentioned woods. It is observed that the birds of prey in question prey on the songbirds living especially in the local deciduous woods. It is also observed that such birds of prey as short-toed eagle, small forest eagle, hen harrier and peregrine falcon stop over and prey while passing through the project site.

The fact that the wind turbines will be built on windy ridges and hills of the mountains in this area, that their foundations will be built on bare ground, and that songbirds fly at low heights will decrease the possibility of them crashing to the turbine blades. On the other hand, such small migratory birds as swallow and swift will be able to migrate by flying between the wind turbines. The ÇAKIL project site is located on topography close to sea level. There are villages and parishes around the project site and they host many species of songbird (Passeriformes), especially in the Spring. Considering that the ridges on which the wind turbines will be built are exposed to strong north wind, the feeding sources for said species are limited there. Therefore, the local species of songbird are not expected to prefer the upper zones containing the wind turbines over the lower zones. On the other hand, interviews with local shepherds, hunters and people verify that white storks stop over on the hills and clearings located in the north of Mecidiyeköy village while they migrate in the Spring and the Fall and that cranes pass over the project site at a height of 1,000 in transit while they migrate (Figure 58).

A study performed on the immigration route of the migratory birds passing through the ÇAKIL project site revealed that such gliding migratory birds as white storks, black storks, cranes, short-toed eagles, small forest eagles, small eagles, black kites, marsh harriers, falcons and honey buzzards take the following routes: Sea of Marmara located in the northeast of the project site-the area located between the coast of Armutlu borough and Yalova Wind Turbine Farm-Fıstıklı; the route over Mecidiye Plains located between the west corner of the project site and Kapaklı village; the route over the northwest corner of the project site-Selimiye parish-Sea of Marmara; and the route on the north-south direction over the valley located between the spots where turbines T1 to T7 and T8 to T14 are planned to be built.

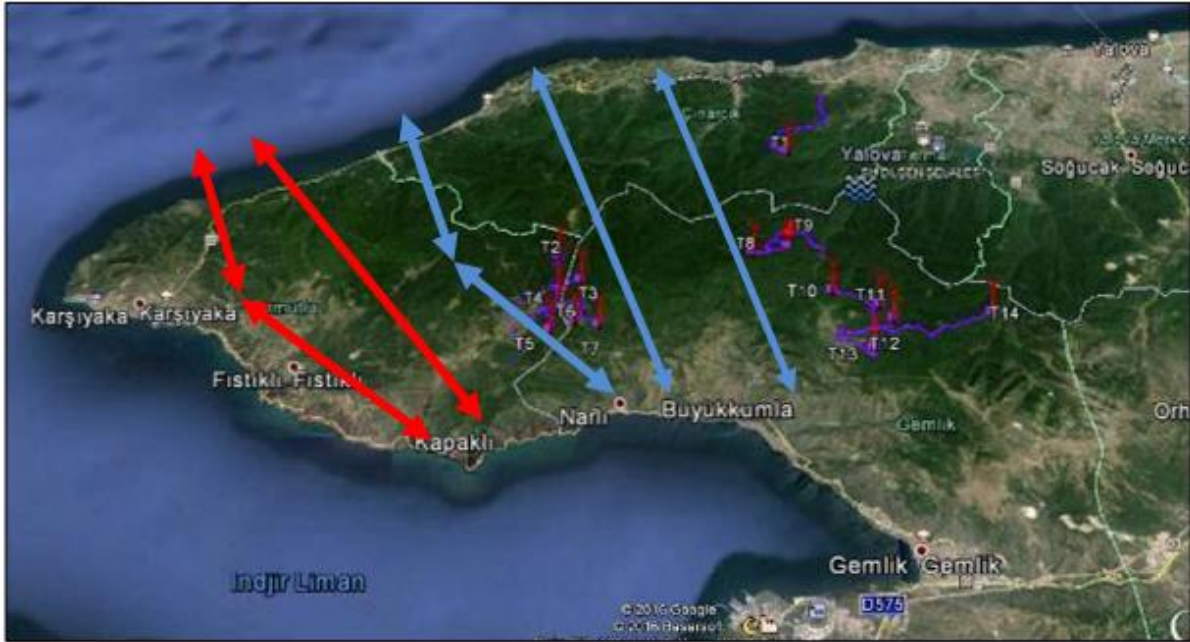


Figure 58: The routes followed by migratory birds over the ÇAKIL project site (blue arrow marks) and its surroundings (red arrow marks).

**Assessment with reference to the Birds of Turkey Red Data Book (Kiziroğlu, 2008):**

7 of the above mentioned species fall in Category A.1.2 defined as species whose populations have decreased throughout Turkey and which are represented by 1 to 10 pairs. These species use the project site and its surroundings to winter or breed. Furthermore, 18 of these species fall in Category A.2, 30 of them fall in Category A.3, 14 of them fall in Category A.3.1, 6 of them fall in Category A.4, and 8 of them fall in Category A.5 (Table 5).

**Assessment with reference to International Union for Conservation of Nature (IUCN):**

The project site and its surroundings host one bird species (turtle dove-*Streptopelia turtur*) in Category VU (Vulnerable) and one bird species (peregrine falcon-*Falco vespertinus*) in Category NT (Near Threatened i.e. not in danger in the present, but expected to fall in Category VU, EN or CR in near future). The project site and its surroundings also host 82 bird species falling in Category LC (Least Concern) (Figure 59).

**Assessment with reference to the Bern Convention:**

Most of the bird species spread in Turkey or passing over this country during migration are protected under the Bern Convention. Therefore 60 of the 84 bird species observed in the project site and its surroundings are strictly protected under Annex II thereof, 18 of them are protected under Annex III, 6 of them are excluded from the Bern Convention (Figure 59).

**Assessment with reference to the resolutions passed by Hunting Board:**

10 species of the wild animals living in the project site and its surroundings are protected under Additional List I issued by the Ministry of Forest and Water Works and it is prohibited to hunt them. 14 of the species protected by the Hunting Board under its Additional List H are observed in the project site and its surroundings. Other 60 species observed in the project site and its surroundings are excluded from said list (Figure 59).

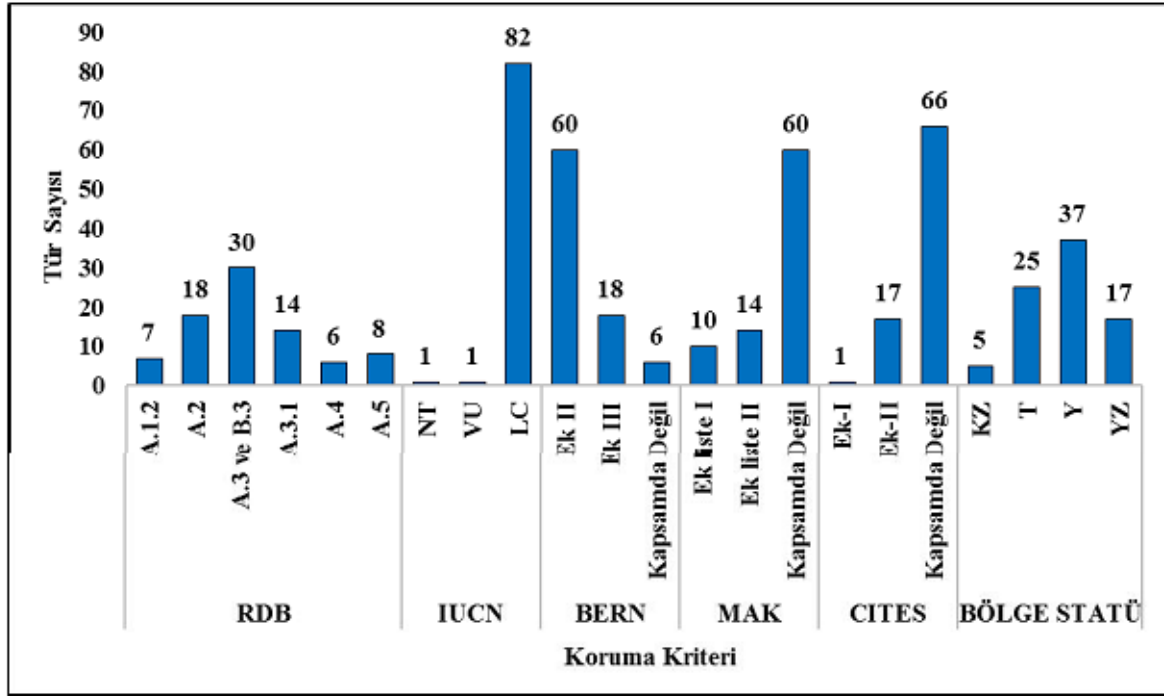


Figure 59. Protection categories and area statutes of the bird species living in the project site and its surroundings

### 4.3 Landscape assessment

The ÇAKIL Wind Turbine Farm project site is located in Armutlu peninsula, Marmara Region of Turkey. The turbine, underground power transmission lines, new road and switchgear station planned to be built and the expansion planned for the existing forest roads will damage the fauna comprising the natural landscape of this site. However, each turbine will cover 625 m<sup>2</sup>, the turbines will be built with intervals 0.8 to 1.1 km between them, and they will be connected with a road. Therefore a plot covering a total surface area of 23.7 hectares will be cleared for the project. The turbines will not comprise a group of structures, so that their damage to the natural landscape will be low. Other items of the natural landscape are the ridges and hills comprising the mountainous part thereof. The turbines will be 80 m tall, so that they will be visible high objects. Therefore it is inevitable for both the turbines and other structures of the project to have impact on the natural, cultural and visual landscape of this area. The turbines and the new road will cover a total surface area of 21.0 hectares.

### 4.4 Geomorphological and hydraulic assessment

The project site is located on a medium elevation in topographic terms, its elevation from the sea level varies between 479 and 821 m. The turbines are planned to be built on ridges extending from north to south in general. Each turbine will be built on a foundation 25 m x 25 m in size and 2 m deep. The new road will be approximately 35 km long and 6 m wide. Therefore neither the turbines nor the new road is expected to change the general topographic structure of the project site.

There is a considerable code difference between the perennial brooks located in the project site and the turbines. Neither the turbines nor the new road is expected to have impact on the local water sources, but the investor must be ensured to undertake to protect the local water sources.



#### 4.5 Assessment in terms of protected areas

Bursa province where the ÇAKIL project site is located contains the protected areas described below.

Two natural parks i.e. Delmece Natural Park situated 1.13 km northeast of Turbine T12 and Harmankaya Natural Park situated 4.4 km southeast of Turbine T1 and 4.7 km northeast of Turbine T9 are protected under the National Park Law no. 2873.

No wildlife development area protected under the Land Game Hunting Law no. 4915 is located in the project site.

No special environmental area protected under the decree no. 90/1117 passed by the Council of Ministers on 22/12/2010 under the Environment Law no. 2872 is located in the project site.

No wetland protected under the Wetland Protection Regulation published in the Turkish Official Gazette dated 30/01/2002 issue no.24656 is located in the project site (Figure 46 and 47). The wetlands nearest to the project site are Iznik Lake situated 14 km east of Turbine T14 and Sea of Marmara situated 3.5 km south of Turbines T5 to T7, 5.6 km south of Turbine T13, and 5.5 km north of Turbine T1 (Figure 60 and 61).

Although two fields protected in different statutes under law are located in the project site, none of them will interact with the project site.

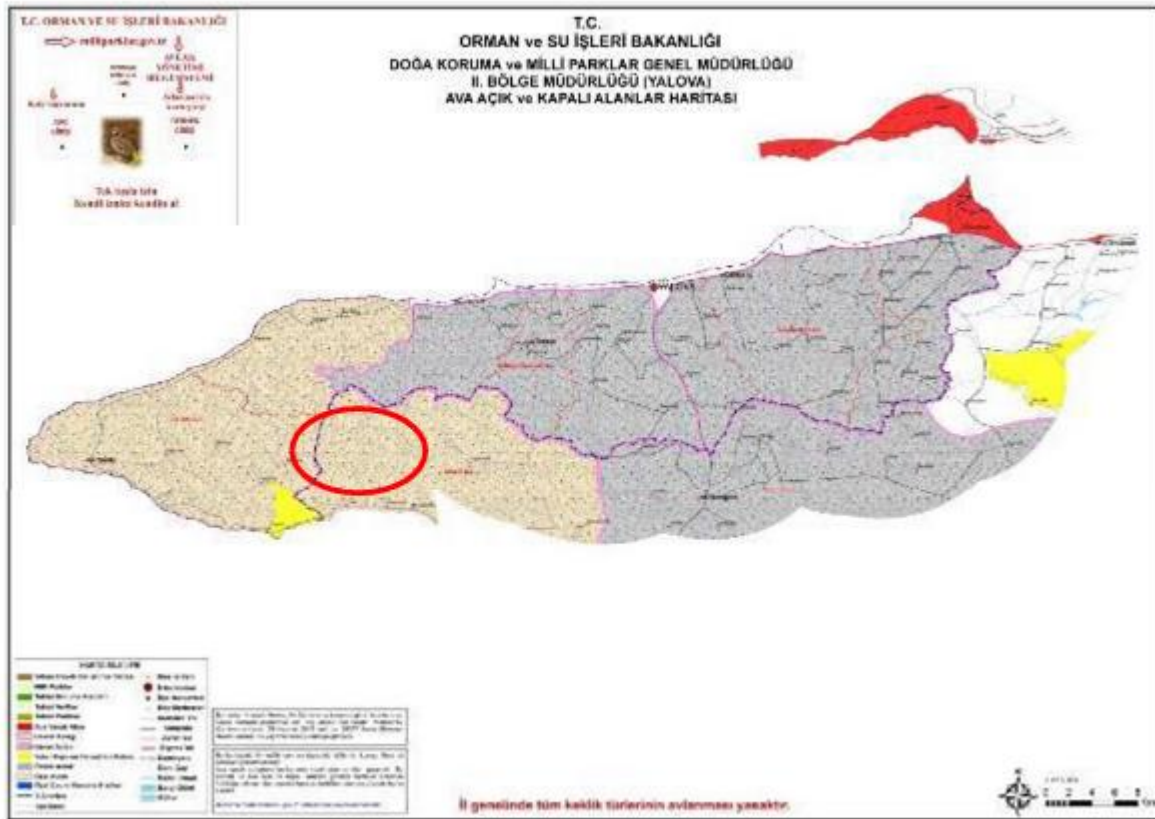


Figure 60. Relation between the project site and the areas protected in Yalova and Bursa provinces.



Figure 61. Map of the relation between the project site and the areas protected in Yalova and Bursa provinces.

## 5. FINDINGS

The 31.55 MW Wind Turbine Farm which Güvenres Enerji Elektrik Üretim A.S. plans to build in Gemlik borough, Bursa province will be situated at an elevation from the sea level ranging between 479 and 821 m. The 14 turbines are planned to be built with intervals 0.8 to 3 km between them on certain ridges extending from north to south. For building and operating the turbines, the existing forest roads will be repaired and maintained and a new road approximately 35.0 km long will be built. Power to be generated by the turbines will be transmitted by an underground cable to a switchgear station to be built within the project site and be delivered through Yalova Transformer Station at 154 kV to the national power grid.

1. Total surface area of the ÇAKIL project will be approximately 23.7 hectares. The whole of the site is located in a forest and its property is owned by the Turkish Treasury Department.
2. Trees and bushes located within the project site will be cut off to build the turbines, underground power cable and new road. The cutting in question will somewhat change both the fauna and landscape characteristics of this area.
3. Most of the project site consists of coppice and woods types of forest, scrubs and ruderal types of vegetation. Several species of plant are available within the project site. It has been found out that 162 taxa of plant from 129 species from 38 families live in and around the project site. 41 of said 162 taxa are Mediterranean phytogeographical region elements, 13 of them are European-Siberian phytogeographical region elements, 11 of them are Iranian-Turan phytogeographical region elements, one of them is Euxin element, and 96 of them are multi-regional or unknown species. Eight of these taxa are native to Turkey. All of said eight taxa are widely spread in this country. It is thought that the project will not exert any pressure on the continuity of these taxa in and around the project site. However, field studies and surveys covering the whole vegetation period must be conducted.
4. Literature does not describe any local endemic or rare species native to the ÇAKIL project site. Therefore it is thought that the damage to be given by the project to this site will not threaten these highly tolerant or cosmopolitan species and the project will not damage the general vegetation structure of the site. In addition to looking the plant species up in the lists described above for floral study, they were assessed in terms of Important Plant Fields and it was found that the project site is not located in any Important Plant Field, but it is obvious

that a land study covering the whole vegetation period will reveal some other species too. Therefore, if such study finds out any species under potential risk, it will be appropriate to move them to near habitats or to take similar protective measures.

5. It is expected that the impact to be had by the wind turbine farm on local plant species will be limited to the area where the construction works will be made. The farm is not expected to have impact on the plant species during the operation stage. The flora lying below the aboveground power transmission cable will not put the cable in any danger and is renewable to a certain extent; and said cable will not damage any habitat. As to the underground power transmission cable, the vegetation around it is expected to renew itself naturally in time.

6. The observations performed in and around the project site, review of literature and interviews with local villagers and hunters indicate that total 84 bird species live here. It is known that most of the songbirds have small bodies in general. Thus they are able to take sudden turns while flying over a limited surface area. The wind conditions and food sources available in the project site are negative factors for these bird species. Therefore, such songbirds as crow, starling and pipit having high ecological tolerance are expected not to prefer the high altitude where the wind turbines are planned to be built over their low altitude. Thanks to being native and fast fliers, they are not expected to suffer from the turbines when they climb to the high altitude due to any reason.

7. The observations, reviews and assessments indicate that 37 of the 84 bird species found here are native, 17 of them are summer visitors, 5 of them are winter visitors, and 25 of them are migrators in transit. The project site is not an important breeding area for any species in danger of extinction. Two of the bird species in question are in danger of extinction: peregrine falcon- *Falco vespertinus* (NT: Near Threatened) and turtle dove-*Streptopelia turtur* (VU: Vulnerable). However, peregrine falcons are rarely seen in and around the project site. Turtle doves are generally seen in the settlements located below the project site.

8. It was found that such gliding migratory birds as white storks, black storks, cranes, short-toed eagles, small forest eagles, small eagles, black kites, marsh harriers, falcons and honey buzzards migrating in large groups take the routes described above for the project site and its surroundings. Furthermore, short-toed eagles, small forest eagles, small eagles, black kites, marsh harriers, falcons and honey buzzards are observed to stop over and pray time to time around the project site.

9. Traffic between the turbines to be built in the project site will be provided by repairing and extending the existing roads and building a new road 35.0 km long. To lay the underground power transmission line between the turbines and to build the new road, local fauna will be cleared, so that wild life will lose some of its habitats. However, this loss will be limited with the project site area of 23.7 hectares, and the fact that a limited number of vertebrate animals use the site as habitat will decrease the negative impact of the project.

## **6. SUGGESTIONS**

All kinds of man-made structure can potentially have negative impact on native species and, if they are along a migration route, on migratory species. Considering that this country needs energy, it looks more rational to rather take certain measures to remove or minimize the potential risks than abandon the wind energy. Therefore, the potential risks of the ÇAKIL project, the measures that must be taken to prevent said risks and the matters that must be taken into consideration are explained below.

1. The land vertebrate animal species which are potentially most vulnerable to a wind turbine farm are birds and bats. In order to prevent the risks that may be caused by the wind turbine farm or to minimize the negative impact of it, the wind turbine farm and its blades must be made visible, noticeable and even cautionary the most vulnerable species of birds and bats. For this purpose, the turbine columns and blades must be painted in a special way. The turbine columns are painted in white, grey or silver in general. This application is widely used in the worldwide. These light color tones make the turbines easily noticeable on land. Visibility of turbines is very important for flight safety and for migratory birds. To increase their visibility, it is important to paint the ends of the blades in a color contrasting white. Therefore black or other dark tones close to black are used as the highest level of contrast. On the other hand, yellow and orange are easier to notice in fog. The last point is birds' sensitivity to orange. Birds can perceive orange much easier and from long distances. Because of these reasons, 1/3 of the blades must be painted from their ends in a color visible and noticeable to birds from far. It is suggested to paint them in orange. It is very important to make the turbines visible especially for bird species migrating at night. Color is not an important factor for birds flying at night, so that both the array and lighting of the turbines are important. Lighting does not refer to lighting the whole of each turbine. On the contrary, experience gained in some countries in the past indicates that wind turbines illuminated all through the night become easily visible attraction points for birds, attract birds and increase the number of crashes. Therefore, the whole of each turbine must not be illuminated. It will be better to install lamps on the highest point of the turbine column, where the generator is housed, preferably under the generator. Said lamps should flash white at daytime and red at nighttime, or a set of white and red lamps must flash on and off at certain intervals day and night, and their power must be high enough to make them visible and noticeable to birds at day and especially night (Erickson et al, 2001; Gehring et al, 2009; Howe et al, 2002).

2. Considering that the ÇAKIL project site is located on routes of certain migratory birds, it is suggested to perform ornithological monitoring here to find out the potential impact of the project operations on migratory birds. Such monitoring must be performed for at least two years before, during and after the construction works and determine the changes occurring at the end of said period. The monitoring in question must collect the data described below by all means:

- Species of the birds using the project site and danger categories for them
- The purpose of the birds to use the project site
- Distinguishing the species migrating over the site from the species using the site for a long time
- Flight heights of the local species, their flight distances from the turbines, and their flight corridors
- Local thermal air currents, climatic data and gathering areas by bird species
- Populations of the bird species using the project site

Details of the methodology that must be employed to collect the data described above are as follows:

**Materials:** Binoculars (7X50; 8X40; 10X46), telescope (20-45X) and tele-objective camera (200-500 mm; 35-420 mm objective) to identify the bird species living in the site and migrating over the site, tape meter and GPS device to measure the locations of dead birds, compass and 1:25.000 contour maps.

Pre-printed observation and scanning charts containing simple diagrams showing the locations of the wind turbines can be used for recording the data collected in the field during scanning and monitoring.

**Method:** In order to identify the bird species living, breeding, feeding or praying in the project site or migrating over the project site, monitoring should be performed at a spot where all wind turbines can be observed. The above mentioned identification can be made by two observers monitoring the site from 08:00 a.m. to 06:00 p.m. using naked eye, binoculars and telescope. After the turbines were built, a 100 m radius of each turbine should be scanned three times a day i.e. morning, noon and evening to find out whether any birds were killed or injured by crashing to the turbines. The spots, distance to each turbine, species, number and reason of death or injury of dead or injured birds spotted this way must be noted in scanning cards.

After performing the tasks described above, data must be collected on the numbers of birds killed or injured by the wind turbines, the numbers of the bird species native to the project site and migratory bird species using the project site, their migration seasons and routes, their flight altitudes, and their distances to the wind turbines.

The monitoring described above should be performed by a team coordinated by a specialist ornithologist in semi-annual periods (January to June, July to December) and more intensely in Spring (March to April) and Fall (late August or September to October). Data collected during the monitoring must be presented every six months to Area Directorate II in Bursa and to General Directorate of Nature Protection and National Parks.

3. Although there are no caves or caverns in and around the project site for bats to live in large groups, it is thought that local bats may dwell in the Nacakli Brook and the coniferous tree forest located within the project site, especially the old beeches and oaks there, to feed, and may be active in local settlements and their surroundings. Data collected by direct observations at night, using the full-time bat sound recorder installed in Yalova Wind Turbine Farm located in the west of the project site, and the scanning performed by using a real time hand-held detector in the same farm reveal that 9 bat species (*Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Myotis myotis*, *Myotis emarginatus*, *Nyctalus noctula*, *Eptesicus serotinus*, *Pipistrellus pipistrellus*, *Pipistrellus kuhlii*, *Hypsugo savii*) live there. Whether or not the ÇAKIL project will have impact on these bat species can only be found out by observing them when they are active.

4. Maximum care must be taken to protect the natural structure of the site during the construction stage. No permanent change must be made to the natural structure except for the roads and construction sites. Heavy duty equipment and vehicles must be parked away from the forest, and more than one area must not be used as construction site.

5. There are no underground or aboveground water sources in or around the project site. The turbines to be built for the project will not have impact on any water sources. However, the investor must be ensured to undertake to protect the local water sources in case of any danger.

## 7. CONCLUSION

GÜVENRES Enerji Elektrik Üretim A.S. plans to build a wind turbine farm consisting of 14 turbines generating a total power of 31.55 MW in Gemlik borough of Bursa province located in Armutlu peninsula of Marmara Region. The ÇAKIL project in question is planned to cover 23.7 hectares and to generate a net power of 116,000,000 kWh/year. Although the turbines

and other structures to be built for the project are not expected to have a considerable impact on the local native bird species and migratory bird species on the condition that the suggestions described above are followed, it is known that such gliding migratory birds as white storks, black storks, cranes, short-toed eagles, small forest eagles, small eagles, black kites, marsh harriers, falcons and honey buzzards migrating in large groups take the routes above the project site and its surroundings to migrate, and that short-toed eagles, small forest eagles, small eagles, black kites, marsh harriers, falcons and honey buzzards are observed to stop over and pray time to time around the project site. Therefore, it is suggested that ornithological monitoring should be performed for at least two years before, during and after the construction works.

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