ARAB REPUBLIC OF EGYPT

MINISTRY OF ELECTRICITY AND ENERGY

NEW AND RENEWABLE ENERGY AUTHORITY (NREA)

# Environmental and Social Impact Assessment Study
# 1,000 MW Wind Farms
# at the GULF OF SUEZ

**financed by**

KfW-Entwicklungsbank

**October 2011**

PREPARED BY THE JOINT VENTURE

LAHMEYER INTERNATIONAL GMBH, BAD VILBEL AND

ECODA DR. BERGEN & FRITZ GBR, DORTMUND, GERMANY

JV LI - ecoda

CONTENTS

## Annexes

Annex 1: Ornithological Investigation Study

Annex 2: Project Design Document for early Stakeholder Participation (English & Arabic)

Annex 3: Correspondence related to early Stakeholder Participation

Annex 4: Non Technical Executive Summary (Arabic)

Annex 5: Documentation of Public Hearing

## ABBREVIATIONS

| | |
|---|---|
| AFD | Agence Française de Développement |
| a.s.l | Above sea level |
| CAA | Competent Administrative Authority |
| EA | Environmental Assessment |
| EC | European Commission |
| EEAA | Egyptian Environmental Affairs Agency |
| EEHC | Egyptian Electricity Holding Company |
| EETC | Egyptian Electricity Transmission Company |
| EA | Environmental Assessment |
| EIA | Environmental Impact Assessment |
| EIB | European Investment Bank |
| EMP | Environmental Management Plan |
| EU | European Union |
| GoE | Government of Egypt |
| GPC | General Petroleum Company (or Corporation), Ministry of Petroleum |
| GUPCO | Gulf of Suez Petroleum Company |
| HV | High Voltage |
| HT | High Tension (e.g. 220 kV) |
| KfW | Kreditanstalt für Wiederaufbau |
| LC | Local currency (EGP) |
| LDC | Load Dispatch Centre |
| LT | Low  Tension |
| MEE | Ministry of Electricity and Energy |
| MOP | Ministry of Oil and Petroleum |
| MT | Medium Tension (e.g. 22 kV) |
| NREA | New and Renewable Energy Authority |
| OHL | Overhead Line |
| TL | Transmission Line |
| WT | Wind Turbine |

# 1. NON TECHNICAL EXECUTIVE SUMMARY

## 1.1 INFORMATION ON THE PROJECT

### 1.1.1 Objective and Scope

For an area of 200 km² ("ESIA AREA") about 15 km inland from the Gulf of Suez near Ras Gharib the Environmental and Social Impacts of wind power utilisation with up to 1000 MW installed capacity had to be studied. This area is part of a total area of 1229 km allocated by presidential decree of May 13th, 2009 to wind power utilisation. The area was proposed by the National Centre for Land-use Planning and was approved by the Council of Ministers. Thus, it can be assumed that assessment of alternatives had already been considered.

The wind power development is coordinated by NREA. The area shall be split into different individual project zones with buffer corridors. Individual projects intended in this –ESIA area" are a BOO project of a private investor as well as public projects financed by European development partners (EU, EIB and AFD) under the lead of KfW and by Governmental Lenders from Abu Dhabi and Spain. The final configuration is subject to further discussions to be based on the results of this ESIA study. Nevertheless, it is the objective of this study to describe the future wind power utilisation in the area as realistic as possible to limit additional efforts for getting the environmental permit for the individual projects.

The objective of wind power utilisation in this area is

- to make use of the excellent wind power potential at the site, and in the same time
- to substitute oil and gas for electricity generation and to safe indigenous fuel resources, and
- to safe $CO_2$ emissions.

The assessment of environmental and social impacts caused by wind power development is targeting

- to determine any likely significant impact caused by wind power development in the area,
- to assess, whether such impacts can be mitigated or whether they require a restriction or a cancellation of wind power development,
- to define eventually necessary mitigation measures and environmental management (EM) requirements, and
- to assess the effects of possibly required mitigation and EM measures with regard to the overall viability of wind power development in the area.

This ESIA study follows the Egyptian Environmental laws, regulations and guidelines. In the same time it is considered that the minimum standards of the Equator Principles are kept. This is to fulfil the financing conditions of international financing institutes as most of them have committed themselves to keep the Equator Principles as minimum environmental standards.

Major elements of the assessment were field surveys such as general area reconnaissance, ornithological field monitoring over spring and autumn migration period, and a representative survey on flora and fauna (others than avifauna). By early public participation the stakeholders were invited to comment. This included one Bedouin family living at a water pumping station within the area.

## 1.1.2 Wind Power Development in the 200 km² ESIA Area

The location of the project area can be seen from Fig. 1.1. It is located on the western bank of the Gulf of Suez, 120 km in the North of Hurghada and 10 to 15 km to the West of the Hurghada – Suez Road. The distance by road to Cairo is about 350 km. The boundary coordinates are given in Table 1.1.


**Fig. 1.1:** Location of the “1,000 MW Project Area”

**Table 1.1:** Boundary Coordinates of the 1,000 MW Project Area

| Border Co-ordinates | GEOGRAPHICAL COORDINATES (DATUM: WGS 1984) | |
|---|---|---|
| 23 | 28°11'8.34"N | 32°56'45.77"E |
| A6-3 | 28°12'55.38"N | 33° 6'32.66"E |
| 21 | 28° 5'27.50"N | 33° 9'14.00"E |
| 20 | 28° 7'28.50"N | 33° 8'13.50"E |
| 17 | 28°12'36.40"N | 33° 6'29.86"E |
| 22 | 28° 3'25.43"N | 33° 5'4.02"E |
| 19 | 28° 9'59.00"N | 33° 6'8.50"E |
| 4 BOO | 28°10'37.56"N | 33° 2'2.88"E |
| 18 | 28°10'40.96"N | 33° 8'6.67"E |
| X2 | 28°15'10.88"N | 32°59'28.54"E |
| X3 | 28°11'53.33"N | 32°55'45.54"E |

More details on the location can be seen from Fig. 1.2. The area is about 20 km away from Ras Gharib. It is partly located in the West of wind parks already under development such as an European financed Wind Park of 200 MW, a Japanese financed wind park of 220 MW and a private developed wind park of Italgen of approximately 100 MW in the South-East.

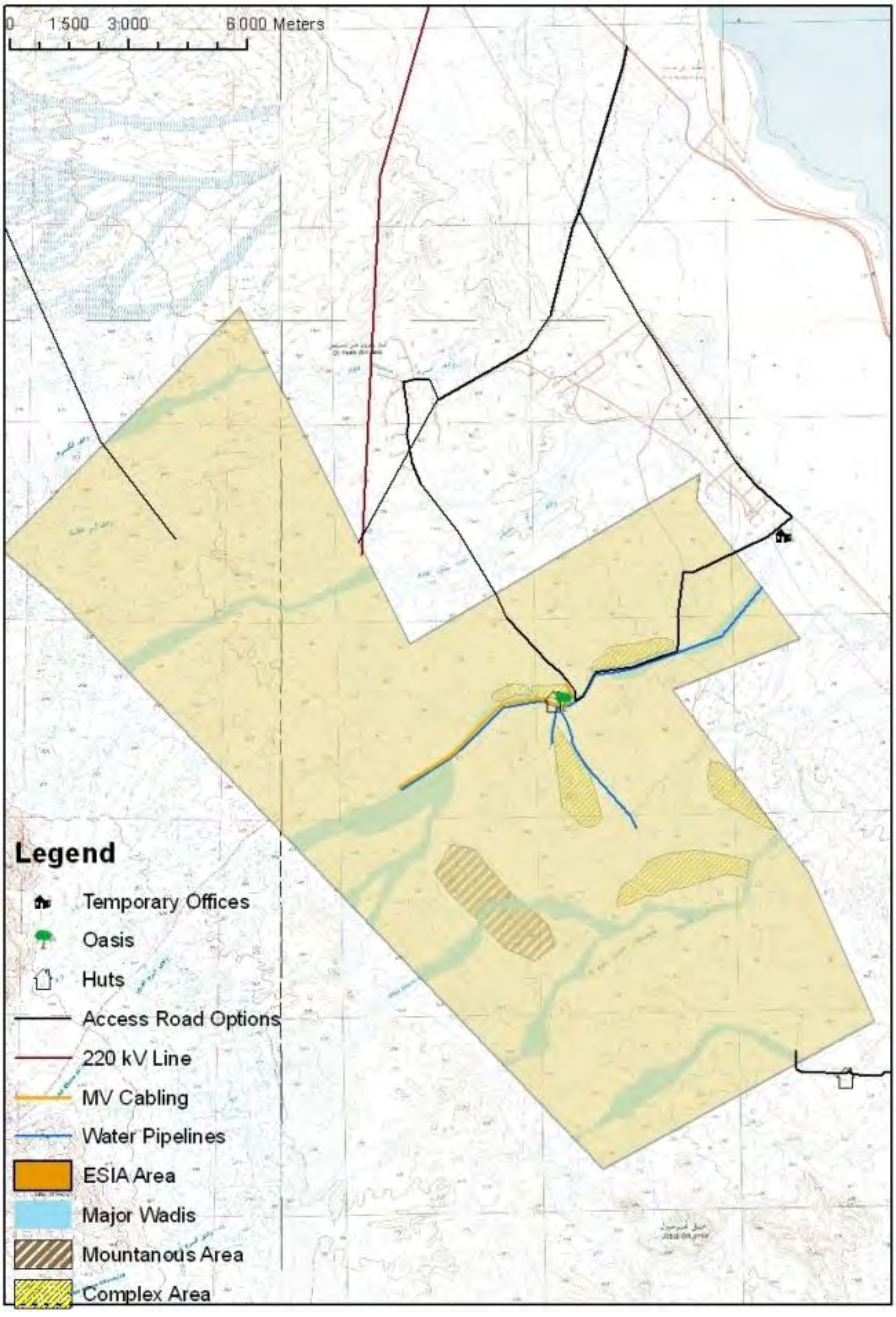



**Fig. 1.2:** The ―1,000 MW Project Area" with possible Access Road Options

The area can be accessed via asphalt roads owned by the General Petroleum Company (GPC) of about 4 m width from the Ras Gharib area in the Northeast and via an earth road which was built by the JIAPCo Oil company in the Southeast. Alternately an access road from the public road Ras Gharib to the Nile Valley would need to be built.

The design lifetime of wind power plants is 20 years. According to the predominating wind direction, wind power would be developed in south-west to north-east rows at distances of about 600 m to 1 km and distances between turbines within a row of about 200 to 300 m. An example for a configuration is given in Fig. 1.3

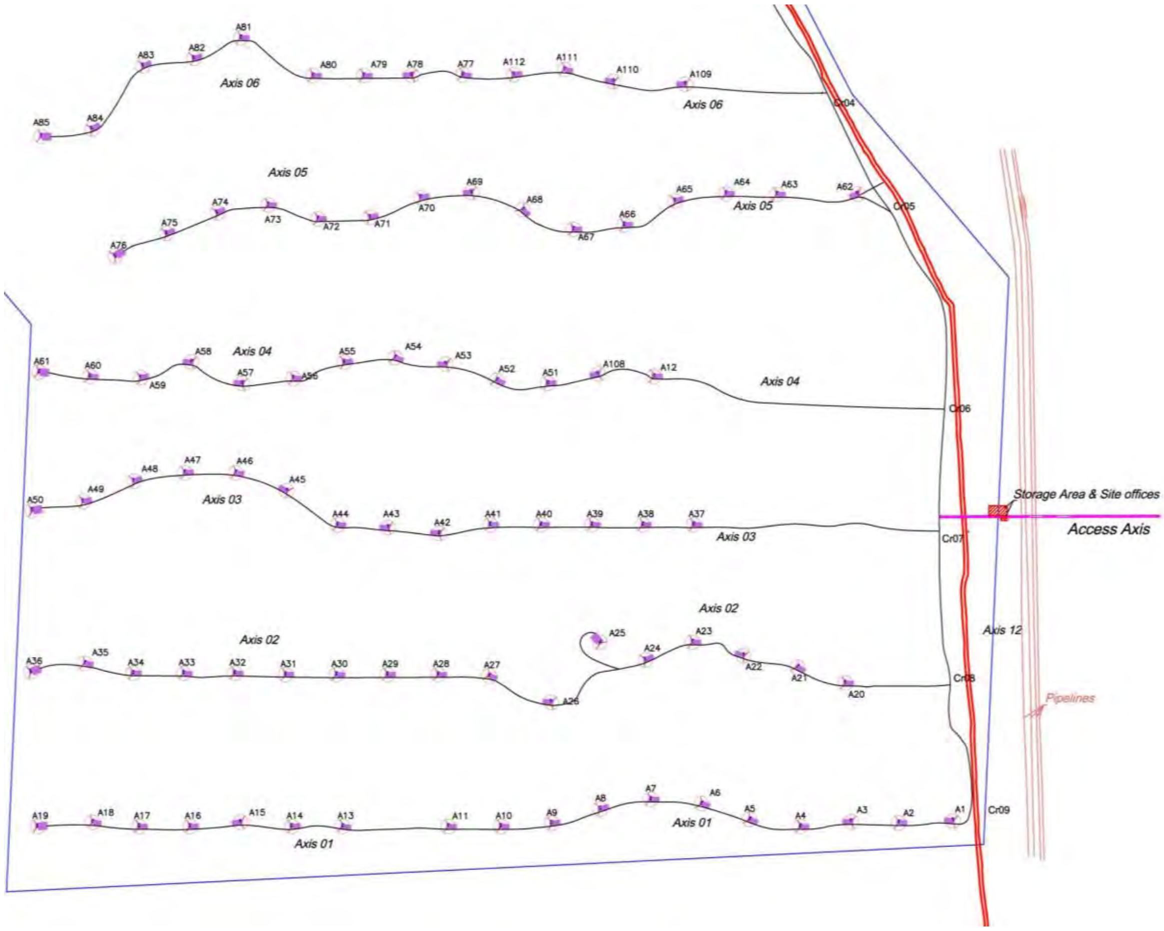



**Fig. 1.3:** Typical Arrangement of a Wind Park including Cabling

Wind turbines with unit capacities of about 0.8 to 2.5 MW, rotor diameters of 52 m to 90 m and max tip heights of 80 m to 120 m are likely to be selected. Other typical features of such a project are the wind turbine foundations of about 2 to 3 m depth and a surface of up to 15 x 15 m² in case of a large turbine (2 to 2.5 MW), wind turbines with tubular towers with diameters of up to 4.5 m at the footing and maximum blade tip heights of about 120 m (allowing wind turbine unit capacities of up to about 2.5 MW). The wind park internal grid consists of cable trenches and small kiosks next to each wind turbine comprising of ring main station and transformer and controller stations, if the latter will not be integrated into the turbines. Further major features are the wind park internal earth roads of about 5 m width and erection platforms of 1,000 to 2,000 m² at each wind turbine.

**Fig. 1.4:** Typical Arrangement of Kiosks and Cabling at each Wind Turbine

The wind power collected by the MT cable grid has to be evacuated via a new transmission line to be built. This ESIA study considers preliminary information on a new 500/220 kV substation to be built in the Ras Gharib area. Accordingly, a central 220 kV substation at a central location of the 200 km² project area is considered for evacuation of the wind power. In the absence of detailed information on the new location of the 500/220 kV SS the routing of the 220 kV TL is only tentatively indicated. Moreover, at this stage of project preparation it is assumed that such service areas (for control and maintenance including spare part and tools stock) will be built at the border of the area, e.g. near to a 220 kV substation or in Ras Gharib, for being interconnected to the LT network.

**Fig. 1.5:** Visualization of a wind park in the ―ESIA Area"

Only very limited land on a wind park site is affected by construction works. The construction area per MW installed is estimated to be 3,900 m². I.e. less than 3 % of the overall area is affected by construction work.

In addition, service and control room facilities will be required. Control may take place by remote control routed through a central wind park server. Such Wind Park Server may be established in a small container within the wind park site next to a wind turbine or within the 220 kV onsite substations. Service and storage facilities with accommodation facilities of the different investors most likely will be installed outside the project area in reach of water and electricity supply, e.g. in the outskirts of Ras Gharib.

Usually such service installations consist of an apartments building, a central facility (conference room, mosque and cantina), a storage premise (e.g. 30 x 20 m), an open storage area and a small control and office building. Water will have to be provided by tanker or through interconnection to the water supply system. The number of persons living & working in the area in shifts to operate and maintain the wind park would be not more than 30 for a wind park size of about 200 MW. I.e. the total number of personnel for O&M of the wind parks is estimated to be 100.

Further installations associated to the wind farm would be one or two MT/220 kV substations in the ESIA area and the 220 kV overhead-line interconnection to a 500 kV substation near to Ras Gharib to come. As such interconnection will be built especially for the wind power interconnection, it is considered as part of the wind power project.

## 1.2 EXISTING ENVIRONMENT

### 1.2.1 Features except Fauna and Flora

The –ESIA area” had been investigated during a site reconnaissance with the focus on all environmental aspects except for Fauna and Flora. For the latter separate field investigations had been carried out. The –ESIA area” is a desert area without any vegetation, except small spots of isolated vegetation at Wadi banks or in major Wadis. The area is crossed by major Wadis. The watersheds of the Wadis extent to the Gabel Ras Gharib Mountain of about 1,750 m a.s.l. The Wadi cross-sections have a pronounced profile. The big dimensions of the Wadis and erosion channels in the Wadi beds are evidence for discharge in the Wadis that occur from time to time.

| | |
|---|---|
| Average maximum Temperature | 20° C (January) to 33 °C (August) |
| Average Temperatures | 15° C (January) to 29° C (August) |
| Average wind speed at 50 m | about 10 m/s |
| Maximum Gust | about 35 m/s |
| Rainfall | very sporadic, hyper arid area |

Further characteristics of the area can be summarised as:

- **Land use:** Land use within the project area is limited to a system of water wells with the related infrastructure such as pumps, pipes, MV electricity supply and roads almost in the middle of the project area associated with a few huts (one Bedouin family of about 20 persons) formed out of palm tree leaves and an irrigated palm-tree garden of about 50 x 70 m. Outside of and adjacent to the eastern part of the area oil production takes place at distances of about 1000 m from the border.

**Fig. 1.6:** Water pumping, water pipeline, buried MV cable and access road

**Fig. 1.7:** Man made ―Oasis" irrigated by pumped water

- the area does not contain any **habitats** of significance (natural or man made) for flora and fauna except the palm tree garden in the Centre of the area.
- Missing vegetation except few small desert grasses at Wadis and very scarce fauna (except birds); no rare or endangered species; the area is near to a major bird migration route with endangered and protected birds. A considerable number of migrating birds were observed during the spring season 2010 passing the area.
- **Infrastructure:** The project area has no infrastructure except asphalt and gravel roads to the water wells with the associated electricity supply, water pipelines and water pumps operated by GPC. Access to the area from the Suez- Hurghada road (a four lane road) via GPC owned 4 m wide asphalt roads and some unpaved roads, that would need to be reinforced; alternately access by earth road to be built from the Ras Gharib – Nile Valley road in the North (see Fig. 1.2).
- Not any utility services in the area; the transmission water pipeline (Nile water) is routed on the western side and in parallel to the Suez – Hurghada road, i.e. about 7 km away from the nearest border of the study area.
- The next settlement is the outskirts of Ras Gharib at a minimum distance of 13 km from the north-eastern border of the project area.
- The area does not contain any **historical sites** or **environmental protection**

**areas, or is located inside or nearby a protected area**.

- Not any antiquities or other sites of historic and cultural significance in the overall area.
- No **surface water** except discharge in the major Wadis that may occur quite seldom.
- **Groundwater:** More than 100 m below surface
- **Geomorphology and Geotechnical** conditions: Most of the area consist of plains (more in the North) and undulated land (middle and South); one mountain range in the Centre with about 100 m above surface is not suitable for wind park construction; The level of the whole project area ranges from 50 m a.s.l. in the East to 250 m a.s.l. in the North-West; Most of the area is covered with compact angular gravels and pebbles forming a so called desert armour. Stable underground, good foundation conditions; area is not affected by fault lines, no special earthquake risk.
- Littering of **waste** originating from far away, such as plastic bags or packing material, which is blown by the northern winds through the desert.
- **Air quality** affected by dusts having their origin in the desert itself and caused by strong winds; no acidic emissions from flare gas burning or unburned flare gas from the near-by GPC oil field were realised, as wind is generally not blowing from the oil fields in the North-East.
- **Natural high noise level** during frequent strong winds; no man made noise emissions in the area, except that from water pumping.
- **Landscape:** The landscape shows typical desert areas of extended plains, undulated –dune" and mountainous areas. It has no specific character that need to be maintained.

### 1.2.2 Flora and Fauna – plants and animals (except birds)

A separate study on plants and animals was carried out during periods of 3 to 4 days, each in spring and autumn 2010, by local experts (EcoConServ).

The study on plants was restricted to areas surrounding existing tracks, sites used for the bird study (Fig. 1.9) and to paths used to reach these sites. In a first step the study area was scanned for spots with vegetation using binoculars. Located spots were investigated in more detail. Moreover, several site visits to record and map plants in spring 2010 were conducted by experts of the bird monitoring team.

With regards to the study on animals, the local expert slowly drove along the paths several times in search of present animals. At certain locations the surrounding was scanned for animals and studied in order to find burrows or scats that indicate the presence of animals. Moreover, additional data on animals was gathered during the monitoring of migrating birds (ornithological field study). Additionally, two inspections restricted to the surrounding of the oasis were done at night using special detectors to investigate the presence of bats.

Finally a review of the literature and available databases relevant to plants and animals of the study area was done.

## Plants

Only a few plant species occur in low numbers of specimen in the study area, mainly restricted to depressions and Wadis. Plants found in the monitored area were mostly limited to loose groups of *Ochradinus baccatus* (e.g. near observation sites C, D, and G) or single individuals of *Zygophyllum coccineum* and *Haloxylon salicornicum*. The only not cultivated, i.e. naturally occurring trees found in the area are some stands of *Acacia tortilis* ssp. *raddiana* (near the oasis, near observation site E and F). Other species rarely occurring within the study area are *Stipagrostis plumose*, *Cyperus conglomerates*, *Handal* or *citrullus colocynthis*.

In addition to scarce natural vegetation, there is cultivated land, i.e. an oasis in the eastern part of the study area. This constitutes a green area less than 2,500 $m^2$ in size. The oasis represents a very important resting point for desert cruises and has created an artificial shelter or habitat for a relatively high number of species, including birds, seeking food, water and shadow. This land is cultivated with unorganized typical farmland plants such as date palms, olives, date and a few other field crops.

Additionally, water pipelines of GPC oil company are found around this area. A number of patches of vegetation are found around the sources of minor leaks from these pipelines.

The results clearly show that the importance of the study area for plants is very limited. The study area does not harbour endangered plants or plant communities. Plants that have been found are common and widespread.

## Animals

Few mammals have been documented in the study area during the field work, indicating that species richness and numbers of specimen are very low because of the harsh living conditions in the desert. During site visits at night no bats were detected.

A total of 13 species of reptiles occurred more or less regularly within the study area: six different gecko species, three agamid species, two lizard species and two snake species (a colubrid and a viper). A colony of Egyptian Dabb Lizard was found with about ten to fifteen individuals near a track running from site H to the North and also south of site H (Fig. 1.8). Several individuals were regularly seen roosting outside their burrows or feeding on vegetation. In autumn a pair of Lizards was recorded which took care of two offspring.


**Fig. 1.8:** Areas with regular occurrence of Egyptian Dabb Lizard near site H

No thorough study of the insect fauna was performed, yet brief examinations prior to or after bird observations did not reveal any relevant occurrence of insects. Nevertheless, flies temporarily are abundant in the area. Migratory insects were also encountered during field work in few hoverfly, butterfly and locust species.

The results clearly show that the importance of the study area as a habitat for animals is rather limited. The Egyptian Dabb Lizard is classified as near threatened in the worldwide Red List of Threatened Species (by IUCN; Cox et al. 2006). All other animals are considered as to be of least concern.

### 1.2.3 Birds

Background and objectives

The Gulf of Suez, in particular the area near Gabel el Zayt, is well known as a bottleneck for migrating birds. Large numbers of birds pass the area twice a year during spring and autumn migration. Previous studies have shown that tens of thousands of White storks and further tens of thousands of raptors as well as other soaring species regularly migrate across the Red Sea Coast area and the Red Sea mountain chain (Bergen 2007a, Bergen 2009, CarlBro 2010).

The main objectives of the bird monitoring (ornithological investigation) that focused on bird migration were

- to collect baseline data on migrating birds (mainly soaring and gliding species migrating during the day),
- to describe migration patterns of relevant species in a quantitative way,
- to identify and assess possible impacts regarding development of wind power within the study area and, finally,
- to recommend mitigation measures in order to minimize possible conflicts.

<u>Methods</u>

Standardized daytime field observations were done in spring (792 hours of observation) and autumn 2010 (803 hours of observation) (covering the main migration periods). Observations were done from eight observation sites which were located at distances of about 5 km (covering major parts of the area, see Fig. 1.9). Observations focused on species that can be regarded as especially vulnerable to collision strikes or other negative impacts caused by wind turbines: these are mainly large birds (first of all, birds of prey, storks and pelicans) that principally migrate by soaring and gliding during daytime.

All local and roosting birds were recorded during standardized observations as well as during travelling within the study area. The Sebkha was regularly checked for roosting birds using binoculars and telescopes from particular points located at the road that follows the western border of the Sebkha to the Southeast.

In order to assess bird migration within the study area the results obtained in 2010 are compared with results obtained by a previous study carried out in autumn 2008 and spring 2009 in an area near Wadi Dara (in the following: ‗Wadi Dara area') which is located a few kilometres South of the study area (Bergen 2009).

A more detailed description of the used methodology and the obtained results can be found in the final report of the ornithological investigation (Annex I).

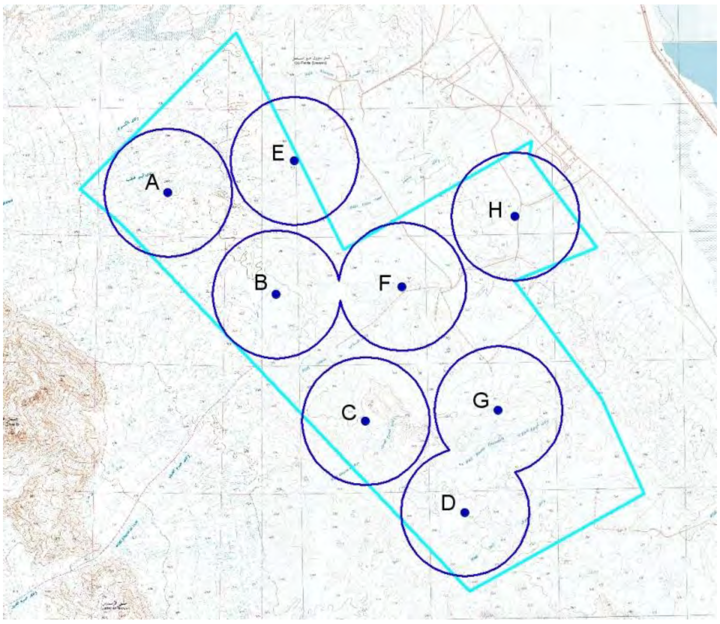



**Fig. 1.9:** Locations of the eight observation sites (A to H) within the study area (circles indicate a radius of 2.5 km around each observation site)

<u>Spring migration – results and assessment of the importance of the area</u>

During standardized field observations in spring 2010, a total of 177,516 birds from 27 relevant species were recorded within the study area. White stork and Steppe buzzard, each constituting almost 38 % of all birds, were the dominant species.

In spring 2010 almost 30 % of all birds recorded at distances of up to 2.5 km to an observation site used altitudes below 100 m. Another 27 % migrated at altitudes between 100 and 199 m, whereas about 44 % flew above 199 m.

In spring 2010 the number of birds migrating at altitudes below 200 m differed between the eight observation sites (especially if Steppe buzzard which is of minor importance for the impact assessment is not considered). A very high number of migrating birds (more than 12,000 individuals) were recorded in the surrounding of sites G and H (Fig. 1.10). A rather high number of migrating birds (between 6,000 and 12,000 individuals) were observed in the surrounding of sites C, D, E and F. In contrast, the recorded number of migrants below 200 m at sites A and B were comparably low (less than 3,000 individuals).

The total number of birds observed in spring 2010 within the study area exceeded 1 % of the total flyway population for 13 species (This is a commonly used criterion, developed by Birdlife International, for assessing the significance of an area: if the 1 %-threshold is met an area is regarded to be of international importance).. More than 15 % of the flyway population of White stork, and more than 5 % of the flyway population of Levant sparrowhawk, Steppe eagle, White pelican, Booted eagle and Steppe buzzard were recorded. More than 3 % of the flyway population of Egyptian vulture classified as globally endangered in the worldwide Red List of Threatened Species (by IUCN, Cox et al. 2006) was recorded here. Further four species of conservational concern (due to their Red List-Category) occurred in comparably low to very low numbers: Spotted eagle, Eastern imperial eagle, Pallid harrier and Lesser kestrel. These results clearly show that the study area is very important for spring migration.

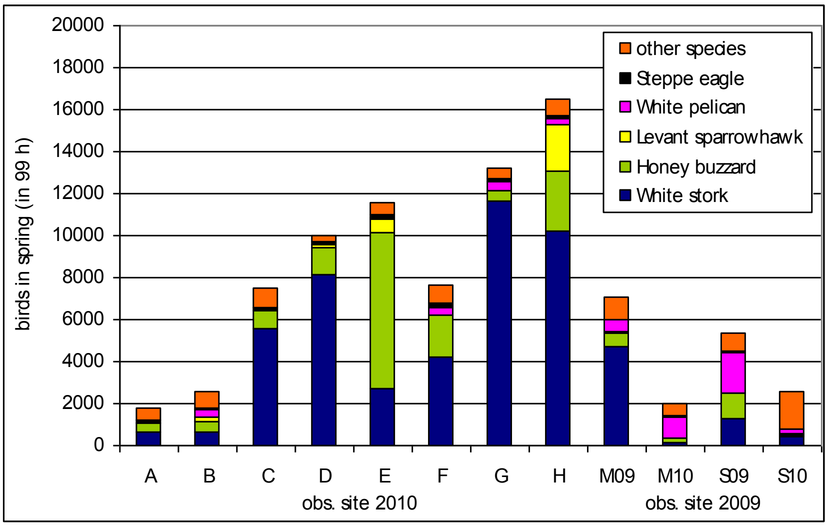



**Fig. 1.10:** Total numbers of recorded birds (except Steppe buzzard) migrating at distances up to 2.5 km to each observation site at altitudes below 200 m in spring 2010 (study area) and in spring 2009 (Wadi Dara area: sites M09 to S10)

Compared to the previous study in the Wadi Dara area (see Bergen 2009), the number of birds migrating at altitudes below 200 m was much higher in spring 2010 at most observation sites (Fig. 1.10). This was mainly due to White storks which occurred at lower altitudes in very high numbers especially at sites C, D, G and H. Moreover, a comparably high number of Steppe buzzards (not shown in Fig. 1.10) migrated through the area at most sites. E.g. nearly 10,000 Steppe buzzards were observed at lower altitudes at site A. However, 4,500 of these birds were recorded during three hours on a single day. Consequently, we do not expect that this result is due to regular migration pattern. Furthermore, Steppe buzzard is not a species of special conservational interest. To conclude, the importance of the study area can be classified as follows:

- The northwestern parts of the study area around the sites A and B has to be classified as significant for bird migration in spring.
- The numbers of birds and recordings observed in the Northeast (site E), in the middle (sites C and F) and in the Southwest (site D) of the study area were clearly higher than at sites A and B and at sites M10, S09 and S10 in spring 2009 in the Wadi Dara area (Fig 1.10). Consequently, the Northeast, the middle and the Southwest of the study area have to be classified as very significant for bird migration in spring.
- At the two sites G and H which cover the eastern and southeastern parts of the study area migratory activity at lower altitudes was highest (Fig. 1.10). This is mainly due to the high amount of White stork which apparently avoided the crossing of the Red Sea, but headed further northwest to Suez. Consequently, the eastern and southeastern parts of the study area have to be classified as extremely significant for bird migration in spring.

Autumn migration – results and assessment of the importance of the area

During standardized field observations in autumn 2010, 25,942 birds from 22 relevant species were recorded within the study area. Again White stork, constituting about 54 % of all birds, was the dominant species. It is noteworthy that all recorded White storks referred to only 17 flocks, indicating that the study area is not located within a main migratory route of White storks in autumn. The only other frequently occurring species were White pelican and Honey buzzard but all at markedly lower numbers. More than 70 % of all migrating birds refer to only six flocks indicating that migratory activity was comparatively low during most periods of the investigation.

The observed numbers of White stork and White pelican refer to about 3 % and 12 % of the total flyway population of each species, respectively. The proportion for all other species observed in the study area by far did not reach 1 % of the flyway population (which is a commonly used criterion for assessing the importance of an area). Three species of conservational concern (due to their IUCN-Red List Category) occurred in low to very low numbers: Pallid harrier, Lesser kestrel, Red-footed falcon and Egyptian vulture.

In autumn 2010 most birds recorded up to 2.5 km to an observation site used lower flight altitudes: Only 25 % of all birds flew above 199 m. This result was probably caused by birds (Storks and Pelicans) that reached the desert plains at low altitudes after crossing the Red Sea, where no thermals enable them to gain height.

Compared to the previous study carried out in autumn 2008 in the Wadi Dara area (see Bergen 2009), the number of birds migrating at altitudes below 200 m was much lower at most sites in autumn 2010 (Fig. 1.11). Only at site H, where about 8,000 White storks were recorded, migratory activity was comparable to that recorded at site S09 in autumn 2008. However, it has to be taken into account that the high number of White storks at site H mainly refers to a single flock of about 7,500 individuals.

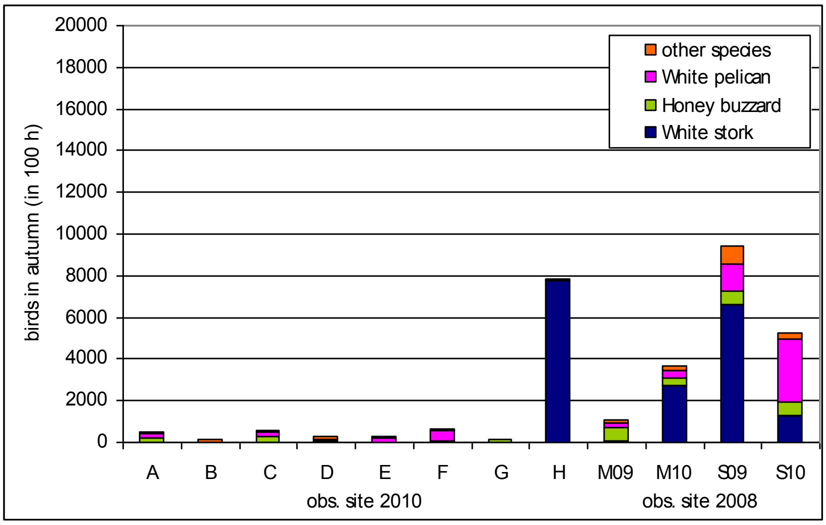



**Fig. 1.11:** Total numbers of recorded birds migrating at distances up to 2.5 km to each observation site at altitudes below 200 m in autumn 2010 (study area) and in autumn 2008 (Wadi Dara area: sites M09 to S10)

Thus, migratory activity in autumn 2010 was low or predominately very low in the whole study area. Consequently, large parts of the study area are not important for autumn migration. This result is very well in accordance with what could be expected from previous studies: The majority of White storks, White pelicans, Honey buzzards and other soaring species seems to reach the Red Sea coast near Gabel el Zayt south of Ras Shukeir after crossing the Red Sea. Only single flocks (with occasionally huge numbers) reach the coastline between Ras Gharib and Ras Shukeir and can then migrate through the eastern part of the study area (site H). Moreover, the results indicate that soaring birds do not reach the coastline North of Ras Gharib. Only very few birds seem to migrate further southeast from Suez over the coastal plains. Most birds which migrate over Suez are believed to head further south along the Red Sea Mountain chain or further in the West along the Nile Valley.

Local birds – results and assessment of the importance of the area

The hyper-arid climate with the desert bare of vegetation as well as the harsh wind conditions make the study area an unattractive habitat for local / breeding birds. Consequently, very few locals birds were observed, all of them classified as "Least Concern" in the IUCN Red List of Threatened Species, e.g. Bar-tailed larks, Desert lark, Greater hoopoe-lark, Brown-necked raven or Crowned sandgrouse.

Consequently, most parts of the study area are of minor importance for local birds. The oasis and the larger Wadis, containing small patches of vegetation, are specific features in the desert. Therefore, these areas are regarded as important for local birds.

Roosting birds – results and assessment of the importance of the area

Storks, Pelicans and birds of prey were occasionally observed roosting in or adjacent to the study area, mainly in the early morning or the late afternoon after or before spending the night in the desert. Those birds apparently stayed only one night in the desert before continuing migration. As those birds were found in the whole study area, there is no particular roosting site of conservational importance within the study area. The larger Wadis within the study area that have small patches of vegetation might be an important roosting place for small passerines.

Even the Sebkha was not often used by Storks and Pelicans although it offers appropriate conditions for roosting. In spring White storks were recorded in the Sebkha during only three of 15 control visits, but in large numbers (up to 4,800 individuals). The results indicate that the Sebkha was not continuously used as a stop-over site. It can be assumed that most birds probably spend only one night in the Sebkha before continuing migration in spring. However, within the desert plains the Sebkha can be classified as an important roosting site for Storks, Pelicans, Herons and probably other species.

Small passerines regularly used the oasis as a stop-over site for several days. Moreover, other species like Bee-eaters, Doves and Herons were occasionally recorded there. Within the desert plains the oasis forms a unique feature with dense vegetation. Consequently, it is an attractive stop-over site and an important stepping stone for these species during migration.

## 1.3 PREDICTION OF IMPACTS

### 1.3.1 Features except Fauna and Flora

The expected impacts can be summarised as follows:

**Land use:** As there will be only a minor land take (about 3 %) and in the absence of ecologically sensitive habitats, attractive landscape, antiquities, agriculture, residents etc. the minor land take has not any significant impact. The impacts easily can be further reduced by avoidance of spots of residual vegetation. The above is valid for both, the **construction** and the **operation phase**.

**Landscape and visual impact:** Considering the absence of receptors and the uniform desert landscape with no special features the impacts on the landscape are judged as being not significant neither during the **construction phase**, nor during the **operation phase**.

**Water resources and waste water**: In general water supply is not relevant for wind power projects. Most water will be required during the construction phase, especially for concrete works related to the foundations and the substation. In case of casting at the site such water would need to be procured by tankers and taken from the Nile water pipeline system. Water demand for sanitary purposes will be marginal even during the construction phase. The small amount of waste water, usually treated in septic tanks with underground rinsing, does not have a significant impact. The groundwater resources used by GPC in the centre of the –200 km² project area” will remain untouched. Construction works near the wells shall be avoided.

During the **operation** period the water consumption was estimated to 3 m³/d only and will be not significant.

**Domestic and hazardous waste:** Considerable amounts of solid waste will be generated by wind power **construction** projects, consisting essentially of packing material (paper, plastics, wood) originating from equipment transport. The waste will occur mostly at the individual turbine erection sites and in the construction yard. Under the heavy wind conditions the waste is easily spread over the desert and transported over large distances. The only possible source of hazardous waste caused during construction is spilled oil and grease originating from construction equipment (e.g. trucks, excavators, craned) and from handling and commissioning of deliveries (e.g. transformer or gear box oil, hydraulic oil). Both, the littering of waste and the spillage of hazards can easily be avoided by proper workmanship and strong supervision.

Waste from the wind park during the **operation phase** would consist of used consumables regularly to be exchanged, when servicing the machines, and smaller defective parts. These are non hazardous materials, most of them valuables and fit for recycling. Larger defective parts such as gear box or generator would anyhow be returned to the factory for repair or reuse of materials. Hazardous used oil will be collected once per year or once in two years and send for recycling. The practice in other Egyptian wind park shows that this works without problems. The volume of used oils will depend on the type of wind turbine selected and on the service intervals requested by the selected contractor. Domestic waste will be generated at the service facilities and the 220 kV substation. The standard method as applied at remote housing facilities in the desert in Egypt would be that waste will be collected in bags or bins, and disposed of on an environmentally safe waste disposal site (desert pits). To reduce the volume the waste is burnt. The residual waste will be covered by sand. The waste is inert and in absence of rain there is no harm for the subsurface. Considering the small amounts of domestic waste (about 60 m³ per year of non compacted waste equivalent to about 1 to 2 m³/a after incineration) this simple method is considered to be acceptable and no significant impacts caused by domestic and hazardous waste are expected, if a proper workmanship and domestic waste management scheme does apply.

**Air quality:** During the **construction** measures some emissions of exhaust gases of machinery and dust at the working places will occur. In the absence of sensitive receptors in the area such emissions during construction will have no significant impacts on the environment. No dust and gaseous emissions will originate from a wind park during operation. Accordingly, there is no significant environmental impact

**Noise:** The only sensitive noise receptors are the Bedouin huts next to the GPC water pumping stations. The area is considered as a ―mixed residential, commercial, small industrial" area with a maximum ambient noise level of 50 dB (A). Such values are respected during the **construction and the operation** phase, if the wind turbines will be located at least at distances of 300 m from the huts

**Vibration:** During both, the **construction and operation** phase, no significant impacts from vibration is expected. Vibrations resulting from wind turbines working under regular conditions show very little vibration with the blades correctly balanced and the main shaft correctly adjusted. The propagation of the vibration is dampened by the foundation body and there is very little transmission into the underground, especially in case of a non rocky underground like in most of the part of the subject project area. Thus, vibration effects will not be measurable in the underground already nearby the wind turbines.

**Electromagnetic Interferences:** Wind turbines could potentially cause electromagnetic interference with aviation radar and telecommunication systems (e.g. microwave, television, and radio). The nature of the potential impacts depends primarily on the location of the wind turbine relative to the transmitter and receiver. There is a military radar in the North-east of the ―ESIA area" at a distance of 8.7 km from the north-eastern corner of the possibly usable area. As the area was already cleared by the Ministry of Defense, it can be assumed that no interference with a coming wind park is expected. There are no telecommunication systems nearby the area that could be disturbed by the operation of wind turbines.

**Light reflection and shadowing:** The blade coating of modern turbines does usually absorb direct sun light and reflection is not a significant environmental impact. Moreover, due to lack of receptors in the surrounding of the wind park that can be affected by reflection, there is no impact from that. The critical impact of shadowing (flickering) as per acceptable standards is 30 hours per year and 30 minutes per day. This can be achieved only at places near to wind turbines, where the observed transition time of the sun through the rotor diameter can achieve such durations. As there are no residences or housing near to the turbines (except the Bedouin family housing, to which a distance of more than 300 m shall be kept), it is obvious that there is no impact from flickering beyond acceptable level.

**Archaeological, historical and cultural heritage:** Not existing in the area.

**Occupational health and safety risks**: There are significant safety risks during the **construction phase** resulting from earth and concrete works, the erection works (working at heights), handling of heavy equipment and electrical installations. During the operation phase such risks origin from the maintenance works in the wind park. The risks can be reduced to acceptable level, if keeping internationally accepted health and safety standards.

**Traffic, utility services and other infrastructure:** As the main roads in the overall region are very well dimensioned and at low traffic frequency there are not any critical impacts on the traffic on public roads during construction. A considerable amount of water will be required for concrete making. The maximum daily amount is estimated to 60 m³/d equivalent to 0.6 l/s to be procured out of the Nile water pipeline supply, or if that will not be possible, from the Nile valley. During operation there will be almost no impact on the traffic and the water demand. The wind parks would work in parallel to the 220 kV or 500 kV transmission level to be constructed. The wind electrical energy will strengthen the electricity supply in general and will contribute to grid stability if being properly designed and operated in coordination with the LDC.

**Socio-economic effects:** Especially during the **construction phase** the wind park will require significant employment of local personal. About 30 to 40 % of the investment volume would be produced locally. The operation of the wind farm will make use of indigenous resources and helps to safe oil and gas resources. Moreover, wind power generation will help to reduce CO2 emissions (about 1890 t $CO^2$ /MW/year).

### 1.3.2 Fauna and Flora

Plants

The land-use by wind farm construction is very limited (usually less than 3 % of the overall area) leaving most of the area free from any interventions. Consequently, the affected area will cover only a small fraction of the 200 $km^2$ study area. No turbine will be installed next or inside the oasis or inside larger Wadi beds. Construction measures in the Wadis will be limited to single crossing by gravel roads and by cable trenches carried out at less sensitive spots. In conclusion, **construction** of wind farms within the study area will cause no significant impacts on vegetation or plant communities.

Operating wind turbines are not known to affect plants or plant growth. During periods of maintenance of wind farms human activities will be restricted to the already existing tracks and storage positions. In conclusion, **operation and maintenance** of wind farms within the study area will cause no significant impacts on vegetation or plant communities.

Animals

Compared to the whole wind farm area, the area required for infrastructural structures is very limited. Thus, even during and after turbine erection there will be enough appropriate habitats available for local animals. In summary, the impact on animals caused by **construction** of wind farms within the study area and / or disturbance is assessed to be insignificant (acceptable). In the oasis, the larger Wadis and the area settled by the Egyptian Dabb Lizard, however, installations of turbines or other technical installations shall be avoided and human activities shall be minimized.

Noise and shading resulting from operating turbines is limited in space and time. Hence operating wind farms are not expected to impact animal wildlife significantly. In conclusion, **operation and maintenance** of wind farms within the study area will cause no significant impacts on animals.

### 1.3.3 Birds

Bird-wind turbine interactions

In recent years the construction of wind turbines has given rise to much controversy relating to bird conservational issues, mainly in Europe and the United States.

Considering installation of wind farms within the study area, the major potential hazards to birds are collision risk and mortality but also barrier effects. Other possible impacts of wind turbines like displacement due to disturbance or direct habitat change and loss for roosting or local birds are of minor importance.

Assessment of impacts on migrating, local and roosting birds- **construction** phase

Birds in active flight will not be affected during the construction phase. Noise and dust emission at distinct construction sites might bring migrating birds to alter their flight path. This cannot be regarded as a significant impact.

Construction of wind farms might lead to a modification or a loss of habitat for local or roosting birds by using areas for foundation of turbines, permanent access roads, trails for power lines, storing positions for heavy machines, other technical installations etc. As mentioned above, the local bird community is very poor in species and, moreover, bird density is very low. And the vast majority of the study area is not a preferred roosting site for birds. The area required for the infrastructural elements is very small compared to the whole wind farm area. Thus, even after the construction of turbines there will be enough appropriate habitats available for local and roosting birds.

The oasis and the larger Wadis that have small patches of vegetation form specific elements in the desert and might be used as foraging and hunting sites for local birds and as a roosting site during migration periods. Therefore, construction works in the oasis and in the larger Wadis shall be minimized.

Moreover, electrical structures associated to wind farms, such as substations or overhead power lines for interconnection with the main corridor are likely to have impacts on migrating birds, and, therefore, shall be constructed and protected according to the Guidelines "Protecting Birds from Power Lines; Nature and environment, No. 140; Council of European Publishing"."

To conclude, the impact on migrating, local and roosting birds caused by the construction of wind farms within the study area is assessed to be not significant (acceptable). Residual impacts can be mitigated by the mentioned measures.

Assessment of impacts on migrating birds - **operation and maintenance** phase

The investigation clearly indicates that parts of the study area are of international importance for migration in spring. Hence, significant impacts (collisions and barrier effect) potentially affecting populations of some species cannot be excluded when building wind farms in the entire study area. However, the results of the investigation indicate a gradual increase of migratory activity from West to East within the study area. This is very well in accordance with the findings from investigations carried out in autumn 2008 in the Wadi Dara area (see Joint Recommendation of CarlBro & ecoda 2009). Thus, an impact assessment of different parts of the study area due to the spatial differences in bird migration observed in spring 2010 seems to be feasible. In accord with the importance of the area for migration and hence according to the strength of expected environmental impact, the study area can be subdivided into the three following zones:

- Zone I

Zone I covers an area of about 53 km$^2$ and encompasses the north-western part of the study area (sites A and B) where migratory activity was lowest in spring 2010 (Fig. 1.12). A relevant collision risk for migrating birds in spring at wind farms within Zone I is not expected if technical avoidance and mitigation measures to the best standard practice are maintained (see Chapter 1.4).

- Zone II

Zone II consists of parts of the study area in the Northeast (site E), in the middle (sites C and F) and in the Southwest (site D) and has a size of about 67 km$^2$ (Fig. 1.12). According to results of the study, Zone II is very significant for bird migration. Considering the huge numbers of birds migrating at altitudes below 200 m, it cannot be excluded that collision risk at wind farms in Zone II will pose a significant threat for migrating birds. Consequently, the expected impact of wind farms in Zone II is unacceptable. However, if turbines do not operate during periods of highest migration, collision risk and barrier effect for migrating birds are minimized. Thus, construction of wind turbines within Zone II is acceptable only, if an effective shutdown programme is developed and established (see Chapter 1.4).

- Zone III

Zone III consists of the eastern and south-eastern parts of the study area (sites G and H) and has a size of about 88 km$^2$ (Fig. 1.12). The results of the study clearly show that Zone III is of extreme significance for bird migration in spring. Consequently, collision rates leading to additional mortality potentially causing significant population effects for some species cannot be excluded when building wind farms in Zone III. The expected impact of wind farms is therefore unacceptable and hence the construction of wind farms has to be strictly banned within Zone III. Even shutdown programmes have to be regarded as being incapable of reducing impacts of wind farms in Zone III to an acceptable level, because significant cumulative impacts with other wind farms cannot be excluded (with regard to collision risk and to barrier effect).

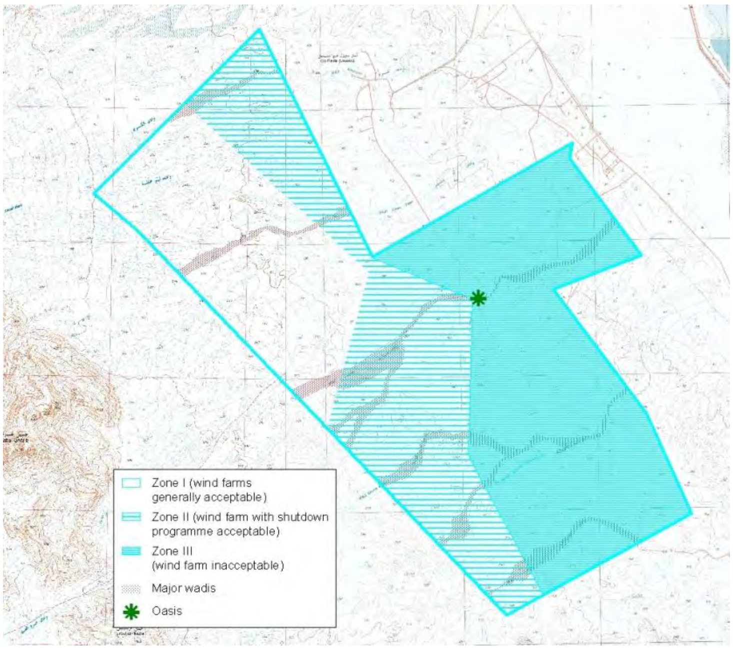



**Fig. 1.12:** Results of the impact assessment of different parts of the study area due to the spatial differences in bird migration observed in spring 2010.

Migratory activity in autumn 2010 was low to very low in the whole study area (in accordance with what can be expected from previous studies). As a consequence, due to the low number of migrating birds in autumn, wind farms within the study area will not pose a relevant risk of collision. Single collisions at wind farms within the study area might occur even during autumn. But the expected collision rate will not cause significant effects on populations. Thus, collisions at wind turbines within the study area during autumn are not regarded to have a significant impact on migrating birds.

Due to the lack of knowledge about behaviour of large soaring birds in the vicinity of wind turbines the impact assessment is subject to a certain degree of uncertainty. Consequently, apart from mitigation measures, a thorough post-construction monitoring programme should be implemented for wind farms in Zone I and Zone II to assess whether impacts of wind farms in Zone I and Zone II remain at an acceptable level, or whether additional measures are necessary to minimize or eliminate unacceptable impacts. The results of the post-construction monitoring shall be used to improve the shutdown programme and to contribute to a final development of a *shutdown-on-demand* (SOD) programme

Assessment of impacts on local birds - **operation and maintenance** phase

Local birds might be affected by disturbance during the operational phase of wind farms. However, most resident birds are expected to be unsusceptible to the nearly constant acoustic and visual stimuli of wind turbines. Moreover, disturbance effects are restricted to a rather small distance and cover at most the area up to 300 m to a turbine. As species variety of local birds and bird density is very low, the impact on local birds caused by disturbance related to operating turbines is assessed as not to be significant (acceptable).

Human activity is expected to be rather limited in time and space. In conclusion, the impact on local birds caused by disturbances related to maintenance is assessed as not to be significant (acceptable).

Local birds will also face the risk of collision at operating turbines. However, resident birds are aware of turbines and their behavior might be better adapted to the presence of turbines. As species variety of local birds and bird density is very low, wind farms in Zone I and Zone II will not lead to significant collision risk on local birds.

Assessment of impacts on roosting birds - **operation and maintenance** phase

It is well known that species which tend to roost in larger flocks avoid operational wind farms. Therefore, we expect that, for example, White storks and White pelicans will usually not roost within wind farms. As the study area is not a preferred roosting site for these species and as there are many alternative roosting sites, operation of wind farms will not lead to significant habitat loss for these species. Other species roosting in small flocks or even singularly, e.g. birds of prey or smaller birds (passerines), are not known to avoid wind turbines. As the Sebkha is located some kilometers away from Zone I and Zone II wind turbines will not affect birds which use the Sebkha as a roosting site.

Human activity is expected to be rather limited in time and space. In conclusion, the impact on roosting birds caused by disturbances related to maintenance is assessed as not to be significant (acceptable).

Roosting birds face the risk of collision at operating turbines. Collision risk might be high in situations when larger flocks of birds i) stop migration in the afternoon to look for a place to spend the night and ii) start migration in the morning after having spent the night in the desert. As the study area is not a preferred roosting site and as species, like White storks or White pelicans, are expected to avoid operating wind turbines; wind farms in Zone I and Zone II will not lead to significant collision risk on roosting birds.

## 1.4 MITIGATION MEASURES

Construction and operation of wind farms within the “200 km² Project Area” will lead to significant impacts on migrating birds in spring. Provided that the following mitigation measures (Chapter 1.4.1) will be maintained the expected impact of wind farms on an area of about 120 $km^2$ can be reduced to an acceptable level.

With regards to other conservation resources wind farms within the study area will cause minor residual impacts. These residual impacts can be mitigated by good design, workmanship practice, keeping health and safety standards as well as housekeeping and supervision (see Chapter 1.4.2).

### 1.4.1 Mitigation measures with regards to migrating birds

Regarding migrating birds the main required mitigation measures can be summarized as follows:

- In order to reduce the expected risk of collision and barrier effects for migrating birds at wind farms within **Zone II** an effective shutdown programme has to be developed and established for the spring migration period (Note that a shutdown programme has to be coordinated with the National LDC). With regard to the development of such a shutdown programme, a two-step approach is conceivable:
  - A *fixed shutdown* (FS) programme stopping all turbines from March, 1st to May, 18th during daytime (1 hour after sunrise to 1 hour before sunset). Based on long term wind data, the expected energy loss caused by such a FS-programme is estimated to be about 10 %.
  - A *shutdown-on-demand* (SOD) programme (probably using radar technology) stopping all turbines during times of high migratory activity and when large flocks approach the wind farm. On the basis of long term wind data and bird migration data obtained in spring 2010, the expected energy loss caused by such a shutdown programme is estimated to be about 2 %.

    Assuming that effective FS- and SOD-programmes are established, wind farms within Zone II are not expected to lead to a relevant collision risk for migrating birds in spring. To regulate and monitor the shutdown programme installation of a central control facility for all wind farms is required.

    Moreover, technical avoidance and further mitigation measures according to best standard practices are required (see below).
- The expected risk of collision and barrier effects for migrating birds at wind farms within **Zone I** during spring have to be reduced by effective measures, i.e. either

- by implementing an escape corridor in the middle of Zone I: The escape corridor shall have a width of about 1 km and shall be orientated in parallel to the main wind direction, i.e. Northwest to Southeast. The corridor will allow birds to leave the wind farm area in a safe way and without larger efforts.

or, alternatively,

- by establishing a shutdown programme (see above). Applying a shutdown-on-demand programme is recommendable, if it was proved to be effectively and sustainable operating and if it was in accordance with the requirements of the LDC. Carry out a central control to regulate and to monitor the wind park shutdown concept.

- If implementation of an escape corridor through Zone I is intended, a concentration of migrating birds can be expected within the corridor area during spring (when birds face strong headwinds and are drifted with the wind to the Southeast or when birds give up struggling against strong headwinds and go with the wind in south-eastern direction) and possibly during autumn, too. Hence, to reduce collision risk and barrier effect for migrating birds the corridor through Zone I has to be expanded in south-eastern direction through Zone II. If, alternatively, a shutdown programme will be applied for wind farms within Zone I (but no escape corridor), an escape corridor through Zone II is dispensable.
- Implement a detailed post-construction monitoring programme for at least the first two years during main migration periods (2.5 months in spring and 2.0 months in autumn) to assess whether impacts of wind farms in Zone I and Zone II remain at an acceptable level, or whether additional measures are necessary to minimize or eliminate unacceptable impacts. Cooperate with national and international environmental organisations.
- No wind turbines with lattice towers are permitted to avoid suitable perching sites. Limit the maximum tip height of the wind turbine to 120 m. Avoid lighting of turbines. If lighting of turbines is absolutely required, use the minimum number of intermittent flashing white lights of lowest effective intensity (Drewitt & Langston 2006) however, still fulfilling aviation requirements of the civil and military aviation authority. Paint turbine blades to increase blade visibility by using blades with black and white aviation markings (see also Hodos et al. 2003).
- Build the wind park internal grid by underground MT cables. If the use of overhead lines cannot be avoided (e.g. 220 kV OHL), such overhead lines have to be designed according to the guidelines ―Protecting birds from power-lines, Nature and Environment No. 140, Council of Europe Publishing”. Analogous measures shall be applied at any substation to be built in that area.

### 1.4.2 Mitigation measures with regards to other features (except migrating birds)

Regarding other features (except migrating birds) the main required mitigation measures can be summarized as follows:

- Construction works next to the oasis, water wells and in the larger Wadi beds shall be minimized and limited to road construction/improvement and laying of cables in trenches.
- Installation of turbines and other technical installations are to be avoided in the areas inhabited by the Egyptian Dabb Lizard. All human activities shall be minimized, both during construction and operation / maintenance phase.
- Supplying or changing oil, lubricant or hydrocarbon to vehicles should be done in gas stations. These activities should not be carried out on site. Strict control must be applied by a site supervisor.
- Contractors should provide effective protection for land and vegetation resources at all times and should be held responsible for any subsequent damage.
- The contractor shall be forced to good workmanship and housekeeping during construction by contractual stipulations and by assignment of supervising engineers in order to assure adequate disposal of solid waste and waste water, to avoid or to collect spillages of used oils, greases, diesel, etc.
- Assignment of a health and safety engineer by the main contractors for the different Lots with full power for giving health and safety instructions.
- Strictly implementation of wind power manufacturers health and safety instructions concerning the erection, commissioning and maintenance of the wind turbines.
- Strict supervision of health and safety measures of the local civil works companies, which may be employed via the main contractor or directly by NREA, especially with regard to wearing safety clothes, to equipment safety and a safe working environment.

## 1.5 ENVIRONMENTAL MANAGEMENT PLAN

The implementation of mitigation measures require actions during the bidding, planning, construction and post construction phase for each individual wind park that would be erected in the accepted or eventually later on in the conditional acceptable area. This can be summarised in the following EMP.

| Project activity | Environmental Concern | Mitigation Measures | Estimated Cost (EUR) |
|---|---|---|---|
| Bidding and Planning Phase | Health and Safety Risks | Make keeping standards as defined in the Environmental, Health and Safety Guidelines for Wind Energy, IFC,2007, a minimum obligation in the Tender Documents | To be included in the investment cost |
| | | Make the assignment of a health and safety engineer during the construction process a condition | To be included in investment cost |
| | | Make a health and safety plan for the construction site obligatory | To be included in investment cost |
| | | Make provision of safety tools & equipment as per accepted standards by the Contractor a bidding condition | To be included in investment cost |
| | Impacts on birds | Limit the maximum tip height of wind turbines to 120 m | No cost |
| | | Define the minimum distances between wind turbines to be not less than 3 x 12 rotor-diameters | To be included in investment cost; this measure would lead to higher infrastructure cost, but would also cause higher energy yield and reduced turbulence and leave room for bird migration. |
| | | Paint turbine blades to increase blade visibility by using blades with black and white aviation markings (see also Hodos et al. 2003) | About 10,000 EUR/MW to be considered in the investment cost |
| | | Build internal grid as underground cable | This is the standard and to be included to the investment cost |
| | | Make keeping guidelines –Protecting birds from power-lines, Nature and Environment No. 140, Council of Europe Publishing" a condition for the design of the 220 kV interconnection to the substation and introduce adequate bird protection measures at the substation | Design of the 220 kV OHL to be dealt with by EETC. For the substation: The MT side to be built as in-house switch-gear building; 220 kV side to fit with the technical connection requirements as per the guidelines; cost to be borne by the project owners |

| | | | |
|---|---|---|---|
| Detailed planning and Construction phase | Health and safety risks | Availability of an adequate health and safety plan | Included in Cost Estimate |
| | | | |
| Construction phase | Health and safety risks | Assignment of health and safety engineer of Contractor with independency with regard to giving health and safety instructions | Included in Investment Cost |
| | | Keeping the -Environmental, Health and Safety Guidelines for Wind Energy, IFC,2007" as a minimum condition | Included in Investment Cost |
| | | Availability and proper utilisation of safety tools and equipment | Included in Investment Cost |
| | | Hygienic temporary sanitary facilities | Included in Investment Cost |
| | | Assure stoppage of erection works during weather conditions beyond limits | Included in Investment Cost, extended erection periods |
| | Pollution | Good workmanship and housekeeping to be assured by supervising engineers to assure adequate disposal of solid waste and waste water, and to avoid or to collect spillages of used oils, greases, diesel, etc. | Included in investment cost |
| | | Force the contractor to put the construction site into tidy conditions, excavations are backfilled, heaps of excavation material is levelled and waste is adequately disposed off. | Included in investment cost |
| | Impact on birds | Assure the constructional work is conducted in accordance with mitigation measures given in Chapter 6.2.<br>In addition: For implementation of a shutdown programme the technical design has to consider a central control facility for all wind farms in the area, which allows a central shutdown and restart operation. | Additional investment cost for central control facilities of an order of 1 Mio. EUR |
| | Impact on flora and fauna (except birds) | Assure the constructional work is conducted in accordance with mitigation measures given in Chapter 6.2; such as no wind turbine construction in major Wadis, road and trench alignment away from vegetation area, no constructions at sites inhabited by Egyptian Dabb Lizard | Very limited additional cost for investors, that can be quantified after detailed design is done only |
| Operation and maintenance phase | Health and safety risks | Assure that O& M at the wind turbines is carried out by personnel only, that has passed a safety training course | Standard requirement to be observed by project owners and monitored by a qualified external expert (50,000 EUR for a larger wind park) |
| | Impacts on birds | Carry out a post construction ornithological monitoring for at least the first two years during main migrating seasons for wind farms in Zone I and | 400,000 EUR per year; expertise to be jointly hired by the project owners or al- |

| | | | |
|---|---|---|---|
| | | Zone II in cooperation with national and international environmental organisations to identify any impacts on birds beyond acceptable level and to apply additional mitigation measures or improve already established mitigation measures, wherever necessary, to the limits defined in this study | ternatively by each individual project owner |
| | | Supervision and central control of a fixed shutdown programme during spring migration season for wind farms in Zone II (and optionally in Zone I) | 150,000 EUR per year for Zone II (and optionally for Zone I) |
| | | Develop, test and establish a (radar based) shutdown-on-demand programme during spring migration season for wind farms in Zone II (and optionally in Zone I), including coordination with LDC | 2 years, about 1 Mio. EUR; to be financed by NREA supported by soft loan facilities |
| | | Carry out a shutdown-on-demand programme (probably at two sites, each one equipped with one radar system) during spring migration season in Zone II (and optionally in Zone I), including coordination with LDC | 300,000 EUR per year for Zone II (and optionally for Zone I); expenses to be shared by project owners or alternatively to be borne by each individual project owner |
| | Pollution | Assure proper management of domestic waste at service buildings (e.g. in cooperation with Ras Gharib waste management scheme ) and of used grease and oils (recycling) | Standard requirement to be observed by owners |
| Decommissioning | Land-use and Landscape | Remove the wind turbine installations at the end of the life time | To be borne by the investor and to be considered in the investment cost |

# 2. DESCRIPTION OF THE PROJECT AND LAYOUT

## 2.1 Objectives and Scope

The Government of Egypt (GoE) has allocated 200 km² of land about 15 km inland from the shores of the Gulf of Suez near Ras Gharib that shall be used for wind power development for up to 1,000 MW. This land is portion of a 1,229 km² area allocated for wind power utilisation by presidential decree of May 13th, 2009. The objective of wind power utilisation in this area is

- To make use of the excellent wind power potential at the site, and in the same time
- to substitute oil and gas for electricity generation and to safe indigenous fuel resources, and
- to safe $CO_2$ emissions.

This ESIA study follows the Egyptian Environmental laws, regulations and guidelines. In the same time it is considered that the minimum standards of the Equator Principles are kept. This is to fulfil the financing conditions of international financing institutes as most of them have committed themselves to keep the Equator Principles as minimum environmental standards.

Major elements of the assessment were field surveys such as general area reconnaissance, ornithological field monitoring over spring and autumn migration period, and a representative survey on flora and fauna (others than avifauna). By early public participation the stakeholders were invited to comment. This included one Bedouin family living at a water pumping station within the area.

The project development is coordinated by NREA. The northern part of the area is intended to be used for the 250 MW BOO project already under tendering by EETC for private . Further projects of a private investor (MASDAR/NREA: 200 MW ) as well as public projects financed by European development partners (EU, EIB and AFD) under the lead of KfW and by Governmental Lenders from Spain with a total installed capacity of 580 MW were planned for the area. The implementation of these projects depends on the environmental compatibility of the area and further feasibility studies to be carried out. This ESIA study focuses on the environmental and social assessment and the identification of necessary avoidance and mitigation measures. For this assessment typical wind park layouts for the project areas under consideration are assumed. Thus, a layout of the future projects as realistic as possible is carried out to consider any eventual environmental and social impacts resulting from the projects. I.e. the ESIA is carried out with the objective to get an environmental clearance for wind park development in that portion of the area, where no environmental impacts are expected or environmental impacts can be mitigated. It may already serve as the final study for environmental clearance of the individual projects, or, at least, the efforts for further ESIA studies and the environmental clearance of individual projects shall be minimised.

The design lifetime of wind power plants is 20 years. According to the predominating wind direction, wind power would be developed in south-west to north-east rows at distances of about 1 km. Typical features of such a project are the wind turbine foundations of about 2 to 3 m depth and a surface of up to 15 x 15 m² in case of a large turbine (2 to 2.5 MW), wind turbines with tubular towers with diameters of up to 4.5 m at the footing and maximum blade tip heights of about 120 m (allowing wind turbine unit capacities of up to about 2.5 MW). The wind park internal grid consists of cable trenches and small kiosks next to each wind turbine comprising of ring main station and transformer and controller stations, if the latter will not be integrated into the turbines. Further major features are the wind park internal earth roads of about 5 m width and erection platforms of 1000 to 2000 m² at each wind turbine. The wind power collected by the MT cable grid has to be evacuated via a new transmission line to be built. A 220 kV line from Hurghada to Zafarana being still in the implementation stage is already completely loaded and cannot absorb further feed in from wind parks. This ESIA study considers preliminary information on a new 500/220 kV substation to be built in the Ras Gharib area. Accordingly, a central 220 kV substation at a central location of the 200 km² project area is considered for evacuation of the wind power. In the absence of detailed information on the new location of the 500/220 kV SS the routing of the 220 kV TL is only tentatively indicated. Accordingly, this feature can be considered on a very general level only. The same is valid for service buildings. At this stage of project preparation it is assumed that such service areas (for control and maintenance including spare part and tools stock) will be built outside the area, e.g. near to the 220 kV substation or in Ras Gharib, for being interconnected to the LT network.

The assessment of environmental and social impacts caused by wind power development is targeting

- to determine any likely significant impact caused by wind power development in the area,
- to assess, whether such impacts can be mitigated or whether they require a restriction or a cancellation of wind power development,
- to define eventually necessary mitigation measures and environmental management (EM) requirements.
- to assess the effects of possibly required mitigation and EM measures with regard to the overall viability of wind power development in the area.

The scope of the project can be summarized as follows: Wind power development shall take place in the 200 km² project area, whereby the greater Wadis and the mountainous and complex parts shall be kept free from wind turbines. The location of the area is shown on Fig. 2.1. It is located within in a greater area of 1229 km², which was designated for wind power utilisation by presidential decree. The area was proposed by the National Centre for Land-use Planning and was approved by the Council of Ministers. Eventually competing uses were already taken care of by excluding areas of petrol activities in the East of the area. Comments of competent authorities such as the air force and aviation authority were already received by NREA. Thus, it can be stated that there was already an internal consultation between competent authorities prior to the approval of the area and to the start of this ESIA.

## 2.2 The “200 km² Project Area”

The location of the project area can be seen from Fig. 2.1. It is located on the western bank of the Gulf of Suez, 120 km in the North of Hurghada and 10 to 15 km to the West of the Hurghada – Suez Road. The distance by road to Cairo is about 350 km. The boundary coordinates are given in Table 1.


**Fig. 2.1:** Location of the 1,000 MW Project Area”

**Table 2.1:** Boundary Coordinates of the 1000 MW Project Area

| Border Co-ordinates | GEOGRAPHICAL COORDINATES (DATUM: WGS 1984) | |
|---|---|---|
| 23 | 28°11'8.34"N | 32°56'45.77"E |
| A6-3 | 28°12'55.38"N | 33° 6'32.66"E |
| 21 | 28° 5'27.50"N | 33° 9'14.00"E |
| 20 | 28° 7'28.50"N | 33° 8'13.50"E |
| 17 | 28°12'36.40"N | 33° 6'29.86"E |
| 22 | 28° 3'25.43"N | 33° 5'4.02"E |
| 19 | 28° 9'59.00"N | 33° 6'8.50"E |
| 4 BOO | 28°10'37.56"N | 33° 2'2.88"E |
| 18 | 28°10'40.96"N | 33° 8'6.67"E |
| X2 | 28°15'10.88"N | 32°59'28.54"E |
| X3 | 28°11'53.33"N | 32°55'45.54"E |

More details on the location can be seen from Fig. 2.2. The area is about 20 km away from Ras Gharib. It is partly located in the West of wind parks already under development such as an European financed Wind Park of 200 MW, a Japanese financed wind park of 220 MW and a private developed wind park of Italgen of approximately 100 MW in the South-East.

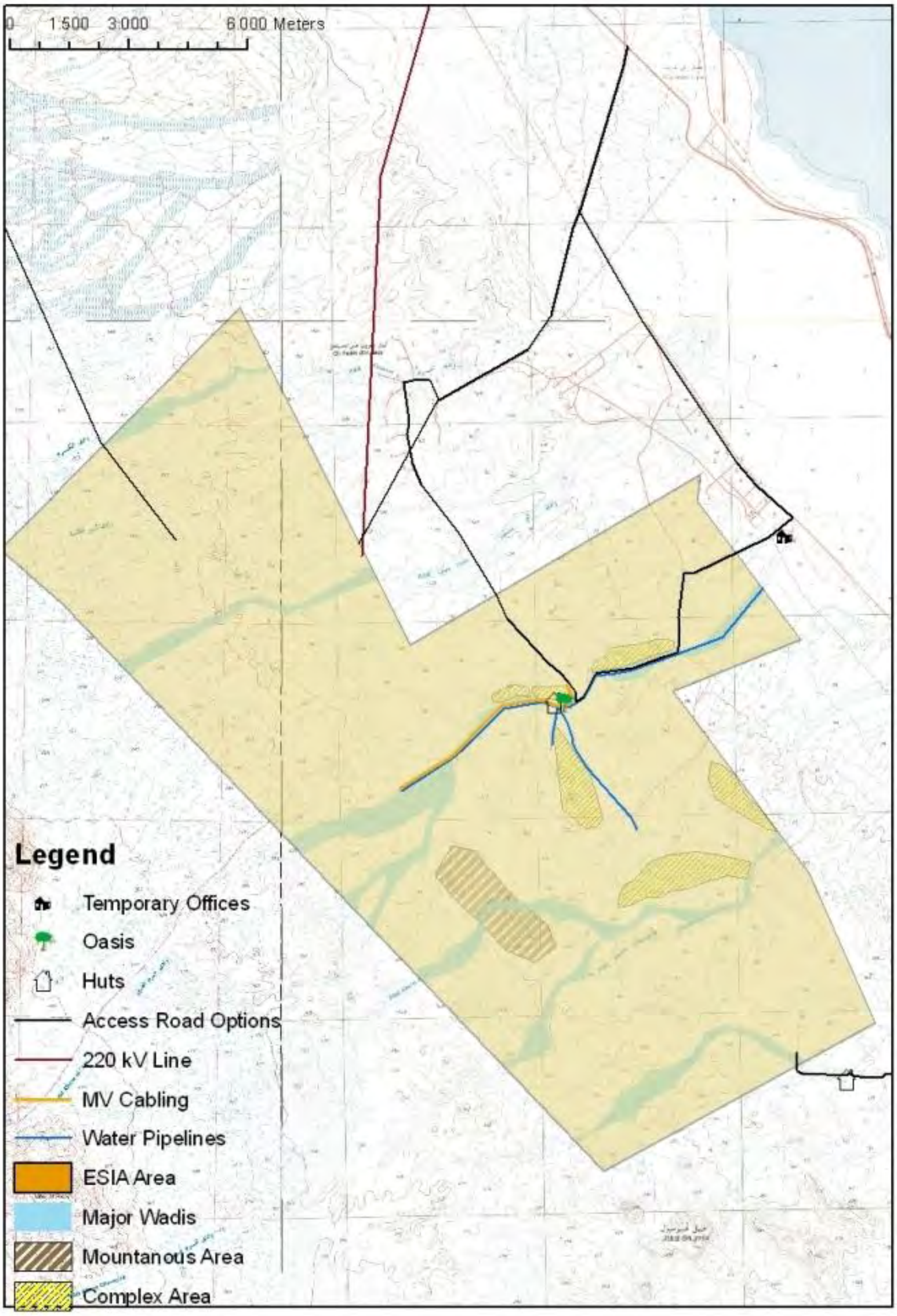



Fig. 2.2: The –1000 MW Project Area" with possible Access Road Options

The area can be accessed via asphalt roads owned by the General Petroleum Company (GPC) of about 4 m width from the Ras Gharib area in the North and via an earth road in the South, which was built by the JIAPCo Oil company. Alternately an access road from the public road Ras Gharib to the Nile Valley in the North would need to be constructed

## 2.3 The Project - Layout of wind power development

### 2.3.1 General Description of the Project

Although the final split up of the total area into wind parks and the final design of the individual wind parks will be known on a later stage only, once the wind turbine will be selected or determined through competitive bidding, the general project layout of wind parks can already be outlined. This is because wind park design follows basic planning rules. Moreover, because of the limitation of the maximum tip height of the wind turbines the spectrum of wind turbines that can be used is also restricted. Accordingly, wind turbines with unit capacities of about 0.8 to 2.5 MW, rotor diameters of 52 m to 90 m and max tip heights of 80 m to 120 m are likely to be selected. Regardless of the type selected the WTG shall consist of tubular towers of heights between 55 m and 80 m and maximum base diameter of about 4 m, the foundation and the nacelle on top of the towers with the rotor. The rotor speed is expected to be variable with 9 to 25 rpm.

Any wind park in the "1000 MW Project Area" would typically be developed in rows perpendicular to the main wind direction with a distance between each row of around 700 to 1100 m or even more, a distance between turbines within a row of about 160 to 250 m and a turbine height up to the upper blade tip of a maximum of 120 m. The size of foundations would be about 10 x 10 m (small wind turbine) to about 17 x 17 m with a maximum depth of 3 m below the surface. An example for a standard foundation of a 0.85 MW wind turbine is shown in Fig. 2.3.

At each wind turbine a kiosk will be constructed (e.g. in Fig. 2.4). Depending on the type of selected wind turbine such kiosk will contain a ring main station, a step up transformer or even the wind turbine controller. In case of a large wind turbine the Controller and the transformer might be contained inside the wind turbine towers. The housing of such compact station (kiosk) would be not more than about 2.5 m x 8 m. Power cable trenches will be attached along the rows near to turbines, having a depth of about 1 to 1.5 m and a width of not more than 2.5 m. Inside the trenches plastic pipes with diameter of 5 cm for the control cables will be placed on top of the power cables. The power cables will be connected to one or two central 220 kV substations with an area requirement of about 350 m x 150 m on central locations at the eastern border of the usable wind farm areas. It is assumed that such HV substations might be co-financed by the different investors in the area and will be constructed under the control of EETC and operated by EETC. Within the wind park earth roads of about 5 m width will be constructed, consisting of compacted desert gravel material. The compacted area will be enlarged next to each wind turbine to erection platforms with a size of about 25 x 20 m to 25 *40 m for the erection of the wind turbines. The wind park design will exclude major Wadis and steep mountainous areas for Wind Turbine construction. Due to both, the nature of the project and the hyper-arid climate, there is no need for surface drainage.

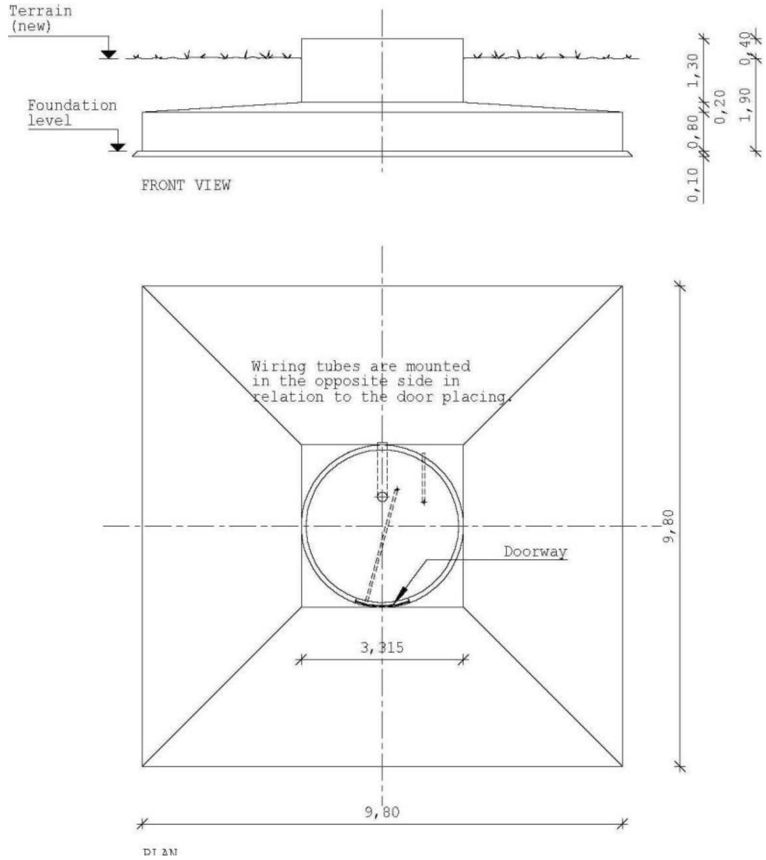



**Fig. 2.3:** Dimensions of a small Wind Turbine Foundation

**Fig. 2.4:** Typical Arrangement of Kiosks and cabling at each Wind Turbine


**Fig. 2.5:** Typical Arrangement of Wind Park Siting Kiosks and cabling to 220 kV SS

While a wind park will extend over the whole area only limited land is used for the construction itself. I.e. estimated considering the major items per MW.

| | |
|---|---:|
| Foundation Area | 400 m²/MW |
| Platforms | 1,000 m²/MW |
| Roads | 2,000 m²/MW |
| Cable Trenches | 1,500 m²/MW |
| **Total** | **3,900 m²/MW** |

Considering a total space requirement of 0.15 km² / MW the area affected by construction works is only 0.0039 km² / MW. I.e. less than 3 % of the overall area is affected by construction work.

In addition, service and control room facilities will be required. Control may take place by remote control routed through a central wind park server. Such Wind Park Server may be established in a small container within the wind park site next to a wind turbine. Service and storage facilities with accommodation facilities of the different investors most likely will be installed outside the project area in reach of water and electricity supply, e.g. in the outskirts of Ras Gharib.

Usually such service installations consist of an apartments building, a central facility (conference room, mosque, cantina), a storage premise (e.g. 30 x 20 m), an open storage area and a small control and office building. Water will have to be taken from the Hurghada – Ras Gharib Nile water pipeline. The number of persons living & working in the area in shifts to operate and maintain the wind park would be not more than 30 for a wind park size of about 200 MW. I.e. the total number of personnel for O&M of the wind parks is estimated to be 100. Accordingly, the amount of domestic waste water generated would be less than 4 m³/d (considering an average per capita consumption of 40 l/d). These small amounts of waste water shall undergo a two stage anaerobic treatment followed by post-treatment of effluents percolated into sandy underground or reuse for irrigation. Sludge would have to be collected every 2 to 4 years (if treatment is properly designed), tried and buried.

Further installations associated to the wind farm would be one or two MT/220 kV substations and the 220 kV overhead-line interconnection to a 500 kV substation near to Ras Gharib to come. Although the routing of the 220 kV line and the location of the 500 kV substation is not yet defined and will have to follow the planning requirements of EETC, these elements are caused by and are part of the wind power development. Accordingly, they are considered as part of the project within the ESIA study.

### 2.3.2 Topographical Restrictions of the Project

While there will be no restriction resulting from foundation bearing capacities there are some topographical features in the area that do not allow a construction of wind turbines in the area such as,

- Wind Turbine construction at major Wadis shall be avoided because they are prone to flash floods, which may occur from time to time, as it can be seen from the Wadi Bed profile. Earth roads to cross Wadi Beds shall be built at the same level as the Wadi Bed to avoid major destructions in case of flash floods, and in the same time not to create any bottleneck for the discharge. This approach also warrants that the few habitats that may exist in some Wadi stretches will remain almost undisturbed.
- The area shows a major inner mountain range that cannot be used for wind turbine construction. Moreover, wind turbine construction in the zones of backpressure and in the lee of the mountain are to be kept free from wind turbine siting.

Furthermore, complex areas were identified, which would require bigger efforts in access and site work construction and therefore should be avoided, if possible.

The differentiation of the area into the respective topographical characteristics can be seen from Fig. 2.2.

## 2.4 Construction Phase: Site preparation & construction measures

Typical works to be carried out for wind power projects in the wind park area itself are limited to:

- Earth works: Excavation, backfilling and compaction works for road and platform construction as well as for foundation pits and trenches. Typical equipment used on the construction site are excavators, front-loaders, graders and compactors. No material will be taken from or to the area.
- Concrete works for foundations. As no water will be available at the site it is expected that either ready mix concrete will be used or the concrete will prepared at a central batching plant within the wind park and all aggregates will be transported to that site. .
- Wind turbine installation works using large mobile lifting capacities.
- Small foundation works and installation of kiosks.
- MT/220 kV substation to be carried out under control of the EEHC/EETC: The works comprise steel structural works, civil works for housing, foundations and trenches and electrical works at medium and high voltage level.
- Construction measures for service and control facilities of the investors (probably outside the wind park area) would be limited to typical house and storage building works.

The erection works of the wind turbines are usually carried out by the wind turbine supplier with a team of own technicians. Civil works and electrical works on the MT and HT lines will probably be carried out by local companies.

For Wind Park construction a temporary construction yard (for storage of materials and servicing of machinery) and a temporary office would be erected at a central place within each wind park site. Such temporary facilities comprise of 4 to 6 rooms with simple sanitary facilities. Water supply would be via tankers. Electricity would be generated by a small mobile generator. Such office building would be for about 20 persons, who, however, spend much time at the construction sites. Proper non-hazardous solid waste management during the construction phase will be the responsibility of the contractor, who shall minimise origin of waste and collect the waste from the site and dispose it of in a regular way. Minor quantities of hazardous waste such as used oil and grease shall be collected and recycled, as it is usually done because of it‘s value.

Construction measures of the investors would be supervised by the investor‘s engineers. Usually international Consultants would be employed for assistance. Such supervision includes the assurance of Contractor‘s proper environmental performance, such as waste management and the proper land reclamation at the end of construction measures. The works and the site personnel have to be supervised by a health and safety engineer, who shall be assigned by the Contractor.

Associated works outside the ―Project Area” would be

- o Construction measures for service and control facilities of the investors outside the wind park area, e.g. near to Ras Gharib, would be limited to typical house and storage building works.
- o Erection of transmission line towers and pulling of wires for the 220 kV interconnection line to a 500 kV substation, to be carried out under control of the EEHC/EETC: Structural steel constructions with small foundations including working activities at heights The routing of the TL and the location of the 500 kV SS has still to be determined.

An exemplary project implementation schedule is enclosed below. The start of the first project would be likely in 2012.

**Typical Wind Power Project Implementation Schedule for a large Project (e.g. 200 MW)**

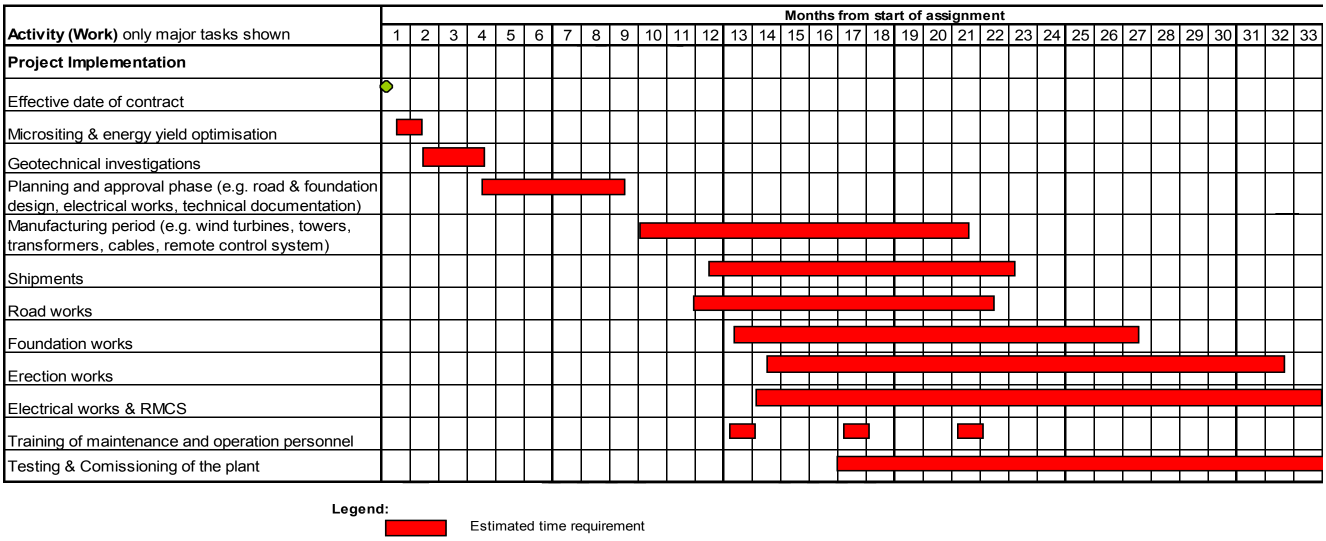



Fig. 2.6: Typical Wind Power Project Implementation Schedule

## 2.5 O&M Phase Activities

Typical O& M services to be carried out during the operation of the wind parks are

- Scheduled maintenance usually every 6 months according to the maintenance plan. Such service comprises a checking of the wind turbine, change of consumables (at certain stages also oil change) and lubrication.
- Trouble shooting, i.e. execution of smaller repairs to restart the turbine after fault stoppage.
- Major repairs such as replacement of major components like gear box, generator, blade.

While scheduled maintenance and trouble shooting are minor activities (only the waste issue of used oil is of significance), the repair or exchange of major parts would require the availability of a large crane, and of heavy transport means.

Other activities are of administrative nature, such as monitoring and control, accounting, etc.

## 2.6 Decommissioning

The wind park is designed for a life time of 20 years. This period might be extended by some time, if the turbines will be well maintained. Decommissioning shall consider the whole wind farm or those parts not any more used, once the decision is taken to stop operation or to re-power the wind park.

The decommissioning shall follow a decommissioning plan. It shall consider all parts of the wind park being out of further use. Turbines shall be dismantled in reverse order of installation. Foundations need to be removed at least up to 1 m below surface, and kiosks and cables shall be from the trenches. All materials shall be either recycled (e.g. tower and rebar steel, copper, aluminum) or shall be disposed off according to accepted environmental standards. Excavation pits shall be refilled and the land shall be leveled to harmonize with the surrounding landscape.

# 3. BACKGROUND INFORMATION

## 3.1 Legislative framework in Egypt

Wind-generated electrical energy is renewable, produces no emissions and is generally considered being environmentally friendly. The environmental protection in Egypt gained a momentum in 1992, when the National Environmental Action Plan (NEAP was adopted. This created the basis for the national environmental policy and the related regulatory framework. Consequently the legal basis for EIA was established by Law No. 4 of 1994, the Law on Protection of the Environment and it's Executive Regulations 1995 (Prime Ministers Decree 338, in which an EIA is required for all electricity project including renewable energies (see Annex 2 to the regulations). The law was amended by Law 9/2009. According to these Regulations the EEAA has the authority for approval of bases and procedures for the assessment of environmental impacts projects. Moreover, according to Article 10 of the regulations “The competent administrative body or the body that grants permits shall assess the environment impact of establishments that are requesting permits, according to the elements, designs, specifications and bases, which are issued by the EEAA in agreement with the competent administrative body”.

Of special relevance for a wind power project are the following annexes to the executive regulations of the environmental Law:

- Annex 2: Establishments subject to environmental impact assessment
- Annex 7: Permissible limits of sound intensity and safe exposure periods.

The law was amended by Law 9/2009 to update the environmental legislation. Major amended issues were:

- An EIA shall be prepared for both, new establishments and expansion of existing establishments.
- The CAA in charge of issuing licences sends the EIA to EEA for evaluation. The EEAA has to comment or communicate its decision within a period of 30 days. Otherwise, the EIA is deemed to be approved. The EEA may request additional information, data or studies. It may approve the EIA or issue a conditional approval defining necessary measures to be implemented by the proponent to avoid negative environmental impacts.
- The EEAA can penalise an investor with fines between 50,000 to 1 Mio. EGP, if conditions imposed by the EIA process would not be implemented.
- The public consultation has been made mandatory for Form C projects, in addition to a public disclosure with an Arabic executive summary.

Further to the Law No. 4 of 1994, the Law on Protection of the Environment, amended by Law 9/2009 and it's executive regulations, the following legal and regulatory framework needs to be considered in case of wind power projects:

- Law No. 38/1967 on Public Cleanliness
- Law No. 93/1966 on Wastewater and Drainage
- Decree No. 44/2000 of Law No. 93/1966.
- Law No. 53/1966 on Agriculture.

Furthermore, legal requirements for wind park construction are defined in Law No. 101/1996 Building Construction and Decree No. 326/1997.

As a signatory state the Government of Egypt has to meet environment protection obligations with regard to the

- Convention on Biological Diversity, (1994)
- Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention, 1979) and the
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

Accordingly, the criteria and conditions defined in these conventions were to be considered for the environmental impact assessment.

There are no national laws and regulations on shadowing/flickering from wind turbines. According to German stipulations (Emission control law) the limit for affecting residencies by shadowing from wind turbine blades is 30 hours per year and/or 30 minutes per day. Moreover, there are neither local nor international standards on the calculation of noise propagation; instead German standards were applied.

## 3.2 Environmental Impact Assessment Process

### 3.2.1 EIA Guidelines

The law and subsequent regulations did not give details on project clusters and corresponding EIA procedures. For that general guidelines for EIAs were issued by the Egyptian Environmental Affairs Agency (EEAA) in 1994. These guidelines available in Arabic only are called ―Guidelines and Basics of Environmental Impacts Assessment, November 1994," and were issued by the Department of Environment of the EEAA. These guidelines classify projects in three groups, i.e. white list projects with minor environmental impact, grey list projects which may result in substantial environmental impacts and black list projects, for which a complete EIA is mandatory due to the magnitude of their potential impact. Wind power and associated power transmission line projects are considered to potentially result in substantial environmental impacts and, therefore, are classified as ―grey list" projects, requiring filling in of Form B for Environmental Screening. However, as known from pervious projects, the EEAA considers large wind power projects as projects, for which a complete EIA is mandatory due to the magnitude of their potential impact.

The General Guidelines define which stakeholders have to be involved in the public participation process, such as

- Land Owner,
- Governorate
- Local public council
- EEAA and it's regional branch
- Representatives of stakeholder groups in the vicinity of the project area such as local citizens or industries.
- Facultative also local environmental groups, universities and/or research centres.

The General Guidelines define a notice period of two weeks prior to the public hearing as a minimum for circulation of the Non Technical Summary of the EIA report in Arabic and invitation of the stakeholders and the advertisement of the public hearing in a local newspaper. Moreover, the Non Technical Summary has to be published 14 days in advance to the public hearing on a web site.

Special guidelines for wind park projects had been issued by the EEAA in 2007. These “Environmental Impact Assessment Guidelines for Electricity Generating Wind Farms” define the EIA process, the structure and content of the EIA report with special consideration of specific impacts likely to originate from wind power development projects. This ESIA study basically follows these guidelines. Accordingly, this study is structured as per the list of contents defined in the guidelines.

### 3.2.2 Equator Principles

Most international financing institutes committed themselves to comply with the Equator Principles. Accordingly, to meet the international financing requirements, it must be assured that the EIA assessment process must satisfy the requirements of the Equator Principles. Major issues to be considered are

- the social and environmental assessment process with regard to
  - completeness of the assessment process according to the minimum performance standards set forth in the IFC “Environmental, Health, and Safety Guidelines for Wind Energy” as well as in the IFC “Performance Standards on Social and Environmental Sustainability”.
  - compliance with national laws, regulations and permits that pertain to social and environmental matters,
  - adequacy of addressing and valuation of the relevant social and environmental issues for the wind park construction and the operation phase (including labour, health and safety aspects) and with special emphasis on possible irreversible and/or significant impacts (e.g. to fauna such as to birds, bats; noise emissions, shadowing) .
- the action plan and management system with regard to
  - completeness of the plan in addressing the relevant findings, and in drawing conclusions of the assessment,
  - adequacy of definition and prioritising of actions to manage the identified impacts and risks during the implementation and operation phase,
  - adequacy of contents, organisation, staffing and budgeting of the social and environmental management system to manage impacts, risks and corrective actions,
  - adequacy of the grievance mechanism, to be introduced in the course of the community engagement process in case of significant risks and adverse impacts, allowing a prompt and transparent addressing of concerns of affected communities throughout the project construction and operation phase.
- consultation documents with regard to
  - adequacy of procedures such as public disclosure of project planning, reasonable minimum periods for public commenting as well as advertising and execution of public hearing,
  - soundness of documentation of the different consultation steps giving evidence on the implementation process and on actions agreed,
  - adequacy of appreciation and consideration of arguments.

Major issues to be addressed in addition to the Egyptian EIA process are early stakeholder participation and social aspects and grievance mechanism, the latter in case of significant risks and adverse impacts to communities only.

### 3.2.3 The EIA and Permitting Process

The CAA in charge of issuing licences in case of wind power projects is the Ministry of Electricity. Provided it is decided to undergo a full impact assessment, the EIA approval process can be subsumed as follows:

- CAA sends the EIA to EEA for evaluation.
- EEAA evaluates the EIA within 30 days.
- EEAA either
  - Approves the EIA, or
  - Issues a conditional approval defining additional requirements to be fulfilled by the proponent,
  - Rejects the EIA, which might be appealed within 30 days.

Further permits required in addition to the Environmental Permit to be obtained through EEAA according to Law 4/1994 for the erection and operation of a wind park are:

- Construction and operation permit for private investors obtained through the Regulatory Board for the Electric Utility and Consumer Protection Agency established per Presidential Decree No. 326/1997 for construction, operation and electricity generation,
- Construction Permit acquired through the Red Sea Governorate according to Law 101/1996 to obtain authorisation to construct wind farm buildings,

## 3.3 Methodology

The scope of the environmental and social impact assessment had been determined by NREA and KfW and was laid down in the TOR for this study. Accordingly, a specialist study had to be carried out for assessment of impacts on migrating birds and bird habitats that might result from wind park construction and operation (see Annex 1). Therefore, a full spring and autumn ornithological field monitoring had been carried out during the year 2010 for the overall project area.

Further baseline investigations were carried out with regard to competing uses, landscape and geomorphology as well as with regard to flora & fauna. In detail these investigations were

- A reconnaissance survey to assess the present land-use, infrastructure and geomorphology in the area was carried out in July 2010.
- Field surveys on fauna (except avifauna) and flora were carried out for representative transects by local experts (EcoConServ).
- Further field surveys to deepen the finding of flora and fauna (except avifauna) were carried out by ecoda specialists.

The findings of the reconnaissance survey were compiled in a ―Project Design Document" (see Annex 2), which was used for early stakeholder information and initiating the stakeholder participation process. The project design at that stage did not consider eventual restrictions, resulting from the ornithological investigations, which were completed lateron. Accordingly the results of the ESIA are more restrictive than outlined in the ―Project Design Document".

The environmental and social impact assessment for the ―1,000 MW wind park area" is further based on a desk study assessment with regard to

- nationally or internationally designated nature conservation areas that might be in conflict with the project purpose,
- protected/threatened/rare species of flora/fauna expected to be present in the area,

- physical environment mainly concerning topography and geomorphology of the greater area, climate, geology & seismology, hydrology.

## 3.4 Consultation

### 3.4.1 Early Stakeholder Participation

To meet Equator Principle Requirements an early stakeholder participation has been initiated. For this purpose a "Project Design Document" (see Annex 2) has been prepared and distributed for information at the beginning of September 2010 by delivery with receipt confirmation. The closing date for receiving comments was End of September 2010. Stakeholders were identified considered the General EIA Guidelines as follows:

| **Designation** | **Address** | **Received by Stakeholder** | **Comments received until September 30th, 2010** |
|---|---|---|---|
| Chairman<br>Egyptian General Petroleum Corporation (EGPC) | Palestine Street part 4,<br>New Maadi, Cairo, Egypt<br>Fax: 702 88 13 / 703 14 57<br>E-mail: info@egpc.com.eg | Sep 1st, 2010 | None |
| Chairman<br>Gulf of Suez Petroleum Company | Palestine Street 4th<br>New Maadi, Cairo, Egypt<br>Tel +202-702 0985 | Sep 6th, 2010 | None |
| The Manager for Assistance Services<br>Gulf of Suez Petroleum Company | Ras Shukheir | Sent Aug 30th 2010 and signed for receipt | None |
| General Secretary<br>Red Sea Governorate | Dahar-Hurghada | Sep 2nd, 2010 | Comments see below |
| General Manager of Environmental Department<br>Red Sea Governorate | Dahar-Hurghada<br>Tel: 002 065 3546892<br>E-mail:<br>info@redsea.gov.eg | Sep 2nd, 2010 | None |
| Chairman<br>Egyptian Environmental Affairs Agency (EEAA) | 30 Misr - Helwan Agricultural Road - Maadi - Cairo, Egypt<br>P.O. Box 11728<br>Tel: 25256452<br>Fax: 25256490 | Sep 5th,2010 | None |
| Chairman<br>Ras Gharib City Administration | Ras Gharib | Sep 5th, 2010 | None |
| Chairman<br>Ras Gharib<br>Local Council | Ras Gharib | Sep 5th, 2010 | None |
| Swalam Amen Family | On site | Sep 5th, 2010 | None |

Except the Swalam Amen Family (Bedouins), nobody is living inside the project area and even the next settlements are about 10 km away from the project borders at the outskirts of Ras Gharib. Nevertheless, the local council and the Ras Gharib City administration had been considered as being stakeholders. The two oil companies working outside the 200 km² project area were addressed as the easiest access to the area is via their concession areas on roads built and guarded by them.

Except from the General Secretary of Red Sea Governorate no comments were received. The comments of the General Secretary contained a general advice on issues to be followed up within the frame of the ESIA study. The comments and suggestions for the EIA study are summarized as follows:

Suggestions for the EIA study:

1. Take care of description of the area with regard to the population and roads in the area
2. Environmental issues to be taken care of:
   - Impact related to the turbine like colour, height and numbers. We advise for having natural views when choosing turbine locations, size and design.
   - Electrical lines shall be underground
   - Taking care of engineering criteria and applying international design criteria for noise abatement
   - Taking care of any effects to the fauna such as bird collision
   - Taking care of shadowing and flickering affecting populated areas and cars. Sun reflection can be avoided through painting.
   - Taking care of interaction between electromagnetic interference with radar, mobile phone communication and wireless.
3. Take care of environmental impacts during preparation and construction such as excavation, fuel transport, concrete making.
4. Preparation of environmental monitoring programme to collect data to reduce the environmental impacts and record any collision of birds with wind turbines (Post monitoring)

A documentation of the documents is enclosed in Annex 3.

### 3.4.2 Public Hearing

A public hearing was held in Hurghada at 21st of September 2011. A total of around 80 participants of various stakeholders participated in the Public Hearing. The public hearing had been prepared by advertisement in the relevant public organ three weeks in advance. As advertised, an Arabic version of the non technical executive summary had been made available simultaneously through establishment of a download facility. Moreover, important stakeholders had been directly invited and provided with the non technical executive summary.

Detailed information and documentation on procedures and execution of the public hearing and the discussed key issues are given in Annex 5. During the discussions no new concern or argument on environmental or social issues appeared that had not already been addressed in the draft ESIA document. Thus, there was no need of weighing of arguments and adjustments or additions. The public hearing was mainly dealing with clarifications and creation of a better understanding of limits defined in the ESIA study, specifically in the Environmental Management Plan (EMP).

## 3.5 Consideration of Alternatives and Justification of the Project

The use of renewable energies is considered to be an environmentally compatible form of electricity supply. It saves $CO_2$ emissions and contributes to resource conservation such as the indigenous oil and gas reserves. Accordingly, and in line with the policy of the Egyptian Government, the renewable energy shall increasingly substitute conventional power generation, i.e. up to 20 % of the total electricity generation by 2020.

Considering that the hydropower potential has almost been fully exploited, the utilization of wind energy is the best choice in case of Egypt. The utilisation of solar power would be an alternative but at significantly higher cost than wind energy.

In general wind power projects have to be developed at areas with good wind conditions. The availability of areas with high wind power potential in Egypt is limited. Previous wind measurements next to the area revealed that the ―1000 MW project area" avails of a very high wind power potential.

The Project Area is part of a greater area dedicated by presidential decree to wind power development. The driving criteria for selecting the area were

- the area is free from competing uses,
- the area is presumed to be one of areas in Egypt with the highest wind power potential,
- the area mostly consist of vast desert grounds and very few vegetation being considered to be of limited ecological relevance
- the geomorphology of the area is favourable for wind power development requiring limited construction and landscape modification measures
- the access to the area can be considered to be easy requiring only limited road construction measures.

Currently, no equivalent alternative areas for wind power development can be made available.

**The 0-alternative**

The no-action alternative would result in an increased deficit between electricity demand and actual power generation. The corresponding amount would have to be supplied to the grid by conventional power stations. The $CO_2$ free renewable electricity generation would have to be mainly compensated by natural gas or heavy fuel oil fired power plant generation with significant $CO_2$ emissions, thus counteracting to emission control goals. Moreover, the high capacity factor of the wind power potential would signify a small firm generation capacity, which can be considered to substitute investments into conventional power generation capacity to meet future demands.

# 4. THE EXISTING ENVIRONMENT

## 4.1 Overview of existing environment

The Project Area is a desert area without any vegetation, except small spots of isolated vegetation at Wadi banks or in major Wadis. The area is crossed by major Wadis, which are from North to South the Wadi Khurayum, Wadi Um Jasan, Wadi Gharib, Wadi Khurm and Wadi Jarf in the South. The watersheds of the Wadis extent to the Gabel Ras Gharib Mountain of about 1750 m a.s.l. The Wadi cross-sections have a pronounced profile. The big dimensions of the Wadis and erosion channels in the Wadi beds are evidence for discharge in the Wadis that occur from time to time. The discharge may have the form of flash floods. One flood has been reported in the Year 2001.

Taking climate data from the nearest long term operated weather station (i.e. Hurghada), the area can be characterised by average maximum temperatures ranging from 20 C° (January) to 33 °C (August) and average minimum temperatures ranging from 13°C (January) to 28 °C (August), relative humidity in the order of 30 to 40 % and a zero cloudiness almost all through the year. Wind speeds can be derived from NREA‘s own measuring stations. Extreme gust wind speeds at 50 m above ground are in the order of 35 m/s. The average wind speed at 50 m height is about 10 m/s. Rainfall is very sporadic in this hyper-arid area. It is variable from year to year and characterized by its irregularity both in time and space. Due to the special landscape feature with the 1750 m high Gabel Ras Gharib, average precipitation should be somehow higher than measured in Hurghada (4 mm).

A reconnaissance has been carried out in June 2010. The project area shows mainly desert gravel plains, but contains also zones of undulated land and mountains elevated about 100 m above the surrounding in the South-West (see Fig. 2.2). The ground surface of the desert plains and the undulated land, i.e. most of the area, is covered with compact angular gravels and pebbles forming a so called desert armour. The level of the whole project area above sea level ranges from 50 m a.s.l. in the East to 250 m in the North-West. The inner mountain top is 285 m a.s.l., elevated by about 100 m above the surrounding. The mountain area and its shade area have to be kept free from wind park utilisation for technical reasons. Moreover, the beds of the major Wadis listed above shall be kept free from siting to safeguard the plant from seldom flash floods and to avoid any negative impact to single habitats that can be spotted inside the Wadis.

Further characteristics of the area are:

- **Land use:** Land use within the project area is limited to a system of water wells with the related infrastructure such as pumps, pipes, MV electricity supply and roads almost in the middle of the project area associated with a few huts (Bedouin family with about 20 Nos.) formed out of palm tree leaves and an irrigated palm-tree garden of about 50 x 70 m (see Fig. 2.2). Adjacent to the eastern part of the area oil production takes place at distances of about 1000 m from the border.
- the area does not contain any **habitats** of significance (natural or man made) for flora and fauna except the palm tree garden in the Centre of the area.
- Missing vegetation except few small desert grasses at Wadis and very scarce fauna not considering avifauna; no rare or endangered species; the area is near to a major bird migration route with endangered and protected birds. A considerable number of migrating birds were observed during the spring sea-

son 2010 passing the area.

- **Infrastructure:** The project area has no infrastructure except asphalt and gravel roads to the water wells with the associated electricity supply, water pipelines and water (see Fig. 2.2) operated by GPC. Access to the area from the Suez- Hurghada road (a four lane road) via GPC owned 4 m wide asphalt roads and some unpaved roads, that would need to be reinforced; alternately access by earth road to be built from the Ras Gharib – Nile Valley road in the North; there is not any bottleneck with regard to traffic/heavy transport capacity on public roads up to the exit to the area.
- Not any utility services in the area; the transmission water pipeline (Nile water) is routed on the western side and in parallel to the Suez – Hurghada road, i.e. about 7 km away from the nearest study area border
- The next settlement is the outskirts of Ras Gharib at a minimum distance of 13 km from the north-eastern border of the project area.
- The area does not contain any **historical sites** or **environmental protection areas, or is located inside or nearby a protected area**.
- Not any antiquities or other sites of historic and cultural significance in the overall area.
- No **surface water** except discharge in the major Wadis that may occur quite seldom.
- Littering of **waste** originating from far away, such as plastic bags or packing material, which is blown by the northern winds through the desert.
- **Air quality** affected by dusts having their origin in the desert itself and caused by strong winds; no acidic emissions from flare gas burning or unburned flare gas from the near-by GPC oil field was realised, as wind is generally not blowing from the oil fields in the North-East.
- **Natural high noise level** during frequent strong winds; no man made noise emissions in the area.

## 4.2 Land characteristics and use

### 4.2.1 Climate

The project area is located at about 33°E and 28°N between the red sea mountains and the Gulf of Suez within the arid zone of Africa. While the area itself can be classified to be hyper-arid further to the West at the mountains seldom strong rain is expected, causing runoff through larger Wadis towards the Gulf of Suez.

The climate is dominated by a wind circulation system from northern high pressure to southern low pressure systems all over the year, causing wind blowing from northerly directions. Due to the channel effects of the Red Sea and the Sinai mountains the strength of the winds is enforced and the direction is pronounced. Accordingly, in the project area the dominant wind direction is from northwest in parallel to the mountain ranges. Winds are stronger and more stable blowing from northwest during summer, when the pressure gradients are more pronounced. During winter winds may turn to the South during some days. However, southerly wind is blowing at reduced strength.

For describing the general climate 20 year average data from the next meteorological station at Hurghada, about 120 km to the South, can be taken:

Table 4.1 Monthly averages at the Hurghada Meteorological station

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Average (C)** | 15.6 | 16.5 | 18.9 | 22.4 | 25.8 | 28.5 | 29.5 | 29.6 | 27.7 | 25 | 20.7 | 17.1 | 23.2 |
| **High Temperature (C)** | 20 | 21 | 24 | 27 | 32 | 34 | 36 | 35 | 33 | 29 | 25 | 22 | |
| **Low Temperature (C)** | 11 | 12 | 14 | 18 | 22 | 25 | 27 | 27 | 25 | 22 | 17 | 12 | |
| **Rain (mm)** | 0.1 | 0.4 | 1 | 0.1 | 0.1 | 0 | 0 | 0 | 0 | 0.2 | 0.4 | 1.2 | 3.9 |

The average maximum temperatures in the area are ranging from 20 C° (January) to 33 °C (August), the average minimum temperatures from 13°C (January) to 28 °C (August). The average temperature varies between 29.6 °C in July and 15.6 °C in January (Measurements near to the project area showed that temperatures are usually about 1.5 °C less than in Hurghada). The absolute maximum temperature for the project area can be taken from the 7 year data series of the El Zayt NW measuring station (measured about 50 m above sea level at a distance of about 20 km to the project area). This was 43 °C. The relative humidity is in the order of 30 to 40 % and there is a zero cloudiness almost all through the year.

The average annual precipitation is about 4 mm in the winter months. Rainfall is very sporadic in this hyper-arid area. It is variable from year to year and characterized by its irregularity both in time and space. Due to the special landscape feature with the 1750 m high Gabel Ras Gharib in the neighbourhood, average precipitation is presumed to be higher in the mountains. Heavy rains in the mountains can cause flash floods in the major Wadis such as Wadi Khurayum, Wadi Um Jasan, Wadi Gharib, Wadi Khurm and Wadi Jarf in the South. There is no statistical evidence on the occurrence interval of such rains. From verbal information received it is guessed that it should be of an order of once in 10 years. Accordingly, wind turbines, even if with protected foundations, shall not be placed inside the beds of larger Wadis.

Wind speeds can be derived from NREA's own measuring stations, especially GoZ1, measured at 50 m height, which is about 5 km to the East of the southern part of the project area. The monthly averages are show in Fig. 4.1. The bolt line shows the long term trend at a 25 m high measuring station about 30 km in the South-east. The average wind speed is more than 10 m/s. At GoZ1 the average wind speed at 50 m height is about 10.5 m/s. Wind is mainly blowing from Northwest, i.e. about 45 % of the wind is from WNW, 35 % from NWN, 10 % from North, 5 % from West and 5 % from South (see Fig. 4.2). Extreme gust wind speeds at 50 m above ground are expected to be in the order of 35 m/s.

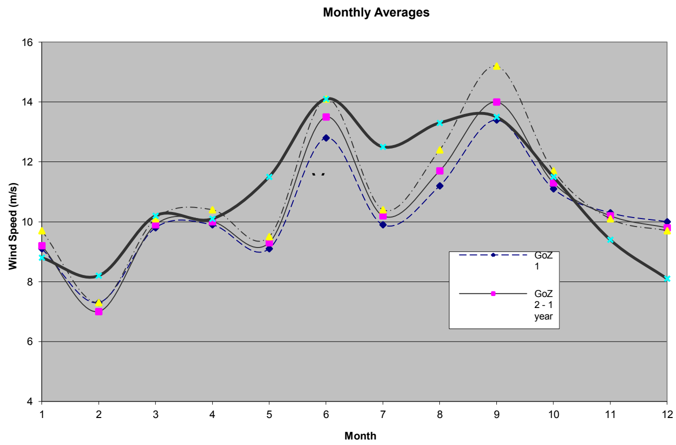



**Fig. 4.1:** Monthly average wind speeds at three NREA measuring stations

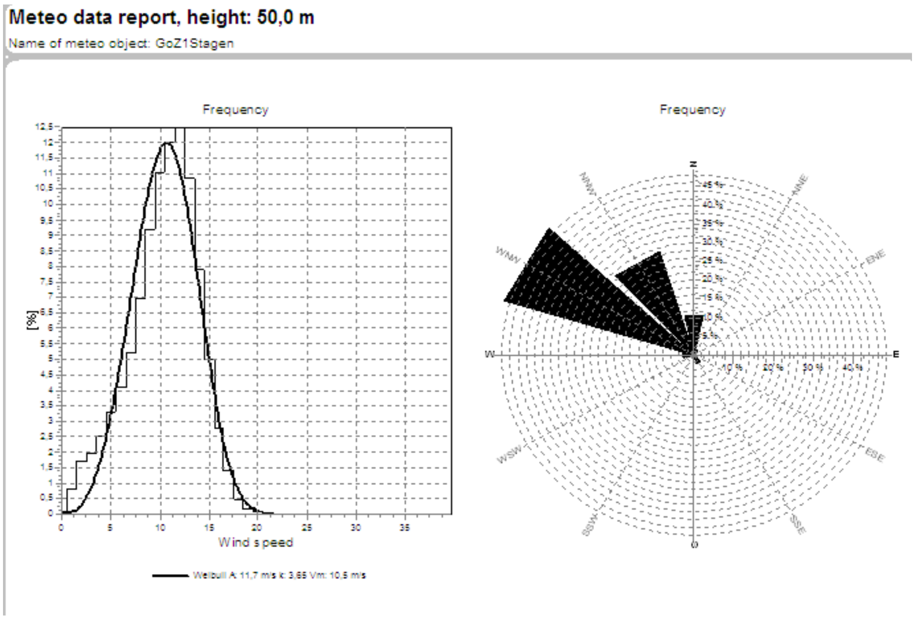



**Fig. 4.2:** Wind speed frequency distribution and wind rose at GoZ1

Winds are usually not blowing from the sea side. Nevertheless, as the desert grounds have high salt content the climate has to be considered to be aggressive.

It is noteworthy that the natural conditions, especially the drastic dry and windy conditions, are very much limiting the biodiversity of the site:

- In exceptionally rainy years, runoff water is being collected in low parts, what may lead to the growth of some plants. However, these plants are subjected to long dry periods leading to their death.
- The high wind velocity in the site plays an important role in the severe erosion of the soil. The ground surface in the site is mainly covered by compact layer of pebbles and gravels. These represent desert armour, which prevents the permeation of rain water or spilled water to the subsoil. The high wind velocity removes the seeds and other prop gules. So, the chance for seeds to germinate and establish themselves is very poor.

## 4.2.2 Geomorphology and Geology

The area can be characterized by

- Almost flat plains in the northern part (about 40 % of the area) intersected only by major Wadis,
- An undulated part with a more complex geomorphology and even a mountain range 100 m elevated above the surrounding in the middle (about 40 % of the area),
- The area in the South, which is consisting of a mix of undulated topography and plains (20 % of the area)

**Fig 4.3:** Typical surface materials in the area

Most of the area is covered with compact angular gravels and pebbles forming a so called desert armour (see Fig. 4.3). The size of the pebbles is around 30 – 50 mm. The level of the whole project area above sea level ranges from 50 m a.s.l. in the East to 250 m in the North-West. The inner mountain top is 285 m a.s.l.

As shown in Fig. 4.4, most of the study area is formed by Miocene that consists of a basalt clastic section overlain by a carbonate unit. Along the Gulf of Suez clastics, gypsum and carbonates are dominant. At the eastern side of the project area raised Pliocene marine beds of the red sea are met. Further portions in the East and in the North-West of the area consist of Quaternary alluvial deposits derived from erosion of raised beaches and corals at the Red sea coast.

The area is not affected by fault lines. Studies of Said, R, 1990: The Geology of Egypt, ELSEVIER, Amsterdam, confirm that the frequency of shallow earthquake occurrences in the Gulf of Suez during the period of 1953 to 1981 was low. Tectonically, the Gulf of Suez is located in the stable shelf of Egypt. In any case the design loads of an IEC Class Ia turbine, that would have to be used for wind power development in that area, would well cover the seismic peak ground acceleration loads induced by earthquakes with low and medium strength.

In general the surface and underground conditions are judged to have good bearing conditions and to be favorable for tower foundation construction. Except smaller soil improvement measures at areas where the Gypsum reaches the surface layers, the geological conditions will not require major construction measures that might be adverse to the environment.

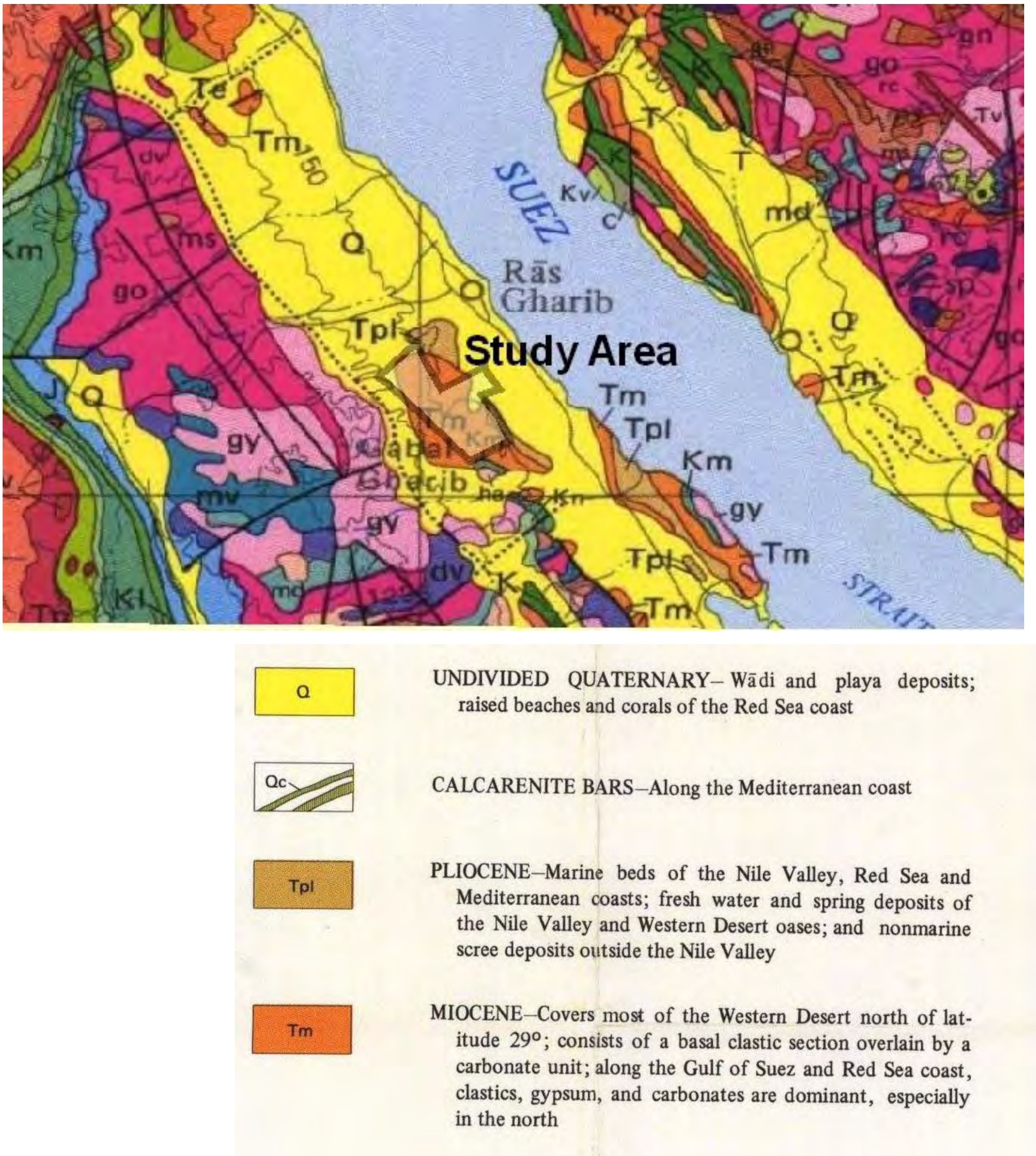



**Fig. 4.4:** Geological features in the area – Excerpts of the Geological Map of Egypt

### 4.2.3 Land use

**Land use:** There is very limited land-use within and in the vicinity of the project area. The land use is shown in the Fig. 2.2:

- A system of water wells with the related infrastructure such as pumps, pipes, MV electricity supply and roads.

**Fig. 4.5:** Water pumping, water pipeline, buried MV cable and access road

- In the centre of the area a Bedouin family has established it domicile and used the water well water to raise a small palm tree garden (about 50 m x 70 m. According to verbal information the family has about 20 family member and is living there and growing the palm tree garden (in Fig. 2.2 designated as Oasis) since about 30 years.

**Fig. 4.6:** Man made “Oasis” irrigated by pumped water

- One oil exploration and production concession of the GPC is adjacent to the eastern part of the project area. Distances between the border of the project area and active production wells are more than 1 km . Nearby temporary (containers) office facilities are established at a distance of about 1200 m to the eastern border of the project area. No actual activities in the oil fields outside the north-eastern part of the project area were observed. Its designation in the topographical map is “oilfields unused”.


**Fig. 4.7:** Activities in the oil fields of GPC more than 1 km outside the project area

- Just outside the area in the South another water well field is operated by the Gulf of Suez Petroleum Company (GUPCO). In a small hut about 700 m outside the project area a Bedouin family is living (6 persons) as guards of the wells. One well extents inside the project area but is out of operation.

**Fig. 4.8:** Guard family living about 1 km south of the project area

## 4.3 Landscape character and existing views

A general investigation of the landscape was carried out during a reconnaissance in June 2010. A summary is compiled as Annex 2 –Area Reconnaissance – Photo Documentation". The landscape shows typical desert areas of extended plains, undulated –dune" and mountainous areas. It has no specific character that need to be maintained.

## 4.4 Terrestrial flora and fauna (excluding birds)

The study area is characterized by the exceeding aridity of the desert climate and a relief basically consisting of gravely and pebbly plains. Accordingly, its potential to serve as a habitat is extremely low. Within an area further south, there are a few spots displaying a little vegetation (Decon/Fichtner 2008), the variety of species to be found being very low.

The fauna of the study area is believed to be very sparse, too. Within an area further south only a few species of insects, reptiles and mammals could occasionally be recorded (Decon/Fichtner 2008).

### 4.4.1 Methods

A separate survey on flora and fauna was carried out during periods of 3 to 4 days, each in spring and autumn 2010, by a local environmentalist.

Due to the large size of the study area it was not possible to cover the entire area in detail. The assessment of the flora had therefore to be restricted to areas surrounding existing tracks, sites used for bird observations (see Chapter 4.5.1) and paths used to reach these sites. In a first step the study area was scanned for spots with vegetation using binoculars. Located spots were investigated in more detail. The focus of the survey was on habitat features, plant life, including identification of present species, their distribution and their assemblage in plant communities. Moreover, a team of ornithologists who are very experienced in flora did several site visits to record and map plants in spring (from April, 06th to 17th).

With regards to the survey on fauna, a combined transect- and point-count method was implemented using direct observations. The local expert slowly drove along the paths several times in search of present animals. At certain locations the surrounding was scanned for animals and studied in order to find burrows or scats that indicate the presence of animals. Moreover, additional data on animals was gathered during the ornithological field study.

Additionally, two inspections restricted to the surrounding of the oasis were done at night. In order to investigate the presence of bats a bat-detector (Pettersson 240x) was used that allows both, the detection of bats sounds and the identification of species. A stationary voice box (System Laar TDM 7C) was installed near the oasis during some nights. The voice box is able to record ultrasonic signals and to store them digitally. Using these systems, data on bat activity during the whole night could be obtained.

Finally a review of the literature and available databases relevant to the study area and the ecosystem characteristics of the region was done.

### 4.4.2 Results

#### *4.4.2.1 Flora*

All of the different natural habitats of the arid environment of the Red Sea desert plains are characterized by a low number of species which have unique adaptations to the harsh physical and climatic conditions of the desert (high temperatures and little, if any, regular rainfall). Floral species show very patchy and relatively poor distribution corresponding with landscape characteristics such as rocky outcrops, dunes and Wadis, where patches of permanent vegetation can be found. A detailed account of the vegetation types of the Red Sea coastal land of Egypt can be found in Kassas & Zahran (1967, 1971), Zahran & Willis (2009) and Zahran (1962, 2010). Here the authors mention several different plant communities in this area that depend on the water available and the exposure to salt.

The cover of vegetation within the study area generally has a low species composition, density and distribution and is mainly restricted to depressions and Wadis. Plants found in the monitored area were mostly limited to very sparse communities of *Ochradinus baccatus*. These woody communities are widely distributed and can be found throughout the Arabian Desert, the coastal desert plains of the Red Sea and in the Sinai Peninsula. In the study area, *O. baccatus* was found mostly in loose groups of bushes mainly at the observation sites C, D, and G (Fig. 4.9).

The second most noticed plant was *Zygophyllum coccineum*. It belongs to the succulent half shrub community which is also widespread in the arid zones of Egypt. *Z. coccineum* is the most widespread *Zygophyllum* species in Egypt and grows in diverse habitats and different types of soil. It is very common in limestone Wadis and plains of the Eastern (Arabian) desert and tolerant of saline soils. As this plant is unpalatable, it is not grazed by animals. Loose stands of this succulent xerophyte can mainly be found in the study area at the observation sites F and B (Fig. 4.9). In the study area it is often accompanied by the halophytic succulent leafless *Haloxylon salicornicum*, which forms its own communities in uncultivated desert areas and in the coastal mountains.


**Fig. 4.9:** *Ochradinus baccatus* near site C *Zygophyllum coccineum* near site B

The only not cultivated, *i.e.* naturally occurring trees found in the area are some stands of *Acacia tortilis* ssp. *raddiana*. This tree belongs to the family of the Mimosaceae and is a keystone species growing across arid ecosystems in Africa and the Middle East, from moist savannas to hyper-arid deserts. It is of importance for people and their domesticated animals, improves soil fertility and increases biodiversity (HOBBS 1989, BELSKY 1994, KRZYWINSKI & PIERCE 2001, MUNZBERGOVA & WARD 2002). In Egypt, *A. tortilis* spp. *raddiana* grows in desert Wadis and sandy plains, usually in water catchments areas at the Red Sea coast, the Eastern Desert, Gebel Elba, and Sinai (BOULOS 1999). Three stands of this *Acacia* tree were found in the surveyed area in the present investigation. One small tree was set up at the oasis (see below), another larger one a few hundred meters south-west from observation site F together with several bushes of *Z. coccineum* (Fig. 4.10). About one kilometer south-west from observation site E another single small tree and a few hundred meters south-west the westernmost water pump at Wadi Gharib (outside the study area) two trees were found. A small group of several trees is located at the edge of Gabel Gharib outside the study area. Moreover, a local guide testified to the existence of some *Acacia* trees outside the study area near the southern and south eastern border.

**Fig. 4.10:** *Acacia tortilis near site F* *Stipagrostis plumose*

*Stipagrostis plumose* (Fig. 4.10) was seen in the southern part of the study area, inside Wadis as well as near observation site D. This species includes the subspecies *Cyperus conglomerates*, which also exists in the study area.

One dry and a few dead specimen of *Handal* or *citrullus colocynthis* (L.) Schrad were encountered near observation site E. Moreover, three other specimens (two dry and one vital) were found close to observation site A (Fig. 4.11).

All mentioned species are considered in the IUCN red list as to be of least concern.

In addition to scarce natural vegetation, there is cultivated land, i.e. an oasis in the eastern part of the study area (Fig. 4.11). This constitutes a green area less than 2,500 $m^2$ in size. It is reported to have been created more than 20 years ago by a "Bedouin Guard" by diversion of some pipeline water for the oil company near the spot. The Bedouin family now consists of 15 to 20 people. The oasis represents a very important resting point for desert cruises and has created an artificial shelter or habitat for a relatively high number of species, including birds, seeking food, water and shadow. This land is cultivated with unorganized typical farmland plants such as date palms, olives, Ziziphus and a few other field crops.

Additionally, water pipelines of GPC oil company are found around this area (see Fig. 2.2) A number of patches of vegetation are found around the sources of minor leaks from these pipelines.

**Fig. 4.11:** *Handal colocynthis near site A* Oasis in the eastern part of the study area

### 4.4.2.2 *Fauna (except birds)*

Mammals

Few mammals have been documented in the study area during the field work, indicating that diversity and density is very low because of the harsh living conditions in the desert. However, most animals are active at night, possibly another reason for the limited numbers of records. Moreover, aestivation is an adaption to very hot summer periods in several rodent species. Another reason for the low numbers of recorded mammals might be hunting. Ammunition cartridges are occasionally found in the study area and a shot Desert Red Fox (*Vulpes vulpes pusilla*) was discovered near the oasis. Some single Red Foxes were more or less regularly observed near the Highway M65 heading from Suez to Hurghada. Based on the literature it is also suspected that wolf-like Egyptian Jackal (*Canis aureus aureus*) and Rueppel´s Fox (*Vulpes rueppellii*) cross through the study area.

Around Ras Gharib and at the control post of the access to the study area, domestic dogs (*Canis lupus familiaris*) were seen regularly. They look for something to feed on which mostly is the rubbish and waste from human settlements. Some were seen outside the study area to run along the pipelines near the highway to feed on careless roosting animals that can be small birds or reptiles.

**Table 4.2:** Recorded and expected mammals within the study area

| **Order** | **English name** | **Scientific name** | **Area** | **IUCN*** | |
|---|---|---|---|---|---|
| | | | | **Red List** | **Population trend** |
| Predators (Carnivora) | | | | | |
| | Desert Red Fox | *Vulpes vulpes pusilla* | Oasis, Highway M65 | least concern | stable |
| | Rueppel's Fox | *Vulpes rueppellii* | ? | least concern | unknown |
| | Egyptian Jackal | *Canis aureus aureus* | ? | least concern | increasing |
| | Domestic Dog | *Canis lupus familiaris* | Eastern Desert, Ras Gharib | - | - |
| | Domestic Cat | *Felis catus* | Ras Gharib | - | - |
| Rodents (Rodentia) | | | | | |
| | Egyptian Jerboa | *Jaculus jaculus* | ? | least concern | unknown |
| | Greater Egyptian Gerbil | *Gerbillus pyramidum* | ? | least concern | stable |
| | Lesser Egyptian Gerbil | *Gerbillus gerbillus* | ? | least concern | stable |
| | Cape Hare | *Lepus capensis* | ? | least concern | decreasing |
| | Bush-Tailed Jird | *Sekeetamys calurus* | ? | least concern | stable |
| | Sundevall's Jird | *Meriones crassus* | ? | least concern | unknown |
| | Cairo Spiny Mouse | *Acomys cahirinus* | ? | least concern | stable |
| | Golden Spiny Mouse | *Acomys russatus* | ? | least concern | unknown |
| | Black Rat | *Rattus rattus* | Ras Gharib | least concern | stable |
| | Brown Rat | *Rattus norvegicus* | Ras Gharib | least concern | stable |
| Bats (Chiroptera) | | | | | |
| | Desert Pipistrelle | *Hypsugo ariel* | Ras Shukeir | data deficient | unknown |
| | Kuhl's Pipistrelle | *Pipistrellus kuhlii* | Ras Shukeir | least concern | unknown |
| | Rueppels'Pipistrelle | *Pipistrellus rueppellii* | Ras Shukeir | least concern | unknown |
| | Botta's Serotine | *Eptesicus bottae* | Ras Shukeir | least concern | unknown |
| Even-Toed Ungulates (Artiodactyla) | | | | | |
| | Dromedary | *Camelus dromedarius* | Eastern Desert | - | - |
| | Nubian Ibex | *Capra ibex nubiana* | Wadi Abu Marwa | vulnerable | decreasing |
| | Dorcas Gazelle | *Gazella dorcas* | ? | vulnerable | decreasing |
| | Barbary Sheep | *Ammotragus lervia* | ? | vulnerable | decreasing |

* See: IUCN Red List of Threatened Species Version. 2010.4; downloaded March, 16th 2011

Rodents have not been observed in the study area, but signs left by these animals lead to the conclusion that rodent species do occur. Species present in the area or at least strongly suspected to live in the area are the Lesser Egyptian Jerboa (*Jaculus jaculus*), the widespread and abundant Greater and Lesser Egyptian Gerbil (*Gerbillus pyramidum*, *Gerbillus gerbillus*) and the nocturnal Cape Hare (*Lepus capensis*) (OSBORNE & HELMY 1980, HOATH 2003). The former three species could occur in numbers, while it is estimated that the latter one needs more vegetation than currently found.

During site visits at night no bats were detected. Moreover, no bat calls were recorded by the used voice box. A brief bat survey was carried out in 2009 at Ras Shukeir near ponds in the sewage farm. Four species occurred there: Desert Pipistrelle (*Hypsugo ariel*), Kuhl‘s Pipistrelle (*Pipistrellus kuhlii*), Rüppel‘s Pipistrelle (*Pipistrellus rueppellii*), and Botta‘s Serotine (*Eptesicus bottae*).

During bird watching observations different numbers of dromedary (*Camelus dromedarius*) straying in groups up to nine individuals or singly through the area were recorded irregularly. They were also seen roosting near observation site E and feeding on patches of vegetation. Another artiodactyl mammal that could occur in and around the area is the Nubian Ibex (*Capra ibex nubiana*). Nubian ibexes live in rough dry mountainous terrain where they eat mainly grasses and leaves. One Ibex was seen far in the South at Wadi Abu Marwa, but it could potentially occur everywhere in the Red Sea Mountains and around Gabel Gharib. Other larger herbivore species known to once have inhabited the Eastern Desert, like the Dorcas Gazelle (*Gazella dorcas*) and the Barbary Sheep (*Ammotragus lervia*), are unlikely to occur in the study area.

Reptiles

According to Baha el Din (2006) about 15 to25 species of the herpetofauna can be expected between Ras Gharib and Gabel Gharib.

During site visits no amphibians, crocodiles or turtles but eight species of lizards and two species of snakes were detected within the study area (Table 4.2).

The Elegant Gecko (*Stenodactylus stenodactylus*) was found in April 2010 between the oasis and observation site F. It is an insectivorous, nocturnal and ground dwelling gecko, inhabiting large Wadis and gravelly coarse and sandy plains. It is one of the most widespread reptiles of Egypt, though not particularly abundant anywhere. It can tolerate a fair amount of habitat disturbance but it suffers more than other geckos of the region from unregulated vehicular use (Baha El Din 2006).

Another member of the family Gekkonidae found near site F was Steudner‘s Pigmy Gecko (*Tropiocolotes cf. steudneri*) (Fig. 4.12). This gecko is found throughout the Eastern Desert from the southern margins of the Delta to the border with Sudan (Baha El Din 2006).

The Saharan Fan-toed Gecko (*Ptyodactylus siphonorina*) was observed in May 2010 in the crevices of the sandstone hill near site E (Fig. 4.12). Furthermore it was seen at sites F and H. In the Eastern Desert it is found sporadically in the inland hyper-arid hilly country, but also in a few localities along the Red Sea coast. The Fan-toed Gecko favors vertical rocky surfaces, boulders, ledges, and caves.


**Fig. 4.12:** *Tropiocolotes cf. steudneri* near site F and *Ptyodactylus siphonorina* near site E

Moreover, three other members of the Gekkonidae were found in the study area: Egyptian Gecko (*Tarentola annularis*), Egyptian Fan-toed Gecko (*Ptyodactylus hasselquistii*) and Keeled Rock Gecko (*Cyrtopodion scabrum*) have been recorded in the surrounding rocky hills of the area.

Three members of the family Agamidae were found within the study area. A colony of Egyptian Dabb Lizard (*Uromastyx aegyptia*) was found with about ten to fifteen individuals near a track running from site H to the North (Fig. 4.13). Several individuals were regularly seen roosting outside their burrows or feeding on vegetation. In autumn a pair of Lizards was recorded which took care of two offspring. Another individual (probably a younger Lizard) was seen southwesterly from observation site H between some bushes of vegetation and not used oil tubes (Fig. 4.13). Moreover, an old big individual was once observed south of site H. The distribution of the Egyptian Dabb Lizard ranges from the northern Eastern Desert to the coastal plains of the Gulf of Suez. Here it has a scattered distribution, mostly concentrating along the coasts of the Gulfs of Suez and Aqaba. Nevertheless, it is also found in the larger Wadis and plains of the region. The species is declining throughout its range in Egypt due to severe collection pressure and the susceptibility of its habitats to developmental activities. The growth in off-road vehicular use is reducing available habitats for the species and increases disturbance. It is classified as near threatened by the IUCN (Cox et al. 2006).


**Fig. 4.14:** Two individuals and a burrow of *Uromastyx aegyptia* North of site H

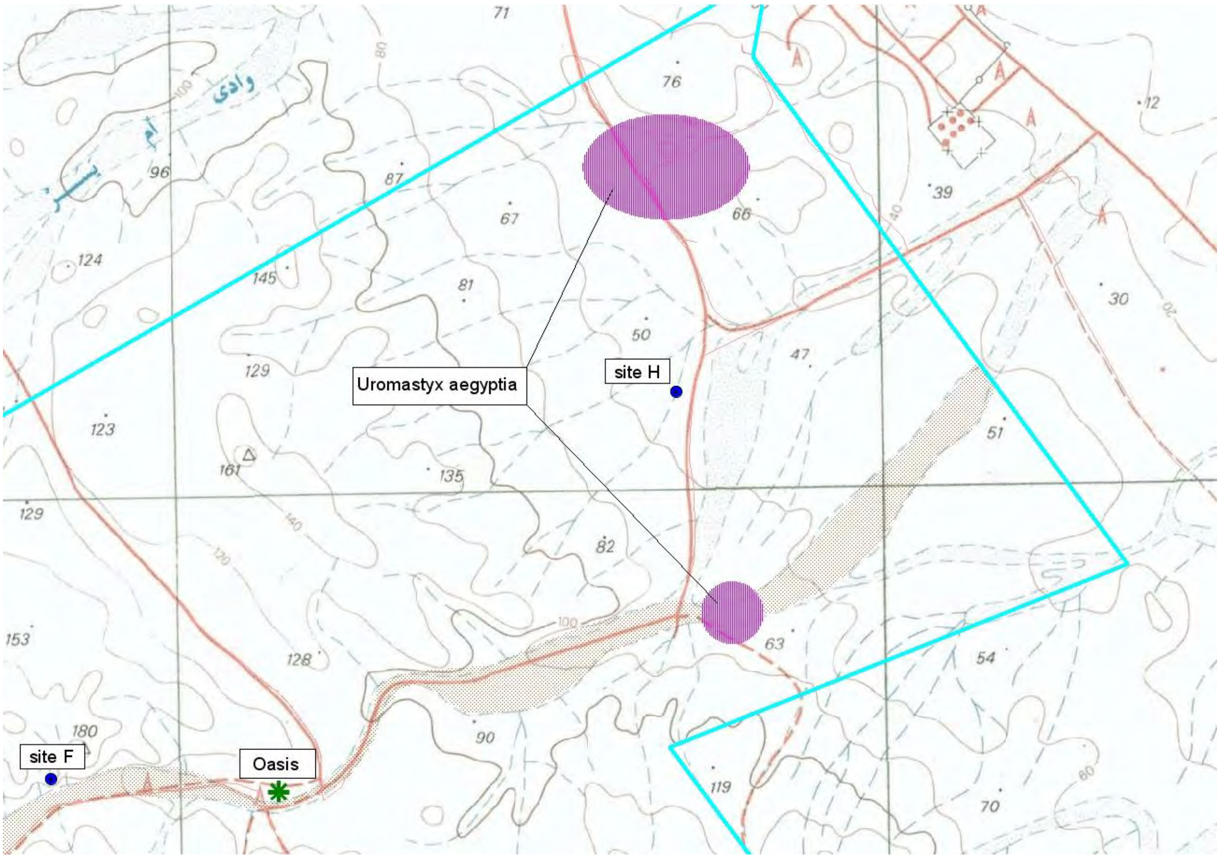



**Fig. 4.13:** Areas with regular occurrence of *Uromastyx aegyptia* near site H

Single individuals of Sinai Agama (*Pseudotrapelus sinaitus*) occasionally occurred near observation sites A, E, F and H. In Egypt one can find this species not only in the Eastern Desert but as well in the Western Desert and in Sinai. However, the distribution of the species in the region is very patchy due to limited and sporadic availability of suitable rocky habitats.

*Trapelus pallidus*, the Pallid Agama, was found at the observation sites H and F in the study area. The Pallid Agama is recorded from the northern part of the Eastern Desert and here especially on the plains of the Gulf of Suez (Baha El Din 2006). Here it is fairly common and widespread.

The family of the True Lizards (*Lacertidae*) is represented in the study area by two species. During the entire investigation on migrating birds, Bosc's Lizard (*Acanthodactylus boskianus*) was observed in the whole area. It was recorded in furrows under shrubs, in gravel and in stony soil. In Egypt it is one of the most common, prominent, and widespread reptiles, found in all suitable locations from an altitude over 1,500 m down to sea level.

Long-footed Lizard (*Acanthodactylus longipes*) was detected near observation sites H, B and F (Fig. 4.15). The distribution of this reptile ranges to the northern Eastern Desert and there is found in more sandy habitats. The Lizard was found on April 21st at observation site H. It was also seen at B and F.


**Fig. 4.15:** *Acanthodactylus longipes* near site B and *Cerastes cerastes* near site E

Snakes are present in the study area with two species. The very slender, medium to large sized Shokari Sand Snake (*Psammophis schokari*) has been recorded in autumn near observation sites C, E, and H. The snake is very common in coastal areas of sandy and rocky deserts and subdeserts. It is often found on trees and bushes if present, especially during periods of bird migration when it feeds on small passerines.

One of the most versatile reptiles inhabiting the Egyptian deserts is the Horned Viper (*Cerastes cerastes*) which occurred within the study area at sites A, E, and H (Fig. 4.15). It often hid typically under the surface of loose soil in fairly exposed situations to ambush potential prey. During bird migration seasons several individuals can often be found in and around isolated trees, waiting for migrating birds to land. The snake is distributed almost through entire Egypt.

As site visits were carried out during daytime but most species of the herpetofauna are night active, the number of individuals and species might be underestimated.

**Table 4.3:** Recorded reptiles within the study area

| Family | English name | Scientific name | Area | IUCN Red List* |
|---|---|---|---|---|
| Geckos (Gekkonidae) | | | | |
| | Elegant Gecko | *Stenodactylus stenodactylus* | Oasis, site F | least concern |
| | Steudner's Pigmy Gecko | *Tropiocolotes* cf. *steudneri* | Site F | least concern |
| | Saharan Fan-toed Gecko | *Ptyodactylus siphonorhina* | Sites E, F, H | - |
| | Egyptian Fan-toed Gecko | *Ptyodactylus hasselquistii* | Study area | least concern |
| | Keeled Rock Gecko | *Cyrtopodion scabrum* | Study area | least concern |
| | Egyptian Gecko | *Tarentola annularis* | Study area | least concern |
| Agamids (Agamidae)) | | | | |
| | Egyptian Dabb Lizard | *Uromastyx aegyptia* | Site H | **near threatened** |
| | Sinai Agama | *Pseudotrapelus sinaitus* | Sites A, E, F, H | least concern |
| | Pallid Agama | *Trapelus pallidus* | Sites H, F | least concern |
| True Lizards (Lacertidae) | | | | |
| | Bosc's Lizard | *Acanthodactylus boskianus* | Study area | least concern |
| | Long-footed Lizard | *Acanthodactylus longipes* | Sites B, F, H | least concern |
| Colubrids (Colubridae) | | | | |
| | Schokari Sand Snake | *Psammophis schokari* | Sites C, E, H | least concern |
| Vipers (Viperidae) | | | | |
| | Horned Viper | *Cerastes cerastes* | Sites A, E, H | least concern |

* according to Baha El Din (2006) and Cox et al. (2006)

Insects

The vegetation in the Wadis forms the basis for local insect life. No thorough investigations of the insect fauna were performed, yet brief examinations prior to or after bird observations did not reveal any herbivore insects. Nevertheless, insects, especially flies, are abundant in the area. During several bird observation periods (especially in times with low wind speed) bird watching was difficult due to hundreds of flies surrounding the observers. Moreover flies were abundant and one and another small butterfly or moth was observed in the oasis.

Individuals of the Desert Pebble Mantis (*Eremiaphila zetterstedti*) were regularly seen at sites A, B, C, D, and G. This plump mantis appears in the hottest parts of Africa where they are running down their prey with incredible long longs. The adults have only tiny bud wings because they never need to fly in the desert.

Migratory insects were also encountered during field work. Mass migration was very obvious in hoverflies (*Simosyrphus* spec.) and in the Painted Lady butterfly (*Vanessa cardui*). Desert Locust (*Schistocerca gregaria*) and the Vagrant Emperor dragonfly (*Anax ephippiger*) could regularly be observed in the entire study area. The closest reproduction areas for the latter two species are probably the Nile Valley region.

Spiders

Camel Spiders (*Galeodes arabs*) occurred numerously in the whole study area. This species lives in northern Africa and the Middle East. Its diet includes insects, small mice, lizards, birds, amphibians, spiders and scorpions. *Galeodes arabs* is neither endangered nor threatened.

Conclusion on threatened Species

The three mammal species that are regarded as vulnerable (according IUCN categories) and that have been mentioned, are unlikely to occur within the study area.

Thus, the only species of conservational concern is the Egyptian Dabb Lizard that is considered to be near threatened (according to IUCN). As of yet there is no national Red List for reptiles. However, the Egyptian Dabb Lizard is formally protected by Egyptian legislation.

Apart from the Egyptian Dabb Lizard, no other animal species mentioned is globally or nationally threatened.

## 4.5 Birds – Avifauna

### 4.5.1 Characteristics of the study area

The area suggested for the wind farms of 1,000 MW capacity (study area) is located about 12 km west of Ras Shukeir at the Gulf of Suez. The Gulf of Suez, in particular the area near Gabel el Zayt, is well known as a bottleneck for migrating birds. Large numbers of birds pass the area twice a year during spring and autumn migration. Previous studies have shown that tens of thousands of White storks (*Ciconia ciconia*) and further tens of thousands of raptors as well as other soaring species (e.g. Pelicans, Cranes) regularly migrate across the Red Sea Coast area and the Red Sea mountain chain (Bergen 2007a, Bergen 2009, CarlBro 2010).

The study area covers about 200 $km^2$ and can be divided into three different parts:

- Flat or slightly undulated gravel plains in the northern part of the study area that are fully exposed to the wind that mostly blows from the Northwest, reaching wind speeds of more than 10 m/s near the ground, and that do not offer shelter for roosting birds except for a few Wadis or depressions.
- An undulated part of a more complex geomorphology and even a mountain range offering some shelter for roosting birds at the slopes opposite to wind direction.
- A southern part consisting of a mix of undulated topography and plains offering some shelter for roosting birds at the slopes opposite to wind direction.

The “oasis” already described in Chapter 4.4 (see also Fig. 2.2 and 4.11) is a specific feature in the study area that forms an attractive roosting site for migrating passerines.

Important features outside the study area are:

- The Red Sea Mountains are located between 5 km (in the North) and 12 km (in the South) west to the study area. Gabel Ras Gharib is as high as 1,750 m a.s.l. and as close as 5 km to the western border of the study area. The slopes of the hills generate upwind effects that are used by soaring birds. In spring 2009 (Bergen 2009) and 2010 (Annex I) substantial numbers of birds of prey gained altitude in these upwinds and subsequently migrated along the Red Sea Mountain chain towards the Northwest to Suez.
- A so-called Sebkha borders the study area in the East. This area contains several pools of hyper-saline water and large patches of salt-marsh, representing attractive roosting sites for birds like Storks, Pelicans, Flamingos or Herons.

## 4.5.2 Methods

The main objectives of the ornithological investigation that focused on bird migration were

- to collect baseline data on migrating birds (mainly soaring and gliding species migrating during the day),
- to describe migration patterns of relevant species in a quantitative way,
- to identify and assess possible impacts regarding development of wind power within the study area and, finally,
- to recommend mitigation measures in order to minimize possible conflicts.

Therefore, standardized daytime field observations were done between March 02nd and May 17th 2010 (spring migration) as well as between August 10th and October 27th 2010 (spring migration), totalling to 792 and 803 hours of observation in spring and in autumn, respectively. The general study design was similar to that used during the –Additional Ornithological Investigation” within the Wadi Dara area which is located further south (see Bergen 2009). Observations were done from eight observation sites (A to H) which were located at distances of about 5 km (see Fig. 4.16). Observations focused on species that can be regarded as especially vulnerable to collision strikes or other negative impacts caused by wind turbines: these are mainly large birds (first of all, birds of prey, storks and pelicans) that principally migrate by soaring and gliding during daytime.

The standard data set which covers all birds migrating at distances of up to 2.5 km to each observation site was analyzed with regards to

- bird numbers, flock size and species composition
- spatial, seasonal and daily distribution of bird migration
- flight altitude
- migratory activity in relation to wind speed and wind direction
- migratory activity in the context of the results of previous studies

All local and roosting birds were recorded during standardized observations as well as during travelling within the study area. The Sebkha was regularly checked for roosting birds using binoculars and telescopes from particular points located at the road that follows the western border of the Sebkha to the Southeast.

In order to assess bird migration within the study area the results obtained in 2010 are compared with results obtained by a previous study carried out in autumn 2008 and spring 2009 in an area near Wadi Dara (in the following: ‗Wadi Dara area‘) which is located a few kilometres South of the study area (Bergen 2009).

A more detailed description of the used methodology and the obtained results can be found in the final report of the ornithological investigation (Annex I).

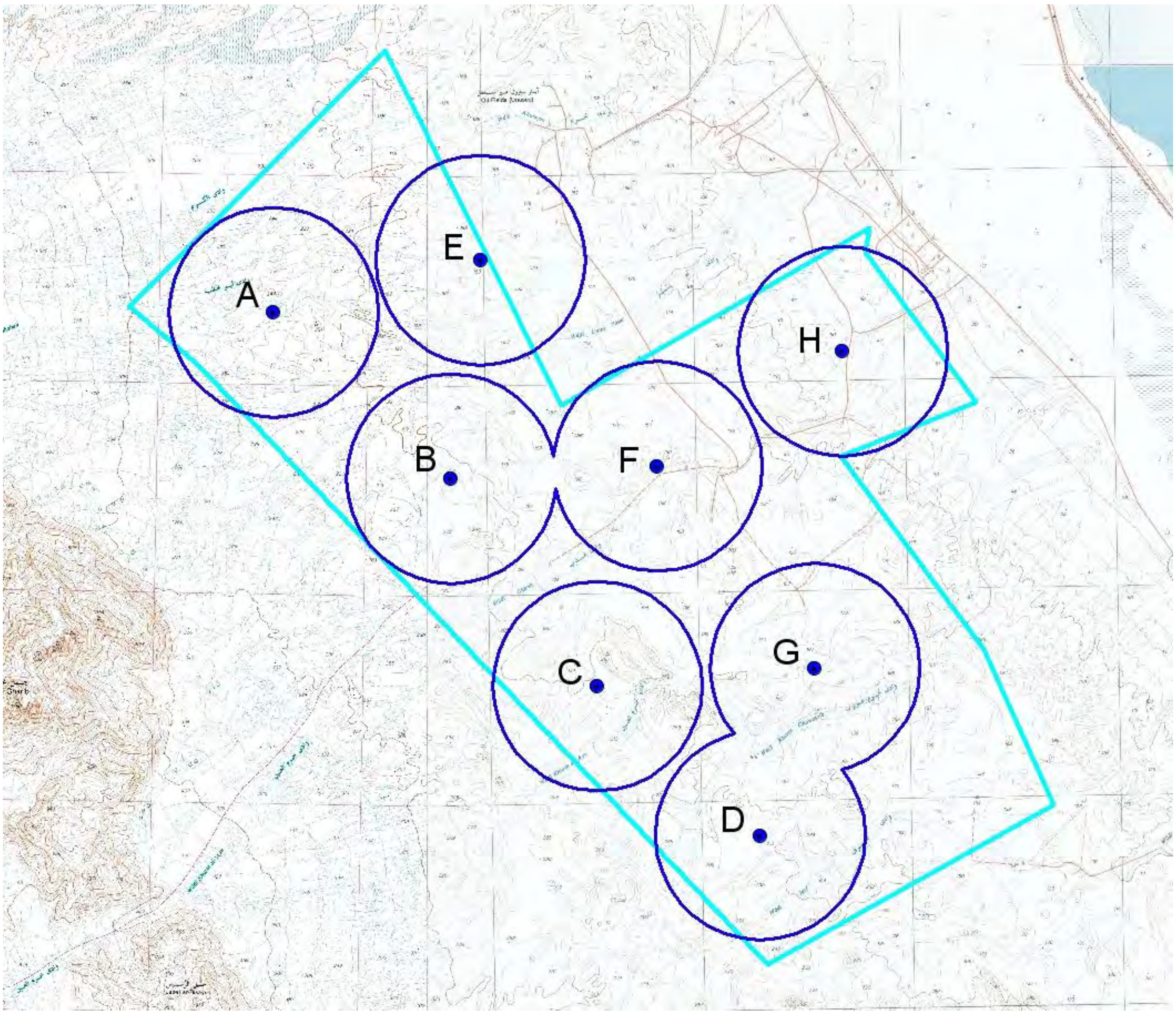



**Fig 4.16:** Locations of the eight observation sites (A to H) within the study area (circles indicate a radius of 2.5 km around each observation site)

## 4.5.3 Results

### 4.5.3.1 Migrating birds

Species composition, number of birds and proportion of flyway population

During standardized field observations in spring 2010, a total of 177,516 birds from 27 relevant species were recorded within the study area. White stork and Steppe buzzard, each constituting almost 38 % of all birds, were the dominant species.

The observed numbers of White stork refer to about 15 % of the total flyway population of this species (This is a commonly used criterion, developed by Birdlife International, for assessing the significance of an area: if the 1 %-threshold is met an area is regarded to be of international importance). For five other species more than 5 %, and for seven other species more than 1 % of the total flyway population occurred in the study area. More than 3 % of the flyway population of Egyptian vulture classified as globally endangered in the IUCN-Red List was recorded here (see Table 4.4).

**Table 4.4:** Number of birds, proportion of the flyway population and conservational status of the most numerous species recorded in spring 2010 within the study area

| Species | Number of birds | % of flyway population | IUCN-Red List | SPEC |
|---|---|---|---|---|
| White stork | 67,405 | 15.5 | Least Concern | 2 |
| Levant sparrowhawk | 5,626 | 7.5 | Least Concern | 2 |
| Steppe eagle | 2,753 | 7.3 | Least Concern | 3 |
| White pelican | 4,427 | 6.3 | Least Concern | 3 |
| Booted eagle | 189 | 6.0 | Least Concern | 3 |
| Steppe buzzard | 66,797 | 5.3 | Least Concern | Non-SPEC |
| Short-toed eagle | 396 | 4.5 | Least Concern | 3 |
| Black stork | 625 | 3.2 | Least Concern | 2 |
| Egyptian vulture | 142 | 3.1 | Endangered | 3 |
| Honey buzzard | 21,564 | 2.2 | Least Concern | non $SPEC^E$ |
| Common crane | 593 | 1.7 | Least Concern | 2 |
| Black kite | 2,208 | 1.7 | Least Concern | 3 |
| Lesser spotted eagle | 568 | 1.1 | Least Concern | 2 |
| Long-legged buzzard | 129 | 0.6 | Least Concern | 3 |
| other species | 4,094 | | | |

The data on flyway populations were taken from CarlBro (2009) after checking by comparing this data with other available sources.

**Fig. 4.17:** White storks migrating through the study area

Further four species of special interest (due to their IUCN-Red List Category) occurred in comparably low to very low numbers: Spotted eagle (vulnerable), Eastern imperial eagle (vulnerable), Pallid harrier (near threatened) and Lesser kestrel (vulnerable). Five of the most numerous species are classified as SPEC 2, *i.e.* these species are concentrated in Europe and have an unfavorable conservation status. Seven other species have an unfavorable conservation status too, but are not concentrated in Europe (SPEC 3, see Table 4.4).

Although large flocks rarely occurred, they have a strong effect on the data set. On the whole there were 25 five flocks with more than a thousand individuals, representing more about 29 % of all migrating birds. In contrast, the fraction of birds migrating individually was about 44 % of all recordings but make up less than 2 % of all birds.

The results clearly demonstrate that

- the study area in general is very important for bird migration in spring.
- the impact assessment should focus on the most endangered and most numerous species. Consequently, Egyptian vulture, White stork, Levant sparrowhawk, Steppe eagle and White pelican should especially be considered, while Steppe buzzard and Honey buzzard, though occurring in huge numbers, are of minor importance for the impact assessment (due to their favorable conservational status).

During standardized field observations in autumn 2010, 25,942 birds from 22 relevant species were recorded within the study area. Again White stork, constituting about 54 % of all birds, was the dominant species. It is noteworthy that all recorded White storks referred to only 17 recordings, indicating that the study area is not located within a main migratory route of White storks in autumn. The only other frequently occurring species were White pelican and Honey buzzard but all at markedly lower numbers (8,252 and 3,028 birds, respectively). More than 70 % of all migrating birds refer to only six flocks of White storks and White pelicans indicating that migratory activity was comparatively low during most periods of the investigation. The observed numbers of White stork and White pelican refer to about 3 % and 12 % of the total flyway population of each species, respectively. The proportion for all other species observed in the study area by far did not reach 1 % of the flyway population.

Four species of special interest (due to their IUCN-Red List Category) occurred in low numbers: Pallid harrier (46 individuals), Lesser kestrel (32 individuals), Red-footed falcon (individuals) and Egyptian vulture (8 individuals).

Flight altitudes and flight direction

In spring 2010 almost 30 % of all birds recorded at distances of up to 2.5 km to a site used altitudes below 100 m (Fig. 4.18). Another 27 % migrated at altitudes between 100 and 199 m, whereas about 44 % flew above 199 m. By contrast, about 45 % of all recordings occurred below 100 m. This difference was mainly caused by Steppe buzzards which regularly migrate individually (and thus had little influence on the variable ―number of birds") at altitudes below 100 m (Fig. 4.18). Moreover, one can assume that the probability to detect a single bird decreases with higher flight altitudes. The proportion of White storks at lower altitudes (below 199 m) was clearly higher, both in terms of birds (about 76 %) and of recordings (about 69 %, see Annex I). Eagles (genus Aquila) seem to slightly prefer higher altitudes. About 62 % of all birds migrated at altitudes of 200 m or more. Since species of special interest (e.g. Pallid harrier, Lesser kestrel, Egyptian vulture) were very rare, the data gives no reliable information about altitude distribution of these species.

In autumn 2010 most birds recorded up to 2.5 km to a site used lower flight altitudes: Only 25 % of all birds flew above 199 m (Fig. 4.18). This result was probably caused by birds (Storks and Pelicans) that reached the desert plains at low altitudes after crossing the Red Sea, where no thermals enable them to gain height. Considering the number of recordings this pattern was even more pronounced: more than 60 % of all recordings were observed at altitudes below 100 m, but only 20 % at altitudes of 200 m or more.

In spring the majority of birds and recordings (about 85 % and 69 %, respectively) migrating at distances up to 2.5 km from observation sites had strictly northern flight directions.

In autumn the vast majority of birds and recordings (about 96 % and 86 %, respectively) migrating at distances up to 2.5 km from observation sites had strictly southern flight directions.

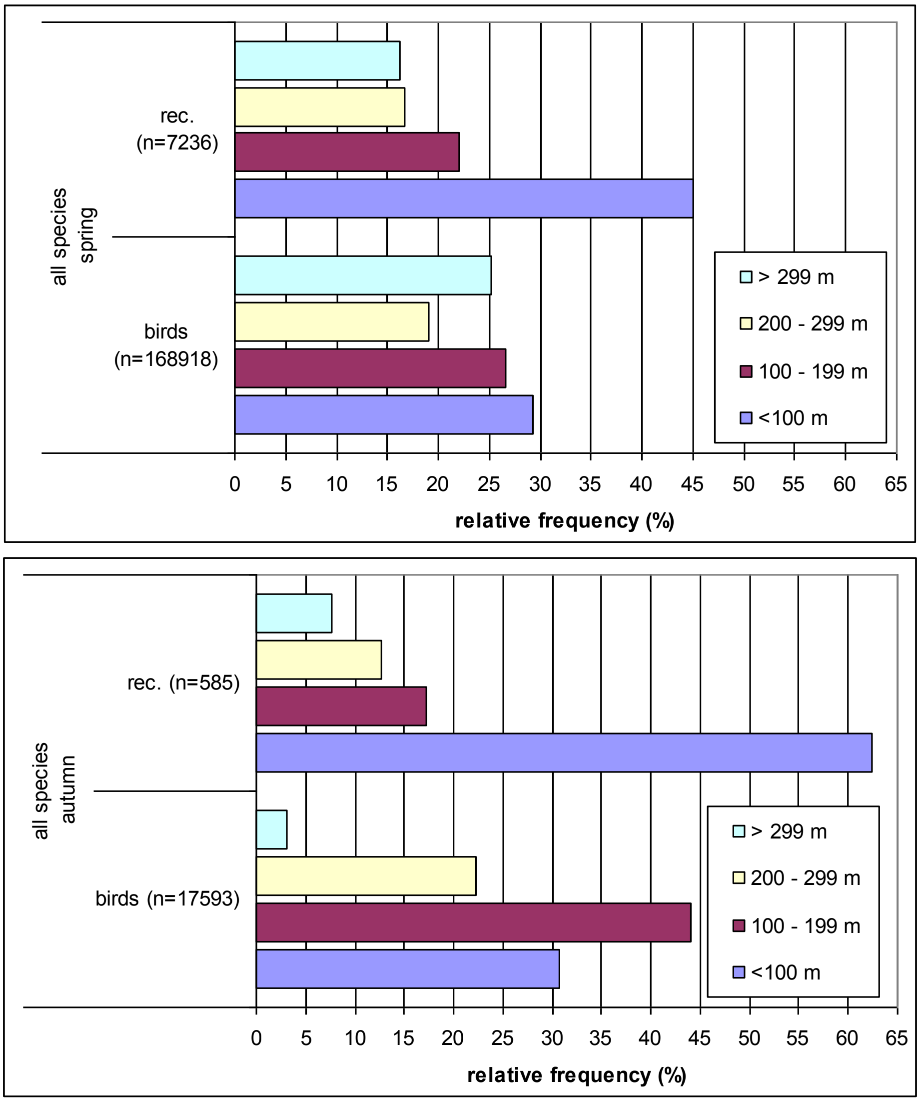



**Fig. 4.18:** Relative frequencies of all birds migrating in spring (above) and autumn (below) 2010 at different flight altitudes through the study area

Migratory activity in relation to wind speed and wind direction

The analysis does not reveal a clear relationship between, on the one hand, migratory activity in spring and, on the other, wind speed and wind direction. The results do not support the expectation that activity is particularly high in conditions with tailwinds or with low winds. Obviously, other variables (e.g. daytime, season, weather conditions during previous days) have a noteworthy effect on migratory activity. Moreover, the analysis shows a highly disproportionate distribution of variables (e.g. many more observation units with winds coming from the North).

The analysis was not carried out for autumn migration, because in autumn migratory activity was very low. The six flocks of White stork and White pelican that made up more than 70 % of all recorded birds were observed in conditions with medium to strong winds from the Northwest.

Spatial distribution of bird migration in the study area

In spring 2010 the number of birds differed between the eight observation sites (Fig. 4.19). The difference was mainly caused by the three most numerous species: Steppe buzzard, White stork and Honey buzzard. The number of White storks and Honey buzzards was comparable low at sites A and B, leading to a rather low number of birds at site B, but not at site A, because very high number (> 15,000 ind.) of Steppe buzzards were recorded there. However, the number of Steppe buzzard was quite high (> 5,000 ind.) at all other sites, too.

A very high number of White storks migrated at distances up to 2.5 km to the sites D, G and H (> 10,000 individuals at each site). As White storks mostly migrated in large flocks the number of recordings was rather low (especially at site D, n=11).

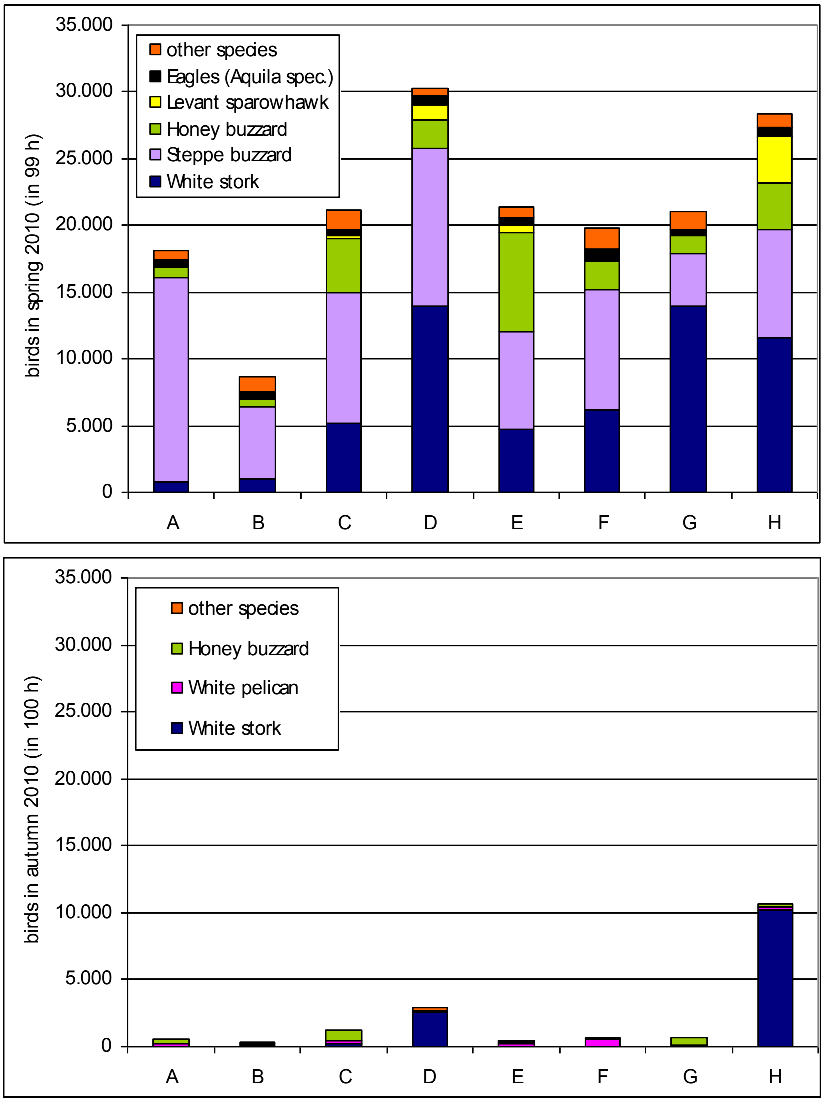



Fig. 4.19: Total numbers of recorded birds at distances up to 2.5 km to each observation site (A to H) in spring (above) and autumn (below) 2010

The number of Honey buzzard was exceptionally high at site E. As about 59 % were recorded during a single 3h observation unit, it is questionable if Honey buzzards prefer to migrate through the area around site E. Likewise, the comparably high number of Levant sparrowhawks at site D and H is not to be expected to be due to regular migration patterns. Levant sparrowhawks often migrate in large flocks, so just a few recordings (4 at site D and H, each) have a huge influence on the data set.

Considering the number of other species (e.g. Black kite) or groups of species (e.g. Eagles form the genus *Aquila*), there were no larger differences that might indicate a particular spatial distribution.

It should be noted that at sites A and B there was no large flock with more than 1,000 individuals, whereas seven / five flocks consisted of about 54 % / 53 % of all individuals recorded at sites D and G. The effect of large flocks was pronounced at sites C and H too, where four and five flocks make up 25 % and 33 % of all individuals, respectively.

In autumn 2010 the number of birds recorded at distances up to 2.5 km to each observation site was much lower than in spring (Fig. 4.19). The only species that occurred in significant numbers, yet very rarely, was White stork: about 2,500 individuals at sites D and about 10,000 individuals at site H. Again, it should be noted that the higher numbers of White storks at the two sites refer to only three flocks: a flock of 2,500 individuals at site D and two flocks at site H with 7,500 and 2,100 individuals.

#### 4.5.3.2 Local birds

The hyper-arid climate with the desert bare of vegetation as well as the harsh wind conditions make the study area an unattractive habitat for local / breeding birds. Consequently, almost all birds found in the area appear there during migration only. Very few locals birds were observed, all of them classified as —Least Concern" in the IUCN Red List of Threatened Species (Version 2010.4; downloaded on March 16th, 2011):

- Between the pebbles and stones near observation site D, a pair of Bar-tailed larks (*Ammomanes cinctura*) nested. This species commonly inhabits flat or undulating deserts with scattered vegetation and gravelly or stony rises (Porter & Aspinall 2010).
- Individuals of Desert lark (*Ammomanes deserti*) were regularly found within the study area at observation sites A, E, and F. The observed behaviour indicated that single pairs are breeding within the study area. The Desert lark is more restricted to the stony and rocky slopes with sparse vegetation of arid hills than the former species (Porter & Aspinall 2010).
- Single breeding pairs of Greater hoopoe-lark (*Alaemon alaudipes*) were frequently recorded near observation sites E and H. Concerning to Porter & Aspinall (2010) the bird prefers sandy deserts, semi-deserts or coastal dunes.
- Single individuals of Common kestrel (*Falco tinnunculus*), Peregrine falcon (*Falco peregrinus*), Barbary falcon (*Falco pelegrinoides*) and Short-toed eagle (*Circaetus gallicus*) were observed hunting on small birds and snakes within the desert on several consecutive days. These birds presumably were non-migrants, but locals spending the spring in the desert and the Red Sea Mountains.
- Brown-necked raven (*Corvus ruficollis*) was regularly recorded in the study area (mainly in its eastern parts, e.g. nine individuals at site G) and outside the study area (e.g. 22 individuals about 7.0 km north of H).
- Other sedentary species were sometimes recorded within the study area, too: e.g. smaller groups (max. eight individuals) of Crowned sandgrouse (*Pterocles coronatus*).

#### 4.5.3.3 Roosting birds

In spring, Storks, Pelicans and birds of prey were occasionally observed roosting in or adjacent to the study area, mainly in the early morning or the late afternoon after or before spending the night in the desert. Those birds apparently stayed only one night in the desert before continuing migration. As those birds were found in the whole study area, there is no particular roosting site of conservational importance within the study area.

Even the Sebkha was not often used by Storks and Pelicans although it offers appropriate conditions for roosting. In spring White storks were recorded in the Sebkha during only three of 15 control visits, but then in large numbers (up to 4,800 individuals). The results indicate that the Sebkha was not used continuously as a stop-over site. It can be assumed that most birds probably spend only one night in the Sebkha before continuing migration in spring.

Small passerines regularly used the oasis as a stop-over site for several days. Moreover, other species like Bee-eaters, Doves and Herons were occasionally recorded here.

In autumn large migratory birds were rarely observed roosting in or adjacent to the study area (in small numbers), mainly in the early morning or the late afternoon after or before spending the night in the desert. Single individuals of other groups of species were recorded roosting within the study area as well, e.g. Golden oriole (*Oriolus oriolus*), European roller (*Coracias garrulus*) or Cream-colored courser (*Cursorius cursor*). Roosting passerines were observed regularly in the desert and at the oasis, e.g. Desert wheatear (*Oenanthe deserti*), Whinchat (*Saxicola rubetra*) or Tawny pipit (*Anthus campestris*).

The regularly visited Sebkha apparently was not used as a roosting site by large migratory birds (e.g. Storks, Pelicans or Cranes) in autumn. Occasionally, waders of different species and few individuals of Herons were recorded at the Sebkha.

In autumn, small passerines and other species regularly used the oasis as a stop-over site for several days (Table 4.5).

**Table 4.5:** Species which used the oasis as a roosting habitat

Black-crowned night heron, *Nycticorax nycticorax*

Spur-winged lapwing, *Vanellus spinosus*

Common cuckoo, *Cuculus canorus*

Namaqua dove, *Oena capensis*

Masked shrike, *Lanius nubicus*

Eastern olivaceous warbler, *Hippolais pallida*

Chiffchaff, *Phylloscopus collybita*

Collared flycatcher, *Ficedula albicollis*

Caspian reed warbler, *Acrocephalus scirpaceus fuscus*

Striated bunting, *Emberiza striolata striolata*

## 4.6 Water resources and waste water

The –200 km² project area" can be classified to be hyper-arid. There is not any surface water in or nearby the project area. It is crossed by some major Wadis, such as the Wadis Khurm, Umm Yasar and Khuraym. In absence of reliable statistics, surface runoff reaching up to the project area is expected to be seldom. Heavy rains in the mountains can cause flash floods in the major Wadis. There is no statistical evidence on the occurrence interval of such rains. From verbal information received it is guessed that it should be of an order of once in 10 years. Accordingly, wind turbines, even if with protected foundations, shall not be placed inside the beds of larger Wadis.

**Groundwater** in that zone can be differentiated into

- Fissure water of the weathering zone, which is confined to igneous, metamorphic and sedimentary rocks (only little water that can be stored and collected during rainfall and that can travel over long distances through fissures),
- Groundwater at the alluvial fill of the Wadis (recharged from occasional rainfalls in the mountains and draining fissure water),
- Deep groundwater that is contained in tectonic fractures and fissures.

Water is pumped from deep zones, more than 100 m below the surface out of Nubian sandstone zones, which are recharged from the existing watersheds in the region. Ground water pumping takes place in the centre of the project area by GPC and in the South of the area by GUPCO, both being petrol companies. The water is slightly saline.

There are no human activities in the project area that use water or cause drainage except the irrigation of the palm tree garden and water used by the Bedouin family in the centre of the area. The general water supply of the region is from Nile water. A main Nile water pipeline is passing at about 6 km distance from the outer eastern border of the project area in parallel to the Suez - Hurghada road.

## 4.7 Air quality

Due to the desert character of the area the level of dust and fine sand content in the air is quite high in case of high wind speeds, e.g. 15 m/s and more. Based on wind speed measurements at nearby stations such high wind speeds are expected to be in the order of 8 % of the time. Outside the eastern part of the project area, sulphate containing flare gases from EPC exploration/production wells cause acidic emissions to the surroundings. However, as 98 % of the wind is blowing from or parallel to the project area there should be almost no impact on the project area.

The desert soil contains significant concentration of salt, which is taken by stronger winds. Moreover, about 10 % of the wind is coming from the northern sector and has absorbed salt, when passing the Gulf of Suez at a distance of about 10 to 20 kms. High variation of the daily temperature can cause condensation during early morning times out of the salt containing air. Accordingly the environment has to be classified having a high corrosion level (C4, ISO 12944-2).

## 4.8 Ambient noise levels

No measurements of the ambient noise level are carried out for reasons of obvious lack of man made noise emission sources and of sensitive receiving bodies in the area. The existing sources of noise are:

- An elevated natural ambient noise level in the project area during frequent times with high winds speeds.
- A singular case of smaller noise emissions caused by the operation of a water pump at a distance of about 100 m to the palm-thatch huts of the Bedouin family (for location see Fig. 2.2).

In the absence of regular car traffic inside or nearby the area (the coastal Hurghada – Suez road is at a minimum distance of 6.5 km from the eastern border of the project area) and other human activities there is no significant man-made background noise that need to be considered.

## 4.9 Archaeological, historical and cultural heritage

Not existing inside or adjacent to the ~~–~~200 km² project area”.

## 4.10 Social and economic context

The next settlements are Ras Gharib about 13 km away from the north-eastern corner and the Ras Shukheir workers camp of GUPCO about 11 km from the south-eastern corner. Accordingly, these settlements would not be directly affected by wind power development in the project area. A tiny community, a Bedouin family of about 20 nos. living next to a water well pumping station in provisional palm-thatch huts in the Centre of the area (see Fig. 2.2) need to be maintained and protected. From interview with the head of the family it was learnt that

- the family is well informed about wind power plants from experience they made in Zafarana,
- they don‘t consider the operation of wind turbines even nearby the house to be a problem as they are anyhow experienced to live with noise levels caused by the nearby pump,
- that they expect employment from the erection of a wind farm.

From that it can be concluded that there would be no social hurdle to wind park development in that project area, if sufficient distance for noise and shadowing abatement according to generally accepted standards would be kept and employment would be created by adequate jobs, e.g. typically guarding of construction and wind park operation side.

## 4.11 Existing transport infrastructure and traffic flows

The access to the area is via the Suez - Hurghada road, which is a four lane road. This road has very little traffic load compared to its capacity. It is fit for heavy transports.

The further access to the 200 km² project area is via private roads of GPC in the Centre and GUPCO in the South (see Fig. 2.2). These roads have a width of about 4 m and are either asphalt or gravel paved. The state of these roads is mostly not perfect and would need maintenance. The present use of these roads is by the petrol companies only with a very low traffic frequency. Beside these external and internal access roads most of the area can only be accessed via off-road tracks and by the use of 4-wheel drive cars.

## 4.12 Existing utilities

There is not any public water or electricity distribution system in the “200 km² project area”. The water wells in the centre of the area are owned and operated by GPC. The pumps are supplied by a 10 kV OHL and underground cabling system (change to underground just east from the “Oasis”). Some of the produced water is deviated for drinking and irrigation purposes of the Bedouin family, which is guarding the installations. The family is also supplied with electricity.

Moreover, one private GUPCO island grid is extending from Ras Shukheir to south of the project area, where another field of water wells is operated.

A 220 kV overhead line between Hurghada – Zafarana was planned since long and the works are contracted. This line is also to supply Ras Gharib and is built independently from any wind power development in the region. The next public utility is in Ras Gharib about 13 km away from the border of the project area.

# 5. PREDICTION OF IMPACTS AND EVALUATION OF SIGNIFICANT ENVIRONMENTAL AND SOCIAL EFFECTS

## 5.1 General and Basic Methodology

The significance of impacts is characterised by the magnitude and value of a residual impact after mitigation. Accordingly, the significance of impacts will be judged after technical assessment of the extent that mitigation will reduce the predicted impacts.

The applied methods for predicting the characteristics of impacts in this study are

- best estimate professional judgement;
- quantitative mathematical models (in case of noise propagation and shadowing calculations).

The evaluation of significance takes place against a framework of criteria and measures. Threshold tests for environmental acceptability are taken as suggested in the table below. However, acceptability level of impacts shall be weighted against other economic and social factors as well as by the level of public concern (particularly over health and safety).

**Table 5.1:** Typical acceptability levels for potential impact thresholds

| Level of acceptability | Potential impact threshold |
|---|---|
| Unacceptable | Exceeds legal threshold, e.g. quality standard |
| | Increases level of risk to public health and safety above qualitative or quantitative criteria |
| | Extinction of biological species, loss of genetic diversity, rare or endangered species, critical habitat |
| Normally unacceptable | Conflict with existing environmental policies, land-use plans |
| | Loss of populations of commercial biological species |
| | Large-scale loss of productive capacity of renewable resources |
| May be acceptable with minimisation, mitigation and management and after weighing with predicted positive impacts | Increased spreading likelihood of biological disease |
| | Taking of rare or endangered species |
| | Some loss of threatened habitat |
| Normally acceptable | Some loss of populations and habitats of non-threatened species |
| | Modification of landscape without downgrading special aesthetic values |
| | Emissions demonstrably less than the carrying capacity of the receiving environment |

Criteria to evaluate adverse impacts on natural resources, ecological functions or designated areas include:

- reductions in species diversity;
- depletion or fragmentation on plant and animal habitat;
- loss of threatened, rare or endangered species;
- impairment of ecological integrity, resilience or health e.g.
  - disruption of food chains;
  - decline in species population;
  - alterations in predator-prey relationships.

Criteria to evaluate the significance of adverse social impacts that result from biophysical changes include:

- threats to human health and safety e.g. from release of persistent and/or toxic chemicals;
- decline in commercially valuable or locally important species or resources e.g. fish, forests and farmland;
- loss of areas or environmental components that have cultural, recreational or aesthetic value;
- displacement of people;
- disruption of communities by influx of a workforce e.g. during project construction; and
- pressure on services, transportation and infrastructure.

Considering above criteria an initial scoping shows that the expected or possible environmental impacts of wind energy projects are quite limited in a desert area, as it is the case of the –200 km² project area”. This is valid for both, the construction and the operation phases. The limitation of environmental impacts is due to the character of the project, i.e. factors like

- the desert nature of the area with a hyper arid climate showing no population, very limited or even no vegetation and wild life inside or near to the area that can be affected by the measure.
- the very small land consumption of about 3 % of the total wind park area of a project consisting of wind turbine foundations, underground cabling, small transformer kiosks, the related portion of the 220 kV SS and 5 m wide gravel roads made from compacted desert gravel using about 3 % of the total area.
- The remoteness of the site without any receptors that might be affected by noise and shadowing or landscape deterioration.

The local fauna (without avifauna) and flora are very few in numbers and were common ones, not being red-listed. Also possible impacts caused by waste water and domestic waste generation during the construction phase and later on during the operation phase would be of very minor nature and could easily be mitigated.

However, due to the location of the project area not far away from a well known main bird migration route, the wind power construction could have significant impacts on migrating birds.

In accordance with the possible significance of the presumed impacts, the following baseline surveys had been carried out:

- an ornithological in depth study has been carried out for the complete spring and autumn season to adequately reflect possible significant impacts,
- a one week area reconnaissance had been carried out in June with the focus on pre-

sent land use, geomorphology and topography,

- an investigation of the flora and fauna (without avifauna) in representative transects of the area had been carried out by specialists of ecoda and local experts (EcoCon-Serv).

Both, the negative and the positive potential residual impacts on the environment identified, are evaluated against the baseline.

## 5.2 Land Use

Even if considering the desert gravel roads and platforms as land take of the wind-park project the overall use of the 200 km² project area by wind power and associated installations would be in the order of 3 % only. The area requirement will be only marginally increased during the construction phase due to temporary additional working areas, construction yards and storage facilities. In the absence of ecologically sensitive habitats, attractive landscape, antiquities, agriculture, residents etc. the minor land take has not any significant impact.

Service and storage facilities with accommodation facilities of the different investors most likely will be installed outside the project area in reach of water and electricity supply, e.g. in the outskirts of Ras Gharib and would be subject to separate construction permit.

The project will have positive impacts to the infrastructure, because

- the existing infrastructure will remain untouched and functional,
- the infrastructure would be even strengthened by reinforcement and extension of access roads and electricity supply inside and in the periphery of the project area.

## 5.3 Landscape Character and Visual Impact

In the absence of people living or passing the area (except the Bedouin family in the centre of the area) effects of change of the landscape would have no significant impacts. Around the Bedouin living place a wind power free zone shall be kept with distances determined by noise and shadowing analysis according to generally accepted standards. Moreover, there is no special landscape view that need to be protected.

As an example a visualisation of a wind park with 2 MW wind turbines with the view from the temporary GPC office facilities in the East of the project area (see Fig. 5.1) are shown.

As a result of the ornithological investigations the area shown in Fig. 5.3 (Zone III) has to be excluded. I.e. that future wind parks would be located even more distant to human activities. Considering the absence of receptors and the uniform desert landscape with no special features the impacts on the landscape are judged as being not significant neither during the construction phase, nor during the operation phase.

**Fig. 5.1:** Visualisation from GPC temporary office facilities about 1 km in the East of the Project area

## 5.4 Terrestrial Flora and Fauna

### 5.4.1 Flora

As the results given in Chapter 4.4 clearly show, the importance of the study area as a habitat for flora species is very limited. The study area does not harbour plants or plant communities of conservational concern. Plants that have been found are common and widespread.

Construction phase

Construction of the wind farm might lead to:

- Direct damage of plants and modification or direct loss of habitat by using areas for fundaments of turbines, permanent access roads, trails for the power line, storing positions for heavy machines, other technical installations etc.

  During construction of wind farms which includes mobilization and demobilization a removal and partial destruction of the top soil surface and some deeper soil layers will occur. However, the land-use by wind farm construction is very limited (usually less than 3 % of the overall area) leaving most of the area free from any interventions. Consequently, the affected area will cover only a small fraction of the 200 km$^2$ study area. Though the precise locations of turbines are not yet known, siting of the wind turbines shall avoid vegetation areas. No turbine shall be installed next or inside the oasis or inside larger Wadi beds. Construction measures in the Wadis will be limited to single crossing by gravel roads and by cable trenches carried out at less sensitive spots. Thus, construction works will be away from these more sensitive areas.

- Compaction of soil due to land-use

  Compaction of soil might lead to a damage of local seed banks and a reduction of the suitability for plant growth. However, as the potential for plant growing in this hyper arid area is very limited this is valued as minor impact. Moreover, as stated above the affected area is very limited (usually less than 3 %), leaving most of the area free from any interventions. Moreover, the study area comprises no threatened species or plant communities of conservational concern.

- Dust emissions

  Dust emissions will be limited to a very small area and limited to rather brief periods. No significant impact is expected due to dust emissions.

- Waste

  Waste resulting from constructional work will cause no significant impact on flora. However, it might pollute larger areas when drifted away by strong winds. Thus, waste should be removed immediately from the site and should be stored at or near the site in appropriate ways.

In conclusion, construction of wind farms within the study area will cause no significant impacts on vegetation or plant communities.

Operation and maintenance phase

Though the precise locations of turbines are not yet known, it can be assumed that almost all affected areas will be without any vegetation. Moreover, operating wind turbines are not known to affect plants or plant growth. Also slight changes in wind speed (turbulences) or in microclimate at ground level will have no effects on plants.

During periods of maintenance of wind farms human activities will be restricted to the already existing tracks and storage positions.

In conclusion, operation and maintenance of wind farms within the study area will cause no significant impacts on vegetation or plant communities. There are also no other activities in the area that might contribute to increased impacts to non-acceptable levels.

### 5.4.2 Fauna

As the results given in Chapter 4.4 clearly show, the importance of the study area as a habitat for animals is rather limited.

Only few mammal species have been found of which none is threatened or particularly prone to human activities. Other mammal species, few of conservational concern, are unlikely to occur in the study area. No bats were recorded during site visits, neither using a bat detector nor a voice box.

The study area seems to be a rather suitable site for some reptile species though most of them are quite common and widespread. The only species of conservational concern is the Egyptian Dabb Lizard of which a colony with about ten to fifteen individuals was found near a track running from site H to the North (Fig. 4.13).

Some other vertebrate and invertebrates occur in the area. However, the area is not of particular importance for these species.

Construction phase

Construction of the wind farm might lead to:

- A loss of habitat for local animals by using areas for fundaments of turbines, permanent access roads, trails for the power line, storing positions for heavy machinery, other technical installations *etc*.

  As stated in Chapter 4.4, the local animal communities have very few species, moreover, density is very low. Compared to the whole wind farm area, the area required for infrastructural structures is very small. Thus, even after turbine erection there will be enough appropriate habitats available for local animals. In summary, the impact on animals caused by building wind farms within the study area is assessed to be insignificant (acceptable). In the oasis, the larger Wadis and the area settled by the Egyptian Dabb Lizard), however, installation of turbines and other technical installations shall be avoided.

- Disturbances by human activities from heavy machines, traffic, noise and dust emission.

  Local animals might be affected by disturbances during the construction phase. Large native mammals (probably only Desert Red Fox) that sporadically use the area will most likely abandon the site because of the disturbance from the constructional work. However, disturbance effects are limited to a rather small area compared to the whole study area. Thus, local animals can find alternative habitats during construction. Moreover, constructional work is limited to a rather short period of time. Local animals can repopulate all areas after construction. In summary, the impact on animals caused by disturbance is assessed to be insignificant (acceptable). In the oasis, the larger Wadis and the area settled by the Egyptian Dabb Lizard, however, human activities should be be minimized.

- Waste

  Waste resulting from constructional work will cause no significant impact on fauna. It will probably attract certain animals, however, especially feral species (dogs, cats, rodents, etc). This might affect indigenous species. Thus, waste should be removed immediately from the site and should be stored at the site in appropriate ways.

- New species of urban and rural environments

  New species of urban and rural environments can be imported into the area together with construction materials and containers. This should be avoided as much as possible, because new species often affect indigenous species.

Operation and maintenance phase

Noise and shading resulting from operating turbines is limited in space and time. Hence operating wind farms are not expected to impact animal wildlife significantly. As, turbines will not be erected near the oasis, in larger Wadi beds and in the area settled by Egyptian Dabb Lizard noise occurring from turbines will not affect animals inhabiting or using these areas.

There might be a risk of disturbance of species by site personnel, by waste from used spare parts or by hazards from non-sufficiently isolated cables during maintenance activities. Disturbance will cause no significant impact on animal wildlife, as maintenance activities are restricted to the area close to the wind turbines.

## 5.5 Birds-Avifauna

### 5.5.1 Bird-wind turbine interactions

In recent years the construction of wind turbines has given rise to much controversy relating to bird conservational issues, mainly in Europe and the United States.

Considering utilization of wind energy within the study area, the major potential hazards to birds are collision risk and mortality but also barrier effects. Other possible impacts of wind turbines like displacement due to disturbance or direct habitat change and loss for roosting or local birds are of minor importance.

Collision risk and mortality

Many studies have shown that birds are generally able to avoid collisions with wind turbines and do not simply fly into them blindly (e.g. Dirksen *et al.* 1998, De Lucas *et al.* 2004, Desholm 2006). Nevertheless, at a low number of locations relevant numbers of collision victims were found, leading to significant increases in mortality rates and possibly to population decreases.

At a wind farm (220 turbines) at the western bank of the Gulf of Suez (Egypt) corpse searches were carried out over a four-week period in spring 2007 (Bergen 2007b). Body parts, feathers and bones were found of three birds that had died weeks or months earlier — possibly by collision with a turbine. No fresh bird corpses were found. Due to the characteristics of the study area and the high intensity of investigation, search efficiency and / or scavengers could reasonably be excluded to play any role. Thus, the results strongly indicate that the number of collisions was very low to zero throughout the period of investigation. It should be noted, however, that the study is limited due to the short period of investigation.

Occasional fatality searches at wind turbines in Hurghada wind farm also did not reveal any evidence of bird mortality (Baha El Din 1996).

As given in Annex I, the scale of collision depends on a wide range of factors which — in some cases — correlate with each other. It is quite plausible that a combination of factors (e.g. flight behaviour, wind speed and relief of location) influences collision risk.

Moreover, manoeuvrability and flight behaviour might be crucial factors to explain differences in collision risks between species (Drewitt & Langston 2006). Ornis Consult (1999) subdivided soaring birds into four different categories depending on manoeuvrability and flight behaviour. On the basis of this classification, the vulnerability of different species to collision can be deduced (see Table 5.2). Due to the number of factors affecting the risk of collision, it is very difficult to transfer the results obtained at a particular wind farm to another. At present, there is insufficient information available to form a reliable judgement on the scale of collision at a proposed wind farm.

**Table 5.2:** Assessment of species-specific vulnerability to collision depending on manoeuvrability and flight behaviour (according to Ornis Consult 1999)

| category | description | species | vulnerability to collision |
|---|---|---|---|
| very passive fliers | very dependent on thermals, generally not able to cross large bodies of water | Egyptian vulture, Short-toed eagle and all Eagles of the genus Aquila | very high |
| less passive fliers | less dependent on thermals, able to cross limited bodies of water | Buzzards, Kites, Honey buzzard, Storks, Cranes and Pelicanes | medium to high |
| less active fliers | rely on thermals to a limited extent able to cross large bodies of water | Harriers and Sparrowhawks | low to medium |
| very active fliers | not dependent on thermals, able to cross the Gulf of Suez at any point | Falcons | very low |

Barrier effect

There are several reliable studies indicating that wind turbines have a disturbing effect on birds and hence may act as barriers to bird movement.

At a wind farm (220 turbines) at the western bank of the Gulf of Suez, the behaviour of migrating birds was investigated over a four-week period in spring 2007 (Bergen 2007b). The results demonstrate that migrating birds were able to detect the presence of wind turbines and thus to react in an appropriate way depending on external (e.g. weather conditions) and internal (e.g. altitude, physical capabilities) factors. Birds at altitudes above 100 m simply migrated over the wind farm without any noticeable reaction. Birds at altitudes below 100 m became aware of the presence of wind turbines and apparently avoided them by changing their flight direction or increasing altitude. Sometimes birds seemed to avoid turbines in operation and purposefully approached a turbine not in operation and subsequently passed by.

A flight reaction of a bird in the vicinity of a turbine was recorded only twice. Irrespective of a bird's motivation (migrating, flying, hunting, resting) or of weather conditions, an appreciably irritated bird or a bird in a critical situation that might have led to a collision or to loss of flight control, never occurred. Since the investigation refers to a rather short period, which did not cover the main migration period of all species, results have to be verified.

Percival (2005) assumed that the ecological consequences of such a barrier effect are unlikely to be a problem at small wind farms. Drewitt & Langston (2006) suggest that none of the barrier effects identified so far have significant impacts on populations. However, in specific circumstances barrier effects might lead to population level impacts indirectly, e.g. where a wind farm effectively blocks a regularly used air route between nesting and foraging areas, or where several wind farms interact cumulatively. Then large wind farms or a number of wind farms might lead to increased energy expenditure for birds and thus might reduce annual survival rates and / or breeding output (Fox et al. 2006, Langston et al. 2006). In summary, until now it is quite difficult to judge whether avoidance behaviour causes a significant effect on individuals and, ultimately, on populations.

### 5.5.2 Importance of the study area for birds

Commonly, the importance of a site is assessed by two criteria: 1. the number of birds (sometimes in relation to the population), and 2. the conservational status (IUCN-Red List Category) of species. In this process, species that are exposed to a higher threat are of special interest. As mentioned in Chapter 4.5.2, such species are Egyptian vulture (Endangered), Spotted eagle, Eastern imperial eagle, Lesser kestrel (all Vulnerable), as well as Pallid harrier and Red-footed falcon (both Near Threatened). The numbers of representatives of these species recorded within the study area, however, was comparatively small and their spatial distribution showed no definite pattern. All of these species mostly occurred singularly at a few sites. This means the conservational status of a species cannot qualify as a decisive criterion in assessing the significance of the study area in a spatially differentiated way. As a consequence, the number of birds (heavily influenced by single species only) remains the only criterion for assessment.

The importance of the area or parts of the area was assessed using three classes: significant, very significant and extremely significant.

### 5.5.3 Migrating birds

Spring Migration

As given in Table 4.4, the total number of birds observed in spring 2010 within the study area exceeded 1 % of the total flyway population for 13 species (which is a commonly used criterion for assessing the importance of an area). More than 15 % of the flyway population of White stork, and more than 5 % of the flyway population of Levant sparrowhawk, Steppe eagle, White pelican, Booted eagle and Steppe buzzard were recorded. These results clearly show that the study area is very significant for spring migration. It was already known that the Red Sea Coast, mainly the area around Gabel al Zayt, is located about 30 km southeast of the study area, is a major bottleneck for large soaring birds. However, for the first time this study provides proof that a huge amount of bird migration occured even further North.

With regard to the impact of wind turbines, flight altitude seems to be a crucial aspect. As we assume that wind turbines will not affect birds migrating at altitudes above 200 m, the assessment of the importance of the study area can be restricted to migration below 200 m. In order to assess the importance of different parts of the study area for migration, we compared bird abundances with the number of birds recorded in spring 2009 within the Wadi Dara area.

Compared to the previous investigation in the Wadi Dara area (Bergen 2009), the number of birds migrating at altitudes below 200 m was much higher in spring 2010 at most observation sites (Fig. 5.2). This was mainly due to White stork which occurred at lower altitudes, in very high numbers especially at sites C, D, G and H. Moreover, a comparably high number of Steppe buzzards migrated through the area at most sites. E.g. nearly 10,000 Steppe buzzards were observed at lower altitudes at site A. However, 4,500 of these birds were recorded during a single 3h-observation unit. Consequently, we do not expect that this result is due to regular migration pattern. Furthermore, Steppe buzzard is not a species of special conservational interest (see above). To conclude, the importance of the study area can be classified as follows:

- The northwestern parts of the study area around the sites A and B has to be classified as significant for bird migration in spring (Fig. 5.3). Particularly Steppe buzzards and fewer numbers of other soaring species were recorded at altitudes below 200 m. Apart from Steppe buzzard, the numbers of birds was rather low at sites A and B (about 2,000 individuals, Fig. 5.2). A comparable migratory activity was observed at sites M10 and S10 in spring 2009 within the Wadi Dara area. Especially, White stork migration was not pronounced at sites A and B, possibly due to the rather large distance to the coastline.

- The numbers of birds and recordings observed in the Northeast (site E), in the middle (sites C and F) and in the Southwest (site D) of the study area were clearly higher than at sites A and B and at sites M10, S09 and S10 in spring 2009 in the Wadi Dara area (Fig 5.2). Only the number of birds collected at M09 in spring 2009 was comparable. At sites C, D and F more than 4,000 White storks migrated in spring 2010 at altitudes below 200 m. Moreover, Honey buzzards and fewer numbers of other species were regularly seen at sites C, D, E and F. Consequently, the Northeast, the middle and the Southwest of the study area have to be classified as very significant for bird migration in spring (Fig. 5.3).
- At each of the two sites G and H which cover the eastern and southeastern parts of the study area more than 12,000 birds (except Steppe buzzard) were seen migrating at altitudes below 200 m (Fig. 5.2). Thus, compared to all other sites of the study area and compared to all sites in the Wadi Dara area, migratory activity at lower altitudes was highest at sites G and H. This is mainly due to the high amount of White stork which apparently avoided the crossing of the Red Sea, but headed further Northwest to Suez. Consequently, the eastern and southeastern parts of the study area have to be classified as extremely significant for bird migration in spring (Fig. 5.3).

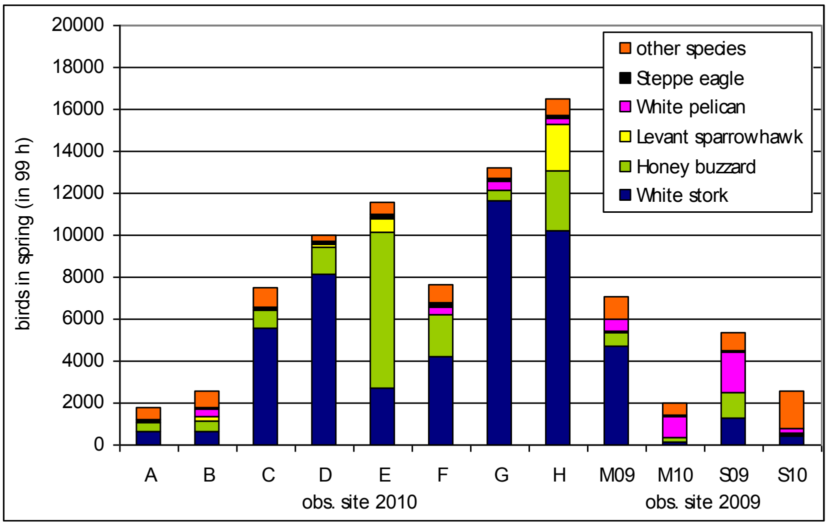



**Fig. 5.2:** Total numbers of recorded birds (except Steppe buzzard) migrating at distances up to 2.5 km to each observation site at altitudes below 200 m in spring 2010 (study area) and in spring 2009 (Wadi Dara area: sites M09 to S10)

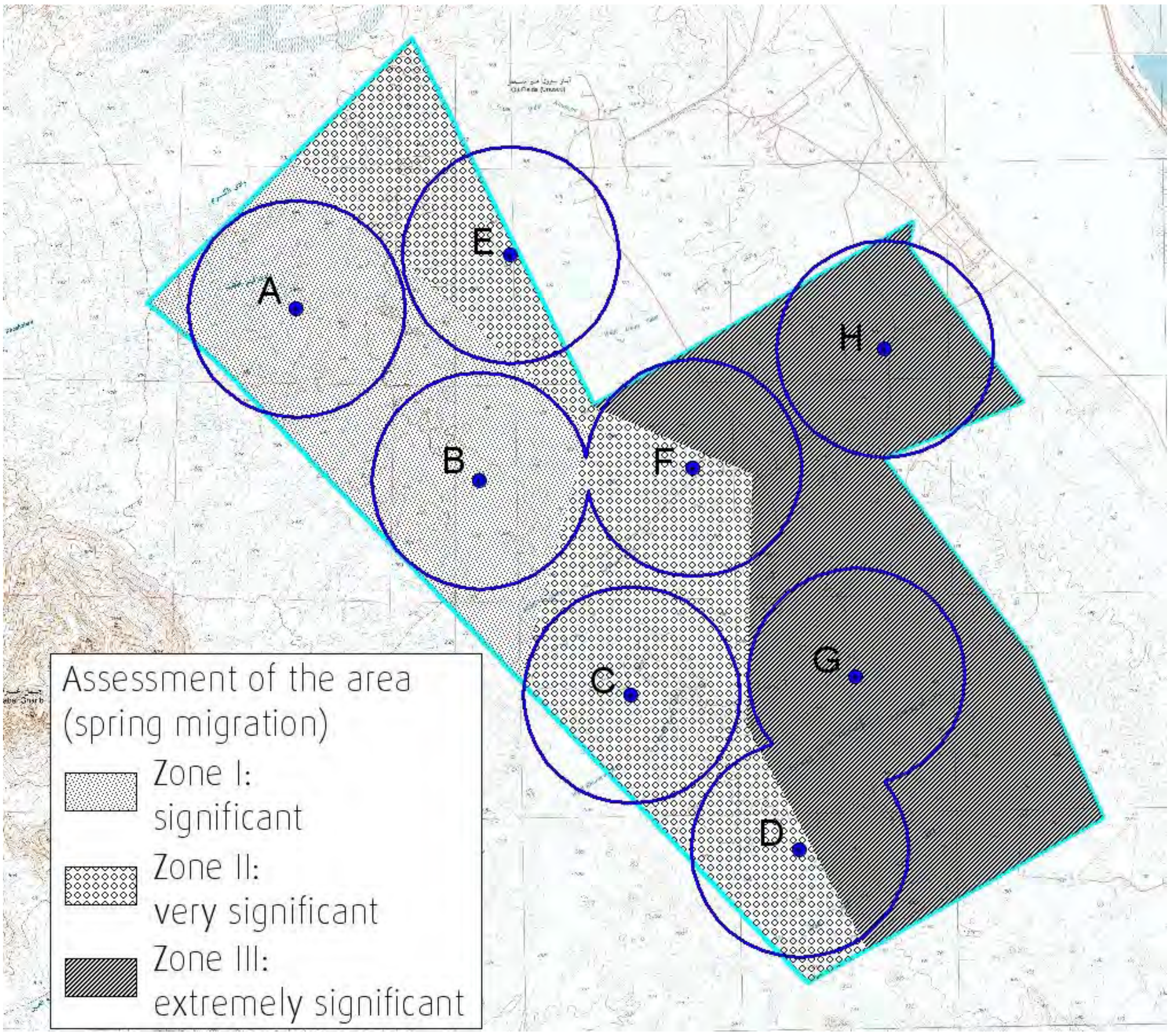



**Fig. 5.3:** Assessment of the importance for spring migration

Autumn Migration

Compared to the previous investigation in the Wadi Dara area (Bergen 2009) the number of birds migrating at altitudes below 200 m was much lower at most sites in autumn 2010 (Fig. 5.4). Only at site H, where about 8,000 White storks were recorded, migratory activity was comparable to that recorded at site S09 in autumn 2008. However, it has to be taken into account that the high number of White storks at site H mainly refers to a single flock of about 7,500 individuals.

Thus, migratory activity in autumn 2010 was low or predominately very low in the whole study area. Consequently, large parts of the study area are not important for autumn migration. This result is very well in accordance with what could be expected from previous studies: The majority of White storks, White pelicans, Honey buzzard and other soaring species seems to reach the Red Sea coast near Gabel el Zayt south of Ras Shukeir after crossing the Red Sea. Only single flocks (with occasionally huge numbers) reach the coastline between Ras Gharib and Ras Shukeir and can then migrate through the eastern part of the study area (site H). Moreover, the results indicate that soaring birds do not reach the coastline North of Ras Gharib. Only very few birds seem to migrate further southeast from Suez over the coastal plains. Most birds which migrate over Suez are believed to head further south along the Red Sea Mountain chain or further in the West along the Nile Valley.

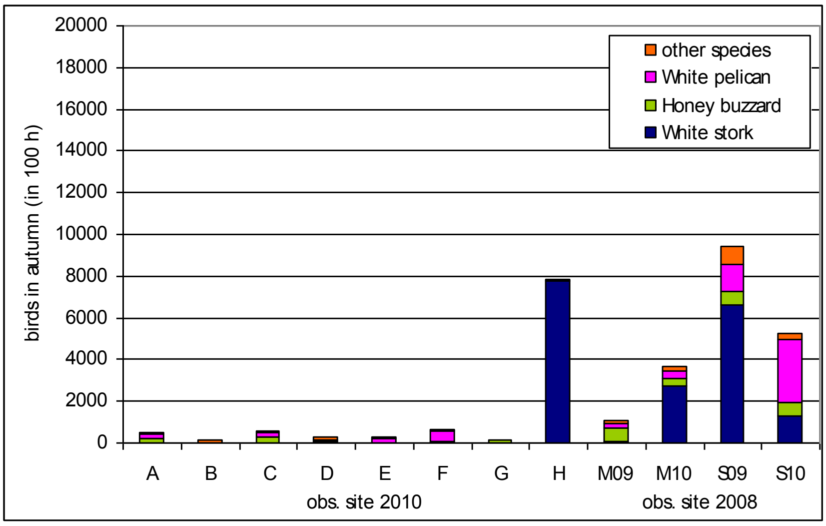



**Fig. 5.4:** Total numbers of recorded birds migrating at distances up to 2.5 km to each observation site at altitudes below 200 m in autumn 2010 (study area) and in autumn 2008 (Wadi Dara area: sites M09 to S10)

### 5.5.4 Local birds

As stated in Chapter 4.5.2.2, there are only few local birds belonging to single species that use the study area as a breeding site (mainly Larks), hunting area (mainly Falcons) or foraging area (e.g. Sandgrouse). All of those species are classified as "Least Concern" in the IUCN Red List of Threatened Species.

Consequently, most parts of the study area are of minor importance for local birds. The oasis and the larger Wadis, containing small patches of vegetation, are specific features in the desert. Therefore, these areas are regarded as important for local birds.

### 5.5.5 Roosting birds

Storks, Pelicans and birds of prey regularly spent a single night in the desert at different locations in the study area (sometimes in large flocks). Roosting birds were found at different locations in the Wadi Dara area (Bergen 2009, CarlBro 2010) and in the concessionary area too (Bergen 2007a). Thus, the study area does not offer special conditions for large soaring birds and is, therefore, not a preferred roosting site for these species.

By contrast, within the desert plains the oasis forms a unique feature with dense vegetation. Consequently, it is an attractive stop-over site which is regularly used by a number of birds (mainly passerines, but other species, like Herons or Bee-eaters, too). For these species the oasis is an important stepping stone during migration.

The larger Wadis within the study area that have small patches of vegetation might be an important roosting place for small passerines, too.

The Sebkha, located to the East of the study area, is believed to be an attractive roosting site for birds like Storks, Pelicans, Flamingos or Herons. However, roosting birds were rarely detected at the Sebkha, mainly in the early morning or the late afternoon. This result indicates that most migrating birds spend only a single night in the Sebkha and continue migration at the next morning. This seems to be reasonable, at least for spring migration when birds aim to reach their breeding sites as soon as possible. Consequently, birds which arrive in the late afternoon and depart during morning cannot be recorded during site visits around midday or early afternoon. So, an assessment based only on the obtained results might lead to an underestimation of the importance of the Sebkha. Probably, the high number of White storks, recorded in spring 2010 at site H, was linked to the Sebkha.

To conclude, the Sebkha is classified as an important roosting site for Storks, Pelicans, Herons and probably other species.

## 5.5.6 Prediction and assessment of expected impacts

### 5.5.6.1 Construction phase

Migrating birds

Birds in active flight will not be affected during the construction phase. Noise and dust emission at distinct construction sites might bring migrating birds to alter their flight path. This cannot be regarded as a significant impact.

Local birds

Construction of wind farms might lead to:

- Modification or a loss of habitat for local birds by using areas for foundation of turbines, permanent access roads, trails for the power line, storing positions for heavy machines, other technical installations *etc*.

  As given in Chapter 4.5.2.2, the local bird community is very poor in species and, moreover, bird density is very low. The area required for the infrastructural elements is rather small compared to the whole wind farm area. Thus, even after the construction of turbines there will be enough appropriate habitats available for local birds. To conclude, the impact on local birds caused by construction of wind farms within the study area is assessed not to be significant (acceptable). However, the oasis and the larger Wadis that have small patches of vegetation form specific elements in the desert and might be used as foraging and hunting sites for local birds. In order to minimize impacts on local birds, constructional works in the oasis and the larger Wadis shall be minimized.

- Disturbance by human activities with heavy machines, traffic, noise and dust emission.

  Local birds, such as Larks or Falcons, might be affected by disturbance during the construction phase. However, disturbance effects are restricted to a rather small area compared to the whole study area. Thus, local birds can find alternative habitats for the time of constructional works. Moreover, constructional work is limited to a rather short period of time. Local birds can reoccupy all areas after construction phase. To conclude, the impact on local birds caused by disturbance is assessed not to be significant (acceptable).

- Attraction of local birds if areas with garbage, open water or houses with vegetation are constructed.

  An increase of bird numbers within the study area might increase the risk of collision during operation of turbines. Thus, attracting birds has to be avoided both, during construction and operation of a wind farm. Therefore, garbage should be removed directly from the wind farm area. Construction of areas with open water and houses with vegetation within the wind farm area should be avoided, too.

Roosting birds

Construction of wind farms might lead to:

- Modification or a loss of habitat for roosting birds by using areas for foundations of turbines, permanent access roads, trails for the power line, storing positions for heavy machines, other technical installations etc.

  The area required for the infrastructural elements is comparatively small in relation to the whole wind farm area. The vast majority of the study area is not a preferred roosting site for birds. Thus, even after the construction of turbines larger soaring birds will use the desert inside but predominantly outside a wind farm. The oasis, however, is regularly used as a roosting site, mainly for passerines and other smaller birds. Further, the larger Wadis with some vegetation form specific sites in the desert and might also be used for roosting by passerines. Therefore, construction works in the oasis and in the larger Wadis shall be minimized. To conclude, the impact on roosting birds caused by the construction of wind farms within the study area is assessed to be not significant (acceptable).

- Disturbance by human activities with heavy machines, traffic, noise and dust emission.

  Large soaring birds mostly spend one night in the desert only, while smaller birds might spend several nights at appropriate roosting sites (oasis, larger Wadis). Thus, roosting birds might temporarily be affected by disturbance during the construction phase. Disturbance effects are restricted to a small area compared to the whole study area. Roosting birds can thus choose alternative habitats during construction phases. To conclude, the impact on roosting birds caused by disturbance is assessed as not being significant (acceptable).

- Attraction of roosting birds if areas with garbage, open waters or houses with vegetation are constructed.

  Increasing numbers of birds within the study area can elevate the risk of collision during turbine operation. Thus, attracting birds should be avoided, both during construction and operation of wind farms. Accordingly, garbage should be removed directly from wind farm areas. Open water areas or houses with vegetation should not be built within and in the vicinity of wind farms.

#### 5.5.6.2 Operation and maintenance phase

Migrating birds

Migrating birds might be affected by collision or barrier effects during operation and maintenance phase:

1. Collision risk

As laid out in Annex I, collision risk depends on several factors and until now the cause-and-effect chain of collision is poorly understood. Very little is known about collision risk for migrating birds. Consequently, it is very difficult for several reasons to assess collision risk caused by a proposed wind farm within the study area.

a. Autumn migration

The study area is indisputably located near one of the most important migratory routes with a high occurrence of raptors, other large migrants and further birds. However, migratory activity in autumn 2010 was low to very low in the whole study area (in accordance with what can be expected from previous studies). Single flocks of White storks occasionally reach the Red Sea coast near Ras Gharib and subsequently enter the study area in the East. Yet the vast majority of White storks reach the coastline at Ras Shukeir or further south. As a consequence, due to the low number of migrating birds in autumn, wind farms within the study area will not pose a relevant risk of collision. Single collisions at wind farms within the study area might occur even during autumn. But the expected collision rate will not cause significant effects on the populations. Thus, collisions at wind turbines within the study area during autumn are not regarded to have a significant impact on migrating birds.

b. Spring migration

In contrast to the investigation into autumn migration in 2010, the preceding investigation into spring migration within the same year indicates that parts of the study area are of international importance for migration in spring. Some species migrating through the study are of international conservational concern; a number of other species are of European or national conservational concern. Hence, collision rates leading to additional mortality potentially causing significant population effects for some species cannot be excluded when building wind farms in the entire study area. However, the results of the investigation indicate a gradual increase of migratory activity from West to East within the study area. Thus, an impact assessment of different parts of the study area due to the spatial differences in bird migration observed in spring 2010 seems to be feasible. In accord with the importance of the area for migration and hence according to the strength of expected environmental impact, the study area can be subdivided into the three following zones:

- Zone I

Zone I covers an area of about 53 km$^2$ and encompasses the north-western part of the study area (sites A and B) where migratory activity was lowest in spring 2010 (Fig. 5.4). Although this part is of general importance for migration (Fig. 5.3), a relevant collision risk for migrating birds in spring is not expected if technical avoidance and mitigation measures to the best standard practice are maintained (Chapter 6.2).

- Zone II

Zone II consists of parts of the study area in the Northeast (site E), in the middle (sites C and F) and in the Southwest (site D) and has a size of about 67 km$^2$ (Fig. 5.4). According to results of the investigation, Zone II is very significant for bird migration. Considering the huge numbers of birds migrating at altitudes below 200 m, it cannot be excluded that collision risk at wind farms in Zone II will pose a significant threat for migrating birds. Consequently, the expected impact of wind farms in Zone II is unacceptable. However, collision risk is restricted to:

  - turbines under operation,
  - a rather small period of the year (main migration period in spring lasts from the begin of March to the mid May) and
  - a certain time of day (migration of soaring birds starts when appropriate thermal uplifts are available)

These considerations hint at appropriate countermeasures for reducing collision risk to an acceptable level. If turbines do not operate during the period of highest migration, collision risk for migrating birds is minimized. Thus, construction of wind turbines within Zone II is recommendable if an effective shutdown programme is developed and established (see Chapter 6.2).

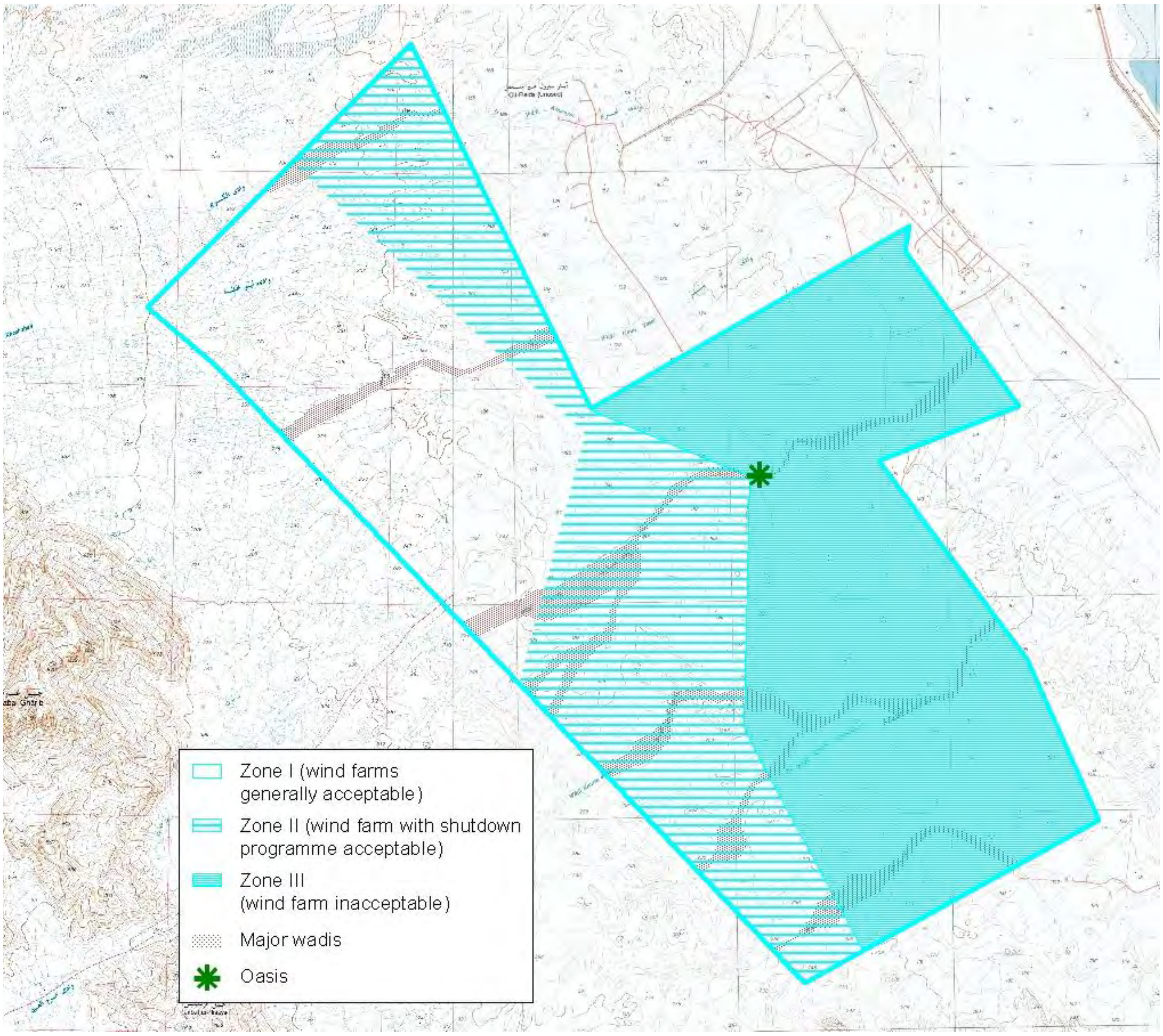



**Fig. 5.4:** Results of the impact assessment of different parts of the study area due to the spatial differences in bird migration observed in spring 2010

- Zone III

Zone III consists of the eastern and south-eastern parts of the study area (sites G and H) and has a size of about 88 $km^2$ (Fig. 5.4). The results of the investigation clearly show that Zone III is of extreme significance for bird migration in spring. Consequently, collision rates leading to additional mortality potentially causing significant population effects for some species cannot be excluded when building wind farms in Zone III. The expected impact of wind farms is therefore unacceptable and hence the construction of wind farms has to be strictly banned within Zone III.

Even shutdown programmes have to be regarded as being incapable of reducing impacts of wind farms in Zone III to an acceptable level, because significant cumulative impacts with other wind farms are likely.

Finally, it is strictly recommended to implement a post-construction monitoring programme for wind farms in Zone I and Zone II to assess whether impacts of wind farms remain at an acceptable level, or whether additional measures are necessary to minimize or eliminate unacceptable impacts.

2. Barrier effects

In order to avoid a wind power plant, birds might change horizontal flight direction which obviously leads to additional expenditure of energy. Assuming a 5 km long string of wind turbines located perpendicular to a bird's flight path, we suggest that the additional distance caused by avoiding the wind power plant will not be much more than 5 km. Considering the overall efforts of bird migration, an additional flight path of 5 km seems unlikely to have a relevant impact on birds.

Another option for a bird to avoid a wind power plant is to change altitude (mostly by rising) and subsequently to migrate above the critical zone of the wind turbines. We do not expect thermals to be a limiting factor within the concessionary area. There should be a number of vertical air currents allowing birds to gain altitude.

In spring, when migratory activity is expected to be much higher than in autumn, birds coming from the South will face a spiky southern edge of wind farms within Zone I (Fig. 5.4) or a rather small (less than 2.0 km) southern edge of wind farms within Zone II. Because of the shape of Zone I and Zone II birds will be directed to the Northwest or Northeast. Subsequently, they will be able to continue migration in northern directions, passing the wind farms at its western or eastern edge.

In summary, although it is very difficult to estimate the degree of additional energy expenditure, it seems unlikely that avoidance behaviour might produce a significant effect on populations. However, as some uncertainty remains, mitigation measures should be implemented in order to minimize possible impact and to ensure that the weight of possible barrier effects remains at a tolerable level. This can be achieved either by establishing escape corridors within wind farms or by implementing proved and tested shutdown programmes (see Chapter 6.2).

Furthermore, cumulative effects, resulting from the installation of a large wind power plant outside the study area, should be taken into account. Installation of wind farms in Zone III will link planned wind farms southeast of the study area with those within Zone I and possibly Zone II. Consequently, wind farms would span over 20 km from the Red Sea mountains in the West to the Sebkha at the Red Sea coast in the East. To conclude, installation of wind farms in Zone III is not recommendable because significant cumulative impacts with other wind farms on migrating birds cannot be excluded.

<u>Local birds</u>

Operation and maintenance of wind farms within Zone I and possibly Zone II might lead to:

- Disturbance by operation of turbines leading to a decrease in habitat quality or a total habitat loss.

  Local birds, such as Larks or Falcons, might be affected by disturbance during the operational phase of wind farms. However, most species (as resident birds) are known to be unsusceptible to the nearly constant acoustic and visual stimuli of wind turbines. Moreover, disturbance effects are restricted to a rather small distance and cover at most the area up to 300 m to a turbine. As given in Chapter 4.5.2.2, the species variety of local birds is very low and bird density is very low as well. To conclude, the impact on local birds caused by disturbance related to operating turbines is assessed as not to be significant (acceptable).

- Disturbance by human activities related with maintenance of wind farms.

  Local birds, such as Larks or Falcons, might be affected by disturbances from human activities during the operational phases of wind farms. However, human activity is expected to be rather limited in time and space. As stated in Chapter 4.5.2.2, the species variety and the density of local birds is very low. In conclusion, the impact on local birds caused by disturbances related to maintenance is assessed as not to be significant (acceptable).

- Collision risk

  Local birds will also face the risk of collision at operating turbines. However, resident birds are aware of turbines and their behaviour might be better adapted to the presence of turbines. As stated in Chapter 4.5.2.2, the species variety and the density of local birds is very low. Therefore, the collision risk for local birds is rather low and, regarding collision risk, wind farms in Zone I and Zone II will not lead to significant impacts on local birds.

- Attraction of local birds if areas with garbage, open water or houses with vegetation are constructed.

  An increase of bird numbers within the study area might increase the risk of collision during operation of turbines. Thus, attracting birds should be avoided both, during construction and operation of a wind farm.

<u>Roosting birds</u>

Operation and maintenance of wind farms within Zone I and possibly Zone II might lead to:

- Disturbance by operation of turbines leading to a decrease in habitat quality or a total habitat loss.

  Roosting birds might be affected by disturbance during the operational phase of wind farms in Zone I and Zone II. It is well known that species which tend to roost in larger flocks avoid operational wind farms. Therefore, we expect that, for example, White storks and White pelicans will usually not roost within wind farms. These species were occasionally recorded within the study area, but the study area is not a preferred roosting site for them. Moreover, there are many alternative roosting sites for these species, so that operation of wind farms will not lead to significant habitat loss for these species.

  Other species roosting in small flocks or even singularly, e.g. birds of prey or smaller birds (passerines), are not known to avoid wind turbines. Consequently, these species will occasionally use the wind farms in Zone I and Zone II for roosting as they did before construction of turbines. Operation of wind farms will not lead to significant habitat loss for these species.

  As the Sebkha is located some kilometer away from Zone I and Zone II wind turbines will not affect birds which use the Sebkha as a roosting site.

- Disturbance by human activities related with maintenance of wind farms.

  Roosting birds might be affected by disturbance of human activities during the operational phase of wind farms. However, such human activity is expected to be rather limited in time and space. Moreover, birds do not stay for a longer period in the study area (large soaring birds usually spend a single night in the desert). Consequently, the impact on roosting birds caused by disturbances related to maintenance is assessed to be insignificant (acceptable).

- Collision risk

  Roosting birds face the risk of collision at operating turbines. Collision risk might be high in situations when larger flocks of birds i) stop migration in the afternoon to look for a place to spend the night and ii) start migration in the morning after having spent the night in the desert. However, as stated these species are usually avoid the wind farm areas and will not roost in the vicinity of turbines.

  By contrast, birds of prey might roost within a wind farm area and will thus face a danger to collide with a turbine (while looking for a roosting site in the afternoon or while starting migration in the morning). However, the recorded number of roosting bird of prey within the study area was very low. The study area is not a preferred roosting site for birds of prey.

  To conclude, regarding collision risk, wind farms in Zone I and Zone II will not lead to significant impacts on roosting birds.

- Attraction of roosting birds if areas with garbage, open water or houses with vegetation are constructed.

  An increase of bird numbers within the study area might increase the risk of collision during operation of turbines. Thus, attracting birds has to be avoided both, during construction and operation of a wind farm.

## 5.6 Water resources & waste water

The groundwater resources used by GPC in the centre of the ―200 km² project area" will remain untouched. In general water supply is not relevant for wind power projects:

***Construction phase:*** For Wind Park construction a temporary construction yard (for storage of materials and servicing of machinery) and a temporary office would be erected at a central place. The office avails of simple sanitary facilities. Water supply would be usually via tankers from the central pipeline. Electricity would be generated by a small mobile generator. Such office building would be for about 20 to 30 persons, who, however, spend much time outside at the individual construction sites. The office will be equipped with simple sanitary facilities. Waste water quantities should be of an order of 1 m³/d. The domestic waste water would undergo anaerobic treatment in a septic tank and post-treatment by percolation into the sandy underground. There would be not any measurable harm to the environment resulting from this treatment. This is analogous in case of the 220 kV substation.

Much more water might be required for concrete making, if the concrete will not be provided as ready mix. In case of having a batching plant at the site the water will have to be provided by tankers.

Liquid waste is not relevant: Liquid waste such as used oil is not likely to have significant effects on the environment as these valuable products are usually carefully collected and send for recycling.

***Operating phase:*** Even though assuming that service facilities (control room. Storage, O&M personnel) would be constructed in the project area the fresh water consumption for the wind park and the substation, essentially caused by human demand, would not be significant.

No liquid emissions will origin from the wind park itself during operation. Very small amounts of domestic waste water would origin from the sanitary facilities of

- the substation control room (3 persons à 30 l/d): 0.090 m³/d
- the service facilities including housing for personnel inside or outside the wind park area: (50 persons à 40 l/d): 2.0 m³/d

This water consumption of about 3 m³/d, equivalent to the waste water amount, is very small. The domestic waste water will undergo 2 stage anaerobic treatment, as it is common and adequate practice in desert areas in Egypt. Residual treated water will either be percolated to the ground or reused for limited watering of plants. There will not be any harm or measurable adverse impact resulting from liquid emissions.

The project will have no measurable impacts with regard to water resources and waste water pollution.

## 5.7 Domestic and hazardous waste management

***Construction phase:*** Considerable amounts of solid waste will be generated by wind power construction projects. The waste essentially consists of packing material (paper, plastics, wood) for transport of the turbine and auxiliary equipment components. The waste will occur mostly at the individual turbine erection sites and in the construction yard. Under the heavy wind conditions the waste is easily spread over the desert and transported over large distances.

The only possible source for hazardous waste caused during construction is spilled oil and grease originating from construction equipment (*e.g.* trucks, excavators, craned) and from handling and commissioning of deliveries (e.g. transformer or gear box oil, hydraulic oil).

Both, the littering of waste and the spillage of hazards can easily be avoided by proper workmanship and strong supervision.

***Operating phase:*** Waste from the wind park would consist of used consumables regularly to be exchanged, when servicing the machines, and smaller defective parts. These are non hazardous materials, most of them valuables and fit for recycling. Larger defective parts such as gear box or generator would anyhow be returned to the factory for repair or re-use of materials.

Hazardous used oil will be collected once per year or once in two years and send for recycling. The practice in other Egyptian wind park shows that this works without problems. The volume of used oils will depend on the type of wind turbine selected and on the service intervals requested by the selected contractor.

Domestic waste will be generated at the service facilities and the 220 kV substation. The Zafarana experience shows that the domestic waste is small in quantities and mainly composed of biodegradable or burnable waste. The estimated volume not compacted is less than 50 persons x 2 to 3 l/d: 150 l/d. The standard method as applied in Zafarana or at remote housing facilities in the desert in Egypt would be that waste will be collected in bags and in bins, and disposed of on an environmentally safe waste disposal site (desert pits). To reduce the volume the waste is burnt. The residual waste will be covered by sand. The waste is inert and in absence of rain there is no harm for the subsurface. Considering the small amounts of domestic waste (about 60 m³ per year of non compacted waste equivalent to about 1 to 2 m³/a after incineration) this simple method is considered to be acceptable.

No significant impacts caused by domestic and hazardous waste are expected if a proper workmanship and domestic waste management scheme does apply.

## 5.8 Air Quality

***Construction phase:*** During the construction measures some emissions of exhaust gases of machinery and dust at the working places will occur. In the absence of sensitive receptors in the area such emissions during construction, such local and temporary deterioration of the air quality will have no significant impacts on the environment.

***Operating phase:*** No dust and gaseous emissions will originate from a wind park during operation. Accordingly, there is no significant environmental impact.

## 5.9 Noise, Vibrations, Electromagnetic Interferences and Light Reflections / Shadowing

### 5.9.1 Noise

The Law 4/1994, executive regulations, Annex 7, require maintaining the following critical ambient noise levels at day (7 am to 6 pm) and night times (10 pm to 7 am):

| Receptor | Day dB (A) | Night dB (A) |
|---|---|---|
| Industrial areas (heavy industries) | 70 | 60 |
| Commercial & downtown | 65 | 55 |
| Mixed Residential, commercial, small industrial | 60 | 50 |
| Residential areas in cities | 55 | 45 |

The following receptors inside and in the surroundings of the project boundaries were identified and assigned to the relevant receptor cluster:

| Receptor | Noise limit cluster | Noise limit dB (A) |
|---|---|---|
| Bedouine family guarding the water pumping installations in side the area | Mixed residential, commercial, small industrial | 50 |
| Office personnel about 7 km outside the eastern border | Commercial & downtown | 65 |
| Ras Gharib and Ras Shukeir Camp (15 km and 17 km away | Residential areas in cities | 45 |

| | | |
|---|---|---|
| from the nearest area point) | | |

***Construction phase:*** **Noise** emissions during construction originate from the use of transport equipment and other machine, most of them with quite limited specific noise emissions. The frequency of transports is very limited and may peak to 30 per day even in case of larger wind park construction places. The machinery will work decentralised at the individual wind turbine erection places and are single noise emission sources. The maximum noise emission that can be expected during the construction phase should originate from the use of heavy earth work equipment at the site such as excavator or front loader, but especially from jack hammering in case of compacted or rocky underground. Considering the minimum distances of the construction places that shall be kept to the living area of the Bedouin family and the big distances of the next settlements outside the area boundaries, no significant noise impacts from temporary construction activities are expected.

***Operating phase:*** **Noise** propagation from the wind park was checked by a standard wind park modelling programme. The calculation was exemplarily carried out using the noise calculation standard ISO 9613-2, Germany and a typical 2 MW configuration with the Vestas V80, 67 m hub height and the highest noise emission level at full load being 105 dB(A). For the calculation a condensed wind park configuration was used to consider an accumulation of noise levels. The configuration used is just exemplary and does not consider siting restrictions resulting from the environmental assessment.

The results are shown in Fig. 5.5. The ambient noise level of 50.8 dB (A) is already achieved at distances of 250 m around the wind turbines (corresponds to the circle radius. Thus, a clearing zone of 300 m around the Bedouin huts is considered to be sufficient to assure a noise level being below the required 50 dB (A).

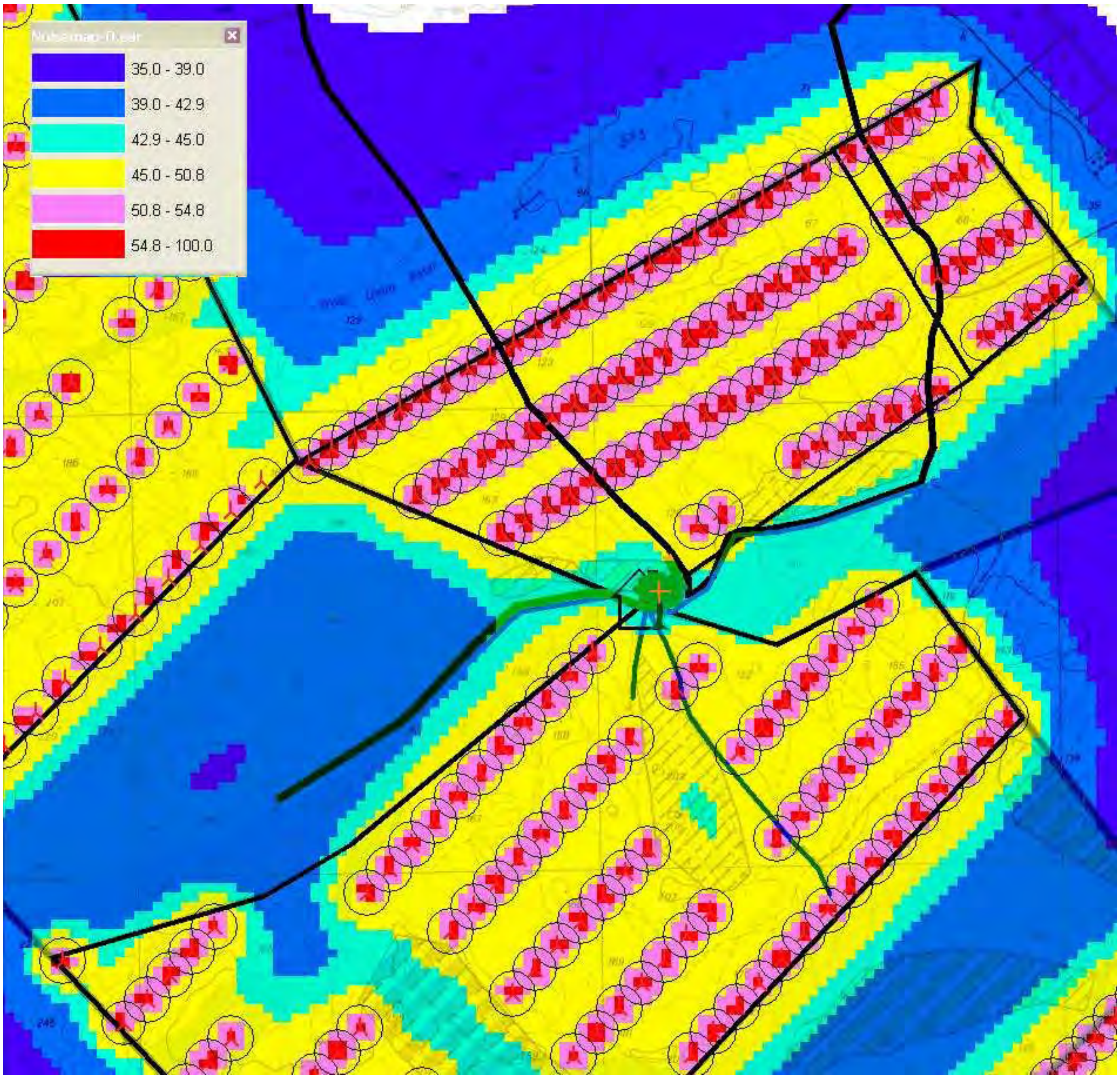



**Fig. 5.5:** Noise propagation calculation results (test configuration)

### 5.9.2 Vibrations

Vibrations result from wind turbine **operation.** However, wind turbines working under regular conditions show very little vibration with the blades correctly balanced and the main shaft correctly adjusted. The propagation of the vibration is dampened by the foundation body and there is very little transmission into the underground, especially in case of a non rocky underground like in most of the part of the subject project area. Thus, vibration effects will not be measurable in the underground already nearby the wind turbines. Moreover, vibrations or very low-frequency "infrasound" produced by wind turbines are the same as those produced by vehicular traffic and home appliances and are similar to the beating frequency of people's hearts. Such –infrasounds” are not special and convey no special risk factors

### 5.9.3 Electromagnetic Interferences

Wind turbines could potentially cause electromagnetic interference with aviation radar and telecommunication systems (e.g. microwave, television, and radio). This interference could be caused by three main mechanisms, namely near-field effects, diffraction, and reflection or scattering. The nature of the potential impacts depends primarily on the location of the wind turbine relative to the transmitter and receiver, characteristics of the rotor blades, signal frequency receiver, characteristics, and radio wave propagation characteristics in the local atmosphere (see IFC, Environmental, Health, and Safety Guidelines, WIND ENERGY)

There is no nearby airport equipped with radar. However, in the North-east of the 200 km² project area a military radar is operated at a distance of 8.7 km from the north-eastern corner of the possibly usable area. As the area was already cleared by the Ministry of Defense it can be assumed that no interference with a coming wind park is expected. This may be due to the big distance to the next possible wind turbine (8.7 km) or the fact, that the radar is not focusing on the southwestern sector. Vice versa it can be expected that the radar will not have negative impacts on the electronic system of wind turbines (e.g. top controller).

Telecommunication systems are placed along the Hurghada – Suez road more than 10 km away from the possible next wind turbine. The wind park would not block any signal from any directional transmitters. The same is valid for television broadcast transmitters, which are far away from the project area.

No significant impact on electromagnetic systems such as radar, telecommunication and television broadcast is expected.

### 5.9.4 Light Reflections and Shadowing

The blade coating of modern turbines does usually absorb direct sun light and reflection is not a significant environmental impact. In case of the 200 km² project area a special blade coating (red, bright white, red) shall apply to increase the visibility to the birds. Thus reflection characteristics would be increased. However, in any case, due to lack of receptors in the surrounding of the wind park that can be affected by reflection, there is no critical impact from that.

The critical impact of shadowing (flickering) as per acceptable standards is 30 hours per year and 30 minutes per day. This can be achieved only at places near to wind turbines, where the observed transition time of the sun through the rotor diameter can achieve such durations. As there are no residences or housing near to the turbines (except the Bedouin family housing, to which a distance of at least 300 m shall be kept), it is obvious that there is no impact from flickering beyond acceptable level.

## 5.10 Archaeological, Historical and Cultural Heritage

In the absence of archaeological, historical and cultural heritages within the projects are or in the surroundings, there would be no impact caused by the wind power project in that regard.

## 5.11 Occupational Health and Safety Risks

Relevant occupational health and safety standards to be considered during the construction of wind power projects include

- Keeping workplace standards with regard to air quality, noise and temperature, as defined by Law 4/1994 and its executive regulations, Annex 8,
- Keeping the Egyptian code of practice issued by the EEA as well as the stipulations of the Labor Law 12/2003 for ensuring strict procedures for de-energizing and checking electrical equipment and the implementation of a safety supervision scheme before maintenance as well as the performance by trained personnel only,
- Keeping general health and safety standards such as
  - Personnel using special protection such as safety boots, helmet, and, as to the kind of work, gloves, masks or eye protection glasses,
  - Adequate sanitary facilities free from pathogens and suitable for washing of personnel,
  - Safety training and safety equipment (safety belts) for working at heights,
  - Elevated platform, stairs, walkways or ramps to be equipped with handrail tand non-slip surfaces,
  - Periodical medical examinations for personnel working at heights,
  - Establishment of health and safety plans and assignment of health and safety engineer for supervision,
  - Periodical safety instructions, etc.

***Construction phase:*** Safety risks during the construction phase are resulting from

- Earth works and concrete works such as foundation constructions (minor nature),
- Working at heights (major risks),
- Loading and de-loading of bulky equipment,
- Electrical works (partly under control by external authority EEHC).

Health and safety risks shall be controlled at least as to the level defined in the IFC Environmental, Health and Safety Guidelines, Wind Energy, April 2007. For electrical works internationally acceptable Electrical Workers Safe-Work Regulations shall apply, such as the code of practice issued by the EEA.

***Operating phase:*** Potential occupational health and safety risks during the operation and decommissioning phase of wind power projects are similar to those during the construction phase.

No significant health and safety risks are expected, if a proper health and safety programme will be established and properly executed.

## 5.12 Impact on Traffic, Utility Services and other Infrastructure

***Construction phase:*** As the main roads in the overall region are very well dimensioned at low traffic frequency there are not any critical impacts on the traffic on public roads during the wind park construction.

A considerable amount of water might be required for concrete making, if the concrete will not be provided as ready mix. In case of having a batching plant at the site the water will have to be provided by tankers. The amount of fresh water required per day can be estimated using the case of making a large size 250 m³ concrete foundation. Accordingly the maximum daily fresh water use is about 35 m³ of fresh water to be supplied by tanker from regional sources or the water supply system of Ras Gharib fed by the Nile water. Some more water would be required in case of simultaneous casting of foundations for the substation, which however are significantly smaller. With a maximum demand of 50 m³ fresh water per day (0.6 l/s average) the nearby water supply systems might already be stressed. If that water cannot be provided from the public utility sources it must be procured from the nile valley by tankers, what is still manageable.

The wind park project will have to be interconnected to the national power grid before commissioning. Provided that the system will be adequately designed (it is under control of EETC) there will be no negative impact on the electricity supply in the region. In contrary, modern wind power systems can contribute to stabilising the power grid.

***Operating phase:*** There is almost no project related traffic except minor car traffic in case of maintenance or in exceptional cases transport of bulky goods for heavy repair.

There will be no water demand of wind park itself during operation. Some water demand may arise from the sanitary facilities of

- the substation control room (3 persons à 30 l/d): 0.090 m³/d
- The service facilities including housing for the investors personnel next to the substation or outside the wind park area: (50 persons à 40 l/d): 2.0 m³/d

The facilities of the investor and of EETC (substation) will be most probably connected to the regional water supply originating from the Nile via Hurghada. The expected amount of water consumption of 2 m³/d will not be critical for the supply of the region.

The wind park will work in parallel to the power grid on 220 kV or 500 kV transmission level. The wind electrical energy will strengthen the electricity supply in general and will contribute to grid stability if being properly designed.

Accordingly, no significant impact on the infrastructure in the region is expected.

## 5.13 Socio-Economic Effects

The wind park will not interfere with any settlement or regional infrastructure. It will employ limited numbers of workers (e.g. 100 to 200) during construction, most of them probably coming from the region. It will have measurable effects on cultural, community and demographic impacts. It will contribute to employment and development of the region.

***Construction phase:*** Wind park construction would have economic benefits for workers in Egypt usually mainly coming from Upper Egypt but also from other regions:

- About 30 to 40 % of the investment volume would be produced locally.
- During construction local personnel would be employed for civil, electrical and installa-

tion works. These works would be carried out essentially by Egyptian companies.

- Local Bedouins are usually employed as guards, as the Zafarana example shows. Accordingly, the Bedouin family living inside the project area, should directly befit from the project.

Considering the unemployment rate in Egypt the demand for construction workers for wind park construction would not create labour bottlenecks in other areas.

***Operating phase:*** During the operating phase the wind park development will contribute to employment, avoidance of greenhouse gas emissions and saving of indigenous resources.

- Wind park operation will typically be carried out by local, especially trained personnel, hired by the Contractor or by NREA, in case of a NREA project. Accordingly, a significant number of electricians, mechanics, engineers and workers would be employed for O&M of the wind park.
- At steadily increasing oil prices, wind power utilisation, especially at a site with very high wind energy potential like in the 200 km² project area, is very competitive, if compared to international level of cost of energy. It saves indigenous gas and oil reserves, which alternatively could be exported at world market prices.
- A wind power project will contribute to the avoidance of $CO^2$ emissions and the wind power development in the project area will most probably be developed in form of CDM projects. Assuming a likely capacity factor of 0.4 and an approximate $CO^2$ emission factor of 0.54 t $CO^2$ /MWh valid for Egypt the saved $CO^2$ emission per each MW wind power installed would be about 1890 t $CO^2$ per year.

No negative socio-economic effects are expected. In contrary wind power development in the project area is likely to have positive impacts on employment and the social and economic development in Egypt with a focus on the project region itself.

# 6. MITIGATION OF ENVIRONMENTAL IMPACTS

## 6.1 Mitigation strategy

Construction and operation of wind farms within the “200 $km^2$ Project Area” will lead to significant impacts on migrating birds in spring. These impacts shall be mitigated based on the results of the ornithological survey. In accord with the importance of the area for bird migration and hence according to the strength of the expected environmental impact, the study area is subdivided into three zones:

Zone I: Being generally acceptable for wind power development.

Zone II: Not being acceptable for wind power development (unless further post-construction monitoring on nearby wind parks would demonstrate little impact on birds or an effective shutdown programme would be introduced).

Zone III: Definitely not being acceptable for wind power development.

Having excluded areas with significant impacts on migrating birds (Zone III) and considering the following mitigation measures (Chapter 6.2.1) the expected impact of wind farms on an area of about 120 $km^2$ can be reduced to an acceptable level.

With regards to other conservation resources wind farms within the study area will cause minor residual impacts. These residual impacts can be mitigated by good design, workmanship practice, keeping health and safety standards as well as housekeeping and supervision (see Chapter 6.2.2).

## 6.2 Mitigation Measures

### 6.2.1 Mitigation Measures with regards to Migrating Birds

Regarding migrating birds the required mitigation measures are:

- In order to reduce the expected risk of collision and barrier effects for migrating birds at wind farms within **Zone II** an effective shutdown programme has to be developed and established for the spring migration period (Note that a shutdown programme has to be coordinated with the National LDC). With regard to the development of such a shutdown programme, a two-step approach is conceivable:
  - A *fixed shutdown* (FS) programme stopping all turbines from March, 1st to May, 18th during daytime (1 hour after sunrise to 1 hour before sunset). Based on long term wind data, the expected energy loss caused by such a FS-programme is estimated to be about 10 %.
  - Improve the FS-programme and develop a *shutdown-on-demand* (SOD) programme. Applying the SOD-programme should stop all turbines during times of high migratory activity and when large flocks approach the wind farm. Within the SOD-programme a monitoring of bird migration in spring (e.g. March, 1st to May, 18th) carried out by experienced ornithologists is required (probably using radar technology). The ornithologists should stay in close contact with the engineering office in charge of monitoring the operation of the wind farms, so that the wind farm can be shutdown rapidly if required. This implies the requirement that all wind farms are centrally controlled (including installation of central control facilities).

On the basis of long term wind data and bird migration data obtained in spring 2010, the expected energy loss caused by such a SOD programme is estimated to be about 2 %. As the criteria for shutting down times were defined rather conservatively, the total energy loss to be expected is less than 2 %. Successfully operating SOD programmes are established, for instance, in a wind farm in Portugal (Parque eólico de Barão de S. João) and in Mexico (La Venta II).
Assuming that effective FS- or SOD-programmes are established, wind farms within Zone II are not expected to lead to a relevant collision risk or barrier effect for migrating birds in spring. Nonetheless, technical avoidance and further mitigation measures according to best standard practices are required (see below).

- The expected risk of collision and barrier effects for migrating birds at wind farms within **Zone I** during spring have to be reduced by effective measures, i.e. either
  - by implementing an escape corridor: The escape corridor should have a width of about 1 km and should be orientated in parallel to the main wind direction, i.e. Northwest to Southeast. A corridor will allow birds to leave the wind farm area in a safe way and without larger efforts. This is particularly important in spring when birds face strong headwinds and have to struggle continuously to migrate further northwest. As gliding birds lose altitude, especially in a headwind situation, they are forced to gain height by circling and soaring in thermal uplifts. During soaring, which usually lasts several minutes but can take half an hour or more, birds drift with the wind to the Southeast. This might be critical if birds drift to a row of operating turbines. Sometimes birds even give up struggling against the strong headwinds and go with the wind in south-eastern direction. In these situations an escape corridor is an effective measure to give birds an opportunity to escape the wind farm area. Zone I has an average width of 4.8 km and an average length of about 11.0 km. One escape corridor reaching from NW to SE should be implemented in the middle of Zone I.

  or, alternatively,

  - by establishing a shutdown programme (see above), if implementation of an escape corridor is not a favorable option for economical or other reasons. Applying a shutdown-on-demand programme is recommendable, if it was proved to be effectively and sustainable operating and if it was in accordance with the requirements of the LDC. Carry out a central control to regulate and to monitor the wind park shutdown concept.
- If implementation of an escape corridor through Zone I is intended, a concentration of migrating birds can be expected within the corridor area during spring (when birds face strong headwinds and are drifted with the wind to the Southeast or when birds give up struggling against strong headwinds and go with the wind in south-eastern direction) and possibly during autumn, too. Hence, to reduce collision risk and barrier effect for migrating birds the corridor through Zone I has to be expanded in south-eastern direction through Zone II. If, alternatively, a shutdown programme will be applied for wind farms within Zone I (but no escape corridor), an escape corridor through Zone II is dispensable. It is known that barrier effect is higher at operating turbines than at non-operating turbines (e.g. Winkelman 1992).
- Avoid turbines with lattice towers in order to reduce suitable perching sites. Avoid wind turbines with a total tip height of more than about 120 m.
- Avoid lighting of turbines. If lighting of turbines is absolutely required (to meet aviation requirements of the civil and military aviation authority), use the minimum number of

intermittent flashing white lights of lowest effective intensity (Drewitt & Langston 2006).

- Paint turbine blades to increase blade visibility by using blades with black and white aviation markings (see also Hodos et al. 2003).
- Avoid establishing areas that would attract migrating birds (waste dump, open water bodies, gardens or houses with vegetation).
- Build the wind park internal grid by underground MT cables. If the use of overhead lines cannot be avoided (e.g. 220 kV OHL), such overhead lines have to be designed according to the guidelines –Protecting birds from power-lines, Nature and environment No. 140, Council of Europe Publishing". Analogous measures shall be applied at any substation to be built in that area.
- The Red Sea coast is a unique site for bird migration and hence results from other studies cannot necessarily be transferred. Furthermore, bird-wind turbine interactions, especially collision risk and barrier effect, are poorly understood. Due to the lack of knowledge about behaviour of large soaring birds in the vicinity of wind turbines the predicted impacts and its magnitude are subject to a certain degree of uncertainty. Consequently, apart from mitigation measures, a thorough post-construction monitoring programme should be implemented for at least the first two years during main migration periods (2.5 months in spring and 2.0 months in autumn) to assess whether impacts of wind farms in Zone I and Zone II remain at an acceptable level, or whether additional measures are necessary to minimize or eliminate unacceptable impacts. In doing so, cooperation with national and international environmental organisations is recommended.

  The main purposes of the post-constructing monitoring programme are:

  - Verification of the assumptions made within the impact assessment and determination of significant deviations from predicted impacts.
  - Testing the effectiveness of mitigation measures (e.g. painting blades, shutdown programme or usage of corridors by migrating birds).
  - Identification of possible critical wind turbines and definition of further operational mitigation measures.
  - Determination of the weight and significance of proposed impacts (especially collision rates).
  - Examination of the behaviour of migrating birds in the vicinity of the proposed wind farm and determination of species-specific avoidance responses.
  - Examination of conditions in which collisions occur and the cause-and-effect chain of collisions.

  Important references for an adequate monitoring programme can be found in National Wind Coordinating Committee (1999), Drewitt & Langston (2006), Band *et al.* (2007), Bergen 2007, Follestad *et al.* 2007, Morrison *et al.* (2007) and Strickland *et al.* (2007).

### 6.2.2 Mitigation Measures with regards to other Features (except migrating birds)

Regarding other features (except migrating birds) the required mitigation measures are:

- Avoid establishing areas that would attract birds (waste dump, open water bodies, gardens or houses with vegetation).
- Constructional works next to the oasis, water wells and in the larger Wadi beds shall be minimized and limited to road construction/improvement and laying of cables in trenches.
- All human activities must be restricted to the boundaries of the construction areas, storage positions and access roads / tracks. Use of the surroundings in any kind must be restricted. All movement should strictly stick to the existing tracks. No new tracks are to be created unless there is no other option.
- Installation of turbines and other technical installations are to be avoided in the areas inhabited by the Egyptian Dabb Lizard. All human activities shall be minimized, both during construction and operation / maintenance phase.
- Non-deliberate and deliberate destruction of habitat should be prevented.
- Hunting or disturbance of animals in the area should be strictly prohibited.
- Influx of foreign (non-local) species in the area should be avoided as much as possible.
- Supplying or changing oil, lubricant or hydrocarbon to vehicles should be done in gas stations. These activities should not be carried out on site. Strict control must be applied by a site supervisor.
- Contingency measures and plans for spill removal must always be ready on site.
- Waste has to be removed immediately and has to be safely stored at the site so that drifting is avoided.
- Contractors should provide effective protection for land and vegetation resources at all times and should be held responsible for any subsequent damage.
- The contractor shall be forced to good workmanship and housekeeping during construction by contractual stipulations and by assignment of supervising engineers in order to assure adequate disposal of solid waste and waste water, to avoid or to collect spillages of used oils, greases, diesel, etc.
- The contractor shall be forced not to leave the construction site unless the area was put into tidy conditions, excavations are backfilled, heaps of excavation material is leveled and waste is adequately disposed off.
- Awareness programs to personnel should be carried out. Behavior and attitude of involved personnel during field activities should be controlled by a site supervisor.

Potential occupational health and safety hazards during the construction phase shall be controlled by

- Assignment of a health and safety engineer by the main contractors for the different Lots with full power for giving health and safety instructions.
- Strictly implementation of wind power manufacturers health and safety instructions concerning the erection, commissioning and maintenance of the wind turbines such as
  - Establishment of a health and safety plan for the construction site,
  - Provision of safety tools & equipment as to accepted standards by the Contractor,
  - Employment of personnel on the turbines only, which has passed a wind power safety training course,
  - Strictly avoidance of works during poor weather conditions (wind speeds beyond limits & lightning risk).
- Strict supervision of health and safety measures of the local civil works companies, which may be employed via the main contractor or directly by NREA, especially with regard to wearing safety clothes, to equipment safety and a safe working environment.
- Strict supervision of keeping health and safety standards for working at electricity generation, transmission and distribution devices.

Minor impacts that can be caused during operation from service installations that will be built outside the wind park area shall be mitigated by

- Regular disposal of domestic waste.
- Regular disposal of hazardous wastes, especially recycling of used oils, which from time to time is generated during oil exchange at the wind turbines.
- Collection of domestic waste water, purification in a simply two stage anaerobic treatment plant and rinsing of treated water into desert gravel for natural post treatment or use for irrigation. Regular disposal of domestic sludge.

# 7. ENVIRONMENTAL AND SOCIAL MANAGEMENT

## 7.1 Environmental and Social Management

The implementation of mitigation measures require actions during the bidding, planning, construction and post construction phase for each individual wind park that would be erected in the accepted or eventually later on in the conditional acceptable area. This can be summarised in the following EMP.

| Project activity | Environmental Concern | Mitigation Measures | Estimated Cost (EUR) |
|---|---|---|---|
| Bidding and Planning Phase | Health and Safety Risks | Make keeping standards as defined in the Environmental, Health and Safety Guidelines for Wind Energy, IFC,2007, a minimum obligation in the Tender Documents | To be included in the investment cost |
| | | Make the assignment of a health and safety engineer during the construction process a condition | To be included in investment cost |
| | | Make a health and safety plan for the construction site obligatory | To be included in investment cost |
| | | Make provision of safety tools & equipment as per accepted standards by the Contractor a bidding condition | To be included in investment cost |
| | Impacts on birds | Limit the maximum tip height of wind turbines to 120 m | No cost |
| | | Define the minimum distances between wind turbines to be not less than 3 x 12 rotor-diameters | To be included in investment cost; this measure would lead to higher infrastructure cost, but would also cause higher energy yield and reduced turbulence and leave room for bird migration. |
| | | Paint turbine blades to increase blade visibility by using blades with black and white aviation markings (see also Hodos et al. 2003) | About 10,000 EUR/MW to be considered in the investment cost |
| | | Build internal grid as underground cable | This is the standard and to be included to the investment cost |
| | | Make keeping guidelines -Protecting birds from power-lines, Nature and Environment No. 140, Council of Europe Publishing" a condition for the design of the 220 kV interconnection to the substation and introduce adequate bird protection measures at the substation | Design of the 220 kV OHL to be dealt with by EETC. For the substation: The MT side to be built as in-house switch-gear building; 220 kV side to fit with the technical connection requirements as per the guidelines; cost to be borne by the project owners |

| | | | |
|---|---|---|---|
| Detailed planning and Construction phase | Health and safety risks | Availability of an adequate health and safety plan | Included in Cost Estimate |
| | | | |
| Construction phase | Health and safety risks | Assignment of health and safety engineer of Contractor with independency with regard to giving health and safety instructions | Included in Investment Cost |
| | | Keeping the -Environmental, Health and Safety Guidelines for Wind Energy, IFC,2007" as a minimum condition | Included in Investment Cost |
| | | Availability and proper utilisation of safety tools and equipment | Included in Investment Cost |
| | | Hygienic temporary sanitary facilities | Included in Investment Cost |
| | | Assure stoppage of erection works during weather conditions beyond limits | Included in Investment Cost, extended erection periods |
| | Pollution | Good workmanship and housekeeping to be assured by supervising engineers to assure adequate disposal of solid waste and waste water, and to avoid or to collect spillages of used oils, greases, diesel, etc. | Included in investment cost |
| | | Force the contractor to put the construction site into tidy conditions, excavations are backfilled, heaps of excavation material is levelled and waste is adequately disposed off. | Included in investment cost |
| | Impact on birds | Assure the constructional work is conducted in accordance with mitigation measures given in Chapter 6.2.<br>In addition: For implementation of a shutdown programme the technical design has to consider a central control facility for all wind farms in the area, which allows a central shutdown and restart operation. | Additional investment cost for central control facilities of an order of 1 Mio. EUR |
| | Impact on flora and fauna (except birds) | Assure the constructional work is conducted in accordance with mitigation measures given in Chapter 6.2; such as no wind turbine construction in major Wadis, road and trench alignment away from vegetation area, no constructions at sites inhabited by Egyptian Dabb Lizard | Very limited additional cost for investors, that can be quantified after detailed design is done only |
| | | | |
| Operation and maintenance phase | Health and safety risks | Assure that O& M at the wind turbines is carried out by personnel only, that has passed a safety training course | Standard requirement to be observed by project owners and monitored by a qualified external expert (50,000 EUR for a larger wind park) |
| | Impacts on birds | Carry out a post construction ornithological monitoring for at least the first two years during main migrating sea- | 400,000 EUR per year; expertise to be jointly hired by the |

| | | | |
|---|---|---|---|
| | | sons for wind farms in Zone I and Zone II in cooperation with national and international environmental organisations to identify any impacts on birds beyond acceptable level and to apply additional mitigation measures or improve already established mitigation measures, wherever necessary, to the limits defined in this study | project owners or alternatively by each individual project owner |
| | | Supervision and central control of a fixed shutdown programme during spring migration season for wind farms in Zone II (and optionally in Zone I) | 150,000 EUR per year for Zone II (and optionally for Zone I) |
| | | Develop, test and establish a (radar based) shutdown-on-demand programme during spring migration season for wind farms in Zone II (and optionally in Zone I), including coordination with LDC | 2 years, about 1 Mio. EUR; to be financed by NREA supported by soft loan facilities |
| | | Carry out a shutdown-on-demand programme (probably at two sites, each one equipped with one radar system) during spring migration season in Zone II (and optionally in Zone I), including coordination with LDC | 300,000 EUR per year for Zone II (and optionally for Zone I); expenses to be shared by project owners or alternatively to be borne by each individual project owner |
| | Pollution | Assure proper management of domestic waste at service buildings (e.g. in cooperation with Ras Gharib waste management scheme ) and of used grease and oils (recycling) | Standard requirement to be observed by owners |
| Decommissioning | Land-use and Landscape | Remove the wind turbine installations at the end of the life time | To be borne by the investor and to be considered in the investment cost |

## 7.2 Monitoring arrangements and actions

The purpose of environmental monitoring is to ensure that the designed mitigation measures are implemented on the ground and then whether they are effective over the time. The latter is especially relevant with regard to the bird protection aspects and the respective post-construction monitoring.

The environmental monitoring follows the management plan and shall be carried out in 4 phases:

1. The bidding and planning phase
2. The implementation and operation phase
3. The checking & corrective actions phase
4. The management review phase

Two monitoring activities have to be initiated for the proposed project. The first is compliance monitoring, and the second is impact detection monitoring.

Compliance monitoring provides for the control of keeping the postulations defined in the EMP. The impact detection monitoring comprises the ornithological post construction monitoring.

The responsibility for monitoring lies with the Competent Authority. Moreover, the financing institutes may make keeping the monitoring and a corresponding reporting a condition in the financing agreements.

For the ornithological post-construction monitoring and for the developing, establishing and supervising of shutdown programmes the owners shall assign a qualified and renowned expert company, which in addition shall cooperate with national and international environmental organization (e.g. Birdlife International).

The post-construction monitoring of migrating birds should be carried out for at least the first two years during main migration periods (2.5 months in spring and 2.0 months in autumn) during the operation phase. It should be carried out by an independent ornithological expert team. The monitoring may result into the following:

a. Verification of ornithological investigation during autumn migration period: main results and proposed impacts of wind farms within the study area. No further action required.
b. Observation of bird behaviour while approaching the wind farm during spring migration period. Checking wind turbines for collision victims in spring. Supervision of fixed shutdown programme. Recommendation to improve or add necessary mitigation measures.

In parallel a (probably radar based) monitoring should be started to investigate, whether shutdown periods during daylight in spring could be further shortened to an event based triggering based on radar observations (shutdown-on-demand (SOD) programme). Developing and establishing a SOD-programme should be a joint effort of the project owners and be carried out by a specialist company in close cooperation with national and international environmental organization and under consideration of the requirements of the National LDC.

Also the keeping of health and safety standards to be implemented by the Owners qualified health and safety engineer, acting in his field independent from eventual instructions of the Owner should be monitored by an external expert as required by the financing institute. A corresponding budget is considered in the cost estimate for that. Moreover, other environmental costs were considered, which is mainly related to the painting of blades and measures at the transmission line and the substation.

# Annexes

# Annex 1

# ESIA Study for 1000 MW Wind Farms at the Gulf of Suez

# Ornithological Investigation Report

# June 30th, 2011

Joint Venture
Lahmeyer – ecoda
Ruinenstr. 33
44287 Dortmund
Germany

Fon +49 231 841697-10
Fax +49 231 589896-0
ecoda@ecoda.de
www.ecoda.de

# Expert Opinion on the Ornithological Investigation at the Gulf of Suez

as part of the ESIA for 1,000 MW Wind Farms at Gulf of Suez,
Arab Republic of Egypt

reported to:

New and Renewable Energy Authority (NREA)
Cairo, Egypt

and

Kreditanstalt für Wiederaufbau (KfW)
Frankfurt am Main, Germany

Prepared by:

Joint Venture Lahmeyer – ecoda
Dr. Frank Bergen

Dortmund, June 30th 2011

# Table of Contents

# List of Figures



## see Annex IXa (spring migration)

## see Annex IXb (autumn migration)

page



## see Annex IXc (assessment of the importance of the study area)

page

# List of Tables

# 1 Introduction

## 1.1 Background and Aim of the Report

Due to the good wind conditions in the area of the Gulf of Suez, the New and Renewable Energy Authority (NREA) under the Ministry of Electricity and Energy has developed plans for several wind farms along the western bank of the gulf. The Gulf of Suez, especially the area near Gabel el Zayt, is well known as a bottleneck for migrating birds. Large numbers of birds pass the area twice a year during spring and autumn migration. Previous studies have shown that hundred thousands White storks (*Ciconia ciconia*) and further hundred thousands of raptors as well as other soaring species (*e.g.* Pelicans, Cranes) regularly migrate across the Red Sea Coast area and the Red Sea Mountain chain (Bergen 2008, Bergen 2009 Carl Bro 2009). There seems to be a decrease of migratory activity from the South (*e.g.* Ras Gemsa) to the north (*e.g.* Ras Shukeir/Ras Gemsa/Zafarana). Nevertheless, large numbers of birds were recorded near Ras Shukeir as well (Bergen 2009, Carl Bro 2009). According to the Bird Atlas, the area suggested for 1,000 MW wind farms is located in an area with high migratory activity even at lower altitudes at least in autumn (Ornis Consult 2002, see p.95ff). Installing large wind farms in this area may lead to significant impacts on migrating birds caused by collisions with turbines or — to a lower degree — by barrier effects. Since there is no comprehensive understanding on the amount and the spatial distribution of migratory activity at the Red Sea Coast between Zafarana and Ras Shukeir, an ornithological investigation was realized during spring and autumn 2010 by the Joint Venture Lahmeyer International GmbH & ecoda Environmental Expert Opinion. The ornithological investigation is part of the "Environmental Social and Impact Assessment (ESIA) for 1,000 MW Wind Farms at Gulf of Suez".

The main purposes of the ornithological investigation are

- to collect baseline data on migrating birds (mainly soaring and gliding species migrating during the day),
- to describe migration patterns of relevant species in a quantitative way,
- to identify and assess possible impacts regarding development of wind power within the study area and finally
- to recommend mitigation measures in order to minimize possible conflicts.

## 1.2 Study Area

The area suggested for 1,000 MW wind farms (study area) is located about 12 km west of Ras Shukeir and has a size of about 200 km$^2$. It has a length of about 22 km from northwest to southeast and an average width of about 9 km. To the west it is framed by the foothills of the Red Sea Mountains. Gabel Gharib Mountain which reaches up to 1,750 m a.s.l. is as close as 5 km to the western border of the study area. The lowest distance to the Red Sea is about 7 km to the east of the study area, while major parts of the area are located at about 15 km from the Red Sea.

Large parts of the area are almost completely without vegetation. Only in the larger wadis some scrub and desert grasses or acacia trees exist. The area is crossed by major Wadis, their watersheds extent to the Gabel Gharib Mountain.

To the east there is a salt depression (Sebkha), which might be an attractive resting site for migrating birds (at least for some species like pelicans or cranes). Whereas the salt depression and its surrounding is very low (35 m a.s.l.) and flat, the terrain rises to the west and becomes hilly within the study area. The level of the study area ranges from 50 m a.s.l. in the East to 250 m in the north-west. In the centre of the area a family of Bedouins has established a domicile and uses the water to raise a small palm tree garden of about 50 m x 70 m ("oasis").

Figure 1.1: The study area consists of dry desert nearly complete without vegetation

Figure 1.2: The study area is framed by the Red Sea Mountains in the west

Figure 1.3: White storks migrating through the study area

# 2 Methods

## 2.1 Data Collection

### 2.1.1 Standardized Daytime Field Observations

Between March 2nd to May 17th 2010 (spring migration) as well as between August 10th and October 27th 2010 (spring migration) standardized daytime field observations were carried out. Thus, the study covers the main migration periods of relevant species (see BERGEN 2009).

The study design was in general similar to that used during the Additional Ornithological Investigation within the Zone II (Orange Zone; see BERGEN 2009). Observations were carried out observation sites by two teams –each with two ornithologists- under guidance of a chief ornithologist, who advised and supervised the ornithologists. The eight observations sites (A to H, see Figure 2.1) were located at distances of about 5 km. Bird observation was not restricted to a particular distance from each site. As known from earlier studies birds or -at least- flocks of migrating birds can be recorded and safely identified at distances of up to 5 km. Thus, it was possible to cover the entire study area with the study design. Nevertheless, data will be prone to lose precision with increasing distance. In order to ensure a standardised recording and a safe identification of soaring and gliding birds, the main part of the analysis will be restricted to birds migrating at distances of up to 2.5 km from each site (see Figure 2.1). Thus, the obtained data set has a very high accuracy regarding species recognition and estimation of numbers of birds as well as flight altitudes and flight directions. Furthermore, it allows us to compare migration at the eight sites and, consequently, to examine whether there are spatial differences within the study area. Due to the distance between observation sites and due to their spatial distribution, the areas within 2,500 m will cover large parts of the study area (see Figure 2.1).

As earlier studies have shown (see Figure 3.4 and 3.15 in BERGEN 2009), migratory activity is very low in the early morning (within two hours after sunrise) and the late afternoon (within two hours before sunset). Furthermore, in the early morning and the late afternoon bird migration is dominated by species, which are more or less active flyers and, thus, do not depend on thermal uplifts (mainly Harriers). These species are not believed to be particularly vulnerable to collision with wind turbines. As a consequence, observations focused on a daily period between 1.5 hours after sunrise to 1.5 hours before sunset. Length of a day varied between about 11.25 and 13.50 hours during spring and autumn migration periods, respectively. Therefore relevant daily migration periods lasted between 8.25 and 10.50 hours. These periods were subdivided into morning, midday and afternoon. A rotation schedule was used according to which all sites were visited within these three periods (see Table 2.1), thus aiming at a representative distribution of spatial and temporal observation samples. Each observation period lasted three hours at a site, observation time per day was six hours per team. Hence, on average, each site was examined every second day for about three hours and it took twelve days for one complete rotation (see Table 2.1). Consequently, the spatial and temporal pattern of observations were be the same on the first (second, ...) and the 13th (14th, ...) day.

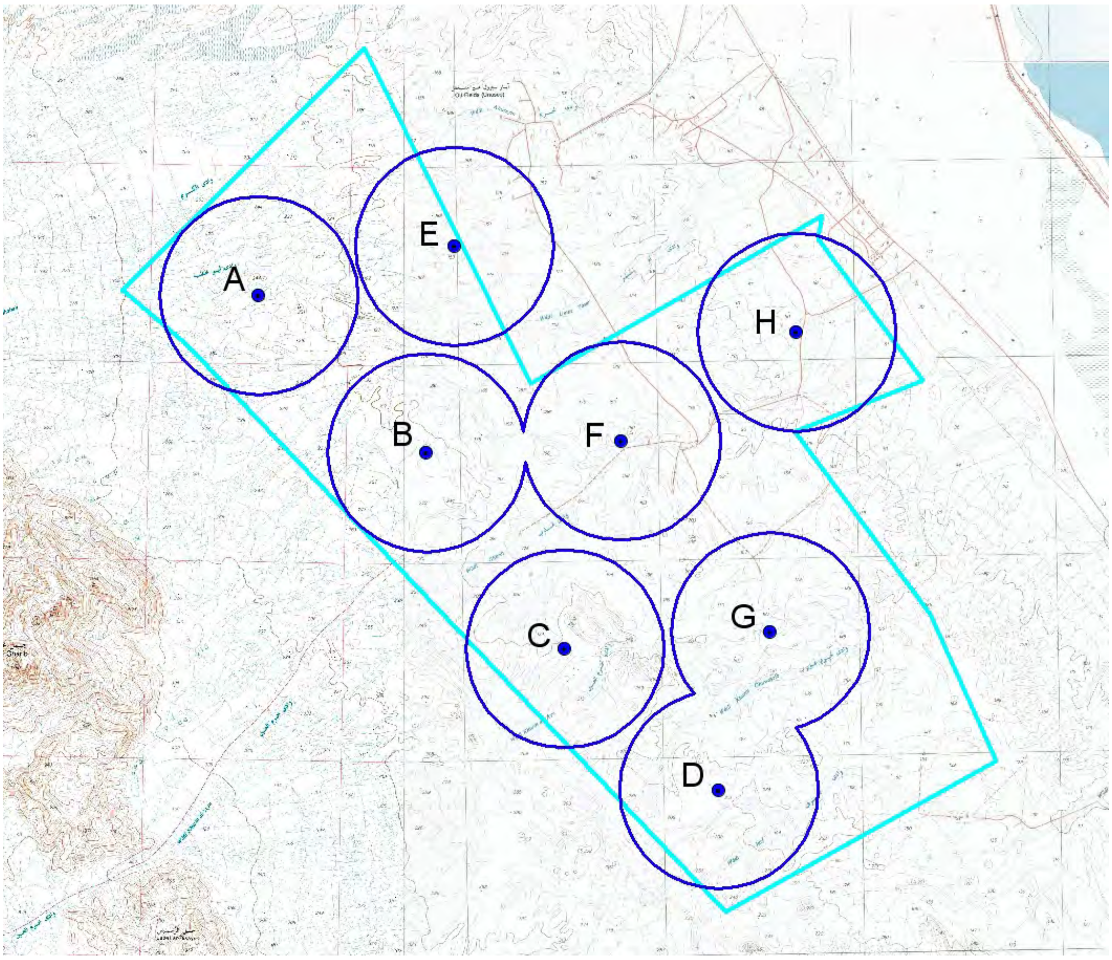



Figure 2.1: Locations of the eight observation sites within the study area in spring 2010 (circles indicate a radius of 2,5 km around each observation site) – in autumn sites were slightly moved to gain a visibility in northern directions

Table 2.1: Rotation schedule for observations at different sites and periods (site: observation site A to H; period: 1-morning, 2-midday, 3-afternoon; a: Team 1; b: Team 2; synchronized observations are shaded)

| | site | A | | | B | | | C | | | D | | | F | | | E | | | G | | | H | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | period | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| day | 1st | a | | | | a | | | | | | | | | b | | | | b | | | | | | |
| | 2nd | | | | | | | | a | | a | | | | | | | | | | b | | | | b |
| | 3th | | a | | | | a | | | | | | | | | b | b | | | | | | | | |
| | 4th | | | | | | | | | a | | a | | | | | | | | | | b | b | | |
| | 5th | | | a | a | | | | | | | | | b | | | | b | | | | | | | |
| | 6th | | | | | | | a | | | | | a | | | | | | | b | | | | b | |
| | 7th | | a | | a | | | | | | | | | | | b | | b | | | | | | | |
| | 8th | | | | | | | a | | | | a | | | | | | | | | | b | | b | |
| | 9th | | | a | | a | | | | | | | | b | | | | | b | | | | | | |
| | 10th | | | | | | | | a | | | | a | | | | | | | b | | | | | b |
| | 11th | a | | | | | a | | | | | | | | b | | b | | | | | | | | |
| | 12th | | | | | | | | | a | a | | | | | | | | | | b | | b | | |

During an observation unit the field ornithologists “scanned” the horizon by binoculars with 8-10 times magnification as well as telescopes with 20-60 times magnification. Once a bird or a flock of birds was detected, the following variables were determined:

- kind of species
- number of birds
- distance and direction to the observation site

  We identified the geographic coordinates of higher structures (hill tops) or conspicuous elements (*e.g.* oasis, single tree, water pump, further elements in the desert) by GPS and calculated the distances of these to each observation site. Moreover, the borders of the study area, the 2,500 m circumference as well as other points were marked by poles (an attached red flag made these poles highly visible). This enabled us to estimate the distance of birds fairly accurately. Distance was estimated in steps of 500 m (up to a distance of 5,000 m). For greater distances we only used two classes: 5,001 - 10,000 m and > 10,000 m.

  Furthermore, we immediately listed whether a bird or flock entered the study area or not.
- altitude

  We estimated minimum and maximum altitudes of birds / flocks above ground using four altitude classes: 1) < 100 m, 2) 100 - 199 m, 3) 200 - 299 m and 4) > 299 m above ground

  In case large flocks ranged over more than one altitude class, we estimated the proportion of birds in each class. This leads to an artificially higher number of recordings since a single flock was divided into two flocks at different altitudes classes. In order to assure a proper quality of field observations estimations of the flight height and distances of the birds were calibrated by laser binoculars.
- flight direction

  Flight direction was estimated using eight classes (with an extension of 45° each): 1) north-northeast (NNE), 2) east-northeast (ENE), 3) east-southeast, ... .
- time of recording

At the beginning and at the end of an observation unit we measured climatic conditions (temperature, wind velocity and wind direction, cloud cover (in %)) and visibility. When climatic conditions changed substantially during a three-hour observation, measuring was repeated.

All variables and further information were recorded on a standard form and transferred to an Excel-sheet after observation.

Observations focused on species which can be regarded as especially vulnerable to collision strikes or other negative impacts caused by wind turbines: these are mainly large birds (first of all, birds of prey, storks and pelicans) which during daytime principally migrate by soaring and gliding. Soaring and gliding birds seem to be especially vulnerable because of their restricted flight agility. Furthermore, these long-lived species are susceptible to any additional cause of mortality because their rate of annual off-spring is so low. Small migrating birds (passerines) were not recorded in a systematic way.

Several of the 40 relevant species that were included in the analysis are of international, European or national conservation concern (see Annex I and II). Six species are of special interest within the impact assessment as they have an unfavourable conservational status according to the IUCN Red List of Threatened Species (see Annex I and II): Egyptian vulture (*Neophron percnopterus*, Endangered), Greater spotted eagle (*Aquila clanga*), Eastern imperial eagle (*Aquila heliaca*), Lesser kestrel (*Falco naumanni*; all Vulnerable) as well as Pallid harrier (*Circus macrourus*) and Red-footed falcon (*Falco vespertinus*; both Near Threatened). In contrast, Steppe buzzard (*Buteo buteo vulpinus*) is a very common and widespread species that is not considered to be endangered, vulnerable or (near) threatened. Consequently, this species is of less interest within the impact assessment.

Since White stork (*Ciconia ciconia*) is known to migrate in large numbers through the Gulf of Suez region, and therefore is an important species regarding impact assessment, we mapped the tracks of all observed White stork flocks. Consequently, we obtained the spatial migration pattern of White stork within and outside the study area.

### 2.1.2 Resting Birds in the Study Area and in the Sebkha

Whenever resting birds occurred in the study area during standard observation or while travelling they were recorded (species, number of birds, location). Moreover, regular visits at the Sebkha, which might be a resting site for Storks, Pelicans or Cranes, were conducted. During these visits a team of ornithologists drove the road which goes along the western border of the Sebkha as far as near the main road (Hurghada – Suez) in the South. At certain locations the team stopped to scan the Sebkha for resting birds using binoculars and telescopes.

## 2.2 Data Analysis

### 2.2.1 Observation Time

The analysis comprises 264 observation units in spring 2010 and 268 observation units in autumn 2010 (Table 2.2). The total observation time amounts to 792 hours in spring 2010 and 803 hours in autumn 2010. In 73 units in spring and 56 units in autumn a synchronized observation at a second site took place. The number of synchronized observations ranges form 14 (sites B & E) to 22 (sites D & G) in spring and from 12 (sites D & G) to 16 (sites B & E) in autumn (see Table 2.2)

Occasionally synchronized observations were carried out at Ras Gharib (*e.g.* 25 hours in autumn) and at the foot of Gabel Gharib (*e.g.* 24 hours in autumn). But, as migratory activity was low at these sites the obtained results are not presented in Chapter 3.

Table 2.2: Observation time and number of observation units at each of the eight observation sites (obs. site) in spring 2010 and autumn 2010 (h (obs.) – hours of observation; n (obs.) - number of observation units; $obs._{syn}$ – synchronized observations)

| | spring 2010 | | | autumn 2010 | | |
|---|---|---|---|---|---|---|
| obs. site | h (obs.) | n (obs.) | n ($obs._{syn.}$) | h (obs.) | n (obs.) | n ($obs._{syn.}$) |
| A | 99.0 | 33 | 20 (F) | 98.0 | 33 | 15 (F) |
| B | 99.0 | 33 | 14 (E) | 96.0 | 32 | 16 (E) |
| C | 99.0 | 33 | 17 (H) | 102.0 | 34 | 13 (H) |
| D | 99.0 | 33 | 22 (G) | 102.0 | 34 | 12 (G) |
| E | 99.0 | 33 | 14 (B) | 99.0 | 33 | 16 (B) |
| F | 99.0 | 33 | 20 (A) | 102.0 | 34 | 15 (A) |
| G | 99.0 | 33 | 22 (D) | 102.0 | 34 | 12 (D) |
| H | 99.0 | 33 | 17 (C) | 102.0 | 34 | 13 (C) |
| total | 792.0 | 264 | | 803.0 | 268 | 0 |

### 2.2.2 Resting and Sedentary Birds

Observations of resting and probably sedentary birds were separated from the standard data set, as far as these birds were not observed in active migration (before or after resting). Frequency and spatial distribution of resting birds are presented in Chapter 3.1.1, so these results can be considered in the impact assessment section.

### 2.2.3 Definition of Different Data Sets Used in the Analysis

While analysing and interpreting the data different data sets with different sample size have to distinguished:

<u>Overall migration</u>

This data set refers to all migrating birds observed in or outside the study area. Although this data set does not necessarily refer to the study area, it can provide useful information about general migration patterns in the wider surrounding of the area.

Though the pairs of sites at which synchronized observations were chosen at best we cannot exclude that some birds were recorded twice ("double counts"). To make sure that the data set is not seriously affected by double counts we checked all synchronized observation units for probable or obvious double counts (*e.g.* a flock of 500 White storks recorded at one site and recorded at the second site 20 min. later). We believe that there might be only a few double counts left in the data set after checking.

Migration within the study area

This data set refers to all birds that entered the study area regardless of their distance to the observer. Again, we checked this data set for double counts (see above).

Standard data set

Most times it was possible to detect larger flocks and even single birds at distances of up to 5 km or even more from the observer. Of course, the data set is prone to lose precision with increasing distance. In order to ensure a standardised recording and a safe identification of soaring and gliding birds, the regular observation distance was restricted to 2.5 km. As a consequence, the standard data set refers to all birds migrating at distances of up to 2.5 km from the site, at which an observation was carried out. This data set is believed to have a very high accuracy regarding species recognition and estimation of numbers of birds as well as flight altitudes and flight directions. Furthermore, it allows us to compare migration at the eight sites and, consequently, to examine whether there are spatial differences within the study area. Problems in this analysis resulted from the location of observation site E at the eastern boundary of the study area (for all other sites this issue is negligible; see Figure 2.1). As a consequence, birds migrating at distances of up to 2.5 km but outside the study area were not included in the analysis. In order to make migration rates at observation sites comparable, correction factors for the area portion within the study area were introduced for site E.

Standard data set without double counts

Though the pairs of sites at which synchronized observations were chosen at best we cannot exclude that some birds were recorded twice ("double counts"). To make sure that the data set is not affected by double counts we excluded one of the two observation units. We did that in an alternating way (*e.g.* A/~~F~~, ~~A~~/F, A/~~F~~,...)

Standard data set without Steppe buzzard

Steppe buzzard was observed in high numbers within the study area. As this species is not of particular interest for the impact assessment due to its conservational status (see Chapter 2.1.1) we exclude all Steppe buzzards from the data set.

Synchronized observations (with or without Steppe buzzard)

This data set refers only to synchronized observations (with or without Steppe buzzard). The sample size of each pair of observation sites is given in Table 2.2 for spring and autumn period.

### 2.2.4 Standardized Daytime Field Observations

Number of Migrating Birds, Species Composition and Flock Size

In order to characterize bird migration, we calculated the total number of birds for each relevant species. Furthermore, we used the number of recordings as a further variable to describe migration patterns. A single recording can either be an individual or a flock (independent of the number of birds). The number of recordings is an important variable because it is not influenced by flock size. In contrast, a single but large flock has a strong effect on the variable "number of birds". Therefore, the number of recordings gives additional information about migratory activity and continuity as well as on species-specific migration behaviour.

In order to estimate the effect of flock size on the data set, we defined five different classes:

1) 1 individual, 2) 2 - 10, 3) 11 - 100, 4) 101 - 1,000 and finally 5) > 1,000 individuals

For each class we added up the total number of birds / recordings. In order to ensure a high accuracy we restricted this analysis to the standard data set (see above).

Seasonal Distribution of Migratory Activity

To identify main migration periods we calculated the cumulative number of birds / recordings over time (for all species within the study area and - if appropriate - species-specific). This allowed us to determine the time frame, in which 50 % or 90 %, respectively, of all birds / recordings have been recorded.

Furthermore, we calculated a weekly migratory activity by summing up the number of birds / recordings for every week of observation (using the standard data set). To analyse changes in migratory activity over the whole period of investigation, we calculated the relative abundance of birds / recordings for each week.

Daily Distribution of Migratory Activity

In order to analyse changes in migratory activity during the day, we calculated the relative frequency of all birds / recordings within observation units carried out during morning, midday and afternoon.

Altitude of Migration

Regarding possible impacts of wind turbines on bird migration, flight altitude is a very important variable. Therefore, for each altitude class (see above) we summed up the total number of birds / recordings i) for all species and ii) species-specific for the most numerous species (using the standard data set). If altitude of birds / recordings had changed during observation we considered the minimum altitude. Note that the numbers of recordings may be higher as in the standard data set due to the division of a flock into two or more altitude classes.

Migratory Rate as a Measure for Migratory Activity

In order to describe migratory activity we calculated the migration rate (birds / recordings per hour) for each observation unit. Subsequently, we were able to calculate average migration rate over all observation units for each observation site (using standard data set). Since migration rates showed no normal distribution we used not only the mean but also the median as a descriptive measure.

Migratory Activity, Wind Speed and Wind Direction

In a first step, we analyzed the whole data set for a possible relationship between migratory activity as the dependent variable and wind speed as well as wind direction as independent variables (as given below). To avoid any methodological bias we used the data set without synchronized observations, *i.e.* without possible double counts. As no remarkable pattern results from this analysis we do not present this data here.

In a second step, we exclude all Steppe buzzards from the data set, because this species has a large influence on the data set, but is not of particular interest for the impact assessment (see above).

For the analysis we built

a) three classes for migratory activity (note that the average migration rate for the data set without Steppe buzzard was 169 birds/h):
   - low migratory activity: migration rate below 100 birds / h
   - average migratory activity: migration rate between 100 and 500 birds / h
   - high migratory activity: migration above 500 birds / h

b) three classes for wind speed (For each observation unit average wind speed (m/s) was calculated and than transformed in the Beaufort-scale.):
   - low wind speed: 1 to 2 Bft
   - medium wind speed: 3 to 4 Bft
   - high wind speed: 5 Bft and higher

Moreover, we distinguish between observation units with prevailing winds from the north, the South or with changing wind directions.

Finally, we rank all observation units according to the described variable.

Migratory Activity and Spatial Distribution of Migration

To analyze the standard data set we compared the total number of birds / recordings observed at all observation units.

This specific rotation schedule regularly leaded to synchronized observations (with comparable independent variables (*e.g.* weather conditions or time of day) at four particular pairs of sites. To identify spatial differences in migration and to assess the significance of a site for migration, we compared migration rates at the two sites of each pair using Mann–Whitney U test.

Comparison of Migration Obtained by the Recent and the Previous Study

To determine whether migration was comparable to the previous study and to assess the significance of the study area for bird migration, at first we compared for each period the total number of birds / recordings recorded in the Orange Zone (2008 and 2009) and in the study area (2010).

Furthermore, we compared for each period average migration rates over all observations sites recorded in the Orange Zone (2008 and 2009) and in the study area (2010).

Birds Migrating at Altitudes below 200 m

As in previous studies, in accordance with the precautionary principle, we supposed that wind turbines with a maximum height of about 120 m do not affect birds migrating at an altitude of 200 m or more. Thus, we restricted the standard data set to all birds / recordings migrating at altitudes lower than 200 m above ground. As far as appropriated, we then calculated overall and species-specific numbers of birds / recordings and migration rates for each observation site.

To assess the significance of each of the eight observation sites, we compared the recorded bird migration at altitudes below 200 m with the data obtained at observation sites in the Orange Zone (BERGEN 2009). To minimize effects leading to biased errors (see ECODA 2007), the total number of birds / recordings has been used to analyse the spatial distribution of migratory activity.

Statistics

All statistical tests were carried out with the software R 2.11.1 (http://www.r-project.org/). We used a = 5% as the probability of error and, thus, p = 0,05 as the level of significance.

# 3 Results

## 3.1 Spring 2010

### 3.1.1 Migrating and Resting Birds – in general

Overall migration

During standardized field observations in spring 2010, a total of 222,102 birds from 28 relevant species was recorded (Annex III). White stork and Steppe buzzard, constituting almost 45 % and 32 % of all birds respectively, were the dominant species. The only other frequently occurring species were, Honey buzzard (*Pernis apivorus*), Levant sparrowhawk (*Accipiter brevipes*) and White pelican (*Pelecanus onocrotalus*) yet all at markedly lower numbers (about 10 %, 4 % and 3 % of all birds, respectively).

Steppe buzzard was the most frequent species with about 36 % of all recordings (see Annex III). Other species which occurred often but at markedly lower frequencies were Steppe eagle (*Aquila nipalensis*, 12 %), Black kite (*Milvus migrans*, 12 %) and Honey buzzard (7 %). Consequently, these species constitute about 67 % of all recordings.

Migrating Birds within the Study Area

Within the study area a total of 177,516 birds from 27 relevant species was recorded during standardized field observations in spring 2010 (Annex III). Again White stork and Steppe buzzard, each constituting almost 38 % of all birds, were the dominant species. The only other frequently occurring species were Honey buzzard, Levant sparrowhawk and White pelican but all at markedly lower numbers (about 12 %, 3 % and 2 % of all birds, respectively).

Steppe buzzard was the most frequent species with about 36 % of all recordings (see Annex III). Other species or groups of species which occurred often but at markedly lower frequencies were Steppe eagle (12 %), Black kite (12 %) and Honey buzzard (7 %). Consequently, these species or groups of species constitute about 67 % of all recordings.

Seasonal Distribution of Migration within the Study Area

Within the study area the migration period lasted from March 9$^{th}$ to May 9$^{th}$ for the vast majority of birds (90 %) as well as for the vast majority of White storks. By contrast, the migration period of Steppe buzzard was much shorter: 90 % of all Steppe buzzards were recorded in the study area between March 21$^{st}$ and April 15$^{th}$ (see Table 3.1). Half of all recorded Steppe buzzards migrated through the study area in only 15 days in late March and early April.

Table 3.1: Period of 90 %- and 50 %-migration considering all species, White storks and Steppe buzzards within the study

| birds within the study area | 90 %-migration | | | 50 %-migration | | |
|---|---|---|---|---|---|---|
| | from | to | days | from | to | days |
| all species | 09.03. | 09.05. | 62 | 21.03. | 20.04. | 31 |
| White storks | 08.03. | 04.05. | 58 | 10.03. | 15.04. | 37 |
| Steppe buzzards | 21.03. | 15.04. | 26 | 24.03. | 07.04. | 15 |

Resting and Sedentary Birds

Resting birds were occasionally observed in or adjacent to the study area, mainly in the early morning or the late afternoon, after or before spending the night in the desert:

In the late afternoon of May 3rd 300 White storks rested about 5.0 km east of observation site E (outside the study area). In the early morning of May 5th 500 White storks rested near site B. On three further days, small flocks (up to 35 individuals) of resting White storks were recorded in the study area.

Once a flock of six Black storks (*Ciconia nigra*) resting in the early morning southwest of site E was observed.

In the late afternoon of April 20th 1,300 White pelicans landed in the desert near site H. A flock of 250 White pelicans tried to gain altitude near site E in the early morning of April 24th – presumably after spending the night in the desert.

Several Honey buzzards (up to 15 individuals) and Steppe buzzards (up to 12 individuals) were recorded in the desert on seven and four days, respectively. Apart from this, single specimen of other raptors (Eagles or Falcons) were recorded resting within the study area as well. Damaged water pipelines (*e.g.* north of site C and near the oasis) were sometimes used by single specimen for drinking.

While Storks, Pelicans and birds of prey apparently stayed only one night in the desert before continuing migration, small passerines regularly used the oasis as a stop-over site for several days. Moreover, other species like Bee-eaters and Herons were occasionally recorded in the oasis.

Single individuals of Common kestrel (*Falco tinnunculus*), Peregrine falcon (*Falco peregrinus*), Barbary falcon (*Falco pelegrinoides*) and Short-toed eagle (*Circaetus gallicus*) were observed hunting on small birds and snakes within the desert on several (consecutive) days. These birds were presumably non-migrants, but locals that had spent the spring in the desert and the Red Sea Mountains.

The Sebkha, located southeast to the study area, was regularly visited and controlled for resting birds. Apparently, the Sebkha was rarely used as a resting site by Storks, Pelicans or Cranes.

On only three of the 15 control visits White storks were recorded in the Sebkha, but in huge numbers (see Table 3.2). In the early morning of March 11th 600 White storks circled at very low altitude near observation point H. These birds had probably spent the night in the Sebkha, too.

Black storks rarely occurred in the Sebkha and in small numbers.

Large flocks of White pelican and Common crane (*Grus grus*) were observed once and twice, respectively.

The results indicate that the Sebkha was not continuously used as a stop-over site. One can assume that most birds probably spend only one night in the Sebkha before continuing migration in spring.

Table 3.2: Birds resting in the Sebkha southeast of the study area during regular control visits

| date | White stork | Black stork | White pelican | Common crane |
|---|---|---|---|---|
| 03.03. | 0 | 0 | 0 | 0 |
| 05.03. | 0 | 0 | 0 | 0 |
| 06.03. | 0 | 0 | 0 | 300 |
| 11.03. | (600) | 0 | 0 | 0 |
| 12.03. | 0 | 6 | 0 | 0 |
| 15.03. | 4,800 | 0 | 30 | 1,000 |
| 23.03. | 0 | 0 | 0 | 30 |
| 24.03. | 0 | 0 | 0 | 7 |
| 29.03. | 400 | 5 | 0 | 10 |
| 12.04. | 0 | 0 | 300 | 0 |
| 15.04. | 0 | 0 | 0 | 0 |
| 17.04. | 1,000 | 0 | 0 | 0 |
| 25.04. | 0 | 0 | 0 | 0 |
| 28.04. | 0 | 0 | 5 | 0 |
| 03.05. | 0 | 0 | 8 | 0 |

### 3.1.2 Standardized Daytime Field Observations

Number of Migrating Birds, Species Composition and Flock Size

During standardized field observations in spring 2010, a total of 168,918 birds from 27 relevant species were recorded at distances of up to 2.5 km from the observation sites (see Annex III). The composition of species seems to be comparable to the overall migration data set. Again Steppe buzzard and White stork were the most numerous species with about 42 % and 34 % of all birds, respectively. The only other frequently occurring species were Honey buzzard and Levant sparrowhawk but both at markedly lower numbers (about 13 % and 3 % of all birds, respectively).
About 39 % of all recordings were corresponding to Steppe buzzards (see Annex III). Eagles from the genus Aquila represented more than 21 % of all recordings (thereof 13 % Steppe eagle). Black kite, Honey buzzard and Short-toed eagle amounted to 12 %, 7 % and 5 % of all recordings, respectively. Only about 2 % of all recordings referred to White stork.

Five species of special interest (due to their Red List Category, see Chapter 2.1) occurred in comparably low to very low numbers:

- Spotted eagle (19 individuals)
- Eastern imperial eagle (40 individuals)
- Pallid harrier (3 individuals)
- Lesser kestrel (8 individuals)
- Egyptian vulture (153 individuals)

(Note that there might have been further individuals of these species which might be found under Eagles (*Aquila* spec.), Falcons (*Falco* spec.), Harriers (*Circus* spec.) or undetermined raptors (see Annex III).)

Although large flocks were rarely recorded, they have a strong effect on the data set. On the whole there were 25 flocks of more than a thousand individuals, representing more than 29 % of all migrating birds (Figure 3.1 in Annex IXa). In contrast, the fraction of birds migrating individually was about 44 % of all recordings yet less than 2 % of all birds (Figure 3.1). Together, single birds and flocks with up to ten individuals constitute about 80 % of all recordings.
Note that at sites A and B there was no large flock of more than 1,000 individuals, whereas seven / five flocks contain about 54 % / 53 % of all individuals recorded at sites D and G (Figure 3.1). The effect of large flocks was pronounced at sites C and H, too, where four and five flocks cover 25 % and 33 % of all individuals, respectively.

Temporal Distribution of Migration

Migratory activity at distances of up to 2.5 km from an observation site was rather low in the first and last week of observation with together less than 3 % of all birds and less than 4 % of all recordings (Figure 3.2). By contrast, migratory activity between the 2nd and 6th week was mostly higher than expected. 65 % of all birds and 62 % of all recordings refer to this period (March 8th to April 11th). Between the 7th and 10th week, migratory activity was more or less as expected, apart from the 8th week with a very low number of birds (Figure 3.2).

Analyzing migration rate in consideration of daytime, the number of birds / h as well as the number of recordings / h was higher during the morning than during midday or afternoon (Figure 3.3).
By contrast, overall migration of White storks was higher during observations units in the afternoon (44 % of all individuals) than those conducted in the morning (24 % of all individuals).

Migratory activity was not equally distributed over the migration period but concentrated on only a few observation units: The majority of migrating birds (about 70%) refer to only 26 observation units which cover only 10 % of all units (and 28 % of all recordings refer to these 26 observation units).

Flight Altitudes

About 30 % of all birds used altitudes below 100 m (Figure 3.4). Another 27 % migrated at altitudes between 100 and 199 m, whereas almost 40 % flew higher than 199 m. By contrast, more than 45 % of all recordings occurred below 100 m. This difference was mainly caused by Steppe buzzards which regularly migrate individually (and thus had little influence on the variable "number of birds") at altitudes below 100 m (Figure 3.4). Moreover, it can be assumed that the probability of detecting a single bird decreases with higher flight altitudes.
The majority of White storks migrated at lower altitudes (below 199 m), both in terms of birds (about 76 %) and of recordings (about 69 %).
More than 40 % of Steppe buzzard migrated at altitudes higher than 199 m. In contrast, the number of recordings was highest at altitudes below 100 m, indicating a difference in flight altitude of small flocks on the one hand and larger flocks on the other: small flocks tended to fly at lower altitudes. Moreover, it can again be assumed that the probability to detect a single birds decreases with higher flight altitude.
Considering both, the numbers of birds as well as the numbers of recordings, Honey buzzards were frequently recorded at altitudes below 199 m (60 % and 66 %, respectively).
More than 50 % of all Levant sparrowhawks migrated at altitudes between 200 and 299 m, although they were quite common at altitudes between 100 and 199 m, too (Figure 3.4). In contrast, the number of recordings was highest at altitudes below 100 m, again indicating a difference in flight altitude of single birds or small flocks on the one hand and larger flocks on the other.

Eagles (genus Aquila) seem to slightly prefer higher altitudes. About 62 % of all birds migrated at altitudes above 200 m. The higher number of recordings at lower altitudes might again be due to bias (higher detection probability of single birds at lower altitudes).
Since species of special interest (*e.g.* Pallid Harrier, Lesser kestrel, Egyptian vulture) were very rare, the data gives no reliable information about altitude distribution of these species.

Flight Directions

The majority of birds and recordings (about 85 % and 69 %, respectively) migrating at distances of up to 2.5 km from observation sites in spring 2010, had strictly northern flight directions (mainly north-northwest, see Figure 3.5). About 11 / 17 % of all birds / recordings, respectively, migrated in a more eastern direction (east-northeast). Less than 2 % of all birds flew in directions with a southern / northern component (ESE, SSE, SSW, WSW). Due to the minimal portion of birds with a southern flight direction, there was no use to examine whether the portion between northern and southern flight directions differed at the eights observation sites. Similarly, there was no use in examining if the portion between northern and southern flight directions had changed under different conditions of wind speed (as in earlier reports, see BERGEN 2009).

Migratory Activity

Mean migration rate for all observation units and sites was about 234 birds per hour (on the monitored area of 19.63 $km^2$) with a standard deviation of about 544 birds per hour (n=264). This high standard deviation clearly shows that the mean alone is not a valid measure to describe migratory activity within the study area. Using the median as a measure, we obtain an average migration rate of about 24 birds per hour (1. quartile: 3 bird/h, 3. quartile: 161 birds/h).
Mean migration rate for all observation units and sites was 9 recordings per hour with a standard deviation of 11 recordings / h. Using the median as a measure, we obtain an average migration rate of 5 recordings per hour (1. quartile: 1 rec./h, 3. quartile: 14 rec. /h).

Calculating mean migration rate for all observation units and sites considering the data set without Steppe buzzard, the result is about 169 ± 462 birds per hour and 6 ± 7 recordings per hour. Using the median as a measure, we obtain an average migration rate of 13 birds per hour (1. quartile: 2 birds/h, 3. quartile: 66 birds/h) and 4 recordings per hours (1. quartile: 1 rec./h, 3. quartile: 8 rec./h).

Migratory Activity, Wind Speed and Wind Direction

As shown in Figure 3.6 (note the Steppe buzzard was excluded as given in Chapter 2.2.4):

1. Observation units with low wind speed were very rare (independent on wind direction): 13 of 194 observation units (6.7 % of all observation units).
2. During the majority of observation units there was a strong (n=84; 43 %) or medium (n=69; 36 %) wind coming from the north. Under these conditions, making up 79 % of all observation units, migratory activity at most times was low (n=130, *i.e.* 85 % or 67 % of all units). In units with strong winds from the north there was only one occasion with a high migratory activity and only five with a medium migratory activity.
3. In about 13 % (n=26) of all units the prevailing wind came from the South. These 26 observation units refer to only 12 observation days. Prevailing winds from the South were also recorded during one longer period in early March ($8^{th}$ to $15^{th}$), three days in April ($10^{th}$, $11^{th}$ and $27^{th}$) and one day in May ($10^{th}$). Even under these conditions migratory activity at most times was low (n=16; 62 %). However, the number of observation units with a high migratory was disproportionally higher when winds were coming from the South than from the north (south: 6 of 26; north: 9 of 162).

To summarize, the analysis does not reveal a clear relationship between migratory activity and speed and direction of wind. However, there seems to be a slight tendency with higher migratory activity on days with winds from the South, though the analysis shows that this trend was not entirely consistent (see Figure 3.6).

Spatial distribution of migration

The number of birds differed between the eight observation sites (see Figure 3.7 and Annex IV). The difference was mainly caused by the three most numerous species: Steppe buzzard, White stork and Honey buzzard.

The number of White storks and Honey buzzards was comparably low at sites A and B, leading to a low number of birds at site B but not at site A, because very high numbers of Steppe buzzards were recorded there (> 15,000 ind.). The number of Steppe buzzard, however, was high at all other sites, too (> 5,000 ind. at each site).

A very high number of White storks migrated at distances of up to 2,500 m to the sites D, G and H (> 10,000 individuals at each site). As White storks mostly migrated in large flocks the number of recordings was low (especially at site D, n=11).

The number of Honey buzzard was exceptionally high at site E (see Figure 3.7). It should be noted that about 59 % of these birds were recorded during a single 3h-observation unit.

Considering the number of birds of other species (*e.g.* Black kite) or groups of species (*e.g.* Eagles form the genus *Aquila*, there were no major differences indicative of a particular spatial distribution.

The number of recordings observed at the eight sites ranged from 657 at site D to 1,000 at site F (see Figure 3.7 and Annex IV). Most recordings refer to Steppe buzzards and Eagles, whereas White storks occurred very rarely (but in large numbers).

There were remarkable differences in mean migration rate of synchronized observations at the two sites of each pair of observation sites. However, due to the high standard deviation, the migration rate did not differ significantly (see Table 3.3).

Table 3.3: Did migration rates during synchronized observations at two sites differ from each other? (Results of Mann–Whitney U test for birds and recordings; data set corrected for area, see Chapter 2.2.3)

| pair of sites | birds | | recordings | |
|---|---|---|---|---|
| | U | p | U | p |
| A/F | 190,5 | 0,807 | 190,5 | 0,807 |
| B/E | 83,0 | 0,511 | 83,0 | 0,511 |
| C/H | 182,0 | 0,201 | 182,0 | 0,201 |
| D/G | 47,0 | 0,401 | 47,0 | 0,401 |

### 3.1.3 Standardized Daytime Field Observations — Birds Migrating at Altitudes below 200 m

Number of Migrating Birds, Species Composition and Flock Size

During standardized field observations in spring 2010 a total of 91,098 birds from at least 25 relevant species were recorded at distances of up to 2.5 km from the observation sites at altitudes below 200 m (see Annex V). White stork and Steppe buzzard were the most numerous species with about 45 % and 29 % of all birds, respectively (Figure 3.8). Other frequently occurring species were Honey buzzard and Levant sparrowhawk but all at markedly lower numbers (about 15 % and 3 % of all birds, respectively).

About 43 % of all recordings were corresponding to Steppe buzzards (Figure 3.8). Eagles from the genus Aquila represented more than 20 % of all recordings (thereof 11 % Steppe eagle). Black kite, Honey buzzard and Short-toed eagle amounted to 12 %, 7 % and 5 % of all recordings, respectively. Only about 2 % of all recordings referred to White stork.

Five species of special interest (due to their Red List Category, see Chapter 2.1) occurred in comparably low to very low numbers:

- Spotted eagle (14 individuals)
- Eastern imperial eagle (18 individuals)
- Pallid harrier (3 individuals)
- Lesser kestrel (8 individuals)
- Egyptian vulture (94 individuals)

(Note that there might have been further individuals of these species recorded as Eagles (*Aquila* spec.), Falcons (*Falco* spec.), Harriers (*Circus* spec.) or undetermined raptors (see Annex V).)

Migratory Activity

Mean migration rate at altitudes below 200 m for all observation units and sites was about 130 birds per hour (on the monitored area of 19.63 $km^2$) with a standard deviation of about 346 birds per hour. Using the median as a measure, we obtain an average migration rate of 8 birds per hour (1. quartile: 1 bird/h, 3. quartile: 82 birds/h).

Mean migration rate at altitudes below 200 m for all observations units and sites was 6 recordings per hour with a standard deviation of 8 recording/h. Using the median as a measure, we obtain an average migration rate of 3 recording per hour (1. quartile: 1 rec./h, 3. quartile: 9 rec. /h).

Spatial Distribution of Migratory Activity

The number of birds migrating at altitudes below 200 m differed between the eight observation sites (see Figure 3.9 and Annex V). The difference was mainly caused by the three most numerous species: Steppe buzzard, White stork and Honey buzzard.

The number of White storks and Honey buzzards was very low at sites A and B, leading to a rather low number of birds at site B, but not at site A, because very high number of Steppe buzzards were recorded there at low altitudes (> 9,000 ind.).

A very high number of White storks migrated below 200 m at distances below 2,500 m to the sites D, G and H (> 7,000 individuals at each site). As White storks mostly migrated in large flocks, the number of recordings is relatively low (especially at site D, n=7).

The number of Honey buzzards was exceptionally high at site E (see Figure 3.9). As already mentioned, a huge number of Honey buzzards was recorded during a single 3h-observation unit. Thus, it is questionable whether Honey buzzards really prefer to migrate through the area around site E. Likewise, we do not expect the comparably high number of Levant sparrowhawk at site H to be due to regular migration patterns. Levant sparrowhawks often migrate in large flocks, so only a few recordings (3 at site H) have a huge influence on the data set.

Considering the number of birds of other species (*e.g.* Black kite) or groups of species (*e.g.* Eagles form the genus *Aquila*), there were no major differences indicative of a particular spatial distribution.

The number of recordings observed at the eight sites ranged from 447 at site D to 659 at site E (see Annex V). Most recordings refer to Steppe buzzards and Eagles, whereas White storks occurred very rarely (but in large numbers).

Considering the data set without Steppe buzzard, the differences between the eight sites become more pronounced (Figure 3.10):

- A comparably low migratory activity at altitudes below 200 m at sites A and B.
- A medium migratory activity at altitudes below 200 m at sites C to F.
- A very high migratory activity at altitudes below 200 m at sites G and H.

## 3.2 Autumn 2010

### 3.2.1 Migrating and Resting Birds — in general

Overall migration

During standardized field observations in autumn 2010, a total of 37,891 birds from 24 relevant species were recorded (Annex VI). White stork constituting about 64 % of all birds, was the dominant species. The only other frequently occurring species were White pelican and Honey buzzard, but both at lower numbers (about 24 % and 10 % of all birds, respectively).

Honey buzzard was the most frequent species with about 39 % of all recordings (see Annex VI). Other species, which occurred often but at markedly lower frequencies, were Marsh harrier (*Circus aeruginosus*, 14 %), Pallid harrier (*C. macrourus*, 6 %) and Montagu`s harrier (*C. pygargus*, 5 %). Honey buzzard and all Harriers constitute 71 % of all recordings.

Migrating Birds within the Study Area

During standardized field observations in autumn 2010 a total of 25,942 birds from 22 relevant species were recorded within the study area (Annex VI). Again White stork, constituting about 54 % of all birds, was the dominant species. The only other frequently occurring species were White pelican and Honey buzzard but both at markedly lower numbers (about 32 % and 12 % of all birds, respectively).

Note that all recorded White storks referred to only 17 recordings, indicating that the study area is not located within a main migration route of White storks in autumn. Honey buzzard was the most frequent species with about 39 % of all recordings (see Annex VI). Other species, which occurred often but at markedly lower frequencies, were Marsh harrier (14 %), Pallid harrier (7 %) and Montagu`s harrier (6 %). Honey buzzard and all Harriers constitute 72 % of all recordings.

Seasonal Distribution of Migration within the Study Area

Migration period within the study area lasted from August 19th to October 12th for the vast majority of birds (90 %). By contrast, the migration period of White stork was much smaller: 90 % of all White storks were recorded in the study area in only 14 days, though it has to be taken into account that these White storks referred to only six flocks. Half of all recorded Honey buzzards migrated through the study area in only 16 days in late August and September. Migration of White pelicans seemed to be less concentrated. The main migration period of White pelicans lasted from September 9th to October 19th.

Table 3.4: Period of 90 %- and 50 %-migration considering all species, White storks and White pelican and Honey buzzards within the study

| birds within the study area | 90 %-migration | | | 50 %-migration | | |
|---|---|---|---|---|---|---|
| | from | to | days | from | to | days |
| all species | 19.08. | 12.10. | 55 | 29.08. | 19.09. | 21 |
| White storks | 19.08. | 01.09. | 14 | 19.08. | 29.08. | 11 |
| White pelicans | 09.09. | 19.10. | 41 | 19.09. | 07.10. | 19 |
| Honey buzzard | 28.08. | 20.09. | 24 | 30.08. | 14.09. | 16 |

<u>Resting and Sedentary Birds</u>

Resting birds were rarely observed in or adjacent to the study area, mainly in the early morning or the late afternoon after or before spending the night in the desert:

In the early morning of September 14$^{th}$, 32 White storks were resting about 10.0 km northeast of observation site E (outside the study area). About one hour later, a flock of 18 White storks rested only 500 m south east of site B.

In the early morning of September 1$^{st}$, 2 Honey buzzards rested about near site A.

Apart from this, single individuals of other species were recorded resting within the study area as well, *e.g.* Golden oriole (*Oriolus oriolus*), European roller (*Coracias garrulus*) or Cream-colored courser (*Cursorius cursor*). Resting passerines were observed regularly in the desert and at the "oasis", *e.g.* Desert wheatear (*Oenanthe deserti*), Whinchat (*Saxicola rubetra*), Tawny pipit (*Anthus campestris*) or Chiffchaff (*Phylloscopus collybita*).

Single individuals of Barbary falcon (*Falco pelegrinoides*) and Common kestrel were observed hunting within the desert on several (consecutive) days. These birds were presumably non-migrants, but locals who spent the spring in the desert and the Red Sea Mountains.

Brown-necked raven (*Corvus ruficollis*) was regularly recorded in the study area (mainly in its eastern parts, *e.g.* nine individuals at site G) and outside the study area (*e.g.* 22 individuals about 7.0 km north of H).

Other sedentary birds were sometimes recorded within the study area, too: *e.g.* single individuals of Desert lark (*Ammomanes deserti)* or smaller groups (with up to eight individuals) of Crowned sandgrouse (*Pterocles coronatus*).

The Sebkha, which was regularly examined and controlled for resting birds, was apparently not used as a resting site by large migratory birds (*e.g.* Storks, Pelicans or Cranes) in autumn. Occasionally, waders of different species (maximum: 50 individuals on August 23rd) and a few individuals of Herons (Little egret (*Egretta garzetta*) and Grey heron (*Ardea cinerea*)) were recorded at the Sebkha.

### 3.2.2 Standardized Daytime Field Observations

Number of Migrating Birds, Species Composition and Flock Size

During standardized field observations in autumn 2010, a total of 17,593 birds from 22 relevant species were recorded at distances of up to 2.5 km from the observation sites (see Annex VI). Species composition seems to be comparable to the overall migration data set. Again White stork was by far the most numerous species with about 74 % of all birds. The only other frequently occurring species were Honey buzzard and White pelican but both at markedly lower numbers (about 13 % and 9 % of all birds, respectively).

About 36 % of all recordings correspond to Honey buzzards. Another 36 % of all recordings correspond to the three species of Harriers.

Three species of special interest (due to their Red List Category, see Chapter 2.1) occurred in low numbers: Pallid harrier (44 individuals), Lesser kestrel (31 individual) and Egyptian vulture (7 individuals). (Note that there might have been further individuals of these species, which could have been recorded as Harriers, Falcons or undetermined raptors; see Annex VI.)

Although large flocks occurred rarely, they have a strong effect on the data set. On the whole, there were only three flocks with more than a thousand individuals, representing about 69 % of all migrating birds. All three flocks were White storks. In contrast, the fraction of birds migrating individually was about 62 % of all recordings but less than 2 % of all birds. Together single birds plus flocks with up to 100 individuals constitute about 96 % of all recordings.

Remarkably, two of the three very large flocks (with a total of 9,600 individuals) were recorded at site H. The third large flock with 2,500 individuals was recorded at site D.

Seasonal and Daily Distribution of Migration

During the first weeks of the study period, no migrating bird was recorded at distances of up to 2.5 km from the observation sites (see Figure 3.11). By contrast, almost 76 % of all birds were recorded within the 2nd and 3rd week. This was mainly due to the three large flocks of White stork. During the following weeks of observation migratory activity was low to very low.

The number of recordings continuously increased until the 7th and 8th week of the study period. About 33 % of all recordings refer to these two weeks. During the last four weeks migratory activity decreased again to a level of less than 8 % of all recordings (see Figure 3.11).

Analyzing bird migration with special reference to daytime does not seem to be reasonable, because migratory activity was rather low during all times of the day. Furthermore, daily distribution would have been largely affected by the three flocks of White stork.

Flight Altitudes and Flight Directions

About 30 % of all birds used altitudes below 100 m (Figure 3.12). Another 44 % migrated at altitudes between 100 and 199 m, whereas only 25 % flew above 199 m. By contrast, more than 60 % of all recordings occurred below 100 m. This difference was mainly caused by Harriers which regularly migrate individually (and thus had little influence on the variable "number of birds") at altitudes below 100 m (Figure 3.12).

White storks were most often recorded at altitudes between 100 and 199 m. Thus, the vast majority migrated at altitudes below 200 m, both in terms of birds (about 78 %) and recordings (about 65 %).

Considering both, the numbers of birds as well as the numbers of recordings, White pelicans were frequently recorded at altitudes below 100 m (61 % and 54 %, respectively). These birds probably already reached the desert plains at the Gulf of Suez at low altitudes after crossing the Red Sea.

The altitude distribution of Honey buzzards was comparatively balanced; the numbers of birds in the four classes show no distinctive difference (Figure 3.12). In contrast, the number of recordings was much higher at altitudes below 100 m, indicating a difference in flight altitude of small flocks on the one hand and larger flocks on the other: small flocks tended to fly at lower altitudes. Moreover, it can be assumed that the probability of detecting a single bird decreases with higher flight altitude.

Since species of special interest (*e.g.* Spotted eagle, Eastern imperial eagle, etc.) were very rare, the data gives no reliable information about altitude distribution of these species.

The vast majority of birds migrating at distances of up to 2.5 km to the observation sites in spring 2009 had strict southern (SSE or SSW) flight directions, both in terms of birds (about 78 %) and of recordings (about 65 %).

Migratory Activity

Mean migration rate for all observation units and sites was about 22 birds per hour (on the monitored area of 19.63 $km^2$) with a standard deviation of about 172 birds per hour. This high standard deviation clearly indicates that the mean alone is not an adequate measure to describe migratory activity within the study area. Using the median as a measure, we obtain an average migration rate of 0 birds per hour (1. quartile: 0 bird/h, 3. quartile: 2 birds/h). Thus, migratory activity at distances of up to 2.5 km to the eight observation sites was very low. In 147 observation units (56 % of all obs. units) not a single bird was recorded at distances of up to 2.5 km to the observation site.

Mean migration rate for all observations units and sites was 0.64 recordings per hour with a standard deviation of 1.16 recordings/h. Using the median as a measure, we obtain an average migration rate of 0 recording per hour (1. quartile: 0 rec./h, 3. quartile: 0.67 rec. /h).

Due to the very low migratory activity, further analysis of the effect of wind speed or wind direction was inappropriate.

Spatial distribution of migration

Migratory activity was very low at all eight observation sites. At five sites the number of birds recorded in 99 hours of observation was (much) less than 1,000 (see Figure 3.13). The slightly higher number of birds at site C refers to five flocks with 873 birds, thereof one flock of White storks (250 ind.) and one flock of White pelicans (250 ind.). The higher number of birds at sites D and H refer to a single flock of White storks with 2,500 birds and two flocks of White storks with 9,600 birds, respectively. So, aside from these very rare recordings migratory activity was very low at site C, D and H, too.

Only 50 recordings were made during 99 hours of observation at sites A, E, F and G (see Figure 3.13). At the other four sites the numbers of recordings still remain on a low level (between 50 to 90 recordings).

In summary, migration rate did not differ significantly between sites. However, the results indicate that few, but large flocks of White storks and White pelicans can occasionally be found in the eastern part of the study area (mainly around site H). These birds probably reach the coastline after crossing the Red Sea and subsequently migrate through the eastern part of the study area.

Due to the very low migratory activity further analysis of mean migration rate at each site or a comparison of bird migration during synchronous observations was inappropriate.

### 3.2.3 Standardized Daytime Field Observations — Birds Migrating at Altitudes below 200 m

Number of Migrating Birds and Species Composition

During standardized field observations in autumn 2010 a total of 10,359 birds from at least 19 relevant species were recorded at distances of up to 2.5 km from the observation sites at altitudes below 200 m (see Annex VIII). White stork was the most numerous species with about 75 % of all birds. Other frequently occurring species were Honey buzzard and White pelican but both at markedly lower numbers (about 12 % and 8 % of all birds, respectively).

Note that all recorded White storks referred to only 7 flocks and that two flocks, one with 7,500 birds and one with 2,100, cover 93 % of all birds recorded at distances of up to 2.5 km and below 200 m in autumn 2010.

About 42 % of all recordings correspond to Harriers, and another 30 % to Honey buzzards. Only about 2 % of all recordings are White stork.

Five species of special interest (due to their Red List Category, see Chapter 2.1) occurred in comparably low to very low numbers:

- Pallid harrier (8 individuals)
- Lesser kestrel (32 individuals)

(Note that there might have been further individuals of these species that were recorded as Falcons (*Falco* spec.), Harriers (*Circus* spec.) or undetermined raptors (see Annex VIII).)

Spatial Distribution of Migratory Activity

As migratory activity was generally very low, there are no considerable spatial differences in bird migration at altitude below 200 m. The differences in bird numbers that can be seen in Figure 3.14 are caused by single, but large flocks that were recorded very rarely at the one or the other. Two flocks, one with 7,500 and the other one with 2,100 White storks recorded at site H, lead to a comparatively high number of birds disguising the very low migratory activity. This is the case for site D too, where once a flock of 2,500 White storks was observed.

# 4 Assessment of the Importance of the Study Area

The following assessment of the importance of the area focuses on migrating birds. Most parts of the study area are of minor importance for local and roosting birds. The oasis and the larger Wadis, containing small patches of vegetation, can be regarded as an important site for local birds, and as an important roosting place for small passerines. Moreover, the Sebkha is classified as an important roosting site for storks, pelicans, herons and probably other species. A more detailed assessment of the importance of the study area for local and roosting birds is given in the final ESIA-document.

## 4.1 General Migration Patterns

### 4.1.1 Basic Considerations of Migration along the Red Sea Coast

Spring migration

During northward migration in spring, there apparently are two major streams: one following the Red Sea coast up from Sudan, and another following the Nile Valley as far north as Qena crossing the Eastern Desert to the coast of the Red Sea. Both streams converge at the Gulf of Suez (Ornis Consult 1999, see also Meyburg *et al.* 2000 and Meyburg *et al.* 2003). The migratory route over the Red Sea to Bab-el-Mendeb does not play a major role during spring migration. Consequently, at the western coast of the Golf of Suez bird numbers are much higher in spring than in autumn.

After reaching the western coast of the Gulf of Suez, birds either cross the southern Gulf to the Sinai or continue up the coast to Suez. Thus, in spring there are three bottlenecks along the coast, where large numbers of soaring birds congregate: at Suez, Ain Sukhna and Gabel el Zayt (Ornis Consult 1999, Bahal El Din unpubl.). Gabel el Zayt is the only mountain ridge adjacent to the coast in the southern Gulf of Suez. Consequently, it serves as a stepping-stone for soaring birds using thermals to cross the Gulf of Suez (BirdLife International 2005). In spring, soaring birds come from the Red Sea Mountain chain and often fly at low altitudes, then cross the coastal plain to Gabel el Zayt (Bergen 2009, CarlBro 2010). Migration paths of these birds shift depending on weather and wind conditions. At Gabel el Zayt birds gain altitude in thermal uplifts before crossing the Gulf. Consequently, in spring Gabel el Zayt is thought to be the main crossing point for White storks, Honey buzzards and Levant sparrowhawks (Ornis Consult 1999, Bahal El Din unpubl.). As most migrating species are of international conservation interest, Gabel el Zayt is nominated as an Important Bird Area (IBA) by BirdLife International. The IBA site consists of a narrow (about 10 km), 100-km-long strip extending along the Gulf of Suez / Red Sea coast, from Ras Gharib in the north to the bay of Ghubbet El Gemsa in the South (BirdLife International 2005). The study area is situated to the west of the IBA. Still, the importance of the area does not end at artificial boundaries of the IBA or the concessionary area.

The majority of other species, like Steppe buzzard, Black kite or Steppe eagle, are believed to follow the Red Sea Mountains north to Suez town, while a smaller proportion tries to cross the Gulf of Suez further south (if the northern wind is not too strong, Ornis Consult 2002).

Autumn migration

In autumn there are apparently three major routes for large migrating birds:

1. A great number of birds cross the Gulf of Suez from the southern point of Sinai to Hurghada (Meyburg & Meyburg 2002). It was found that Ras Mohammed in South Sinai is a major bottleneck for migrating White storks in autumn. A total of 275,743 individuals were counted by Celmins in 1998 (Bahal El Din unpubl.). Celmins estimated that 390,000 to 470,000 birds occur in the area. Yet the majority of storks did not cross the Gulf of Suez in this area. Only about 87,700 storks or 30 % were observed crossing at Ras Mohammed (Bahal El Din unpubl.). During the same season large numbers of White storks were seen reaching the western coast of the Red Sea at Gabel el Zayt. Also, Attum (according to Meyburg & Meyburg 2002) argued that the majority of storks cross further northwest from El Yora to Gabel el Zayt where the Gulf is substantially narrower (see also Ornis Consult 2002). Therefore, in autumn Gabel el Zayt is considered to be a major bottleneck for White storks and other soaring species (e. g. Black stork, Honey buzzard). Although not well documented, Ornis Consult (1999) argued that Gemsa bay, which is used as a resting site, might be the main crossing point for storks and other soaring birds in autumn. Ornis Consult (2002) pointed out that large migrating birds arrive at the western coastline in a broad front between Gabel el Zayt in the north and up to Hurghada in the south — influenced by wind directions (see also Meyburg *et al.* 2002). Bahal El Din (unpubl.) also mentioned that Storks too were reported arriving at Hurghada, and that there is a need for surveys within the area between Hurghada and Safaga (and further south). However, the investigations carried out in the so-called Orange Zone near Wadi Dara to the northwest of Gabel el Zayt clearly show that large numbers of White storks and White pelicans even reach the coastline north of Gabel el Zayt, between Ras Shukeir and the northern tip of the mountain ridge. In autumn 2010, we even recorded White storks and White pelicans entering the western coast of the Red Sea between Ras Gharib and Ras Shukeir, however in minor numbers.
2. Large concentrations of soaring birds can also be found at Suez. These birds bypass the Gulf of Suez entirely at Suez in the north, heading further south along the Red Sea Mountain chain. As migratory activity within the study area near Ras Gharib was very low in autumn, these birds apparently do not migrate over the desert plains of the Red Sea coast.
3. Finally, large migrating birds breeding in Asia mainly use a third migratory route along the eastern coast of the Red Sea along the Arabian Peninsula and cross the sea further south at Bab-el-Mendeb towards Djibouti and Ethiopia. (e. g. Steppe eagle, Meyburg *et al.* 2003 and Meyburg & Meyburg 2007).

### 4.1.2 Number of Migrating Birds, Species Composition and Flock Size within the Study Area

During the investigation in spring 2010 a high number of migrating birds passed through the study area. During 792 hours of observation 177,516 birds (5,932 recordings) were recorded within the study area and, in addition, 44,589 birds outside the study area (Annex III).

By contrast, in autumn the number of birds was much lower: 25,942 birds (597 recordings) were observed during 803 hours, and another 11,949 birds migrated outside the study area (Annex VI).

In spite of the high number of migrants, there seemed to be no or low migration of relevant species in a number of observation units: migration rate was less than 5.00 birds / recordings per hour in about 32 % / 50 % (spring) and 82 % / 99 % (autumn) of all observation units. Thus, migration within the study area was i) quite irregularly distributed over time, and ii) dominated by large flocks (as shown in Figures 3.1, large flocks have a strong effect on the data set, although they occurred rarely). As a consequence, migratory activity shows a high variation at every observation site as well as between different observation sites.

A comparison between the number of birds and the number of recordings indicates that

- White storks occurred quite rarely, but often in larger flocks which is quite typical for this species (*e.g.* ORNIS CONSULT 2002, BERGEN 2007, 2009). In fact, the total number of White storks was 67,405 in 141 flocks in spring and 14,034 in 17 flocks in autumn, amounting to an average flock size of 478 and 826 individuals, respectively.
- White pelicans migrated predominately in large flocks, too: average flock size was 177 individuals in spring and 485 individuals in autumn.
- Honey buzzards, Black kites, Steppe eagles and, to a lower degree, Steppe buzzards regularly migrated individually or in small flocks.
- Harriers usually migrated individually.

### 4.1.3 Bird Migration within the Study Area in Comparison to Previous Studies

Spring Migration

In spring 2010 migratory activity within the study area was much higher than at an observation site northwest of Zafarana, where 4,582 birds passed through during 111 hours of observation within the main migration period (four weeks) in spring 2007 (BERGEN 2007).

Compared with results obtained in spring 2009 in the so-called Orange Zone near Wadi Dara (BERGEN 2009), the total number of recorded migrants was more than four times higher in spring 2010 within the study area (Table 4.1). This difference was mainly caused by Steppe buzzard, White stork and Honey buzzard. Even Levant sparrowhawk and Steppe eagle occurred in higher numbers. It has to be taken into account, however, that the total observation time was about two times higher than in spring 2009. Furthermore, the methodology was slightly different: In 2010 the daily observation period lasted 9 h and thus covered the whole migration period from 1 h after sunrise to 1 h before sunset. In contrast, in the previous study in spring 2009 observation time was only 6 h a day and included the first hour after sunrise and the last hour before sunset, when migratory activity is rather low. Consequently, the differences might to some degree be due to differences in total observation time and methodology.

Even if recent results are compared with bird numbers recoded in spring 2007 within the whole concessionary area, a noteworthy finding is the higher number of birds and recordings for most species, especially for Steppe buzzard and Honey buzzard (Table 4.1). Again differences in total observation time and methodology have to be taken into account.

Table 4.1: Number of several species migrating at distance up to 2.5 km from the observer within the study area (spring 2010), in the Orange Zone near Wadi Dara (spring 2009, BERGEN 2009) and in the original concessionary area (spring 2007, BERGEN 2007) under consideration of total observation time

| Study Area | Gulf of Suez | | Gulf of Zayt | | | |
|---|---|---|---|---|---|---|
| | | | Orange Zone | | Concessionary area | |
| Year | 2010 (792 h) | | 2009 (396 h) | | 2007 (604 h) | |
| Species | birds | rec. | birds | rec. | birds | rec. |
| White stork | 67,405 | 141 | 17,871 | 49 | 61,504 | 71 |
| Steppe buzzard | 66,797 | 2,163 | 9,121 | 909 | 16,448 | 1,159 |
| Honey buzzard | 21,564 | 421 | 2,875 | 113 | 1,036 | 87 |
| Levant sparrowhawk | 5,626 | 28 | 351 | 34 | 6,400 | 26 |
| White pelican | 4,427 | 25 | 6,973 | 25 | 760 | 8 |
| Steppe eagle | 2,753 | 739 | 710 | 226 | 1,226 | 311 |
| Total | 177,516 | 5,932 | 42,464 | 2,359 | 95,067 | 2,592 |

The six most abundant species mentioned in Table 4.1 made up between about 90 and 95 % of all birds recorded in each study (Figure 4.1). White stork was the most abundant species in all three areas and years. However, with 65 % of all birds the portion of White stork was exceptionally high in 2007 within the concessionary area (in 2009 and 2010 it was about 42 and 38 %, respectively).

In spring 2010 the relative abundance of Steppe buzzards and Honey buzzards was much higher than in the previous studies, conducted further to the south (Figure 4.1).

In contrast, the portions of White pelican and Levant sparrowhawk were lower than in 2009 and 2007, respectively (Figure 4.1). Other groups such as Harriers or Falcons occurred in comparatively small numbers, both during the previous studies and the recent investigation.

In summary, as the previous studies conducted at the Gulf of Zayt (2007 and 2009) indicated a decreasing migratory activity from south to north, migratory activity obtained in spring 2010 within the study area was unexpectedly high. This finding is not completely in accordance with common understanding of spring migration along the Red Sea Coast (Chapter 4.1.1). There are at least three plausible (non-excusive) explanations for this finding at hand:

1. The results indicate that significant numbers of White storks, Honey buzzards and probably even White pelicans first head for Gabel el Zayt but avoid crossing the sea and migrate further northwest along the Red Sea coast. Subsequently, these birds reach the eastern parts of the study area or pass the study area in the east (Figure 4.2). The results obtained by standard observations within the study area and by occasional observations from the roof of a house in Ras Gharib give no evidence that White storks or other species started the crossing of the Red Sea near Ras Gharib or further north. Accordingly, birds recorded within the study area apparently head further north to Ain Sukhna or Suez. Ornis Consult (2002) also noticed that high numbers of White storks avoid crossing the sea in spring and continue north along the Red Sea Mountains to Suez.

2. Steppe buzzards, Steppe eagles and other species are supposed to follow the Red Sea Mountains north to Suez (Chapter 4.1.1). One explanation for the high numbers of birds recorded within the study area can be that large numbers of these species avoid crossing over the highest mountain tops (*e.g.* Gabel Gharib which reaches up to 1,750 m a.s.l.) and thus migrate close to the Red Sea Mountains (Figure 4.3). This would also explain the low numbers of these species recorded in previous studies, as the study areas in previous studies were far away (about 20 km and more) from the higher mountains. Finally, this explanation fits very well with the results of the so-called mountain counts done by CarlBro (2010) in spring 2009: migration rates near the mountains were higher for seven species, mainly birds of prey. But, surprisingly, White and Black stork too occurred in higher total numbers near the mountains. Probably, a relevant portion of White storks follow the Red Sea Mountains, too. This hypothesis is in accordance with the high numbers of White storks that reached the study area from the south and the southwest (see sites D and G in Figure 3.7).

3. If higher mountains (*e.g.* Gabel Gharib) act as a barrier for bird movement, birds would most probably pass Gabel Gharib in the west. Consequently, these birds, together with birds coming from Gabel el Zayt (after avoiding crossing the sea) and birds migrating over the coastal plains concentrate within the rather narrow area of about 25 km between Gabel Gharib and the Red Sea coast (Figure 4.4). In contrast, the area opens up further north between the higher mountains and the coastline.

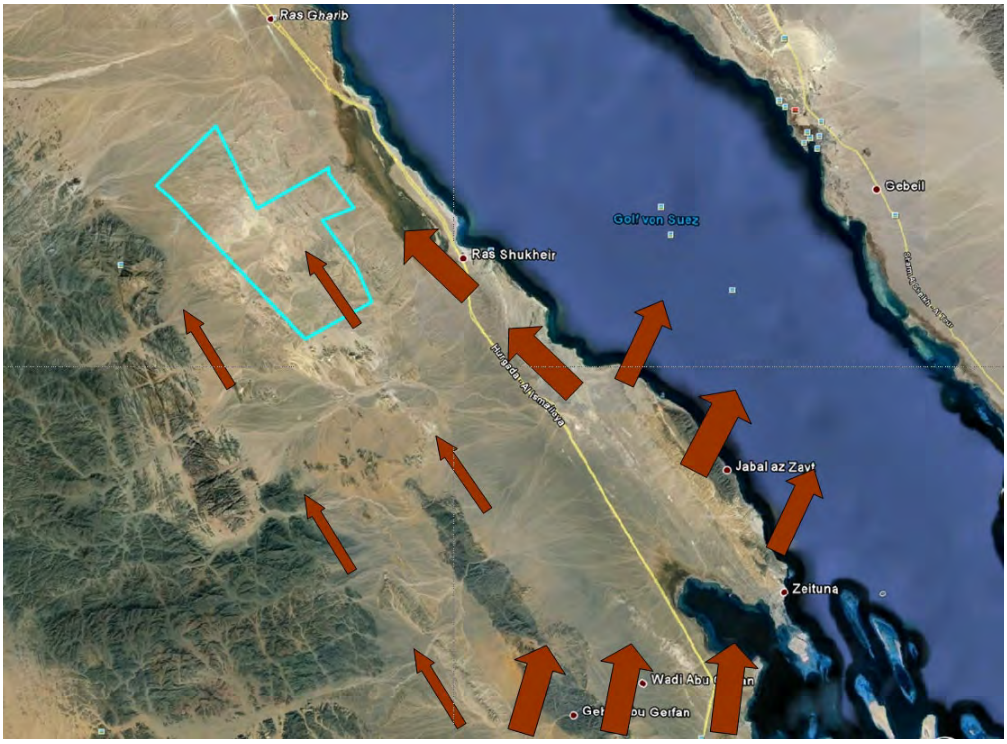



Figure 4.2: Schematic of assumed spring migration of White stork, Honey buzzard and White pelican: the majority of birds cross the Red Sea near Gabel el Zayt. However, large numbers of birds avoid crossing the sea and migrate along the coast further northwest.

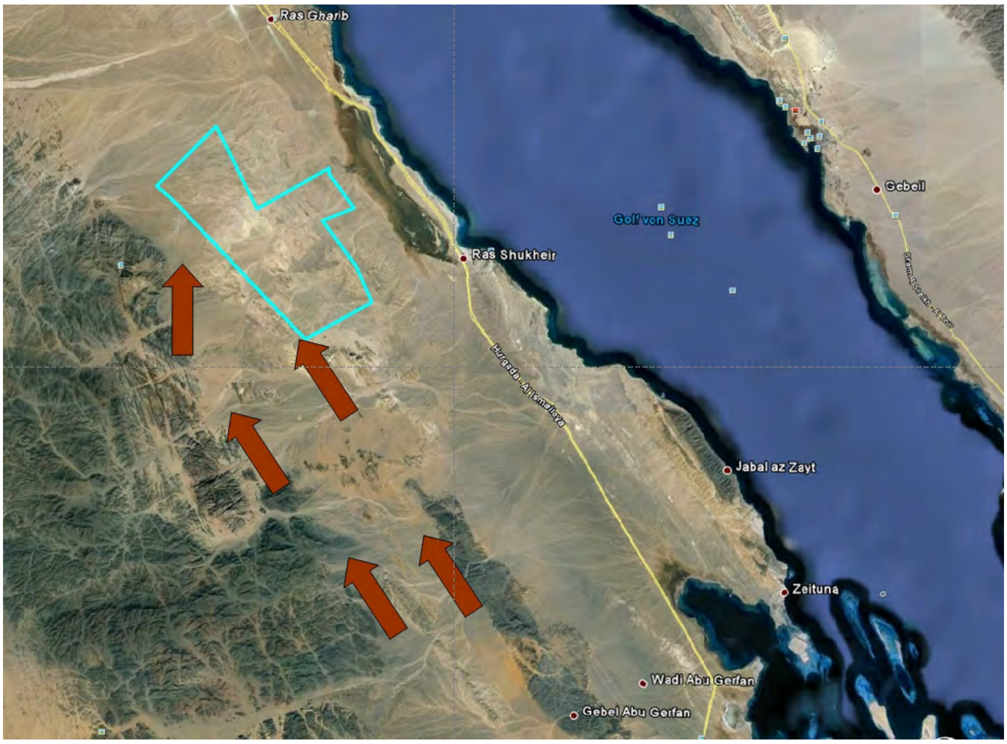



Figure 4.3: Schematic of assumed spring migration of Steppe buzzard and Steppe eagle and other species: the majority of birds cross the Red Sea near Gabel el Zayt. However, large numbers of birds avoid crossing the sea and migrate along the coast further northwest.


Figure 4.4: Schematic of assumed spring migration of several species: concentration of migrating birds within a rather narrow area of about 25 km between the highest mountain (Gabel Gharib) and the Red Sea coast.

Autumn Migration

In autumn 2010 migratory activity within the study area near Ras Gharib was significantly lower than in previous studies:

- Compared to the study carried out in autumn 2008 within the Orange Zone near Wadi Dara, the number of recorded birds was similar, whereas the total observation time was about twice as high in 2008 (Table 4.2). Moreover, compared to 2008 the methodology was optimized (see above) in 2010, probably leading to a higher detection rate of bird migration and, hence, to higher bird counts, *i.e.* in autumn 2008 more migrating birds were not counted. Despite the higher effort in autumn 2010, the number of recordings was clearly lower indicating that migration within the study area was much more dominated by a few larger flocks, whereas periods of low migratory activity within the study area were extended in comparison to autumn 2008.
- Compared to the study carried out in autumn 2006 within the whole concessionary area in the south, the number of recorded birds was considerably lower, whereas the total observation time was nameable higher (Table 4.2). Again, the optimized methodology used in 2010 is believed to have lead to a higher detection rate of bird migration and to higher bird numbers. Despite better methodology in autumn 2010, the number of recordings was much lower in comparison to autumn 2008.

Species composition in general was similar in all three investigations: White stork, Honey buzzard and White pelican occurred in relevant numbers, whereas the numbers of Steppe buzzard, Levant sparrowhawk and Steppe eagle was very low. (The comparably low number of White pelican recorded in autumn 2006 is probably due to the rather low observation time spent at each of the 26 observation sites: on average about 18 h per site.)

Table 4.2: Number of several species migrating at distances of up to 2.5 km from the observation point within the study area (autumn 2010), in the Orange Zone near Wadi Dara (autumn 2008) and in the original concessionary area (autumn 2006) under consideration of total observation time

| Study Area | Gulf of Suez | | Gulf of Zayt | | | |
|---|---|---|---|---|---|---|
| | | | Orange Zone | | Concessionary area | |
| Year | 2010 (803 h) | | 2008 (411 h) | | 2006 (459 h) | |
| Species | birds | rec. | birds | rec. | birds | rec. |
| White stork | 14,034 | 17 | 13,233 | 43 | 32,938 | 83 |
| Steppe buzzard | 11 | 9 | 57 | 41 | 25 | 15 |
| Honey buzzard | 3,028 | 232 | 2,616 | 240 | 5,223 | 400 |
| Levant sparrowhawk | 19 | 4 | 16 | 8 | 16 | 12 |
| White pelican | 8,252 | 17 | 7,464 | 24 | 209 | 5 |
| Steppe eagle | 0 | 0 | 5 | 2 | 0 | 0 |
| Total | 25,942 | 597 | 25,090 | 904 | 39,687 | 1,117 |

Comparing average migration rates (birds/h and recordings/h) over all observation sites in autumn 2010 with average migration rates in autumn 2008 within the Orange Zone near Wadi Dara lead to the following results:

- In autumn 2010 the number of birds/h within the study area near Ras Gharib was much lower than in the Orange zone near Wadi Dara (20 to 83 birds per hour).
- Standard deviation was very high in both studies.
- Regarding the number of recordings/h, migratory activity was significantly lower in 2010, too (0.64 to 2.88 recordings per hour).

The findings of the recent investigation are very well in accordance with the common understanding of autumn migration obtained so far (see Figure 4.5 and Chapter 4.1.1):

- Species like Steppe buzzard, Steppe eagles and other birds of prey do not migrate along the Red Sea coast in autumn.
- The majority of White storks, Honey buzzards, White pelicans and a few other species migrate through the Sinai peninsula, cross the Red Sea and reach the western coast near Gabel el Zayt (between Ras Shukeir in the north and Ras Gemsa in the south) or further to the south.

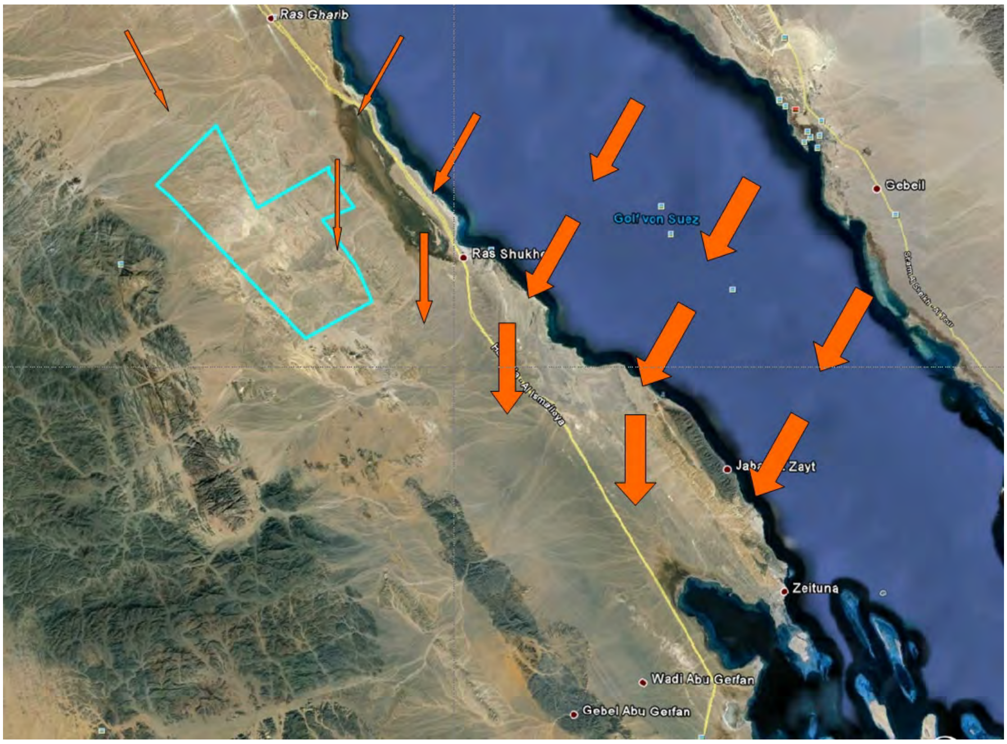



Figure 4.5: Schematic of autumn migration of several species: the vast majority of birds reach the western coast of the Red Sea near Gabel el Zayt.

- Only a minority of White storks, Honey buzzards and White storks occasionally reach the coastline between Ras Gharib and Ras Shukeir or further north. Taking the differences with regards to methodology into account, the results of the three investigations clearly show that the numbers of birds and, even more pronounced, the numbers of recordings were significantly lower within the study area near Ras Gharib. Only a few flocks of White storks and White pelicans (occasionally with large numbers of birds) migrated through the study area. Most of these birds migrated through the eastern (site H) and southern parts (site D) of the study area (Figure 3.13) indicating that these birds reached the coastline south of Ras Gharib.

  It remains unclear, however, whether Honey buzzards, recorded in the northern and western parts of the study area, also crossed the sea north of Ras Gharib or migrated from Suez along the Red Sea Mountains in south-eastern directions.

### 4.1.4 Effect of Wind Speed on Migration

Investigations into spring migration do not reveal any clear relationships between migratory activity, wind speed and wind direction (Figure 3.6). One expectation that has to be rejected is that activity is particularly high in conditions with tailwinds or with low winds. Obviously, other variables (*e.g.* daytime, season, weather conditions during previous days) have a much more pronounced effect on

migratory activity. Moreover, analysis is hampered by the disproportionate distribution of variables (*e.g.* many more observation units with winds coming from the north).
There seems to be a slight tendency, however, of higher migratory activity on days with winds from the south, though the analysis shows that this trend is not consistent (see Figure 3.6).
Autumn migration occurred comparably fast because of strong winds coming from northern directions, pushing the birds to the south. Wind speed did not seem to have any effect on migration rate or flight direction.

### 4.1.5 Spatial Distribution of Migration within the Study Area

<u>Spring Migration</u>

An analysis of spatial distribution of bird migration within the study area reveals no distinctive patterns. Although the number of birds differed between all eight observation sites (Figure 3.7), mainly caused by the three most numerous species (Steppe buzzard, White stork and Honey buzzard), migration rate itself did not differ significantly between observation units (probably because of the high deviation, see Chapter 3.1.2).
The number of Honey buzzard was exceptionally high at site E. As about 59 % of these birds were recorded during a single 3 h observation unit, it is questionable if Honey buzzards prefer to migrate through the area around site E. Likewise, the comparably high number of Levant sparrowhawks at sites D and H is not expected to be due to regular migration patterns. Levant sparrowhawks often migrate in large flocks, so just a few recordings (4 at sites D and H, each) have a huge influence on the data set. Considering the number of other species (*e.g.* Black kite) or groups of species (*e.g.* Eagles form the genus *Aquila*), there were no larger differences that might indicate a particular spatial distribution.
The number of White storks was comparably low in the north-western parts of the study area, whereas very high numbers of White storks migrated through the eastern and southern parts of the study area.

In summary, specific flight paths within the study area do not seem to exist. Of course, the vast majority of birds / flocks tended to fly in northern directions independent of where they passed the study area. In contrast to the findings of previous studies, the portion of birds migrating in western, eastern or southern directions was very low in spring 2010. Thus, it can be assumed that most recorded birds follow the western coast of the Red Sea and the Red Sea Mountains up to Suez.
Moreover, the recent findings indicate that birds which avoid crossing the sea subsequently follow the coastline further northwest and migrate through the eastern part of the study area. Considering only birds that migrate at altitudes below 200 m, migratory activity decreased from southeast to northwest (Figure 3.9; note that the high number of Steppe buzzards mainly refers to a single observation in

which 4,500 individuals were recorded). This tendency becomes even more pronounced when Steppe buzzard is excluded from the data set — Steppe buzzard is a common and abundant species with a favourable conservation status and thus is of minor interest in the impact assessment (Figure 3.10).

Autumn Migration

According to the low migratory activity observed in the recent study, there are no apparent distinctive spatial patterns or special flight paths within the study area in autumn.

Flocks with large numbers of birds (mainly White storks and to a lower degree White pelicans) were only recorded in the eastern and southern parts of the area. These birds apparently reached the western coast of the Red Sea between Ras Gharib and Ras Shukeir and subsequently crossed the study area in the east and the south. So, as in spring, there might be a decrease in the numbers of birds from southeast to northwest. However, flocks of White storks and White pelicans occurred very rarely and overall migration was very low.

## 4.2 Assessment of the Importance of the Study Area

### 4.2.1 Methods for assessing the Importance of an Area

Commonly, the importance of a site is assessed by two criteria: 1. the number of migrating birds / recordings, and 2. the conservational status (IUCN-Red List Category, see Annex I & II) of migrating species. In this process, species that are exposed to a higher threat are of special interest. As noted in Chapter 2.1, such species are Egyptian vulture (Endangered), Spotted eagle, Eastern imperial eagle, Lesser kestrel (all Vulnerable), as well as Pallid harrier and Red-footed falcon (both Near Threatened). The numbers of representatives of these species (apart from Egyptian vulture) recorded within the study area, however, were rather small and their spatial distribution showed no definite spatial pattern. All species occurred mostly singularly at a few sites. This means, the conservational status according to the IUCN-Red List of a species cannot qualify as a decisive criterion in assessing the significance of the concessionary area in a spatially differentiated way.

According to Birdlife International, few species which occurred within the study area in relevant numbers, mainly White stork and Levant sparrowhawk, have an unfavourable conservation status in Europe and are concentrated in Europe (SPEC 2-category, see Annex I & II). Other species occurring within the study area have an unfavourable conservation status in Europe but are not concentrated there (SPEC 3): mainly Steppe eagle and White pelican. In contrast, Steppe buzzard and Honey buzzard are not of special conservational concern, as both species have a favourable status in Europe. Consequently, these two species (despite of the high numbers recorded in spring) are of minor importance in the impact assessment, whereas White Stork, Levant sparrowhawk, Steppe eagle, White pelican and Egyptian vulture have to be considered with special attention.

Several criteria have been developed by Birdlife International for the selection of areas which are internationally important for birds. Within the scope of this investigation two criteria are particularly relevant:

1. An area where at least 20,000 storks, raptors or cranes regularly pass during spring or autumn migration is of international importance.
2. The second criterion is the abundance of each species in relation to the total flyway population. According to this, an area that regularly holds at least 1% of a flyway population of a threatened migratory species is of international importance, too. A flyway population, is a population of a species sharing the same migration route linking breeding areas and wintering areas.

For a spatially differentiated assessment of the importance of the study area, *i.e.* of different parts of the study area, migratory activity at each observation site is compared with the data obtained at the four observation sites in the previous study (Bergen 2009). As mentioned before, we assume that wind turbines will not affect birds migrating at altitudes above 200 m. Thus, the spatially differentiated assessment focuses on migration below 200 m but should also be valid for overall migration. For this reason we used three classes: significant, very significant and extremely significant for bird migration.

### 4.2.2 Importance of the whole Study Area

Spring Migration

During standardized field observations in spring 2010, more than 170,000 storks and raptors were recorded within the study area (Annex III). Hence, the study area as a whole meets the first mentioned criterion developed by Birdlife International (see Chapter 4.2.1: "...at least 20,000 storks, raptors...") and is therefore of international importance for spring migration. Considering that the observed area covers only a part of the whole study area and that a portion of all migrating birds were probably not counted (due to several factors, *e.g.* flight altitude, awareness of the observer, detection probability is not 100 %), the recorded migrants obviously were only a fraction of all migrating birds. Therefore, the results definitely show that the study area is situated within one of the most important migratory routes for birds in spring. It was already known that the Red Sea Coast, mainly the area around Gabel al Zayt, located about 30 km southeast of the study area, is a major bottleneck for large soaring birds that breed in Europe, the Middle East and Asia but winter in tropical and southern Africa. However, for the first time this study provides proof that in spring a huge amount of bird migration occurred even further north.

The observed numbers of White stork refer to about 15 % of the total flyway population of this species (Table 4.3). For five other species more than 5 %, and for seven other species more than 1 % of the total flyway population occurred in the study area. More than 3 % of the flyway population of

Egyptian vulture classified as globally endangered in the IUCN-Red List was recorded (Table 4.3). In summary, the 1 %-criterion (see Chapter 4.2.1) is met for 13 species, clearly showing that the study area is of international importance for spring migration, especially for the migration of White stork, Levant sparrowhawk, Steppe eagle and White pelican, but also for migration of Common crane, Steppe buzzard, Honey buzzard and other birds of prey. Again, it has to be considered that the recorded migrants obviously were only a fraction of the whole migration, so that the proportion of the flyway population might be underestimated. Taking into account that the precise size of populations of some species is not known very well, the estimate of the total flyway population might be underestimated.

The region is not a bottleneck for Lesser kestrel, Pallid harrier and other Harriers, which migrate on a broad front between breeding and wintering sites. ORNIS CONSULT (1999) pointed out that Falcons are active fliers and do not depend on thermals, enabling them to cross the Gulf of Suez everywhere. Consequently, Falcons are not concentrated at any particular location. Harriers are soaring birds that do rely on thermals to a limited extent and are able to cross large bodies of water. Harriers do not even avoid crossing the Mediterranean Sea.

Table 4.3: Number of recorded birds, proportion (%) of the flyway population and conservational status of the most numerous species recorded in spring 2010 within the study area

| Species | Number of birds | % of flyway population | IUCN-Red List | SPEC |
|---|---|---|---|---|
| White stork | 67,405 | 15.5 | Least Concern | 2 |
| Levant sparrowhawk | 5,626 | 7.5 | Least Concern | 2 |
| Steppe eagle | 2,753 | 7.3 | Least Concern | 3 |
| White pelican | 4,427 | 6.3 | Least Concern | 3 |
| Booted eagle | 189 | 6.0 | Least Concern | 3 |
| Steppe buzzard | 66,797 | 5.3 | Least Concern | Non-SPEC |
| Short-toed eagle | 396 | 4.5 | Least Concern | 3 |
| Black stork | 625 | 3.2 | Least Concern | 2 |
| Egyptian vulture | 142 | 3.1 | Endangered | 3 |
| Honey buzzard | 21,564 | 2.2 | Least Concern | Non SPEC$^{E}$ |
| Common crane | 593 | 1.7 | Least Concern | 2 |
| Black kite | 2,208 | 1.7 | Least Concern | 3 |
| Lesser spotted eagle | 568 | 1.1 | Least Concern | 2 |
| Long-legged buzzard | 129 | 0.6 | Least Concern | 3 |
| other species | 4,094 | | | |

The data on flyway populations are taken from CarlBro (2009) after comparing this data with other available sources.

Autumn Migration

During standardized field observations in autumn 2010, about 17,500 storks and raptors were recorded within the study area (Annex III). Hence, the study area as a whole does not meet the first mentioned criterion developed by Birdlife International (see Chapter 4.2.1: "...at least 20,000 storks, raptors..."). However, considering that a fraction of the whole migration was not recorded (see above) the study area probably is of international importance for autumn migration, too.

The observed numbers of White storks and White pelicans refer to about 3 and 12 % of the total flyway population of each species, respectively (Table 4.3). Holding on to the 1 %-criterion, the study area at first sight is of international importance for autumn migration for these two species, too. For all other species less than 1 % of the flyway population was recorded. As the number of birds was very low for these species, we do not expect that the 1 %-criterion was met even under the assumption that a fraction of the whole migration was not recorded.

With regards to an assessment it has to be considered that only three flocks of White storks and three flocks of White pelicans cover more than 70 % of all recorded birds. Moreover, the three flocks of White stork make up 86 % of all recorded individuals and constitute 2,7 % of the total flyway population of this species. Similarly, the three flocks of White pelican make up 74 % of all recorded individuals and constitute 8,7 % of the total flyway population of this species.

Moreover, the total flyway population of the two relevant species might be significantly underestimated because, in addition to adult birds a huge amount of young birds migrate for the first time in their wintering areas in autumn.

To conclude, the high numbers of recorded storks and pelicans refer to only very few incidents and do depict a regular pattern. Consequently, it unlikely that 20,000 storks, raptors or cranes regularly pass the area or that the area regularly holds at least 1% of a flyway population of a threatened migratory species as given in the criteria developed by Birdlife International. Accordingly, the area is not believed to be of international importance for bird migration in autumn.

### 4.2.3 Spatially Differentiated Assessment of the Importance (Spring Migration below 200 m)

As mentioned before, we assume that wind turbines will not affect birds migrating at altitudes above 200 m. Thus, the following assessment focuses on migration below 200 m.

Spring Migration

Compared to the previous study within the Orange Zone near Wadi Dara (BERGEN 2009), the number of birds migrating at altitudes below 200 m was much higher in spring 2010 at most observation sites (Figure 4.6). This was mainly due to White stork which occurred at lower altitudes in very high numbers especially at sites C, D, G and H. Moreover, a comparably high number of Steppe buzzards migrated through the area at most sites. For example, almost 10,000 Steppe buzzards were observed at lower altitudes at site A (Figure 4.6). However, 4,500 of these birds were recorded during a single 3h-observation unit. Consequently, we do not expect this result to be due to regular migration patterns. Furthermore, Steppe buzzard is not a species of special conservational interest (see above). In summary, the importance of the study area can be classified as follows:

- The north-western parts of the study area around the sites A and B have to be classified as significant for bird migration in spring (Figure 4.7). Particularly Steppe buzzards and fewer numbers of other soaring species were recorded at altitudes below 200 m. Apart from Steppe buzzard, the numbers of birds was rather low at sites A and B (about 2,000 individuals, Figure 4.6). A comparable migratory activity was observed at sites M10 and S10 in spring 2009 within the Orange Zone near Wadi Dara. Especially, White stork migration was not pronounced at sites A and B, possibly due to the rather large distance to the coastline.
- The numbers of birds and recordings observed in the northeast (site E), in the middle (sites C and F) and in the southwest (site D) of the study area were clearly higher than at sites A and B and at sites M10, S09 and S10 in spring 2009 in the Orange Zone near Wadi Dara (Figure 4.6). Only the number of birds collected at M09 in spring 2009 was comparable. At sites C, D and F more than 4,000 White storks migrated in spring 2010 at altitudes below 200 m. Moreover, Honey buzzards and fewer numbers of other species were regularly seen at sites C, D, E and F. Consequently, the northeast, the middle and the southwest of the study area have to be classified as very significant for bird migration in spring (Figure 4.7).
- At each of the two sites G and H, covering the eastern and south-eastern parts of the study area, more than 12,000 birds (except Steppe buzzard) were seen migrating at altitudes below 200 m (Figure 4.6). Thus, compared to all other sites of the study area and compared to all sites in the Orange Zone near Wadi Dara, migratory activity at lower altitudes was highest at sites G and H. This is mainly due to the high amount of White stork which apparently avoided crossing the sea, but headed further northwest to Suez. Consequently, the eastern and south-eastern parts of the study area have to be classified as extremely significant for bird migration in spring (Figure 4.7).

<u>Autumn Migration</u>

Compared to the previous investigation in the Orange Zone near Wadi Dara rea (BERGEN 2009), the number of birds migrating at altitudes below 200 m was much lower at most sites in <u>autumn</u> 2010 (Figure 4.8). Only at site H, where about 8,000 White storks were recorded, migratory activity was comparable to that recorded at site S09 in autumn 2008. However, it has to be taken into account that the high number of White storks at site H mainly refers to a single flock of about 7,500 individuals.

Thus, migratory activity at altitudes below 200 m in autumn 2010 was low or predominately very low in the whole study area. Consequently, large parts of the study area are not important for autumn migration.

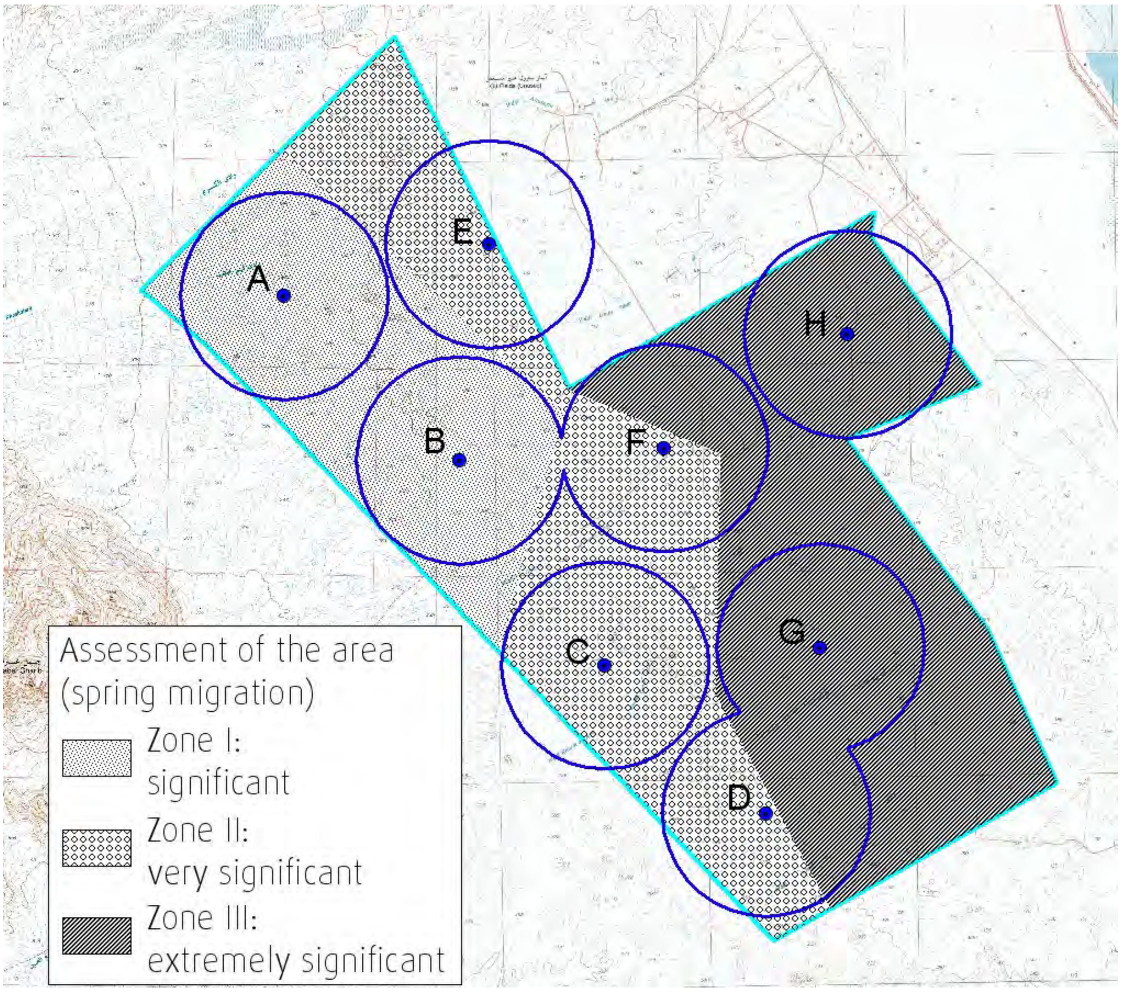



Figure 4.7: Assessment of the importance for spring migration

# 5 Bird-Wind Turbine Interactions

In recent years the construction of wind turbines has given rise to much controversy relating to bird conservational issues, mainly in Europe and the United States.

Considering utilization of wind energy within the study area, the major potential hazards to birds are mortality due to collision as well as barrier effects. Other possible impacts of wind turbines like displacement due to disturbance or direct habitat change and loss can be neglected, because the area, which is characterized by practically no vegetation and very dry climatic conditions with large differences in temperature between night and day, does not serve as an important breeding, wintering or resting site for one of the relevant species. Although resting birds might occur within the study area occasionally, they do not constantly use particular parts of it and only rest for a short period of time.

## 5.1 Collision Risk and Mortality

Wind turbines seem to add an obstacle for bird movements and research has shown that birds fly into rotor blades. Although some studies have recorded bird collisions, other studies give evidence that birds could detect the presence of wind turbines and generally avoid them.

### 5.1.1 Results of Collision Risks at Different Wind Farms

ERICKSON *et al.* (2001) collected data from many studies conducted at different wind farms in the U.S. The results indicate an average of 2.19 avian fatalities per turbine per year in the U.S. for all species combined and 0.033 raptor fatalities per turbine per year. At different wind farms in Europe the annual number of dead birds per turbine varies between 0.04 (PERCIVAL 2000) and 35.00 (EVERAERT *et al.* 2002) depending on site characteristics and bird densities. MADDERS & WHITFIELD (2006) pointed out that simply presenting mortality rates per turbine or per installed MW, in the absence of further information on the abundance of birds (or birds at risk of death), does little to inform about the collision risk by a wind farm. And LANGSTON & PULLAN (2004) suggested that a low collision rate per turbine does not necessarily mean that collision mortality is insignificant, especially in wind farms comprising several hundreds or thousands of turbines.

Comparably high mortality rates due to collision have been recorded at large wind farms in areas with high concentrations of birds: Altamont Pass in California (ORLOFF & FLANNERY 1992, HUNT 1995, SMALLWOOD & THELANDER 2004, THELANDER & SMALLWOOD 2007, SMALLWOOD & THELANDER 2008) and in the Campo de Gibraltar region (Cádiz) in Spain (BARRIOS & RODRIGUEZ 2004). In particular, large numbers of raptors have collided with wind turbines at these sites, including substantial numbers of Golden eagles (*Aquila chrysaetos*) and Griffon vultures (*Gyps fulvus*). These wind farm areas are characterized by

large numbers of turbines (c. 7,000 at Altamont and 256 at Cádiz, which are often closely packed together) and by predominantly small turbines comprised of lattice towers and high-speed rotors relatively close to the ground (PERCIVAL 2005). Both areas are located in mountainous surroundings, sustain important food resources and, consequently, high densities of birds, which thus are susceptible to collisions with turbines.
As with Altamont or Cádiz, most of all investigated wind farms affect stationary (breeding or wintering) birds and / or small passerines migrating at night. Thus, there is a great lack of information about collision risk for migrating birds, in particular about migrating raptors or other large birds.

During a 14-month study, which included two autumn migration periods, only two bird carcasses were found at a wind farm (66 turbines) near the Strait of Gibraltar: a Griffon vulture, which is a stationary (wintering) bird species in the region, and a Short-toed eagle (*Circaetus gallicus*). JANSS (2000) estimated that about 45,000 Griffon vultures and 2,500 Short-toed eagles fly over the wind farm per year.

In contrast to these findings BARRIOS & RODRIGUEZ (2004), during a one-year period at a wind farm (called "PESUR", 190 turbines) located less than 10 km away from the above mentioned study area, found 28 Griffon vultures, twelve Common kestrels (*Falco tinnunculus*), three Lesser kestrels, two Short-toed eagles, one Black kite and two White storks. The authors estimated a mortality rate of 0.36 raptors per year per turbine. Considering the number of turbines, such increases in mortality rates may be significant for some birds, especially large, long-lived species with a generally low annual productivity and long maturation. BARRIOS & RODRIGUEZ (2004) concluded that mortality at wind power plants reflects a combination of site-specific (wind-relief interaction), species-specific and seasonal factors.

During a three-year study (2000-2002) 13 wind power plants containing 741 turbines were studied in Navarra (Spain; LEKUONA & URSÚA 2007). Thirty seven study plots containing 277 turbines were selected for fatality searches and behavioural bird observations. Overall 345 bird fatalities were recorded. Most dead birds were raptors (72.8 %) with the Griffon vulture representing 63.1 % of raptor fatalities. Most raptors were killed during spring (March to June). By contrast, all three Lesser kestrels were found during postbreeding migration, because there was a postbreeding roost near a wind plant.

At the wind farm "Al Koudia" (84 turbines) in northern Morocco, corpse searches were done over a three-month period in 2001 (EL GHAZI *et al.* 2001). Only two carcasses were found in autumn 2001 (one Pallid Swift (*Apus pallidus*) and one Woodlark (*Lullula arborea*), but no raptor or large bird). In autumn 2000, four other birds (mainly local, stationary species) were found by chance. It must be mentioned that the results might lead to an underestimation of collision risk, because no correction factors (*e.g.* for search efficiency or scavenger activity) were used.

At a wind farm (220 turbines) at the western bank of the Gulf of Suez (Egypt) corpse searches were carried out over a four-week period in spring 2007 (BERGEN 2007). Body parts, feathers and bones of three birds were found, which had died weeks or months ago — possibly by collision with a turbine. No fresh bird corpse was found. Due to the characteristics of the study area and the high intensity of investigation, search efficiency and / or scavengers were not regarded to play an important role. Thus, the results strongly indicate that the number of collisions was very low if not zero throughout the period of investigation. It must be pointed out, however, that the study is limited due to the short period of investigation.

Occasional fatality searches at wind turbines in Hurghada wind farm did not reveal any evidence of bird mortality (BAHA EL DIN 1996).

### 5.1.2 Factors Influencing Vulnerability to Collision

The risk of collision depends on a broad range of external and internal factors (JOHNSON *et al.* 2000).

Weather, Visibility and Season

Collision risk seems to be greatest in poor flying conditions, such as strong winds that affect the birds' ability to control flight manoeuvres, or in rain, fog, and on dark nights when visibility is reduced (WINKELMAN 1992, LANGSTON & PULLAN 2004). But collisions occurred in conditions of good visibility, too: all of the 68 collisions at turbines of the above mentioned wind farm "PESUR" occurred on clear days (BARRIOS & RODRIGUEZ 2004); and collision of Vultures occurred rarely in strong winds, which could have indicated little manoeuvrability by the Vultures (see below).
At the wind farm "PESUR" all Vultures died between October and April, with 66.7 % of all accidents taking place between December and February (although the Griffon vulture is a resident species in the region). BARRIOS & RODRIGUEZ (2004) assumed that the seasonal pattern of Vulture deaths might be explained by flight behaviour. As is known, Griffon Vultures need vertical air currents to gain height. In winter low temperatures make thermals scarcer. Birds are thus constrained to gain height with slope updrafts, whose force on most winter days may be insufficient to lift Vultures well above the ridge, thereby exposing them to wind turbines.

Site-specific Factors

It is quite obvious that a higher collision rate is to be expected at locations with high bird densities (LANGSTON & PULLAN 2004), especially by species vulnerable to collision. When comparing wind energy facilities, it appears that birds tend to be killed at rates that are proportional to their relative abundance amongst wind farms (SMALLWOOD & THELANDER 2004). However, there are several wind farms where the correlation between usage by birds and fatality is low (ERICKSON *et al.* 2001). An investigation at several wind power plants in Spain also confirmed that the relative abundance of species does not predict the relative frequency of fatalities (LEKUONA & URSÚA 2007).

CALIFORNIA ENERGY COMMISSION (2002) and ORLOFF & FLANNERY (1992) suggested that the abundance of ground squirrels within the Altamont Pass Wind Resource Area might significantly increase raptor foraging, and thus collision risk. Within some wind farms in Navarra (Spain), Vultures and Kites were apparently killed because of the nearby livestock carcass and dump sites (LEKUONA & URSÚA 2007).

HOWELL & DI DONATO (1991) identified significant topographical features associated with collision mortality. Notably mountain passes and hill shoulders, which tend to be the preferred crossing places for soaring species, were associated with multiple collisions.

Field studies in the Altamont Pass resource Area have clearly shown that not all turbines have an equal probability of causing raptor fatalities (MORRISION *et al.* 2007). While some turbines were involved in multiple fatalities, others killed none. Fifteen turbine strings, which are located in highly complex topographic areas, were responsible for 60 % of all raptor fatalities: 80 % of Red-tailed hawk (*Buteo jamaicensis*) and 100 % of Golden eagle.

The 190 wind turbines at the wind farm "PESUR" — which prompted a relatively high number of collisions (BARRIOS & RODRIGUEZ 2004) — are arranged in rows along the ridges of mountains or hills, too. However, the wind farm which is less than 10 km away from "PESUR" and which is arranged in a similar way, yielded evidence of only very few collision victims (DE LUCAS *et al.* 2004).

Turbine-specific Factors

ORLOFF & FLANNERY (1992) suggested that the high collision rate at Altamont Pass might be correlated to the lattice towers of the wind turbines which provide many perches, thus attracting birds, particularly raptors, into the collision-risk zone. However, recent investigation showed that perching on wind turbines is a less important factor contributing to mortality than previously suspected (SMALLWOOD & THELANDER 2004).

PERCIVAL (2005) assumed that collision risk at small turbines with high-speed rotors and with the turbines often packed closely together is higher.

Differences in collision rates also appear between turbines within a single wind farm although the same turbine type is used: in the wind farm "PESUR" a single group of 28 turbines (from 190) was responsible for 57 % of Griffon vulture mortality. These turbines were arranged in two rows with little space between consecutive turbines (Barrios & Rodriguez 2004). However, little or no risk was recorded for five turbine rows having exactly the same windwall spatial arrangement.

Smallwood & Thelander (2004) found that wind turbines were most dangerous at the ends of turbine strings, at the edges of gaps in strings, and at the edges of clusters of wind turbines. Furthermore, most isolated wind turbines killed disproportionately more birds.

Barclay *et al.* (2007) found that neither rotor diameter nor tower height have an effect on bird fatalities.

Species-specific Factors

Manoeuvrability and flight behaviour might be crucial factors to explain differences in collision risks between species (Drewitt & Langston 2006).

Especially soaring birds, like Griffon vulture or Golden eagle, are believed to be particularly vulnerable to collision with wind turbines (Langston & Pullan 2004), because of their lower manoeuvrability and their dependence on thermals. In contrast, at "PESUR" other soaring birds, such as Common buzzards (*Buteo buteo*) or Short-toed eagles, often circled together with Vultures in slope updrafts but did not closely approach the turbine blades and rarely collided with them. Barrios & Rodriguez (2004) suggest that these species have lower wing loads than Vultures, and make a more efficient use of the ascending currents, gaining altitude faster and farther away from the turbines.

In the Altamont Pass Wind Resource Area Smallwood *et al.* (2009) found that fatality rates were high for Red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*), but low for Common raven (*Corvus corax*) and Turkey vulture (*Cathartes aura*), indicating specific behaviours or visual acuity differentiated these species by susceptibility to collision.

Ornis Consult (1999) subdivided soaring birds into four different categories depending on manoeuvrability and flight behaviour. On the basis of this classification we can deduce the vulnerability of different species to collision (see Table 5.1).

Table 5.1: Assessment of species-specific vulnerability to collision depending on manoeuvrability and flight behaviour (according to Ornis Consult 1999)

| category | description | species | vulnerability to collision |
|---|---|---|---|
| very passive fliers | very dependent on thermals, generally not able to cross large bodies of water | Egyptian vulture, Short-toed eagle and all Eagles of the genus Aquila | very high |
| less passive fliers | less dependent on thermals, able to cross limited bodies of water | Buzzards, Kites, Honey buzzard, Storks, Cranes and Pelicanes | medium to high |
| less active fliers | rely on thermals to a limited extent able to cross large bodies of water | Harriers and Sparrowhawks | low to medium |
| very active fliers | not dependent on thermals, able to cross the Gulf of Suez at any point | Falcons | very low |

Nevertheless, collision risk seems to depend not only on manoeuvrability and flight behaviour but also to a large (or maybe larger) extent on species-specific avoidance behaviour.
The high number of collided Common kestrel (a very active flier that does not depend on lifting air currents) and maybe Griffon vultures too, might be explained with the absence of avoidance behaviour. At "PESUR" Kestrels sometimes perched on lattice towers, and Vultures frequently flew at close distance to the blades, or between two adjacent turning turbines (BARRIOS & RODRIGUEZ 2004). Soaring flights at low wind speeds and crossing flights that commenced below blade height increased the risk of collision, as Vultures showed little reaction to the turbine with only 2 % altering their approaching flight pattern.
In the wind farm at the western bank of the Gulf of Suez the majority of birds migrating at altitudes below 100 m showed clear avoidance behaviour in the presence of the wind turbines (BERGEN 2007). While Steppe buzzards predominately changed flight direction and avoided to enter the wind farm area altogether, most Black kites increased altitudes and subsequently entered the wind farm at heights above rotor blades but also at heights of the area swept by the rotor. Thus, they passed over or through the wind farm. Furthermore, the results of the study indicate that birds migrating individually are less sensitive to the presence of wind turbines than flocks. Large flocks seem to avoid wind turbines at greater distances.

The preferred altitude of migration is likely to be another factor effecting collision risk in a species-specific way. Most birds of such species that tend to migrate at altitudes above 199 m (*e.g.* Eagles) are unlikely to come close to the area swept by rotors of wind turbines. Other species that prefer to migrate at altitudes around turbine height, might often come into the range of rotors and hence face a risk to collide.

There are indications that migrating passerines might be vulnerable to collision, especially when migrating at night (because of poor visibility; LANGSTON & PULLAN 2004). Collisions of passerines were recorded at several wind farms (*e.g.* ERICKSON *et al.* 2001). But mass collisions, which occurred at lighthouses during some nights, were not documented at wind turbines. Until now, collision risk of nocturnal migrants at onshore wind farms does not seem to be a major concern, possibly for several reasons:

- Usually nocturnal migration by passerines is at altitudes well above turbine height (*e.g.* ALERSTAM 1990), so there is a very low potential for these birds to come into the collision risk zone. We can suggest that nocturnal migrants should be most vulnerable during take-off soon after sunset and during descent. Furthermore, birds facing strong headwinds, forcing them to fly at lower altitudes, might face an increased risk of collision.

- Due to the large populations of most passerine species, they are not of major conservational interest. Results from studies in the United States indicate that the levels of fatalities are not considered significant enough to threaten local or regional population levels (STERNER *et al.* 2007).
- Most passerines have an r-selected reproductive strategy: individuals are short-lived, mature rapidly, have many offspring and a high adult and juvenile mortality. Consequently, additional mortality caused by wind turbines is unlikely to have a significant effect on populations of most passerine species.
- Mortality of passerines seems to be much higher at other man-made structures compared to mortality at wind turbines (ERICKSON *et al.* 2001).

Individual Factors

Finally, collision risk might be influenced by individual attributes of a bird (*e.g.* age, experience or fitness). It is quite obvious that the risk of collision varies depending on the stage of a bird's annual cycle (breeding, roosting or migrating).

Some studies indicate that immature birds are more vulnerable than adults, a phenomenon which may be attributed to the inexperience of younger birds. However, within the Altamont Pass Wind Resource Area most Golden eagle mortalities were not juveniles but subadults and non-breeding adults (CALIFORNIA ENERGY COMMISSION 2002).

At "PESUR" (as well as at "Al Koudia") victims were usually species with resident populations rather than species appearing during migration (EL GHAZI *et al.* 2001, BARRIOS & RODRIGUEZ 2004).

### 5.1.3 Conclusion

Many studies have shown that birds are generally able to avoid collisions with wind turbines and do not simply fly into them blindly (*e.g.* DIRKSEN *et al.* 1998, DE LUCAS *et al.* 2004, DESHOLM 2006). Nevertheless, at a few locations relevant numbers of collision victims were found, leading to significant increases in mortality rates and possibly to population decreases.

As shown, the scale of collision depends on a wide range of factors which — in some cases — correlate with each other. It is quite plausible that a combination of factors (*e.g.* flight behaviour, wind speed and relief of location) influences collision risk. As a consequence, it is very difficult to transfer the results obtained at a particular wind farm to another. At present, there is insufficient information available to form a reliable judgement on the scale of collision at a proposed wind farm.

## 5.2 Barrier Effect

There are several reliable studies indicating that wind turbines have a disturbing effect on birds and hence may act as barriers to bird movement.

During a 14-month study at a wind farm (66 turbines in a single row on top of a mountain ridge) near the Strait of Gibraltar, 72,000 migrating birds were recorded during about 1,000 hours of observation from fixed observation points (JANSS 2000). The most abundant species were Black kites, White storks, House martins (*Delichon urbica*) and Swallows (*Hirundo rustica*). Most of the migrating birds observed were passing over the wind farm, but at a higher average altitude than over two control areas. Average flight altitude at the wind farm was more than 100 m above ground. Almost 72 % of all soaring birds (n = 16,225) displayed changes in flight direction in the wind farm area (DE LUCAS *et al.* 2004, DE LUCAS *et al.* 2007). Raptors appeared to be accustomed to the presence of turbines and many birds flew close to turbines (DE LUCAS *et al.* 2004).

During a behavioural study at thirty seven study plots containing 277 turbines most birds (58.6 %) flew very low (< 5 m). 24.1 % of all birds showed panic behaviour in the risk zone, 20,3 % a sudden change of flight, and 15,6 % a slight change of flight (LEKUONA & URSÚA 2007).

At the wind farm "Al Koudia" (84 turbines) in northern Morocco, autumn migration was observed over a three-month period in 2001 (EL GHAZI *et al.* 2001). Most birds (depending on species up to 100 %) showed clear avoidance behaviour in the presence of the turbines.

At a wind farm (220 turbines) at the western bank of the Gulf of Suez, the behaviour of migrating birds was observed over a four-week period in spring 2007 (BERGEN 2007). In the vicinity of the wind farm most birds (almost 88 %) used altitudes above 100 m, showed no clear reaction in presence of wind turbines and migrated over the wind farm. Most birds (over 83 %) migrating at altitudes below 100 m showed a clear reaction to the presence of wind turbines.
Black kites most often increased altitude and subsequently entered the wind farm at heights above rotor blades but also at heights swept by the rotor. Thus, they passed over or through the wind farm. Some birds reacted to the presence of wind turbines with a combined vertical and horizontal behaviour. But change in flight direction alone was recorded relatively rarely. Accordingly, less than 11 % of all Black kites did not pass the wind farm. In contrast, Steppe buzzards did not change altitude in relevant numbers. The majority of birds changed their flight direction, so that they subsequently did not enter the wind farm area. Thus, Steppe buzzards seem to regard the whole wind farm as a barrier. Consequently, Steppe buzzards appear to be more sensitive to the presence of wind turbines, whereas Black kites might be more vulnerable to collision.

The proportion of recordings of Black kites changing altitude was markedly lower than the proportion of birds, indicating that birds migrating individually or in small flocks are less sensitive to the presence of wind turbines than flocks. The analysis of behaviour of Steppe buzzards presents similar patterns.
Harriers usually migrated alone only a few meters above the ground. In the presence of wind turbines most Harriers showed no conspicuous reaction and simply flew through the wind turbines at heights below the rotor blades. A relevant number of birds (about 42 %) changed flight direction. As a consequence, one-third of migrating Harriers did not enter the wind farm area. Nevertheless, since the number of migrating Harriers was very low the findings must be treated with caution.
The results demonstrate that migrating birds were able to detect the presence of wind turbines and thus to react in an appropriate way depending on external (*e.g.* weather conditions) and internal (*e.g.* altitude, physical capabilities) factors. Birds at altitudes above 100 m simply migrated over the wind farm without any noticeable reaction. Birds at altitudes below 100 m became aware of the presence of wind turbines and apparently avoided them by changing their flight direction or increasing altitude. Sometimes birds seemed to avoid turbines in operation and purposefully approached a turbine not in operation and subsequently passed by.
A flight reaction of a bird in the vicinity of a turbine was recorded only twice. Irrespective of a bird's motivation (migrating, flying, hunting, resting) or of weather conditions, an appreciably irritated bird or a bird in a critical situation that might have led to a collision or to loss of flight control never occurred. Since the investigation refers to a rather short period, which did not cover the main migrating period of all species, results have to be verified.

Further studies have shown that birds alter their routes to avoid flying through on- and offshore wind farms (*e.g.* DIRKSEN *et al.* 1998, OSBORN *et al.* 2000, DESHOLM & KAHLERT 2005). However, there are also locations where large numbers of birds regularly fly through wind farms without diverting around it (*e.g.* EVERAERT *et al.* 2002, EVERAERT & STIENEN 2007).

PERCIVAL (2005) assumed that the ecological consequences of such a barrier effect are unlikely to be a problem at small wind farms. DREWITT & LANGSTON (2006) suggest that none of the barrier effects identified so far have significant impacts on populations. However, under certain circumstances barrier effects might lead to population level impacts indirectly, *e.g.* where a wind farm effectively blocks a regularly used air route between nesting and foraging areas, or where several wind farms interact cumulatively. Then large wind farms or a number of wind farms might lead to increased energy expenditure for birds and thus might reduce annual survival rates and / or breeding output (FOX *et al.* 2006, LANGSTON *et al.* 2006). In summary, until now it is quite difficult to judge whether avoidance behaviour causes a significant effect on individuals and, ultimately, on populations.

# 6 Impact Assessment

The following assessment focuses on large migrating birds, because most parts of the study area are of minor importance for local and roosting birds. A detailed impact assessment with regards to local and roosting birds is given in the final ESIA-document.

## 6.1 General Remarks on Limitations of Risk Assessment

As detailed in Chapter 5, collision rate depends on several factors and until now the cause-and-effect chain of collision is poorly understood. Very little is known about collision risk for migrating birds.

There have been a few attempts to predict collision rate at a given wind farm with mathematical models (TUCKER 1996, BAND 2000, BAND *et al.* 2007). Modelling collision risk under the BAND model is a two-stage process. Stage 1 estimates the number of birds that fly through the rotor-swept area. Stage 2 predicts the proportion of these birds that will be hit by a rotor blade. The reliability of the collision model is limited by difficulties in gathering appropriate field data and by the large numbers of assumptions necessary during the modelling process, notably the level of collision avoidance. As a consequence, care must be taken not to overstate the model outputs. Nevertheless, MADDERS & WHITFIELD (2006) pointed out that alternative methods for estimating collision risk are less transparent or more subjective and at least vulnerable to the same potential biases. In contrast, CHAMBERLAIN *et al.* (2006) suggest that the value of the BAND collision risk model in estimating actual mortality rates is questionable until species-specific and state-specific avoidance probabilities can be better established. Therefore, the authors do not recommend the use of the model without further research into avoidance rates. LANGSTON & PULLAN (2004) sum up that collision risk models provide a potentially useful means of predicting the scale of collision attributable to wind turbines in a given location, but only if they incorporate actual avoidance rates in response to fixed structures and post-construction assessment of collision risk at wind farms that do proceed, to verify the models.

In summary, it is very difficult for several reasons to assess collision risk as well as avoidance behaviour, which might lead to increased energy expenditure caused by a proposed wind power plant within the study area. Thus, the following impact assessment should be regarded as a rough qualitative prediction of possible impacts, which needs to be specified by further field investigations in bird-wind turbine interactions (post-construction monitoring) at the Red Sea coast.

## 6.2 Assessment of Possible Impacts on Large Migrating Birds

### 6.2.1 Predicting and Assessing the Weight of Collision Risk

Spring migration

In spring 2010, migratory activity at altitudes below 200 m was (very) high in large parts of the study area. Though there is not always a strict correlation between abundance of birds and collision rate (see Chapter 5.1.1), it is reasonable to assume that collision risk is higher in areas with high bird densities. Consequently, collision rates leading to additional mortality potentially causing significant population effects for some species cannot be excluded when building wind farms within these parts of the study area (mainly the eastern and south-eastern parts: sites G and H).

Collision rates, which might have significant population effects, cannot be excluded for White stork, and White pelican (and possibly for Honey buzzard, too) despite their comparably high levels of total population. As relevant numbers of these species were recorded at lower levels, these birds might come into the range of the rotors and hence face the risk of collision. On the other hand, as large flocks seem to avoid wind turbines at greater distances, collisions of White storks and White pelicans, usually migrating in large flocks, should occur very rarely. Yet if a flock does enter a wind farm, then a great number of victims can be expected.

According to the relatively high number of Griffon vulture fatalities in Spanish wind farms, indicative of the absence of avoidance behaviour, a relevant collision risk must be expected for Egyptian vulture, too. Moreover, Egyptian vultures mostly fly passively, strongly depending on thermals.

An effect on Eagle populations, especially on Steppe Eagle, seems not to be unlikely, because Eagles are very passive fliers. On the other hand, at the western coast of the Gulf of Suez, the majority of Eagles tend to migrate at altitudes well above 100 m (Figure 3.4; see also ORNIS CONSULT 2002, BERGEN 2007). Thus, it can be assumed that most birds do not come close to the area swept by the rotors of wind turbines (assuming a maximum turbine height of about 120 m), so that collisions occur rarely despite the comparably low manoeuvrability by Eagles. (Note that this might be completely different at breeding sites of Eagles, as known from wind farms in Europe; see FOLLESTAD *et al.* 2007, BEVANGER *et al.* 2008 & 2010, DÜRR unpubl.)

Wind farms within the study area are not believed to affect populations of Harriers, and thus of Pallid harrier. Collision risk seems to be very low for Harriers because they often migrate below the area swept by the rotors of wind turbines. In fact, in different wind farms in the United States, no (or only very few) fatalities were recorded for Northern harrier, which frequently hunts below the 9 m minimal blade height (STERNER *et al.* 2007). In Germany too only twelve Harriers were found after collision with a turbine until now (DÜRR unpubl., 28.06.2011). Bearing in mind that migration of Harriers is not concentrated to the study area, additional mortality caused by wind turbines is not believed to have population effects.

It is unlikely that wind farms within the study area will affect populations of Lesser kestrel or other Falcons, because these species are very active fliers (Table 5.1) and migrate on a large front and thus are not concentrated within the study area. Nevertheless, a possible absence of avoidance behaviour, like investigations indicate for Common kestrel, might increase the risk of collision.

Conditions of poor visibility are not supposed to be a major factor increasing collision rate within the concessionary area (see also BAHA EL DIN 1996).

To conclude, bearing in mind the uncertainty of predictions and the critical conservational status of some species, establishing wind farms in large parts of the study area might include a notable risk potential for some populations.

Autumn migration

As migratory activity in autumn was very low, collision risk is not assumed to pose a major threat for migrating birds. Single collisions at wind farms within the study area might occur even during autumn, but the expected collision rate will not cause significant effects on the populations. Thus, collisions at wind turbines within the study area during autumn are not regarded to have a significant impact on migrating birds.

### 6.2.2 Predicting and Assessing the Weight of Barrier Effects

While avoidance behaviour reduces collision risk, it could result in wind farms acting as barriers to bird movement (*e.g.* DREWITT & LANGSTON 2006).

Birds might change horizontal flight direction in order to avoid a wind farm, which obviously leads to additional energy expenditure. Assuming a 5 km long string of wind turbines located perpendicular to a bird's flight path, we assume that the additional flight distance caused by avoiding the wind power plant will not be much more than 5 km. It cannot be excluded that this decreases the fitness of individuals (especially when already weakened), but considering the efforts of migration it seems unlikely that a relevant number of birds is affected, for instance:

- White storks need between 8 to 15 weeks to cover a total distance of 10,000 km or more between breeding and wintering area. The average length of daily migration varies between 150 and 300 km.
- In Israel, Egypt and Sudan, average distance of daily migration of two tracked Lesser spotted eagles was 207 km (MEYBURG *et al.* 2001). For the entire northward migration (more than 8,000 km) it took a bird about 8 weeks. The average daily flight distances of Lesser spotted eagles varies between 144 km and 214 km per day (MEYBURG *et al.* 2004a). In 2006 MEYBURG & MEYBURG (2009) tracked a Lesser spotted eagle, which migrated 379 km in 6.5 hours with an average speed of 58 km/h and an maximum speed of 114 km/h.

Furthermore, Meyburg *et al.* (2002) recorded an adult female of Lesser spotted eagle that initially migrated to the southern point of the Sinai Peninsula in 1997. One day after arrival it changed direction and flew 280 km northwest along the eastern coast of the Red Sea straight to Suez. In 1998 it repeated the detour to the southern tip of the Sinai Peninsula and back north to Suez. The reasons why the bird did not cross the Gulf from the southern tip of Sinai (which is about 66 km wide at this point) but took a detour of 500 km, remain unclear. Unfortunately, no information about the bird's breeding output is given in Meyburg *et al.* (2002).

- Extremely long stretches were recorded of an Egyptian vulture that flew through southwest Egypt, northwest Sudan and northeast Chad a total of 1,017 km in two days (Meyburg *et al.* 2004b). The average migration path within another period of seven days was 185 km per day.

Thus, an additional flight path of 5 km seems unlikely to have a relevant impact on a bird's fitness. Moreover, there is no need to assume that an additional flight path would be covered unexceptionally by active flight, consuming much more energy than gliding.

Another option to avoid a wind power plant is to change altitude (mostly by increasing) and subsequently to migrate above the critical zone of the wind turbines. Thermals are not believed to be a limiting factor within the study area. There should be a number of vertical air currents allowing birds to gain altitude. Hence, there is no reason to assume that increasing altitude will only be accomplished by active flight.
Since weather conditions (especially wind speed and direction) should be nearly the same within the whole study area, we do not expect that birds will face additional headwinds or other unfavourable conditions as a consequence of avoiding a wind farm.

In summary, although the degree of additional energy expenditure cannot be estimated precisely, it seems unlikely that avoidance behaviour might produce a significant effect on populations (see also Masden *et al.* 2009). However, as some uncertainty remains, mitigation measures should be implemented in order to minimize possible impact. Furthermore, cumulative effects, which might result from the installation of several wind farms at the Gulf of Suez should be accounted for (Masden *et al.* 2010). It is of great importance to avoid those cumulative effects by installing appropriate mitigation measures, and to ensure that the weight of possible barrier effect remains at a safe level (see Chapter 6.4).

## 6.3 Synopsis — Final Assessment

Langston & Pullan (2004) pointed out that, as a precautionary measure, it should be avoided to locate a wind power plant at international or national sites for nature conservation or other areas with large concentrations of birds, such as points of migration crossings. According to Percival (2005) it is important to avoid developing wind farms at sites i) with high-density raptor populations where collisions could be significant, and ii) with high densities of other species vulnerable to a low level of additional mortality where their susceptibility to wind turbine collision may be high.

The results of the resent investigation clearly show that parts of the study area are of international importance for bird migration in spring. Some species migrating through the study are of international conservational concern; a number of other species are of European or national conservational concern. Hence, collision rates leading to additional mortality potentially causing significant population effects for some species cannot be excluded when building wind farms in the entire study area. However, the results of the investigation indicate a gradual increase of migratory activity at relevant altitudes from West to East within the study area. Thus, an impact assessment of different parts of the study area due to the spatial differences in bird migration observed in spring 2010 seems to be feasible. In accord with the importance of the area for migration and hence according to the strength of expected environmental impact, the study area can be subdivided into the three following zones:

- Zone I

  Zone I covers an area of about 53 km$^2$ (see Figure 6.1) and encompasses the north-western part of the study area (sites A and B) where migratory activity at altitudes below 200 m was lowest in spring 2010 (Figure 4.6). Although this part is of general importance for migration (Figure 4.7), a relevant collision risk for migrating birds in spring is not expected if technical avoidance and mitigation measures to the best standard practice are maintained (Chapter 6.4.2).

  However, it is strictly recommended to implement a post-construction monitoring programme for wind farms in Zone I to assess whether impacts of wind farms remain at an acceptable level, or whether additional measures are necessary to minimize or eliminate unacceptable impacts.

- Zone II

  Zone II consists of parts of the study area in the northeast (site E), in the middle (sites C and F) and in the southwest (site D) and has a size of about 67 km$^2$ (see Figure 6.1). According to results of the investigation, Zone II is highly significant for bird migration. Considering the huge number of birds migrating at altitudes below 200 m, it cannot be excluded that collision risk at wind farms in Zone II will pose a significant threat for migrating birds.

Consequently, the expected impact of wind farms in Zone II is unacceptable. However, collision risk is restricted to:

a. turbines under operation,
b. a rather small period of the year (main migration period in spring lasts from the begin of March to the mid May) and
c. a certain time of day (migration of soaring birds starts when appropriate thermal uplifts are available)

These considerations hint at appropriate countermeasures for reducing collision risk to an acceptable level. If turbines do not operate during the period of highest migration, collision risk for migrating birds is minimized. Thus, construction of wind turbines within Zone II is recommendable if an effective shutdown programme is developed and established (see Chapter 6.4.2). Moreover, implementation of a post-construction monitoring programme for wind farms in Zone II is crucial to ensure that the shutdown programme meets its goals and to decide whether additional measures are necessary to minimize or eliminate unacceptable impacts.

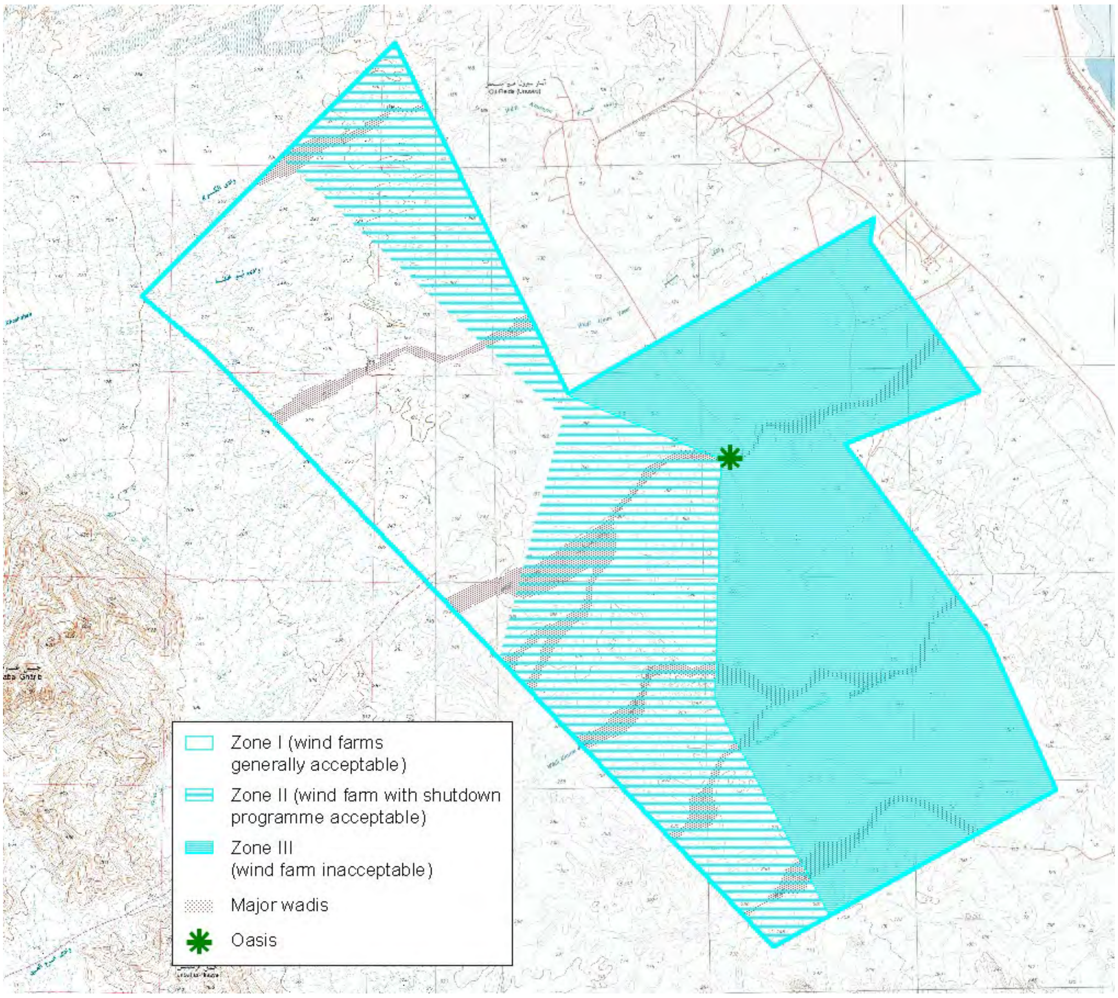



Figure 6.1: Results of the impact assessment of different parts of the study area due to the spatial differences in bird migration observed at altitudes below 200 m in spring 2010

- Zone III

  Zone III consists of the eastern and south-eastern parts of the study area (sites G and H) and has a size of about 88 km$^2$ (Figure 6.1). The results of the investigation clearly show that Zone III is of extreme significance for bird migration in spring. Consequently, collision rates leading to additional mortality potentially causing significant population effects for some species cannot be excluded when building wind farms in Zone III. The expected impact of wind farms therefore is unacceptable and hence the construction of wind farms has to be strictly banned within Zone III.

  Even shutdown programmes have to be regarded as being incapable of reducing impacts of wind farms in Zone III to an acceptable level, because significant cumulative impacts with other wind farms are likely.

## 6.4 Mitigation Measures

### 6.4.1 Current Knowledge

As a general recommendation, mitigation measures developed to avoid impacts should be given priority over those that reduce impacts or compensate for impacts. Apparently a key factor in avoiding impacts is a careful turbine placement (macro-siting), that is to say, ensuring that key areas of conservational importance and sensitivity are avoided.

JOHNSON *et al.* (2007) distinguish between three primary types of mitigation measures to reduce collision risk at wind turbines: modifying the siting of entire wind farms as well as placement of individual turbines, modification of turbines and other wind power plant structures and modification of habitats. Following JOHNSON *et al.* (2007) one can differentiate between:

<u>Modification of the siting of entire wind farms as well as placement of individual turbines</u>

First, a reasonable siting of wind farms is crucial to prevent unacceptable impacts. This includes avoiding critical areas, *i.e.* areas with very high migratory activity at altitudes below 200 m of species that are of conservational concern.

DREWITT & LANGSTON (2006) recommend avoiding alignment of turbines perpendicular to main flight paths of birds and providing corridors between clusters, aligned with main flight trajectories, within large wind farms. Also HÖTKER (2005) and EXO *et al.* (2005) suppose that maintaining gaps within large wind power plants could decrease impacts. Gaps might enable migrating birds to avoid turbines and to pass a large wind power plant safely. Consequently, shorter turbine strings may mitigate a barrier effect (DE LUCAS *et al.* 2007). Hence, implementing escape corridors might allow birds to leave the wind farm area in a safe way and without larger efforts. At the Red Sea, this might be particularly

important in spring when birds face strong headwinds and have to struggle continuously to migrate further northwest (see Chapter 6.4.2).
However, effects of such corridors need to be examined and tested (LANGSTON *et al.* 2006).

ORLOFF & FLANNERY (1992) reported that end-row turbines had higher fatality rates than turbines within strings. Also, SMALLWOOD & THELANDER (2004) found that wind turbines were most dangerous at the ends of turbine strings, at the edge of gaps in strings, and at the edges of clusters of wind turbines. Other studies found no significant difference in the rate of mortality at end-row versus other turbine locations (*e.g.* HOWELL & NOONE 1992, THELANDER & RUGGE 2001). Higher collision rates found at end-row turbines might be related to topographical features (ridges, slopes or hill shoulders), where turbine strings end, or to other factors (prey availability).
The CALIFORNIA ENERGY COMMISSION (2002) indicated that turbines spaced closely together might enhance collision risk by making it more difficult for large birds to clear the space between blades. BARRIOS & RODRIGUEZ (2004) found most fatalities and risk situations at two strings with little space between consecutive turbines, indicating that more space might reduce collision risk.
Overall, the relationship between spatial configuration of turbines and higher fatalities (including impacts of end-row versus mid-row turbines, differently sized gaps between turbines in a string, and clustering versus open configurations) remains uncertain (STERNER *et al.* 2007).

Modification of turbines
Perching by raptors on wind turbines has been implicated in higher rates of mortality (ORLOFF & FLANNERY 1992). Although not all investigations support this assumption (*e.g.* THELANDER & RUGGE 2000, SMALLWOOD & THELANDER 2004), installation of turbines with tubular towers and avoiding other structures suitable for perching are simple measures to reduce raptor activity within an area and hence collision risk.

Due to the large area swept by a rotor, collision risk is believed to be higher at taller turbines. Nevertheless, ORLOFF & FLANNERY (1992) found no relationship between height of turbines and risk of collision. Furthermore, in other studies shorter turbines appear to have even higher collision rates (CALIFORNIA ENERGY COMMISSION 2002). Obviously, other factors (slope, topography, proximity to prey, species concerned, status of species (breeding, resting, migrating)) all play a more important role for collision mortality (see also HÖTKER 2006). Thus, regarding turbine height, mitigation measures should be site-specific and dependent on the group of species most likely at risk (JOHNSON at al. 2007).
Lighting of turbines is believed to increase the risk of collision on man-made structures by attracting and disorientating birds (*e.g.* DREWITT & LANGSTON 2006). This is mostly a problem for nocturnal migrants (primarily passerines) during conditions of poor visibility. According to UGORETZ (2001), birds are more sensitive to and even appear attracted by red light. Quickly flashing white strobe lights appear to be

less attractive. The consensus among researchers is to avoid lighting turbines when and where possible (JOHNSON *et al.* 2007). If lighting is crucial, the current recommendation is to use the minimum number of intermittent flashing white lights of lowest effective intensity (DREWITT & LANGSTON 2006).

Research with captive American kestrels (*Falco sparverius*) and Red-tailed hawks indicates that painting turbine blades can increase blade visibility in a variety of conditions. Based on experiments with several patterns painted on blades, MCISAAC (2001) recommended a pattern with square-wave black-and-white bands that run across the blade. HODOS (2003) have proposed that motion smear may reduce the ability of raptors and other birds to see turbine blades. Thus, motion smear might be a reason for collisions during daytime, in which the visual faculty of birds is actually good. Motion smear primarily occurs at the tips of the blades, and may make blades virtually transparent at high velocities. Anti-motion smear patterns may increase the visibility of turbine blades at distances at which raptors could still safely manoeuvre away from them. Studies with captive raptors indicate that a single, solid black blade paired with two white blades (or a single-blade, thin-stripe pattern) is the most visible stimulus (HODOS 2003).
Since most diurnal birds, including raptors, seem to be able of detecting Ultra Violet (UV) light, there have been efforts to reduce collision risk by painting turbine blades with UV reflective paint (KREITHEN & SPRINGSTEEN 1996, MCISAAC & KREITHEN 1996, see also JOHNSON *et al.* 2007). However, YOUNG *et al.* (2003), who tested this hypothesis in the wind plant of Foot Creek Rim (Wyoming) found no evidence that there is a difference in bird use, collision risk or mortality (which was generally low) between turbine blades with a UV-light reflective paint and those covered conventionally.

Scare or warning devices that emit sounds have been used at airports or agricultural fields to deter birds. Most studies of these devices have found that birds become habituated to the devices, reducing the long-term effectiveness of these techniques (JOHNSON *et al.* 2007). However, migrating birds are unlikely to habituate to sounds. Whether deterrent devices (see for instance www.dtbird.com) are an effective measure to reduce impacts for wind farms has yet to be examined.

Finally, for certain problematic turbines associated with unacceptable mortality due to their location or other factors, the only suitable form of mitigation may be removal of the these turbines.

Modification of operation of turbines

If there are a few critical turbines within a large wind farm or if collision risk is limited to certain (short) periods of time, a temporal shutdown of critical wind turbines might be another option to reduce or eliminate bird collisions (*e.g.* LANGSTON *et al.* 2006).

A relatively new attempt to prevent collisions is to use radar systems originally developed for NASA and the US Air Force (MCDERMOTT 2009). The intent is to detect approaching birds from as far as 6.0 km away, to analyze weather conditions, and to determine the risk of collision in real time. If a relevant collision risk exists, the turbines are programmed to shutdown, restarting once the birds have passed. This new radar technology is currently tested at the 202 MW large Peñascal wind farm in Texas. A successfully operating SOD programme was established in a wind farm in Mexico (La Venta II). Moreover, an effective shutdown programme controlled by observers is currently used at the wind farm "Parque eólico de Barão de S. João" in Potugal (TOMÉ unpubl.).

Modification of habitats

Several authors (*e.g.* JOHNSON *et al.* 2007, STERNER *et al.* 2007) recommend the following habitat modifications in order to minimize impacts:

- avoid natural or artificial perching sites;
- avoid establishing wind farms in areas with high natural food sources;
- avoid structures within a wind power plant that might attract birds (*e.g.* waste dump);
- reduce local food sources (as a management option in some wind farms).

Since the study area is neither a breeding nor a feeding area for relevant species, modification of habitat does not seem to be an appropriate measure to minimize impacts, and hence needs no detailed consideration. However, even at the Red Sea, areas that would attract migrating birds should not be established in the surrounding of coming wind farms.

Other mitigation measures

Apart from modification of turbines, DREWITT & LANGSTON (2006) recommend installing transmission cables underground (especially in areas of high bird concentrations) and to mark overhead cables using deflectors or so-called bird flappers.

### 6.4.2 Final Recommendations with regards to Mitigation Measures

Construction and operation of wind farms within the entire study area will lead to significant impacts on migrating birds in spring. To reduce significant impacts the following mitigation measures are required:

- Avoid wind farm development in the eastern and south-eastern parts of the study area which are extremely important for bird migration in spring. The expected impact of wind farms on migrating birds is therefore unacceptable and hence the construction of wind farms has to be strictly banned within Zone III (Figure 6.1).
- In order to reduce the expected risk of collision and barrier effects for migrating birds at wind farms within Zone II (Figure 6.1) an effective shutdown programme has to be developed and established for the spring migration period. With regard to the development of such a shutdown programme, a two-step approach is conceivable:
  - A *fixed shutdown* (FS) programme stopping all turbines from March, 1st to May, 18th during daytime (1 hour after sunrise to 1 hour before sunset). Based on long term wind data, the expected energy loss caused by such a FS-programme is estimated to be about 10 % (JV LAHMEYER INTERNATIONAL & ECODA 2011).
  - Improve the FS-programme and develop a *shutdown-on-demand* (SOD) programme. Applying the SOD-programme should stop all turbines during times of high migratory activity and when large flocks approach the wind farm. Within the SOD-programme a monitoring of bird migration in spring (*e.g.* March, 1st to May, 18th) carried out by experienced ornithologists is required (probably using radar technology). The ornithologists should stay in close contact with the engineering office in charge of monitoring the operation of the wind farms, so that the wind farm can be shutdown rapidly if required.

    On the basis of long term wind data and bird migration data obtained in spring 2010, the expected energy loss caused by such a SOD programme is estimated to be about 2 % (JV LAHMEYER INTERNATIONAL & ECODA 2011). As the criteria for shutting down times were defined rather conservatively, the total energy loss to be expected is less than 2 %. The criteria were selected on the basis of the recent investigation. For coming wind farms new criteria have to be defined and should then be improved continuously.

  Assuming that effective FS- or SOD-programmes are established, wind farms within Zone II are not expected to lead to a relevant collision risk or barrier effect for migrating birds in spring. Nonetheless, technical avoidance and further mitigation measures according to best standard practices are required (see below).
- The expected risk of collision and barrier effects for migrating birds at wind farms within Zone I during spring have to be reduced by effective measures, *i.e.* either
  - by implementing an escape corridor: The escape corridor should have a width of about 1 km and should be orientated in parallel to the main wind direction, *i.e.* northwest to southeast. A

corridor will allow birds to leave the wind farm area in a safe way and without larger efforts. This is particularly important in spring when birds face strong headwinds and have to struggle continuously to migrate further northwest. As gliding birds lose altitude, especially in a headwind situation, they are forced to gain height by circling and soaring in thermal uplifts. During soaring, which usually lasts several minutes but can take half an hour or more, birds drift with the wind to the southeast. This might be critical if birds drift to a row of operating turbines. Sometimes birds even give up struggling against the strong headwinds and go with the wind in south-eastern direction. In these situations an escape corridor is an effective measure to give birds an opportunity to escape the wind farm area. Zone I has an average width of 4.8 km and an average length of about 11.0 km. One escape corridor reaching from northwest to southeast should be implemented in the middle of Zone I.

or, alternatively,

- o by establishing a shutdown programme (see above), if implementation of an escape corridor is not a favorable option for economic or other reasons. Applying a shutdown-on-demand programme is recommendable, if it was proved to be effective and operating sustainably, and if it was in accordance with the requirements of the Load Dispatch Center.

- If implementation of an escape corridor through Zone I is intended, a concentration of migrating birds can be expected within the corridor area during spring (when birds face strong headwinds and are drifted with the wind to the southeast or when birds give up struggling against strong headwinds and go with the wind in south-eastern direction) and possibly during autumn, too. Hence, to reduce collision risk and barrier effect for migrating birds the corridor through Zone I has to be expanded in south-eastern direction through Zone II. If, alternatively, a shutdown programme will be applied for wind farms within Zone I (but no escape corridor), an escape corridor through Zone II is dispensable. It is known that barrier effect is higher at operating turbines than at non-operating turbines (*e.g.* WINKELMAN 1992).
- Avoid wind turbines with a total tip height of more than about 120 m.
- Avoid lighting of turbines. If lighting of turbines is absolutely required (to meet aviation requirements of the civil and military aviation authority), use the minimum number of intermittent flashing white lights of lowest effective intensity (DREWITT & LANGSTON 2006).
- Paint turbine blades to increase blade visibility by using blades with black and white aviation markings (see also HODOS *et al.* 2003).
- Avoid turbines with lattice towers in order to reduce suitable perching sites.
- Avoid establishing areas that would attract migrating birds (waste dump, open water bodies, gardens or houses with vegetation).
- Build the internal wind park grid by underground MT cables. If the use of overhead lines cannot be avoided (*e.g.* 220 kV OHL), such overhead lines should be designed according to the guidelines

"Protecting birds from power-lines, Nature and environment No. 140, Council of Europe Publishing". Analogous measures should be applied at any substation to be built in that area.

- The Red Sea coast is a unique site for bird migration and hence results from other studies cannot necessarily be transferred. Furthermore, bird-wind turbine interactions, especially collision risk and barrier effect, are poorly understood. Due to the lack of knowledge about behaviour of large soaring birds in the vicinity of wind turbines, the predicted impacts and their magnitude are subject to a certain degree of uncertainty. Consequently, apart from mitigation measures, a thorough post-construction monitoring programme should be implemented for at least the first two years during main migration periods (2.5 months in spring and 2.0 months in autumn) to assess whether impacts of wind farms in Zone I and Zone II remain at an acceptable level, or whether additional measures are necessary to minimize or eliminate unacceptable impacts. In doing so, cooperation with national and international environmental organizations is recommended.

  The main purposes of the post-constructing monitoring programme are:

  - Verification of the assumptions made within the impact assessment and determination of significant deviations from predicted impacts.
  - Testing the effectiveness of mitigation measures (*e.g.* painting blades, shutdown programme or usage of corridors by migrating birds).
  - Identification of possible critical wind turbines and definition of further operational mitigation measures.
  - Determination of the weight and significance of proposed impacts (especially collision rates).
  - Examination of the behaviour of migrating birds in the vicinity of the proposed wind farm and determination of species-specific avoidance responses.
  - Examination of conditions in which collisions occur and the cause-and-effect chain of collisions.

  Important references for an adequate monitoring programme can be found in National Wind Coordinating Committee (1999), Drewitt & Langston (2006), Band *et al.* (2007), Bergen 2007, Follestad *et al.* 2007, Morrison *et al.* (2007) or Strickland *et al.* (2007).

# 7 Summary

The New and Renewable Energy Authority (NREA) under the Ministry of Electricity and Energy has developed plans for several wind farms along the western bank of the Gulf of Suez. The Gulf of Suez, especially the area near Gabel el Zayt, is well known as a bottleneck for migrating birds. Large numbers of birds pass the area twice a year during spring and autumn migration. Hence, installing large wind farms at the Gulf of Suez may lead to significant impacts on migrating birds caused by collisions with turbines or — to a lower degree — by barrier effects. Since there is no comprehensive understanding on the amount and the spatial distribution of migratory activity at the Red Sea Coast between Zafarana and Ras Shukeir, an ornithological investigation was realized during spring and autumn 2010 by the Joint Venture Lahmeyer International GmbH & ecoda Environmental Expert Opinion. The ornithological investigation is part of the "Environmental Social and Impact Assessment (ESIA) for 1,000 MW Wind Farms at Gulf of Suez".

The area suggested for 1,000 MW wind farms (study area) is located about 12 km west of Ras Shukeir and has a size of about 200 km$^2$. It has a length of about 22 km from northwest to southeast and an average width of about 9 km. To the west it is framed by the foothills of the Red Sea Mountains.

The main purposes of the ornithological investigation are i) to collect baseline data on migrating birds (mainly soaring and gliding species migrating during the day), ii) to describe migration patterns of relevant species in a quantitative way, iii) to identify and assess possible impacts regarding development of wind power within the study area and finally iv) to recommend mitigation measures in order to minimize possible conflicts.

In spring high numbers of large migrants passed trough the study area: During standardized field observations 177,516 birds from 28 relevant species were observed within 792 hours. The observed numbers of White stork constitute about 15 % of the total flyway population of this species. For five other species more than 5 %, and for seven other species more than 1 % of the total flyway population occurred within the study area (among these the globally endangered Egyptian vulture). The results clearly show that (at least parts of) the study area is of international importance for bird migration in spring. Despite the high number of migrants, during some periods there seemed to be no or only a low migratory activity of relevant species, indicating that migration within the concessionary area was i) distributed irregularly over time, and ii) dominated by large flocks. As a consequence, migratory activity showed a high variation at every as well as between different observation sites.
In contrast, in autumn migratory activity was much lower. A total of 25,942 migrants were recorded during 803 hours of observation. Note that only six flocks (of White storks and White pelicans) constitute more than 70 % of all recorded birds. Hence, over long periods of the investigation in

autumn, practically no bird migration was observed. To conclude, due to the very low migratory activity the study area is not believed to be of international importance for bird migration in autumn.

In spring, relevant numbers of the recorded birds migrated at altitudes below 200 m and hence might come into the critical zone of the area swept by rotors when wind farms will be established. Because of the high migratory activity (at least in particular parts of the study area) and the critical conservational status of some species, we cannot generally exclude collision rates leading to additional mortality, which in turn might cause significant population effects for some species (*e.g.* Egyptian vulture, White stork or White pelican). Currently it is not possible to give reliable quantitative estimates on the weight of species-specific collisions at a wind farm within the study area. Hence, bearing in mind the uncertainty of predictions, establishing wind farms in the entire study area will entail a noticeable risk potential for bird migration in spring.
In contrast, it seems unlikely that barrier effects caused by avoidance behaviour might produce significant effects on populations, although it is currently impossible to estimate the degree of additional energy expenditure. Furthermore, cumulative effects which might result from the installation of several wind farms at the Gulf of Suez should be taken into consideration.

In accord with the importance of the area for spring migration (focusing on migration at lower altitudes) and hence according to the strength of expected environmental impact, the study area can be subdivided into the three following zones:
Zone I covers an area of about 53 $km^2$ and encompasses the north-western part of the study area where migratory activity at altitudes below 200 m was lowest in spring 2010. A relevant collision risk for migrating birds in spring is not expected at wind farms in Zone I if technical avoidance and mitigation measures to the best standard practice are maintained.
Zone II consists of parts of the study area in the northeast, in the middle and in the southwest and has a size of about 67 $km^2$. Considering the huge numbers of birds migrating at altitudes below 200 m, it cannot be excluded that collision risk at wind farms in Zone II will pose a significant threat for migrating birds. However, collision risk is restricted to turbines under operation during a rather short period of the year (March to mid May) and to a certain time of day. If turbines do not operate during periods of highest migration, collision risk for migrating birds is minimized. Thus, construction of wind farms within Zone II is recommendable if an effective shutdown programme is developed and established.
Zone III consists of the eastern and south-eastern parts of the study area and has a size of about 88 $km^2$. The results of the investigation clearly show that Zone III is of extreme significance for bird migration in spring. Consequently, collision rates leading to additional mortality potentially causing significant population effects for some species cannot be excluded when building wind farms in

Zone III. The expected impact of wind farms is therefore unacceptable and hence the construction of wind farms has to be strictly banned within Zone III.

Finally, implementation of post-construction monitoring programmes for wind farms in Zone I and Zone II is crucial to assess whether impacts of wind farms remain at an acceptable level or additional measures are necessary to minimize or eliminate unacceptable impacts. Moreover, another purpose of post-construction monitoring programmes is to test the effectiveness of established shutdown programme and to ensure that this programme meets its goals.

# Final Declaration

We confirm that this report was prepared impartially and according to the best and latest state of knowledge. Data analysis was conducted with most possible accuracy.

Dortmund, June 30th 2011

Dr. Frank Bergen

# References

ALERSTAM, T. (1990): Bird migration. Cambridge University Press.

BAHA EL DIN (1996): Spring migration of birds at Ras Zaafarana, Egypt, with reference to risk from planned wind energy developments. Report submitted to the Danish Embassy in Cairo. June 1996.

BAHA EL DIN, M. (unpubl.): White Stork Migration in Egypt. [Available from http://www.bergenhusen.nabu.de/m03/m03_04/01681.html]

BAND, W. (2000): Windfarms and birds: Calculating a theoretical collision risk assuming no avoiding action. Guidance note series. Scottish Natural Heritage. [Available from http://www.snh.org.uk/pdfs/strategy/renewable/COLLIS.pdf]

BAND, W., M. MADDERS & D. P. WHITFIELD (2007): Developing field and analytical methods to assess avian collision risk at wind farms. In: DE LUCAS, M., G. F. E. JANSS & M. FERRER (2007): Birds and Wind Farms. Risk Assessment and Mitigation. p. 259-275. Quercus. Madrid.

BARCLAY, M. R., E. F. BAERWALD & J. C. GRUVER (2007): Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Can. J. Zool. 85: 381-387.

BARRIOS, L. & A. RODRIGUEZ (2004): Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology 41: 72-81.

BERGEN, F. (2007): Ornithological Investigation on Bird-Wind Power Interactions at a Wind Farm near Zafarana, Egypt. Report to DECON - Deutsche Energie-Consult Ingenieurgesellschaft mbH & New and Renewable Energy Authority (NREA). Dortmund. 36 pp.

BERGEN, F. (2009): Expert Opinion on the Additional Ornithological Investigation in Zone II (Orange Zone) as part of the Feasibility Study for a large wind farm at the Gulf of Zayt, Egypt. Final report for MVV decon GmbH. Dortmund. 71 pp. plus Annex

BIRDLIFE INTERNATIONAL (2005): BirdLife's online World Bird Database. IBA Factsheet EG031 Gebel El Zeit. [Available from http://www.birdlife.org /datazone/sites/index.html]

BIRDLIFE INTERNATIONAL (2007): BirdLife's online World Bird Database. [Available from http://www.birdlife.org/datazone/species/index.html]

BEVANGER, K., S. CLAUSEN, Ø. FLAGSTAD, A. FOLLESTAD, J. O. GJERSHAUG, D. HALLEY, F. HANSSEN, P. LUNF HOEL, K.-O. JACOBSEN, L. JOHNSEN, R. MAY, T. NYGÅRD, H. C. PEDERSEN, O. REITAN, Y. STEINHEIM & R. VANG (2008): Pre- and post-construction studies of conflicts between birds and wind turbines in coastal Norway. Progress Report 2008. NINA Report 409.

BEVANGER, K. F. BERNTSEN, S. CLAUSEN, E. L. DAHL, Ø. FLAGSTAD, A. FOLLESTAD, D. HALLEY, F. HANSSEN, L. JOHNSEN, P. KVALØY, P. LUND-HOEL, R. MAY, T. NYGÅRD, H. C. PEDERSEN, O. REITAN, E. RØSKAFT, Y. STEINHEIM, B. STOKKE & R. VANG (2010): Pre- and post-construction studies of conflicts between birds and wind turbines in coastal Norway (Bird-Wind). Report on findings 2007-2010. NINA Report 620.

CALIFORNIA ENERGY COMMISSION (2002): Golden Eagles In A Perilous Landscape: Predicting The Effects Of Mitigation For Wind Turbine Blade-Strike Mortality. Consultant Report prepared for Public Interest Energy Research (PIER) - Environmental Area. 52 pp. + Appendices.

CARLBRO (2010): Bird Migration Study El Zayt, Egypt. Report from bird migration studies autumn 2008 and spring 2009. Report for Italgen – Italcementi Group.

CHAMBERLAIN, D. E., REHFISCH, M. R., FOX, A. D., DESHOLM, M. & ANTHONY, S. J. (2006). The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. Ibis 148 (Suppl. 1): 198-202.

DE LUCAS, M., G. F. E. JANSS & M. FERRER (2004): The effects of a wind farm on birds in a migration point: the Strait of Gibraltar. Biodiversity and Conservation 13: 395-407.

DE LUCAS, M., G. JANSS & M. FERRER (2007): Wind farm effects on birds in the Strait of Gibraltar. In: DE LUCAS, M., G. F. E. JANSS & M. FERRER (2007): Birds and Wind Farms. Risk Assessment and Mitigation. p. 219-228. Quercus. Madrid.

DESHOLM, M. & J. KAHLERT (2005): Avian collision risk at an offshore wind farm. Biol. Lett. The Royal Society. 3 pp.

DESHOLM, M. (2006): Wind farm related mortality among avian migrants — a remote sensing study and model analysis. PhD thesis. Dept. of Wildlife Ecology and Biodiversity, NERI, and Dept. of Population Biology, University of Copenhagen. National Environmental Research Institute, Denmark. 128 pp.

DIRKSEN, S., A. L. SPAANS, J. VAN DER WINDEN & L. M. J. VAN DEN BERGH (1998): Nachtelijke vliegpatronen en vlieghoogtes van duikeenden in het Ijsselmeergebied. Limosa 71: 57-68.

DREWITT, A. L. & R. H. W. LANGSTON (2006): Assessing the impacts of wind farms on birds. Ibis 148: 29-42.

DÜRR, T. (unpubl.): Vogelverluste an Windenergieanlagen in Deutschland. Daten aus der zentralen Fundkartei der Staatlichen Vogelschutzwarte im Landesumweltamt Brandenburg. Stand: 07. Juni 2007.

ECODA (2007): Ornithological Expert Opinion as a part of the Feasibility Study for a large wind farm at Gulf of Zayt, Egypt. Unpubl. report for DECON GmbH. November 5th 2007. Dortmund.

EL GHAZI, A. & F. FRANCHIMONT (2001). Evaluation de l'impact du parc éolien d'Al Koudia Al Baïda (Peninsule Tingitane, Maroc) sur l'avifaune migratrice post-nuptiale. GOMAC & ABIES, Gardouch.

ERICKSON, W. P., G. D. JOHNSON, M. D. STRICKLAND, D. P. YOUNG JR., K. J. SERNKA & R. E. GOOD (2001): Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. Report by Western EcoSystems Technology, Inc. for National Wind Coordinating Committee. 62 pp.

EVERAERT, J., K. DEVOS & E. KUIJKEN (2002): Windturbines en vogels in Vlaanderen. Voorlopige onderzoeksresultaten en buitenlandse bevindingen. Rapport Instituut voor Natuurbehoud. R.2002.03. Brussel. 76 pp.

EVERAERT, J. & E. W. M. STIENEN (2007): Impact on wind turbines on birds in Zeebrugge (Belgium). Significant effect on breeding tern colony due to collision. Biodivers. Conserv. 16: 3345-3359.

EXO, K.-M., T. DITTMANN, B. RADDATZ & F. BAIRLEIN (2005): Mögliche Beeinträchtigungen der Vogelwelt durch einen nahe Tanger (Marokko) geplanten Windpark: II. Untersuchungen zur Zeit des Frühjahrszuges 2005. Institut für Vogelforschung „Vogelwarte Helgoland" im Auftrag von Office National de l'Electricite vertreten durch die Kreditanstalt für Wiederaufbau. Wilhelmshaven. 44 pp. + Appendices.

FOLLESTAD, A., Ø. FLAGSTAD, T. NYGÅRD, O. REITAN & J. SCHULZE (2007): Wind power and birds at Smøla 2003-2006. - Norsk institutt for naturforskning, NINA Report 248. 78 pp.

FOX, A. D., M. DESHOLM, J. KAHLERT, T. K. CHRISTENSEN & I. K. PETERSEN (2006): Information needs to support environmental impact assessment of the effects of European marine offshore wind farms on birds. Ibis 148: 129-144.

HODOS, W. (2003): Minimization of Motion Smear: Reducing Avian Collisions with Wind Turbines. Report for National Renewable Energy Laboratory. 33 pp.

HÖTKER, H. (2006): Auswirkungen des „Repowering" von Windkraftanlagen auf Vögel und Fledermäuse. MICHAEL-OTTO-INSTITUT IM NATURSCHUTZBUND DEUTSCHLAND (Hrsg.). Untersuchung im Auftrag des Landesamtes für Natur und Umwelt des Landes Schleswig-Holstein.

HOWELL, J. A. & J. E. DI DONATO (1991): Assessment of the avian use and mortality related to wind turbine operations: Altamont Pass, Alameda and Contra Costa Counties, California. Final Report prepared for Kenentech Windpower. 72 pp.

HUNT, G. (1995): A Pilot Golden Eagle Population Study in the Altamont Pass Wind resource Area California. Report for National Renewable Energy Laboratory. 218 pp.

JANSS, G. (2000): Bird Behaviour In and Near a Wind Farm at Tarifa, Spain: Management Considerations. In: NATIONAL WIND COORDINATING COMMITTEE (NWCC): Proceedings of the National Avian - Wind Power Planning Meeting III. p. 110-114.

JOHNSON, G. D., M. D. STRICKLAND, W. P. ERICKSON & D. P. YOUNG JR. (2007): Use of data to develop mitigation measures for wind power development impacts on birds. In: DE LUCAS, M., G. F. E. JANSS & M. FERRER (2007): Birds and Wind Farms. Risk Assessment and Mitigation. p. 241-258. Quercus. Madrid.

JOHNSON, G. D., W. P. ERICKSON, M. D. STRICKLAND, M. F. SHEPHERD & D. A. SHEPHERD (2000): Avian monitoring studies at the Buffalo Ridge, Minnesota Wind Resource Area: results of a 4-year study. Final report. Northern States Power Company, Minneapolis. 62 pp.

JV LAHMEYER INTERNATIONAL & ECODA (2011): Short Production Loss Estimate: Shutdown during Bird Migration in Spring. 200 km2 Wind Farm Development Area at Gulf of Suez. Unpubl. Report on behalf of NREA/KfW. March 28th 2011.

KREITHEN, M. L. & A. SPRINGSTEEN (1996): Development of an optical painted pattern designed to reduce avian collisions with obstacles. 2nd International Conference on Raptors 1996. Urbino, Italy. S. 12.

LANGSTON, R. H. W. & J. D. PULLAN (2004): Effects of wind farms on birds. Nature and environment, no. 139. Council of Europe Publishing. 82 pp.

LANGSTON, R. H. W., A. D. FOX & A. L. DREWITT (2006): Conference plenary discussion, conclusions and recommendations. Ibis 148: 210-216.

LEKUONA, J. M. & C. URSÚA (2007): Avian mortality in wind power plants of Navarra (Northern Spain). In: DE LUCAS, M., G. F. E. JANSS & M. FERRER (2007): Birds and Wind Farms. Risk Assessment and Mitigation. p. 177-192. Quercus. Madrid.

MADDERS, M. & D. P. WHITFIELD (2006): Upland raptors and the assessment of wind farm impacts. Ibis 148 (Suppl. 1): 43-56.

MASDEN, E. A., D. T. HAYDON, A. D. FOX, R. W. FURNESS, R. BULLMAN, & M. DESHOLM (2009): Barriers to movement: impacts of wind farms on migrating birds. – ICES Journal of Marine Science, 66: 746–753.

MASDEN, E. A., D. T. HAYDON, A. D. FOX, R. W. FURNESS, R. BULLMAN, & D. T. HAYDON (2009): Cumulative impact assessments and bird/wind farm interactions: Developing a conceptual framework. Environmental Impact Assessment Review 30 (2010) 1–7.

MCDERMOTT (2009): Texas Wind Farm uses NASA Radar to prevent Bird Deaths. 28.11.2009. [Available from http://www.treehugger.com/files/2009/05/texas-wind-farm-uses-nasa-radar-prevent-bird-deaths.php]

MCISAAC, H. P. & M. L. KREITHEN (1996): Addressing the problem of raptor strikes with turbines in the Altamont Pass Wind Plant. 2nd International Conference on Raptors 1996. Urbino, Italy. S. 13.

MCISAAC, H. P. (2001): Raptor acuity and wind turbine blade conspicuity. In: NATIONAL WIND COORDINATING COMMITTEE (NWCC): Proceedings of the National Avian - Wind Power Planning Meeting IV. p. 59-87.

MEYBURG, B.-U., & C. MEYBURG (2007): Quinze années de suivi de rapaces par satellite. Alauda 75 (3): 265-286.

MEYBURG, B.-U., C. MEYBURG, T. BELKA, O. SREIBR & J. VRANA (2004a): Migration, wintering and breeding of a lesser spotted eagle (*Aquila pomarina*) from Slovakia tracked by satellite. J. Ornithol. 145: 1-7.

MEYBURG, B.-U., D. H. ELLIS, C. MEYBURG, J. M. MENDELSOHN & W. SCHELLER (2001): Satellite tracking of two Lesser Spotted Eagles, Aquila pomarina, migrating from Namibia. Ostrich 72 (1 & 2): 35-40.

MEYBURG, B.-U., J. MATTHES & C. MEYBURG (2002): Satellite-tracked Lesser Spotted Eagle avoids crossing water at the Gulf of Suez. British Birds 95: 372-376.

MEYBURG, B.-U., M. GALLARDO, C. MEYBURG & E. DIMITROVA (2004b): Migrations and sojourn in Africa of Egyptian vultures (*Neophron percnopterus*) tracked by satellite. J. Ornithol. 145: 273-280.

MEYBURG, B.-U., P. PAILLAT & C. MEYBURG (2003): Migration routes of steppe eagles between Asia and Africa: a study by means of satellite telemetry. The Condor 105: 219-227.

MEYBURG, B.-U., W. SCHELLER & C. MEYBURG (2000): Migration and Wintering of the Lesser Spotted Eagle *Aquila pomarina*: A Study by Means of Satellite Telemetry. Global Environ. Res. 4 (2): 183-193.

MORRISON, M. L., K. C. SINCLAIR & C. G. THELANDER (2007): A sampling framework for conducting studies of the influence of wind energy developments on birds and other animals. In: DE LUCAS, M., G. F. E. JANSS & M. FERRER (2007): Birds and Wind Farms. Risk Assessment and Mitigation. p. 101-116. Quercus. Madrid.

NATIONAL WIND COORDINATING COMMITTEE (1999): Studying wind energy / bird interactions: a guidance document. Metrics and methods for determining or monitoring potential impacts. Prepared for the Avian Subcommittee and NWCC. 76 pp. + Appendices

ORLOFF, S. & A. FLANNERY (1992): Wind turbine effects on avian activity, habitat use, and mortality in Altamont Pass and Solano County Wind Resource Areas 1989 - 1991. Final Report by BioSystems Analysis, Inc. to California Energy Commission.

ORNIS CONSULT (1999): Biodiversity review of the western Gulf of Suez. Prepared by M. BAHA EL DIN & F. P. JENSEN. Copenhagen, Denmark. 43 pp.

ORNIS CONSULT (2002): Atlas of bird migration at the Gulf of Suez, Egypt. Ministry of Foreign Affairs. DANIDA. Copenhagen, Denmark. 103pp.

OSBORN, R. G., K. F. HIGGINS, R. E. USGAARD, C. D. DIETER & R. D. NEIGER (2000): Bird mortality associated with wind turbines at the Buffalo Ridge Wind Resource Area, Minnesota. Am. Midl. Nat. 143: 41-52.

PERCIVAL, S. (2005): Birds and windfarms: what are the real issues? British Birds 98: 194-204.

PERCIVAL, S. M. (2000): Birds and wind turbines in Britain. British Wildlife 12: 8-15.

SMALLWOOD, K. S. & C. G. THELANDER (2004): Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area. Final Report by BioResource Consultants to the Energy Commission, Public Interest Energy Research-Environmental Area. 363 pp. + Appendices.

SMALLWOOD, K. S. & C. G. THELANDER (2008): Bird mortality in the Altamont Pass Wind Resource Area, California. Journal of Wildlife Management 72 (1): 215-223.

SMALLWOOD, K. S., L. RUGGE & M. L. MORRISON (2009): Influence of Behaviour on bird mortality in wind energy developments. Journal of Wildlife Management 73 (7): 1082-1098.

STERNER, D., S. ORLOFF & L. SPIEGEL (2007): Wind turbine collision research in the United States. In: DE LUCAS, M., G. F. E. JANSS & M. FERRER (2007): Birds and Wind Farms. Risk Assessment and Mitigation. p. 81-100. Quercus. Madrid.

STRICKLAND, D., W. ERICKSON, D. YOUNG & G. JOHNSON (2007): Selecting study design to evaluate the effect of windpower on birds. In: DE LUCAS, M., G. F. E. JANSS & M. FERRER (2007): Birds and Wind Farms. Risk Assessment and Mitigation. p. 117-136. Quercus. Madrid.

THELANDER, C. G. & K. S. SMALLWOOD (2007): The Altamont Pass Wind Resource Area's effects on birds: A case history. In: DE LUCAS, M., G. F. E. JANSS & M. FERRER (2007): Birds and Wind Farms. Risk Assessment and Mitigation. p. 25-46. Quercus. Madrid.

THELANDER, C. G. & L. RUGGE (2000): Avian Risk Behavior and Fatalities at the Altamont Wind Resource Area. Report by BioResource Consultans to National Renewable Energy Laboratory. 22 pp.

THELANDER, C. G. & L. RUGGE (2001): Examining relationships between bird risk behaviors and fatalities at the Altamont Wind Resource Area: a second year`s progress report. In: NATIONAL WIND COORDINATING COMMITTEE (NWCC): Proceedings of the National Avian - Wind Power Planning Meeting IV. p. 5-14.

TUCKER, V. A. (1996): A mathematical model of bird collisions with wind turbine rotors. Journal of Solar Energy Engineering 118: 253-262.

UGORETZ, S. (2001): Avian mortalities at tall structures. In: NATIONAL WIND COORDINATING COMMITTEE (NWCC): Proceedings of the National Avian - Wind Power Planning Meeting IV. p. 165-166.

WHITFIELD, D. P. & M. MADDERS (2006): Deriving collision avoidance rates for red kites *Milvus milvus.* Natural Research Information Note 3. Natural Research Ltd, Banchory, UK.

WINKELMAN, J. E. (1992): De invloed van de Sep-proefwindcentrale te Oosterbierum (Fr.) op vogels, 1: aanvaringsslachtoffers. RIN-rapport 92/2. DLO-Instituut voor Bos- en Natuuronderzoek. Arnhem.

YOUNG, D. P. JR., W. P. ERICKSON, M. D. STRICKLAND, R. E. GOOD & K. J. SERNKA (2003): Comparison of Avian Responses to UV-Light-Reflective Paint on Wind Turbines. Report by Western EcoSystems Technology, Inc. to National Renewable Energy Laboratory. 38 pp + Appendices.

# Annex

I Relevant species, which are known to migrate along the Red Sea coast

| no. | trivial name | scientific name | IUCN-Red List | SPEC |
|---|---|---|---|---|
| 1 | Levant sparrowhawk | Accipiter brevipes | Least Concern | 2 |
| 2 | Sparrowhawk | Accipiter nisus | Least Concern | Non-SPEC |
| 3 | Spotted eagle | Aquila clanga | Vulnerable | 1 |
| 4 | Eastern imperial eagle | Aquila heliaca | Vulnerable | 1 |
| 5 | Steppe eagle | Aquila nipalensis | Least Concern | 3 |
| 6 | Lesser spotted eagle | Aquila pomarina | Least Concern | 2 |
| 7 | Grey heron | Ardea cinerea | Least Concern | Non-SPEC |
| 8 | Purple heron | Ardea purpurea | Least Concern | 3 |
| 9 | Squacco heron | Ardeola ralloides | Least Concern | 3 |
| 10 | Cattle egret | Bubulcus ibis | Least Concern | Non-SPEC |
| 11 | Steppe eagle | Buteo buteo vulpinus | Least Concern | Non-SPEC |
| 12 | Long-legged buzzard | Buteo rufinus | Least Concern | 3 |
| 13 | White stork | Ciconia ciconia | Least Concern | 2 |
| 14 | Black stork | Ciconia nigra | Least Concern | 2 |
| 15 | Short-toed eagle | Circaetus gallicus | Least Concern | 3 |
| 16 | Marsh harrier | Circus aeruginosus | Least Concern | Non-SPEC |
| 17 | Pallid harrier | Circus macrourus | Near Threatened | 1 |
| 18 | Montagu's harrier | Circus pygargus | Least Concern | non SPEC[E] |
| 19 | Western reef heron | Egretta gularis | Least Concern | not evaluated |
| 20 | Lanner falcon | Falco biarmicus | Least Concern | 3 |
| 21 | Lesser kestrel | Falco naumanni | Vulnerable | 1 |
| 22 | Peregrine | Falco peregrinus | Least Concern | Non-SPEC |
| 23 | Barbary falcon | Falco pelegrinoides | Least Concern | Non-SPEC |
| 24 | Hobby | Falco subbuteo | Least Concern | Non-SPEC |
| 25 | Kestrel | Falco tinnunculus | Least Concern | 3 |
| 26 | Red-footed falcon | Falco vespertinus | Near Threatened | 3 |
| 27 | Common crane | Grus grus | Least Concern | 2 |
| 28 | Griffon vulture | Gyps fulvus | Least Concern | Non-SPEC |
| 29 | Booted eagle | Hieraaetus pennatus | Least Concern | 3 |
| 30 | Bee-eater | Merops apiaster | Least Concern | 3 |
| 31 | Blue-cheeked bee-eater | Merops persicus | Least Concern | Non-SPEC |
| 32 | Black kite | Milvus migrans | Least Concern | 3 |
| 33 | Egyptian vulture | Neophron percnopterus | Endangered | 3 |
| 34 | Night heron | Nycticorax nycticorax | Least Concern | 3 |
| 35 | Osprey | Pandion haliaetus | Least Concern | 3 |
| 36 | White pelican | Pelecanus onocrotalus | Least Concern | 3 |
| 37 | Honey buzzard | Pernis apivorus | Least Concern | non SPEC[E] |
| 38 | Flamingo | Phoenicopterus ruber | Least Concern | not evaluated |
| 39 | Spoonbill | Platalea leucorodia | Least Concern | 2 |
| 40 | Glossy ibis | Plegadis falcinellus | Least Concern | 3 |

IIa Explanation of different categories of "The IUCN Red List of Threatened Species" (International Union for the Conservation of Nature and Natural Resources) http://www.iucnredlist.org/)

ENDANGERED (EN)
A species is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A species is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A species is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A species is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant species are included in this category.

IIb Explanation of different categories of conservation status of all wild birds in Europe (BirdLife International) http://www.birdlife.org/action/science/species/birds_in_europe/index.html

SPEC 1
European species of global conservation concern

SPEC 2
Unfavourable conservation status in Europe, concentrated in Europe

SPEC 3
Unfavourable conservation status in Europe, not concentrated in Europe

NON-SPEC$^{E}$
Favourable conservation status in Europe, concentrated in Europe

NON-SPEC
Favourable conservation status in Europe, not concentrated in Europe

III Total number of birds / recordings (rec.) observed (overall migration), observed within the study area and observed within distances of 2.5 km to an observation site (obs. site) in spring 2010

| no. | species | overall migration | | within study area | | obs. site | |
|---|---|---|---|---|---|---|---|
| | | birds | rec. | birds | rec. | birds | rec. |
| 1 | Accipiter brevipes | 8846 | 35 | 5626 | 28 | 5626 | 28 |
| 2 | Accipiter nisus | 126 | 97 | 118 | 91 | 129 | 101 |
| | Accipiter spec. | 13 | 11 | 13 | 11 | 12 | 10 |
| 3 | Aquila clanga | 18 | 17 | 17 | 16 | 19 | 18 |
| 4 | Aquila heliaca | 73 | 31 | 73 | 31 | 40 | 34 |
| 5 | Aquila nipalensis | 2864 | 792 | 2753 | 739 | 2991 | 860 |
| 6 | Aquila pennata | 195 | 167 | 189 | 166 | 211 | 183 |
| 7 | Aquila pomarina | 579 | 215 | 568 | 208 | 682 | 250 |
| | Aquila spec. | 801 | 306 | 663 | 251 | 628 | 234 |
| 8 | Buteo rufinus | 133 | 86 | 129 | 82 | 129 | 82 |
| 9 | Buteo b. vulpinus | 69954 | 2279 | 66797 | 2163 | 70326 | 2560 |
| | Buteo spec. | 7 | 6 | 6 | 5 | 5 | 4 |
| 10 | Ciconia ciconia | 98938 | 183 | 67405 | 141 | 57491 | 138 |
| 11 | Ciconia nigra | 664 | 105 | 625 | 98 | 597 | 96 |
| | Ciconia / Pelecanus | 300 | 1 | 0 | 0 | | |
| 12 | Circaetus gallicus | 412 | 315 | 396 | 303 | 436 | 339 |
| 13 | Circus aeruginosus | 39 | 35 | 35 | 33 | 34 | 32 |
| 14 | Circus macrourus | 3 | 3 | 3 | 3 | 3 | 3 |
| 15 | Circus pygargus | 8 | 8 | 8 | 8 | 8 | 8 |
| | Circus spec. | 3 | 3 | 3 | 3 | 2 | 2 |
| 16 | Falco columbarius | 1 | 1 | 1 | 1 | 1 | 1 |
| 17 | Falco naumanni | 8 | 8 | 8 | 8 | 8 | 7 |
| 18 | Falco peregrinus | 20 | 15 | 20 | 15 | 10 | 8 |
| 19 | Falco subbuteo | 2 | 1 | 0 | 0 | | |
| 20 | Falco tinnunculus | 18 | 18 | 18 | 18 | 18 | 18 |
| | Falco tinnunculus/naumanni | 5 | 5 | 5 | 5 | 5 | 5 |
| | Falco spec. | 8 | 8 | 7 | 7 | 7 | 7 |
| 21 | Grus grus | 1628 | 23 | 593 | 16 | 543 | 15 |
| 22 | Gyps fulvus | 3 | 3 | 3 | 3 | 3 | 3 |
| 23 | Merops apiaster | 1046 | 72 | 986 | 70 | 1058 | 74 |
| 24 | Milvus migrans | 2278 | 738 | 2208 | 710 | 2277 | 772 |
| 25 | Neophron percnopterus | 154 | 110 | 142 | 104 | 153 | 113 |
| 26 | Pandion haliaetus | 19 | 18 | 17 | 16 | 17 | 16 |
| 27 | Pelecanus onocrotalus | 7080 | 34 | 4427 | 25 | 2275 | 17 |
| 28 | Pernis apivorus | 22265 | 440 | 21564 | 421 | 22105 | 474 |
| | undetermined raptor | 3591 | 174 | 2090 | 133 | 1069 | 95 |
| | total number | 222102 | 6363 | 177516 | 5932 | 168918 | 6607 |

IV Total number of birds / recordings (rec.) migrating within distances of 2.5 km to an observation site in spring 2010 (without "area-correction" factor for site E)

| no. | species | A | | B | | C | | D | | E | | F | | G | | H | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. |
| 1 | Accipiter brevipes | 0 | 0 | 165 | 5 | 250 | 1 | 1154 | 4 | 542 | 12 | 1 | 1 | 10 | 1 | 3504 | 4 |
| 2 | Accipiter nisus | 24 | 21 | 3 | 3 | 15 | 13 | 16 | 14 | 22 | 17 | 24 | 16 | 13 | 8 | 12 | 9 |
| | Accipiter spec. | 0 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 5 | 4 | 0 | 0 |
| 3 | Aquila clanga | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 3 | 3 | 4 | 4 | 3 | 2 | 1 | 1 |
| 4 | Aquila heliaca | 3 | 3 | 2 | 2 | 4 | 4 | 1 | 1 | 3 | 3 | 8 | 8 | 12 | 7 | 7 | 6 |
| 5 | Aquila nipalensis | 410 | 128 | 202 | 101 | 293 | 101 | 594 | 110 | 330 | 108 | 503 | 131 | 257 | 94 | 402 | 87 |
| 6 | Aquila pennata | 49 | 42 | 16 | 15 | 32 | 23 | 11 | 11 | 28 | 27 | 40 | 32 | 16 | 16 | 19 | 17 |
| 7 | Aquila pomarina | 75 | 34 | 136 | 37 | 28 | 15 | 27 | 17 | 130 | 47 | 216 | 61 | 46 | 21 | 24 | 18 |
| | Aquila spec. | 47 | 32 | 66 | 31 | 70 | 17 | 50 | 19 | 62 | 31 | 96 | 50 | 90 | 34 | 147 | 20 |
| 8 | Buteo rufinus | 25 | 25 | 11 | 8 | 10 | 10 | 6 | 6 | 52 | 10 | 9 | 7 | 10 | 10 | 6 | 6 |
| 9 | Buteo b. vulpinus | 15315 | 422 | 5374 | 336 | 9792 | 298 | 11760 | 239 | 7266 | 370 | 8899 | 342 | 3861 | 299 | 8059 | 254 |
| | Buteo spec. | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 10 | Ciconia ciconia | 798 | 10 | 994 | 11 | 5126 | 17 | 14010 | 11 | 4748 | 19 | 6240 | 21 | 13991 | 25 | 11584 | 24 |
| 11 | Ciconia nigra | 29 | 4 | 31 | 6 | 104 | 22 | 28 | 13 | 63 | 9 | 94 | 17 | 81 | 12 | 167 | 13 |
| 12 | Circaetus gallicus | 47 | 40 | 64 | 52 | 52 | 41 | 61 | 46 | 51 | 45 | 86 | 57 | 43 | 29 | 32 | 29 |
| 13 | Circus aeruginosus | 3 | 3 | 1 | 1 | 5 | 4 | 4 | 3 | 9 | 9 | 8 | 8 | 1 | 1 | 3 | 3 |
| 14 | Circus macrourus | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 15 | Circus pygargus | 1 | 1 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 |
| | Circus spec. | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 16 | Falco columbarius | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 17 | Falco naumanni | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 6 | 5 |
| 18 | Falco peregrinus | 0 | 0 | 0 | 0 | 7 | 5 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 0 | 0 |
| 19 | Falco tinnunculus | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 1 | 1 | 4 | 4 |
| | Falco tinnunculus/naumanni | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 |
| | Falco spec. | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 3 | 3 | 0 | 0 | 0 | 0 |
| 20 | Grus grus | 8 | 1 | 200 | 1 | 110 | 1 | 0 | 0 | 0 | 0 | 110 | 4 | 0 | 0 | 115 | 8 |
| 21 | Gyps fulvus | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 |
| 22 | Merops apiaster | 138 | 7 | 125 | 10 | 63 | 4 | 77 | 13 | 83 | 9 | 329 | 18 | 61 | 4 | 182 | 9 |
| 23 | Milvus migrans | 399 | 117 | 117 | 71 | 239 | 101 | 389 | 81 | 347 | 116 | 434 | 133 | 128 | 63 | 224 | 90 |
| 24 | Neophron percnopterus | 14 | 13 | 13 | 10 | 31 | 18 | 24 | 17 | 22 | 14 | 20 | 16 | 11 | 8 | 18 | 17 |
| 25 | Pandion haliaetus | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 3 | 4 | 4 | 1 | 1 | 0 | 0 | 2 | 2 |
| 26 | Pelecanus onocrotalus | 0 | 0 | 367 | 2 | 305 | 2 | 0 | 0 | 150 | 1 | 410 | 4 | 763 | 4 | 280 | 4 |
| 27 | Pernis apivorus | 713 | 55 | 592 | 24 | 4063 | 76 | 2088 | 37 | 7486 | 124 | 2227 | 38 | 1381 | 55 | 3555 | 65 |
| | undetermined raptor | 12 | 8 | 141 | 11 | 562 | 21 | 5 | 5 | 10 | 4 | 88 | 17 | 232 | 18 | 19 | 11 |
| | total number | 18117 | 973 | 8629 | 746 | 21177 | 809 | 30317 | 657 | 21420 | 991 | 19861 | 1000 | 21020 | 720 | 28377 | 711 |

V Total number of birds / recordings (rec.) migrating within distances of 2.5 km to an observation site and at altitudes below 200 m in spring 2010 (without "area-correction" factor for site E)

| no. | species | A | | B | | C | | D | | E | | F | | G | | H | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. |
| 1 | Accipiter brevipes | 0 | 0 | 164 | 4 | 0 | 0 | 154 | 3 | 445 | 7 | 1 | 1 | 0 | 0 | 2004 | 3 |
| 2 | Accipiter nisus | 11 | 10 | 2 | 2 | 7 | 6 | 14 | 12 | 14 | 10 | 21 | 13 | 8 | 7 | 12 | 9 |
| | Accipiter spec. | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 3 | 3 | 0 | 0 | 2 | 2 | 0 | 0 |
| 3 | Aquila clanga | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 3 | 3 | 3 | 2 | 1 | 1 |
| 4 | Aquila heliaca | 2 | 2 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 3 | 3 | 5 | 5 | 5 | 4 |
| 5 | Aquila nipalensis | 105 | 71 | 112 | 67 | 153 | 73 | 90 | 56 | 107 | 59 | 194 | 64 | 204 | 75 | 115 | 42 |
| 6 | Aquila pennata | 32 | 26 | 7 | 7 | 23 | 18 | 10 | 10 | 13 | 13 | 27 | 22 | 10 | 10 | 14 | 12 |
| 7 | Aquila pomarina | 18 | 11 | 55 | 19 | 5 | 4 | 21 | 14 | 40 | 22 | 53 | 27 | 34 | 15 | 19 | 14 |
| | Aquila spec. | 32 | 22 | 24 | 15 | 55 | 12 | 19 | 11 | 17 | 11 | 25 | 17 | 14 | 10 | 6 | 3 |
| 8 | Buteo rufinus | 20 | 20 | 9 | 6 | 8 | 8 | 3 | 3 | 9 | 8 | 7 | 5 | 9 | 9 | 6 | 6 |
| 9 | Buteo b. vulpinus | 9388 | 297 | 2450 | 273 | 2974 | 245 | 1284 | 176 | 2953 | 282 | 3464 | 242 | 2500 | 235 | 1664 | 184 |
| | Buteo spec. | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 10 | Ciconia ciconia | 641 | 5 | 641 | 8 | 4944 | 11 | 7694 | 7 | 1963 | 17 | 4196 | 9 | 11654 | 18 | 9125 | 18 |
| 11 | Ciconia nigra | 3 | 3 | 28 | 4 | 93 | 15 | 14 | 4 | 11 | 3 | 52 | 9 | 49 | 8 | 160 | 11 |
| 12 | Circaetus gallicus | 35 | 28 | 51 | 40 | 44 | 33 | 33 | 29 | 29 | 26 | 63 | 39 | 35 | 24 | 22 | 21 |
| 13 | Circus aeruginosus | 3 | 3 | 0 | 0 | 4 | 3 | 4 | 3 | 8 | 8 | 8 | 8 | 1 | 1 | 3 | 3 |
| 14 | Circus macrourus | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 15 | Circus pygargus | 1 | 1 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 |
| | Circus spec. | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 16 | Falco naumanni | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 6 | 5 |
| 17 | Falco peregrinus | 0 | 0 | 0 | 0 | 7 | 5 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | | |
| 18 | Falco tinnunculus | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 4 | 4 |
| | Falco tinnunculus/naumanni | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | | |
| | Falco spec. | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | | |
| 19 | Grus grus | 0 | 0 | 200 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 108 | 3 | 0 | 0 | 65 | 7 |
| 20 | Merops apiaster | 138 | 7 | 125 | 10 | 62 | 3 | 77 | 13 | 98 | 10 | 284 | 17 | 61 | 4 | 182 | 9 |
| 21 | Milvus migrans | 284 | 75 | 91 | 56 | 188 | 85 | 110 | 56 | 138 | 72 | 158 | 68 | 86 | 48 | 149 | 64 |
| 22 | Neophron percnopterus | 7 | 6 | 6 | 5 | 25 | 15 | 10 | 10 | 16 | 9 | 6 | 6 | 11 | 8 | 13 | 12 |
| 23 | Pandion haliaetus | 0 | 0 | 0 | 0 | 2 | 2 | 4 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 1 |
| 24 | Pelecanus onocrotalus | 0 | 0 | 367 | 2 | 0 | 0 | 0 | 0 | 70 | 1 | 398 | 3 | 400 | 1 | 270 | 3 |
| 25 | Pernis apivorus | 413 | 36 | 522 | 15 | 742 | 36 | 1240 | 30 | 5447 | 88 | 2009 | 31 | 485 | 35 | 2507 | 49 |
| | undetermined raptor | 7 | 5 | 130 | 6 | 273 | 12 | 3 | 3 | 9 | 3 | 10 | 8 | 109 | 8 | 16 | 9 |
| | total number | 11145 | 632 | 4991 | 547 | 9619 | 596 | 10789 | 447 | 11397 | 659 | 11099 | 607 | 15685 | 530 | 16373 | 498 |

VI Total number of birds / recordings (rec.) observed (overall migration), observed within the study area and observed within distances of 2.5 km to an observation site (obs. site) in autumn 2010

| no. | species | overall migration | | within study area | | obs. site | |
|---|---|---|---|---|---|---|---|
| | | birds | rec. | birds | rec. | birds | rec. |
| 1 | Accipiter brevipes | 19 | 4 | 19 | 4 | 19 | 4 |
| 2 | Accipiter nisus | 2 | 2 | 2 | 2 | 2 | 2 |
| | Accipiter spec. | 2 | 1 | 2 | 1 | 2 | 1 |
| 3 | Aquila clanga | 1 | 1 | 0 | 0 | 0 | 0 |
| 4 | Aquila pomarina | 2 | 2 | 2 | 2 | 2 | 2 |
| | Aquila spec. | 3 | 3 | 1 | 1 | 0 | 0 |
| 5 | Buteo rufinus | 4 | 4 | 4 | 4 | 4 | 4 |
| 6 | Buteo b. vulpinus | 11 | 9 | 11 | 9 | 11 | 9 |
| | Buteo spec. | 4 | 3 | 3 | 2 | 1 | 1 |
| 7 | Ciconia ciconia | 24239 | 25 | 14034 | 17 | 13020 | 13 |
| 8 | Ciconia nigra | 52 | 6 | 52 | 6 | 52 | 6 |
| 9 | Circaetus gallicus | 4 | 3 | 3 | 2 | 3 | 2 |
| 10 | Circus aeruginosus | 134 | 100 | 105 | 82 | 98 | 76 |
| 11 | Circus macrourus | 47 | 43 | 46 | 42 | 44 | 41 |
| 12 | Circus pygargus | 44 | 38 | 40 | 34 | 38 | 33 |
| | Circus pygargus/macrourus | 43 | 39 | 33 | 31 | 29 | 29 |
| | Circus spec. | 13 | 13 | 8 | 8 | 7 | 7 |
| 13 | Falco naumanni | 32 | 15 | 32 | 15 | 31 | 14 |
| 14 | Falco subbuteo | 4 | 4 | 4 | 4 | 4 | 4 |
| 15 | Falco tinnunculus | 13 | 11 | 8 | 7 | 8 | 7 |
| | Falco tinnunculus/naumanni | 20 | 18 | 15 | 14 | 12 | 11 |
| 16 | Falco vespertinus | 13 | 7 | 12 | 6 | 12 | 6 |
| | Falco spec. | 13 | 10 | 13 | 10 | 13 | 10 |
| 17 | Gyps fulvus | 1 | 1 | 0 | 0 | 0 | 0 |
| 18 | Hieraaetus pennatus | 3 | 3 | 3 | 3 | 3 | 3 |
| 19 | Merops apiaster | 110 | 2 | 110 | 2 | 110 | 2 |
| 20 | Milvus migrans | 71 | 25 | 53 | 20 | 53 | 20 |
| 21 | Neophron percnopterus | 8 | 3 | 8 | 3 | 7 | 2 |
| 22 | Pandion haliaetus | 2 | 2 | 1 | 1 | 1 | 1 |
| 23 | Pelecanus onocrotalus | 9282 | 19 | 8252 | 17 | 1661 | 11 |
| 24 | Pernis apivorus | 3641 | 280 | 3028 | 232 | 2317 | 184 |
| | undetermined raptor | 54 | 27 | 38 | 16 | 29 | 13 |
| | total number | 37891 | 723 | 25942 | 597 | 17593 | 518 |

VII Total number of birds / recordings (rec.) migrating within distances of 2.5 km to an observation site in autumn 2010 (without “area-correction” factor for site E)

| no. | species | A | | B | | C | | D | | E | | F | | G | | H | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. |
| 1 | Accipiter brevipes | | | 2 | 1 | | | 13 | 2 | | | | | 4 | 1 | | |
| 2 | Accipiter nisus | | | | | | | | | | | 1 | 1 | | | 1 | 1 |
| | Accipiter spec. | | | | | 2 | 1 | | | | | | | | | | |
| 3 | Aquila pennata | | | 1 | 1 | | | | | | | 1 | 1 | | | 1 | 1 |
| 4 | Aquila pomarina | | | | | | | | | | | 1 | 1 | 1 | 1 | | |
| 5 | Buteo rufinus | 1 | 1 | | | | | | | | | | | 1 | 1 | 2 | 2 |
| 6 | Buteo b. vulpinus | | | | | 1 | 1 | 7 | 5 | 1 | 1 | 1 | 1 | | | 1 | 1 |
| | Buteo spec. | | | | | 1 | 1 | | | | | | | | | | |
| 7 | Ciconia ciconia | | | | | 250 | 1 | 2538 | 2 | | | 7 | 2 | 11 | 2 | 10214 | 7 |
| 8 | Ciconia nigra | | | | | | | 19 | 3 | 18 | 1 | | | 15 | 2 | | |
| 9 | Circaetus gallicus | | | | | | | | | | | | | 2 | 1 | 1 | 1 |
| 10 | Circus aeruginosus | 5 | 5 | 20 | 14 | 6 | 6 | 9 | 9 | 7 | 6 | 19 | 10 | 11 | 9 | 21 | 17 |
| 11 | Circus macrourus | 3 | 3 | 8 | 7 | 6 | 6 | 4 | 4 | 11 | 9 | 2 | 2 | 2 | 2 | 8 | 8 |
| 12 | Circus pygargus | 3 | 3 | 2 | 2 | 7 | 6 | 4 | 3 | 8 | 6 | 2 | 2 | 6 | 5 | 6 | 6 |
| | Circus pygargus/macrourus | | | 2 | 2 | 4 | 4 | 3 | 3 | 4 | 4 | 1 | 1 | 4 | 4 | 8 | 8 |
| | Circus spec. | 3 | 3 | 3 | 3 | | | | | 1 | 1 | 1 | 1 | 2 | 2 | | |
| 13 | Falco naumanni | 1 | 1 | | | 3 | 2 | 22 | 8 | | | 6 | 4 | | | | |
| 14 | Falco subbuteo | | | 2 | 2 | | | 2 | 2 | | | | | | | | |
| 15 | Falco tinnunculus | 1 | 1 | 1 | 1 | | | 4 | 3 | 2 | 2 | | | | | | |
| | Falco tinnunculus/naumanni | 1 | 1 | 1 | 1 | | | 2 | 2 | 4 | 4 | 3 | 2 | 1 | 1 | | |
| 16 | Falco vespertinus | | | 1 | 1 | | | 9 | 3 | 1 | 1 | | | | | 1 | 1 |
| | Falco spec. | | | 3 | 3 | 6 | 4 | 3 | 2 | | | 1 | 1 | | | | |
| 17 | Merops apiaster | | | 60 | 1 | | | 50 | 1 | | | | | | | | |
| 18 | Milvus migrans | 2 | 2 | 4 | 4 | | | 34 | 4 | 2 | 2 | 5 | 4 | 4 | 3 | 2 | 1 |
| 19 | Neophron percnopterus | | | | | | | | | | | 6 | 1 | | | 1 | 1 |
| 20 | Pandion haliaetus | | | 1 | 1 | | | | | | | | | | | | |
| 21 | Pelecanus onocrotalus | 276 | 1 | 120 | 1 | 251 | 2 | | | 223 | 2 | 510 | 2 | 60 | 1 | 221 | 2 |
| 22 | Pernis apivorus | 269 | 25 | 74 | 23 | 746 | 45 | 141 | 31 | 126 | 7 | 156 | 14 | 599 | 18 | 206 | 21 |
| | undetermined raptor | 2 | 2 | | | 4 | 2 | 1 | 1 | 15 | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| | total number | 567 | 48 | 305 | 68 | 1287 | 81 | 2865 | 88 | 423 | 47 | 725 | 52 | 725 | 54 | 10696 | 80 |

VIII Total number of birds / recordings (rec.) migrating within distances of 2.5 km to an observation site and at altitudes below 200 m in autumn 2010 (without "area-correction" factor for site E)

| no. | species | A | | B | | C | | D | | E | | F | | G | | H | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. | birds | rec. |
| 1 | Accipiter brevipes | | | 2 | 1 | | | 8 | 1 | | | | | | | | |
| 2 | Accipiter nisus | | | | | | | | | | | 1 | 1 | | | 1 | 1 |
| 3 | Aquila pomarina | | | | | | | | | | | 1 | 1 | 1 | 1 | | |
| 4 | Buteo rufinus | 1 | 1 | | | | | | | | | | | 1 | 1 | | |
| 5 | Buteo b. vulpinus | | | | | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | | | | |
| 6 | Ciconia ciconia | | | | | | | 38 | 1 | | | 7 | 2 | | | 7760 | 4 |
| 7 | Ciconia nigra | | | | | | | 13 | 2 | | | | | 12 | 1 | | |
| 8 | Circaetus gallicus | | | | | | | | | | | | | | | 1 | 1 |
| 9 | Circus aeruginosus | 5 | 5 | 19 | 13 | 5 | 5 | 9 | 9 | 7 | 6 | 18 | 9 | 11 | 9 | 17 | 13 |
| 10 | Circus macrourus | 3 | 3 | 8 | 7 | 5 | 5 | 4 | 4 | 10 | 8 | 1 | 1 | 2 | 2 | 8 | 8 |
| 11 | Circus pygargus | 3 | 3 | 2 | 2 | 7 | 6 | 4 | 3 | 8 | 6 | 2 | 2 | 6 | 5 | 6 | 6 |
| | Circus pygargus/macrourus | 2 | 2 | 1 | 1 | 4 | 4 | 3 | 3 | 3 | 3 | 1 | 1 | 4 | 4 | 6 | 6 |
| | Circus spec. | | | 3 | 3 | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| 12 | Falco naumanni | 1 | 1 | | | 3 | 2 | 22 | 8 | | | 6 | 4 | | | | |
| 13 | Falco subbuteo | | | 2 | 2 | | | 2 | 2 | | | | | | | | |
| 14 | Falco tinnunculus | 1 | 1 | 1 | 1 | | | 4 | 3 | | | | | | | | |
| 15 | Falco vespertinus | | | 1 | 1 | | | 9 | 3 | 1 | 1 | | | | | 1 | 1 |
| | Falco tinn./nau. | 1 | 1 | 1 | 1 | | | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | | |
| | Falco spec. | | | 3 | 3 | 6 | 4 | 3 | 2 | 4 | 4 | 1 | 1 | | | | |
| 16 | Merops apiaster | | | 60 | 1 | | | 50 | 1 | | | | | | | | |
| 17 | Milvus migrans | 2 | 2 | 4 | 4 | | | 2 | 2 | 2 | 2 | 5 | 4 | 3 | 2 | 2 | 1 |
| 18 | Pelecanus onocrotalus | 276 | 1 | | | 251 | 2 | | | 223 | 2 | 500 | 1 | | | 21 | 1 |
| 19 | Pernis apivorus | 185 | 17 | 28 | 16 | 278 | 34 | 90 | 26 | 17 | 4 | 81 | 9 | 112 | 11 | 23 | 6 |
| | undetermined raptor | 2 | 2 | | | 3 | 2 | 1 | 1 | | | 2 | 2 | 2 | 1 | 2 | 2 |
| | total number | 482 | 39 | 135 | 56 | 563 | 65 | 266 | 75 | 279 | 40 | 630 | 41 | 156 | 39 | 7848 | 50 |

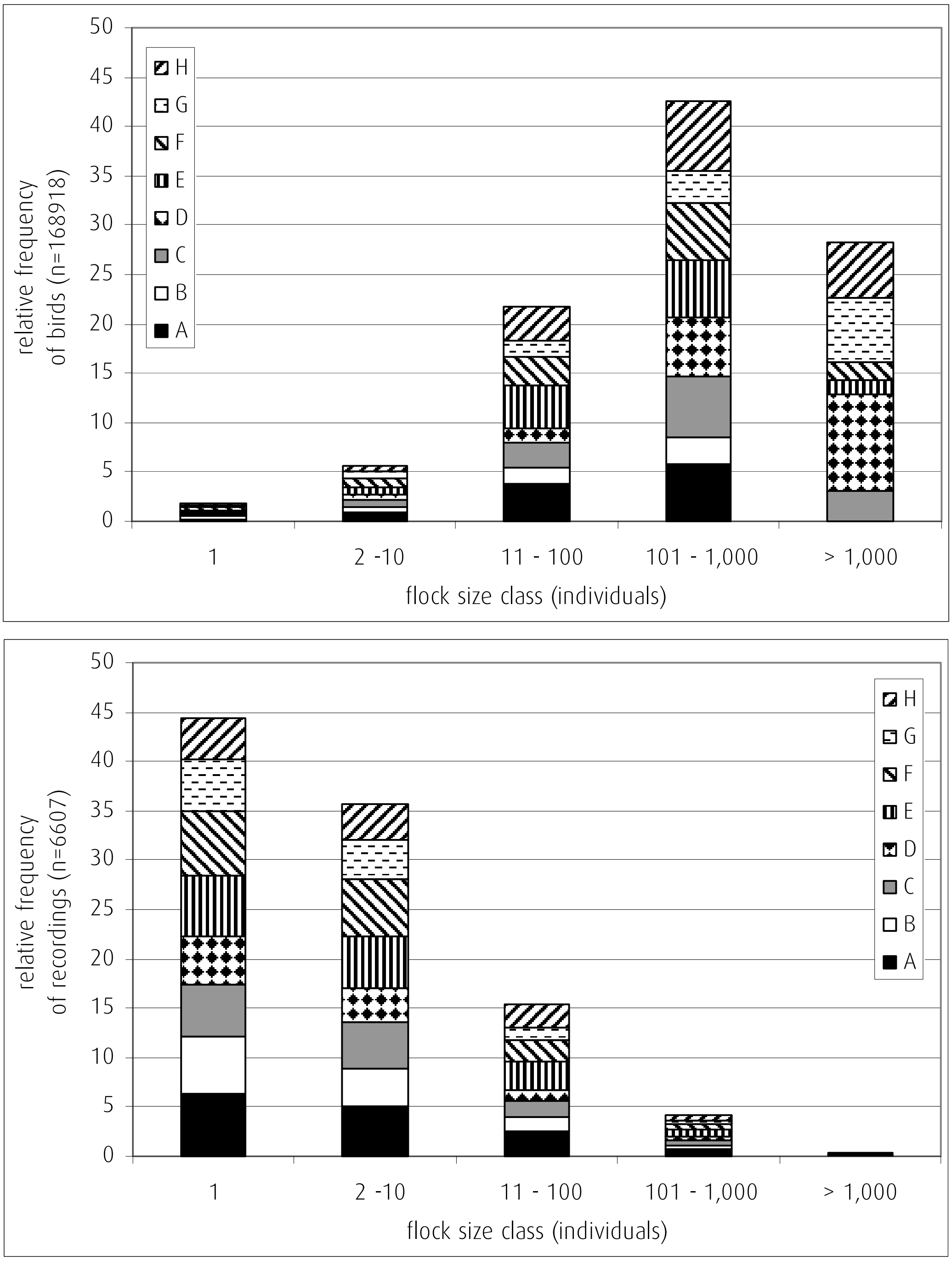



Figure 3.1: Relative frequency of all birds (above) / recordings (below) migrating at distances below 2.5 km to an observation site in consideration of flock size (without “area-correction” – factor for site E)

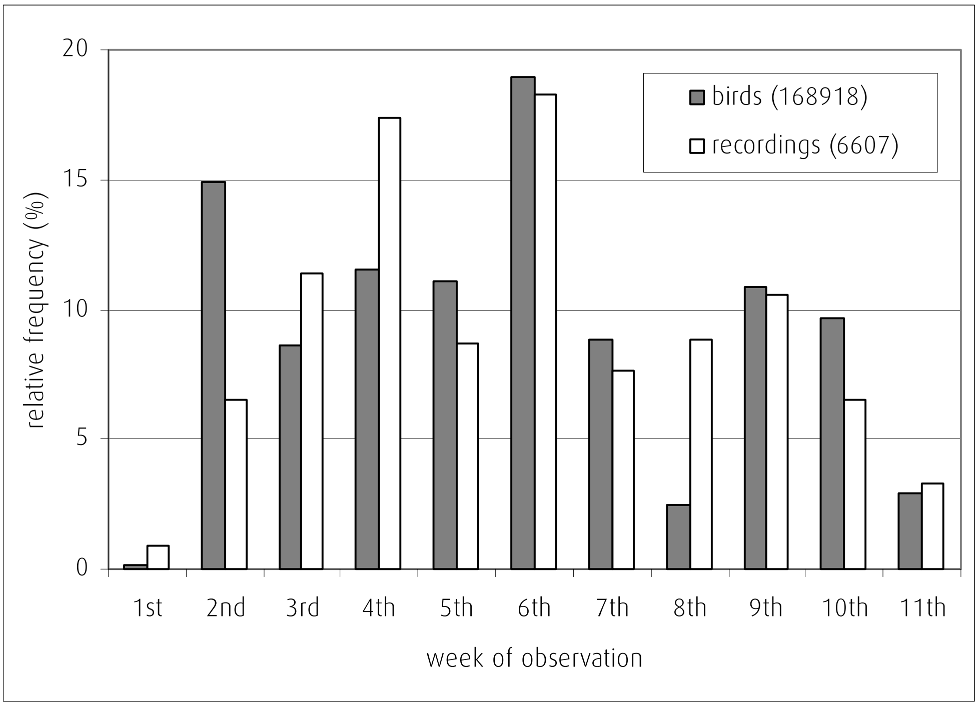
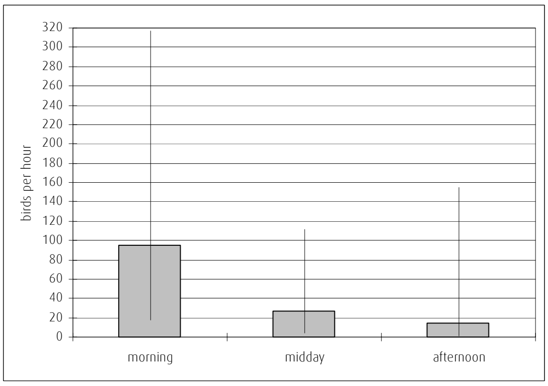



Figure 3.2: Relative frequency of birds / recordings migrating at distances up to 2.5 km from an observation site in different weeks of observation (1st week: 2nd to 7th of March 2010; 24 observation units within each week, except for 1st week with 20 observation units)



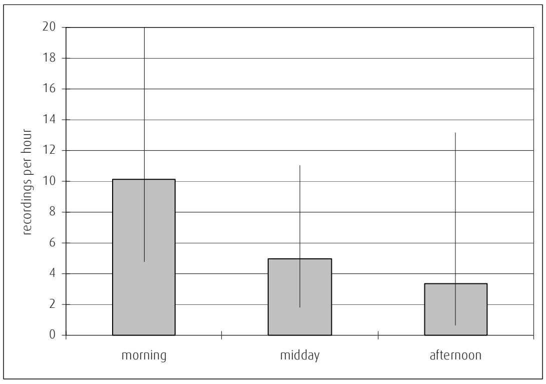




Figure 3.3: Migration rate at distances of up to 2.5 km from an observation site within different periods of the day (birds (168918): left / recordings (6607): right)

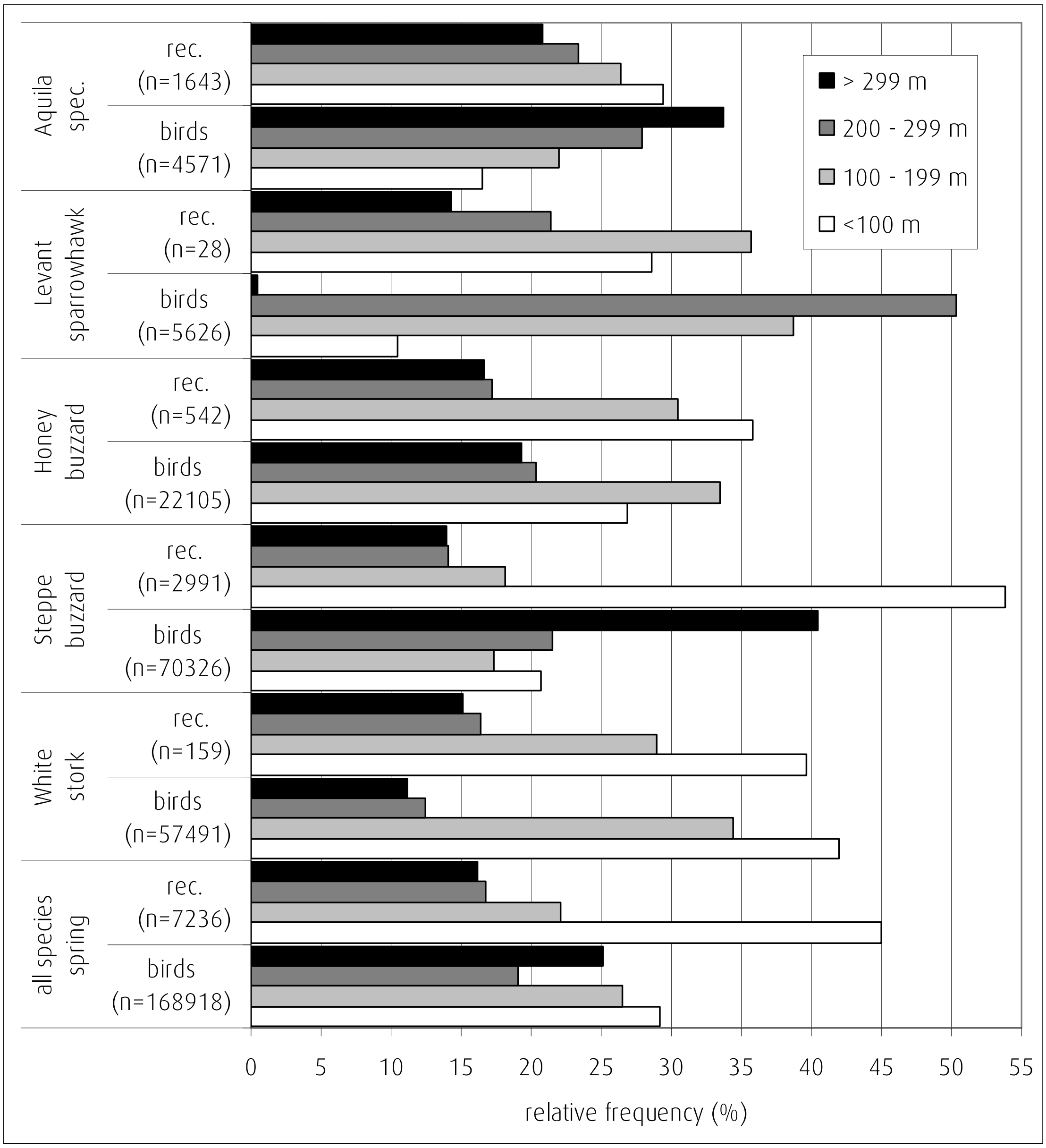



Figure 3.4: Relative frequency of all species, White stork, Steppe buzzard, Honey buzzard, Levant sparrowhawk and Eagles migrating at different flight altitudes at distances of up to 2.5 km from an observation site

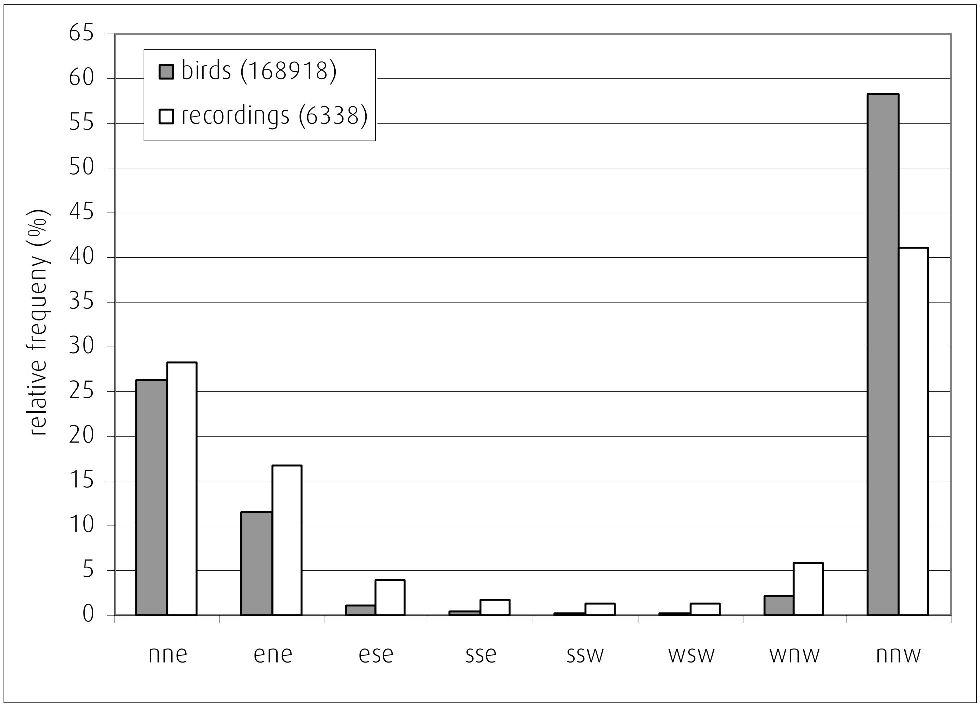



Figure 3.5: Relative frequency of birds (grey) / recordings (white) migrating with different flight directions at distances of up to 2.5 km from an observation site

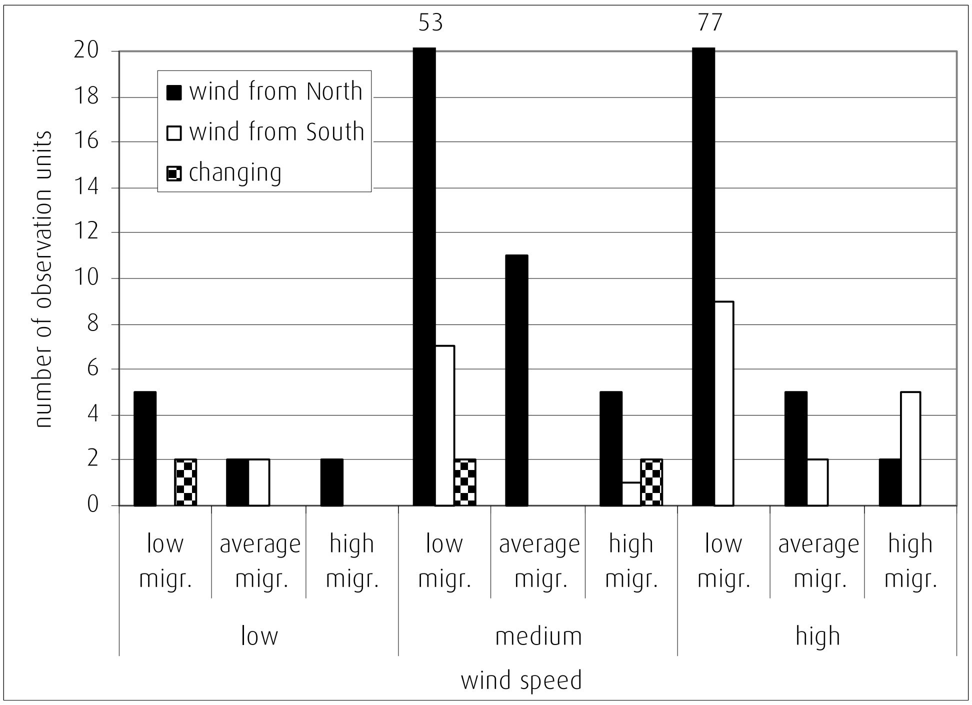
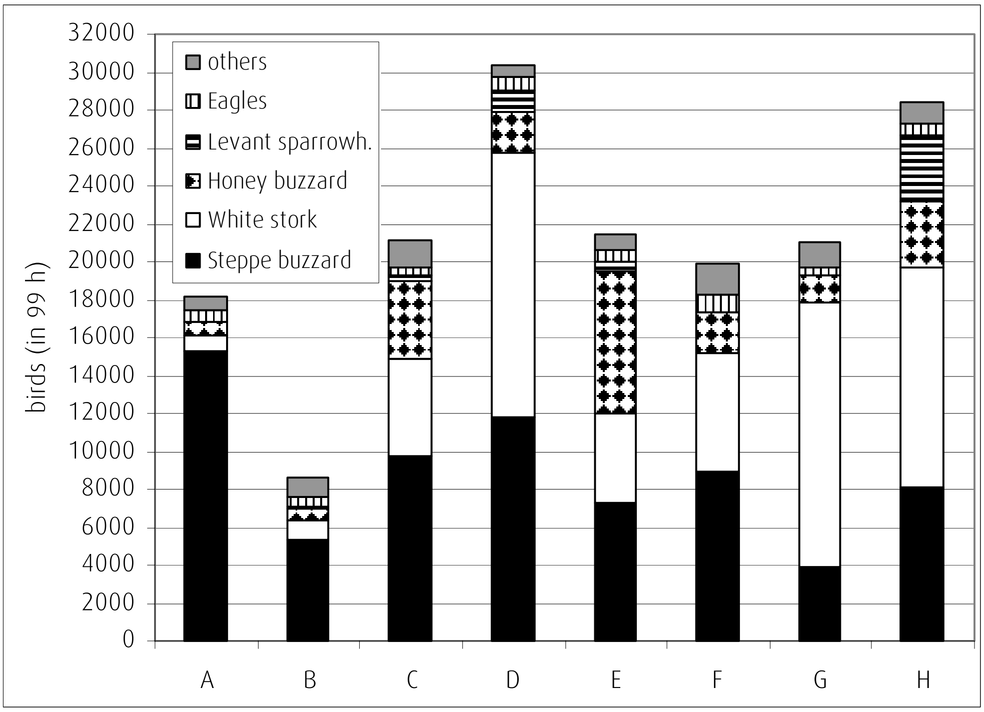



Figure 3.6: Number of observation units with high, medium and low migratory activity in relation to wind speed and wind direction



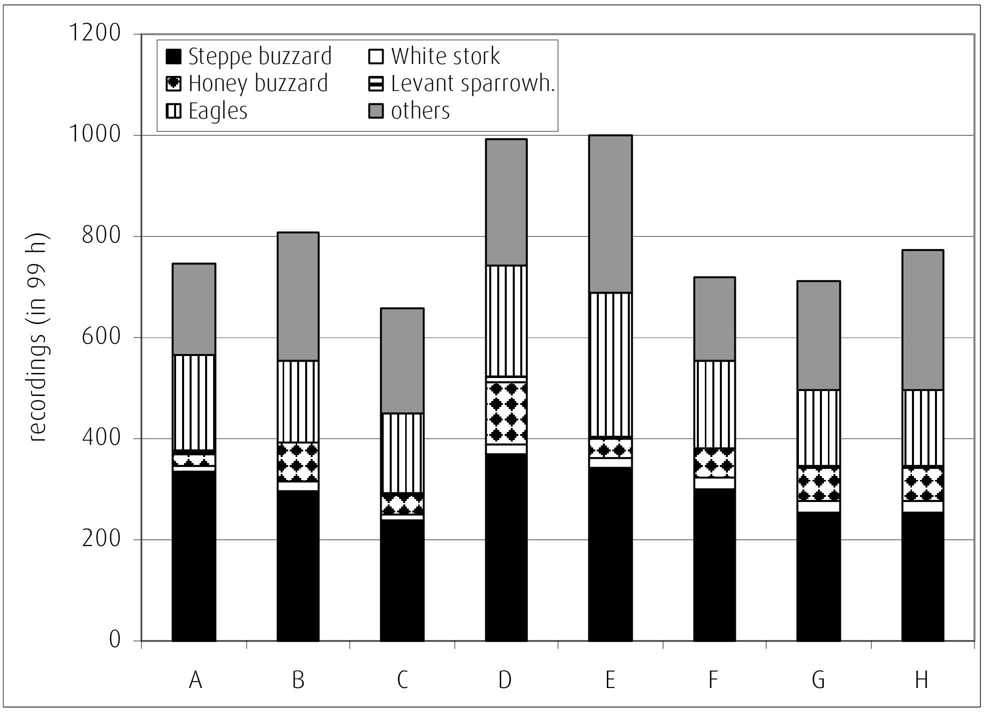
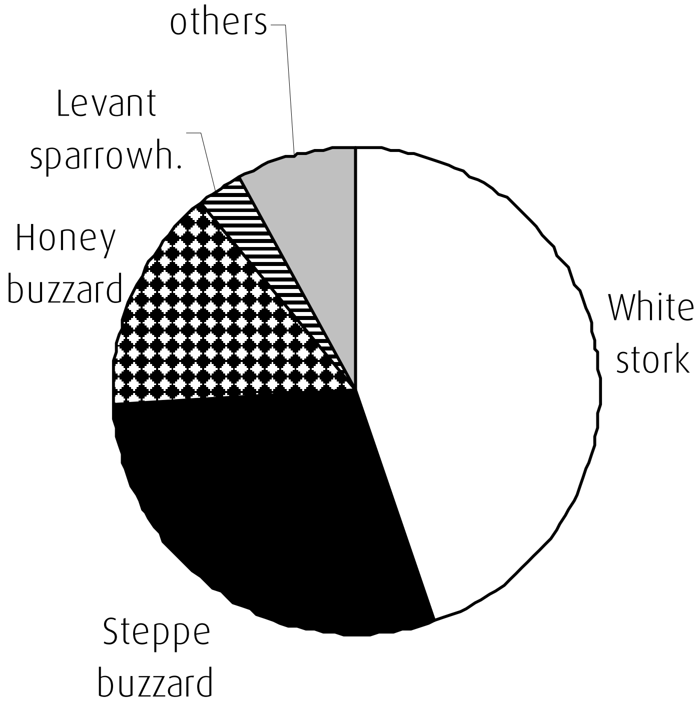




Figure 3.7: Total number of birds (above) / recordings (below) recorded at distances of up to 2.5 km to each observation site (in 99 hours of observations; without "area-correction" – factor for site E)



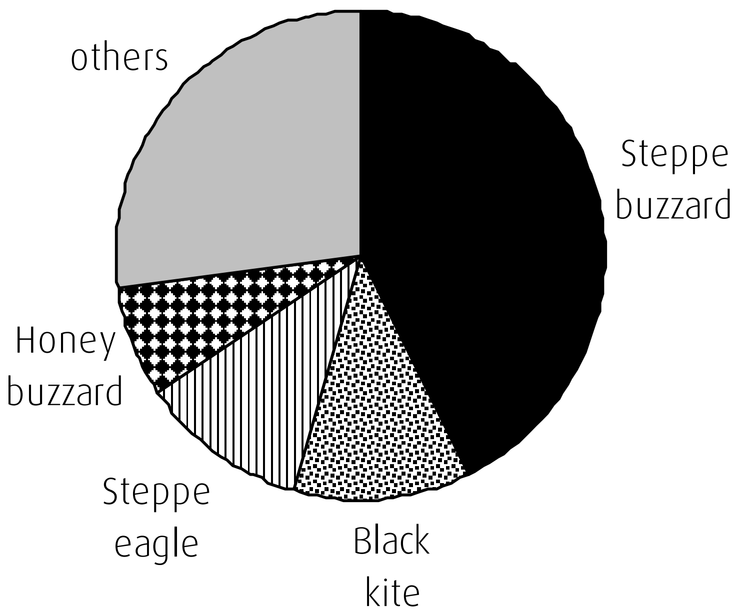




Figure 3.8: Relative frequency of different species (birds: above; recordings: below) migrating at distances of up to 2.5 km to an observation site and at altitudes below 200 m

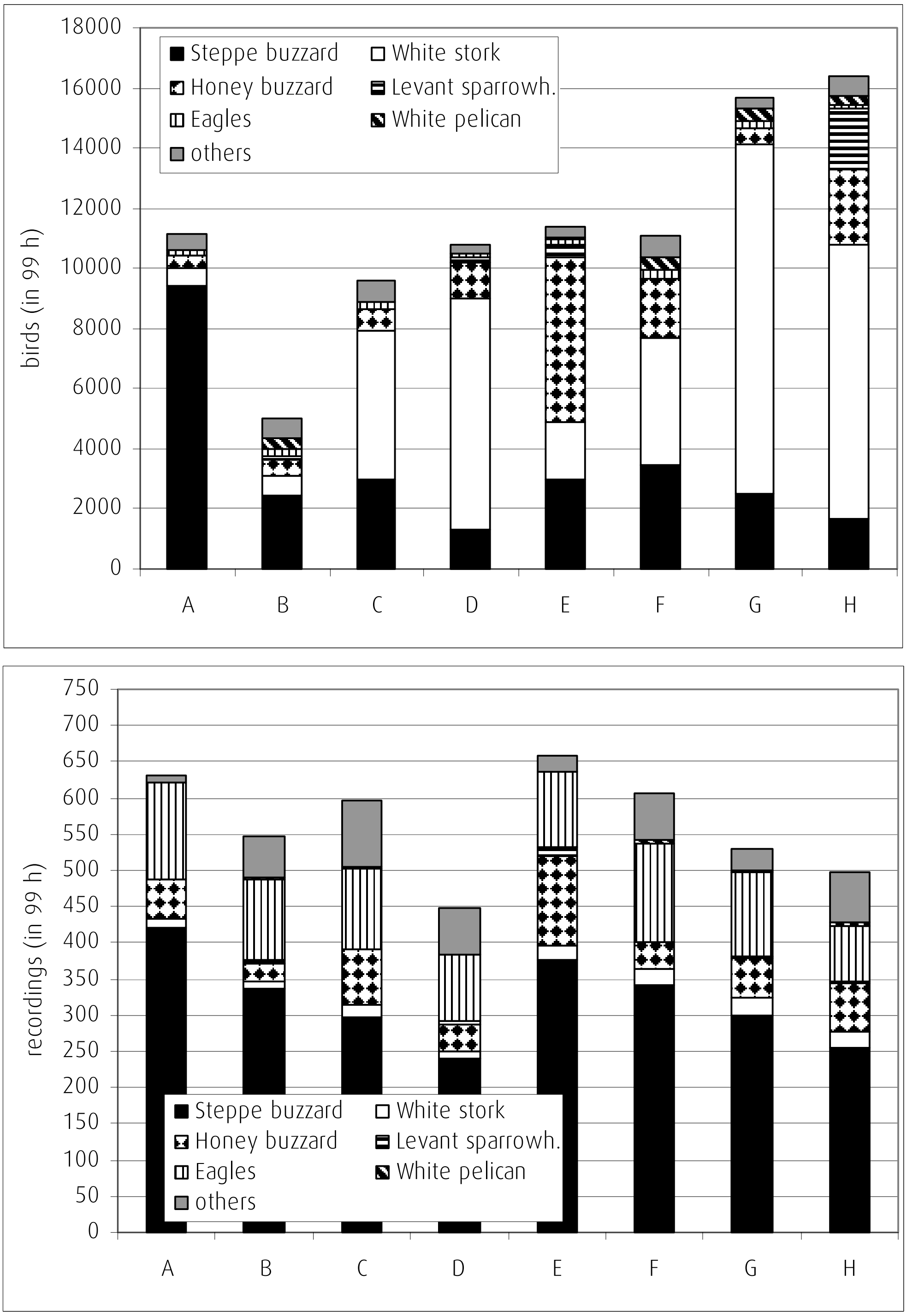
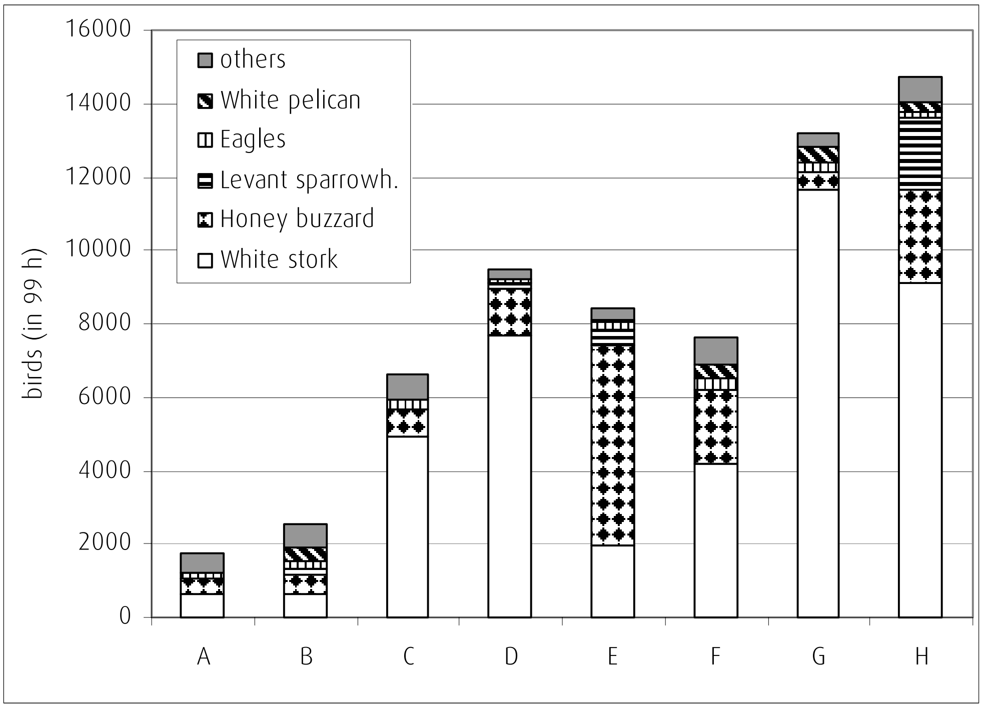



Figure 3.9: Total number of birds (above) / recordings (below) migrating at distances of up to 2.5 km to each observation site and at altitudes below 200 m (in 99 hours of observations; without "area-correction" – factor for site E)



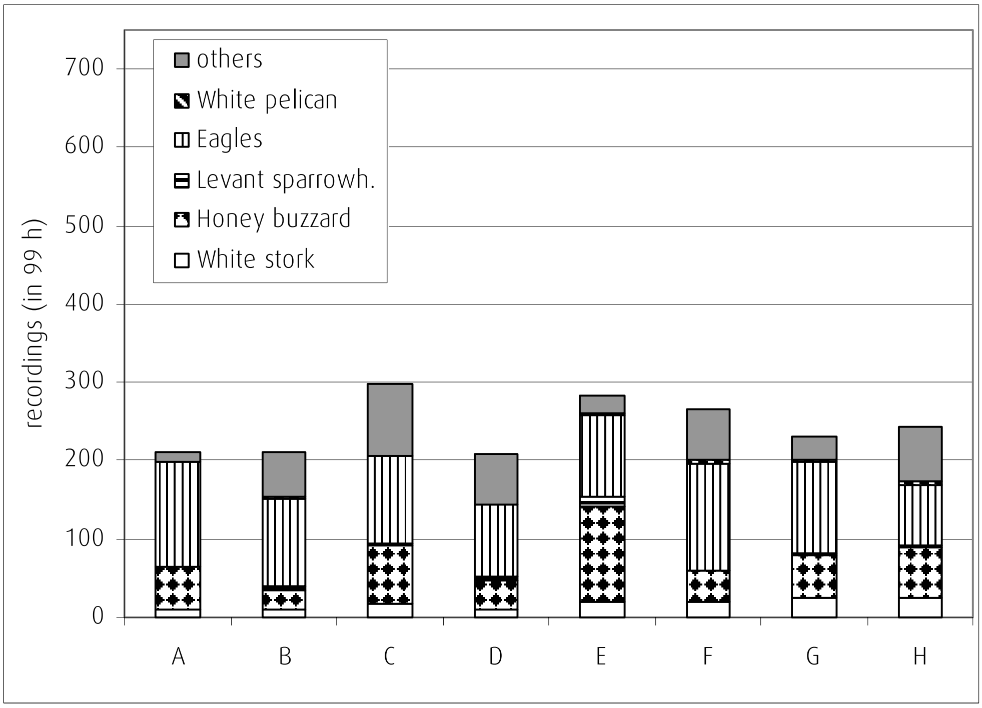




Figure 3.10: Total number of birds (above) / recordings (below) – without Steppe buzzard - migrating at distances of up to 2.5 km to each observation site and at altitudes below 200 m (in 99 hours of observations; without "area-correction" – factor for site E)

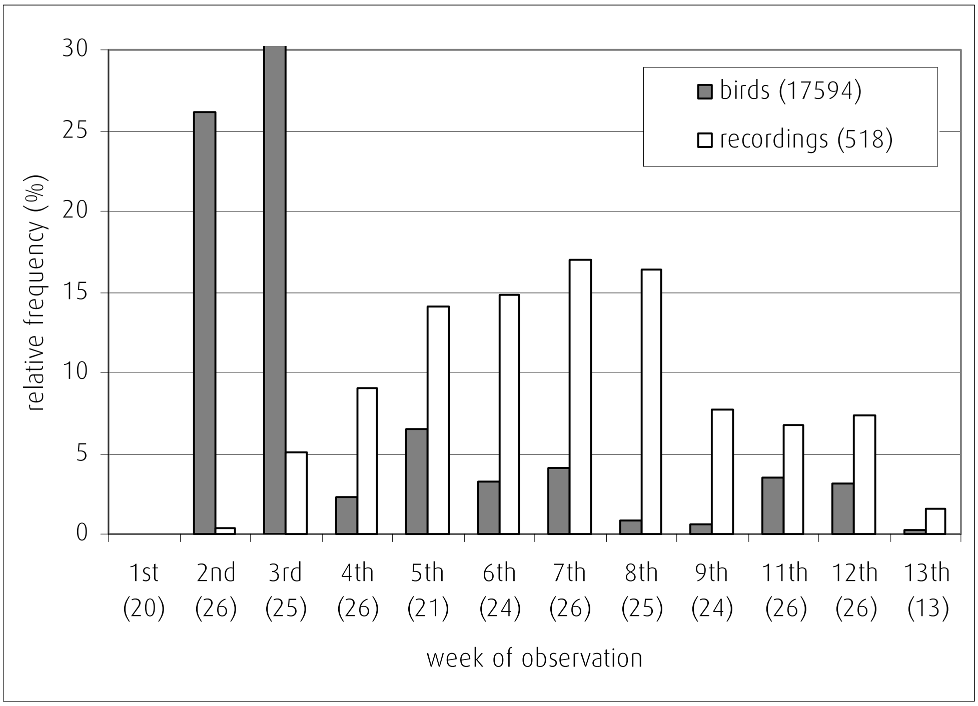



Figure 3.11: Relative frequency of birds / recordings migrating at distances of up to 2.5 km from an observation site in different weeks of observation (1st week: 10th to 15th of August 2010; numbers of observation units are given in brackets)

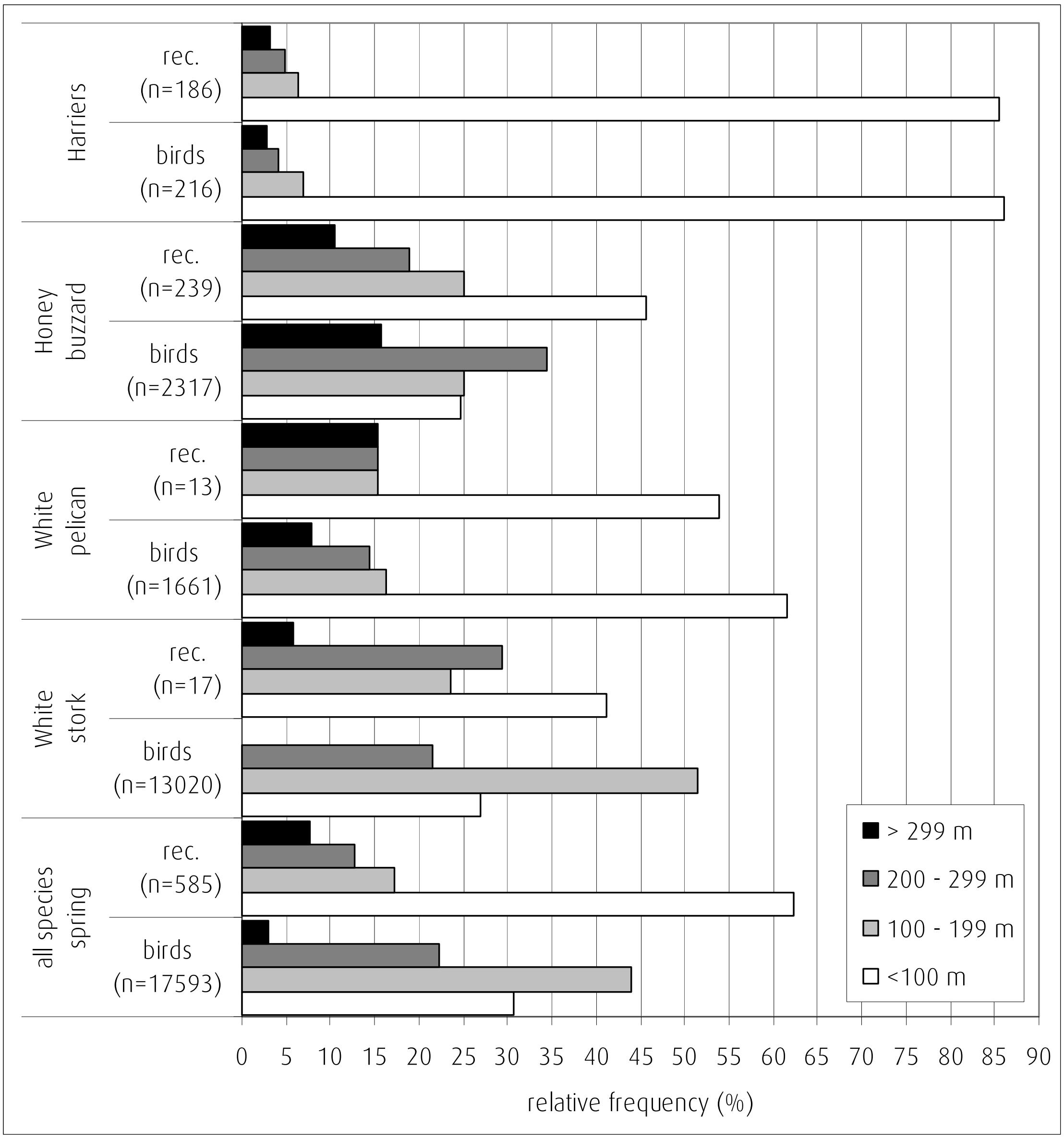



Figure 3.12: Relative frequency of all species, White stork, White pelicans, Honey buzzard and Harriers migrating at different flight altitudes at distances of up to 2.5 km from an observation site

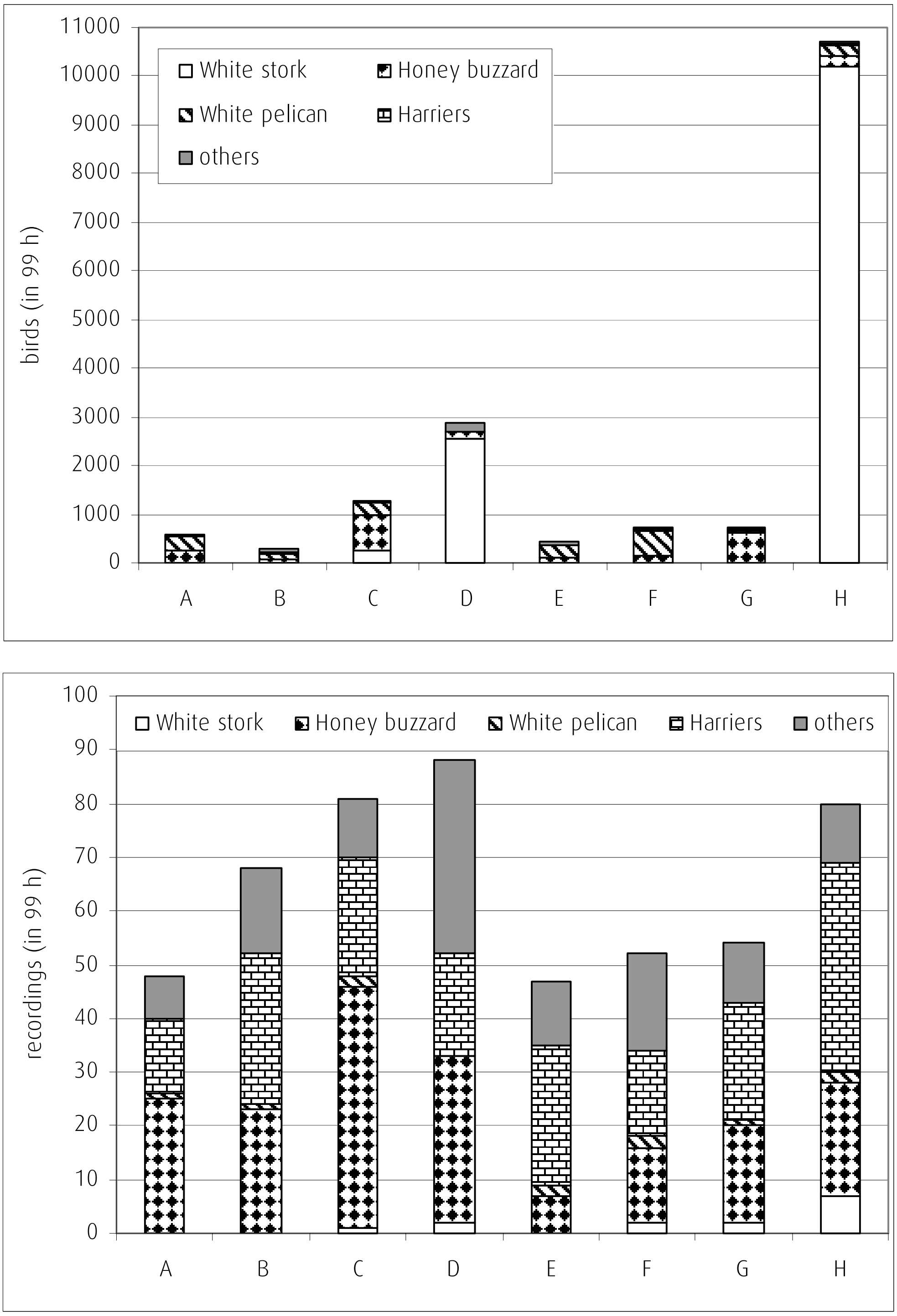
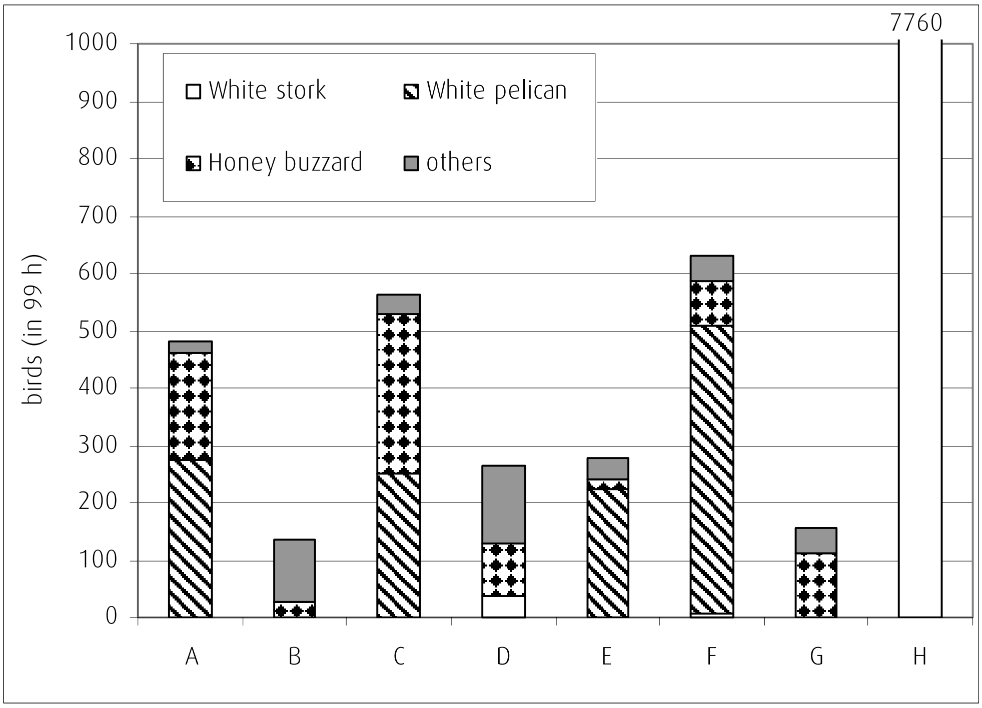



Figure 3.13: Total number of birds (above) / recordings (below) migrating at distances of up to 2.5 km to each observation site (in 99 hours of observations; without "area-correction" – factor for site E)



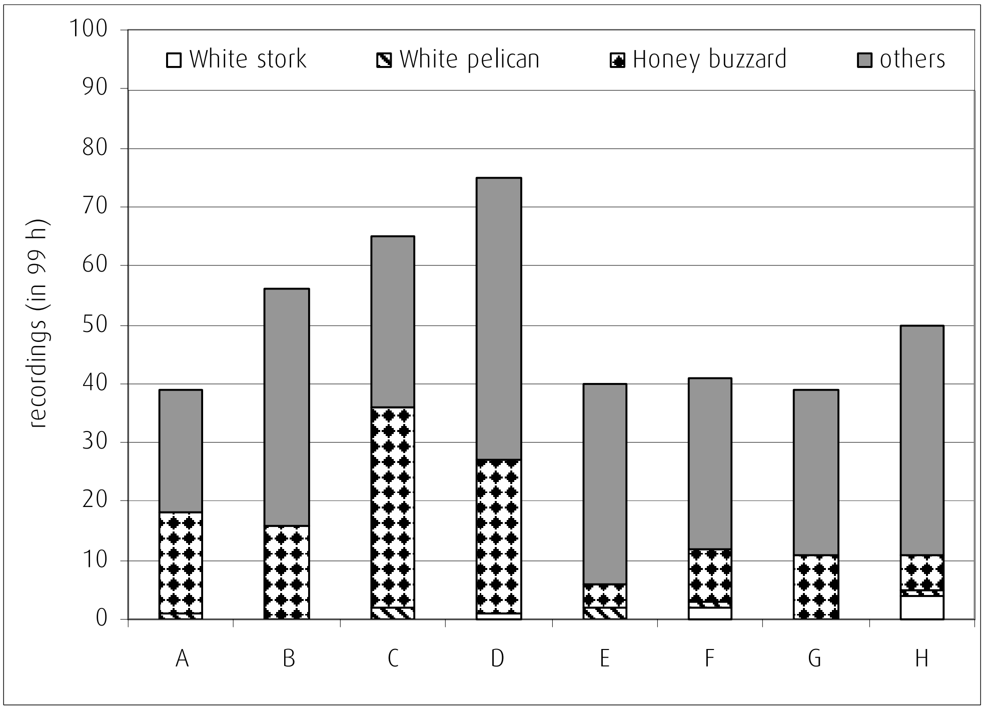




Figure 3.14: Total number of birds (above) / recordings (below) migrating at distances of up to 2.5 km to each observation site and below 200 m (in 99 hours of observations; without "area-correction" – factor for site E)

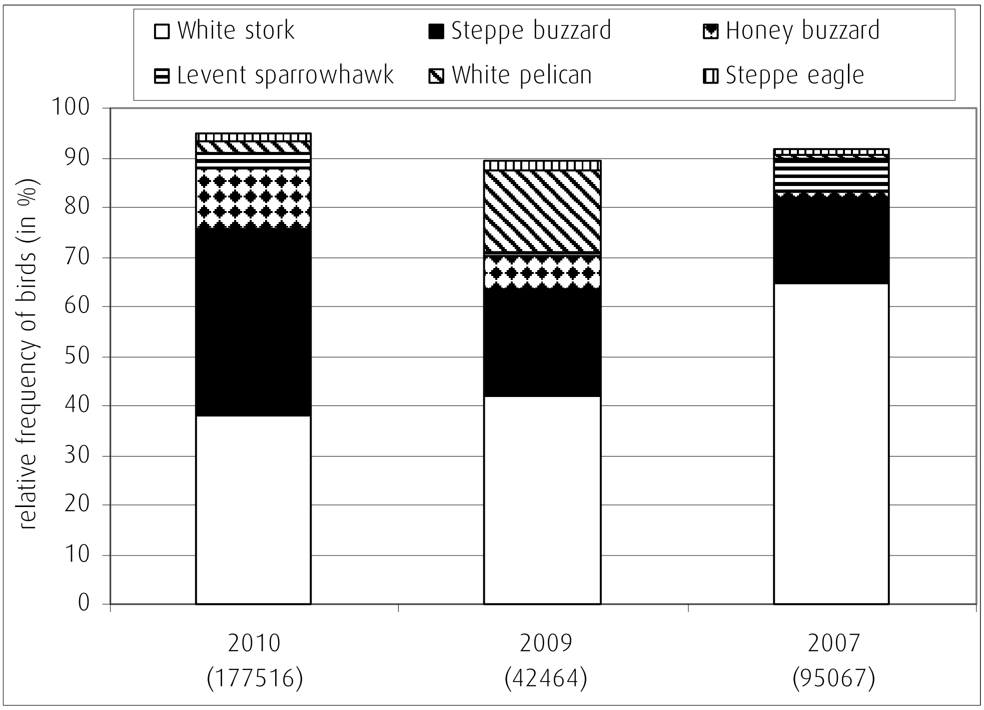



Figure 4.1: Comparison of the relative frequency of the most abundant species in the recent study conducted at the Gulf of Suez (spring 2010) and in previous studies conducted at the Gulf of el Zayt (BERGEN 2007: spring 2002; BERGEN 2009: spring 2009)

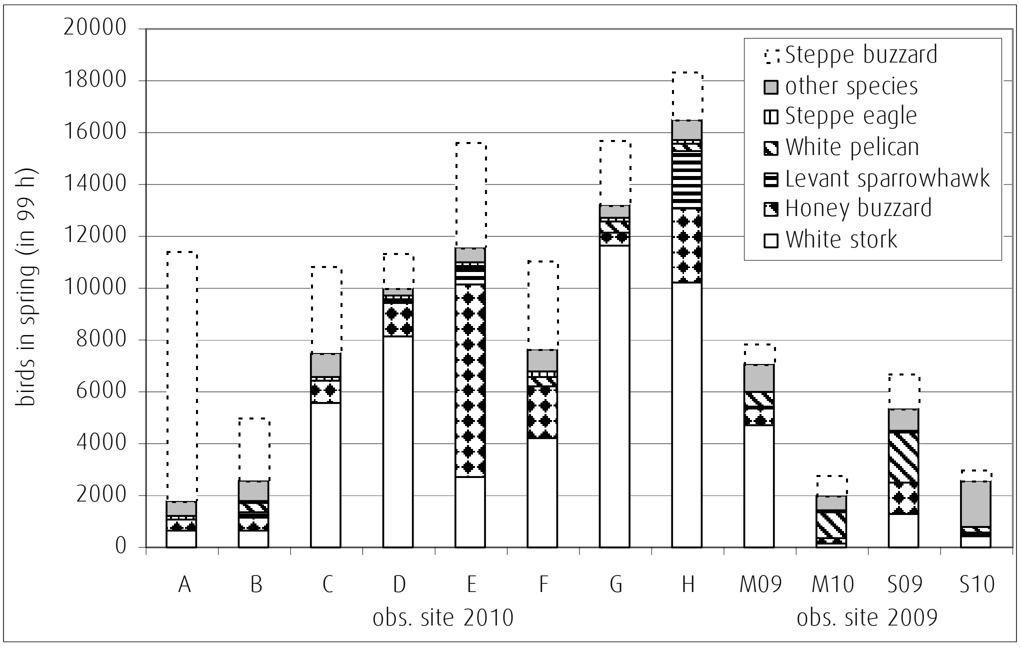



Figure 4.6: Total numbers of recorded birds migrating at distances of up to 2.5 km to each observation site at altitudes below 200 m in spring 2010 (study area) and in spring 2009 (Wadi Dara area: sites M09 to S10)

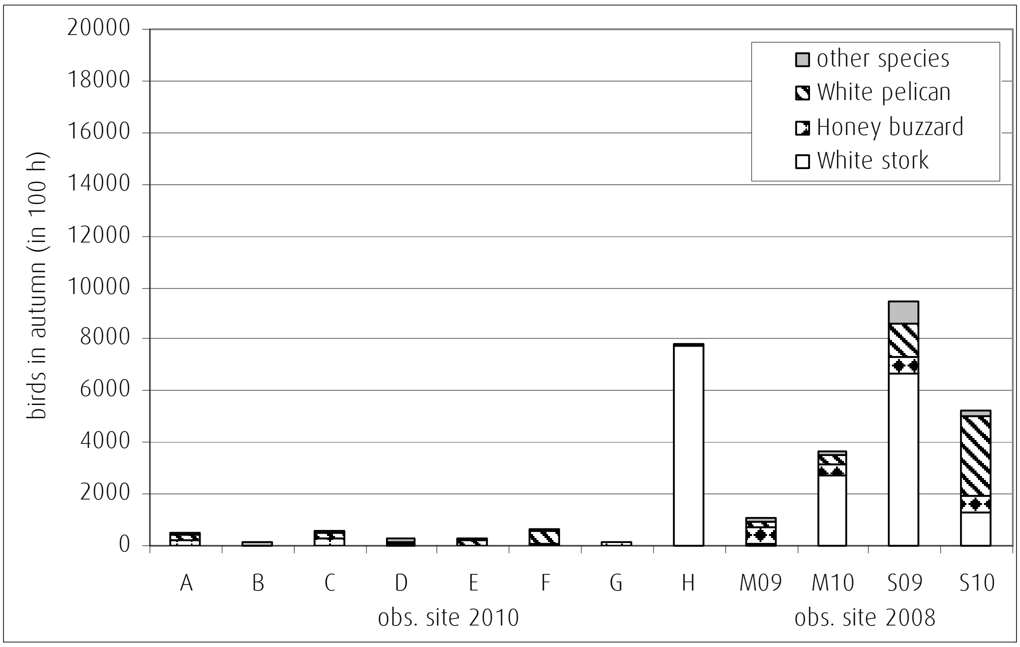



Figure 4.8: Total numbers of recorded birds migrating at distances of up to 2.5 km to each observation site at altitudes below 200 m in autumn 2010 (study area) and in autumn 2008 (Wadi Dara area: sites M09 to S10)

# Annex 2

# Project Design Document for early Stake-holder Participation

# English & Arabic

ARAB REPUBLIC OF EGYPT
MINISTRY OF ELECTRICITY AND ENERGY
NEW AND RENEWABLE ENERGY AUTHORITY (NREA)

# Project Design Document

# 1000 MW Wind Farm at Gulf of Suez

Bad Vilbel, 20.07.2010

JV LI - ecoda

## Table of Contents



## List of Figures

# 1 Executive Summary

The Government of Egypt (GoE) has allocated 200 km² of land at the Gulf of Suez near to Ras Gharib that shall be used for wind power development for up to 1000 MW. The project development is coordinated by NREA. The northern part of the area shall be used for the 250 MW BOO project. Further projects with a total installed capacity of 535 MW are in the pipeline. Currently an Environmental and Social Impact Assessment is carried out with the objective to satisfy the requirements for all individual projects. Major elements of the assessment are field surveys such as ornithological field monitoring over a spring and an autumn migration period, a representative survey on flora and fauna (others than avifauna) and a site reconnaissance survey.

The project design document considers the results of the reconnaissance survey only. The other surveys shall be concluded with the ornithological survey in autumn by end of 2010. Accordingly, the project design document does not yet consider ornithological restrictions. It needs to be emphasized that the ornithological spring surveys showed significant bird movement which will necessarily lead to restriction in wind power utilisation not yet shown in the design document.

As the individual projects are likely to be financed by International Financing Institutes the fulfilment of the Equator Principles shall be warranted. This document shows a typical wind farm configuration that shall be used for public disclosure of project planning, i.e. early stakeholder participation. The configuration considers restrictions identified during the reconnaissance survey such as

- Major Wadis that should not be used for siting of wind turbines,
- Geomorphologic constraints such as mountainous or escarpment areas,
- Bedouin family settlement with small palm tree garden,
- Existing infrastructure such as roads, electrical cable and water pipeline corridors and well pumps.

The wind farm layout shows typical wind farm configurations including buffer areas between wind parks for energy recovery. The access to the wind parks would be from the coastal Hurghada – Suez road via existing roads of the oil companies GPC (in the northern part) and Jiapco (in the south of the area). A 220 kV substation shall be erected centrally. From there a 220 kV transmission line shall evacuate the electricity to a 220/500 kV substation to be located near to Ras Gharib.

Operation and Maintenance of the wind parks shall be done

- Through central wind park server rooms for non continues use,
- Through local storage facilities in the area, e.g. next to the Hurghada - Suez Road in the reach of water and electricity (Outskirts of Ras Gharib),
- Office facilities and accommodation of personnel in Ras Gharib.

# 2 Purpose

The purpose of this “Project Design Document” is to show the typical wind park arrangements in the 200 km² development areas together with the related infrastructure and external access routes. The objective is to satisfy the ESIA requirements for all individual projects within the area so that ideally no additional ESIA will be required by the individual investors. Accordingly the wind power development in that area shall be done as realistic as it is possible at this stage of project development. This project design document shall be disclosed to the Public to allow early stakeholder participation and comments. It considers the findings as to date. Likely further restrictions will result from the ornithological surveys. Moreover, the comments and concerns of stakeholders will have to be considered in the final planning.

# 3 Introduction

The Government of Egypt (GoE) has allocated 200 km² of land at the Gulf of Suez near to Ras Gharib that shall be used for wind power development for up to 1000 MW. The project development is coordinated by NREA. The northern part of the area shall be used for the 250 MW BOO project. Further projects with a total installed capacity of 535 MW are in the pipeline. Currently an Environmental and Social Impact Assessment is carried out with the objective to satisfy the requirements for all individual projects. This document shall serve for early information and early participation of the public and other stakeholders to allow integration of concerns and comments in an early planning stage.

# 4 Description of the Project and typical Layout

## 4.1 Wind Power Development in the 200 km² area

For the development of up to 1000 MW of wind power by different investors the GoE has allocated an area of 200 km². The area is located at the Gulf of Suez about 20 km in the South-West of Ras Gharib. The approximate location is shown in Figure 1.

The access to the area is via the Hurghada – Suez road and from there by use of existing petroleum company roads such as GPC from the East and a JIAPCO controlled road in the South. The 200 km² area and the intended access roads and 220 kV transmission line are shown on Figure 2.

The clustering of the 200 km² area corresponds to the present ideas of NREA in land utilisation. The Northern Area is assigned to the 250 MW BOO project and the Southern area to MASDAR.


**Figure 1:** **Location of the ESIA Area**

The boundary coordinates are as follows:

| Border Co-ordinates | GEOGRAPHICAL COORDINATES (DATUM: WGS 1984) | |
|---|---|---|
| 23 | 28°11'8.34"N | 32°56'45.77"E |
| A6-3 | 28°12'55.38"N | 33° 6'32.66"E |
| 21 | 28° 5'27.50"N | 33° 9'14.00"E |
| 20 | 28° 7'28.50"N | 33° 8'13.50"E |
| 17 | 28°12'36.40"N | 33° 6'29.86"E |
| 22 | 28° 3'25.43"N | 33° 5'4.02"E |
| 19 | 28° 9'59.00"N | 33° 6'8.50"E |
| 4 BOO | 28°10'37.56"N | 33° 2'2.88"E |
| 18 | 28°10'40.96"N | 33° 8'6.67"E |
| X2 | 28°15'10.88"N | 32°59'28.54"E |
| X3 | 28°11'53.33"N | 32°55'45.54"E |

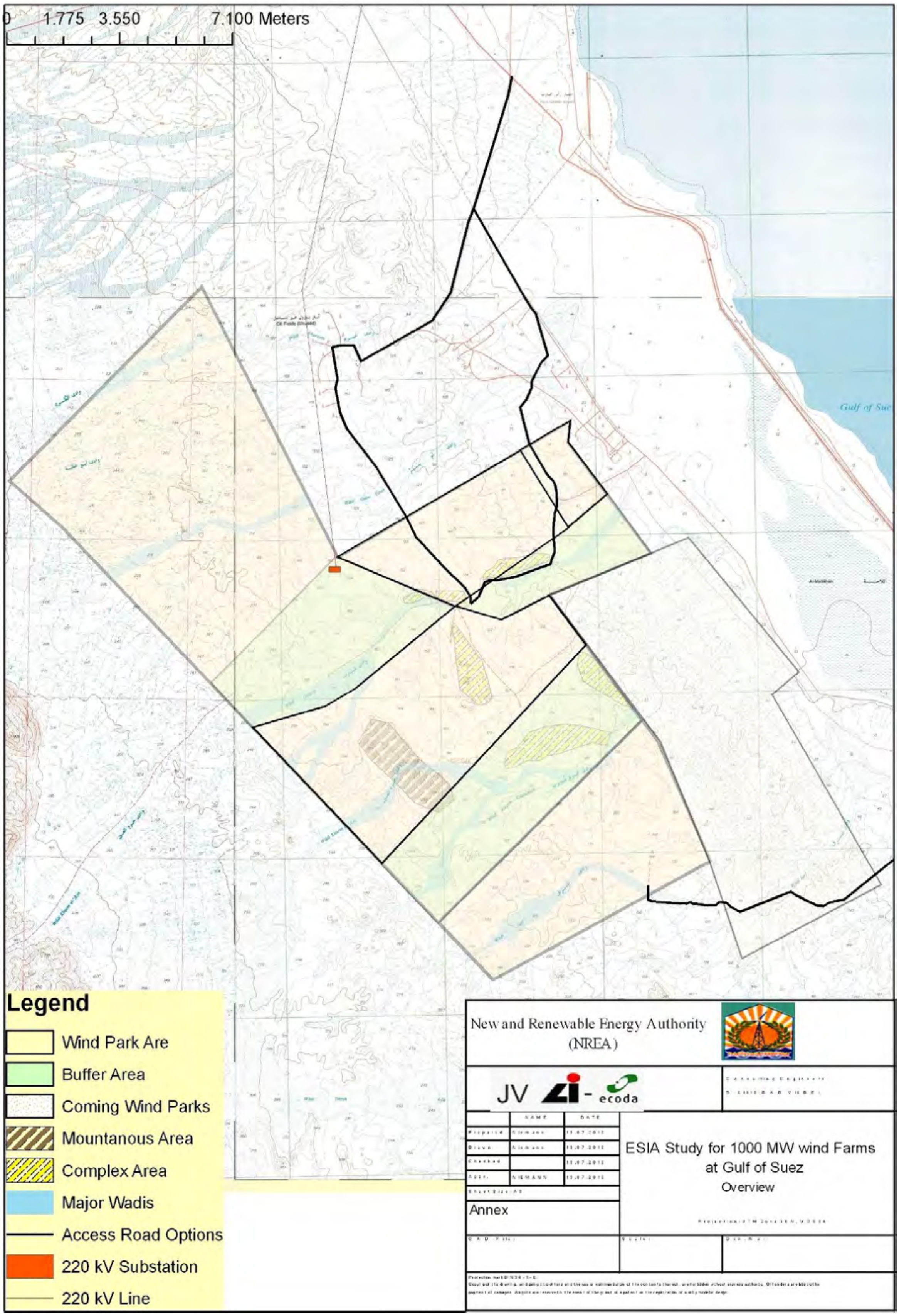



**Figure 2: General Overview**

## 4.2 Project Layout

The design lifetime of wind power plants is 20 years. Wind Power would typically be developed in rows perpendicular to the main wind direction in south-west to north-east direction at distances of about 10 to 12 times the rotor diameter, i.e. in case of larger wind turbines about 1000m. The distance within the rows is about 3.5 to 4 rotor diameters, i.e. 200 to 300 m. Further typical features of such a project within the project area are

- the wind turbine foundations of about 2 to 3 m depth and a surface of up to 15 x 15 m² in case of a large turbine (2 to 2.5 MW).
- tubular towers with diameters of up to 4.5 m at the footing and maximum blade tip heights of a maximum of 120 m above ground as per approval by military.
- depending on the type of selected wind turbine transformer stations may be contained inside the wind turbine towers or a small transformer compact station might be placed next to each turbine. The housing of such compact station would be not more than 2 m x 6 m.
- power cable trenches attached along the rows near to turbines, having a depth of about 1 to 1.5 m and a width of not more than 2.5 m. Inside the trenches plastic pipes with diameter of 5 cm for the control cables will be placed on top of the power cables.
- For each wind park a switchgear station container for electrical protection near to the 220 kV substation with dimensions in the order of 10 x 3 m.
- a central substation of 22/220 kV with an area requirement of about 150 to 350 m, assuming that it shall serve all wind parks within the 200 km² area.
- For each wind park a central wind park server room being a prefabricated container of about 3 x 5 m.
- wind park internal earth roads of 5 m width and erection platforms in the order of 25 x 40 m at each wind turbine, depending on the size of the wind turbine. Due to both, the nature of the project and the hyper-arid climate, there is no need for surface drainage.

Outside the project area the following measures have to be taken:

- Construction of a 220 kV transmission line towards Ras Gharib, where a 220/500 kV Substation is planned,
- Reinforcement of existing access roads of the petroleum companies as indicated in Figure 2.
- Erection of service facilities in the outskirts of Ras Gharib such as spare part store, office for O&M personnel and accommodation. These facilities shall have access to the Ras Gharib water and waste water schemes. They are subject to building permission of Ras Gharib Municipality.

The wind park design will exclude Wadis and steep mountainous areas. A typical wind park layout is shown in Figure 3. A visualisation of the wind park with 2 MW wind turbines from the temporary GPC offices is shown as Figure 4.

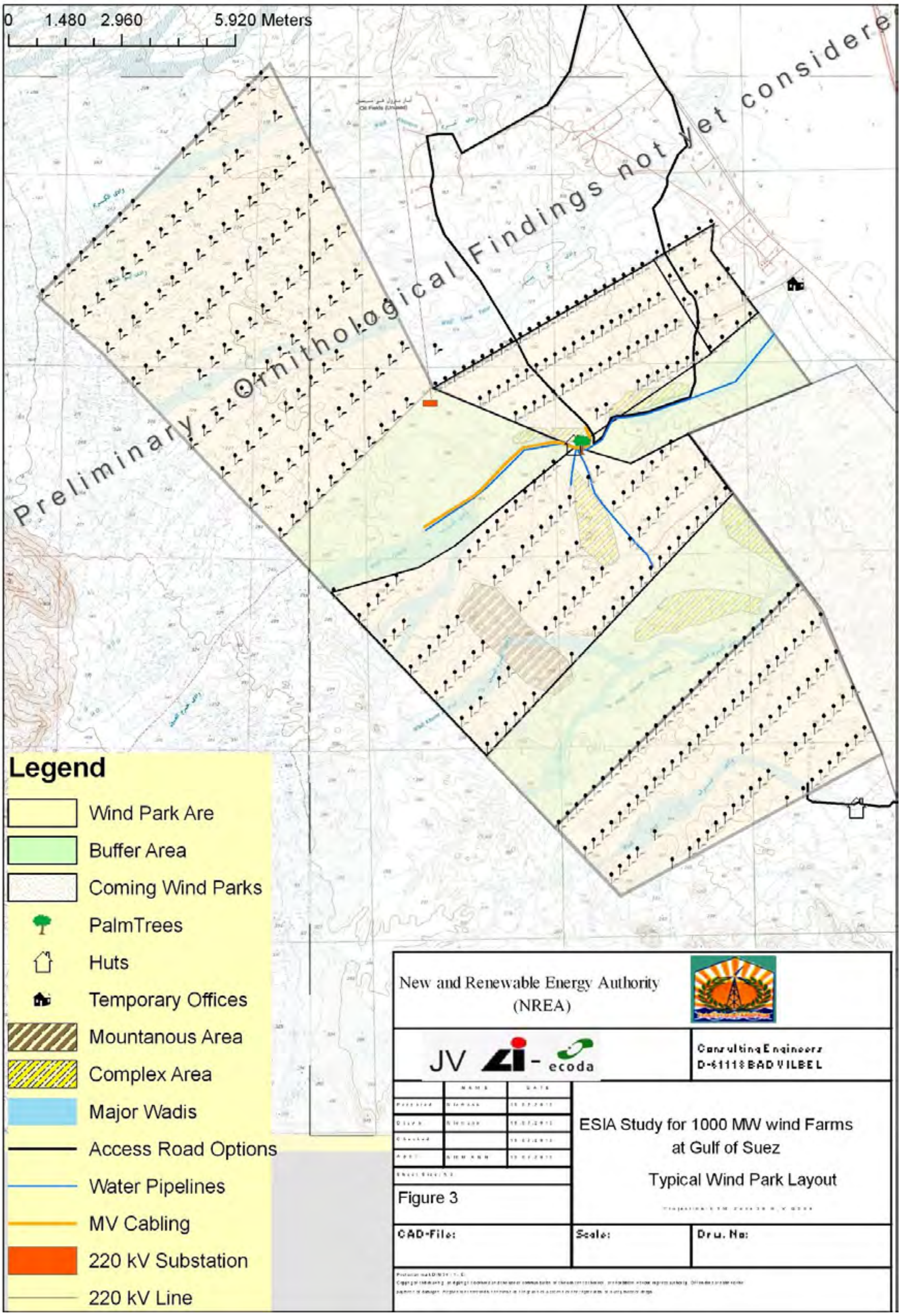



**Figure 3: Typical Wind Park Layouts**

**Figure 4: Visualisation from temporary GPC Offices**

## 4.3 Measures during the Construction Phase

Typical works to be carried out for wind power projects are limited to:

- Earth works: Excavation, backfilling and compaction works for road and platform construction as well as for foundation pits and trenches. Typical equipment used on the construction site are excavators, front-loaders, graders and compactors. No material will be taken from or to the area.
- Concrete works for foundations. As no water will be available at the site it is expected that ready mix concrete will be used. Otherwise aggregates and water will have to be brought to the site for concrete making in Contractor's batching plant.
- Wind turbine installation works using large mobile lifting capacities.

The erection works of the wind turbines are usually carried out by the wind turbine supplier with a team of own technicians, but supported by workers hired in the region. Civil works will probably be carried out by local companies.

For each Wind Park construction a temporary construction yard (for storage of materials and servicing of machinery) and a temporary office will be erected at a central place within the site. Such temporary facilities comprise of 4 to 6 rooms with simple sanitary facilities. Water supply would be via tankers. Electricity would be generated by a small mobile generator. Such office building would be for about 20 persons, who, however, spend much time at the construction sites. Proper non-hazardous solid waste management during the construction phase will be the responsibility of the contractor, who shall minimise origin of waste and collect the waste from the site and dispose it of in a regular way.  Minor quantities of hazardous waste such as used oil and grease shall be collected and recycled, as it is usually done because of it's value.

Construction measures would be supervised by engineers. Moreover, usually international Consultants would be employed for assistance. This supervision includes the assurance of Contractor's proper waste management and the proper land reclamation at the end of construction measures. The works and the site personnel shall be supervised by a health and safety engineer, who shall be assigned by the Contractor.

Associated works outside the "European Area" would be

- Contractors service installations: structural civil (house building) works in the outskirts of Ras Gharib
- 22 kV/220 kV substation to be carried out under control of the EEHC/EETC: The works comprise steel structural, civil works for housing, foundations and trenches and electrical works at medium and high voltage level.
- 220 kV transmission line interconnection to be carried out under control of the EEHC/EETC: Structural steel constructions with small foundations including working activities at heights

## 4.4 Measures during the O&M Phase

Measures during the O&M phase are very limited to

- Regular servicing of the wind park equipment, usually once per six months for each wind turbine and once per year for the electrical works.
- Repair of wind park equipment in case of defects. In case of defects on larger parts the provision of a large crane will be required from time to time.

# جمهورية مصر العربية

## وزارة الكهرباء والطاقة

## هيئة الطاقة الجديدة والمتجددة

## (NREA)

# أسس ووثائق تصميم مشروع

# انشاء مزارع رياح بقدرة 1000 ميجاوات

# بمنطقة خليج السويس

---

JV LI - ecoda

**بمنطقة خليج السويس**



**قائمة الرسومات واللوحات الايضاحية**



## 1- ملخص المشروع

قامت الحكومة المصرية بتخصيص 200 كيلومترمربع من الارض في منطقة خليج السويس قرب مدينة راس غارب وذلك لاستخدامها بواسطة هيئة الطاقة الجديدة

والمتجددة لتنمية وانشاء  مزارع رياح تصل إلى قدرة 1000 ميجاوات. وقد تم تخصيص الجزء الشمالي من الارض لمشروع انشاء مزرعة رياح بقدرة 250 ميجاوات تدار بواسطة القطاع الخاص. وهناك المزيد من المشاريع التي يبلغ مجموع الطاقة الاجمالية لها حوالي 535 ميجاوات بنفس المنطقة وهي في طور الاعداد حاليا. كما يجري الان دراسة المنطقة من ناحية البيئية وذلك بهدف تقييم الأثر البيئي والاجتماعي للمشروع والذي يعمل على تلبية احتياجات كافة المشاريع الفرديةالاخري.والعناصر الرئيسية بالدراسة هي المسح الحقلي مثل دراسة هجرة الطيور بالمنطقة في فترات الهجرة في موسمي الربيع والخريف كذلك دراسات النبات والحيوان بالمنطقة اضافة الي دراسات الموقع الاستكشافية وطبيعة الارض. ومع ملاحظة ان وثائق تصميم المشروع المبدئية اخذت في الاعتبار نتائج المسح الحقلي المبدئي من الطبيعة أما باقي استطلاعات البحث الحقلي ستأخذ في الاعتبار دراسة هجرة الطيور والمتوقع الانتهاء منها في نهاية خريف 2010 وبالتبعية فان وثائق تصميم المشروع لم تأخذ في الاعتبار اية قيود من نتائج دراسة هجرة الطيور في فترة الربيع.

ومن الضروري التأكيد علي ان نتائج الاستطلاعات والدراسات الخاصة بهجرة الطيور في فصل الربيع قد أظهرت بعض التغيير في حركة وانواع الطيور التي ستؤدي بالضرورة الي التاثير علي استخدامات مزارع الرياح بالمنطقة ولكن لم تظهر حتي الان في وثائق تصميم المشروع المبدئية.

ويشار الي ان المشاريع الفردية والتي ستمول بواسطة جهات تمويل دولية وهي جهات تلتزم بالمعايير والنظم ستكون ضمن نطاق هذه الدراسة.

وهذه الوثائق التي توضح مواصفات مزرعة الرياح النمطية او المثالية سوف تستخدم كمخطط للكشف العام عن خطة المشروع وبما يضمن المشاركة الشعبية من الجهات المختصة والمتعلقة بالمشروع مبكرا في دراسة المشروع وابداء الرأي.

وهناك بعض القيود التي تم رصدها من المسح الحقلي وهي مرتبة كالاتي:-

* الآودية الرئيسية والتي لايمكن وضع اوتوقيع التوربينات في مساراتها
*الطبيعة الجيولوجية للموقع مثل وجود بعض المناطق الجبلية العالية
* وجود بعض العائلات البدوية بالمنطقة حول الزراعات والاشجار
* وجود بعض المرافق والبنية التحتية بمنطقة الدراسة مثل الطرق وكابلات الكهرباء ومواسير المياه ومضخات ابار .

- مخطط مزرعة الرياح يوضح شكل مزرعة الرياح المثالية شاملة المناطق العازلة بين مزارع الرياح لاستعادة الطاقة (استرجاع طاقة الرياح).

- المسارات و الطرق المؤدية الى مزارع الرياح ستكون من الطريق الساحلى السويس – الغردقة عبر الطرق الخاصة القائمة حاليا و هى خاصة بشركات البترول

(الشركة العامة للبترول فى الجزء الشمالى ) و شركة جابكو فى الجزء الجنوبى من المنطقة .

- وسوف تنشئ محطة فرعية بقوة 220 كيلو فولت فى المنتصف و من هناك سوف يتم نقل الكهرباءبقوة 220 كيلو فولت عبر خطوط نقل الى المحطة الفرعية بالقرب من مدينة راس غارب بقدرة 220\500 كيلوفولت .

**التشغيل و الصيانة لمزرعة الرياح سوف يتم عن طريق :-**

1) غرف تحكم مركزية موجودة فى وسط المزرعة للاستخدامات الوقتية المتقطعة .

2) مرافق و تسهيلات خدمية و مخازن فى المنطقة بالقرب من طريق السويس – الغردقة بالقرب من مصادر المياة و الكهرباء المتاحة من مدبنة راس غارب.

3) مكاتب و اماكن سكن للافراد فى منطقة راس غارب.

**الغرض من المشروع :**

الغرض من وثيقة تصميم المشروع هو توضيح الشكل المثالى لتنمية مزارع الرياح فى مسطح 200 كيلو متر مربع مع المرافق البنية التحتية . و الهدف هو تحقيق او تطبيق الاشتراطات البيئية لكل المشروعات الفرعية الصغيرة بالمنطقة و بالتالى لن يكون هناك اية تطبيقات او اشتراطات بيئية اخرى لمشروعات المستثمريين المنفردة.
و علية فان تطوير و تنمية مزارع الرياح بهذه المنطقة سيتم بصورة اقرب الى الحقيقة فى هذه المرحلة من الدراسة .
ووثيقة تصميم المشروع سوف تحتوى مبكرا علي اراء جميع الجهات الشعبية والتنفيذية ذات الصلة بالمشروع لاتاحة الوقت لهم لتقديم مقترحاتكم و ملاحظاتكم و سيتم الاستجابة السريعة لهذه المشاركات و الاراء و بالاضافة الى القيود التى قد تنتح من دراسة هجرة الطيور.
و بالاضافة الى انه سيتم اخذ جميع الاراء و المقترحات من جميع الجهات فى المخطط النهائى .

**3- مقدمة :**

قامت الحكومة المصرية بتخصيص 200 كم مربع من الاراضى الواقعة على خليج السويس بالقرب من مدينة راس غارب و سوف تستخدم هذه الاراضى فى تنمية و انشاء مزارع الرياح بقدرة حتى 1000 ميجاوات.
و هذا المشروع سوف يتم تنميته بالاشتراك مع هيئة الطاقة الجديدة و المتجددة.

الجزء الشمالى من هذه الارض سوف يخصص لانشاء مزرعة رياح بقدرة 250 ميجاوات بنظام (القطاع الخاص ).اما باقى المشروعات المتوقعة فى حدود طاقة قدرة 525 ميجاوات فهى فى طى التنفيذ و جارى الان اعداد دراسة بيئية و اجتماعية لتحقيق مطالب و تغطية احتياجات جميع المشروعات المنفردة. وهذه الوثيقة سوف تاخذ فى الاعتبار مبكرا جميع المعلومات و جميع الملاخظات من جميع الهيئات و الجهات وثيقة الصلة بالمشروع لوضعها فى الحسبان فى التخطيط المبدئى و دراسة المشروع فى المرحلة الاولى .

## 4- وصف المشروع والمخطط العام للمشروع :

### 1-4 تنمية طاقة الرياح في منطقة 200 كم مربع :-

لتنمية مشروع انتاج الكهرباء من طاقة الرياح بقدرة 1000ميجاوات عن طريق المستثمريين قامت الحكومة المصرية بتخصيص منطقة مساحاتها و قدرها 200 كم مربع وهذه المنطقة تقع على خليج السويس حوالى 20 كيلو متر مربع من الجنوب الغربى لمدينة راس غارب (المنطقة المقترحة واضحة فى شكل رقم 1).

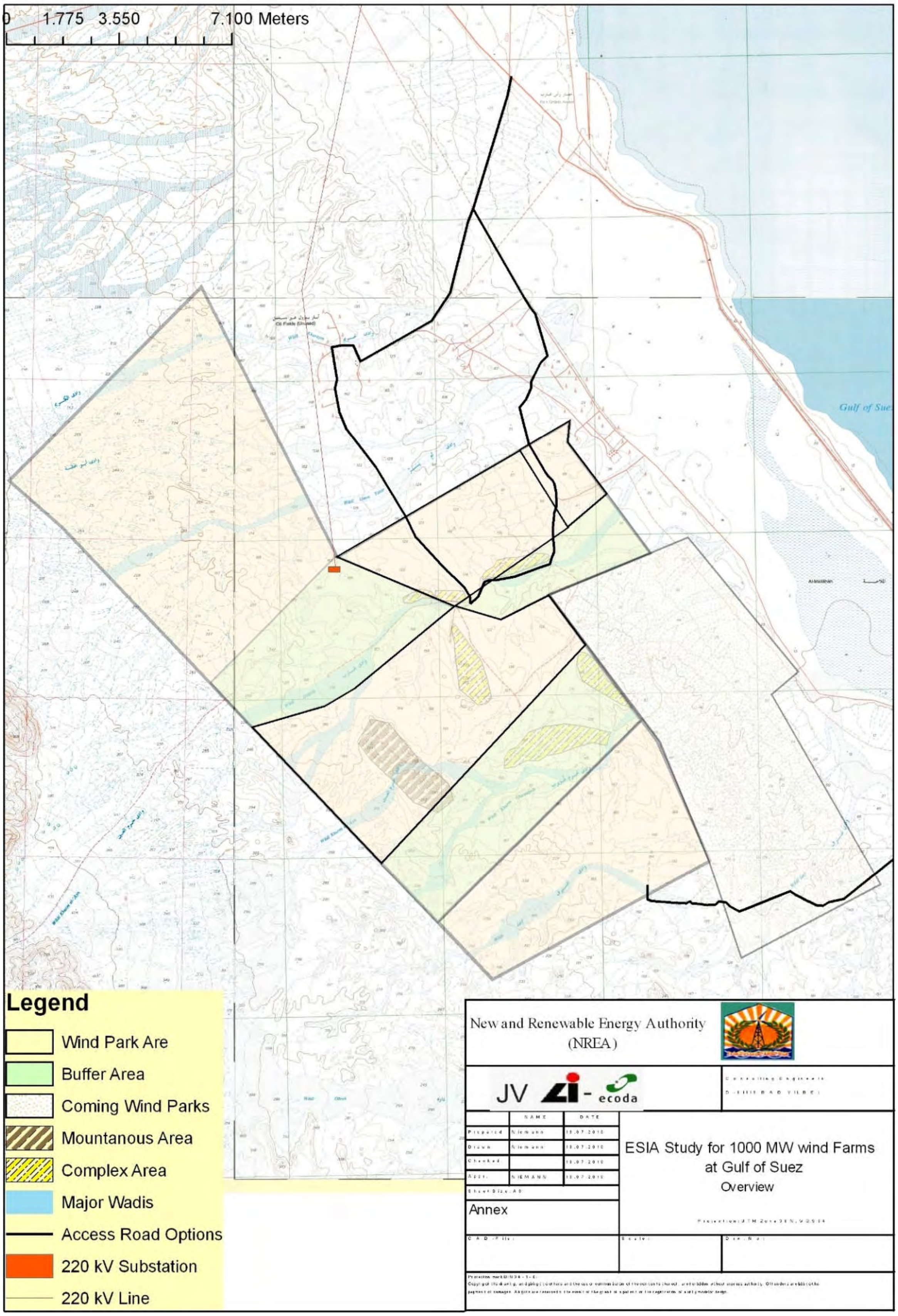
والوصول لهذه المنطقة من طريق السويس – الغردقة عن طريق استعمال الطرق الموجودة بالفعل و هى خاصة بشركات البترول العاملة فى المنطقة مثل الشركة العامة للبترول من الجهة الشرقية و طريق شركة جابكو من الجهة الجنوبية .و المنطقة المختارةو طرق الوصول البها و كذلك خطوط نقل الكهرباء يقدرة 220 كيلوفولت (موضحة بشكل رقم 2 ).

و يمثل تجميع هذه المساحة و قدرها 200 كم مربع فى الوقت الحاضر فرصة للاستفادة من هذه الافكار فى كيفية استخدام هذه الاراضى بواسطة هيئة الطاقة الجديدة و المتجددة والجزء الشمالى من هذه المنطقة تم تخصيصه لمشروع مزرعة الرياح بقدرة 250 ميجاوات بنظام (القطاع الخاص ).و الجزء الجنوبى تم تخصيصه لشركة المصدر الاماراتية.


**شكل رقم 1 :- موقع المشروع**

**احداثيات حدود موقع المشروع**

| اسم النقطة | احداثيات حدود موقع المشروع بنظامWGS 84 | |
|---|---|---|
| 23 | 28°11'8.34"N | 32°56'45.77"E |
| A6-3 | 28°12'55.38"N | 33° 6'32.66"E |
| 21 | 28° 5'27.50"N | 33° 9'14.00"E |
| 20 | 28° 7'28.50"N | 33° 8'13.50"E |
| 17 | 28°12'36.40"N | 33° 6'29.86"E |
| 22 | 28° 3'25.43"N | 33° 5'4.02"E |
| 19 | 28° 9'59.00"N | 33° 6'8.50"E |
| 4 BOO | 28°10'37.56"N | 33° 2'2.88"E |
| 18 | 28°10'40.96"N | 33° 8'6.67"E |
| X2 | 28°15'10.88"N | 32°59'28.54"E |
| X3 | 28°11'53.33"N | 32°55'45.54"E |




**2-4 مخطط المشروع**

العمر الافتراضى لمزرعة الرياح هو 20 عاما. اما توزيع توربينات الرياح يكون عادة ما يتم وضعها في صفوف عامودية على اتجاه الرياح في اتجاه الجنوب- الغرب الي الشمال- الشرق على مسافات تبلغ حوالي 10 إلى 12 امثال قطر الريشة.اي انه فى حالة التوربينات الكبيرة تكون المسافة حوالى 1000مترونكون المسافة بين الصفوف حوالى من 3.5 الى 4 اضعاف قطر الريشة (200 الى 300 متر). كذلك هناك المزيد من ملامح المزرعة النموذجية موجودة فى هذا المشروع وفي اطار نفس المنطقة وهي

*اساسات التوربينة الهوائية ستكون بعمق 2الى 3 متر من سطح الارض و بمساحات قدرها 15 ×15 متر مربع فى حالة التوربينات الكبيرة (2 الى 2.5 ميجاوات).

*التوربينات الهوائية ستكون انبوبية ذات قطريصل الى 4.5 متر عند القاعدة الخرسانية و بارتفاع يصل الى 120 متر كاقصى ارتفاع من فوق سطح الارض حتى اعلى منسوب بالريشة و ذلك حسب اعتماد الجهات العسكرية .

*اعتمادا على نوع التوربينة المختارة من الممكن ان يكون المحول الكهربائى الخاص بالتوربينة داخل التوربينة نفسها او يكون المحول بجانب كل توربينة وفى هذه الحالة سيكون المكان المخصص للمحول فى مساحة لا تتجاوز 2متر ×6 متر.

*مجارى كابلات التغذية ستكون ملاصقة للتوربينات فى صفوف طولية و ستكون بعمق من 1 متر الى 1.5 متر و بعرض لا يزيد عن 2.5 متر و سيكون بداخل هذه المجارى مواسير بلاستيك بقطر 5 سم لكابلات الكونترول و التى ستوضع فى اعلى منسوب كابلات التغذية.

*لكل مزرعة رياح سيتم وضع محطة تحويل فرعية و ذلك للحماية الكهربائية بالقرب من محطة 220 ك.فولت بمقاسات حوالى 10 ×3 متر.

*المحطة المركزية بقدرة 22\220 كيلوفولت امبير تحتاج الى مساحة قدرها من 150 الى 350 متر مربع وذلك على افتراض استخدام كل مزارع الرياح في مساحة 200 كم

*لكل مزرعة رياح سيتم وضع غرفة تحكم و تحويل سابقة التجهيز بمساحة قدرها 3متر ×5 متر.

*الطرق الداخلية لمزرعة الرياح ستكون بعرض 5 متر و منطقة تخزين مسطحة لتركيب التوربينة بمساحة قدرها 25 × 40 متر عند كل توربينة و ذلك حسب نوع و

حجم كل توربينة ويسبب طبيعة المشروع و المناخ الجافة فليس هناك مجال لاى صرف سطحى .

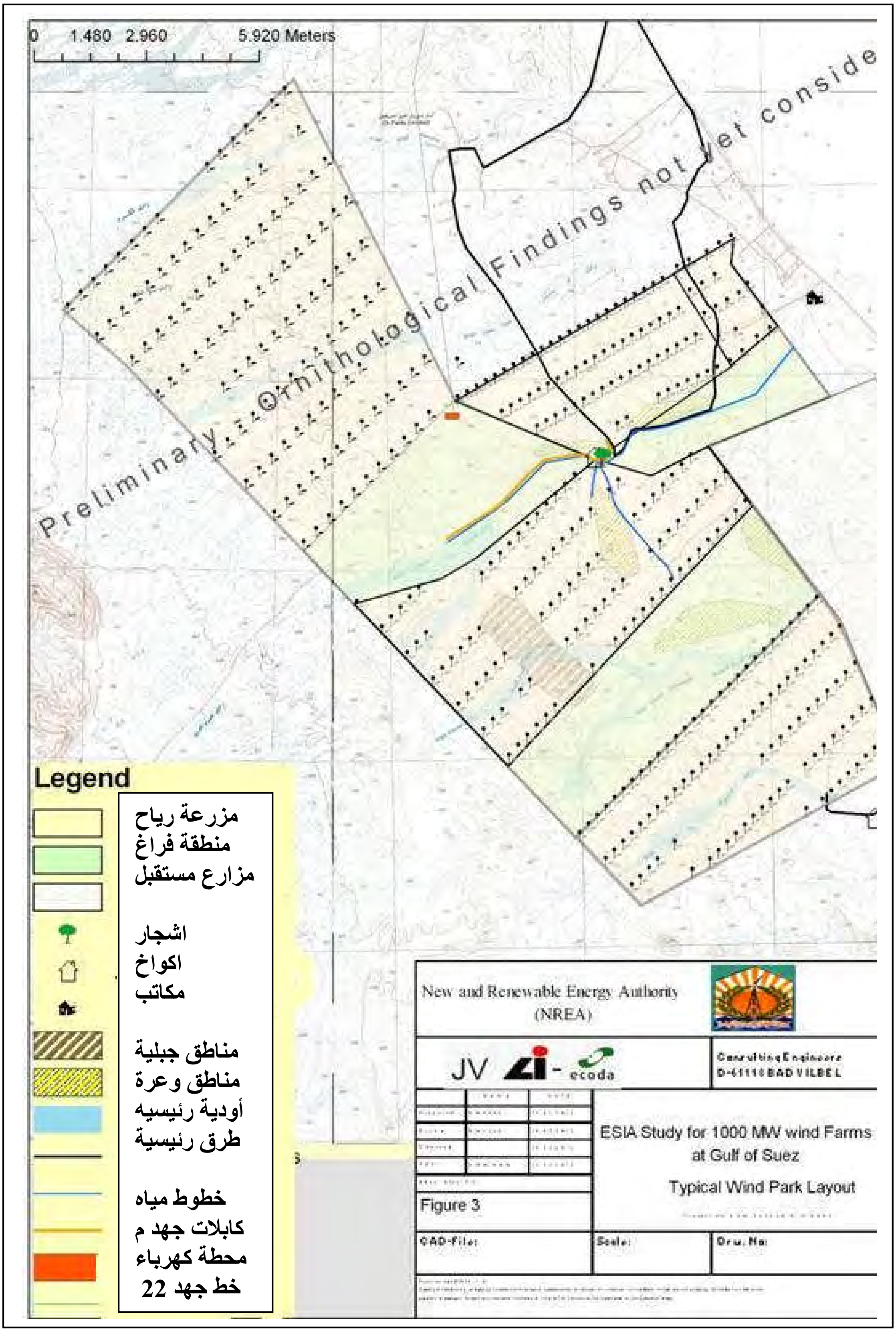
**اما خارج نطاق مساحة المشروع فهناك بعض الاعتبارات و التدابير يجب اتخاذها :**

- انشاء خط نقل للكهرباء بقدرة 220 ك.فولت باتجاه مدينة راس غارب حيث توجد مخطط لمحطة رئيسية بقدرة 220\500 كيلو فولت .

- الطرق المساندة للمشروع الخاصة بشركات البترول موضحة فى الشكل( 2 ).

- تشييد مرافق خدمية قريبة من مدينة راس غارب مثل مخازن قطع الغبار و مكاتب للتشغيل و الصيانة و اماكن لاقامة الافراد .هذه المرافق ستكون موصلة بخدمات المياة و الصرف الصحى التابعة لبلدية اس غارب.

* تصميم مزرعة الرياح لن يشمل الاودية و الاماكن الجبلية المنحدرة .
المخطط المثالى لمزرعة الرياح موضح فى الشكل 3.
المنظور الخاص بمزرعة الرياح ذات توربينات قدرة 2 ميجاوات من المكاتب المؤقتة للشركة العامة للبترول موضح فى شكل (4).



0 1.480 2.960 5.920 Meters
Preliminary Ornithological Findings not yet conside
Legend
مزرعة رياح
منطقة فراغ
مزارع مستقبل
اشجار
اكواخ
مكاتب
مناطق جبلية
مناطق وعرة
أودية رئيسيه
طرق رئيسية
خطوط مياه
كابلات جهد م
محطة كهرباء
خط جهد 22
New and Renewable Energy Authority
(NREA)
JV
ecoda
Consulting Engineers
ESIA Study for 1000 MW wind Farms
at Gulf of Suez
Typical Wind Park Layout
Figure 3
CAD-File:
Scale:
Draw. No:

**شكل 4 :- يوضح المنظور لمقترح مزرعة الرياح من جهة مكاتب الشركة العامة للبترول**

## <u>3-4:التدابير الواجب اتخاذها اثناء فترة التنفيذ:</u>

بالنسبة للاعمال الاعتيادية فى مشروعات طاقة الرياح تكون محدودة فى :-

-**اعمال ترابية** :-وهى عبارة عن الحفر و الردم و الدك للطرق و اماكن التخزين و كذلك اعمال حفر القواعد و مجارى الكابلات و المعدات المعروفة تستعمل فى هذه الاعمال مثل الحفارو اللودر و الجريدارات و الدكاكات و لاتورد مواد او تنقل اية مواد من المنطقة .

**اعمال الخرسانه بالنسبه للقواعد:**

حيث انه لا يوجد مصادر للماء بالقرب من المنطقه فمن التوقع استخدام خرسانه جاهزه لصب القواعد او قيام المقاول بتوريد المواد الخام من رمل و زلط و اسمنت الى الموقع و استخدام الخلاطه الميكانيكيه بالموقع لصب الخرسانه المسلحه .

توريد التوربينات يتطلب استخدام اوناش كبيره ذات اوزان كبيره و مختلفه .

اما اعمال التركيبات الخاصه بالتوربينات ففى معظم الاحيان تتم عن طريق المقاول مورد التوربينات و بواسطة معداته و طاقمه الفنى مدعما ببعض العماله المحليه الفنيه من المنطقه بينما تتم تنفيذ الاعمال المدنيه فى الغالب عن طريق شركات محليه .

و لكل مشروع مزرعة رياح تخصص منطقه مؤقته و مفتوحه ( لتخزين المواد و المعدات المستخدمه فى المشروع ).
كذلك يتم انشاء مكتب مؤقت للمشروع يتوسط منطقة انشاء المشروع حيث يتكون المكتب المؤقت من اربع او ست غرف مع صرف صحى مؤقت ويتم امداد المكاتب بالمياه عن طريق خزانات مياة مؤقته تملئ بالسيارات .
و يتم توصيل الكهرباء للمكاتب عن طريق مولد كهربائى صغير و يتسع هذا المكتب لحوالى 20 فرد من المقيمين معظم الوقت بالمشروع ومن المحتمل عدم وجود اية اضرار من المخلفات الصلبه البشريه الناتجه من الصرف اثناء التنفيذ حيث انها مخلفات غير ضارة بالصحه كما ان مشئولية التخلص منها بطريقة امنه ستكون مسئولية المقاول. اما الكميات الصغيره من المخلفات السائله مثل الزيوت و الشحوم فسوم يتم تجميعها و اعادة تدويرها و ذلك بسبب قيمتها العاليه.

اثناء التنفيذ سيتم مراقبة الاعمال بواسطة المهندسين و دائما فى الغالب يتم تكليف استشارى عالمى بالاشراف و متابعة تنفيذ الاعمال بالمشروع . وهذا الاشراف يضمن حسن ادارة المقاول للمشروع بصوره سليمه حتى نهاية مراحل الانشاء و تسليم الاعمال بصورة مرضيه .

جميع الاعمال و كذلك العاملين بالمشروع يخضعون لاجراءات الامن و السلامه و الاجراءات الصحيه السليمه الهندسيه و هى مسئوليه مقاول المشروع.

الاعمال المرتبطه باجراءات خارج المنطقه الاوروبيه كالاتى :-
*خدمات مقاول التوريدات :-
منشات و مبانى سكنيه بضواحى مدينة راس غارب

محطة كهرباء فرعية بقدره 220 كيلوفولت تنشئ تحت اشراف شركة النقل و شركة توزيع الكهرباء :-

و هذه الاعمال تشمل اعمال منشات معدنيه و اعمال مدنيه ومنشات سكنيه و قواعد و مجارى كابلات و اعمال الكهرباء للجهد المتوسط و الجهد العادى

اعمال خطوط النقل و التوزيع و الربط وتتم تحت اشراف شركتي النقل و التوزيع:-

و تشمل هذه الاعمال اعمال ابراج معدنيه و قواعد صغيرة و اعمال و انشطه تتم على ارتفاعات عاليه بالابراج

## 4-4 الاجراءات الواجب اتخاذها اثناء فترة التشغيل و الصيانه

اما الاجراءات الواجب اتخاذها اثناء فترة التشغيل و الصيانه فهى محدده كالاتى :-
*الصيانه و الخدمه المنتظمه لمعدات مزرعه الرياح و فى الغالب تتم مره واحده كل 6 شهور لكل توربينه و مره واحده سنويا لاعمال الكهرباء.

*تصليح معدات مزرعة الرياح فى حالة وجود عيوب بها و فى حالة وجود عيوب فى اجزاء كبيره من التوربينه سوف تكون هناك حاجة ضروريه لاستعمال ونش كبير الحجم من وقت لاخر.

# Annex 3

# Correspondence related to early Stake-holder Participation

Ministry of Electricity & Energy
**New & Renewable Energy Authority**
**(NREA)**
Dr. Ibrahim Aboulnaga St., Ext. of Abbas El Akkad St.,
Nasr City, Cairo, Egypt

وزارة الكهرباء والطاقة
**هيئة تنمية واستخدام الطاقة الجديدة والمتجددة**
شارع د. إبراهيم أبو النجا - امتداد شارع عباس العقاد
حى الزهور - مدينة نصر - القاهرة

١٢١١
٢٠١٠/٨/٣٠
(١٣١)

**السيد المهندس / رضا أحمد مصطفي**

**رئيس مجلس إدارة الشركة العامة للبترول**

تحية طيبة ... وبعـد ،،،

أتشرف بإحاطة سيادتكم أنه بناء علي القرار الجمهوري الصادر عن الحكومة المصرية تم تحديد مساحة حوالي ٢٠٠ كم$^2$ بمنطقة خليج السويس بالقرب من رأس غارب وذلك لإستخدامها في مشروع إنشاء وتنفيذ مزارع رياح تصل قدراتها الإجمالية إلي حوالي ١٠٠٠ ميجاوات، وستقوم هيئة الطاقة الجديدة والمتجددة بدور المنسق للمشروع.

يتم حالياً إعداد دراسة تقييم التأثيرات البيئية والإجتماعية للمنطقة المشار إليها، متضمناً ذلك مراقبة هجرات الطيور في فصلي الربيع والخريف لعام ٢٠١٠.

أتشرف أن أرفق مع هذا مستند أسس ووثائق تصميم المشروع الذي يوضح تصميماً نمطياً لمزارع الرياح المتوقع تنفيذها، والإستغلال الأمثل لمساحة الأرض، وذلك للعرض علي الجهات المهتمة والمحيطة بالمشروع من هيئات ووحدات إدارية وأفراد، للإطلاع وإبداء الرأي.

رجاء التكرم بالتنبيه نحو الإطلاع والدراسة وموافاتنا بتعليقات أو بمقترحات سيادتكم بشأن تنفيذ المشروع المشار إليه عاليه في موعد أقصاه ٣٠ سبتمبر ٢٠١٠، وذلك بخطاب مسجل بعلم الوصول علي العنوان التالي:

هيئة تنمية وإستخدام الطاقة الجديدة والمتجددة
شارع د. إبراهيم أبو النجا – إمتداد شارع عباس العقاد – حي الزهور – مدينة نصر _ القاهرة.

**وتفضلوا بقبول فائق الإحترام،،**

**الرئيس التنفيذي**

مع خالص الاحترام ٢٠١٠/٩/٢

**مهندس / عبد الرحمن صلاح الدين**

تم التسليم ٢٠١٠/٩/١٢

P.O. Box : 4544 Masakin Dobat - Elsaff
El-Hay El-Sades, Nar City, Cairo
Fax : (202) 22717173 - 22717172
Tel. Switch : 22725891 , 2 , 3 , 4

ص. ب : ٤٥٤٤ مكتب بريد مساكن ضباط الصف
الحى السادس - مدينة نصر - القاهرة
فاكس : ٢٢٧١٧١٧٣ - ٢٢٧١٧١٧٢ (٢٠٢)
التليفونات العمومية : ٢٢٧٢٥٨٩١ ، ٢ ، ٣ ، ٤

Ministry of Electricity & Energy
**New & Renewable Energy Authority**
**(NREA)**
Dr. Ibrahim Aboulnaga St., Ext. of Abbas El Akkad St.,
Nasr City, Cairo, Egypt

**وزارة الكهرباء والطاقة**
**هيئة تنمية واستخدام الطاقة الجديدة والمتجددة**
شارع د. إبراهيم أبو النجا - امتداد شارع عباس العقاد
حى الزهور - مدينة نصر - القاهرة

١٣٠٧
٣٠/٨/٢٠١٠
(١٣)

**السيدة الدكتورة / مواهب أبو العزم**

**الرئيس التنفيذي لجهاز شئون البيئة**

تحية طيبة ... وبعـد ،،،

أتشرف بإحاطة سيادتكم أنه بناء علي القرار الجمهوري الصادر عن الحكومة المصرية تم تحديد مساحة حوالي ٢٠٠ كم$^2$ بمنطقة خليج السويس بالقرب من رأس غارب وذلك لإستخدامها في مشروع إنشاء وتنفيذ مزارع رياح تصل قدراتها الإجمالية إلي حوالي ١٠٠٠ ميجاوات، وستقوم هيئة الطاقة الجديدة والمتجددة بدور المنسق للمشروع.

يتم حالياً إعداد دراسة تقييم التأثيرات البيئية والإجتماعية للمنطقة المشار إليها، متضمناً ذلك مراقبة هجرات الطيور في فصلي الربيع والخريف لعام ٢٠١٠.

أتشرف أن أرفق مع هذا مستند أسس ووثائق تصميم المشروع الذي يوضح تصميماً نمطياً لمزارع الرياح المتوقع تنفيذها، والإستغلال الأمثل لمساحة الأرض، وذلك للعرض علي الجهات المهتمة والمحيطة بالمشروع من هيئات ووحدات إدارية وأفراد، للإطلاع وإبداء الرأي.

رجاء التكرم بالتنبيه نحو الإطلاع والدراسة وموافاتنا بتعليقات أو بمقترحات سيادتكم بشأن تنفيذ المشروع المشار إليه عاليه في موعد أقصاه ٣٠ سبتمبر ٢٠١٠، وذلك بخطاب مسجل بعلم الوصول علي العنوان التالي:

**هيئة تنمية وإستخدام الطاقة الجديدة والمتجددة**

**شارع د. إبراهيم أبو النجا - إمتداد شارع عباس العقاد - حي الزهور - مدينة نصر _ القاهرة.**

**وتفضلوا بقبول فائق الإحترام،،**

**الرئيس التنفيذي**

مع خالص الاحترام ٢٠/٨/٢٠١٠

**مهندس / عبد الرحمن صلاح الدين**

P.O. Box : 4544 Masakin Dobat - Elsaff
El-Hay El-Sades, Nar City, Cairo
Fax : (202) 22717173 - 22717172
Tel. Switch : 22725891 , 2 , 3 , 4

ص. ب : ٤٥٤٤ مكتب بريد مساكن ضباط الصف
الحى السادس - مدينة نصر - القاهرة
فاكس : ٢٢٧١٧١٧٣ - ٢٢٧١٧١٧٢ (٢٠٢)
التليفونات العمومية : ٢٢٧٢٥٨٩١ ، ٢ ، ٣ ، ٤

Ministry of Electricity & Energy
New & Renewable Energy Authority
(NREA)
Dr. Ibrahim Aboulnaga St., Ext. of Abbas El Akkad St.,
Nasr City, Cairo, Egypt

وزارة الكهرباء والطاقة
هيئة تنمية واستخدام الطاقة الجديدة والمتجددة
شارع د. إبراهيم أبو النجا - امتداد شارع عباس العقاد
حى الزهور - مدينة نصر - القاهرة

١٢١٦
٢٠١٠/٨/٢٠
(٦٢)

**السيد العميد / محمد عبد الجواد**

**مدير عام الإدارة العامة للبيئة**

تحية طيبة ... وبعـد ،،،

أتشرف بإحاطة سيادتكم أنه بناء علي القرار الجمهوري الصادر عن الحكومة المصرية تم تحديد مساحة حوالي ٢٠٠ كم² بمنطقة خليج السويس بالقرب من رأس غارب وذلك لإستخدامها في مشروع إنشاء وتنفيذ مزارع رياح تصل قدراتها الإجمالية إلي حوالي ١٠٠٠ ميجاوات، وستقوم هيئة الطاقة الجديدة والمتجددة بدور المنسق للمشروع.

يتم حالياً إعداد دراسة تقييم التأثيرات البيئية والإجتماعية للمنطقة المشار إليها، متضمناً ذلك مراقبة هجرات الطيور في فصلي الربيع والخريف لعام ٢٠١٠.

أتشرف أن أرفق مع هذا مستند أسس ووثائق تصميم المشروع الذي يوضح تصميماً نمطياً لمزارع الرياح المنوقع تنفيذها، والإستغلال الأمثل لمساحة الأرض، وذلك للعرض علي الجهات المهتمة والمحيطة بالمشروع من هيئات ووحدات إدارية وأفراد، للإطلاع وإبداء الرأي.

رجاء التكرم بالتنبيه نحو الإطلاع والدراسة وموافاتنا بتعليقات أو بمقترحات سيادتكم بشأن تنفيذ المشروع المشار إليه عاليه في موعد أقصاه ٣٠ سبتمبر ٢٠١٠، وذلك بخطاب مسجل بعلم الوصول علي العنوان التالي:

هيئة تنمية وإستخدام الطاقة الجديدة والمتجددة
شارع د. إبراهيم أبو النجا - إمتداد شارع عباس العقاد - حي الزهور - مدينة نصر _ القاهرة.

**وتفضلوا بقبول فائق الإحترام،،**

**الرئيس التنفيذي**

مع خالص الاحترام ٢٠١٠/٨/٢٢

**مهندس / عبد الرحمن صلاح الدين**

٢٠١٠/٩/٥
استلمت الأصل
٢٠١٠/٩/٥

P.O. Box : 4544 Masakin Dobat - Elsaff
El-Hay El-Sades, Nar City, Cairo
Fax : (202) 22717173 - 22717172
Tel. Switch : 22725891 2, 3, 4

ص. ب : ٤٥٤٤ مكتب بريد مساكن ضباط الصف
الحى السادس - مدينة نصر - القاهرة
فاكس : ٢٢٧١٧١٧٣ - ٢٢٧١٧١٧٢ (٢٠٢)
التليفونات العمومية : ٢٢٧٢٥٨٩١ ٢ ، ٣ ، ٤

Ministry of Electricity & Energy
New & Renewable Energy Authority
(NREA)
Dr. Ibrahim Aboulnaga St., Ext. of Abbas El Akkad St.,
Nasr City, Cairo, Egypt

وزارة الكهرباء والطاقة
هيئة تنمية واستخدام الطاقة الجديدة والمتجددة
شارع د. إبراهيم أبو النجا - امتداد شارع عباس العقاد
حى الزهور - مدينة نصر - القاهرة

NREA

١٢٠٨
٢٠١٠/١/٨ ح
(١٢)

**السيد الأستاذ / على العشري**

**رئيس المجلس المحلى لمدينة رأس غارب**

**تحية طيبة ... وبعـد ،،،**

أتشرف بإحاطة سيادتكم أنه بناء علي القرار الجمهوري الصادر عن الحكومة المصرية تم تحديد مساحة حوالي ٢٠٠ كم$^2$ بمنطقة خليج السويس بالقرب من رأس غارب وذلك لإستخدامها في مشروع إنشاء وتنفيذ مزارع رياح تصل قدراتها الإجمالية إلي حوالي ١٠٠٠ ميجاوات، وستقوم هيئة الطاقة الجديدة والمتجددة بدور المنسق للمشروع.

يتم حالياً إعداد دراسة تقييم التأثيرات البيئية والإجتماعية للمنطقة المشار إليها، متضمناً ذلك مراقبة هجرات الطيور في فصلي الربيع والخريف لعام ٢٠١٠.

أتشرف أن أرفق مع هذا مستند أسس ووثائق تصميم المشروع الذي يوضح تصميماً نمطياً لمزارع الرياح المتوقع تنفيذها، والإستغلال الأمثل لمساحة الأرض، وذلك للعرض علي الجهات المهتمة والمحيطة بالمشروع من هيئات ووحدات إدارية وأفراد، للإطلاع وإبداء الرأي.

رجاء التكرم بالتنبيه نحو الإطلاع والدراسة وموافاتنا بتعليقات أو بمقترحات سيادتكم بشأن تنفيذ المشروع المشار إليه عاليه في موعد أقصاه ٣٠ سبتمبر ٢٠١٠، وذلك بخطاب مسجل بعلم الوصول علي العنوان التالي:

**هيئة تنمية وإستخدام الطاقة الجديدة والمتجددة**

شارع د. إبراهيم أبو النجا - إمتداد شارع عباس العقاد - حي الزهور - مدينة نصر _ القاهرة.

**وتفضلوا بقبول فائق الإحترام،،**

**الرئيس التنفيذي**

مع خالص التحية ٢٠١٠/١/١٢

**مهندس / عبد الرحمن صلاح الدين**

المجلس الشعبي المحلي لمدينة رأس غارب

٢٠١٠/١٩/٥

Ministry of Electricity & Energy
New & Renewable Energy Authority
(NREA)
Dr. Ibrahim Aboulnaga St., Ext. of Abbas El Akkad St.,
Nasr City, Cairo, Egypt

وزارة الكهرباء والطاقة
هيئة تنمية واستخدام الطاقة الجديدة والمتجددة
شارع د. إبراهيم أبو النجا - امتداد شارع عباس العقاد
حي الزهور - مدينة نصر - القاهرة

١٢٠٩
٢٠١٠/٨/٢٠
(١٢١)

**السيد اللواء / سعد الدين أمين**

**رئيس مجلس مدينة رأس غارب**

تحية طيبة ... وبعـد ،،،

أتشرف بإحاطة سيادتكم أنه بناء علي القرار الجمهوري الصادر عن الحكومة المصرية تم تحديد مساحة حوالي ٢٠٠ كم$^2$ بمنطقة خليج السويس بالقرب من رأس غارب وذلك لإستخدامها في مشروع إنشاء وتنفيذ مزارع رياح تصل قدراتها الإجمالية إلي حوالي ١٠٠٠ ميجاوات، وستقوم هيئة الطاقة الجديدة والمتجددة بدور المنسق للمشروع.

يتم حالياً إعداد دراسة تقييم التأثيرات البيئية والإجتماعية للمنطقة المشار إليها، متضمناً ذلك مراقبة هجرات الطيور في فصلي الربيع والخريف لعام ٢٠١٠.

أتشرف أن أرفق مع هذا مستند أسس ووثائق تصميم المشروع الذي يوضح تصميماً نمطياً لمزارع الرياح المتوقع تنفيذها، والإستغلال الأمثل لمساحة الأرض، وذلك للعرض علي الجهات المهتمة والمحيطة بالمشروع من هيئات ووحدات إدارية وأفراد، للإطلاع وإبداء الرأي.

رجاء التكرم بالتنبيه نحو الإطلاع والدراسة وموافاتنا بتعليقات أو بمقترحات سيادتكم بشأن تنفيذ المشروع المشار إليه عاليه في موعد أقصاه ٣٠ سبتمبر ٢٠١٠، وذلك بخطاب مسجل بعلم الوصول علي العنوان التالي:

**هيئة تنمية وإستخدام الطاقة الجديدة والمتجددة**

شارع د. إبراهيم أبو النجا - إمتداد شارع عباس العقاد - حي الزهور - مدينة نصر _ القاهرة.

**وتفضلوا بقبول فائق الإحترام،،**

استلمت الأصل
٢٠١٠/٩/٥

مع خالص الاحترام

**الرئيس التنفيذي**

**مهندس / عبد الرحمن صلاح الدين**

P.O. Box : 4544 Masakin Dobat - Elsaff
El-Hay El-Sades, Nar City, Cairo
Fax : (202) 22717173 - 22717172

ص. ب : ٤٥٤٤ مكتب بريد مساكن ضباط الصف
الحي السادس - مدينة نصر - القاهرة
فاكس : ٢٢٧١٧١٧٣ - ٢٢٧١٧١٧٢ (٢٠٢)
التليفونات العمومية : ٢٢٧٢٥٨٩١ ، ٢ ، ٣ ، ٤

Ministry of Electricity & Energy
New & Renewable Energy Authority
(NREA)
Dr. Ibrahim Aboulnaga St., Ext. of Abbas El Akkad St.,
Nasr City, Cairo, Egypt

وزارة الكهرباء والطاقة
هيئة تنمية واستخدام الطاقة الجديدة والمتجددة
شارع د. إبراهيم أبو النجا - امتداد شارع عباس العقاد
حى الزهور - مدينة نصر - القاهرة

١٥١٢
٢٠١٠/٨/٣٠
(١٢)

**السيد المهندس/ إبراهيم طه الخليفي**

**مدير عام المنطقة للخدمات المساعدة - خليج السويس**

**شركة بترول خليج السويس (جابكو)**

**تحية طيبة ... وبعـد ،،،**

أتشرف بإحاطة سيادتكم أنه بناء علي القرار الجمهوري الصادر عن الحكومة المصرية تم تحديد مساحة حوالي ٢٠٠ كم٢ بمنطقة خليج السويس بالقرب من رأس غارب وذلك لإستخدامها في مشروع إنشاء وتنفيذ مزارع رياح تصل قدراتها الإجمالية إلي حوالي ١٠٠٠ ميجاوات، وستقوم هيئة الطاقة الجديدة والمتجددة بدور المنسق للمشروع.

يتم حالياً إعداد دراسة تقييم التأثيرات البيئية والإجتماعية للمنطقة المشار إليها، متضمناً ذلك مراقبة هجرات الطيور في فصلي الربيع والخريف لعام ٢٠١٠.

أتشرف أن أرفق مع هذا مستند أسس ووثائق تصميم المشروع الذي يوضح تصميماً نمطياً لمزارع الرياح المتوقع تنفيذها، والإستغلال الأمثل لمساحة الأرض، وذلك للعرض علي الجهات المهتمة والمحيطة بالمشروع من هيئات ووحدات إدارية وأفراد، للإطلاع وإبداء الرأي.

رجاء التكرم بالتنبيه نحو الإطلاع والدراسة وموافاتنا بتعليقات أو بمقترحات سيادتكم بشأن تنفيذ المشروع المشار إليه عاليه في موعد أقصاه ٣٠ سبتمبر ٢٠١٠، وذلك بخطاب مسجل بعلم الوصول علي العنوان التالي:

هيئة تنمية وإستخدام الطاقة الجديدة والمتجددة

**شارع د. إبراهيم أبو النجا - إمتداد شارع عباس العقاد - حي الزهور - مدينة نصر _ القاهرة.**

**وتفضلوا بقبول فائق الإحترام،،**

**الرئيس التنفيذي**

مع فائق الاحترام

**مهندس / عبد الرحمن صلاح الدين**

استلمت الاصل

GULF OF SUEZ PETROLEUM CO.

P.O. Box : 4544 Masakin Dobat - Elsaff
El-Hay El-Sades, Nar City, Cairo
Fax : (202) 22717173 - 22717172

ص. ب : ٤٥٤٤ مكتب بريد مساكن
الحى السادس - مدينة نصر - القاهرة
فاكس : ٢٢٧١٧١٧٣ - ٢٢٧١٧١٧٢ (٢٠٢)
التليفونات العمومية : ٤ ، ٣ ، ٢ ٢٢٧٢٥٨٩١

Ministry of Electricity & Energy
w & Renewable Energy Authority
(NREA)
Ibrahim Aboulnaga St., Ext. of Abbas El Akkad St.,
Nasr City, Cairo, Egypt

وزارة الكهرباء والطاقة
هيئة تنمية واستخدام الطاقة الجديدة والمتجددة
شارع د. إبراهيم أبو النجا - امتداد شارع عباس العقاد
حى الزهور - مدينة نصر - القاهرة

**السيد المهندس / محمد أبو الوفا**

**رئيس مجلس إدارة شركة بترول خليج السويس (جابو)**

تحية طيبة ... وبعـد ،،،

أتشرف بإحاطة سيادتكم أنه بناء علي القرار الجمهوري الصادر عن الحكومة المصرية تم تحديد مساحة حوالي ٢٠٠ كم٢ بمنطقة خليج السويس بالقرب من رأس غارب وذلك لإستخدامها في مشروع إنشاء وتنفيذ مزارع رياح تصل قدراتها الإجمالية إلي حوالي ١٠٠٠ ميجاوات، وستقوم هيئة الطاقة الجديدة والمتجددة بدور المنسق للمشروع.

يتم حالياً إعداد دراسة تقييم التأثيرات البيئية والإجتماعية للمنطقة المشار إليها، متضمناً ذلك مراقبة هجرات الطيور في فصلي الربيع والخريف لعام ٢٠١٠.

أتشرف أن أرفق مع هذا مستند أسس ووثائق تصميم المشروع الذي يوضح تصميماً نمطياً لمزارع الرياح المتوقع تنفيذها، والإستغلال الأمثل لمساحة الأرض، وذلك للعرض علي الجهات المهتمة و المحيطة بالمشروع من هيئات ووحدات إدارية وأفراد، للإطلاع وإبداء الرأي.

رجاء التكرم بالتنبيه نحو الإطلاع والدراسة وموافاتنا بتعليقات أو بمقترحات سيادتكم بشأن تنفيذ المشروع المشار إليه عاليه في موعد أقصاه ٣٠ سبتمبر ٢٠١٠م وذلك بخطاب مسجل بعلم الوصول علي العنوان التالي:

**هيئة تنمية وإستخدام الطاقة الجديدة والمتجددة**

شارع د. إبراهيم أبو النجا - إمتداد شارع عباس العقاد - حي الزهور - مدينة نصر _ القاهرة.

**وتفضلوا بقبول فائق الإحترام،،**

**الرئيس التنفيذي**

**مهندس / عبد الرحمن صلاح الدين**

P.O. Box : 4544 Masakin Dobat - Elsaff
El-Hay El-Sades, Nar City, Cairo
Fax : (202) 22717173 - 22717172
Tel. Switch : 22725891 , 2 , 3 , 4

ص. ب : ٤٥٤٤ مكتب بريد مساكن ضباط الصف
الحى السادس - مدينة نصر - القاهرة
فاكس : ٢٢٧١٧١٧٣ - ٢٢٧١٧١٧٢ (٢٠٢)
التليفونات العمومية : ٢٢٧٢٥٨٩١ ، ٢ ، ٣ ، ٤

١٢٦١
٩/٢

Ministry of Electricity & Energy
New & Renewable Energy Authority
(NREA)
Dr. Ibrahim Aboulnaga St., Ext. of Abbas El Akkad St.,
Nasr City, Cairo, Egypt

وزارة الكهرباء والطاقة
هيئة تنمية واستخدام الطاقة الجديدة والمتجددة
شارع د. إبراهيم أبو النجا - امتداد شارع عباس العقاد
حى الزهور - مدينة نصر - القاهرة

١٢١٥
٢٠١٠/٨/٢٠
(١٢)

**السيد اللواء / سعيد محمد جبر**

**سكرتير عام محافظة البحر الأحمر**

تحية طيبة ... وبعـد ،،،

أتشرف بإحاطة سيادتكم أنه بناء علي القرار الجمهوري الصادر عن الحكومة المصرية تم تحديد مساحة حوالي ٢٠٠ كم$^2$ بمنطقة خليج السويس بالقرب من رأس غارب وذلك لإستخدامها في مشروع إنشاء وتنفيذ مزارع رياح تصل قدراتها الإجمالية إلي حوالي ١٠٠٠ ميجاوات، وستقوم هيئة الطاقة الجديدة والمتجددة بدور المنسق للمشروع.

يتم حالياً إعداد دراسة تقييم التأثيرات البيئية والإجتماعية للمنطقة المشار إليها، متضمناً ذلك مراقبة هجرات الطيور في فصلي الربيع والخريف لعام ٢٠١٠.

أتشرف أن أرفق مع هذا مستند أسس ووثائق تصميم المشروع الذي يوضح تصميماً نمطياً لمزارع الرياح المتوقع تنفيذها، والإستغلال الأمثل لمساحة الأرض، وذلك للعرض علي الجهات المهتمة والمحيطة بالمشروع من هيئات ووحدات إدارية وأفراد، للإطلاع وإبداء الرأي.

رجاء التكرم بالتنبيه نحو الإطلاع والدراسة وموافاتنا بتعليقات أو بمقترحات سيادتكم بشأن تنفيذ المشروع المشار إليه عاليه في موعد أقصاه ٣٠ سبتمبر ٢٠١٠، وذلك بخطاب مسجل بعلم الوصول علي العنوان التالي:

**هيئة تنمية وإستخدام الطاقة الجديدة والمتجددة**

شارع د. إبراهيم أبو النجا - إمتداد شارع عباس العقاد - حي الزهور - مدينة نصر _ القاهرة.

**وتفضلوا بقبول فائق الإحترام،،**

**الرئيس التنفيذي**

مع خالص الاحترام ٢٠١٠/٨/٢١

**مهندس / عبد الرحمن صلاح الدين**

أ. ستلمت الأصل
ناديه
٢٠١٠/٩/٢

P.O. Box : 4544 Masakin Dobat - Elsaff
El-Hay El-Sades, Nar City, Cairo
Fax : (202) 22717173 - 22717172

ص. ب : ٤٥٤٤ مكتب بريد مساكن ضباط الصف
الحى السادس - مدينة نصر - القاهرة
فاكس : ٢٢٧١٧١٧٣ - ٢٢٧١٧١٧٢ (٢٠٢)
التليفونات العمومية : ٤ ، ٣ ، ٢ ٢٢٧٢٥٨٩١

محافظة البحر الأحمر
الإدارة العامة لشئون البيئة
ادارة التفتيش والملاحقة القانونية

**السيد المهندس/ عبدالرحمن صلاح الدين**

الرئيس التنفيذى لهيئة تنمية وإستخدام الطاقة الجديده والمتجدده

العنوان : هيئة تنمية وإستخدام الطاقة الجديده والمتجدده – ش د/إبراهيم أبوالنجا - إمتداد ش عباس العقاد – مدينة نصر- القاهره

*تحيه طيبه ... وبعد ،،،*

بناءا على كتابكم الوارد لنا برقم ٢٠٥٦ بتاريخ ٢٠١٠/٩/٢ بشأن المقترحات الخاصة بتنفيذ مشروع مزارع الرياح جنوب غرب مدينة رأس غارب .

نتشرف بأن نحيط سيادتكم ببعض المقترحات اللازمه لإعداد دراسة تقييم الأثر البيئى للمشروع :

**١- وصف المنطقة المقترح إنشاء المشروع عليها وصفا تفصيليا والمنطقة المحيطة مع الأخذ فى الإعتبار أقرب منطقة سكنية وكذلك الطرق الرئيسيه والأودية والتى يمكن أن تكون مخرات للسيول ومسارات الطائرات .**

**٢- هناك بعض القضايا البيئية المرتبطة بمشاريع مزارع الرياح والتى يجب مراعاتها عند إعداد دراسة تقييم الأثر البيئى للمشروع وهى كما يلى :-**

>> الآثار البصرية والتى تتعلق عادة بالتوربينات ذاتها مثل لونها وارتفاعها وعددها ويوصى
أ- مراعاة خواص المناظر الطبيعية عند إختيار موقع التوربينات وتماثل التوربينات فى الحجم والتصميم.
ب- الحد من الإنشاءات الملحقة فى الموقع عن طريق تجنب التسييج وتقليل الطرق ودفن خطوط الطاقه

>> الضوضاء والتى تسببها حركة الرياح حول أرياش التوربينات والبرج والتى يمكن التقليل من شدتها بمراعاة معايير التصميم الهندسى والالتزام بالمعايير التصميمه الدولية للتوربينات الهوائية.

>> نفوق الأنواع الحيه أو إصابتها أو إقلالها : فقد يؤدى تشغيل التوربينات الهوائية إلى إصطدام الطيور بالأرياش الدواره للتوربينات الهوائية أو الأبراج ويوصى بالرجوع فى هذا الشأن إلى قطاع حماية الطبيعة بجهاز شئون البيئة لمعرفة مسارات هجرة الطيور والمناطق التى تتركز فيها .

>> مراعاة إهتزاز الظل وتلألؤ الأرياش بسبب إنعكاس ضوء الشمس مما يؤثر على المناطق السكنية وحركة السيارات على الطرق القريبة وهذه ظاهرة مؤقته فقط للتوربينات الجديده وتختفى عادة مع الوقت ويوصى بطلاء ابراج التوربينات بطلاء غير عاكس.

>> التداخل الكهرومغناطيسى والذى قد يحدث مع أنظمة رادار الطيران والاتصالات السلكية واللاسكية ( مثل الميكروييف والتلفزيون والراديو).

**٣- الآثار البيئية أثناء أعمال الإنشاء وتهيئة الأرض من أجل إعداد الموقع وإنشاء طرق الوصول والحفر والتفجير والردم ؛ نقل مواد الإمداد والوقود وإنشاء الأساسات التى تتضمن الحفر ووضع الخرسانه .**

**٤- إعداد برنامج للرصد البيئى لتوفير بيانات تهدف إلى تقليل ألاثار البيئية المتواجده ورصد اى آثار أخرى قد تتولد عن المشروع وتسجيل معدل نفوق وإصابة الطيور.**

وتفضلوا بقبول وافر الإحترام .

المديـر العـام
التوقيع/
مهندس/محمد عبد الجواد على

وكيـل أول الـوزارة
التوقيع/
سعيـد محمـد جبـر
سكرتير عام المحافظـة

# Annex 4

# Non Technical Executive Summary

# Arabic

# جمهورية مصر العربية

وزارة الكهرباء والطاقة

هيئة الطاقة الجديدة والمتجددة (NREA)

## ملخص تنفيذي غير فني

## لدراسة تقييم التأثير البيئي والاجتماعي

## لمزارع رياح بقوة 1,000 ميجا وات

## خليج السويس

**بتمويل من بنك التعمير الألماني KFW**

**يونيو 2011**

## جدول المحتويات

# 1- ملخص تنفيذي غير فنى

## 1-1 معلومات عن المشروع

### 1-1-1 الهدف ونطاق العمل

تم دراسة الآثار البيئية والاجتماعية لمشروع مزرعة الرياح بطاقة 1000 ميجاوات و المزمع إنشائها في مساحة تبلغ 200 كم² (منطقة تقييم الآثار البيئية والاجتماعية)، و على ما يقرب من 15 كم داخلي من خليج السويس، بالقرب من رأس غارب. وتعد هذه المنطقة جزءًا من مساحة إجمالية تبلغ 1229 كم² خُصصت بموجب قرار جمهوري صدر في 13 مايو 2009 لاستغلالها في توليد طاقة الرياح. وقد رشح المركز القومي لتخطيط استخدامات الأراضي هذه المنطقة تحديدًا، وأجمع عليها مجلس الوزراء بالموافقة بعد دراسة البدائل الأخرى.

وقد قامت هيئة الطاقة الجديدة والمتجددة بتنسيق مشروع تطوير طاقة الرياح، حيث يجب تقسيم منطقة المشروع إلى عدة مناطق مختلفة بينها ممرات فاصلة. و من المخطط أن يتم تشغيل أراضي المشاريع المخصصة في هذه المنطقة "منطقة تقييم الآثار البيئية والاجتماعية" بنظام مشروعات بناء وتملك وتشغيل لمستثمر خاص فضلاً عن مشاريع حكومية يمولها شركاء التنمية الأوروبيون (الاتحاد الأوروبي، وبنك الاستثمار الأوروبي، والوكالة الفرنسية للتنمية) بريادة بنك التعمير الألماني وجهات حكومية مقرضة من أبو ظبي وإسبانيا. ويخضع التشكيل النهائي لمزيد من النقاش طبقًا لنتائج هذه الدراسة. ومع ذلك، فإن هدف هذه الدراسة هو توضيح الاستفادة المستقبلية من طاقة الرياح في المنطقة في إطار واقعي قدر المستطاع؛ وذلك للحد من الجهود الزائدة التي تبذل للحصول على تصريح بيئي للمشاريع الفردية.

وتوضح النقاط التالية هدف الاستفادة من طاقة الرياح في المنطقة:

- استغلال طاقة الرياح الممتازة في الموقع،
- استبدال النفط والغاز بتوليد الكهرباء، وتوفير موارد الوقود الطبيعية الموجودة في المنطقة،
- وخفض نسبة انبعاثات ثاني أكسيد الكربون.

وتستهدف دراسة تقييم الآثار البيئية والاجتماعية لتطوير طاقة الرياح ما يلي:

- تحديد أي تأثير حقيقي محتمل لتطوير طاقة الرياح في المنطقة،
- تقييم ما إذا كان يمكننا التخفيف من حدة هذه التأثيرات أو أنها تستدعي وضع قيود على مشروع تطوير طاقة الرياح أو إلغائه،
- تحديد التدابير اللازمة للتخفيف من حدة التأثيرات ومتطلبات الإدارة البيئية ،
- تقييم الآثار المترتبة على التدابير المحتمل وضعها للتخفيف من حدة التأثيرات ومتطلبات الإدارة البيئية بالنظر إلى جدوى مشروع تطوير طاقة الرياح في المنطقة.

وتتبع دراسة تقييم الآثار البيئية والاجتماعية القوانين البيئية المصرية واللوائح والتوجيهات المتعلقة بها. وفي الوقت ذاته، يراعى الالتزام بالحد الأدنى من معايير "مبادئ خط الاستواء"، وذلك لتلبية شروط التمويل الخاصة بمؤسسات التمويل الدولية التي التزم معظمها بالحفاظ على "مبادئ خط الاستواء" باعتبارها الحد الأدنى للمعايير البيئية.

وقد خضعت عناصر التقييم الرئيسية لدراسات مسحية أجريت في إطار استطلاع عام للمنطقة، ورصد ميداني للطيور في فترتي الهجرة بالربيع والخريف، ودراسة مسحية نموذجية عن الحياة النباتية والحيوانية بالمنطقة (فضلاً عن حياة الطيور). وقد فُتحت

الأبواب للمشاركة العامة مبكرًا ودُعيت الجهات القائمة على المشروع للتعليق كما ضمت المشاركة العامة عائلة بدوية تعيش ناحية محطة ضخ مياه داخل المنطقة.

### 1-1-2 تطوير طاقة الرياح في منطقة المشروع التي تبلغ مساحتها 200 كم².

يوضح الشكل 1-1 الموقع المخصص للمشروع، و يقع غرب خليج السويس على بعد 120 كم شمال الغردقة، و10 إلى 15 كم غرب طريق الغردقة-السويس. وتقدر المسافة بين موقع المشروع والقاهرة بـــ 350 كم برًا. ويوضح الجدول 1.1 إحداثيات الحدود.

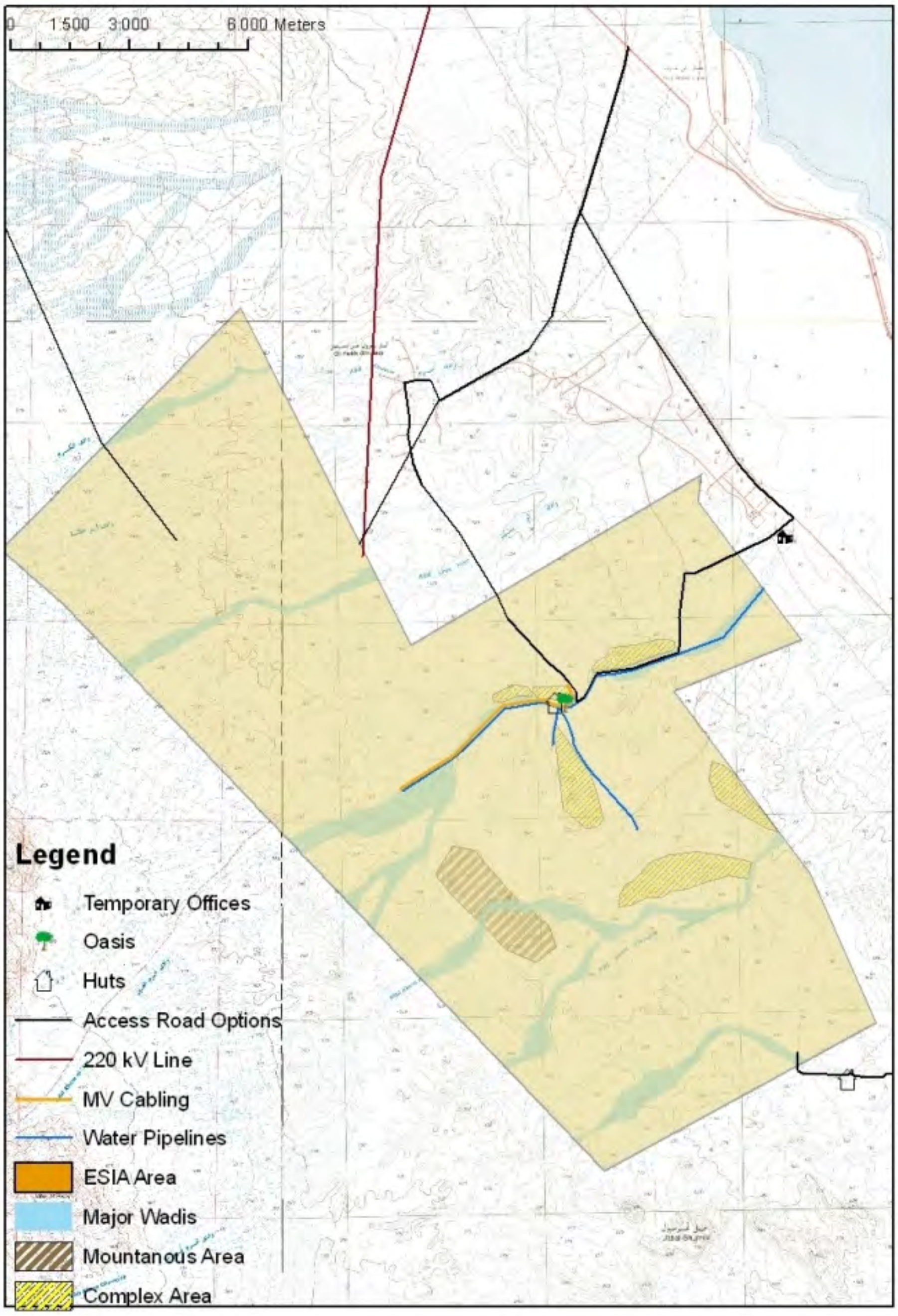

**الشكل 1-1: موقع مشروع الـــ 1000 ميجاوات**

**الجدول 1.1: إحداثيات الحدود لموقع مشروع الـــ 1000 ميجاوات.**

| إحداثيات الحدود | الإحداثيات الجغرافية (الإسناد: نظام تحديد المواقع العالمي WGS 1984) | |
|---|---|---|
| 23 | 28°11'8.34"N | 32°56'45.77"E |
| A6-3 | 28°12'55.38"N | 33° 6'32.66"E |
| 21 | 28° 5'27.50"N | 33° 9'14.00"E |
| 20 | 28° 7'28.50"N | 33° 8'13.50"E |
| 17 | 28°12'36.40"N | 33° 6'29.86"E |
| 22 | 28° 3'25.43"N | 33° 5'4.02"E |

| | | |
|---|---|---|
| 33° 6'8.50"E | 28° 9'59.00"N | 19 |
| 33° 2'2.88"E | 28°10'37.56"N | 4 BOO |
| 33° 8'6.67"E | 28°10'40.96"N | 18 |
| 32°59'28.54"E | 28°15'10.88"N | X2 |
| 32°55'45.54"E | 28°11'53.33"N | X3 |

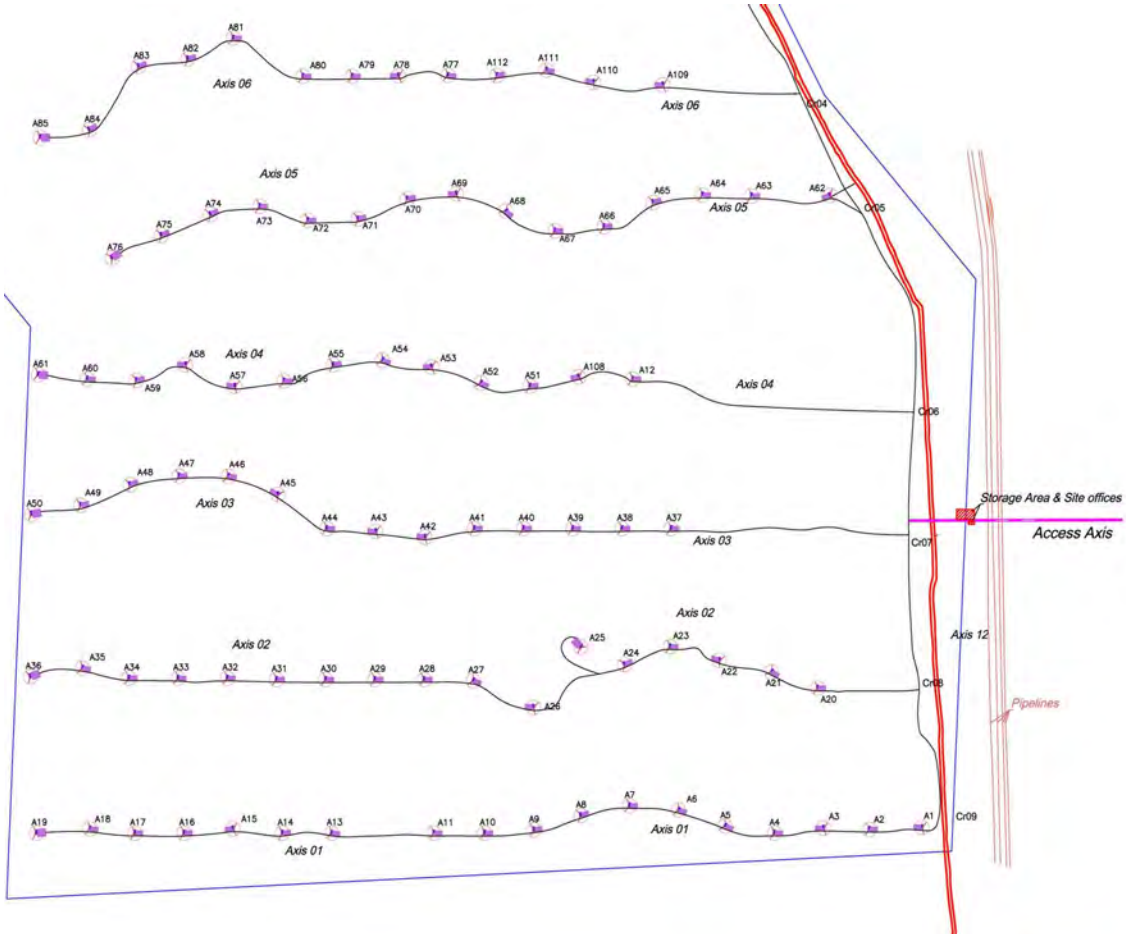
يوضح الشكل 1-2 مزيدًا من التفاصيل عن موقع المشروع؛ فهو يبعد 20 كم تقريبًا عن رأس غارب، ويقع في الغرب جزئيًا من مزارع رياح تحت الأنشاء: مزرعة رياح أوروبية التمويل بقوة 200 ميجاوات، و مزرعة رياح يابانية التمويل بقوة 220 ميجاوات، إضافةً إلى مزرعة رياح بتمويل خاص من شركة إيتالجين بقوة تقرب من 100 ميجاوات في الجنوب الشرقي.




**الشكل 1–2: موقع "مشروع الـــ1000 ميجاوات" وخيارات الطرق المؤدية إليه**

يمكن الوصول إلى المنطقة عن طريق طرق أسفلتية مملوكة للهيئة العامة للبترول يبلغ عرضها أربعة أمتار. تمتد هذه الطرق من منطقة رأس غارب في الشمال الشرقي، وتتصل بطريق ترابي مهدته شركة جيابكو للنفط في الجنوب الشرقي. وقد يكون هناك أحتياج إلى تمهيد طريق بديل يمتد من طريق رأس غارب العمومي حتى وادي النيل.

إن العمر الافتراضي لتصميم محطات طاقة الرياح هو 20 عامًا. وتعمل المحطات طبقًا للاتجاه الغالب للرياح؛ فتتولد طاقة الرياح وتنمو بين صفوف التوربينات الممتدة من الجنوب الشرقي إلى الشمال الشرقي على مسافة تقدر بـــ600 متر إلى 1 كم تقريبًا، وتقدر المسافة بين توربينات الصف الواحد بـــ 200 إلى 300 متر. يوضح الشكل 1–3 مثالاً لهذا التصميم.




**الشكل 1–3 ترتيب نموذجي لمزرعة رياح يشمل الأسلاك والتوصيلات**

يقع الاختيار غالبًا على توربينات رياح بقوة تتراوح ما بين 0,8 و2,5 ميجاوات للوحدة الواحدة، بحيث يبلغ قطر ذراعها الدوار 52 مترًا إلى 90 مترًا، وتتراوح ارتفاعاتها القصوى بين 80 مترًا و120 مترًا. توجد سمات أخرى تميز هذا النوع من المشاريع؛ تلك السمات تتعلق بعمق الأساسات الموضوعة لتوربينات الرياح بحيث تتراوح بين مترين وثلاثة أمتار، وتصل مساحة السطح الذي تؤسس عليه التوربينات كبيرة الحجم (2 إلى 2,5 ميجاوات) إلى 15×15 متر²، إضافةً إلى التوربينات ذات الأبراج الأنبوبية التي يصل قطرها إلى أربعة أمتار ونصف المتر عند القاعدة، ويبلغ أقصى ارتفاع لسن الريشة بها إلى 120 مترًا (مما يسمح بوصول قوة وحدة توربينة الرياح إلى 2,5 ميجاوات تقريبًا). وتتكون الشبكة الكهربائية الداخلية لمزرعة الرياح من أخاديد للكابلات وأكشاك صغيرة بجانب كل توربينة تتألف من محطة حلقية رئيسية، ومحطات تحويل وتحكم إذا لم تدمج الأخيرة داخل التوربينة ذاتها. ومن السمات التي تميز مثل هذه المشاريع أيضًا هي الطرق الترابية الداخلية بمزرعة الرياح التي يصل عرضها إلى 5 أمتار، ومنصات النصب التي تبلغ مساحتها 1000 إلى 2000 متر² عند كل توربينة.

**الشكل 1-4: نموذج للأكشاك والأسلاك والتوصيلات الموجودة بجانب كل توربينة رياح.**

يجب تفريغ طاقة الرياح التي تجمعها الشبكة الكهربائية متوسطة الجهد عن طريق خط نقل جديد خُطط لبنائه. ومن ناحية أخرى، تقيّم هذه الدراسة بعض المعلومات الأولية عن محطة فرعية جديدة بقوة 220/500 كيلو فولت يفترض إنشاؤها في منطقة رأس غارب. وبناءً على ذلك، يتم التخطيط لمحطة فرعية مركزية بقوة 220 كيلو فولت في موقع مركزي داخل منطقة المشروع التي تبلغ مساحتها 200 كم² لتفريغ طاقة الرياح. وفي غياب المعلومات المفصلة عن الموقع الجديد للمحطة الفرعية التي تبلغ قوتها 220/500 كيلو فولت، فقد أشير مبدئيًا فقط إلى توصيل خط النقل الـــ220 كيلو فولت. وإلى جانب ذلك، يفترض إنشاء مناطق الخدمة (للتحكم والصيانة بما في ذلك مخزن قطع الغيار والأدوات) في منطقة الحدود، بالقرب من محطة فرعية بقوة 220 كيلو فولت أو في رأس غارب على سبيل المثال، في هذه المرحلة من الإعداد للمشروع لكونها متصلة بشبكة الجهد المنخفض.

**الشكل 1-5: تصور لمزرعة رياح في منطقةالمشروع.**

يتأثر جزء محدود فقط من أراضي موقع مزرعة الرياح بأعمال البناء؛ حيث تقدر مساحة البناء المطلوبة لكل ميجاوات بـــ3,900 متر²، مما يعني أن نسبة الأراضي التي تتأثر بأعمال البناء تقل عن 3% من المساحة الإجمالية.
إضافةً إلى ذلك، سنحتاج إلى مرافق خدمة وغرف تحكم. وفيما يتعلق بإجراءات التحكم، فمن الممكن أن تتم عن بعد من خلال جهاز خادم مركزي بمزرعة الرياح. ويمكن وضع هذا الجهاز الخادم في حاوية صغيرة داخل موقع المزرعة بجانب توربينة رياح أو داخل المحطات الفرعية الـــ220 كيلو فولت. ومن المرجح إنشاء مرافق الخدمة والتخزين ومرافق الإقامة الخاصة بمختلف المستثمرين خارج منطقة المشروع، بضواحي رأس غارب على سبيل المثال، بحيث تكون إمدادات المياه والكهرباء متاحة بها.

وغالبًا ما تتألف منشآت الخدمة هذه من بناية شقق، ومرفق مركزي (قاعة مؤتمرات، ومسجد، ومقهى صغير)، ومكان مغلق للتخزين (20×30 مترًا على سبيل المثال)، ومكان مفتوح للتخزين، وبناية صغيرة للمكاتب وغرف التحكم. وفيما يتعلق بإمدادات المياه، فإنها تصل عن طريق شاحنة أو بتوصيلات بين المرفق ونظام إمدادات المياه. ومن ناحية أخرى، سيزيد عدد الأشخاص المقيمين بالمنطقة والعاملين فيها بالتناوب لتشغيل مزرعة الرياح وصيانتها عن 30 شخصًا في مزرعة بقوة 200 ميجاوات تقريبًا؛ مما يعني أن إجمالي عدد العاملين لتشغيل مزارع الرياح وصيانتها يقدر بـــ100 شخص.

وفيما يتعلق بالمنشآت الأخرى المرتبطة بمزرعة الرياح، فقد تقام محطة فرعية واحدة أو اثنتين متوسطتي التوتر بقوة 220 كيلو فولت في منطقة تقييم الآثار البيئية والاجتماعية، وسيصل خط هوائي بقوة 220 كيلو فولت إلى محطة فرعية بقوة 500 كيلو فولت بالقرب من رأس غارب. وبما أن الخط الهوائي هذا سينشأ خصيصًا لتوصيل طاقة الرياح، فإنه يعتبر جزءًا من مشروع طاقة الرياح.

## 2-1 الوضع الراهن

### 1-2-1 السمات المميزة للبيئة بعيدًا عن الحياة النباتية والحيوانية

تم فحص منطقة المشروع أثناء استطلاع أجري على الموقع ركز على كافة الجوانب البيئية فيما عدا الحياة النباتية والحيوانية؛ فقد أجريت عدة فحوصات ميدانية منفصلة خاصة بهذين الجانبين. و منطقة المشروع هي منطقة صحراوية خالية من النباتات باستثناء بعض البقع الصغيرة التي تظهر بها نباتات قليلة بالقرب من الأودية الرئيسية؛ حيث أن المنطقة تقطعها عدة أودية رئيسية. وتمتد الأحواض المائية للأودية إلى جبل رأس غارب إلى ما يقرب من 1,750 مترًا فوق سطح البحر. إن المقاطع العرضية للوادي شديدة الوضوح، والأبعاد الكبيرة للأودية وقنوات التآكل الموجودة في القاع إنما تدل على حدوث انفراغ في الأودية من وقت إلى آخر.

| | |
|---|---|
| متوسط الحرارة القصوى | 20° مئوية (يناير) إلى 33° مئوية (أغسطس) |
| متوسط الحرارة | 15° مئوية (يناير) إلى 29° مئوية (أغسطس) |
| متوسط سرعة الرياح عند 50 مترًا | 10 أمتار/ثانية تقريبًا |
| الحد الأقصى للعواصف | 35 مترًا/الثانية تقريبًا |
| سقوط الأمطار | متقطع جدًا، منطقة شديدة الجفاف |

ويمكن تلخيص الخصائص الأخرى للمنطقة في النقاط التالية:

- **استخدام الأراضي:** يقتصر استخدام الأراضي داخل منطقة المشروع على نظام للآبار المائية وما يتعلق به من بنية تحتية مثل المضخات، والأنابيب، وإمدادات الكهرباء متوسطة الجهد، والطرق الممتدة في منتصف منطقة المشروع تقريبًا، إضافةً إلى بعض الأكواخ القليلة المرتبطة به (لعائلة بدوية واحدة تتكون من 20 فردًا) المصنوعة من سعف النخيل، وحديقة نخيل على مساحة تبلغ 50×70 مترًا تقريبًا. وخارج حدود منطقة المشروع بجوار الناحية الشرقية للموقع، تقع أعمال إنتاجية للنفط على بعد 1000 متر تقريبًا من الحدود.

**الشكل 1–6: أعمال ضخ المياه، وخط أنابيب المياه، والأسلاك متوسطة الجهد المدفونة، والطرق المؤدية إليها.**

**الشكل 1–7 : "واحة" من صنع الإنسان تروى بمياه المضخات.**

- تخلو المنطقة من أية **مواطن** ذات أهمية للحياة النباتية والحيوانية (طبيعية كانت أو من صنع الإنسان) باستثناء حديقة النخيل الموجودة في مركز الموقع.
- تفتقر المنطقة إلى الخضرة فيما عدا بعض الأعشاب الصحراوية عند الأودية؛ ولا توجد إلا بعض المظاهر النادرة جدًا للحياة الحيوانية (فيما عدا الطيور) دون ملاحظة أي أنواع نادرة أو مهددة بالانقراض. وتقع المنطقة بالقرب من مسار رئيسي لهجرة طيور من بينها طيور محمية ومهددة بالانقراض. و قد شوهد عدد

كبير من الطيور المهاجرة تعبر المنطقة خلال موسم ربيع عام 2010.

- **البنية التحتية:** تخلو منطقة المشروع من البنية التحتية فيما عدا الطرق الأسفلتية والحصوية المؤدية إلى آبار المياه وإمدادات الكهرباء، وخطوط الأنابيب، ومضخات المياه التي تقوم بتشغيلها الهيئة العامة للبترول. ومن ناحية أخرى، توجد حاجة إلى بناء طريق يؤدي إلى منطقة المشروع من طريق السويس–الغردقة (طريق بأربع حارات) مرورًا بالطرق الأسفلتية المملوكة للهيئة العامة للبترول التي يبلغ عرضها أربعة أمتار وبعض الطرق غير المرصوفة التي تحتاج إلى تقوية، والتي يؤدي إليها طريق ترابي بديل، ليمتد من طريق رأس غارب–وادي النيل في الشمال (انظر الشكل 1–2).
- لا توجد أي خدمات في المنطقة؛ حيث يمتد خط أنابيب نقل المياه (مياه النيل) موازيًا لطريق السويس–الغردقة على الجانب الغربي منه، أي أنه يبعد 7 كم تقريبًا عن أقرب حد من حدود منطقة الدراسة.
- تقع المنطقة السكنية الأقرب في ضواحي رأس غارب على مسافة تزيد عن 13 كم من الحدود الشمالية الشرقية لمنطقة المشروع.
- تخلو المنطقة من أي **أماكن تاريخية**، أو **مناطق حماية بيئية**، ولا تقع داخل حدود أي **منطقة محمية** أو بالقرب منها.
- لا توجد أي آثار تاريخية، أو غيرها من المواقع ذات الأهمية التاريخية والثقافية في منطقة المشروع بأكملها.
- لا توجد أي **مياه سطحية** سوى المياه الناتجة عن انفراغات الأودية الرئيسية التي نادرًا ما تحدث.
- **المياه الجوفية:** على عمق يزيد عن 100 متر تحت سطح الأرض.
- ظروف **التشكيلات الجيولوجية والجيومورفلوجية:** يتكون الجزء الأعظم من المنطقة من سهول (في الشمال خصيصًا) وأراضي متموجة (في الوسط والجنوب)، إلا أنه توجد سلسلة جبال واحدة وسط الموقع بارتفاع 100 متر تقريبًا فوق السطح، ولذا؛ فهي لا تصلح لإنشاء مزرعة رياح حيث يتراوح مستوى ارتفاع منطقة المشروع ما بين 50 مترًا فوق سطح البحر في الشرق و250 مترًا في الشمال الغربي. ويغطي الحصى المضغوط ذو الزوايا الحادة والحصوات الصغيرة معظم أراضي الموقع ليشكل ما يسمى بالدرع الصحراوي. إلى جانب ذلك، تمتاز المنطقة باستقرار تحت سطح أراضيها، وظروف جيدة لوضع الأساسات، فضلاً عن أنها غير متأثرة بأية تصدعات أرضية وغير معرضة لمخاطر الهزات الأرضية الخاصة.
- توجد بها نفايات، مثل أكياس البلاستيك ومواد التعبئة والتغليف، حملتها الرياح الشمالية عبر الصحراء من مناطق بعيدة.
- تتأثر **جودة الهواء** بالغبار الصحراوي الذي تحمله الرياح القوية؛ إلا أنه يخلو من الانبعاثات الحمضية الناتجة عن احتراق الغازات المشتعلة أو عن الغازات المشتعلة غير المحترقة في حقل النفط القريب من الموقع الذي تديره الهيئة العامة للبترول؛ وذلك، لأن الرياح لا تهب عادةً من حقول النفط الموجودة في الجهة الشمالية الشرقية من الموقع.
- يصدر **مستوى عالٍ من الضوضاء الطبيعية** خلال هبات الرياح القوية والمتكررة، إلا أن المنطقة تخلو من الضوضاء التي يسببها البشر باستثناء صوت ضخ المياه.

- **المنظر الطبيعي:** يظهر المشهد مناطق صحراوية نموذجية تتكون من سهول ممتدة، وأراضٍ متموجة "كثبان"، ومناطق جبلية، ولا يوجد بها عناصر محددة تحتاج إلى صيانة.

### 1-2-2 الحياة النباتية والحيوانية (عدا الطيور)

أجرى عدد من الخبراء المحليين (من شركة إكوكنسرف) دراسة منفصلة عن النباتات والحيوانات في المنطقة في فترات امتدت من 3 إلى 4 أيام في فصلي ربيع وخريف عام 2010.

وقد اقتصرت دراسة النباتات على المناطق المحيطة بالمسارات الموجودة والمواقع المستخدمة لدراسة الطيور (الشكل 1-9) والطرق المؤدية إليها. وفي الخطوة الأولى، تم استطلاع المنطقة لتحديد مناطق الخضرة باستخدام المناظير المكبرة؛ ومن ثم، أجريت فحوصات أكثر دقة على المناطق المحددة. وفضلاً عن ذلك، قام عدد من خبراء فريق مراقبة الطيور بعدة زيارات للموقع لتسجيل النباتات الموجودة ورسم مواقعها في ربيع عام 2010.

وفيما يتعلق بالدراسة التي أجريت عن الحيوانات، قام الخبير المحلي بالقيادة عدة مرات ببطء شديد على طول المسارات الموجودة بحثًا عن وجود حيوانات. وفي أماكن محددة، قام الخبراء بفحص مناطق محيطة ودراستها بحثًا عن جحور أو مسالك هرب للاستدلال على وجود حيوانات. وإلى جانب ذلك، جُمعت بيانات إضافية عن الحيوانات خلال رصد الطيور المهاجرة (دراسة ميدانية عن الطيور)، إضافةً إلى إجراء فحصين اقتصرا على المناطق المحيطة بالواحة أثناء الليل باستخدام كشافات خاصة للتحقق من وجود خفافيش.

و قد قام الخبراء بمراجعة قواعد البيانات المتاحة والموضوعات المتعلقة بالنباتات والحيوانات الموجودة في منطقة الدراسة.

**النباتات**

وُجد عدد قليل من الفصائل النباتية في منطقة الدراسة، وتحديدًا في مناطق المنخفضات والأودية. وتنتمي تلك النباتات في معظمها إلى فصائل رخوة من نبات القرضئ (بالقرب من مناطق الرصد C وD وG على سبيل المثال)، كما وجدت بعض النباتات المنفردة التي تنتمي إلى فصائل الرطريط والرمث. وفيما عدا ذلك، لم يعثر على أي أشجار غير مزروعة (نمت طبيعيًا) سوى بعض أشجار السيال (بالقرب من الواحة ومنطقتي الرصد E وF). ونادرًا ما تظهر فصائل أخرى داخل منطقة الدراسة مثل فصائل السبط والسعدة والحنظل.

وإلى جانب النباتات الطبيعية النادرة، توجد أرض مزروعة (أرض الواحة) في الجهة الشرقية من منطقة الدراسة، وهي تشكل مساحة خضراء أقل من 2,500 م². وتمثل الواحة نقطة استراحة غاية في الأهمية لرحلات الصحراء، وقد شكلت ملجأً صناعيًا أو موطنًا لعدد كبير نسبيًا من الفصائل (بما فيها الطيور) التي تبحث عن طعام، وماء، وظل. وقد زرعت هذه الأرض بنباتات زراعية نموذجية غير منظمة مثل النخيل، وأشجار الزيتون، وغيرهما من المحاصيل الزراعية.

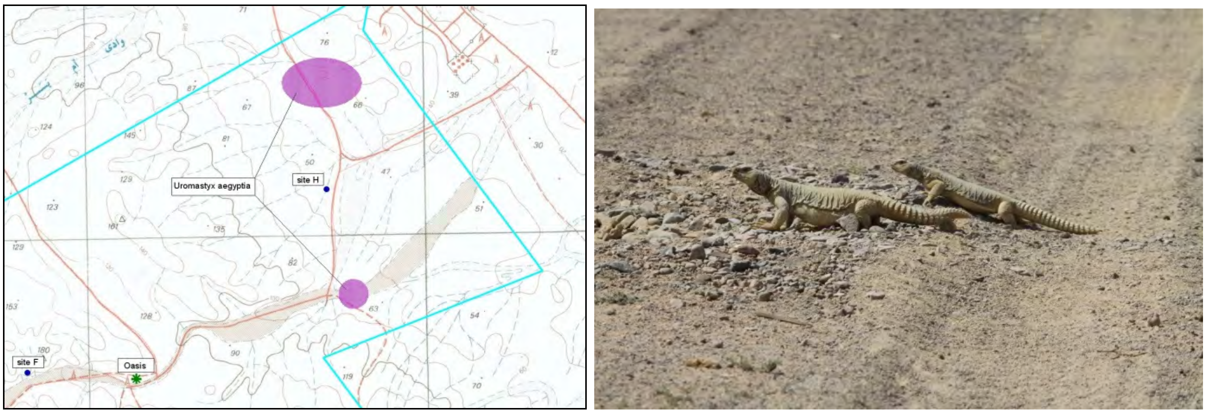
إضافة إلى ذلك، يلاحظ وجود خطوط أنابيب المياه التي تملكها الهيئة العامة للبترول في المنطقة المحيطة، وقد رصد عدد من البقع الخضراء حول أماكن التسريبات الطفيفة في هذه الأنابيب.

وبناء على ما سبق، تثبت النتائج أن أهمية دراسة النباتات في المنطقة محدودة للغاية، وأنها لا تضم أي نباتات أو مجتمعات نباتية معرضة للانقراض. فإن كافة النباتات التي وجدت في المنطقة شائعة وواسعة الانتشار.

**الحيوانات**

سُجّل وجود عدد قليل من الثدييات في منطقة الدراسة أثناء العمل الميداني، مما يشير إلى قلة أعداد الأنواع وعدم ثرائها بسبب قسوة ظروف الحياة في الصحراء. إضافة إلى ذلك، لم يلاحظ وجود خفافيش أثناء الزيارات الليلية للموقع.

وقد وجد 13 نوعًا من الزواحف داخل منطقة الدراسة: ستة أنواع مختلفة من الأوزاغ، وثلاثة أنواع من الحرابي، ونوعين من العظايا، ونوعين من الحيات (نوعي الأفعى والحنش). كما وجدت أيضًا مجموعة من عظايا الضب المصري تضم من 10 إلى 15 عظاية بالقرب من مسار يمتد من الموقع هـ إلى شماله وجنوبه أيضًا (الشكل 1-8). وقد شوهد عدد منهم وهم جاثمين خارج جحورهم، وأيضًا وهم يأكلون من البقع الخضراء الموجودة داخل الموقع بمعدل منتظم. وفي الخريف، شوهد اثنين من العظايا القائمين على رعاية اثنين من صغارهم.




**الشكل 1-8** : مناطق يظهر بها الضب المصري بانتظام بالقرب من الموقع "هـ".

لم تُجرى أي دراسة مستفيضة عن حياة الحشرات داخل الموقع سوى بعض الفحوصات المصغرة التي جرت قبل مراقبة الطيور أو بعدها ولم تكشف عن ظهور للحشرات. ومع ذلك، يلاحظ انتشار الذباب في فترات مؤقتة داخل الموقع. كما لوحظ أيضًا وجود بعض أنواع الحشرات المهاجرة أثناء العمل الميداني مثل فصائل الذبابة الحوامة، والفراشات، والجراد.

وقد أظهرت النتائج أن دراسة مواطن الحيوانات داخل الموقع ليست ذات أهمية كبيرة. وتجدر الإشارة إلى أن الضب المصري صنف ضمن الأنواع المهددة بالانقراض في القائمة الحمراء العالمية (التي وضعها الاتحاد الدولي للمحافظة على البيئة، وكوكس وغيرهما عام 2006)، أما سائر الحيوانات الأخرى فأنها محدودة الأهمية.

### 1-2-3 الطيور

<u>الخلفية والأهداف</u>

يُعد خليج السويس بشكل عام، ومنطقة جبل الزيت فيه على وجه الخصوص، معبرًا لأعداد كبيرة من الطيور المهاجرة، حيث تشكل المنطقة مسارًا للهجرة تمر به الطيور مرتين في العام خلال فصلي الربيع والخريف. وقد أظهرت الدراسات أن آلافًا من طيور اللقلاق الأبيض والطيور القناصة ومجموعات كبيرة من الطيور المحلقة على ارتفاعات متباينة تهاجر بانتظام عبر سلسلة الجبال المنتشرة في أرجاء ساحل البحر الأحمر (بيرجين 2007، بيرجين 2009، كارل برو 2010).

ولعل أبرز الأهداف الكامنة وراء الحرص على مراقبة الطيور وتنفيذ إجراءات الرصد التي تركز على متابعة الأنماط المختلفة لهجرة الطيور تتمثل فيما يلي:

- جمع البيانات الأساسية حول الطيور المهاجرة (الطيور التي تستخدم أسلوبي التحليق والانزلاق في الطيران والتي تعبر المنطقة نهارًا في رحلة الهجرة).
- وصف أنماط الهجرة التي تتبعها أنواع محددة من الطيور من ناحية الكم وتحديد الأعداد.
- تحديد وتقييم الآثار المحتملة لتطوير وبناء محطات توليد الطاقة باستخدام طاقة الرياح في منطقة الدراسة.
- وضع التوصيات حول اتخاذ التدابير اللازمة لتخفيف حوادث الاصطدام المحتملة.

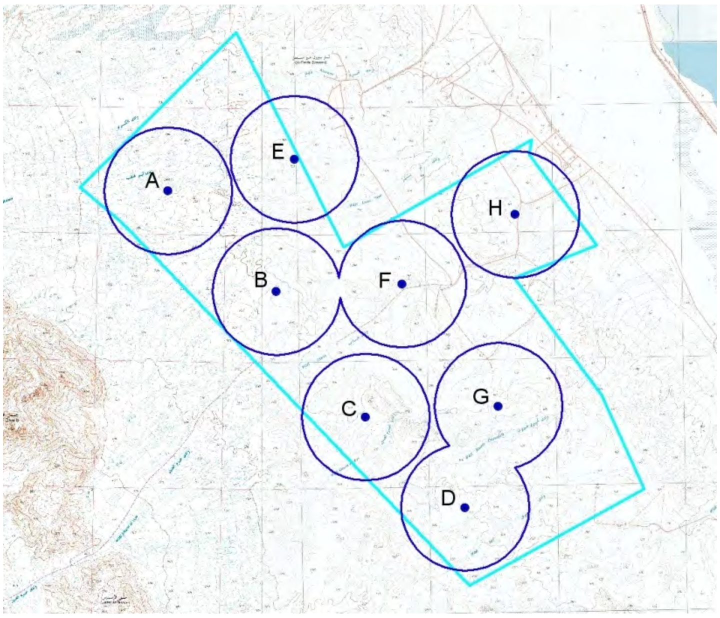
<u>الوسائل المتبعة</u>

تم تنفيذ إجراءات مراقبة ميدانية موحدة خلال ساعات النهار في ربيع وخريف 2010، كان الهدف منها تسجيل الملاحظات ومراقبة أنماط السلوك التي تتبعها الطيور المهاجرة، حيث بلغ مجموع ساعات المراقبة في فصل الربيع 792 ساعة، بينما وصل المجموع إلى 803 ساعة طوال فصل الخريف من نفس العام. وبذلك غطت إجراءات المراقبة والمتابعة جميع فترات الهجرة التي تشهدها المنطقة. وقد غطى فريق المراقبة ثمانية مواقع يفصل فيما بينها مسافة 5 كم، وبذلك فقد غطى فريق المراقبة أجزاء كبيرة من المنطقة (انظر الشكل 1-9). وتركزت إجراءات المراقبة على الطيور المعرضة للاصطدام بنسبة أكبر أو لأية آثار سلبية أخرى تنجم عن توربينات الرياح. وتشمل تلك الفئة من الطيور الطيور كبيرة الحجم (وأبرزها الكواسر وطيور اللقلاق والبجع) التي تهاجر باستخدام أسلوبي التحليق والانزلاق خلال ساعات النهار.

وقد قام فريق العمل المعني بتنفيذ المراقبة الميدانية الموحدة بتسجيل جميع الطيور المحلية والباحثة عن مجثم خلال دوريات المراقبة وأثناء تنقلاته بين أرجاء منطقة الدراسة. وقد قام الفريق بمسح منطقة السبخة بأوقات منتظمة بحثًا عن الطيور المقيمة والباحثة عن مجثم باستخدام المناظير الثنائية والتلسكوبات مع التركيز على مواقع معينة طوال الطريق الذي يتبع الحدود الغربية للسبخة تجاه الجنوب الشرقي.

وقد تم إجراء مقارنة بين النتائج التي تم الحصول عليها في الدراسة المنجزة في عام 2010 ونتائج دراسة أخرى أجريت في خريف 2008 وربيع 2009 في منطقة قريبة من وادي دارة (يشار إليها فيما بعد باسم "منطقة وادي دارة") التي تقع على بعد بضعة كيلومترات إلى الجنوب من منطقة الدراسة (بيرجن 2009). ولقد كان الهدف من إجراء المقارنة تقييم نمط هجرة الطيور ضمن المنطقة المحددة لإجراء الدراسة.

يتضمن التقرير النهائي لرصد الطيور (الملحق 1 من دراسة تقييم الأثر البيئي والاجتماعي) تفاصيل أكثر حول منهج العمل المتبع والنتائج التي خلُصت إليها الدراسة.




**الشكل 1-9** : مواقع المراقبة الميدانية الثمانية (أ : ح) الواقعة ضمن منطقة الدراسة (تشير الدوائر إلى نصف قطر مقداره 2.5 كم عن مركز كل موقع مراقبة)

الهجرة في فصل الربيع- النتائج وتقييم مدى أهمية المنطقة

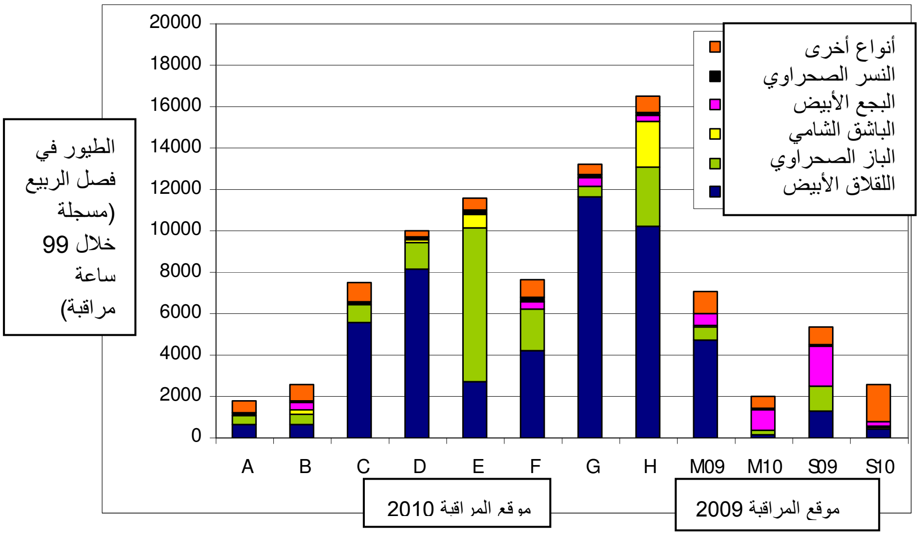
تم في إطار إجراءات المراقبة الميدانية الموحدة التي غطت منطقة الدراسة في ربيع 2010 تسجيل حوالي 77,516 طيرًا مصنفة إلى 27 نوع مختلف، شكل منها اللقلاق الأبيض والنسر الصحراوي ما نسبته 38% من مجموع الطيور، وبذلك فقد تم تصنيفهما باعتبارهما نوعين مهيمنين بالمقارنة مع الأنواع الأخرى.

وفي الدراسة التي أجريت في ربيع 2010، حلق ما نسبته 30% من مجموع الطيور المسجلة ضمن مسافة 2.5 كم عن موقع المراقبة على ارتفاعات تقل عن 100 م، بينما هاجر 27% من تلك الطيور على ارتفاعات تتراوح ما بين 100-199 م، وقد تجاوز 44% منها ارتفاع 199 م.

وقد أظهرت الدراسة المنجزة في ربيع 2010 تباينًا في أعداد الطيور المهاجرة على ارتفاعات تقل عن 200 م في المواقع الثمانية المحددة للمراقبة (خصوصًا في حال ما لم يتم الأخذ بالاعتبار النسر الصحراوي الذي يُعد ذو أهمية ثانوية). وقد تم تسجيل عدد كبير جدًا من الطيور المهاجرة (ما يزيد عن 12 ألف طير) في المنطقة المحيطة بالموقعين (ز) و(ح) (الشكل 1-10)، بينما بلغ عدد الطيور التي شوهدت وسُجلت في المناطق المحيطة بالمواقع (ج) و(د) و(هـ) و(و) ما بين 6 إلى 12 ألف طير. ولم يشهد الموقعان (أ) و(ب) إقبالاً مماثلاً، فقد بلغ مجموع الطيور المهاجرة على ارتفاعات تقل عن 200 م ما يقل عن 3 آلاف طير.

وقد بلغ عدد الطيور التي قام فريق العمل بمراقبتها وتسجيلها في نطاق منطقة الدراسة في ربيع 2010 ما يزيد عن 1% من تعداد الطيور التي تتبع مسار الهجرة المعتمد من قبل 13 صنف (يُعد هذا المعيار معيارًا شائع الاستخدام وضعته منظمة حياة الطيور العالمية لتقييم مدى أهمية منطقة ما: في حال حققت

تلك المنطقة الحد الأدنى البالغ 1%، فإن تلك المنطقة ستدرج من بين قائمة المواقع ذات الأهمية الدولية). وقد تم تسجيل ما يزيد عن 5% من طيور الباشق الشامي والنسر الصحراوي والبجع الأبيض ونسر المسيرة – النسر المجروب والباز الصحراوي التي تتبع مسار الهجرة في المنطقة. ومن الطيور التي تتبع المسار طائر والتي قام الفريق بتسجيل 3% منها طائر الخرمة المصرية الذي تم تصنيفه باعتباره طير مهدد بالانقراض على المستوى العالمي، وهو مدرج في القائمة الحمراء للأنواع المهددة بالانقراض (IUCN، كوكس وآخرون). ومن الطيور التي ظهرت في مسار الهجرة بأعداد قليلة نسبيًا إلى قليلة جدًا، وهي بذات الوقت مصنفة ضمن قائمة الأنواع الخاضعة للحماية (بسبب تصنيفها ضمن القائمة الحمراء أيضًا): النسر المرقط والنسر الإمبراطوري الشرقي والمرزة الباهتة والعوسق الصغير. وتظهر هذه النتائج مدى أهمية منطقة الدراسة لهجرات فصل الربيع.




**الشكل 1–10** : مجموع الطيور المسجلة (باستثناء الباز الصحراوي) التي تهاجر ضمن مساحة تبلغ 2.5 كم في ككل موقع من مواقع المراقبة، وعلى ارتفاع يقل عن 200 م في ربيع 2010 (منطقة الدراسة: المواقع من (أ) إلى (هـ) وربيع 2009 (منطقة وادي دارة: المواقع M09 لغاية S10)

وفي مقارنة مع دراسة سابقة أُجريت في وادي دارة (أنظر بيرجن 2009)، كانت أعداد الطيور التي تهاجر على ارتفاعات تقل عن 200 م أعلى بكثير في معظم مواقع المراقبة (الشكل 1–10) التي خضعت لبرنامج مراقبة في ربيع 2010. يُعزى هذا الارتفاع إلى طيور اللقلاق الأبيض بشكل رئيسي، حيث طارت تلك الطيور على ارتفاعات أقل وبأعداد كبيرة جدًا، وكان أكبر ظهور لهذا الطائر في المواقع (ج) و(د) و(ز) و(ح). وقد هاجرت أيضًا أعداد كبيرة نسبيًا من طائر الباز الصحراوي (لا يظهر في الشكل 1–10) عبر المنطقة التي غطتها غالبية المواقع. وقد شوهد أكثر من 10 آلاف طائر باز صحراوي تحلق على ارتفاعات منخفضة في الموقع (أ)، إلا أنه قد تم تسجيل ما مجموعه 4,500 من طيور الباز المذكورة خلال ثلاث ساعات فقط من المراقبة المتواصلة في يوم واحد، ولهذا فنحن لا نتوقع أن يكون هذا التجمع ناتج عن نمط اعتيادي للهجرة. إضافة إلى ذلك، فإن الباز الصحراوي غير مصنف من ضمن الأنواع الخاضعة للحماية. وفي النهاية، بالإمكان تصنيف مدى أهمية المنطقة على الشكل التالي:

- ينبغي تصنيف الأجزاء الشمالية الغربية من منطقة الدراسة والمحيطة بالموقعين (أ) و(ب) باعتبارها مناطق مهمة لهجرة الطيور في الربيع.

- أعداد الطيور والبيانات التي تم تسجيلها في مناطق شمال شرق (الموقع "هـ") ووسط (الموقعين "ج" و"و") وجنوب غرب (الموقع "د") منطقة الدراسة كانت أعلى بكثير من تلك المسجلة في الموقعين "أ" و"ب" والمواقع M10 وS09 و S10 في ربيع 2009 في منطقة وادي دارة (الشكل 1-10)، مما يستلزم تصنيف منطقة شمال شرق ووسط وجنوب غرب منطقة الدراسة باعتبارها مهمة جدا لهجرة الطيور في الربيع.

- لقد كان نشاط الهجرة على ارتفاعات منخفضة هو الأكثر كثافة في الموقعين (ز) و(ح) اللذين يغطيان شرق وجنوب شرق منطقة الدراسة (الشكل 1-10)، ويُعزى ذلك بشكل رئيسي إلى الأعداد الكبيرة من طائر اللقلاق الأبيض الذي يظهر وكأنه قد تجتب عبور البحر الأحمر، ولكنه تقدم ن بشكل أكبر باتجاه شمل غرب السويس. ولهذا يتعين تصنيف الأجزاء الشرقية والجنوب شرقية من منطقة الدراسة باعتبارها ذات أهمية عالية لهجرة الطيور في فصل الربيع.

<u>الهجرة في فصل الخريف- النتائج وتقييم مدى أهمية المنطقة</u>

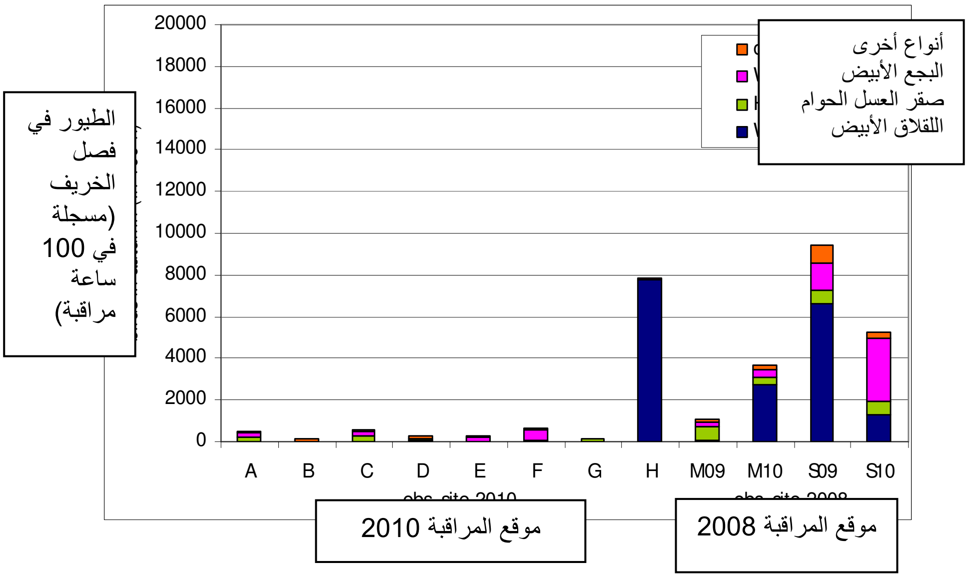
تمخضت إجراءات المراقبة الميدانية الموحدة التي غطت منطقة الدراسة في خريف 2010 عن تسجيل ما مجموعه 25,942 طيرًا مصنفة إلى 22 نوع مختلف، كان اللقلاق الأبيض هو الطائر المهيمن أيضًا وبنسبة بلغت 54% من مجموع الطيور. تجدر الإشارة إلى أن جميع طيور اللقلاق الأبيض التي تم تسجيلها تعود إلى 17 سرب فقط، مما يشير إلى أن منطقة الدراسة لا تقع ضمن مسار هجرة هذا الطائر في فصل الخريف. ومن الأنواع التي شوهدت على نحو متكرر في المنطقة البجع الأبيض وصقر العسل الحوام، ولكن بأعداد قليلة. ويعود أكثر من 70% من جميع الطيور المهاجرة إلى ستة أسراب فقط، مما يشير إلى أن نشاط الهجرة كان متواضعًا ف نسبيًا خلال معظم فترات الدراسة.

وتعود أعداد طيور اللقلاق الأبيض والبجع الأبيض التي تم تسجيلها إلى ما نسبته 3% و12% على التوالي من مجموع نوعي الطيور اللذان اتبعا مسار الهجرة ذاك. ولم تحقق الأنواع الأخرى التي شوهد وجودها في منطقة الدراسة أكثر من 1% على الأكثر من مجموع الطيور التي اتبعت المسار (وتشكل النسبة المسجلة معيارًا يُستخدم في تقييم مدى أهمية المنطقة). وقد ظهرت في المنطقة ثلاثة أنواع من الطيور بأعداد قليلة نسبيًا إلى قليلة جدًا، وهي بذات الوقت مصنفة ضمن قائمة الأنواع الخاضعة للحماية (بسبب تصنيفها ضمن القائمة الحمراء المعدة من قبل IUCN): المرزة الباهتة والعوسق الصغير والصقر ذو الأرجل الحمراء والخرمة المصرية.

وقد كانت معظم الطيور التي تم تسجيلها في خريف 2010 في المناطق المحيطة بمواقع المراقبة بمسافة 2.5 كم تحلق على ارتفاعات منخفضة؛ فقد حلق 25% من مجموع الطيور على ارتفاع يزيد عن 199م. وعلى الأرجح فإن هذه النتيجة تُعزى إلى الطيور التي تمكنت من الوصول إلى المسطحات الصحراوية (اللقلاق والبجع) محلقة على ارتفاعات منخفضة بعد أن قطعت البحر الأحمر، حيث تفتقر المنطقة إلى التيارات الحرارية التي تساعد الطير ليطير على ارتفاع عالى.

وبالمقارنة مع نتائج الدراسة السابقة التي تم تنفيذها في خريف 2008 في منطقة وادي الدرة (أنظر بيرجين 2009)، فقد كانت أعداد الطيور المهاجرة على ارتفاعات تقل عن 200 م أقل بكثير في خريف 2010 وفي معظم مواقع الدراسة عما تم تسجيله في ذات الفترة من عام 2008

(الـشكل 1-11). إلا أن الموقـــع (ح) ســـجل مـــا يقـــارب 8 آلاف لقلاقـًــا أبـــيض، حيـــث كـــان نـــشاط الهجـــرة فيـــه مـــشابهًا لمـــا تـــم تـــسجيله فـــي الموقـــع (S09) فـــي خريـــف 2008. إلا أنـــه يتعـــين الأخـــذ بالاعتبـــار أن الأعـــداد الكبيـــرة لطـــائر اللقـــلاق الأبـــيض التـــي تواجـــدت فـــي الموقـــع (ح) تعـــود بـــشكل رئيـــسي إلـــى ســـرب واحد تكون من 7,500 طير.




**الشكل 1-11** : المجموع المسجل لأعـداد الطيـور المهـاجرة ضـمن مـسافات تـصل إلـى 2.5 كـم عـن كـل موقـع مراقبـة وعلـى ارتفاعـات تقـل عـن 200 م فـي فتـرة المراقبـة الواقعـة فـي خريـف 2010 (منطقـة الدراسـة: المواقـع مـن (أ) لغايـة (ح))، وفـي خريـف 2008 (منطقـة وادي الـدرة: المواقع من **M09 لغاية S10**).

وبناءً على ما ســبق، يمكــن وصــف نــشاط الهجــرة فــي خريــف 2010 بأنــه مــنخفض أو أنــه فــي أغلــب الأحيــان كان منخفضًا جــدًا فــي منطقــة الدراســة عمومًــا، ممــا يــشير إلــى أن أجــزاء كبيــرة مــن منطقــة الدراســة لا تُعــد ذات أهمية لهجــرات الخريــف. ينــسجم هــذا الاســتنتاج كثيــرًا مــع التوقعــات المبنيــة علــى دراســات ســابقة: فيبــدو أن غالبية طيــور اللقــلاق الأبــيض والبجــع الأبــيض وصــقر العــسل الحــوام والعديــد مــن الطيــور المحلقــة تــصل إلى ساحل البحــر الأحمــر بــالقرب مــن جبــل الزيــت الواقــع إلــى الجنــوب مــن رأس شــقير بعــد عبــور الأحمــر البحر. وتتمكن أسراب منفــردة فقــط (تتكــون فــي بعــض الأحيــان مــن أعــداد كبيــرة مــن الطيــور) مــن الوصــول إلى الساحل بــين رأس غــارب ورأس شــقير، حيــث يــصبح بإمكانهــا بعــد ذلــك الهجــرة عبــر الجــزء الــشرقي مــن منطقــة الدراســة (الموقــع "ح"). وتــشير النتــائج إلــى أن الطيــور المحلقــة لا تــصل إلــى الــساحل الواقــع شــمال رأس غــارب، ويبــدو أن عــددًا قليــلاً جــدا مــن الطيــور تهــاجر باتجــاه الجنــوب الــشرقي مــن الــسويس فــوق السهول الساحلية. كمــا يعتقــد بــأن معظــم الطيــور التــي تهــاجر عبــر الــسويس تتجــه جنوبًــا لتطيــر علــى طــول سلسلة جبال البحر الأحمر، أو تتعمق باتجاه الغرب على طول وادي النيل.

الطيور المحلية– النتائج وتقييم مدى أهمية المنطقة

تتداخل عوامل المناخ الجاف والقاحل والأراضي الصحراوية العارية من الغطاء النباتي والرياح الشديدة لتجعل من منطقة الدراسة موائل غير جاذبة للطيور المحلية/المعششة. ولهذه الأسباب فقد شوهد خلال فترة الدراسة عدد قليل جدا من الطيور المحلية مصنفة جميعها باعتبارها كل "الأقل إثارة للقلق" في قائمة IUCN الحمراء للأنواع المهددة بالانقراض. ومن الأمثلة على تلك الطيور قبرة الصحراء موشمة الذيل و قبرة الصحراء والقبرة الهدهد والغراب النوحي والقطا المتوج.

ولهذا تُعد معظم أجزاء منطقة الدراسة ذات أهمية متواضعة بالنسبة للطيور المحلية، وتحتوي الواحة والوديان الأكبر على رقع أوسع يكسوها الغطاء النباتي توفر بعض المزايا في قلب الصحراء. ولهذا فإن تلك المناطق تعتبر ذات أهمية للطيور المحلية.

الطيور الجاثمة– النتائج وتقييم مدى أهمية المنطقة

وخلال فترات المراقبة، شوهدت في بعض الأحيان طيور اللقلاق والبجع والطيور القناصة جاثمة في منطقة الدراسة أو في المناطق القريبة منها، وخصوصًا في الصباح الباكر أو في وقت متأخر من بعد الظهر والفترة التي تليها، إلى حين قضاء الليل في المنطقة الصحراوية. يظهر أن تلك الطيور قد أمضت ليلة واحدة في الصحراء قبل استكمالها رحلة الهجرة. وقد شوهدت تلك الطيور في جميع أجزاء منطقة الدراسة، ولا يوجد مجثم محدد يمكن اعتباره ذو أهمية تجعل منه خاضعًا للحماية داخل حدود المنطقة. وقد تكون الأودية الكبيرة الواقعة ضمن حدود منطقة الدراسة والمحتوية على رقع من الغطاء لنباتي ذات أهمية للجواثم الصغيرة.

وفي كثير من الأحيان لم تستغل اللقالق والبجع ظروف السبخة المواتية لاستخدامها مجثمًا. وفي فصل الربيع تمكن الفريق من تسجيل طيور اللقلاق الأبيض في السبخة خلال ثلاث زيارات من أصل 15 زيارة مراقبة، إلا أن تلك الطيور تواجدت بأعداد كبيرة حينها (تصل إلى 4,800 طير)، مما يشير إلى أن السبخة لا تستخدم باستمرار باعتبارها محطة توقف خلال رحلة الهجرة. يمكننا الافتراض هنا بأن معظم الطيور ربما لا تمضي ليلة كاملة في السبخة قبل استكمال هجرة الربيع، ولكن يمكن تصنيف السبخة القابعة وسط السهول الصحراوية باعتبارها مجثمًا مهمًا لطيور اللقلاق والبجع والبلشون وربما بعض الأنواع الأخرى.

وتستخدم الجواثم الصغيرة الواحة باستمرار باعتبارها محطة توقف وتقيم فيها عدة أيام. وقد تم تسجيل ظهور عدد من الأنواع الأخرى التي شوهدت بين حين وآخر، ومنها طيور الوروار واليمام والبلشون، حيث تشكل الواحة ملاذًا فريدًا في أحضان الصحراء، وخصوصًا عند الأخذ بالاعتبار الغطاء النباتي الكثيف فيها، ولهذا فهي تُعد محطةً توقف ونقطة انطلاق مهمة لتلك الأنواع خلال رحلة الهجرة.

## 3-1 الآثار المتوقعة

### 1-3-1 مظاهر الحياة النباتية والحيوانية

بالإمكان تلخيص الآثار المتوقعة على الشكل التالي:

**استخدام الأراضي:** بالنظر إلى أن مساحة الأراضي المستغلة لأغراض المشروع صغيرة نسبيًا (تقارب 3%)، وفي غياب الموائل الحساسة بيئيًا والمناظر الطبيعية الجذابة والآثار، وعلى اعتبار أن الأراضي لا تستغل زراعيًا أو للسكن، لن ينتج عن أخذ تلك الأراضي آثارًا هامة. كما يمكن تخفيض الآثار الناجمة بسهولة عن طريق تجنب المواقع التي تتضمن بقايا من الغطاء النباتي. ما يشكل ما سبق عوامل هامة لمرحلتي البناء والتشغيل.

**المناظر الطبيعية ومدى التأثير البصري:** بالنظر إلى غياب المستقبلات وإلى تماثل المناظر الطبيعية الصحراوية، ومع عدم وجود سمات مميزة للمكان، فإن التأثير على المناظر الطبيعية لا تُعد ذات أهمية سواء خلال مرحلة البناء أو مرحلة التشغيل.

**المياه وموارد المياه:** لا تشكل المياه عاملاً هامًا ومتصلاً بمشاريع توليد الطاقة المستندة على قوة الرياح. تنحصر الحاجة إلى استخدام المياه باستخدامات مرحلة التشييد، وخصوصًا أعمال الخرسانة الخاصة ببناء الأساسات والمحطة الفرعية. وإذا ما أُنجزت أعمال الخلط في الموقع، سيتم تأمين المياه عن طريق ناقلات يتم تزويدها بالمياه من منظومة خطوط مياه النيل. وستكون الاحتياجات من المياه المخصصة لأغراض الخدمات الصحية متواضعة، وينطبق ذلك على مرحلة البناء أيضًا. إن الكميات الصغيرة من الفاقد من المياه والتي يتم بالعادة معالجتها باستخدام صهاريج يتم تصريفها تحت الأرض لا تشكل عاملاً بالغ الأثر في البيئة المحيطة. ولن يتم استخدام مصادر المياه الجوفية التي تستخدمها الهيئة العامة المصرية للبترول في مركز مشروعها الممتد على مساحة 200 كم$^2$.

وقد تم تقدير كميات المياه المستهلكة خلال مرحلة التشغيل بما يعادل 3 م$^3$/يوم فقط، ولن تشكل تلك الكميات أهمية تذكر.

**المخلفات البلدية و المخلفات الخطرة:** من المتوقع أن يترتب على المشروع كميات كبيرة من المخلفات الصلبة تتألف من مواد التعبئة والتغليف (الورق والبلاستيك والخشب)، وهي مواد مستخدمة في نقل المعدات. ستظهر تلك المخلفات على الأغلب في مواقع نقل التوربينات الفردية وفي ساحة البناء. وفي ظل الظروف الجوية التي تنطوي على رياح قوية، فقد تنتشر تلك المخلفات بسهولة في الصحراء وستنتقل عبر مساحات شاسعة. يمكن القول بأن المصدر الوحيد المحتمل للمخلفات الخطرة أثناء عملية البناء هي تلك الناجمة عن انسكاب الزيوت والشحوم القادمة من معدات البناء (مثل الشاحنات والحفارات والرافعات وغيرها)، وأيضًا من إجراءات التعامل مع وتركيب المواد المنقولة (ومنها المحولات والزيوت المستخدمة في صناديق التروس والزيت الهيدروليكي). يمكن تجنب رمي النفايات وانسكاب المواد الخطرة بسهولة باستخدام تدابير عمل ملائمة وتطبيق إجراءات رقابية فعالة.

تتألف المخلفات الناشئة عن مزرعة الرياح خلال مرحلة التشغيل من المواد الاستهلاكية المستخدمة بشكل منتظم والتي يتم عادة استبدالها، وخصوصًا عند صيانة الآلات والقطع الصغيرة التالفة. تصنف هذه المواد باعتبارها غير خطرة، كما أن معظمها تحمل قيمة ويمكن إعادة تدويرها. وفي جميع الأحوال يتم

بالعادة إرجاع الآلات والقطع الكبيرة التي تصيبها أعطال أو تلف، مثل صناديق التروس والمولدات إلى المصنع ليتم تصليحها أو إعادة استخدام المواد الداخلة فيها. وسيتم في المشروع جمع الزيوت الخطرة التي يتم استخدامها مرة واحدة سنويًا، أو مرة كل سنتين، ومن ثم إرسالها لأغراض إعادة التدوير. وقد أثبتت هذه الممارسات المطبقة في مزارع رياح أخرى في مصر أن تنفيذها لا ينطوي على أية مشاكل. وسيعتمد حجم الزيوت المستعملة على نوع توربينات الرياح التي سيتم اختيارها للمشروع، وعلى فترات الصيانة والخدمة المطلوبة من قبل المقاول الذي سيتم اختياره. أما فيما يخص المخلفات البلدية، فهي تنتج بشكل عام في مرافق الخدمة والمحطة الفرعية العاملة بطاقة 220 كيلو فولت. و تشتمل الخطط المعتادة المطبقة على المرافق السكنية النائية المقامة في صحراء مصر على جمع المخلفات في أكياس أو صناديق والتخلص منها في موقع آمن بيئيًا يستخدم مكبًا للنفايات (حفر في الصحراء). ولأغراض تقليل حجم النفايات، يتم تطبيق إجراءات لحرقها، بينما يتم تغطية ما يتبقى من المخلفات والنفايات بواسطة الرمال. وتُعد تلك المخلفات من النوع الخامل، ومع غياب المطر، فإنها لن تتسبب بأية أضرار لباطن الأرض. وبالنظر إلى صغر كميات المخلفات الداخلية (يعادل ما مقداره 60 م$^3$/سنة من النفايات غير المضغوطة حوالي 1 إلى 2 متر مكعب/سنة بعد الحرق) ويُعد هذا الأسلوب البسيط مقبولاً ولا يتوقع ظهور آثار هامة ناتجة عن المخلفات البلدية والخطرة في حال تم تطبيق إجراءات ملائمة لإدارة المخلفات.

**جودة الهواء:** سو تظهر خلال مرحلة البناء بعض الانبعاثات من غازات العوادم الخاصة بالآلات و الماكينات، وكميات من الغبار المنبعثة في أماكن العمل. ونظرًا لغياب المستقبلات الحساسة في تلك المنطقة، فلن يكون لتلك الانبعاثات خلال مرحلة البناء أي تأثيرات هامة على البيئة. من ناحية أخرى، لن يترتب على تشغيل مزرعة الرياح انبعاثات غازية أو أنبعاثات غبار، وبالتالي لن يكون لها أي تأثير على البيئة المحيطة.

**الضوضاء:** تنحصر مستقبلات الضوضاء الحساسة في أكواخ البدو المقيمين بجوار محطات ضخ المياه التابعة للهيئة العامة المصرية للبترول. والمنطقة مقسمة رسميًا لأغراض مختلفة سكنية وتجارية وصناعية صغيرة، ويبلغ الحد الأعلى لمستوى الضوضاء المحيطة بها 50 ديسيبل. وسيتم الامتثال لهذه الحد خلال مرحلتي البناء والتشغيل، وذلك في حال تم تثبيت توربينات الرياح على بعد 300 م على الأقل من تلك الأكواخ.

**الاهتزاز:** من غير المتوقع أن تنشأ تأثيرات هامة عن الاهتزاز خلال مرحلتي البناء والتشغيل.و الأهتزازات التي تصدر عن توربينات الرياح في الظروف العادية اهتزازات قليلة جدًا وخصوصًا عند التأكد من التوازن بين ريشات الدفع وتثبيت الذراع الرئيسي بشكل صحيح. ويتم تقليل انتشار الاهتزاز بواسطة الهيكل الأساسي للتوربينة، كما أن انتقال الاهتزازات إلى ما دون سطح الأرض محدود جدًا وخصوصًا عندما تكون تلك الطبقة خالية من الصخور، كما هو الحال في معظم أجزاء المنطقة التي سيقام عليها المشروع. وبناءً على ما سبق، فإن الآثار الناجمة عن الاهتزاز في الطبقة الواقعة تحت سطح الأرض والقريبة من توربينات الرياح لن تكون قابلة للقياس.

**التداخلات الكهرومغناطيسية:** من المحتمل أن تتسبب توربينات الرياح بإحداث تداخلات كهرومغناطيسية مع رادارات الطيران وأنظمة الاتصالات (مثل الميكروويف والتلفاز والراديو). وتعتمد طبيعة الآثار المحتملة في الأساس على موقع التوربينة بالمقارنة مع أجهزة الإرسال والمستقبلات. يوجد في المنطقة

الواقعة شمال-شرق منطقة الدراسة رادار عسكري مثبت على بعد 8.7 كم من الركن الشمالي الشرقي من المنطقة المحتمل استخدامها. يُذكر بأن وزارة الدفاع قد قامت بإخلاء المنطقة ولهذا يمكن افتراض عدم وجود تداخل مع مزرعة الرياح المستقبلية. تجدر الإشارة أيضًا إلى عدم وجود أية أنظمة اتصالات واقعة بالقرب من المنطقة قد تتأثر بفعل تشغيل التوربينات.

**انعكاس الضوء و الظلال:** تتميز نوعيات الطلاء المستخدمة على ريش التوربينات الحديثة بقدرتها على امتصاص أشعة الشمس المباشرة، ولا يشكل انعكاس الضوء تأثيرًا ذو أهمية على البيئة. ومع غياب مستقبلات الأثر في المنطقة المحيطة بمزرعة الرياح والتي قد تتأثر بالانعكاس، يمكن القول بأن هذا الجانب لا يشكل أي أهمية ولا ينطوي على أية آثار سلبية. ويبلغ معدل الأثر الهام الناتج عن تداخل الظلال حسب المعايير المقبولة 30 ساعة في السنة و 30 دقيقة في اليوم. ويتحقق هذا المعدل فقط في الأماكن القريبة من توربينات الرياح، فيمكن الوصول إلى هذه الفترات الزمنية عند انتقال الشمس عبر قطر ذراع الدوار. وتخلو المنطقة من أية مساكن وتجمعات سكنية قريبة من التوربينات (باستثناء مقر العائلات البدوية والذي يتعين الابتعاد عنه بما لا يقل عن 300 م)، مما يؤكد غياب الآثار الناجمة عن الوميض والتي قد تتعدى المستوى المقبول.

**الموروث الأثري والتاريخي والثقافي:** لا يوجد في المنطقة ما يصنف ضمن هذه الفئة.

**مخاطر الصحة والسلامة المهنية:** توجد بعض المخاطر المتعلقة بالسلامة المهنية خلال مرحلة البناء و التي تنشأ بالضرورة عن أعمال الحفر والخرسانة وتنصيب المعدات (العمل على علو مرتفع) والتعامل مع المعدات الثقيلة والكهربائية وتركيبها. وتنشأ هذه المخاطر خلال مرحلة التشغيل عن أعمال الصيانة المنفذة في مزرعة الرياح. ويمكن تقليل المخاطر لتصبح ضمن حدود المستوى المقبول إذا ما تم تطبيق معايير الصحة والسلامة المعتمدة دوليًا.

**حركة المرور والمرافق العامة والبنية التحتية الأخرى:** تتميز الطرق الرئيسية في المنطقة بأبعاد مناسبة جدًا، وهي على الأغلب لا تشهد حركة مرور نشطة. ولهذا، لا يوجد أي تأثير للمشروع على حركة المرور التي تشهدها الطرق العامة خلال مرحلة البناء. وسيتطلب إعداد الخرسانة قدرًا وافرًا من المياه، ويقدر الحد الأعلى من كمية المياه المطلوبة يوميًا بما يقارب 60 م$^3$/يوم، وهو ما يعادل 0.6 لتر/ثانية سيتم الحصول عليها من شبكة خطوط الأنابيب المزودة بمياه النيل، وفي حال تعذر ذلك، يمكن عندها الحصول على المياه من وادي النيل. ولن يكون هناك أي تأثير يذكر خلال مرحلة التشغيل على حركة المرور أو معدل الطلب على المياه. وستعمل مزرعة الرياح بالتزامن مع مستوى نقل كهربي يبلغ 220 أو 500 كيلو فولت، وهو المستوى المأمول تحقيقه من خلال المشروع. وسوف تدعم الطاقة الكهربائية التي يتم توليدها باستخدام الرياح معدل الإمداد بالطاقة الكهربائية بشكل عام، وستسهم في استقرار الشبكة في حال تم تصميمها وتشغيلها بشكل سليم، بالتعاون مع مركز توزيع الأحمال الكهربائية.

**الآثار الاجتماعية والاقتصادية:** سوف تتطلب مزرعة الرياح خلال مرحلة البناء تحديدًا أعداد كبيرة من القوى العاملة المحلية. وسوف يتم إنتاج حجم استثمار محلي يتراوح ما بين 30-40%. وسوف يستفيد تشغيل مزرعة الرياح من الموارد المحلية التي ستشكل مصدرًا للنفط والغاز. كما ستساعد توربينات توليد الطاقة الكهربائية في تخفيض انبعاثات ثاني أكسيد الكربون (بما يعادل 1890 طن من ثان أكسيد الكربون/ميجا وات/سنة)

### 1-3-2 الحياة النباتية والحيوانية (باستثناء الطيور)

النباتات

يُعد نطاق استغلال الأراضي في بناء مزرعة الرياح محدودًا جدًا (ويقل عادة عن 3% من إجمالي حدود المنطقة)، وبهذا تبقى معظم أجزاء المنطقة خالية من أية تدخلات عمرانية. بناءًا على ذلك، سوف تغطي المنطقة المتأثرة جزءًا صغيرًا من منطقة الدراسة البالغة 200 كم$^2$ . وسوف يتجنب فريق العمل تركيب أية توربينات بجانب الواحة أو داخلها، أو في أحواض الأودية المنتشرة. وسوف تنحصر أعمال البناء في الأودية بعبور الطرق المفروشة بالحصى وبممرات الكابلات تحت الأرض، بحيث يتم تنفيذها في المواقع الأقل حساسية. وخلاصة ما سبق أن بناء مزارع رياح في منطقة الدراسة لن ينتج عنه أي آثار ملحوظة على الغطاء النباتي ومختلف الأنواع النباتية.

ولم يثبت حتى الآن وجود أي تأثير على النباتات أو على الغطاء النباتي ناتج عن تشغيل توربينات الرياح. وسوف يقتصر النشاط الإنساني خلال فترات صيانة مزارع الرياح على المسارات وعلى مواقع التخزين القائمة حاليًا. من هنا يمكن القول بأن تشغيل وصيانة مزارع الرياح ضمن نطاق منطقة الدراسة لن يتسبب بأية آثار ضارة على الغطاء النباتي ومختلف الأنواع النباتية.

الحيوانات

وبالمقارنة مع المنطقة المراد استغلالها في بناء مزرعة الرياح، فإن المنطقة اللازمة لإقامة هياكل البنية التحتية تُعد محدودة جدًا. ولهذا، ستحافظ المنطقة على موائل مناسبة للحيوانات المحلية خلال فترة إقامة التوربينات والفترة التي تليها. وخلاصة القول أن الأثر على البيئة الحيوانية الناتج عن بناء مزارع الرياح والتشويش الناتج عن ذلك ضمن نطاق منطقة الدراسة يُعد عديم الأهمية (مقبول). إلا أنه يتعين تجنب إقامة التوربينات أو أية مرافق فنية في الواحة والأودية الكبرى والمنطقة التي تُعد موطنًا لحيوان الضب المصري، كم يجدر التخفيف من حدة النشاط البشري في تلك المواقع.

ويًعد مستوى الضوضاء و الظلال الناتجين عن تشغيل التوربينات محدودًا من ناحية مساحة الأثر وزمنه. ولهذا فمن غير المتوقع أن يكون لمزارع الرياح تأثير خطيرا على الحيوانات لبرية، وبهذا فإن تشغيل وصيانة مزارع الرياح ضمن نطاق منطقة الدراسة لن يتسبب بأية آثار ضارة على الحيوانات.

### 1-3-3 الطيور

خطر الاصطدام والتأثير المتبادل ما بين الطيور وتوربينات الرياح

لقد أثار بناء توربينات الرياح في السنوات الأخيرة جدلاً عميقًا حول القضايا المتعلقة بحماية أنواع الطيور، وخصوصًا في أوروبا والولايات المتحدة.

وفيما يتعلق بإقامة توربينات الرياح ضمن حدود منطقة الدراسة، فإن المخاطر الرئيسية المحتملة على الطيور ترتبط بخطر التصادم والموت، إضافة إلى ما يترتب عن وضع الحواجز في تلك البيئة. ولا

تحمل الآثار الأخرى المحتملة لإقامة التوربينات أهمية تذكر، وتضم تلك الآثار النزوح عن البيئة الطبيعية بسبب التشويش، وتغيير مباشر للموائل وفقدان الجواثم والطيور المحلية.

تقييم الأثر على الطيور المهاجرة والمحلية والباحثة عن مجثم– مرحلة البناء

لن تتأثر الطيور أثناء الطيران الفعلي بمرحلة البناء. وقد تستلزم الضوضاء وانبعاثات الغبار في مواقع البناء الواضحة تعديل مسار الطيران، وهو أمر لا يشكل بحد ذاته أثرًا ضارًا.

قد تؤدي مراحل بناء مزارع الرياح إلى تعديل أو فقدان موائل الطيور المحلية أو الجاثمة وخصوصًا بسبب استغلال المنطقة في تنفيذ الأساسات لإقامة التوربينات، والطرق الدائمة التي تسمح بدخول المنطقة والمسارات التي يتم تحديدها لتثبيت خطوط الطاقة ومواقع تخزين المعدات الثقيلة والتركيبات الفنية الأخرى وغيرها. من ناحية أخرى، فإن أنواع الطيور المحلية وكثافة تعدادها محدودة جدًا، ولا تشكل معظم أجزاء منطقة الدراسة موقعًا مفضلاً للطيور الجاثمة. وتعتبر المنطقة اللازمة لإقامة عناصر البنية التحتية صغيرة جدًا بالمقارنة مع إجمالي المساحي المخصصة لإقامة مزرعة الرياح. ولهذا، ستبقى المنطقة محتوية على موائل مناسبة وكافية للطيور المحلية والجاثمة حتى بعد الانتهاء من بناء التوربينات.

وتحتوي الواحة والأودية الكبرى الرئيسية على رقع صغيرة من الغطاء النباتى الذى يشكل عناصر محددة داخل الأرض الصحراوية، وقد يتم استخدامها باعتبارها مصادر للغذاء ومواقع صيد للطيور المحلية، وأيضًا باعتبارها مجثم خلال فترات الهجرة. ولهذا يتعين الحد من أعمال البناء في الواحة وفي الأودية الرئيسية.

كما أن الهياكل الكهربائية المرتبطة بمزارع الرياح، ومن المحطات الفرعية أو خطوط الطاقة العلوية المستخدمة للربط الكهربي والممرات الرئيسية جميعها تؤثر في نمط الهجرة المتبع لدى الطيور، ولهذا ينبغي تنفيذ أعمال البناء وإجراءات الحماية وفقًا لتوجيهات حماية الطيور من خطوط الكهرباء، لائحة الطبيعة والبيئة رقم 140، المجلس الأوروبي للنشر.

وخلاصة القول بأنه يتم تقييم التأثير على الطيور المهاجرة والمحلية والجاثمة الناتج عن بناء مزارع الرياح ضمن حدود منطقة الدراسة باعتباره مقبول. ومن الممكن تخفيف الآثار المتبقية عن طريق تطبيق التدابير المذكورة.

تقييم الآثار على الطيور المهاجرة – مرحلة التشغيل والصيانة

تشير الدراسة بوضوح إلى أن بعض أجزاء منطقة الدراسة تحمل أهمية عالمية لأنماط الهجرة السائدة في فصل الربيع. ولذلك، فمن المحتمل أن يكون استثناء التأثيرات المهمة (الاصطدامات وتأثير الحواجز) التي قد تعاني منها تجمعات بعض الأنواع عند إنشاء مزارع الرياح في جميع أرجاء منطقة الدراسة أمرًا متعذرًا. ومع ذلك، تشير نتائج الدراسة إلى وجود ارتفاع تدريجي في نشاط الهجرة من الغرب إلى الشرق في حدود منطقة الدراسة. وهذا يعتبر أمرًا جيدًا عند النظر إلى نتائج الدراسات التي أجريت في

خريف 2008 في منطقة وادي الدارة (انظر التوصية المشتركة لكارل برو وإكودا 2009). وعليه، يصبح من المفيد إجراء دراسة لتقييم الأثر في الأجزاء المختلفة لمنطقة الدراسة بسبب وجود اختلافات في أنماط هجرة الطيور التي تمت دراستها في ربيع 2010. وعند الأخذ بالاعتبار مدى أهمية المنطقة لنشاط الهجرة وحدة الأثر البيئي المتوقع، يمكن تقسيم منطقة الدراسة إلى ثلاث مناطق حسب التالي:

- **المنطقة 1**

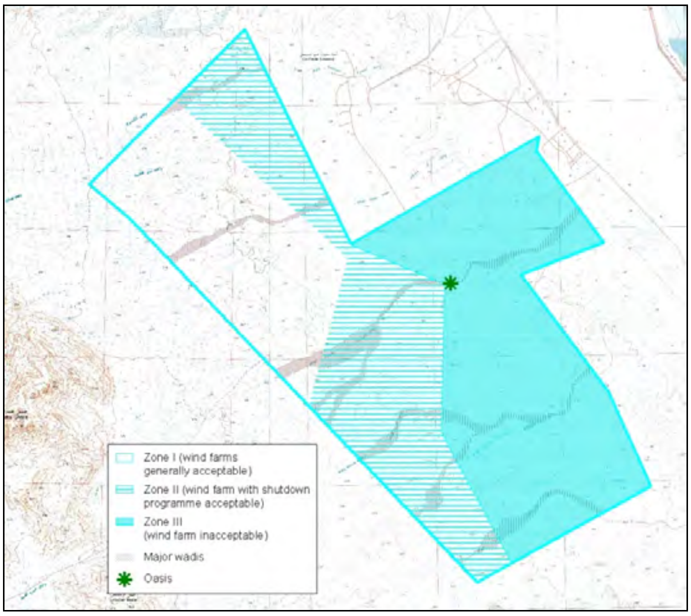
تغطي المنطقة 1 مساحة 53 كم$^2$ وتشمل الجزء الشمالي الغربي من منطقة الدراسة (الموقعين أ و ب) حيث وصل نشاط الهجرة إلى أدنى مستوى له في ربيع 2010 (الشكل رقم 1-12). لا يتوقع وجود خطر اصطدام للطيور المهاجرة في الربيع في مزارع الرياح وفي نطاق المنطقة 1 إذا تم ال تجنب ذلك من خلال تطبيق تدابير التخفيف حسب أفضل مستوى من الممارسة (انظر الفصل 1-4).

- **المنطقة 2**

تتكون المنطقة 2 من أجزاء من منطقة الدراسة الواقعة في الشمال الشرقي (الموقع هـ)، في الوسط (الموقعين ج ، و) وفي الجنوب الغربي (الموقع د) وتبلغ مساحتها 67 كم$^2$ (الشكل 1-12). ووفقاً لنتائج الدراسة، تعتبر المنطقة 2 مهمة جداً لهجرة الطيور. وبالنظر إلى الأعداد الهائلة من الطيور التي تهاجر على ارتفاعات تقل عن 200 متر، فلا يمكن هنا أستبعاد وجود مخاطر أصطدام للطيور بمزارع الرياح في المنطقة 2 مما سيشكل تهديداً كبيراً بالنسبة للطيور المهاجرة. وبناء على ذلك، لا يمكن قبول الأثر المتوقع لمزارع الرياح في المنطقة 2. ومع ذلك، فإن إيقاف التوربينات في فترات الهجرات الأكثر ارتفاعاً سيسهم في الحد من خطر الاصطدام والأثر الحاجز بالنسبة للطيور المهاجرة. ولذلك، يمكن قبول بناء التوربينات في حدود المنطقة 2 فقط إذا تم تطوير وإنشاء برنامج وقف العمل (انظر الفصل 1-4).

- المنطقة 3

تتكون المنطقة 3 من القسمين الشرقي و الجنوبي الشرقي من منطقة الدراسة (الموقع ز ، ح) وتبلغ مساحتها 88 كم$^2$ (الشكل 1-12). وتبين نتائج الدراسة بوضوح أن المنطقة 3 تعتبر ذات أهمية بالغة بالنسبة لهجرة الطيور في الربيع. وبناء على ذلك، لا يمكن استثناء معدلات الاصطدام التي تؤدي إلى وفيات إضافية، ومن المحتمل أنها تؤدي إلى وجود آثار سلبية حادة خاصة بالتجمعات الخاصة ببعض الأنواع، وذلك عند بناء مزارع الرياح في المنطقة 3. وعليه لا يمكن قبول الأثر المتوقع لمزارع الرياح وبالتالي يجب أن يكون إنشاء مزارع الرياح محظوراً بشكل صارم في نطاق المنطقة 3. حتى أنه لا ينبغي الاعتقاد في أن برامج إيقاف التوربينات قادرة على تقليل الآثار السلبية لمزارع الرياح في المنطقة 3 إلى مستوى مقبول، لأنه لا يمكن استثناء آثاراً تراكمية مهمة (فيما يتعلق بخطر الاصطدام وتأثير الحواجز).




**الشكل 1-12** نتائج تقييم الأثر الخاص بأجزاء مختلفة من منطقة الدراسة نتيجة للاختلافات الخاصة في هجرة الطيور الملاحظة في ربيع 2010.

كان نشاط الهجرة في خريف 2010 ما بين منخفض ومنخفض جداً في كافة أرجاء منطقة الدراسة (وفقاً لما يمكن توقعه من الدراسات السابقة). وبالتالي، ونتيجة للعدد المنخفض للطيور المهاجرة في الخريف، لن تشكل مزارع الرياح الموجودة في حدود منطقة الدراسة خطر اصطدام. قد تحدث اصطدامات منفردة في مزارع الرياح في نطاق منطقة الدراسة حتى خلال الخريف. ولكن معدل الاصطدام المتوقع لن يتسبب في آثار هامة على التجمعات. ولذلك، لا يتم النظر إلى الاصطدامات في توربينات الرياح في حدود منطقة الرياح خلال الخريف على أنه يوجد لها أثر كبير على الطيور المهاجرة.

ونتيجة للافتقار إلى المعلومات المتعلقة بسلوك الطيور الكبيرة التي تحلق في محيط توربينات الرياح، يكون تقييم الأثر غير مؤكد. وبناء على ذلك، وبصرف النظر عن إجراءات التخفيف، ينبغي تنفيذ برنامج رصد دقيق خاص بمرحلة ما بعد التشييد، لمزارع الرياح في المنطقة 1 والمنطقة 2 لتقييم ما إذا كانت آثار مزارع الرياح في المنطقة 1 والمنطقة 2 تبقى عند مستوى مقبول، أو ما إذا كان هناك تدابير إضافية ضرورية لتقليل أو الحد من الآثار غير المقبولة. سيتم استخدام نتائج عملية رصد مرحلة ما بعد التشييد لإعداد برنامج إيقاف التوربينات حسب الطلب.

تقييم الآثار على الطيور المحلية – مرحلة التشغيل والصيانة

قد تتأثر الطيور المحلية بسبب الاضطرابات أثناء مرحلة تشغيل مزارع الرياح. ومع ذلك، لا تكون غالبية الطيور المحلية سريعة التأثر بالمؤثرات الصوتية والبصرية الثابتة تقريباً الخاصة بتوربينات الرياح. وفضلاً عن ذلك، تقتصر آثار الاضطرابات على مساحة صغيرة جداً وتغطي على الأغلب مساحة تصل إلى 300 متر ضمن نطاق التوربينة. وحيث أن تنوع وكثافة الطيور المحلية يعتبران في

مستوى منخفض، يتم تقييم أثر الاضطرابات المتعلقة بتشغيل التوربينات على الطيور المحلية على أنه ليس أثراً كبيراً (مقبول).

من المتوقع أن يكون النشاط الإنساني محدود من حيث الوقت والمساحة. وفي المجمل، يتم تقييم أثر الاضطرابات المتعلقة بالصيانة على الطيور المحلية على أنه أثراً مقبولا.

كذلك ستواجه الطيور المحلية خطر الاصطدام في التوربينات التي يتم تشغيلها. ومع ذلك، فأن وعي الطيور المقيمة بالتوربينات مرتفع و بالتالي يكون سلوكها في تجنب التوربينات أفضل. وحيث أن أنواع وكثافة الطيور المحلية تعتبر ذات مستوى منخفض جداً، فلن تؤدي مزارع الرياح في المنطقة 1 والمنطقة 2 إلى وجود خطر اصطدام كبيير على الطيور المحلية.

<u>تقييم الأثر على الطيور المقيمة والباحثة عن مجثم – مرحلة التشغيل والصيانة</u>

من المعروف أن الأنواع التي تميل إلى الوجود في مجثم في أعداد كبيرة تتجنب مزارع الرياح التي يتم تشغيلها. ولذلك، نتوقع أن اللقلق الأبيض والبجع الأبيض، على سبيل المثال، لن تتجمع في العادة في مجثم في حدود مزارع الرياح. وحيث أن منطقة الدراسة لا تعتبر موقعاً مفضلاً لاستخدامه مجثمًا بالنسبة لهذه الأنواع وحيث أنه يوجد العديد من المواقع البديلة لاستخدامها مجثمًا، لن يؤدي تشغيل مزارع الهواء إلى فقدان المواطن بالنسبة لهذه الأنواع. ولا يعرف عن الأنواع التي تحط في مجثم في أعداد قليلة أو حتى بمفردها – على سبيل المثال الطيور الجوارح أو الطيور الصغيرة (الطيور الجاثمة) – أنها تتجنب توربينات الرياح. وحيث تقع السبخة على بعد بعض الكيلومترات من المنطقة 1 والمنطقة 2، فلن تؤثر التوربينات على الطيور التي تستخدم السبخة موقعًا للجثوم.

من المتوقع أن يكون النشاط الإنساني محدود من حيث الوقت والمساحة. وفي المجمل، يتم تقييم أثر الاضطرابات المتعلقة بالصيانة على الطيور المحلية على أنه أثراً مقبولا.

تواجه الطيور المقيمة والباحثة عن مجثم خطر الاصطدام في التوربينات التي يتم تشغيلها. قد يكون خطر الاصطدام عالياً في حالات عندما يكون هناك أعداداً كبيرة من الطيور حيث: (1) تتوقف عن الهجرة في ساعات الظهيرة للبحث عن مكان لقضاء الليل و(2) تبدأ الهجرة في الصباح بعد قضاء الليل في الصحراء. وحيث أن منطقة الدراسة لا تعتبر موقع جثوم مفضل وحيث يتوقع مع أنواع، مثل اللقلق الأبيض أو البجع الأبيض، أن تتجنب توربينات الرياح التي يتم تشغيلها، لن تؤدي مزارع الرياح في المنطقة 1 والمنطقة 2 إلى وجود خطر اصطدام كبير على الطيور المقيمة والباحثة عن مجثم.

## 4-1 تدابير التخفيف

إن بناء مزارع الرياح وتشغيلها في مساحة المشروع البالغة 200 كم$^2$ سيكون له آثاراً كبيرة على هجرة الطيور في فصل الربيع. وإن تطبيق الإجراءات الاحترازية الآتية (الفصل 1-4-1) سيساهم بالحد من الآثار الناجمة عن بناء مزارع الرياح في مساحة قدرها 120 كم$^2$ إلى المستوى المقبول.

وفيما يتعلق بالحفاظ على الموارد الأخرى، تضمن مزارع الرياح في المنطقة محل الدراسة تقليل الآثار الضئيلة الأخرى والتي يمكن الحد منها عن طريق التصميم الجيد والممارسة المهنية والحفاظ على معايير الصحة والسلامة بالإضافة إلى الإشراف والمراقبة (انظر الفصل 1-4-2).

### 1-4-1 تدابير التخفيف المتعلقة بهجرة الطيور

و فيما يأتي أبرز تدابير التخفيف اللازمة للحد من هجرة الطيور:

- من أجل الحد من المخاطر المتوقعة للاصطدام و تأثير الحواجز التي تتعرض لها الطيور المهاجرة في منطقة 2، يجب إعداد برنامج فعال لإيقاف التوربينات لاستخدامه خلال فترة الهجرة في موسم الربيع. وبشأن تطوير برنامج الإغلاق يجب التقيد بالمرحلتين الآتيتين:

  - برنامج لإيقاف التوربينات بشكل محدد يوقف كافة التوربينات اعتباراً من 1 مارس و حتى 18 مايو في النهار (ساعة قبل الشروق وساعة بعد الغروب). واستناداً على بيانات طويلة الأجل، تقدر الطاقة المتوقع فقدانها لتشغيل هذا البرنامج بحوالي 10%.

  - برنامج لإيقاف التوربينات عند الطلب (باستخدام تقنية الرادار) لإيقاف كافة التوربينات خلال الأوقات التي تبلغ فيها الهجرة ذروتها وعند اقتراب الأسراب من مزرعة الرياح. واستناداً على بيانات الرياح وهجرة الطيور طويلة المدى تم جمعها في ربيع 2010، تقدر الطاقة المتوقع فقدانها لتشغيل هذا البرنامج بحوالي 2%.

  و من غير المتوقع أن تتسبب مزارع الرياح في المنطقة 2 في خاطر الاصطدام للطيور المهاجرة في فصل الربيع في حالة تنفيذ برنامج فعال لإيقاف التوربينات. ولتنظيم ومراقبة برنامج الإغلاق يلزم تركيب معدات تحكم مركزية لكافة مزارع الرياح.

  وعلاوة على ذلك، يجب استخدام وسيلة تقنية للتفادي وزيادة تدابير التخفيف وفقاً لأعلى المعايير العالمية (انظر التالي).

- الحد من مخاطر الاصطدامو آثار الحواجز للطيور المهاجرة في مزارع الرياح في **المنطقة 1** خلال موسم الربيع باتخاذ التدبير الفعالة وذلك إما:

- عن طريق إنشاء ممر للهروب في المنطقة الوسطى 1: يجب أن يبلغ عرض ممر الهروب 1 كيلومتر ويكون بمواجهة اتجاه الرياح الرئيسي أي الشمال الغربي إلى الجنوب الشرقي، وسيسمح هذا الممر للطيور بمغادرة منطقة مزارع الرياح بطريقة آمنة ودون بذل جهود كبيرة.

أو

- تنفيذ برنامج لإيقاف التوربينات (انظر أعلاه). ويوصى بتطبيق برنامج لإيقاف التوربينات بناءً على الطلب، إذا أثبت فعاليته وقدرته على التشغيل المستدام وكان متوافقاً مع متطلبات أقل البلدان نمواً. ويجب إجراء رقابة مركزية لتنظيم ومراقبة برنامج إغلاق مزرعة الرياح.

- وإذا كان من المقرر إنشاء ممر الهروب في المنطقة 1، فإن من الممكن أن يتم التركيز على الطيور المهاجرة في منطقة الممر أثناء موسم الربيع (عندما تواجه الطيور رياحاً قوية وتنجرف مع الريح باتجاه الجنوب الشرقي أو عندما تستسلم الطيور لاتجاه الرياح القوية وتتجه مع الريح إلى الجنوب الشرقي)، وخلال فصل الخريف كذلك. وبالتالي ، للحد من خطر الاصطدام وتأثير الحاجز للطيور المهاجرة عبر منطقة الممر الأول لابد من التوسع في اتجاه الجنوب الشرقي من خلال المنطقة الثانية. وإلا، بدلا من ذلك ، سيتم تطبيق برنامج لإيقاف التوربينات في منطقة 1 (ولكن لا يوجد ممر الهروب) ، وهو ممر للهروب عن طريق المنطقة الثانية ولا يمكن الاستغناء عنه.

- إنشاء برنامج مراقبة مفصل لما بعد بناء المزارع مدته سنتين خلال أوقات الهجرة الرئيسية (شهرين ونصف في الربيع وشهرين في الخريف) لتقييم ما إذا كانت تأثيرات مزارع الرياح في منطقة 2 ما زالت في المستوى المقبول أو ما إذا كانت التدابير الإضافية ضرورية للحد من الآثار غير المقبولة. والتعاون مع المنظمات البيئية المحلية والعالمية.

- لا تستطيع توربينات الرياح ذات الأبراج الشعرية تجنب المواقع القائمة؛ إذ ينبغي ألا يصل طول ارتفاع توربين الرياح إلى ما يزيد عن 120 متر. ويجب تفادي إنارة التوربينات، وفي حال استدعت الحاجة إلى إنارة التوربينات، فيجب استخدام أقل عدد من الأنوار منخفضة الاستهلاك للطاقة (دريويت أند لانغستون 2006) وقادرة على تلبية متطلبات الطيران المفروضة من سلطة الطيران المدني والعسكري. ويجب استخدام ريش التوربين الملون للمساعدة على رؤية الريش بوضوح أكبر باستخدام الريش باللون الأبيض والأسود (هودوز و آخرون، 2003).

- بناء مزرعة رياح ذات شبكة داخلية بواسطة كابلات أرضية، ولا يمكن تجنب استخدام الخطوط الهوائية (220 kV OHL) ويجب تصميم الخطوط الهوائية وفقاً لتوجيهات حماية الطيور من خطوط الكهرباء و المنصوص عليها في لائحة الطبيعة والبيئة رقم 140، المجلس الأوروبي للنشر، بالإضافة إلى تطبيق التدابير المماثلة في أية محطة فرعية يتم بناؤها في هذه المنطقة.

### 1-4-2 تدابير التخفيف المتعلقة بالعناصر الأخرى (باستثناء الطيور المهاجرة)

فيما يتعلق بالعناصر الأخرى (عدا الطيور المهاجرة) نورد فيما يأتي أبرز تدابير التخفيف اللازمة بهذا الشأن:

- الحد من أعمال البناء بجانب الواحات وآبار المياه الوديان وأن تقتصر على أعمال الطرق وتحسينها وحفر الخنادق لتمديد الكابلات.
- تفادي تركيب التوربينات وغيرها من التجهيزات التقنية في المناطق التي يقطنها الضب المصري. ويجب تقليص جميع الأنشطة البشرية، سواء خلال مرحلة البناء والتشغيل أو الصيانة.
- تغيير الزيت ومواد التشحيم أو المركبات الهيدروكربونية في محطات الوقود. لا يجب إجراء هذه الأنشطة في الموقع. ويجب على مشرف الموقع أن يقوم بوضع ضوابط مراقبة صارمة.
- إلزام المقاولين بتوفير الحماية الفعالة لموارد الأراضي والمزارع في جميع الأوقات، ويتحملون مسؤولية أي ضرر لاحق.
- إلزام المقاول بالتعاقد مع أيدي عاملة مؤهلة وعمال نظافة لتنظيف الموقع أثناء عمليات البناء وفقاً للشروط التعاقدية وتعيين مهندسي إشراف بما يكفل التخلص من النفايات الصلبة ومياه المجاري والصرف الصحي ومنع انسكاب الزيوت المستعملة والشحوم والديزل، إلخ.
- تعيين مهندس صحة وسلامة من قبل المقاولين الرئيسيين للأقسام المختلفة ومنحه الصلاحية الكاملة لإعطاء تعليمات الصحة والسلامة.
- تطبيق تعليمات الصحة والسلامة على المصنعين الذين يقوموا بعمليات تركيب وتجهيز وصيانة توربينات الرياح.
- التأكد من تطبيق شركات الأشغال المدنية المحلية لتدابير الصحة والسلامة والتي يتم التعاقد معها من قبل المقاول الرئيسي أو هيئة الطاقة الجديدة والمتجددة وخاصة فيما يتعلق بارتداء الملابس المناسبة، ومعدات السلامة وتوفير بيئة عمل آمنة.

## 1-5 خطة الإدارة البيئية

يتطلب تنفيذ تدابير التخفيف لوائح معينة خلال عملية المناقصة والتخطيط والبناء ومرحلة ما بعد البناء لكل مزرعة رياح سيتم إنشاءها في المنطقة المعتمدة أو التي يتم اعتمادها لاحقاً بناءً على شروط مقبولة. ونوجز ذلك في خطة الإدارة البيئية الآتية.

| التكلفة التقديرية (باليورو) | تدابير التخفيف | المخاوف البيئية | نشاط المشروع |
|---|---|---|---|
| يتم تضمينه في تكلفة الاستثمار | المحافظة على المعايير على النحو المذكور في تعليمات | مخاطر الصحة والسلامة | مرحلة البناء والتخطيط |

| التكلفة التقديرية (باليورو) | تدابير التخفيف | المخاوف البيئية | نشاط المشروع |
|---|---|---|---|
| | ولوائح البيئة والصحة والسلامة لطاقة الرياح، مؤسسة التمويل الدولية، 2007، والالتزام بحد أدنى في وثائق المناقصة. | | |
| يتم تضمينه في تكلفة الاستثمار | تعيين مهندس صحة وسلامة خلال عمليات البناء متطلب أساسي. | | |
| يتم تضمينه في تكلفة الاستثمار | وضع خطة للصحة والسلامة لموقع البناء شرط إلزامي. | | |
| يتم تضمينه في تكلفة الاستثمار | توفير معدات وأدوات السلامة وفقاً للمعايير المقبولة من قبل المقاول شرط أساسي للتقدم للمناقصة. | | |
| لا يوجد | الحد من ارتفاع توربينات الرياح بشرط ألا يتجاوز 120 متر | التأثير على الطيور | |
| يتم تضمينها في تكلفة الاستثمار، وسيؤدي هذا التدبير إلى رفع تكلفة البنية التحتية، ورفع عوائد الطاقة والحد من الاضطراب وإفساح المجال للطيور. | تحديد المسافات الدنيا بين توربينات الرياح بشرط ألا تقل عن 12 x 3 للقطر | | |
| حوالي 10,000 يورو لكل ميجاوات وسيتم تضمينه في تكلفة الاستثمار. | استخدام ريش التوربين الملون للمساعدة على رؤية الريش بوضوح أكبر باستخدام الريش باللون الأبيض والأسود (انظر هودوز وآخرون 2003). | | |
| هذا هو المعيار وسيتم تضمينه في تكلفة الاستثمار. | بناء شبكة داخلية مثل الكابل الأرضي | | |
| تصميم OHL يبلغ 220 كيلوفولت بالاتفاق مع هيئة التدريب على استخدام المحركات والأجهزة. وبالنسبة للمحطة: يتم بناء MT وفقاً للقواطع الكهربائية في محطات الطاقة؛ وبناء 220 كيلوفولت بما يتناسب مع متطلبات الاتصال الفنية وفقاً للمبادئ التوجيهية؛ويتحمل أصحاب المشروع التكاليف. | وضع توجيهات لحماية الطيور من خطوط الكهرباء، لائحة الطبيعة والبيئة رقم 140، المجلس الأوروبي للنشر شرط أساسي لتصميم تمديدات داخلية تبلغ 220 kV لأية محطة وتوفير التدابير الوقائية الكافية لحماية الطيور في المحطات. | | |
| يتم تضمينها في تكلفة الاستثمار. | تجهيز خطة كافية للصحة | مخاطر الصحة والسلامة | مرحلة التخطيط والبناء التفصيلية |

| نشاط المشروع | المخاوف البيئية | تدابير التخفيف | التكلفة التقديرية (باليورو) |
|---|---|---|---|
| | | والسلامة | |
| مرحلة البناء | مخاطر الصحة والسلامة | تعاقد المقاول مع مهندس صحة وسلامة مستقل لتوفير تعليمات الصحة والسلامة | يتم تضمينها في تكلفة الاستثمار. |
| | | المحافظة على المعايير على النحو المذكور في تعليمات ولوائح البيئة والصحة والسلامة لطاقة الرياح، مؤسسة التمويل الدولية، 2007، هو التزام بحد أدنى. | يتم تضمينها في تكلفة الاستثمار. |
| | | توفير والاستخدام الأمثل لمعدات وأدوات السلامة. | يتم تضمينها في تكلفة الاستثمار. |
| | | نظافة المرافق الصحية المؤقتة. | يتم تضمينها في تكلفة الاستثمار. |
| | | ضمان إيقاف أعمال التنصيب في الأحوال الجوية السيئة | يتم تضمينها في تكلفة الاستثمار، وتمديد مدة التنصيب. |
| | التلوث | يُلزم المقاول بالتعاقد مع أيدي عاملة جيدة وعمال نظافة لتنظيف الموقع أثناء عمليات البناء وفقاً للشروط التعاقدية وتعيين مهندسي إشراف بما يكفل التخلص من النفايات الصلبة ومياه المجاري والصرف الصحي ومنع انسكاب الزيوت المستعملة والشحوم والديزل، إلخ. | يتم تضمينها في تكلفة الاستثمار. |
| | | إلزام المقاول بالمحافظة على ترتيب ونظافة الموقع من خلال ردم الحفريات وإزالة مواد الحفر والتخلص من النفايات على الوجه الأتم. | يتم تضمينها في تكلفة الاستثمار |
| | | امتثال أعمال البناء للتدابير الاحترازية المذكورة في فصل 6-2.<br>بالإضافة إلى ذلك، لتنفيذ برنامج الإغلاق يجب تصميم منشأة مراقبة مركزية لكافة مزارع الرياح في المنطقة التي تتيح الإغلاق المركزي وإعادة التشغيل. | تكلفة استثمارية إضافية لمرافق المراقبة المركزية بناءً طلبية بقيمة مليون يورو. |

| التكلفة التقديرية (باليورو) | تدابير التخفيف | المخاوف البيئية | نشاط المشروع |
|---|---|---|---|
| تكلفة إضافية محدودة جداً للمستثمرين، لا يمكن حسابها إلا بعد إجراء التصميم التفصيلي فقط. | ضمان تنفيذ أعمال البناء وفقاً للتدابير الاحترازية المذكورة في فصل 6-2 ولا يجوز بناء توربينات الرياح في الأودية الرئيسية والطرق والخنادق التي تكون بعيدة عن المناطق الزراعية وعدم تنفيذ أعمال البناء في الأماكن المأهولة بالضب المصري. | التأثير على الحياة النباتية والحيوانية (باستثناء الطيور) | |
| يحدد المتطلب الأساسي من قبل أصحاب المشروع ويخضع لمراقبة خبير خارجي مؤهل (50,000 يورو لمزرعة الرياح الكبيرة) | ضمان تنفيذ عمليات التشغيل والصيانة في توربينات الرياح من قبل عمالة مؤهلة فقط اجتازت دورة تدريبية في السلامة. | مخاطر الصحة والسلامة | التشغيل والصيانة |
| 400,000 يورو في العام، يتم تعيين الخبراء من قبل أصحاب المشروع أو يعين كل صاحب مشروع خبيراً من جانبه. | مراقبة التأثير البيئي على الطيور بعد عمليات البناء خلال العامين الأولين على الأقل أثناء المواسم الرئيسة للهجرة في مزارع الرياح في المنطقة 1 والمنطقة 2 بالتعاون مع المنظمات المحلية والعالمية لتحديد التأثيرات على الطيور في حال تجاوز المستوى المقبول وتنفيذ تدابير احترازية إضافية أو تحسين تدابير التخفيف الحالية عند الاقتضاء وفق الحدود المحددة في هذه الدراسة | التأثيرات على الطيور | |
| 150,000 يورو سنوياً للمنطقة 2 (و/أو المنطقة 1). | الإشراف على والمراقبة المركزية لبرنامج الإغلاق خلال موسم هجرة الطيور في الربيع في المنطقة 2 في مزارع الرياح (أو المنطقة 1) | | |
| خلال عامين، حوالي مليون يورو يتم تمويله بالتكافل أو التضامن من قبل أصحاب المشروع. | تطوير واختبار وإنشاء برنامج إغلاق بناءً على الطلب (باستخدام الرادار) خلال موسم هجرة الطيور في الربيع في المنطقة 2 في مزارع الرياح (أو المنطقة 1)، بالإضافة إلى التعاون مع الدول الأقل نمواً. | | |

| التكلفة التقديرية (باليورو) | تدابير التخفيف | المخاوف البيئية | نشاط المشروع |
|---|---|---|---|
| 300,000 يورو سنوياً للمنطقة 2 (و/أو المنطقة 1) ويتقاسم أصحاب المشروع التكاليف أو يتحمل كل منهم هذه التكاليف. | تنفيذ برنامج الإغلاق عند الطلب (في موقعين ويجهز لكل منهما بنظام رادار واحد) في منطقة 2 خلال موسم هجرة الطيور في الربيع (أو المنطقة 1)، بالإضافة إلى التعاون مع الدول الأقل نمواً. | | |
| متطلب أساسي يحدده أصحاب المشروع. | ضمان الإدارة السليمة للنفايات القائمة في مباني الخدمة (بالتعاون مع رأس غريب لإدارة النفايات) وإعادة تدوير الزيوت والشحوم المستخدمة | التلوث | |
| يتحمل التكلفة المستثمر ويتم تضمينها في تكلفة الاستثمار. | إزالة تركيبات توربين الرياح عند انتهاء صلاحيتها. | الأراضي المستخدمة والمساحات الطبيعية | التفكيك |

ARAB REPUBLIC OF EGYPT
MINISTRY OF ELECTRICITY AND ENERGY
NEW AND RENEWABLE ENERGY AUTHORITY
(NREA)

# Annex 5

# 1000 MW Wind Farm at Gulf of Suez

# Public Hearing Report

Bad Vilbel, 20.10.2010

JV - ecoda

## Public Hearing for the Environmental and Social Impact Assessment (ESIA) Study

## for 1,000 MW Wind Farms at the Gulf of Suez, Egypt

**AMC Azur**
**Hurghada, Red Sea, Egypt**
*Wednesday 21 September 2011*

## Public Hearing Report

The methodology adapted for the preparation and disclosure of the ESIA was participatory and involving for the various groups of stakeholders. The views and consultations of stakeholders not only added value to the findings but also increased the sense of stakeholders' ownership to the project and involved awareness raising and capacity building for local stakeholders on technical issues of relevance to the project.

As part of reviewing the results of the drafted ESIA, the Consultant arranged for a Public Hearing after the production of the first draft of the study. The Public Hearing event has been organized on 21st September 2011 in AMC Azur Hurghada, Red Sea, Egypt. The event had the primary interest of engaging wider range of relevant stakeholders and disclosing the ESIA preliminary results including the identified impacts and the proposed mitigation measures under the ESMP and allowing the stakeholders the opportunity to comment on the draft ESIA. The participants' feedbacks were meant to inform the final version of the ESIA through full consideration and incorporation for the relevant comments.

The Public Hearing invitation was publicly announced in Al Ahram national newspaper (scanned copy of the announcement is attached in Annex A). This announcement contained a reference to the website of the ESIA Consultant, for downloading an Arabic and an English version of the non-technical executive summary of the draft ESIA. In addition to that, personal invitations have been distributed to stakeholders of relevance to the project along with non-technical executive summary of the draft ESIA. Parts of the invitations have been circulated by NREA, while other parts have been circulated by the ESIA Consultant. As per the requirements of the EEAA, the list of proposed participants in the Public Hearing included various categories of relevance to the project. Arabic and English registration forms were prepared and used during the workshop for documenting the lists of participants. Annex B includes translation for the lists of participants and the scanned registration form of the workshop is attached in Annex C. A total of around 80 participants of various affiliations participated in the Public Hearing. The stakeholders who participated in the event involved but were not limited to, governmental organizations, non-governmental organizations, media, neighboring communities to the project site, private sector organizations as well as consultants.

The Public Hearing workshop was divided into two main sessions as indicated in the attached Agenda on Annex D. The first session involved various welcome speeches by representative of Egyptian Environmental Affairs Agency (EEAA), representative of New Renewable Energy Authority (NREA) and representative from the Governorate of Red Sea. This was followed by presentations for the project over view, the ESIA methodology and the key findings of the study by the representative of the Consultancy firms involved in the ESIA. Copies of the delivered presentations are attached on Annex E.

This session was followed by a 30 minutes break that has been followed by an open discussion session where all participants were invited to present their comments and feedbacks on the presented information. During this session, the concerned stakeholders from Governmental authorities as well as the team of consultants provided replies on the raised issues. In order to ensure efficient documentation for the participants' feedbacks, several tools have been employed. This included video and cassette recording and feedback sheets that have been distributed on participants to keep written records of their feedbacks. Sample of the written feedback sheets is attached in Annex F.

Figure A4.1: Part of the Public Hearing Participants

Figure A4.2: Presenting the ESIA findings

Figure A4.3: Participants Comments and Questions during the Open Discussion

Figure A4.3: Answers to the Raised Comments and Questions

Several raised issues are already included in the draft ESIA report. Participants were invited to download and go through the draft ESIA report which was made available on the consultant's website. The other relevant comments and feedbacks that have been raised were considered to the extent possible in developing the final version of the ESIA.

The following sections present the key issues raised during the Public Hearing event.

## 1) Introductory statements:

**Eng. Mohammad Abdullah – The General Department of Energy Projects, EEAA**

- Welcome all participants and thanked them for their interest in the event.
- Public consultations are one of the key requirements for the EEAA as part of the ESIA process. It is a crucial step for checking and validating the ESIA results.
- The project is a clean environmental friendly model of power generation. However, any potential negative impacts should be identified and mitigated through the environmental management plan.

**Dr. Mahmoud Hanafy – Environmental Affairs and Protected Areas Consultant to the Red Sea Governor and Representative of the Governorate of Red Sea**

- Welcome all participants and apology on behalf of the Red Sea Governor who was not able to participate.
- The project goes in line with the Governorate strategy and the national strategy to enhance power production through green methods.
- The Red Sea Governorate is one of the key spots for development in Egypt. The Governorate consists of vast desert and limited resources. However, the Governorate is of high economic, scientific and environmental value.

**Dr. Abdel Rahmaan Salah – NREA Chairman**

- Welcome all participants.
- The Gulf of Suez area holds one of the strongest wind potential across the world.
- At the same time, the Gulf of Suez is well known as a bottleneck for migrating birds. NREA is very much aware of the bird migration issue and pays big attention to it. NREA has thus contracted international experts to conduct comprehensive impacts studies for this aspect and set strategic management plan for the potential impacts.

## 2) Key Comments/Questions during the Open Discussion

**Question: Hamdy Fahmy Ossman – Journalist**

What is the return of the project on the Governorate and what is the risk margin?

**Answer: Dr. Abdel Rahmaan Salah – NREA Chairman**

This type of project which results in power generation is usually a key attraction for new communities, industries and new opportunities. From technical and environmental point of view, the project will provide a clean and green source of energy. It will create job opportunities which will benefit the Governorate's citizens especially those who have the needed qualifications. It will help in reducing CO2 emissions.

**Answer: Dr. Tarek Genena – EcoConServ President**

It is difficult to mention a specific risk margin related to the project. The ESIA assessed the potential impacts and set mitigation measures to address the negative impacts.

**Comment: Dr. Mahmoud Hanafy – Environmental Affairs and Protected Areas Consultant to the Red Sea Governor**

Land use and ownership issues are crucial for the wind farm projects. We are talking about 200 $km^2$. I urge the responsible agencies to pay the due attention to the land use and the potential future development issues. Some other valuable natural resources might be discovered in the future. In particular due to the involvement of the private sector in these projects, it is very important for the government to maintain sovereignty over the land.

The ESIA should also pay the due attention to the diverse interests of different parties.

**Question: Dr. Mahmoud Hanafy – Environmental Affairs and Protected Areas Consultant to the Red Sea Governor**

The total area of land that will be used under the project does not exceed 3% of the total project area. Is there any way to make utilization of the remaining 97% of the project site. Is there relevant international experience on utilizing the land use?

**Answer: Dr. Abdel Rahmaan Salah – NREA Chairman**

For land use issues, NREA's roles include allocating land after getting approvals from the various authorities. This is done in coordination with the National Land Use Authority which also considers the future plans of development and provides the license for the land use.

There are coordination protocols between the different actors involved in the area for both current and future plans.

**Answer: Dr. Ernst Niemann – Project Director, Lahmeyer International GmbH**

Other countries are utilizing the land under the wind farms as long as the buffer zones and low building heights are respected. This is the case in Germany, where the land of the wind farm is cultivated.

**Question: Eng. Tarek Tarek Awad Ibrahim – Head of the Prevention and Tests Department, EETC**

How was the project area determined?
If we are speaking about 300 m of impact zone for birds around each turbine, does this not mean that big parts of the site could be classified as risky?
I want to know more about the recommendation of not lighting turbines.

**Answer: Dr. Abdel Rahmaan Salah – NREA Chairman**

The area of the project has been determined based on the wind and solar power in cooperation with international agencies and this helped in indicating the project areas and borders.

**Answer: Dr. Frank Bergen – CEO, ecoda Environmental Consultancy GbR**

As given in the draft ESIA disturbance effects on local birds are restricted to a rather small distance and cover at most the area up to 300 m to each turbine. Species variety of local birds and bird density within the study area is very low. Consequently, the impact on local birds was assessed as not to be significant (acceptable).

Species that migrate at night are attracted by lighting and, hence, might get into the collision risk zone of wind turbines. Therefore, it is a general recommendation to reduce lighting of turbines (and other tall structures) as much as possible.

**Question: Faysal Yahiaa – El Swedy for Wind Energy**

The question is about the restrictions on the height of the turbine to 100/120 m. We wonder who takes the decision on the allowed height. Is this decision already announced or shall we wait on the final ESIA report to determine the allowed height.
Another question is about the Bedouin residing in the project site. We wonder why not to consider a relocation alternative.

**Answer: Dr. Abdel Rahmaan Salah – NREA Chairman**

The allowed height is recognized and announced in each area. For instance, in Gabal El Zeit it is 120 m. Several parties are involved in such decision such as the Civil Aviation Authority, the Defense Authority and environmental (birds) considerations. Another instance is the area located at the West Nile Valley where the allowed height is 150 m and this was determined after coordination with different parties.

Regarding the relocation it could be considered only in the cases where the local communities are disadvantaged and are in favour of relocation. This is not the case in our project.

**Answer: Eng. Ashraf Abdel Meguid – NREA Consultant**

Given the nature of economic activities of the residents of the Bedouin community within the project site and the fact that they have been working for long years with the Petroleum companies in the area, it is not feasible to propose relocation options.

**Comment: Eng. Mohamed Mohamed Eid – Consultant at IEHEE**

The study has not investigated in alternative sites to deal with the birds issues.

**Answer: Dr. Tarek Genena – EcoConServ President**

We mentioned zoning for the site to mitigate for impacts on birds and mentioned different mitigation measures based on the nature and severity of the impacts in each of the zones.

**Question: Eng. Mohammad Moustafa El Khayat – NREA**

The question is related to the escape corridor as a mitigation measure. I wonder if we are here assuming that birds are intelligent enough to realize the corridor, but not intelligent enough to overfly the wind turbines.
Regarding the 88 $km^2$ (40%) of the land space which will be restricted. I wonder if birds fly over it or settle in this area.
Regarding noise, has there been measure for the current level of noise?

**Answer: Dr. Frank Bergen – CEO, ecoda Environmental Consultancy GbR**

Due to the lack of knowledge there are still some uncertainties in the impact assessments. Of course, experiences obtained from wind farms in other parts of the world are available. However, due to the unique characteristics of the Gulf of Suez area, its importance for bird migration and the characteristics of the proposed wind farms -with hundreds of turbines- the results and conclusions obtained in other countries are not directly applicable for wind developments at the Gulf of Suez. Up to now, we have no experience on how birds will interact with a huge wind farm in this area. On the one hand it seems reasonable to assume that birds are able to avoid turbines, but on the other hand relevant numbers of collision victims have been found under wind turbines in Europe and the U.S.
Moreover, the situation at the Gulf of Suez is complicated: In spring, birds face strong headwinds and have to struggle continuously to migrate further northwest. As gliding birds lose altitude, especially in headwind situations, they are forced to gain height by circling and soaring in thermal uplifts. During soaring birds drift with the wind. This might be critical if birds drift to a row of operating turbines. Sometimes birds even give up struggling against the strong headwinds and go with the wind in south-eastern direction. In these situations a corridor might be an effective measure to give birds an opportunity to escape the wind farm area.
In zone 3 very large numbers of migratory birds were recorded. Consequently, it was concluded that wind turbines should be strictly banned in this area. Even a shutdown programme is not believed to be capable of reducing impacts in zone 3 to an acceptable level, because significant cumulative impacts with other wind farms cannot be excluded. If it turns out by a post-construction-monitoring at neighboring wind farms that the impact on migrating birds is rather low, zone 3 might be opened in the future.

**Comment: Shazly Abou Hassan Mohamed – Technician at NREA, Zafarana Wind Farm**

From our experience for around 15 years now, we observed that birds avoid wind turbine and no birds has been affected.

**Comment: Eng. Yasser Gaffar – NREA Zafaranna**

We have worked for 11 years in Zafaranna area and no impact on birds has been observed. Also, there is no noise impact and the area is full of touristic resorts and no noise impact is generated from the turbines.

**Comment: Dr. Frank Bergen – CEO, ecoda Environmental Consultancy GbR**

I very much appreciate these comments. But, as we know from studies carried out in 2007, bird migration is rather low in Zafarana wind farm area, because the majority of birds migrated further West near the Red Sea Mountains. As a consequence, the situation is not comparable to the study area.

**Question: Eng. Anwar Galal Tharwat – Environmental Consultant**

Has there been coordination between this ESIA and the other ESIA conducted previously by other international consultants in the area?
We also suggest field monitoring for mortality rates?

**Answer: Dr. Frank Bergen – CEO, ecoda Environmental Consultancy GbR**

Yes, we benefited from two main studies. The first one was conducted by Carl Bro and the second one by us. Both studies have been very important references for the recent ESIA.

In 2007, we conducted a post construction monitoring at Zafarana wind farms. During this investigation no collision victim was recorded, confirming that bird migration is concentrated further West near the Red Sea Mountains.
We learnt from recent observations that bird migration is much higher in our study area and, hence, that the area is much more sensitive. Investigating mortality rates is considered in coming post-construction monitoring, which is one of the important procedures that has been recommended in the ESIA.

**Question: Eng. Mouard Magdy Nassar – EETC**

Concerning the shut down on demand, we suggest this to be done in coordination with EETC for the times of operation and shutting down.
Why did you not consider placing turbines in the restricted zone and consider a shut down on demand program instead of losing the opportunity.

**Answer: Dr. Abdel Rahmaan Salah – NREA Chairman**

We assure you that coordination is ongoing and will be functioning in the future. Regarding your second question, this suggestion needs a feasibility study assessment and this could be decided after the post construction monitoring.

**Question: Eng. Khaled Alaam – EEAA**

Zone 3 is a very sensitive migratory birds' spot which is recognized internationally so it is very important to restrict the construction of wind turbines in this area.
Regarding the shut down program, I wonder who is taking the decision of the shut down?

**Answer: Dr. Abdel Rahmaan Salah – NREA Chairman**

Of course we are committed to the international conventions ratified by Egypt and the national legislations for environmental and biodiversity protection.
Regarding the second part of the question, the main three actors engaged in the shut down decision are the EEAA, NREA and EETC. The shut down should be made in full cooperation between these actors

**Question: Akihiro Yoshida – Project Coordinator Toyota Tsush, Japan**

My question is concerning the maximum tip height. Is it confirmed that for Gabal El Zeit it is 120 m or does it depend on decisions made by different authorities?

**Answer: Dr. Ernst Niemann – Project Director, Lahmeyer International GmbH**

The 120 m tip height is the requirement of the Ministry of Civil Aviation and the Ministry of Defense and the same recommendation was confirmed by the environmental study.

**Comment: Emad Ghally – RES Country Manager**

Regarding coordination in case of any new developments in the future (e.g. the emergence of new resources that need to be utilized in the area), we confirm from our previous experience that this could be coordinated and managed.

**Comment: Wahed Salama Hamyed – General Manager of the Red Sea General Directorate Department**

The efforts of NREA, not only in this current ESIA, but in all previous ESIAs in this important bird area are highly appreciated. The alternative and the mitigation measures developed by these studies are crucial for protecting birds.

We started to have local/national qualified human resources in the field of birds and bird migration and they are valuable assets for such studies.
I suggest establishing a risk center for the birds in the area to avail immediate veterinary treatments in the unfavorable cases of accidents.

**Comment: Mahmoud Attia – NREA Deputy for Projects Department**

I want to add a comment about the coordination among the various concerned authority and emphasize that the various ministries of relevance to the project usually discuss their future plans and consult together during the preparation of the project.

## Annex A: Scanned Copy of the Public Hearing Announced in Al Ahram on 31st August 2011

الاربعاء ٣١/٨/ ٢٠١١

تتشـــرف
هيئة الطاقة الجديدة والمتجددة
وبنك التعمير الألمانى KFW
واستشارى الدراسات البيئية
لمشروع محطة كهرباء الرياح بخليج السويس

بدعوة الجهات المعنية للمشاركة وابداء الرأى فى جلسة المشورة الجماهيرية المزمع عقدها عن تقييم التأثيرات البيئية لمشروع محطة كهرباء قوى الرياح فى خليج السويس بقدرة ١٠٠٠ ميجاوات

وذلك يوم الأربعاء ٢١ سبتمبر ٢٠١١

بقاعة مؤتمرات فندق AMC AZUR بالغردقة - طريق الاحياء - محافظة البحر الأحمر
ويمكن لراغبى الاطلاع على الدراسة الاطلاع عليها حتى ٢٠ يوما من تاريخ نشر هذا الإعلان بالموقع الإلكترونى لهيئة الطاقة الجديدة والمتجددة
www.nrea.gov.eg
وموقع الاستشارى
http://www.lahmeyer.de/en/energy/wind-energy/

للاستعلام تليفون: ٠١٦٣٣٣٢٢٥٣٧

## Annex B: NREA Official Invitation Letters to major Stakeholders

In addition to the Advertisement in the Al Ahram newspaper of August 31st, 2011, the following stakeholders had been invited by NREA through official letters of September 5th and 7th, 2011 to participate in the Public Hearing on September 21st, 2011:

| *NAME* | *DESIGNATION* | *ORGANISATION* |
|---|---|---|
| Dr. Fatma Abu el Shouk | Head of Environmental Sector | EEAA, Cairo |
| Eng. Mohammed Shawky | Chairman of Central Sector EIA | EEAA, Cairo |
| General Mahmoud Asim Gaad | Governor | Red Sea Governorate, Hurghada |
| General Said Mohammed Moussa | Secretary | Red Sea Governorate, Hurghada |
| General Mohammed Abdul Gawed | Manager Environmental Department | Red Sea Governorate, Hurghada |
| Dr. Wahed Salama | Manager of Natural Reserves | Red Sea Governorate, Hurghada |
| General Saad al Din Amin | Chairman of Ras Gharib Council | Ras Gharib |
| Eng. Mohammed Ala Alam | Chairman | GPC, Cairo |
| Eng. Mohammed Abdul Fatak | Manager of Operation Ras Gharib | GPC, Ras Gharib |
| Eng. Abdul Khader Abdullah | Chairman | GAPCO, Maadi, Cairo |
| Eng. Ibrahim al Khlefy | Manager of General Relations | GAPCO, Maadi, Cairo |

Further invitations were circulated by telephone, such as to environmental organisations and Bedouins settled in the surrounding of the project area.

## Annex C: Translation for the lists of participants

| No. | Name | Job Title | E-mail | Phone no. |
|---|---|---|---|---|
| 1 | Samir Lamei | Consultant at Kamy Group | Samirsolmaiman@yahoo.com | 0105898206 |
| 2 | Mohamed Mohamed Eid | Consultant at IEHEE | Iehee2@yahoo.com | 01519407205/0127553265 |
| 3 | Ashour Abd El Salam Abd El Manaam | General Manager, NREA | ashour_2am@yahoo.com | 0177473802 |
| 4 | Sherif Sharobeem | Director at Orascom Construction | sherif.shourbeem@orang.com | 0125912343 |
| 5 | Amr Amin Omar | Safety Engineer- GUPCO | amrmohi260@hotmail.com | 0105855363 |
| 6 | Faysal Yahiaa | El Swedy for Wind Energy | f.eissa@elswedy.com | 0110333400 |
| 7 | Waled Abd El Rahim | KfW | walid.abdel-rehim@kfw.de | 0122224848 |
| 8 | Saad Mohamed Mahmoud | | | |
| 9 | Ahmed Mohamed Mahmoud Mohamed | Freelance Lawyer | alsehlaby@yahoo.com | 0127234378 |
| 10 | Swelam Awad Salem | One of the site residents (Bedouin) | | |
| 11 | Fatma Swelam | One of the site residents (Bedouin) | | |
| 12 | Amany Salah El Saied | EEAA | amanysalah@msn.com | 0101948860 |
| 13 | Mahmoud Hassan Hanfy | Red Sea Governor Environmental Consultant and Professor at Suez Canal University | hanfy@hepca.com | 0129776006 |
| 14 | Hany Ibrahim | GIPCO | ibrahim@gipco.net | 0127344616 |
| 15 | Sayed Attalah | | sayed.attalah@eg.abb.com | 0122181963 |
| 16 | Emad Ghalli | RES Country Manager | emad.ghali@res-med.ea | 0100890021 |
| 17 | Mohamed Hassan Ahmed | El Swedy for Wind Energy | moh.hassan@elsewedy.com | 0110333422 |

| No. | Name | Job Title | E-mail | Phone no. |
|---|---|---|---|---|
| 18 | Mohamed Saad Zaghlol | Egypt Wind Power | | 0123987492 |
| 19 | Mohamed Abdullah Awad | The General Department of Energy, EEAA | Moahd72@yahoo.com | 0196009809 |
| 20 | Tag El Din Hussein Ahmed | Head of Wadi Dara LGU | | ?????????? |
| 21 | Hamdy Fahmy Ossman | Journalist | | 2702178 |
| 22 | Abd El Kader Moubark Souliman | Officer in the LGU | | 0104183405 |
| 23 | Ihab Ahmed Darwish | Officer in the LGU | | 0102761282 |
| 24 | Sharkawi Salem Ibrahim | Officer in the LGU | | 0103074451 |
| 25 | Ossama Fared | | | 0122332831 |
| 26 | Wahed Salama Hamyed | General Manager of the Red Sea General Directorate Department | hamednature@hotmail.com | 0108309350 |
| 27 | Khaled Allam Mohamed Ahmed | Head of the birds protection project | Khaledallam4@hotmail.com | 0101288508 |
| 28 | Wed Abd El Latif Ibrahim | Head of the Economic Management Of Biological Diversity Department | Wed-abdoa@yahoo.com | 0105701340 |
| 29 | Ossama Noaaman Nada | General Manager of the Maintenance Department, NREA | ossamaneada@hotmail.com | 01802200291 |
| 30 | Mourad Magdy Mohamed Nasar | Accountant for the private sector stations connections | morad-doda@hotmail.com | 0125015888 |
| 31 | Mohamed Magdy Aly Mohamed | NREA, Red SEA | | |
| 32 | Mohamed Hussein Mohamed | | | 0117240255 |
| 33 | Mohamed Moustafa El Khayat | NREA | mohamed.elkhayat@yahoo.com | 0128090810 |
| 34 | Ashraf Abd El Meged | NREA Consultant | ashrafkaka@hotmail.com | 0163322537 |
| 35 | Afaf Mekhail Tawfik | General Manager for the | afaftawfic@hotmail.com | 222712267 |

| No. | Name | Job Title | E-mail | Phone no. |
|---|---|---|---|---|
| | | Engineering Studies Department, NREA | | |
| 36 | Anwar Galal Tharwat | Environmental Consultant | | 0105085797 |
| 37 | Ayman Afify | Environmental Consultant | ayman.afifi@nvironics.org | 0127785911 |
| 38 | El Sayed Mahmoud Mansour | Project Site Manager | sayedmansour-1960@yahoo.com | 0109402423 |
| 39 | Ahmed Borai Ahmed | Project Site Accountant | actopus_newman@yahoo.com | 0100911008 |
| 40 | Mansour Mohamed Abdel Baset | Driver | | 0127373162 |
| 41 | Abd el Fatah Mohamed Kamel | Adminstartive Manager | | 0122084487 |
| 42 | Mohamed Sayed Mahmoud Mohamed | NREA Technician | | 0122864601 |
| 43 | Abd El Rahman Salah El Din | NREA Executive Director | | |
| 44 | Khaled Mohamed Fakry | Head of Sector at NREA | khfakry@nrea.com | 0123760002 |
| 45 | Ashraf Ahmed Mohamed Saad | | | 0107170113 |
| 46 | Rafik Youseif Soubaty | NREA Consultant | rafikyousef19@gmail.com | 0123810014 |
| 47 | Ahmed sayed Ahmed Mohamed | NGO | | 0112333660 |
| 48 | Mohamed Akmaal Mahmoud | Engineer at the Wind Department | akmal_mahmoud@hotamil.com | 0102753506 |
| 49 | Tarek Awad Ibrahim | Head of the Prevention and Tests Department, EETC | noalata77@hotmail.com | 0101815668 |
| 50 | Essam El Din Mohamed Omar | Technican at NREA | | 0163594501 |
| 51 | Abd El Bast abuas Mostafa | Technican at NREA | | 0128931380 |
| 52 | Shazly Abou Hassan Mohamed | Technican at NREA | | 01522948510 |
| 53 | Ismail Mohamed Ismail | Operation and Maintenance | obrisho5g@yahoo.com | 0118614453 |

| No. | Name | Job Title | E-mail | Phone no. |
|---|---|---|---|---|
| | | Technician | | |
| 54 | Hoda Hassan El Maghraby | Head of the Regional Unit for the Training and Education project | desrs-redsea@yahoo.com | 0109439964 |
| 55 | Mostafa Razk Mostafa | Supervisor at the Regional Unit for the Training and Education project | | 0109691498 |
| 56 | Hamada Rabia Mohamed Aly | Supervisor at the Regional Unit for the Training and Education project | hamada2006sh@yahoo.com | 0160708811 |
| 57 | Abady Razaz Aly | Services worker | | |
| 58 | Mohamed abd Allah Fareid | Operation worker | | |
| 59 | Tarek Mohamed Selim | Driver | | 0143503234 |
| 60 | Ragab Mohamed Kalhy | Guard | | 0115287304 |
| 61 | Mohamed Abd El Wahab Mohamed | Physician | | 0171823785 |
| 62 | Mohamed Abd El Ghany Abd El Naaem | | | 0127271990 |
| 63 | Mohamed Fahem Shaltot | Electricity Technician at NREA | | 0100186727 |
| 64 | Yaser Abd El Manaam Abd El Salam | Driver, NREA | | 0112157058 |
| 65 | Sharkawe Mostafa Beshara | Health and Safety Technician, NREA | | 0119490154 |
| 66 | Mounir Hussein Ahmed | Health and Safety Technician, NREA | | |
| 67 | Fawzy Abaas Sayed | Guard, NREA | | 35526030 |
| 68 | Ashraf Abd El Monaim | Head of the Operation Unit, Electricity Distribution Company , Suez Canal | | |
| 69 | Frank Bergen | CEO, Ecoda Environmental Consultancy GbR | bergen@ecoda.de | +491782094158 |

| No. | Name | Job Title | E-mail | Phone no. |
|---|---|---|---|---|
| 70 | Frank Kretz | Technical Director, WKN | | |
| 71 | Ernst Niemann | Senior Project Manager Renewable Energies, Lahmeyer International GmbH | ernst.niemann@lahmeyer.de | +49 6101 55 1801 |
| 72 | Mun Sang Yi | Proejct Director, Egypt Powertech | | |
| 74 | Emad Ghally | Siemens | Emad.ghaly@siemens.com | |
| 75 | Gabriele Maraschin | Business Development | | |
| 76 | Akihiro Yoshida | Project Coordinator | akihiro_yoshida@toyota-tsusho.com | |
| 77 | Han Ba da | Kepco | oceanhan@kepco.co.kr | |
| 78 | Mina Farouk rizk | Ibordrola Iatcom | atcon@ie-eg.com | |
| 79 | Soren Krohn Hansen | World Bank | sk@skpower.net | |
| 80 | Ihab Shaalan | World Bank | imshaalan@yahoo.com | |

## Annex D Scanned Registration Form of the Public Hearing Workshop

وزارة الكهرباء و الطاقة
هيئة الطاقة الجديدة و المتجددة

JV Li - ecoda

RECEIVED 22 SEP 2011 EcoConServ

جلسة الاستماع و مشاركة المجتمع المحلي لدراسة تقييم الأثر البيئي والاجتماعي لمشروع مزرعة الرياح بخليج السويس بطاقة ١٠٠٠ ميجاوات

فندق AMC AZUR - الغردقة- محافظة البحر الأحمر

الأربعاء ٢١ سبتمبر ٢٠١١

استمارة تسجيل

| No. | الاسم | الوظيفة و الجهة التابع لها | الإيميل | تليفون | التوقيع |
|---|---|---|---|---|---|
| ١ | سمير علي | استشاري Kamy GROUP | SameirSoLIMAN@yahoo.com | ٠١٠٥٨٩٨٢٠٦ | |
| ٢ | [illegible] | استشاري IEHEE | iehee2@yahoo.com | 0151940720 5 0127553265 | [illegible] |
| ٣ | [illegible] | [illegible] | ashour_zam@yahoo.com | ٠١٧٧٤٧٧٤٨٢ | [illegible] |
| ٤ | شريف شاويش | مدير OCI Orascom Construction | sherif.Shawish@orascom | ٠١٢٥٩١٢٧٤٧ | [illegible] |
| ٥ | عمرو أمين عمر | Safety Eng. - GUPCo | amrmohi260@hotmail | 0105855363 | Amr Amin |
| ٦ | فيصل عيسى | El-Sewedy for Wind Energy Generation | f.eisa@elsewedy | 0110333400 | [illegible] |
| ٧ | وليد عبد الرحيم | [illegible] | walid.abdelrahim | | [illegible] |
| ٨ | سعد محمد محمود | | | | [illegible] |
| ٩ | أحمد محمود محمد | [illegible] | ALSEHLABY@yahoo | 0122234378 | [illegible] |
| ١٠ | [illegible] | [illegible] | | | [illegible] |
| ١١ | [illegible] | [illegible] | | | [illegible] |
| ١٢ | [illegible] | وزارة البيئة | amanysaleh@msuez | 0101948860 | [illegible] |
| ١٣ | د.م محمود [illegible] | مستشار [illegible] | hanafy@hepca.com | ٠١٢٩٧٧٦٠٠٦ | [illegible] |

١

وزارة الكهرباء و الطاقة
هيئة الطاقة الجديدة و المتجددة

JV Li - ecoda

جلسة الاستماع و مشاركة المجتمع المحلي لدراسة تقييم الأثر البيئي والاجتماعي لمشروع مزرعة الرياح بخليج السويس بطاقة ١٠٠٠ ميجاوات

فندق AMC AZUR - الغردقة- محافظة البحر الأحمر

الأربعاء ٢١ سبتمبر ٢٠١١

استمارة تسجيل

| No. | الاسم | الوظيفة و الجهة التابع لها | الإيميل | تليفون | التوقيع |
|---|---|---|---|---|---|
| ١٤ | هاني ابراهيم | Elect Eng. Gulf of Suez Petroleum | Ibrahimhe@gupco.net | 01219344616 | هاني |
| ١٥ | سيد MLbs | | Sayed.attalah@eg.abb.com | 0122181963 | ABB [illegible] |
| ١٦ | عماد غالي | RES-Country Mgr. | emad.ghali@res-med.eu | 0100890021 | Emad |
| ١٧ | محمد [illegible] | El Sewedy for Wind | moh.elsewedy@com. | 0110333422 | [illegible] |
| ١٨ | محمد زغلول | Egypt wind Power | mohamed.zaghlol@yahoo | 0123987492 | M. Zaghlol |
| ١٩ | [illegible] | [illegible] | mosaba72@yahoo | 0196009809 | [illegible] |
| ٢٠ | [illegible] | [illegible] | | [illegible] | |
| ٢١ | [illegible] | [illegible] | | [illegible] | [illegible] |
| ٢٢ | [illegible] | موظف بالمطابع | | [illegible] | |
| ٢٣ | [illegible] | موظف بالمطابع | | [illegible] | |
| ٢٤ | [illegible] | موظف بالمطابع | | ٠١٠٣٠٧٤٤٥١ | [illegible] |
| ٢٥ | [illegible] | [illegible] | | [illegible] | [illegible] |
| ٢٦ | | | | | |

٢

JV Ai - ecoda

وزارة الكهرباء و الطاقة
هيئة الطاقة الجديدة و المتجددة

جلسة الاستماع و مشاركة المجتمع المحلي لدراسة تقييم الأثر البيئي والاجتماعي لمشروع مزرعة الرياح بخليج السويس بطاقة ١٠٠٠ ميجاوات

فندق AMC AZUR – الغردقة– محافظة البحر الأحمر

*الأربعاء ٢١ سبتمبر ٢٠١١*

استمارة تسجـيل

| No. | الاسم | الوظيفة و الجهة التابع لها | الإيميل | تليفون | التوقيع |
|---|---|---|---|---|---|
| ٢٧ | [illegible] | مدير [illegible] | hamiedncture@hot | ٠١٠٨٢٠٩٢٥٠ | [signature] |
| ٢٨ | خالد علام محمد أحمد | مدير مشروع [illegible] | Khaledalam4@hotmail.com | ٠١٠٢٨٨٥٠٠٨ | [signature] |
| ٢٩ | وديع عبد اللطيف ابراهيم | مدير ادارة [illegible] | Wed_abdon@yahoo.com | ٠١٠٥٧٠٦٢٤٠ | [signature] |
| ٣٠ | [illegible] | مدير عام [illegible] | ossamo[illegible]@hotmail.com | ٠١٨٠٢٢٠٠٤٩١ | [signature] |
| ٣١ | مراد مجدى محمد [illegible] | محاسب إدارة [illegible] | Mora-dod@hot. | ٠١٢٥٠١٥٨٧٧ | [signature] |
| ٣٢ | محمد [illegible] | مهندس [illegible] | | | |
| ٣٣ | محمد حسين محمد | هيئة الطاقة بالغردقة | | ٠١١٧٧٢٤٠٢٥٥ | [signature] |
| ٣٤ | [illegible] | [illegible] | mohamed.elkhayat@yahoo.com | ٠١٢٨٠٩٠٨٦٠ | [signature] |
| ٣٥ | | | | | |
| ٣٦ | اشرف عبد المجيد | [illegible] | ASHRAFKaKa@[illegible] | ٠١٦٣٢٢٢٥٨٧ | [signature] |
| ٣٧ | عاطف [illegible] | مدير عام الدراسات [illegible] | afaftawfiq@hotmail | ٠٢٢٧١٢٢٦٧ | [signature] |
| ٣٨ | أنور [illegible] | استشاري [illegible] | | 0105085797 | [signature] |
| ٣٩ | أيمن عفيفي | استشاري [illegible] | ayman.afifi@environics.org | 012778911 | [signature] |

٣

JV Ai - ecoda

وزارة الكهرباء و الطاقة
هيئة الطاقة الجديدة و المتجددة

جلسة الاستماع و مشاركة المجتمع المحلي لدراسة تقييم الأثر البيئي والاجتماعي لمشروع مزرعة الرياح بخليج السويس بطاقة ١٠٠٠ ميجاوات

فندق AMC AZUR – الغردقة– محافظة البحر الأحمر

*الأربعاء ٢١ سبتمبر ٢٠١١*

استمارة تسجـيل

| No. | الاسم | الوظيفة و الجهة التابع لها | الإيميل | تليفون | التوقيع |
|---|---|---|---|---|---|
| ٤٠ | السيد محمود منصور | [illegible] | sagedmansour-1960@yahoo | ٠١٠٩٤٠٢٤٢ | [signature] |
| ٤١ | [illegible] | [illegible] | octopus_[illegible]@yahoo | 0100911008 | [signature] |
| ٤٢ | منصور [illegible] | سائق | | ٠١٢٧٢٧٢١٦٢ | [signature] |
| ٤٣ | [illegible] | [illegible] | | ٠١٦٢٥٠٨١٢٥٨٧ | [signature] |
| ٤٤ | [illegible] | [illegible] الطاقة [illegible] | | ٠١٢٤٨٦٢٤٦٠١ | |
| ٤٥ | [illegible] | [illegible] | | | |
| ٤٦ | [illegible] | [illegible] | Khfekry@[illegible].com | [illegible] | [signature] |
| ٤٧ | [illegible] | [illegible] | | ٠١٠٧٧٧٠١١٢ | [signature] |
| ٤٨ | [illegible] | [illegible] | rafikyousef[illegible]@gmail.com | 0123810014 | |
| ٤٩ | [illegible] | [illegible] | | ٠١١٢٤٢٢٦٦٠ | |
| ٥٠ | محمد [illegible] محمد | مهندس [illegible] | akmal_mahmoud@hotmail | 0102753506 | [signature] |
| ٥١ | | | | | |
| ٥٢ | [illegible] ابراهيم | [illegible] | nadata77@Hotmail.com | ٠١٠١٨١٥٦٦٨ | [signature] |

٤

JV Li - ecoda

وزارة الكهرباء و الطاقة
هيئة الطاقة الجديدة و المتجددة

جلسة الاستماع و مشاركة المجتمع المحلي لدراسة تقييم الأثر البيئي والاجتماعي لمشروع مزرعة الرياح بخليج السويس بطاقة ١٠٠٠ ميجاوات

فندق AMC AZUR - الغردقة- محافظة البحر الأحمر

الأربعاء ٢١ سبتمبر ٢٠١١

استمارة تسجيل

| No. | الاسم | الوظيفة و الجهة التابع لها | الإيميل | تليفون | التوقيع |
|---|---|---|---|---|---|
| ٥٣ | [illegible] | فني تشغيل [illegible] | — | ٠١٦٢٢٠٩٤٥٠١ | [signature] |
| ٥٤ | عبد السلام [illegible] | مهندس تشغيل محطة الطاقة | — | ٩٦/٨٩٣١٣٨ | [signature] |
| ٥٥ | شاذلي ابو الحسن محمد | فني تشغيل و الصيانة | — | [illegible] | [signature] |
| ٥٦ | [illegible] | مهندس صيانة | obrisho56@yahoo.com | ٠١١٨٦١٤٤٥٠٢ | [signature] |
| ٥٧ | | | | | |
| ٥٨ | د/ الحسن حسن المغربي | مدير الوحدة الاقليمية للتعليم الزراعي | desrs_Redsea@yahoo | ٠١٠٩٤٢٩٩٦٤ | |
| ٥٩ | مصطفى [illegible] | مشرف بالوحدة الاقليمية للتعليم الزراعي | | ٠١٠٩٦٩١٤٩٨ | |
| ٦٠ | [illegible] | مشرف بالوحدة الاقليمية للتعليم الزراعي | hamada[illegible]@yahoo | ٠١٦٠٧٠٨٨١١ | |
| ٦١ | | | | | |
| ٦٢ | | | | | |
| ٦٣ | | | | | |
| ٦٤ | | | | | |
| ٦٥ | | | | | |

٥

JV Li - ecoda

وزارة الكهرباء و الطاقة
هيئة الطاقة الجديدة و المتجددة

جلسة الاستماع و مشاركة المجتمع المحلي لدراسة تقييم الأثر البيئي والاجتماعي لمشروع مزرعة الرياح بخليج السويس بطاقة ١٠٠٠ ميجاوات

فندق AMC AZUR - الغردقة- محافظة البحر الأحمر

الأربعاء ٢١ سبتمبر ٢٠١١

استمارة تسجيل

| No. | الاسم | الوظيفة و الجهة التابع لها | الإيميل | تليفون | التوقيع |
|---|---|---|---|---|---|
| ٦٦ | جابر رزق [illegible] | عامل [illegible] | | | [signature] |
| ٦٧ | محمد عبد الله زيد | فني تشغيل | | | [signature] |
| ٦٨ | طارق محمد سليم | سائق | | ٠١٤٢٥٠٢٢٣٤ | [signature] |
| ٦٩ | رجب محمد [illegible] | حارس | | ٠١١٥٢٨٧٣٠٤ | [signature] |
| ٧٠ | [illegible] | دكتور | | ٠١٧١٩٢٧٧٨٥ | [signature] |
| ٧١ | محمد [illegible] | [illegible] | | ٠١٢٧٢٧١٩٩٠ | [signature] |
| ٧٢ | محمد [illegible] | [illegible] الطاقة الجديدة | | ٠١٠٠١٨٦٧٨٧ | [signature] |
| ٧٣ | ياسر عبد المنعم [illegible] | سائق الطاقة الجديدة | | ٠١١٢١٦٥٧٠٨ | [signature] |
| ٧٤ | [illegible] | فني [illegible] هيئة الطاقة | | ٠١١٩٤٩٠١٥٤ | [signature] |
| ٧٥ | فتحي [illegible] احمد | حارس امن هيئة الطاقة | | | [signature] |
| ٧٦ | فوزي عيادة سيد | حارس امن هيئة الطاقة ٢٥٥٢٦٠٣٠ | | | [signature] |
| ٧٧ | | | | | |
| ٧٨ | اشرف عبد المنعم | مدير ادارة التشغيل شركة توزيع [illegible] | | | [signature] |

٦

EcoConServ
ENVIRONMENTAL SOLUTIONS

Ministry of Electricity and Energy
New and Renewable Energy Authority (NREA)

JV LI - ecoda



**Public Hearing for the Environmental and Social Impact Assessment (ESIA) Study**

**for 1,000 MW Wind Farms at the Gulf of Suez, Egypt**

**AMC Azur**

**Hurghada, Red Sea, Egypt.**

*Wednesday 21 September 201*

Registeration Form

| No. | Name | Position and firm | Email | Telephone | Signature |
|---|---|---|---|---|---|
| 1 | DR. FRANK BERGEN | CEO, ecoda | berger@ecoda.de | +491782094158 | |
| 2 | FRANK KRATZ | Technical Director, Egypt Wind | KRATZ@WKN-AG.DE | +491755203185 | |
| 3 | Dr. Ernst Niemann | LI, Project Manager | ERNST.NIEMANN@lahmeyer.de | 00496101551801 | |
| 4 | Mun Sang Yip | Proj. Director, Egypt Wind | sangyip.mun@powertek.com.my | | |
| 5 | Emad Ghaly | Siemens | emad.ghaly@siemens.com | | |
| 6 | Gabriele Marasch... | Enel Green Power | gabriele.marasch...@enel.com | | |
| 7 | AKIHIRO YOSHIDA | Project Coordinator | akihiro_yoshida@toyota-tsusho.com | | |
| 8 | Han Bada | KEPCO | oceanhan@kepco.co.kr | +44 1198 549 915 | Han Bada |
| 9 | Mahmoud Aziz | NREA | NREE-NREA@gmail.com | 012000 4982 | |
| 10 | Mina Farouk Rizk | Iberdrola IATCON | atcon@ie-eg.com | 0123969773 | |
| 11 | SOREN KROHN | WORLD BANK | SK@SKPOWER.NET | | |
| 12 | Ihab Shaalan | World Bank | imshaalan@yahoo.com | 010-1900690 | |
| 13 | | | | | |

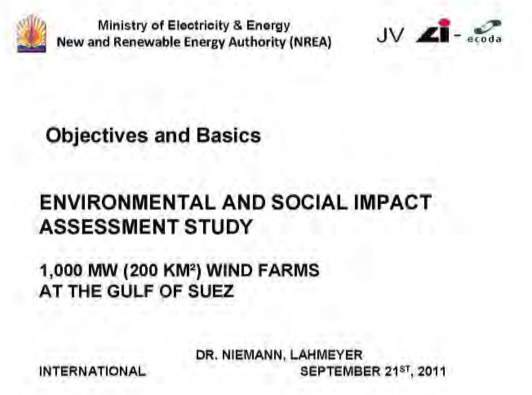
1

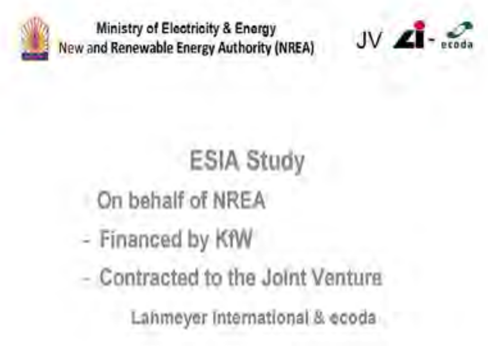
## Annex E: Public Hearing Agenda

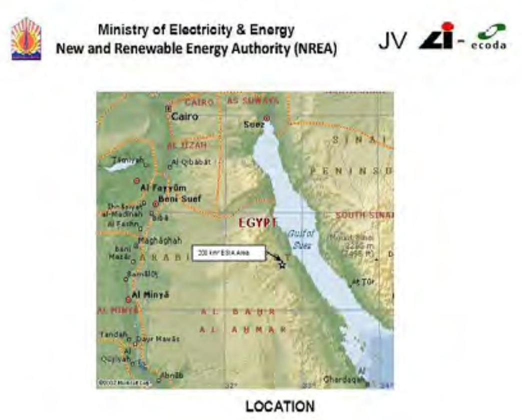
| Time | Activity | Speaker |
|---|---|---|
| 09.00 – 10.00 | **Registration** | |
| 10.00 – 10.20 | **Welcome** | • Dr. Tarek Genena, EcoConServ President<br>• Eng. Mohammad Abdallah - EEAA Representative<br>• Representative from Red Sea Governorate<br>• Eng. Abdel Rahman Salah- NREA Executive Director |
| 10.20 – 10.30 | **Project Overview** | • Dr. Ernst Niemann - Project Director, Lahmeyer International GmbH |
| 10.30 – 11.30 | **Presenting the findings of the Environmental and Social Impact Assessment (ESIA) Study** | • Dr. Tarek Genena, EcoConServ President |
| 11.30 – 12.00 | **Coffee Break** | |
| 12.00 – 13.00 | **Open Discussion** | |
| 13.00 – 13.15 | **Conclusion** | |
| 13.15 – 14.00 | **Lunch** | |

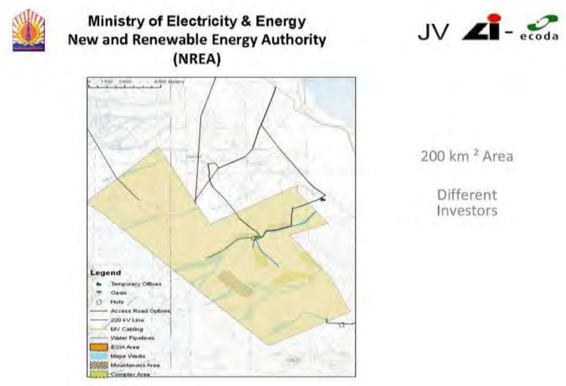
## Annex F: Copies of the delivered Presentations

### 1 - Project Overview Presentation

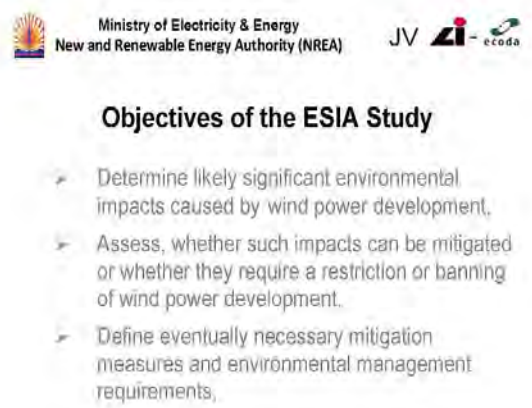






Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
JV Li - ecoda

## Further Objectives of the Study

- describe the project as realistic as possible to facilitate environmental approval of investors in the area later-on,
- to follow Egyptian Environmental Law, Regulations and Guidelines,
- to keep minimum Equator Principle Standards on ESIA to allow private investor financing by renowned Banks

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
JV Li - ecoda

## Purpose of Public Hearing

- Early stakeholder participation already carried out
- To collect further EIA arguments that might not have been adequately considered in the Draft Study
- Consequently, weighing of arguments regarding acceptability

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
JV Li - ecoda

## Public Hearing addresses to Stakeholders such as

- Land owners; in this case GoE
- Local citizens possibly affected and/or their representatives (inside or near to the area)
- Industrial/commercial activities possibly affected inside or next to the area
- Environmental expert groups and associations
- Competent authorities, e.g. EEAA and it's regional Branch, Governorate, etc.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
JV Li - ecoda

## Realistic Project Description

- In case of the Gulf of Suez area the wind park development follows typical design:
  - Wind Turbines in Rows perpendicular to main Wind Direction,
  - Big Distances in wind directions (1000 -1200 m) and short Distances along the rows (200 – 300 m),
  - Underground cabling to substation and gravel roads ( 5m width)
  - Limited special features such as substation or control and storage areas.

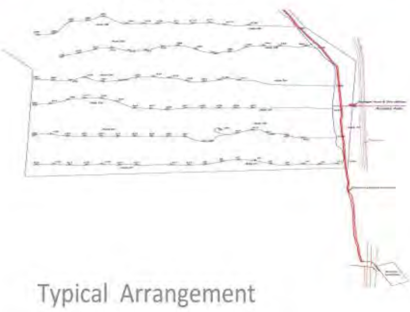
Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
JV Li - ecoda

## Other Features

- Wind Turbine Foundations about 14/18 m x 14/18 m x 1.5 m (250-400 m³),
- Maximum Tip Height: 120 m, tubular towers;
- Unit capacities between 0.8 and 2.5 MW
- 220 kV Substations + Interconnection to planned 500 kV Ras Gharib SS
- Effective use of area only about 3 % of overall area

Project Features of later Investments can be described close to Reality!

Ministry of Electricity & Energy
New and Renewable Energy Authority
(NREA)
JV Li - ecoda



Typical Arrangement

Ministry of Electricity & Energy
New and Renewable Energy Authority
(NREA)

JV LI - ecoda

Cable trenching

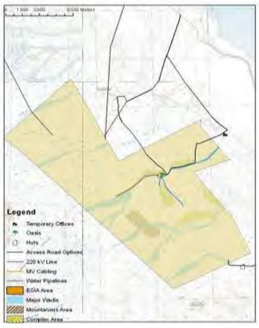
Ministry of Electricity & Energy
New and Renewable Energy Authority
(NREA)

JV LI - ecoda

Visual Simulation

Ministry of Electricity & Energy
New and Renewable Energy Authority
(NREA)

JV LI - ecoda



200 km $^2$
Area

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)

JV LI - ecoda

Typical major environmental Impacts of On-shore Wind Farm Projects

- Noise and Shadowing
- Landscape Pollution
- Loss of Habitat (effective area affected is small)
- Endangering of Birds and Bats

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)

JV LI - ecoda

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY**

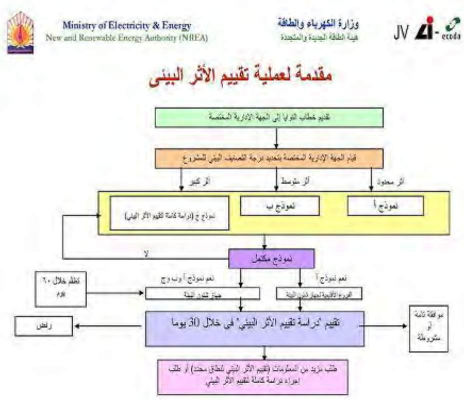
**1,000 MW (200 KM²) WIND FARMS AT THE GULF OF SUEZ**

**THANK YOU!**

Dr. Niemann, Lahmeyer International
September 21st, 2011

## 2 – Presentation on the ESIA Findings








Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## الهيكل القانونى للمشروع

### الاتفاقيات الدولية

- إتفاقية كيوتو
- اتفاقية بون (اتفاقية حفظ أنواع الحيوانات البرية المهاجرة)
- اتفاقية التنوع الحيوى
- اتفاقية ايوا (اتفاق بشأن حفظ الطيور المائية الافريقية – الأوروبية – الأسيوية المهاجرة)
- اتفاقية رامسار لحماية الأراضي الرطبة

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## الهيكل التشريعي للمشروع

### الخطوط/ الأطر الإرشادية

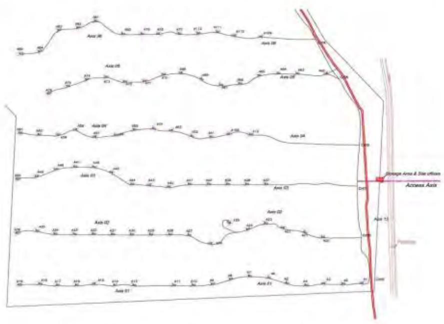
- الخطوط الإرشادية المحدثة لإعداد دراسات تقييم الأثر البيئي
- الخطوط الإرشادية لجهاز شئون البيئة و الخاصة بالتأثيرات البيئية لمزارع الرياح

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## خلفيـــة عامـــة


- من المزمع إنشاء مزارع رياح بطاقة ١٠٠٠ ميجاوات على مساحة تبلغ ٢٠٠ كم² بالقرب من رأس غارب على مسافة ما يقرب من ١٥ كم من خليج السويس.
- تعد المنطقة جزءا من مساحة إجمالية تبلغ ١٢٢٩ كم² خُصصت بموجب قرار جمهوري صدر في ١٣ مايو ٢٠٠٩ لاستغلالها في توليد الطاقة الكهربائية من الرياح. وقد رشح المركز القومي لتخطيط استخدامات الأراضي هذه المنطقة تحديدا، و وافق عليها مجلس الوزراء بعد دراسة البدائل الأخرى.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda



ترتيب نموذجي لمزرعة رياح يشمل الأسلاك والتوصيلات

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## أهم الموضوعات البيئية التي تم دراستها

### البيئة الحيوية

- البيئات الطبيعية والمحميات، والكائنات النباتية والحيوانية والطيور

### البيئة الطبيعية

- الظروف المناخية، سطح الأرض، سمات سطح الأرض، طبقات الأرض، السمات الطبيعية للموقع، تربة السطح، موارد المياه، النشاط الزلزالي، الضوضاء.

### البيئة الاجتماعية والاقتصادية

- السكان، الأنشطة الاقتصادية، الثقافة المحلية

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## موقـــع المشـــروع


- الموقع المخصص للمشروع يقع غرب خليج السويس على بعد ١٢٠ كم شمال الغردقة، و١٠ إلى ١٥ كم غرب طريق الغردقة- السويس. وتقدر المسافة بين موقع المشروع والقاهرة بـ ٣٥٠ كم براً.


EcoConServ
ENVIRONMENTAL SOLUTIONS

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئية المميزة لموقع المشروع

### ثانيا : استخدامات الأراضي

- يقتصر استخدام الأراضي داخل منطقة المشروع على نظام للآبار المائية وما يتعلق به من بنية تحتية مثل المضخات، و خطوط المياه، وإمدادات الكهرباء متوسطة الجهد، والطرق الممتدة في منتصف منطقة المشروع تقريبًا، إضافة إلى عائلة بدوية واحدة تتكون من ٢٠ فردًا و بعض الأكواخ القليلة المصنوعة من سعف النخيل و التي تمتلكها تلك العائلة.
- تخلو المنطقة من أية مواطن ذات أهمية للحياة النباتية والحيوانية
- تخلو منطقة المشروع من البنية التحتية فيما عدا الطرق الأسفلتية والحصوية المؤدية إلى آبار المياه وإمدادات الكهرباء، وخطوط المياه، ومضخات المياه التي تقوم بتشغيلها الهيئة العامة للبترول
- لا توجد أي خدمات في المنطقة
- لا توجد مناطق ذات قيمة تاريخية
- لا توجد أي محميات طبيعية
- لا توجد أي مجارى للمياة السطحية
- تقع أقرب منطقة سكنية في ضواحي رأس غارب على مسافة تزيد عن ١٣ كم

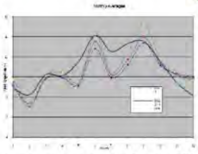
Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## الوضع الراهن

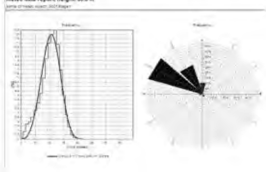
## السمات البيئية المميزة

### اولا : المناخ العام

| | |
|---|---|
| متوسط الحرارة القصوى | ٢٠° مئوية (يناير) إلى ٣٣° مئوية (أغسطس) |
| متوسط الحرارة | ١٥° مئوية (يناير) إلى ٢٩° مئوية (أغسطس) |
| متوسط سرعة الرياح عند ٥٠م مترا | ١٠ أمتار/ثانية تقريبًا |
| الحد الأقصى لسرعة الرياح | ٣٥ مترًا/الثانية تقريبًا |
| سقوط الأمطار | متقطع جدًا، منطقة شديدة الجفاف |



Monthly average wind speeds at three NREA measuring stations




Wind speed frequency distribution and wind rose at GoZ1

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئية المميزة

### ثالثا: الجيولوجيا و الجيومورفولوجيا

- يتكون الجزء الأعظم من المنطقة من سهول (في الشمال خصيصًا) وأراضي متموجة (في الوسط والجنوب)، إلا أنه توجد سلسلة جبال واحدة وسط الموقع بارتفاع ١٠٠ متر تقريبًا فوق سطح البحر، ولذا؛ فهي لا تصلح للأستغلال. ويغطي الحصى والحصوات الصغيرة معظم أراضي الموقع. إلى جانب ذلك، تمتاز المنطقة باستقرار التربة و تمثل ظروفا جيدة لوضع الأساسات، فضلاً عن أنها غير متأثرة بأية تصدعات أرضية وغير معرضة لمخاطر الهزات الأرضية.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئية المميزة

عائلة بدوية

نظام ضخ مياه الابار

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئية المميزة

- تتأثر **جودة الهواء** بالغبار الصحراوي الذي تحمله الرياح؛ إلا أنه لا يوجد أية انبعاثات حمضية ناتجة عن احتراق الغازات المشتعلة أو عن الغازات المشتعلة غير المحترقة من حقل النفط القريب من الموقع (الهيئة العامة للبترول)؛ وذلك نظرا لأتجاه الرياح السائدة.
- يصدر **مستوى عالٍ من الضوضاء الطبيعية** خلال هبات الرياح القوية والمتكررة، إلا أن المنطقة تخلو من الضوضاء التي يسببها البشر باستثناء صوت ضخ المياه.
- **المنظر الطبيعي:** مناطق صحراوية تتكون من سهول ممتدة، وأراض متموجة "كثبان"، ومناطق جبلية، ولا يوجد بها عناصر ذات ثراء من حيث المنظر الطبيعي.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئية المميزة

### المصادر المائية

- لا توجد أي **مياه سطحية** سوى المياه الناتجة عن سيول بالأودية الرئيسية و التي نادرًا ما تحدث.
- **المياه الجوفية**: على عمق يزيد عن ١٠٠ متر تحت سطح الأرض.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئية المميزة

رابعا : الحياة النباتية والحيوانية

- وُجد عدد قليل من الفصائل النباتية في منطقة الدراسة، وتحديدًا في مناطق المنخفضات والأودية. وتنتمي تلك النباتات في معظمها إلى فصائل رخوة من *Ochradinus baccatus*.
- كما وجدت بعض النباتات التي تنتمي إلى فصائل *Zygophyllum coccineum* و *Haloxylon salicornicum*
- لم يعثر على أي أشجار غير مزروعة (نمت طبيعيًا) سوى بعض أشجار السيال .
- إلى جانب النباتات الطبيعية القليلة بالموقع، توجد أرض منزرعة (أرض الواحة) في الجهة الشرقية من منطقة الدراسة، وهي تشكل مساحة خضراء أقل من ٢،٥٠٠ م$^2$. وتمثل الواحة نقطة استراحة حيث شكلت ملجأ صناعيًا أو موطنًا لعدد كبير نسبيًا من الفصائل (بما فيها الطيور) التي تبحث عن طعام، وماء، وظلال.
- اثبتت نتائج دراسة النباتات في المنطقة انها محدودة للغاية، لا تضم أي نباتات أو مجتمعات نباتية معرضة للانقراض وكافة النباتات التي وجدت في المنطقة شائعة وواسعة الانتشار.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## الحياة النباتية

أرض الواحة

أشجار طبيعية

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئية المميزة

خامسا : الحياة الحيوانية

- وجد ١٣ نوعًا من الزواحف داخل منطقة الدراسة : الأوزاغ و الحرابي و العضايا gecko ، agamid، lizard و فصيلتين من الحيات colubrid and a viper و الضب المصري Egyptian Dabb Lizard.
- سُجّل وجود عدد قليل من الثدييات في منطقة الدراسة أثناء العمل الميداني، مما يشير إلى قلة أعداد الأنواع وعدم ثرائها.
- لم يلاحظ وجود خفافيش أثناء الزيارات الليلية للموقع.
- وقد أظهرت النتائج أن دراسة مواطن الحيوانات داخل الموقع ليست ذات أهمية كبيرة.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## الحياة الحيوانية

مناطق يظهر بها الضب المصري

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

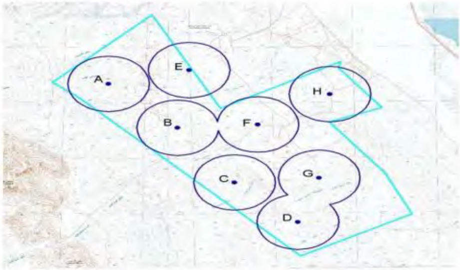
## السمات البيئية المميزة

سادسا : الطيور

- يُعد خليج السويس بشكل عام، ومنطقة جبل الزيت على وجه الخصوص، معبرًا لأعداد كبيرة من الطيور المهاجرة، حيث تشكل المنطقة مسارًا للهجرة تمر به الطيور مرتين في العام خلال فصلي الربيع والخريف. وقد أظهرت الدراسات أن آلافا من طيور اللقلاق الأبيض والطيور القناصة ومجموعات كبيرة من الطيور المحلقة على ارتفاعات متباينة تهاجر بانتظام عبر سلسلة الجبال المنتشرة في أرجاء ساحل البحر الأحمر.
- بلغ مجموع ساعات المراقبة في فصل الربيع ٧٩٢ ساعة، بينما وصل المجموع إلى ٨٠٣ ساعة طوال فصل الخريف.
- وتركزت إجراءات المراقبة على الطيور المعرضة للاصطدام بنسبة أكبر أو لأية آثار سلبية أخرى تنجم عن توربينات الرياح.
- وقد قام فريق العمل بتسجيل جميع الطيور المحلية والباحثة عن مجثم خلال دوريات المراقبة وأثناء تنقلاته بين أرجاء منطقة الدراسة. وتم عمل مسح منطقة السبخة بأوقات منتظمة بحثا عن الطيور المقيمة والباحثة عن مجثم باستخدام المناظير الثنائية والتلسكوبات.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## مواقع المراقبة الميدانية




Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئيةالمميزة

سادسا : الطيور : الهجرة فى فصل الربيع

- تم تسجيل حوالي ٧٧،٥١٦ طيرًا مصنفة إلى ٢٧ نوع مختلف ، منها اللقلاق الأبيض والنسر الصحراوي و التي مثل كل منها ما نسبته 38 % من مجموع الطيور، تم تصنيفهما باعتبارهما نوعين مهيمنين بالمقارنة بالأنواع الأخرى.
- حلق ما نسبته ٣٠% من مجموع الطيور المسجلة ضمن مسافة ٢,٥ كم عن موقع المراقبة على ارتفاعات تقل عن ١٠٠ م، بينما هاجر ٢٧% من تلك الطيور على ارتفاعات تتراوح ما بين ١٠٠-١٩٩ م، وقد تجاوز ٤٤% منها ارتفاع ١٩٩ م.
- ينبغي تصنيف الأجزاء الشمالية الغربية من منطقة الدراسة والمحيطة بالموقعين (A) و(B) باعتبارها مناطق مهمة لهجرة الطيور في الربيع.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

## السمات البيئيةالمميزة

الهجرة فى فصل الربيع

- كان نشاط الهجرة على ارتفاعات منخفضة هو الأكثر كثافة في الموقعين (G) و(H) اللذين يغطيان شرق وجنوب شرق منطقة الدراسة.
- أعداد الطيور والبيانات التي تم تسجيلها في مناطق شمال شرق (الموقع E) ووسط (الموقعين C ، F) وجنوب غرب (الموقع D) منطقة الدراسة كانت أعلى بكثير من تلك المسجلة في الموقعين A و B مما يستلزم تصنيف منطقة شمال شرق ووسط وجنوب غرب منطقة الدراسة باعتبارها مهمة لهجرة الطيور في الربيع.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

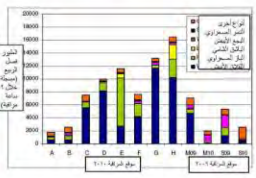
## السمات البيئيةالمميزة

سادسا : الطيور : الهجرة فى فصل الخريف

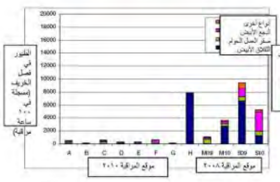
- تمخضت إجراءات المراقبة الميدانية في خريف ٢٠١٠ عن تسجيل ما مجموعه ٢٥،٩٤٢ طيرًا مصنفة إلى ٢٢ نوع مختلف، كان اللقلاق الأبيض هو الطائر المهيمن أيضًا وبنسبة بلغت ٥٤% من مجموع الطيور. تجدر الإشارة إلى أن جميع طيور اللقلاق الأبيض التي تم تسجيلها تعود إلى ١٧ سرب فقط، مما يشير إلى أن منطقة الدراسة لا تقع ضمن مسار هجرة هذا الطائر في فصل الخريف. ومن الأنواع التي شوهدت على نحو متكرر في المنطقة البجع الأبيض وصقر العسل الحوام، ولكن بأعداد قليلة
- كانت معظم الطيور التي تم تسجيلها في خريف ٢٠١٠ في المناطق المحيطة بمواقع المراقبة بمسافة ٢,٥ كم تحلق على ارتفاعات منخفضة؛ فقد حلق ٢٥% من مجموع الطيور على ارتفاع يزيد عن ١٩٩م. وعلى الأرجح فإن هذه النتيجة تُعزى إلى الطيور التي تمكنت من الوصول إلى المسطحات الصحراوية (اللقلاق والبجع ) محلقة على ارتفاعات منخفضة بعد أن قطعت البحر الأحمر ، حيث تفتقر المنطقة إلى التيارات الحرارية التي تساعد الطير ليطير على ارتفاع عالي.
- يمكن وصف نشاط الهجرة في خريف ٢٠١٠ بأنه منخفض أو أنه في أغلب الأحيان كان منخفضا جدا في منطقة الدراسة عموما، مما يشير إلى أن أجزاء كبيرة من منطقة الدراسة لا تُعد ذات أهمية لهجرات الخريف.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV

الهجرة فى فصل الربيع



الهجرة فى فصل الخريف



Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## السمات البيئية المميزة

**الطيور المحلية**

- شوهد خلال فترة الدراسة عدد قليل جدا من الطيور المحلية مصنفة جميعها باعتبارها لا تمثل اهمية
- تُعد معظم اجزاء منطقة الدراسة ذات أهمية متواضعة بالنسبة للطيور المحلية

**الطيور الجاثمة**

•شوهدت في بعض الأحيان طيور اللقلاق والبجع والطيور القناصة جاثمة في منطقة الدراسة أو في المناطق القريبة منها، وخصوصًا في الصباح الباكر أو في وقت متأخر من بعد الظهر والفترة التي تليها.

•لا يوجد مجثم محدد يمكن اعتباره ذو أهمية تجعل منه خاضعًا للحماية داخل حدود المنطقة. وقد تكـــون الأوديـــة الكبيرة الواقعة ضمن حدود منطقة الدراسة والمحتوية على رقع من الغطاء لنباتي ذات أهمية للجوائم الصغيرة.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## الآثار المتوقعة

- **استخدام الأراضي:**

بالنظر إلى أن مساحة الأراضي المستغلة لأغراض المشروع صغيرة نسبيًا وفي غياب الموائل الحساسة بيئيًا والمناظر الطبيعية الجذابة والآثار، و حيث أن الأراضي لا تستغل زراعيًا أو للسكن، لن ينتج عن استغلال تلك الأراضي آثارًا هامة.

- **المناظر الطبيعية ومدى التأثير البصري:**

بالنظر إلى غياب المستقبلات وإلى شيوع المناظر الطبيعية الصحراوية، ومع عدم وجود سمات مميزة للمكان، فإن التأثير على المناظر الطبيعية لا تُعد ذات أهمية سواء خلال مرحلة البناء أو مرحلة التشغيل.

- **المياه وموارد المياه:**

لا تشكل المياه عاملاً هامًا ومتصلاً بمشاريع توليد الطاقة من الرياح ، ، سيتم تأمين المياه عن طريق ناقلات يتم تزويدها بالمياه من منظومة خطوط مياه النيل. تقدر كميات المياه المستهلكة خلال مرحلة التشغيل بما يعادل ٣ م$^3$/يوم فقط.

Ministry of Electricity & Energy
Ministry New and Renewable Energy Authority
(NREA)of Electricity & Energy
ارة الكهرباء والطاقة
الطاقة الجديدة والمتجددة
JV Li - ecoda

## الآثار المتوقعة

- **المخلفات البلدية و المخلفات الخطرة:**

من المتوقع أن يترتب على المشروع كميات من المخلفات الصلبة تتألف من مواد التعبئة والتغليف، يمكن تجنب التخلص الغير آمن من المخلفات الصلبة و الخطرة من خلال تفعيل تدابير عمل ملائمة وتطبيق إجراءات رقابية فعالة.

- **الاهتزاز:**

من غير المتوقع أن تنشأ تأثيرات هامة عن الاهتزاز خلال مرحلتي البناء والتشغيل.
والأهتزازات التي تصدر عن توربينات الرياح في الظروف العادية اهتزازات غير مؤثرة.

- **التداخلات الكهرومغناطيسية:**

من المحتمل أن تتسبب توربينات الرياح بإحداث تداخلات كهرومغناطيسية مع رادارات الطيران وأنظمة الاتصالات. تجدر الإشارة إلى عدم وجود أية أنظمة اتصالات واقعة بالقرب من المنطقة قد تتأثر بفعل تشغيل التوربينات .

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## الآثار المتوقعة

- **انعكاس الضوء و الظلال:**

تتميز نوعيات الطلاء المستخدمة على ريش التوربينات الحديثة بقدرتها على امتصاص أشعة الشمس المباشرة ولا يشكل انعكاس الضوء تأثيرًا ذو أهمية على البيئة.

- **الموروث الأثري والتاريخي والثقافي:**

لا يوجد في المنطقة ما يصنف ضمن هذه الفئة.

- **مخاطر الصحة والسلامة المهنية:**

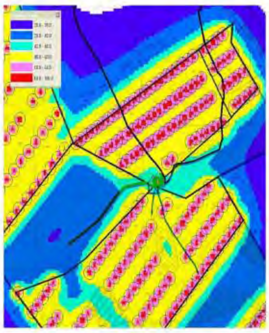
توجد بعض المخاطر المتعلقة بالسلامة المهنية خلال مرحلة البناء و التي تنشأ بالضرورة عن أعمال الحفر وتنصيب المعدات ويمكن تقليل المخاطر لتصبح ضمن حدود المستوى المقبول إذا ما تم تطبيق معايير الصحة والسلامة المعتمدة دوليًا.

- **حركة المرور والمرافق العامة والبنية التحتية الأخرى:**

تتميز الطرق الرئيسية في المنطقة بأبعاد مناسبة جدًا، وهي على الأغلب لا تشهد حركة مرور نشطة. ولهذا، لا يوجد أي تأثير للمشروع على حركة المرور التي تشهدها الطرق العامة خلال مرحلة البناء.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV Li - ecoda

## الآثار المتوقعة



**الضوضاء:**

تنحصر مستقبلات الضوضاء في أكواخ البدو المقيمين بجوار محطات ضخ المياه التابعة للهيئة العامة المصرية للبترول ويبلغ الحد الأعلى لمستوى الضوضاء المحيطة بها ٥٠ ديسيبل. وسيتم الامتثال لهذا الحد خلال مرحلتي البناء والتشغيل و سيتم تثبيت توربينات الرياح على بعد ٣٠٠ م على الأقل من تلك الأكواخ.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

# الآثار المتوقعة

الآثار الاجتماعية والاقتصادية أثناء الإنشاء:

- سوف تتطلب مزرعة الرياح خلال مرحلة البناء تحديدًا أعداد كبيرة من القوى العاملة المحلية
- وسوف يشارك الإقتصاد المحلي بحوالي ما بين ٣٠-٤٠% من إجمالي حجم الأستثمار.
- تأثيرات الضوضاء (على العاملين بالموقع)
- تأثيرات المرور
- إحتمالية وقوع إصابات عمل

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

# الآثار المتوقعة

- جودة الهواء:

سوف تظهر خلال مرحلة البناء بعض الانبعاثات من غازات العوادم الخاصة بالآلات و المركبات ونظرًا لغياب المستقبلات في تلك المنطقة، فلن يكون لتلك الانبعاثات خلال مرحلة البناء أي تأثيرات هامة على البيئة.

- النباتات:

يُعد نطاق استغلال الأراضي في بناء مزرعة الرياح محدودًا جدًا ولم يثبت حتى الآن وجود أي تأثير على النباتات أو على الغطاء النباتي ناتج عن تشغيل توربينات الرياح.

- الحيوانات:

المنطقة اللازمة لإقامة هياكل البنية التحتية تُعد محدودة جدًاو على ذلك فإن الأثر على البيئة الحيوانية الناتج عن بناء مزارع الرياح والتشويش الناتج عن ذلك ضمن نطاق منطقة الدراسة يُعد عديم الأهمية .

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

# الآثار المتوقعة

- الطيور:
  - خطر الاصطدام ما بين الطيور وتوربينات الرياح : المخاطر الرئيسية المحتملة على الطيور ترتبط بخطر التصادم، إضافة إلى ما يترتب عن وضع الحواجز في تلك البيئة.
  - تقييم الأثر على الطيور المهاجرة والمحلية والباحثة عن مجثم- مرحلة الانشاء لن تتأثر الطيور أثناء الطيران الفعلي بمرحلة الانشاء. وقد تؤدي الضوضاء وانبعاثات الغبار في مواقع البناء إلى تعديل مسار الطيران، وهو أمر لا يشكل بحد ذاته أثرًا ضارًا. كما أن الهياكل الكهربائية المرتبطة بمزارع الرياح، ومن المحطات الفرعية أو خطوط الربط الكهربي قد تؤثر في نمط الهجرة المتبع لدى الطيور، ولهذا ينبغي تنفيذ أعمال البناء وإجراءات الحماية وفقا للدلائل الإرشادية لحماية الطيور من خطوط الكهرباء، لائحة الطبيعة والبيئة رقم ١٤٠، المجلس الأوروبي للنشر.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

# الآثار المتوقعة

الآثار الاجتماعية والاقتصادية أثناء التشغيل

**تحسين الإمداد بالكهرباء سيسهم في تحقيق الفوائد الاجتماعية الاقتصادية التالية:**

- دعم الفرص الاقتصادية و تعظيم فرص الاستفادة من مقومات المنطقة
- خلق فرص عمل
- تنمية المجتمعات البدوية بالمنطقة
- تحسين الخدمات بالمنطقة
- زيادة قيمة الأراضي
- زيادة توافد السكان على المنطقة و ما يصاحب ذلك من مخاوف (مثل زيادة الضغط على الموارد أو عدم أمكانية الخدمات الحالية على الوفاء بالمتطلبات المتزايدة للسكان)
- التأثير على الثقافة المحلية للبدو

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

# الآثار المتوقعة

تقييم الآثار على الطيور المهاجرة – مرحلة التشغيل

- تشير الدراسة بوضوح إلى أن بعض أجزاء منطقة الدراسة تحمل أهمية عالمية لأنماط الهجرة السائدة في فصل الربيع و تشير نتائج الدراسة إلى وجود زيادة تدريجية في نشاط الهجرة من الغرب إلى الشرق في حدود منطقة الدراسة. كان نشاط الهجرة في خريف ٢٠١٠ ما بين منخفض ومنخفض جداً في كافة أرجاء منطقة الدراسة. وبالتالي، ونتيجة للعدد المنخفض للطيور المهاجرة في الخريف، لن تشكل مزارع الرياح الموجودة في حدود منطقة الدراسة خطر اصطدام.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

# الآثار المتوقعة

- تقييم الأثر على الطيور المقيمة والباحثة عن مجثم – مرحلة التشغيل: من المعروف أن الأنواع التي تميل إلى الوجود في مجثم في أعداد كبيرة تتجنب مزارع الرياح. ولذلك فمن المتوقع أن اللقلق الأبيض والبجع الأبيض، لن تتجمع في العادة في مجثم في حدود مزارع الرياح

**نتائج تقييم الأثر الخاص بهجرة الطيوربمنطقة الدراسة طبقا نتيجة للملاحظات الحقلية في ربيع ٢٠١٠.**


Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV
ecoda
الآثار المتوقعة
تقييم الآثار على الطيور المحلية – مرحلة التشغيل
• من غير المتوقع أن تتأثر الطيور المحلية بالمؤثرات الصوتية والبصرية الدائمة التي ستنتج من توربينات الرياح. كما أن هذه المؤثرات محدودة النطاق، حيث لا يزيد نطاق أثرها عن مساحة ٣٠٠ متر حول التوربينة.


Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV
ecoda
تدابير التخفيف
• تدابير التخفيف المتعلقة بهجرة الطيور في المنطقة ٢ :
– يجب إعداد برنامج فعال لإيقاف التوربينات لتنفيذه خلال فترة الهجرة في موسم الربيع، على أن يتم تنفيذه على مرحلتين:
• برنامج لإيقاف التوربينات بشكل محدد يوقف كافة التوربينات اعتباراً من ١ مارس و حتى ١٨ مايو في النهار (ساعة قبل الشروق وساعة بعد الغروب). واستناداً على بيانات طويلة الأجل تقدر الطاقة المتوقع فقدانها من تشغيل البرنامج بحوالي ١٠%.
• برنامج لإيقاف التوربينات عند الطلب (باستخدام تقنية الرادار) لإيقاف كافة التوربينات خلال الأوقات التي تبلغ فيها الهجرة ذروتها وعند اقتراب الأسراب من مزرعة الرياح. واستناداً على بيانات الرياح وهجرة الطيور طويلة المدى تم جمعها في ربيع ٢٠١٠، تقدر الطاقة المتوقع فقدانها لتشغيل هذا البرنامج بحوالي ٢%.


Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV
ecoda
تدابير التخفيف
• الحد من مخاطر الاصطدام و آثار الحواجز للطيور المهاجرة في منطقة ١ من مزارع الرياح خلال موسم الربيع باتخاذ التدبير الفعالة وذلك إما:
– عن طريق إنشاء ممر للهروب في المنطقة الوسطى : يجب أن يبلغ عرض ممر الهروب ١ كيلومتر ويكون بمواجهة اتجاه الرياح الرئيسي أي الشمال الغربي إلى الجنوب الشرقي، وسيسمح هذا الممر للطيور بمغادرة منطقة مزارع الرياح بطريقة آمنة.
أو
– تنفيذ برنامج لإيقاف التوربينات ويوصى بتطبيق برنامج لإيقاف التوربينات بناءً على الطلب. ويجب إجراء رقابة مركزية لتنظيم ومراقبة برنامج إغلاق مزرعة الرياح


Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV
ecoda
تدابير التخفيف
– إعداد و تنفيذ برنامج مراقبة لما بعد بناء المزارع مدته سنتين خلال أوقات الهجرة الرئيسية (شهرين ونصف في الربيع وشهرين في الخريف) لتقييم ما إذا كانت تأثيرات مزارع الرياح ما زالت في المستوى المقبول أو ما إذا كانت التدابير الإضافية ضرورية للحد من الآثار غير المقبولة
– يجب تفادي إنارة التوربينات، وفي حال استدعت الحاجة إلى إنارة التوربينات، فيجب استخدام أقل عدد من الأنوار منخفضة الاستهلاك للطاقة .
– بناء مزرعة الرياح بشبكة داخلية بواسطة كابلات أرضية، ويجب تصميم الخطوط الهوائية وفقاً للخطوط الإرشادية لحماية الطيور من خطوط الكهرباء و المنصوص عليها في لائحة الطبيعة والبيئة رقم ١٤٠، المجلس الأوروبي للنشر.


Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV
ecoda
تدابير التخفيف
• تدابير التخفيف المتعلقة بالعناصر الأخرى:
– الحد من أعمال البناء بجانب الواحات وآبار المياه والوديان.
– تفادي تركيب التوربينات وغيرها من التجهيزات في المناطق التي يقطنها الضب المصري.
– إلزام المقاول بالتعاقد مع أيدي عاملة مؤهلة وعمال نظافة لتنظيف الموقع أثناء عمليات البناء وفقاً للشروط التعاقدية وتعيين مهندسي إشراف بما يكفل التخلص من النفايات الصلبة ومياه المجاري والصرف الصحي.
– تعيين مهندس صحة وسلامة من قبل المقاولين الرئيسيين للأقسام المختلفة ومنحه الصلاحية الكاملة لإعطاء تعليمات الصحة والسلامة.


Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV
ecoda
تدابير التخفيف
• تدابير التخفيف المتعلقة بالعناصر الأخرى:
– تغيير الزيت ومواد التشحيم أو المركبات الهيدروكربونية في محطات الوقود لا يجب إجراء هذه الأنشطة في الموقع.
– إلزام المقاولين بتوفير الحماية الفعالة لموارد الأراضي والمزارع في جميع الأوقات، ويتحملون مسؤولية أي ضرر لاحق.
– تطبيق تعليمات الصحة والسلامة على المقاولين الذين يقوموا بعمليات تركيب وتجهيز وصيانة توربينات الرياح.
– التأكد من تطبيق شركات الأعمال المدنية لتدابير الصحة والسلامة والتي يتم التعاقد معها من قبل المقاول الرئيسي أو هيئة الطاقة الجديدة والمتجددة وخاصة فيما يتعلق بارتداء الملابس المناسبة، ومعدات السلامة وتوفير بيئة عمل آمنة.

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

## خطة الإدارة البيئية (EMP)

| نشاط المشروع | المخاوف البيئية | تدابير التخفيف |
|---|---|---|
| مرحلة العطاء والتخطيط | التأثيرات على الطيور | الحد من ارتفاع توربينات الرياح بشرط ألا يتجاوز ١٢٠ متر |
| | | تحديد الحد الادنى المسافات بين توربينات الرياح بشرط ألا تقل عن 12 x 3 لقطر ريش التوربينة |
| | | استخدام ريش ملونة للمساعدة على رؤيتها بوضوح أكبر (باستخدام الريش باللونين الأبيض والأسود) |
| | | بناء شبكة داخلية بأستخدام الكابل الأرضي كلما أمكن وضع توجيهات لحماية الطيور من خطوط الكهرباء، لائحة الطبيعة والبيئة رقم ١٤٠، المجلس الأوروبي للنشر شرط أساسي لتصميم تمديدات داخلية تبلغ ٢٢٠ kV لأية محطة وتوفير التدابير الوقائية الكافية لحماية الطيور في المحطات. |

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

## (EMP) خطة الإدارة البيئية

| نشاط المشروع | المخاوف البيئية | تدابير التخفيف |
|---|---|---|
| مرحلة العطاء والتخطيط | مخاطر الصحة والسلامة | المحافظة على المعايير على النحو المذكور في تعليمات ولوائح البيئة والصحة والسلامة لطاقة الرياح، مؤسسة التمويل الدولية، ٢٠٠٧، والالتزام بها كحد أدنى للشروط في وثائق المناقصة. |
| | | تعيين مهندس صحة وسلامة خلال عمليات البناء متطلب أساسي. |
| | | وضع خطة للصحة والسلامة لموقع البناء شرط إلزامي. |
| | | توفير معدات وأدوات السلامة وفقا للمعايير المقبولة من قبل المقاول شرط أساسي للتقدم للمناقصة. |

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

## خطة الإدارة البيئية (EMP)

| نشاط المشروع | المخاوف البيئية | تدابير التخفيف |
|---|---|---|
| مرحلة البناء (الإنشاء) | التلوث | يُلزم المقاول بالتعاقد مع أيدي عاملة ماهرة وعمال نظافة لتنظيف الموقع أثناء عمليات البناء وفقاً للشروط التعاقدية وتعيين مهندسي إشراف بما يكفل التخلص الامن من النفايات الصلبة ومياه المجاري والصرف الصحي ومنع انسكاب الزيوت المستعملة والشحوم والديزل، إلخ. |
| | | إلزام المقاول بالمحافظة على ترتيب ونظافة الموقع من خلال ردم الحفر وإزالة مواد الحفر والتخلص من النفايات على الوجه الأكمل. |
| | التأثير على الطيور | امتثال أعمال البناء للتدابير الاحترازية المذكورة في فصل ٦-٢ و إنشاء وحدة مراقبة مركزية لكافة مزارع الرياح في المنطقة لتنفيذ برنامج الإغلاق |
| | التأثير على الحياة النباتية والحيوانية (باستثناء الطيور) | ضمان تنفيذ أعمال البناء وفقاً للتدابير الاحترازية المذكورة في فصل ٦-٢ ولا يجوز بناء توربينات الرياح في الأودية الرئيسية والطرق و مناطق النباتات و الأماكن المأهولة بالضب المصري. |

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

## خطة الإدارة البيئية (EMP)

| نشاط المشروع | المخاوف البيئية | تدابير التخفيف |
|---|---|---|
| مرحلة التخطيط التفصيلى و الإنشاء | مخاطر الصحة والسلامة | إعداد خطة فعالة للصحة والسلامة |
| مرحلة البناء (الإنشاء) | مخاطر الصحة والسلامة | تعاقد المقاول مع مهندس صحة وسلامة مستقل لتوفير تعليمات الصحة والسلامة |
| | | الالتزام بتعليمات ولوائح البيئة والصحة والسلامة لطاقة الرياح، مؤسسة التمويل الدولية، ٢٠٠٧ كحد أدنى. |
| | | توفير والاستخدام الأمثل لمعدات وأدوات السلامة. |
| | | نظافة المرافق الصحية المؤقتة. |
| | | ضمان إيقاف أعمال البناء في الأحوال الجوية السيئة |

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

## خطة الإدارة البيئية (EMP)

| نشاط المشروع | المخاوف البيئية | تدابير التخفيف |
|---|---|---|
| التشغيل و الصيانة | التلوث | ضمان الإدارة السليمة للنفايات القائمة في مباني الخدمة (بالتعاون مع الوحدة المحلية برأس غارب) وإعادة تدوير الزيوت والشحوم المستخدمة |
| الإيقاف (إزالة التربينات) | الأراضي المستخدمة والمساحات الطبيعية | إزالة تركيبات توربينات الرياح عند انتهاء صلاحيتها. |

Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV ecoda

## خطة الإدارة البيئية (EMP)

| نشاط المشروع | المخاوف البيئية | تدابير التخفيف |
|---|---|---|
| مرحلة التشغيل و الصيانة | مخاطر الصحة والسلامة | ضمان تنفيذ عمليات التشغيل والصيانة في توربينات الرياح من قبل عمالة موهلة فقط اجتازت دورة تدريبية في السلامة. |
| | التأثيرات على الطيور | مراقبة الأثر البيئي على الطيور بعد عمليات البناء خلال العامين الأولين على الأقل أثناء المواسم الرئيسية للهجرة في المنطقة ١ والمنطقة ٢ بالتعاون مع المنظمات المحلية والعالمية، وتنفيذ تدابير احترازية إضافية أو تحسين تدابير التخفيف الحالية عند الاقتضاء وفق الحدود المحددة في هذه الدراسة |
| | | الإشراف على والمراقبة المركزية لبرنامج الإغلاق خلال موسم هجرة الطيور في الربيع في المنطقة ٢ في مزارع الرياح (أو المنطقة ١) |
| | | تطوير واختبار وإنشاء برنامج إغلاق بناء على الطلب (باستخدام الرادار) خلال موسم هجرة الطيور في الربيع في المنطقة ٢ في مزارع الرياح (أو المنطقة ١)، بالتنسيق مع مركز توزيع الأحمال |
| | | تنفيذ برنامج الإغلاق عند الطلب (في موقعين ويجهز لكل منهما بنظام رادار واحد) في منطقة ٢ خلال موسم هجرة الطيور في الربيع (أو المنطقة ١)، بالتنسيق مع مركز توزيع الأحمال |


Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV
مناقشة مفتوحة


Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)
وزارة الكهرباء والطاقة
هيئة الطاقة الجديدة والمتجددة
JV
خلاصـــــة الدراســة
• سيترتب على مشروع مزرعة الرياح العديد من الآثار الإيجابية، التي تفوق في أهميتها التأثيرات السلبية الطفيفة التي تم تحديدها. يمكن تدارك التأثيرات السلبية من خلال تنفيذ توصيات خطة الإدارة البيئية المقترحة.
• فما يخص موضوع التأثيرات على الطيور:
▪ لا توجد تأثيرات خطيرة على الطيور المقيمة
▪ بتطبيق إجراءات التخفيف المناسبة، سوف لا يترتب من المشروع آثار خطيرة على الطيور المهاجرة

## Annex G: Sample of the Written Feedback Sheets

JV Li - ecoda

وزارة الكهرباء و الطاقة
هيئة الطاقة الجديدة و المتجددة

**جلسة الاستماع و مشاركة المجتمع المحلي لدراسة تقييم الأثر البيئي والاجتماعي لمشروع مزرعة الرياح بخليج السويس بطاقة ١٠٠٠ ميجاوات**

**فندق AMC AZUR – الغردقة**
**محافظة البحر الاحمر**

*الأربعاء ٢١ سبتمبر ٢٠١١*

**ملاحظات و تعليقات السادة المشاركين**

**اسم المشارك:** م/ إسماعيل محمد علي ____________ (اختياري)

**الجهة التى يمثلها:** هيئة الطاقة الجديدة والمتجددة ________ (اختياري)

**رقم الهاتف:** ٠١١٨٦١٤٤٠٢ (اختياري) **البريد الاليكتروني** obrisha56@yahoo.com (اختياري)

**ملاحظاتكم:**
* أن المنطقة (A) التي تم اختيارها هي مقبولة لما لديها
زيادة قدرة حمل تورينة عند دمجها مع العلم أن
متوسط سرعة الرياح في هذه المنطقة ١٠ م/ث
* علينا الاستفادة من الرياح في المنطقة أفضل
مشاريع ذات بيانات الرياح مثل محطة تحلية المياه
وقد تم تنفيذ ذلك في محطة الغردقة.

**برجاء تسليم هذا النموذج لممثلي المكتب الاستشارى لتضمين آرائكم في الدراسة**