AJSR
AFRICAN JOURNAL OF SCIENCE AND RESEARCH

African Journal of Science and Research,2014,(3)6:01-09
ISSN: 2306-5877
Available Online: http://ajsr.rstpublishers.com/

STUDY OF THE WILDLIFE OF JHIMPIR WIND CORRIDOR, DISTRICT THATTA, SINDH AND DEVELOPMENT OF BIRD MONITORING STRATEGY IN THE AREA.

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Received:18, July,2014 ***Accepted: 29 ,Nov,2014.***

Abstract

The paper aims to describe the wildlife of the Jhimpir Wind Corridor consisting of 15 species of mammals, 79 species of birds, 13 species of reptiles and 20 species of plants recorded during the environmental studies undertaken in the area during 2012 to 2014.The area is under the influence of the existing/future, Wind Power Plants. This will affect the general ecology of the area and may also affect the distribution and movements of the birds in the area.There are chances of bird mortality in the area due to possible collision against the rotating blades of the turbines of the Wind Power Plants.A Bird Monitoring Strategy has been suggested for the study of the impacts of Wind Power Plants on the ecology and movement of birds in the impacted area.

Keywords: *Impact assessment of wind farms, Wind Energy Projects, Birds Monitoring*.

INTRODUCTION

Pakistan due to its geographical location is fortunate enough to possess an quantum of renewable energy potential including wind energy.

Pakistan adopted a policy for the use of renewable energy in 2006. The policy encourages the Private Sector to implement renewable energy projects, including wind power generation, by providing various regulatory, fiscal and financial incentives.

The AEDB has issued a number of LOIs to private sector investors for development of 50 MW wind power projects. The active projects in the area include: Metro Power, Gul Ahmed Energy, Lucky Energy, Sachal Engineering, Wind Eagle, Sapphire, CWE, Master Wind Energy, FFC and Zurlu Enerji. (Anon. 2012)

INLAND JHIMPIR

Wind farm region is located at approximately 80 to 100 km East/Northeast of the city of Karachi. Its topography is generally flat with an increasing height above sea level from 30-40 m in the south upto 70 to 100 m in north western direction. Some hill slopes of upto 130 m above sea level exist in the centre and the in the north of the region. The rioughness is lower in the southern part. The entire area is characterized by being dry land and with agricultural activities mainly in its southern part. Jhimpir village is located in this area but it is not included in the defined wind farm region. In the rest of the region, scattered human settlements can be found.

It is mainly flat and barren with little grass, shrubs and little or no vegetation. The soil texture in the area is mostly rocky and gravely with the Kohistan hills in the surroundings which area an extension of the Khirthar Range. Various water bodies including Keenjhar Lake at a distance of 20km and Haleji Dhand at distance at 32 km are also present in the vicinity.

METHODOLOGY

Data in respect of fauna and flora were gathered from both primary and secondary sources. The sampling locations were randomly selected, ensuring that representative locations are sampled for each habitat and the maximum possible number of species belonging to each habitat is recorded.

Secondary data were collected through literature search including the studies conducted within and in the surroundings of the Project Area and information collected from the local communities and from the Sindh Wildlife Department.

The vegetation surveys were carried out by laying 20 x 20m quadrates within the study area. The plant communities were determined within the habitat.

Field Surveys were undertaken in the project area to collect data about the fauna of the area. Standard direct and indirect methods were applied to record the occurrence, distribution and population of various animal species in the area, which included point count surveys, roadside or track counts, line transect method and tracks/signs counts.

RESULTS

15 species of mammals, 78 species of birds and 13 species of reptiles were recorded during the present survey from the area (Tables 1, 2 and 3). Important sampling sites have been identified in the area (Table 6).

Mammals

During the present survey, 15 species were recorded. The area has very thin population of mammals. Only solitary individuals of big mammals such as Indian Jackal and Red Fox could be sighted. One den of Indian Crested Porcupine was located. The small mammals such as Five Striped Palm Squirrel, Indian and Desert Gerbils, House mouse were scarce. Desert Hedgehog, Desert Hare, Ratel and Indian Pangolin have been reported from the area.

Birds:

The area supports Grey Partridges, Chestnut bellied and Lichtenstein Sand grouses, Pigeons, Doves, Bee-eaters, Mynahs, Shrikes, Bulbuls, Indian Robin, Purple Sunbird, Black Drongo, Black Kite, House Sparrow, and House Crow. Indian Silverbill and Sind Jungle Sparrows area quite common near the villages or near the water points.

Reptiles:

As regards the Reptiles, 13 species were recorded during the present survey. Snakes such as Saw-scaled Viper, Indian Cobra, Indian Krait, Indian Sand Boa, Plain Racer have been reported from the area. Indian Desert Monitor was found to be scarce, while Indian Garden Lizard and Indian Spiny tailed Lizard were common in the area.

Threats:

Threats include any activity or process that may cause or is likely to cause any adverse effect upon the status of any species. At present, there are no serious threats to the species. Disturbance is a minor threat.

Threatened Species:

Threatened species may be of the following categories depending upon the level of threat: Critically Endangered (CE), Endangered (E), Vulnerable (V) or Near- threatened (NT). Small flocks of Houbara Bustard (V) and Black–bellied Tern (NT) fly across the surrounding area. The other threatened species may also be passing through the area such as Indian Vulture (CE), Dalmatian Pelican (V), Pallas's Fish Eagle (V) and Greater Spotted Eagle (V). Indian Pangolin (NT) has also been reported from the surrounding area.

Note on the Key Species of the Area:

The key species of the Study Area is the Indian Spiny tailed Lizard (*Saara hardwickii*) which needs special mention.

It is widely distributed throughout the Indus Valley and Balochistan. The animals make its burrows in desolated hard soil of sparse vegetation of grasses and bushes. The burrow is a narrow sloping zigzag tunnel about 2m long, ending in a spacious chamber. Barrows are 2-3 m apart from each other. The lizard lives singly in its burrow.

Homing instinct is very strong and the lizard does not venture far from its burrow. On the retiring for the night, the opening of the burrow is plugged with a lump of earth.

It is vegetarian, feeding on leaves, twigs, flowers and fruits. It feeds on nymphs and adult locusts. It breeds from March – early May. 6 – 16 eggs are laid in a special chamber in the burrow.

Generally, young ones are active by June. It falls prey to Hawks, Jackals and Foxes. It is used extensively in dissections in colleges. Moreover, its oil (Fat) is said to have aphrodisiac and medicinal properties. Falconers usually use it as bait to trap wild falcons in Punjab.

Flora:

During the fieldwork in the Project Area, 20 plant species belonging to 13 families were identified. Out of these, 13 species are perennial, 05 are annual and 02 are herbs. The quantitative analysis of the floral composition was made and four distinct plant communities were identified based on life forms of the identified species.

S. No	Life Form	Number
1.	Trees	03
2.	Shrubs	09
3.	Herbs	06
4.	Grasses	02

No endemic or rare plant species was recorded during the survey. Table 4. provides the list of floral species observed in the three main habitats viz. Flat Plains, Streambeds and hillocks/ foothills in quadrates measuring 20 x 20 m and 2 x2 m.

Protected Areas:

Two Ramsar Sites are located within this wind corridor viz. Haleji Lake, and Keenjhar Lake. There is no Wildlife Protected Area in the close vicinity of the site. Keenjhar Wildlife Sanctuary is more than 20 km away from the site.

Seasonal Migratory Pattern:

The main migrants to the province of Sindh during the winter season are the Waterbirds, Raptors, Houbara Bustard, Common Quail and the Passerines (Warblers, Pipits, Wagtails and Buntings).

The waterbirds migrate to the wetlands in very large number in winter. They are a very diverse group of 160 species comprising of Diver, Grebes, Pelicans, Cormorants, Darter, Herons, Egrets, Bitterns, Storks, Ibises, Spoonbill, Flamingo, Ducks, Geese, Swans, Cranes, Watercock, Rails, Crakes, Coot, Waders, Gulls and Terns.

The wintering birds of Prey include: Eurasian Griffon, Cinereous Vulture, Marsh Harrier, Montagu's Harrier, Common Buzzard, Longlegged Buzzard, Booted Eagle, Greater Spotted Eagle, Steppe Eagle, Common Kestrel, Merlin and Eurasian Hobby.

Migratory birds recorded from the Jhimpir Area:

The following 24 species of birds have been recorded from the Jhimpir Area. These species may be expected to be passing through the Jhimpir Area but sporadically due to the absence of favourable habitat for them.

Black-bellied Tern, Black Redstart, Caspian Tern, Common Buzzard, Common Redstart, Common Chiffchaff, Ringed Plover, Common Sandpiper, Desert Wheatear, Gull-billed Tern, Houbara Bustard, Kentish Plover, Large Egret, Lesser Whitethroat, Little Stint, Little Tern, Marsh Harrier, Marsh Sandpiper, Redshank, Sandwich Tern, Tawny Pipit, Tufted Duck, White Wagtail, Wood Sandpiper, kestrel, Whiskered Tern, Common Hoopoe, Bluecheecked Bee-eater, Common Swallow, Pale Sand Martin and Sind Yellow Sparrow.

The Indus Flyway:

Pakistan is one of the principal wintering grounds for waterbirds in South Asia. The lakes in the Indus Valley are major refuge for the migratory waterbirds which breed in Northern Eurasia. Pakistan forms part of their "Indus River Green Route". When the climate in their breeding grounds in Russia becomes too rigorous and the food gets scare, then the birds leave the place and disperse to their winter resorts further south along the following seven distinct flyways.

1. Northern Europe Scandinavia – North Sea.
2. Central and Southern Europe - Black Sea –Mediterranean
3. West Siberia- Caspian Sea- Nile.
4. Siberian – Kazakhstan- Pakistan/ Central Asian Flyway.
5. East Siberia – Tibet- Ganges/ East Asian- Australian Flyway.
6. Far East- Kamchatka- China/Japan. West Pacifica Flyway.
7. North East Siberia- Chokotha – California/ Pacific Flyway.

Most of the sub-continent's visitors come through Pakistan

route to India and Srilanka or Africa. Majority of winter visitors to the sub-continent enter via Indus Plain. Some come down the Indus River Valley and its far northern tributaries as well as the Chenab and Jhelum rivers further east. A very significant number enter from further west coming over the Peiwar Pass and following down the Kurram River. Some of these autumn migrants fanout eastwards into Northern India and thus avoid the Rajasthan Desert to the South, while other follow the Indus River down to the Indus Delta (Roberts, 1991)

A list of 236 species of birds is available, both resident and migratory, whose range of occurrence covers the most important wetland of the surrounding area of the Wind Farms in the Jhimpir Wind Corridor viz. Keenjhar Lake. (Khan *et al.* 2012)

The list is quite comprehensive and is based mainly on the experience gained during the waterbirds surveys undertaken during the last five years. It gives an overall idea about the resident and migratory birds, many of which may be expected to be observed on their migration/ local movement to and from the lake to the surrounding areas.

The results of the recent Asian Waterbird Census undertaken on Keenjhar Lake and Haleji lake are given below which show that these lakes have suffered from significant decline in bird numbers during the recent years due to disturbance and other anthropological activities.

Year	2000	2001	2002	2003	2004	2010	2011
Haleji Lake	69, 194	44,931	40,062	15,367	2,570	3,000	2,370
Keenjhar Lake	**30,270**	**38,958**	**30,470**	**15,886**	**3,770**	**7,174**	**2,252**

Environmental Impacts of Wind Farms and Screening of Potential Issues:

Through environmental screening the range of potential effects may be determined which need detailed assessment and the screening process has been detailed out below through a matrix in tabular form. The matrix contains the Potential Environmental Issues, Receptors of the Impacts, Effects of Issues, Evaluation of Risk and suggested Mitigation Guideline with notes on the site situation. (Anon. 2009, 2009a).

The issues of high relevance in the Biological Environment have been grouped in two categories as loss and fragmentation of habitat and disturbance to the Animal species. These are analyzed on page number 8:

Environmental Impacts:

Wind Forms can lead to the following potential impacts related to loss of habitat for certain species:

- Impact on a range of threatened species, populations and ecological communities.
- Impact on birds or bats from strikes.
- Impacts on bird flight movement and behavior that could affect their survival
- Disturbance to the habitats of ground mammals and reptiles.

The potential and realized ecological impacts of wind-energy development on the fauna and flora of the Project Area have been identified and mitigation measures have been addressed assessing the types of research and monitoring needed for the proposed project.

Environmental assessments are routinely carried out for wind-energy development projects with potential impacts on the local environment (e.g. plants, animals, and soils etc) are evaluated. Turbine locations and operations are often modified as part of the approval process to avoid or minimize impacts on threatened species and their habitats.

Impacts can be modelled on migratory and residential wildlife to provide a basis for science-based decisions. Thus, existing data on migratory and other wildlife can be utilized to ascertain predictive threats, and specific species or sets of species could be identified mostly at risk in areas of high potential wind resources.

It is apprehended that the developmental activities will affect the biological environment through loss and fragmentation of habitat and disturbance to Indian spiny tailed lizard (*Saara hardwickii*) and the rodents fairly available in the area.

Wind turbines may cause some disturbance to the avifauna but the main population of the migratory avifauna will not be affected as the area is not located on the main water bird flyway which passes close to the Indus River. The nearest wildlife protected area viz. Keenjhar Wildlife Sanctuary and Ramsar Site is about 20 km away from the Project Sites. Bats are not reported from the area as the environment is not suitable for them.

Large mammals and birds of prey are scarce in the area and their preferred habitats are the less disturbed areas on the periphery of the project area. Other bird species were found to be present near the villages or water points.

Mitigation Measures:

The following mitigation measures have been suggested.

1) Disturbance to the habitat of the Indian spiny tailed Lizard be minimized / controlled.
2) As far as possible, the burrows / holes of the lizard be safeguarded against any developmental activity. The animals be specially protected during the construction phase.
3) Monitoring the birds during the migratory season be undertaken to record their distribution and migratory pattern and use of the area during the season.
4) Hunting, feeding or harassment of wildlife be strictly prohibited during the entire course of operation.
5) Vegetation clearing and land uptake during the operation be minimized.
6) Development of new access tracks during operations be minimized.
7) Routes involving minimum clearing of vegetation be selected.
8) Operation must avoid disturbing live bird nests and small mammal and reptile holes.
9) Food wastes not to be disposed off in the open. Food wastes collected in waste segregation units be disposed off according to waste disposal procedure on a regular and strict basis.
10) Night work during construction be prohibited, night traveling not be allowed unless absolutely necessary.
11) All mitigations related to minimizing noise be adhered to.
12) Construction work near areas which show small mammal and reptile populations should commence after a soft start up and be randomly monitored.
13) Vehicle speeds on access road be controlled to avoid incidental mortalities of reptiles. Any such incident be reported and vehicle speeds be randomly checked.

14) Movement of all project personnel be restricted to work areas.
15) Movement of project vehicles be restricted only to the project access road or to routes approved.
16) Operation camp be located 500m away from perennial water bodies.

Development of a Monitoring Strategy and Strengthen Capacity for monitoring birds:

Regular and region-wide waterbird monitoring will provide the basis to determine the status and trends of populations and the effectiveness of management actions being implemented. The existing regional monitoring programmes for waterbirds in the Central Asian Flyway include the International Waterbird Census that is conducted every January. Information generated by the programs is providing useful baseline information and has led to the identification of important sites and monitoring of many of them on a regular basis. A number of other surveys and local census programs have also provided the basis to collect valuable information.

Bird Monitoring will give the assessment of the impacts of Wind Power Project on the migrating waterbird flocks in the area. It will help to draw out the migratory routes of the avifauna in the project area and the extent and limits of the migration corridors and the Indus Flyway.

Bird Monitoring Strategy in Jhimpir Wind Corridor:

1.The need for bird monitoring

There is a need to develop a Bird Monitoring Plan keeping in view the possibility of risk of collision of flying birds against the huge rotating blades of the turbines or power transmission lines/towers. Additionally, there may be adverse impact on the bird diversity, bird density and bird behavior due to disturbance and noise produced during the project activities. At least, one year bird monitoring is necessary to compile substantive data about the impacts of wind power plants on the birds and other important wildlife of the area.

2.Bird Monitoring Methodology

i. The resident and the migratory birds in particular need to be recorded to collect latest data about their occurrence and status. The density and diversity of the birds available in the area also need to be determined along with the role of birds of prey as predators, and density of migratory birds flying over WEF.

ii. Physical features/topography of the study site needs to be studied to identify the potential habitats of birds as feeding, resting, roosting, and staging areas and the nature of the terrain and the limits of the monitoring area.

iii. Observations on bird movement from and to the study area.

iv. Demarcation/mapping of the total area of the wind turbines. The area to be surveyed around the wind turbines will cover about 1 km around the central zone.

v. Linear and Strip census methods will be used for collection of data. Four vantage point will be made, one each, in the four directions of the wind turbines.

vi. Daily observations on bird movement in early morning and at sunset will be made to record the feeding, resting and roosting areas of the birds of the area and also the flight patterns of nocturnal birds need to be studied.

vii. Each bird monitor will make observations by moving straight along 1 km area, covering at least 100 m on each site. 4 monitors will be employed.

viii. Use of binoculars, spottingscope, GPS and field guide book will be made to make observations, identify the birds and record the data.

ix. Weekly/monthly/quarterly study/Monitoring Reports will be compiled incorporating all relevant data such as date, time, location, species recorded and results.

Work Plan for Bird Monitoring:

1) Studies may initially be undertaken for a period of one year.

2) Field surveys may be made and data collected every quarter (July-Sept, Oct-Dec, Jan-March and April-June). More detailed studies will be made especially during the peak migratory season of birds (December-January). The duration of visit in each quarter may be 3-6 days depending on the season and influx of the migratory birds.

3) In the first instance, the study site may be visited to record the topography of the area, to identify the key habitats of the animal species, and to select the vantage points for observing and recording the birds visiting the area.

4) Observations may be made by bird experts to record the species particularly at sunrise and sunset each day during their field visits.

5) Local staff may also be trained in bird identification and collection of data on the Information Sheets prepared for the purpose.

6) Report may be compiled on the basis of data collected through observations made during the field visits as well as the information gathered through filled in proformas received from the local data collectors trained for the purpose.

7) Reporting – information may be summarized on fatality species composition, seasonality of use, search numbers, and estimated mortality rates for bird, bats and especially raptors and species of concern.

Methodology of birds monitoring after the wind Turbines operations:

The following methodology of Bird Monitoring has been suggested.

1) Monitoring may be undertaken in the study area in the active zone of wind turbines to determine the effect of noise to the birds in the 500m area around the turbines.
2) Subsequent observations may be made in the area further around extending to about 1km along the periphery of the turbines to record the occurrence and movements of birds in the area.
3) Linear transect method may be used to study the overall occurance and distribution of the birds of the area around.
4) Point Count Method may be used to study birds habits and habitats, their movements and activities. Observation may be made from three vantage points each selected at the centre and at the corners of the study area.
5) Binoculars, Spotting scopes, GPS, Field Guides, and Camera to be used to aid in field studies.
6) Data may be collected each day in early morning and also before sunset, with respect to species, their numbers, directions of flights, probable height, time, location, feeding areas, roosting areas, staging areas and resting areas, effect of noise and disturbance to the species.
7) Record may be made of any bird collision with the turbines with all necessary details. Such study be specially made during the

migratory season of the birds during October – March, particularly with reference to waterbirds and Birds of Prey.

Cumulative Impact of Wind Power Projects:

The overall impact of effluents entering the Harilo Drain/ Sorh Nai/ Loyach Naddi and ultimately into the Keenjhar Lake may also be kept in view.

Cumulative effects may not be ascertained at this stage from one project proposal unless it is taken as a strategic environmental study. A limited study of this size will give only very localized or marginal impacts. At present, any study about the threatened species in particular, or about the species of conservation significance is not available, nor is there any Conservation Plan for which may serve as bench mark for the cumulative assessment of the impacts. In view of the presents situation, the main target should be to:

i. maintain the integrity of IBAs.
ii. monitor the population levels of target species over the wetlands so as to ensure continued presence of main migrant groups over the wetland sites.
Indentify potential and existing threats to the species and to suggest measures for mitigating the impacts.

Priority Actions:

1. Areas of high seasonal bird concentration may be identified and surveyed to record bird movements.
2. Bird activity near turbines may be reduced through prey control/preservation.
3. Threatened birds of the area, (Table 5) if any, may be particularly recorded to determine the importance of the area and to reduce the threats to the species.
4 .Preparation of Training Manual for Bird Identification in the Study Area may be undertaken as it is urgently required in view of the absence of necessary field books on the subject.

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Table 1. List of Mammals recorded:

S. No	Common Name	Scientific Name	Occurance / Status	Listing		
				SWPO	IUCN Red List	CITES Appendix
1	Asiatic Jackal	*Canis aureus*	LC			
2	Balochistan Gerbil	*Gerbillus nanus*	LC			
3	Common Red Fox	*Vulpes vulpes*	LC			
4	House Mouse	*Mus musculus*	C			
5	House/ Roof Rat	*Rattus rattus*	C			
6	Indian Fox	*Vulpes bengalensis*	LC		DD	
7	Indian Gerbil	*Tatera indica*	LC			
8	Indian Porcupine	*Hystrix indica*	LC			
9	Indian Desert Cat	*Felis silvestris*	Ra	+		II
10	Indian Grey Mongoose	*Herpestes edwardsi*	LC			
11	Indian Hare	*Lepus nigricollis*	LC			
12	Indian Pangolin	*Manis crassicaudata*	Ra	+		II
13	Long-eared Desert Hedgehog	*Hemiechinus collaris*	LC			
14	Northern Palm Squirrel	*Funambulus pennantii*	C			
15	Small Indian Mongoose	*Herpestes javanicus*	LC			

Table 3. List of Reptiles recorded:

S. No	Common Name	Scientific Name	Occurance / Status	Listing		
				SWPO	IUCN Red List	CITES Appendix
1	Bengal Monitor	*Varanus bengalensis*	LC	+		I
2	Black Rock Agama	*Laudakia melanurus*	LC			
3	Cliff Racer	*Coluber rhodorachis*	LC			
4	Desert Monitor	*Varanus griseus*	LC	+		I
5	Garden Lizard	*Calotes versicolor*	C			
6	Indian Cobra	*Naja naja*	LC		DD	II
7	Saw scaled Viper	*Echis carinatus*	LC			
8	Spiny Tailed Lizard	*Saara hardwickii*	C			II
9	Spotted Indian House Gecko	*Hemidactylus brookii*	C			
10	Indian Sand Boa	*Eryx johnii*	LC			II
11	Yellow bellied House Gecko	*Hemidactylus flaviviridis*	C			
12	Brilliant Agama	*Trapelus Agilis*	LC			
13	Bluetail Sand Lizard	*Acanthodactylus contoris*	LC			

Legend: C= Common, LC = Less common, Ra = Rare

Table 4. List of vegetation recorded

Family Name	Scientific Name	Common Name	Life Form	Life-span
Poaceae	*Aeluropus lagopoides*	Kalar Garh	Grass	Perennial
	Cymbopogon jwarancusa	Katan	Grass	Annual
Amaranthaceae	*Aerva javanica*	Booh	Sub-shrub	Perennial
Apocynaceae	*Rhazya stricta*	Sahaer	Shrub	Pemnial
Asclepiadaceae	*Calotropis procera*	Ak	Shrub	Pemnial
	Leptadenia pyrotechnica	Khip	Shrub	Pemnial
Boraginaceae	*Heliotropium crispum*	Kharsan	Herb	Annual
Caesalpiniaceae	*Cassia italica*	Ghora Wal	Herb	Annual
Capparidaceae	*Capparis decidua*	Kirar	Shrub	Perennial
Convolvulaceae	*Cressa cretica*	Oin	Herb	Herb
	Convolvulus Spinosus	Khirhanji	Herb	Herb
Euphorbiaceae	*Euphorbia caducifolia*	Kheer Wal	Herb	Annual
Fabaceae	*Indigofera oblongifolia*	Lathio	Herb	Annual
Mimosaceae	*Acacia jacquemontii*	Banwar	Shrub	Perennial
	Acacia nilotica	Sindhi Babur	Tree	Perennial
	Prosopis cineraria	Kandi	Tree	Perennial
	Prosopis glandulosa	Devi	Shrub	Perennial
	Prosopis juliflora	Devi	Shrub	Perennial
Polygonaceae	*Zizyphus mauritiana*	Ber	Tree	Perennial
Salvadoraceae	*Salvadora oleoides*	Jar / Peroon	Shrub	Perennial

Table-5: Threatened/Near threatened species of birds of Haleji/Keenjhar Lake and Allied Areas

Species		Status
Indian Vulture	*Gyps indicus*	CE
Dalmatian Pelican	*Pelecanus crispus*	V
Pallas's Fish Eagle	*Haliaeetus leucoryphus*	V
Houbara Bustard/Macqueen's Bustard	*Chlamydotis macqueenii*	V
Greater Spotted Eagle	*Aquila clanga*	V
Cinereous Vulture	*Aegypius monachus*	NT
Pallid Harrier	*Circus macrourus*	NT
Ferruginous Pochard	*Aythya nyroca*	NT
Blackbellied Tern	*Sterna acuticauda*	NT

Table – 6: Important Sampling Sites:

S.No	Study area	Co-ordinates
1.	Near Durgagh Gogrho Pir	N 25 0 6 30.3 E 67 50 55.1
2.	Keenjhar Lake	N 25 0 2 38.6 E 68 09 20.6
3.	Kallogoth Naddi	N 25 0 6 56.9 E 67 47 12.6
4.	Sampling Point (Jamshoro)	N 25 0 7 54.9 E 67 47 52.6
5.	Haji Lakhano Jakhro	N 25 1 0 21.9 E 67 54 23.3
6.	Murad Chang	N 65 0 8 45.5 E 67 59 23.6
7.	Qasim Burfat	N 25 1 0 15.7 E 67 57 47.7
8.	Sandgrouse Area	N 25 0 8 0 3.5 E 67 59 44.0
9.	Kandi Forest	N 25 0 2 16.1 E 68 0 2 41.0
10.	Herilo Drain, Jhimpir – Thatta Road	N 25 0 2 16.1 E 68 0 2 41.0
11.	Hadero Lake	N 24 4 9 0 7.6 E 67 5 0 33.8
12	Near Zurlo Wind Farm	N 25 0 6 49.7 E 67 59 17.5
13	Haleji Lake (Information Centre)	N 24 4 7 12.2 E 67 4 7 24.0
14	KB Feeder Canal	N 25 0 2 21.7 E 68 0 7 55.2

Table 2. List of Birds recorded:

S. NO	ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
01	Podicipediformes	Podicipedidae	*Tachybaptes ruflcollis*	Little Grebe or Dabchick	R
02	Pelecaniformes	Phalacrocoracidae	*Phalacrocorax niger*	Little Cormorant	R
03	Ciconiiformes	Ardeidae	*Ardeola grayii*	Pond Heron	R
04	Ciconiiformes	Ardeidae	*Casmerodius alba*	Great Egret	V
05	Anseriformes	Anatidae	*Aytha fuligula*	Tufted Duck	WV
06	Falconiformes	Accipitridae	*Elanus caeruleus*	Black winged Kite	R
07	Falconiformes	Accipitridae	*Milvus migrans*	Black Kite	R
08	Falconiformes	Accipitridae	*Haliastur indus*	Brahminy Kite	R
09	Falconiformes	Accipitridae	*Butastur teesa*	White-eyed Buzzard	R
10	Falconiformes	Accipitridae	*Aquila rapax*	Tawny Eagle	R
11	Falconiformes	Accipitridae	*Buteo buteo*	Common Buzzard	WV
12	Falconiformes	Accipitridae	*Circus aeruginosus*	Eurasian Marsh Harrier	WV
13	Falconiformes	Falconidae	*Falco tinnunculus*	Kestrel	R/WV
14	Galliformes	Phasianidae	*Francolinus francolinus*	Black Patridge	R
15	Galliformes	Phasianidae	*Francolinus pondicerianus*	Grey Patridge	R
16	Gruiformes	Rallidae	*Gallinula chloropus*	Indian Moorhen	R
17	Gruiformes	Otididae	*Chlamydotis undulata*	Houbara Bustard	WV
18	Charadriiformes	Charadriidae	*Vanellus indicus*	Red Wattled Lapwing	R
19	Charadriiformes	Charadriidae	*Charadrius hiaticula*	Ringed Plover	WV
20	Charadriiformes	Charadriidae	*Charadrius alexandrinus*	Kentish Plover	R/WV/PM
21	Charadriiformes	Scolopacidae	*Tringa totanus*	Common Redshank	WV
22	Charadriiformes	Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	WV
23	Charadriiformes	Scolopacidae	*Tringa glareola*	Wood or Spotted Sandpiper	WV
24	Charadriiformes	Scolopacidae	*Tringa hypoleucos*	Common Sandpiper	WV
25	Charadriiformes	Scolopacidae	*Calidris minutus*	Little Stint	WV
26	Charadriiformes	Recurvirostridae	*Himantopus himantopus*	Blackwinged Stilt	R
27	Charadriiformes	Sternidae	*Chlidonias hybrida*	Whiskered Tern	M
28	Charadriiformes	Sternidae	*Gelochelidon nilotica*	Gullbilled Tern	WV
29	Charadriiformes	Sternidae	*Hydroprogne caspia*	Caspian Tern	M
30	Charadriiformes	Sternidae	*Sterna aurantia*	River Tern	R
31	Charadriiformes	Sternidae	*Sterna acuticauda*	Black-bellied Tern	R
32	Charadriiformes	Sternidae	*Sterna albifrons*	Little Tern	R
33	Charadriiformes	Sternidae	*Sterna sandvicensis*	Sandwich Tern	M
34	Columbiformes	Pteroclididae	*Pterocles exustus*	Chestnut-bellied or Common or Indian Sandgrouse	R
35	Columbiformes	Pteroclididae	*Pterocles lichtensteinii*	Close-barred or Lichtenstein Sandgrouse	R
36	Columbiformes	Columbidae	*Columba livia*	Blue Rock Pigeon	R
37	Columbiformes	Columbidae	*Streptopelia decaocto*	Ring Dove	R
38	Columbiformes	Columbidae	*Streptopelia senegalensis*	Little Brown or Senegal Dove	R
39	Coraciiformes	Alcedinidae	*Ceryle rudis*	Pied Kingfisher	R
40	Coraciiformes	Meropidae	*Merops superciliosus*	Blue cheeked Bee-eater	M/R
41	Coraciiformes	Meropidae	*Merops orientalis*	Green Bee-eater	R
42	Coraciiformes	Coraciidae	*Coracias benghalensis*	Indian Roller	R
43	Coraciiformes	Upupidae	*Upupa epops*	Common Hoopoe	M/R
44	Passeriformes	Alaudidae	*Eremopterix grisea*	Ashycrowned Finch-Lark	R
45	Passeriformes	Alaudidae	*Eremopterix nigriceps*	Blackcrowked Finch-Lark	R
46	Passeriformes	Alaudidae	*Ammomanes deserti*	Desert Lark	R
47	Passeriformes	Alaudidae	*Alaemon alaudipes*	Greater Hoopoe Lark	R
48	Passeriformes	Alaudidae	*Galerida cristata*	Crested Lark	R

49	Passeriformes	Hirundinidae	*Riparia diluta*	Pale Collarad Sand Martin	WV
50	Passeriformes	Hirundinidae	*Hirundo rustica*	Brown or Common Swallow	WV
51	Passeriformes	Lanidae	*Lanius isabellinus*	Rufous-tailed or Isabelline Shrike	PM
52	Passeriformes	Laniidae	*Lanius excubitor*	Southern Grey Shrike	R
53	Passeriformes	Laniidae	*Lanius vittatus*	Baybacked Shrike	R
54	Passeriformes	Dicruridae	*Dicrurus adsimilis*	Black Drongo	R
55	Passeriformes	Sturnidae	*Acridotheres ginginianus*	Bank Myna	R
56	Passeriformes	Sturnidae	*Acridotheres tristis*	Indian Myna	R
57	Passeriformes	Corvidae	*Dendrocitta vagabunda*	Tree Pie	R
58	Passeriformes	Corvidae	*Corvus splendens*	Sind House Crow	R
58	Passeriformes	Pyconotidae	*Pycnonotus leucogenys*	White-cheeked Bulbul	R
60	Passeriformes	Pyconotidae	*Pycnonotus cafer*	Red-vented Bulbul	R
61	Passeriformes	Timaliidae	*Turdoides caudatus*	Common Babbler	R
62	Passeriformes	Timaliidae	*Turdoides striatus*	Sind Jungle Babbler	R
63	Passeriformes	Sylviidae	*Prinia flaviventris*	Yellow-bellied Prinia	R
64	Passeriformes	Sylviidae	*Prinia burnesii*	Long tailed Grass Warbler / Rufous Vented Prinia	R
65	Passeriformes	Sylviidae	*Sylvia curruca*	Lesser White throat	WV
66	Passeriformes	Sylviidae	*Phylloscopus collybita*	Common Chiffchaff	WV
67	Passeriformes	Turdidae	*Phoenicurus ochruros*	Black Redstart	WV
68	Passeriformes	Turdidae	*Saxicola caprata*	Pied Bush Chat	R
69	Passeriformes	Turdidae	*Oenanthe deserti*	Desert Wheatear	WV
70	Passeriformes	Turdidae	*Oenanth alboniger*	Hume Wheatear	R
71	Passeriformes	Turdidae	*Saxicoloides fulicata*	Indian Robin	R
72	Passeriformes	Motacilliidae	*Anthus campestris*	Tawny Pipit	WV
73	Passeriformes	Motacilliidae	*Motacilla alba*	White or Pied Wagtail	WV
74	Passeriformes	Nectariniidae	*Nectarinia asiatica*	Purple Sunbird	R
75	Passeriformes	Passeridae	*Passer domesticus*	House Sparrow	R
76	Passeriformes	Passeridae	*Passer pyrrhonotus*	Sind Jungle Sparrow	R
77	Passeriformes	Passeridae	*Petronia xanthocollis*	Sind Yellow headed Sparrow	SBV
78	Passeriformes	Estrildidae	*Lonchura malabarica*	White throated Munia	R

Legend:

R = Resident
WV = Winter Visitor
M = Migratory
PM = Passage Migrant
IRV = Irregular Visitor
SBV = Summer Breeding Visitors

Impact Matrix for Environmental Effects of the Wind Farms:

Potential Environmental Issues	Receptors	Effects	Evaluation of Risk	Mitigation Measures	Present Situation
❖ Loss of Habitat	Existing Flora and Fauna	There may be some loss of habitat due to construction activities of the Project	Natural habitat of some small mammals and reptiles may be affected. Some plant species may also disappear	Identification of the main habitats of flora and fauna of the Project Area. Efforts to be made to save/restore the key specis.	Inventories of the flora and fauna have been compiled. No endemic or rare species of flora recorded in the Project Area.
❖ Avian Collision with Turbines	Resident and Migratory Avifauna of the area.	There are chances of bird collision with the wind turbines.	Injury to or mortality of birds.	Study of the behavior and status of the birds of the area.	

		Special concern in case of a location close to a wetland site	Disturbance in the migratory pattern or movement of birds	Waterbird Monitoring Programme needs to be framed out and implemented. Records of annual waterbird Census and Periodic Counts. Careful watch of movement of birds during the migratory season from Oct- March. AWC needs to be regularly undertaken each year in January, which is the peak season for migratory waterbirds Bird habits studies required.	AWC has been carried out on Haleji and Keenjhar Wetlands of the area. Important habitats have been identified in the Project Area.
❖ Disturbance to Birds	Residents and Migratory Birds of area	Changes in the Ecosystem due to Construction	The feeding, resting and breeding activities/ habitats of the birds may be affected	Safeguard such prime habitats at least by maintaining safe distance. Habitat of Indian Spiny tailed Lizard to be safeguarded, which is fairly available in the area. Ecologically compensating areas may be sorted out, if possible. It may be ensured that the birds are safe from hunting, poaching or disturbance along their route, particularly the Waterbirds, Birds of Prey, Partridges and Sandgrouses. Arrange running power lines in parallel system. Self-supporting pylon structures fitted with PVC or similar "Bird Guards	
❖ Overhead Electricity Cables causing disturbance to birds	Resident and Migratory Birds of the area	There are chances of bird collision with the wind turbines. Special concern in case of a location close to a wetland site	Chances of electrocution, collision or obstruction		