Cumulative Effects Assessment for the Gebel El Zeit 580 MW Wind Farm, Egypt

THE BIODIVERSITY CONSULTANCY

Front cover image is of Gebel El Zeit 580 MW Wind Farm by Filipe Canário (TBC)

Citation: TBC. (2026). Cumulative Effects Assessment for the Gebel El Zeit 580 MW Wind Farm, Egypt. The Biodiversity Consultancy, Cambridge, United Kingdom.

THE BIODIVERSITY CONSULTANCY

This report was prepared for Alcazar Energy Partners

Document information	
Document title	Cumulative Effects Assessment for the Gebel El Zeit 580 MW Wind Farm, Egypt
Document subtitle	
Project No.	AEP01
Date	21 September 2026
Version	Final CEA
Author	L. Murrell, F. Canário; V Katariya, M. Coroi
Client name	Alcazar Energy Partners

Document history

Revision no.	Author/s	Reviewer 1	Reviewer 2	Date	Comments	Final/draft
1	LM, FC, VK	MC		20 February 2026	For client review	Draft
2	LM, FC	FC		27 March 2026	Updated mortality thresholds	Draft
3	LM, FC	FC		29 July 2026	Addressing client and lender's comments	Draft
4	LM, FC	FC		16 September 2026	Addressing lender's comments	Draft
5	LM, FC	FC		21 September 2026	Addressing lender's comments	Final

THE BIODIVERSITY CONSULTANCY

Table of contents

THE BIODIVERSITY CONSULTANCY

Acronym table

Acronym	Definition
ATMP	Active Turbine Management Program
BAP	Biodiversity Action Plan
BMP	Biodiversity Management Plan
CEA	Cumulative Effects Assessment
CH	Critical Habitat
CHA	Critical Habitat Assessment
CMS	Convention of Migratory Species
CR	Critically Endangered
EBRD	European Bank of Reconstruction and Development
EIB	European Investment Bank
EN	Endangered
EOO	Extent of Occurrence
ESR6	(EBRD) Environmental and Social Requirement 6
ESIA	Environmental and Social Impact Assessment
ESS4	(EIB) Environmental and Social Standard 4
GBIF	Global Biodiversity Information Facility
IBA	Important Bird and Biodiversity Area
IBAT	Integrated Biodiversity Assessment Tool
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
LC	Least Concern
LoE	Likelihood of Effect
MSBs	Migratory Soaring Birds
NG	Net Gain
NNL	No Net Loss
NREA	New and Renewable Energy Authority
NT	Near Threatened
OHTL	Overhead Transmission Line
PBF	Priority Biodiversity Feature
PBR	Potential Biological Removal
PCFM	Post-construction Fatality Monitoring
PS6	(IFC) Performance Standard 6

Acronym	Definition
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
SVI	Species Vulnerability Index
TBC	The Biodiversity Consultancy
UoA	Unit of Analysis
VEC	Valued Environmental Component
VU	Vulnerable

THE BIODIVERSITY CONSULTANCY

Executive summary

This report is a Cumulative Effects Assessment (CEA) of biodiversity for the Gebel El Zeit 580 MW Wind Farm (the Project) and other wind energy developments in the Gulf of Suez, Egypt. This assessment identified 10 migratory bird species, two bat species, and one ecosystem/habitat type (wadis with permanent vegetation) as priority Valued Environmental Components (VECs) for the Project, which are most at risk from the combined impacts of existing and potential wind developments. Impact thresholds have been set for each priority bird VEC, which range between zero and five annual fatalities, above which an adaptive management response is triggered.

In addition, the Project has carried out a Critical Habitat Assessment (CHA) (TBC 2026) which identified six bird species that qualify as critical habitat, and 19 (17 birds, one mammal and one reptile) species as Priority Biodiversity Features (PBFs). The Project has a Net Gain (NG) target for critical habitat- qualifying species and a No Net Loss (NNL) target for priority VECs and PBFs.

The CEA sets mortality thresholds (Table 1) for all soaring bird VECs and proposes a framework for adaptive management.

Table 1. Priority VECs (in bold), CH and PBF qualifying species for the Gebel el Zeit Wind Farm

Species	Scientific name	Type	IUCN status	CH	PBF	Overall risk	Threshold (fatalities/year)
Black Kite	*Milvus migrans*	Bird	LC		✓	Major	3
Black Stork	*Ciconia nigra*	Bird	LC	✓		Major	0
Booted Eagle	*Hieraaetus pennatus*	Bird	LC		✓	Minor	0
Common Crane	*Grus grus*	Bird	LC		✓	Mahor	0
Common Kestrel	*Falco tinnunculus*	Bird	LC		✓	-	5
Eastern Imperial Eagle	*Aquila heliacal*	Bird	VU		✓	Minor	0
Egyptian Vulture	*Neophron percnopterus*	Bird	EN		✓	Minor	0
Eurasian Buzzard	*Buteo buteo*	Bird	LC		✓	Moderate	5
Eurasian Sparrowhawk	*Accipiter nisus*	Bird	LC		✓	-	0
European Honey-buzzard	*Pernis apivorus*	Bird	LC	✓		Moderate	5
Great White Pelican	*Pelecanus onocrotalus*	Bird	LC	✓		Major	0
Greater Spotted Eagle	*Clanga clanga*	Bird	VU		✓	Moderate	0
Lesser Spotted Eagle	*Clanga pomarina*	Bird	LC		✓	Minor	3
Levant Sparrowhawk	*Accipiter brevipes*	Bird	LC	✓		Major	3
Long-legged Buzzard	*Buteo rufinus*	Bird	LC		✓	Minor	3
Montagu's Harrier	*Circus pygargus*	Bird	LC		✓	Minor	3
Osprey	*Pandion haliaaetus*	Bird	LC		✓	-	0
Pallid Harrier	*Circus macrourus*	Bird	NT		✓	-	0
Short-toed Snake Eagle	*Circaetus gallicus*	Bird	LC		✓	Minor	0
Sooty Falcon	*Falco concolor*	Bird	VU		✓	Minor	0
Steppe Eagle	*Aquila nipalensis*	Bird	EN	✓		Major	0
Western Marsh Harrier	*Circus aeruginosus*	Bird	LC		✓	-	3

Species	Scientific name	Type	IUCN status	CH	PBF	Overall risk	Threshold (fatalities/year)
White Stork	*Ciconia ciconia*	Bird	LC	✓		Major	5
Desert Pipistrelle	*Hypsugo ariel*	Mammal	DD			Moderate	Not established
Rüppel's Pipistrelle	*Pipistrellus rueppellii*	Mammal	LC			Moderate	Not established
Greater Mouse-tailed Bat	*Rhinopoma microphyllum*	Mammal	LC		✓	N/A	N/A
Egyptian Spiny-tailed Lizard	*Uromastyx aegyptia*	Reptile	VU		✓	N/A	N/A

THE BIODIVERSITY CONSULTANCY

1 Introduction

1.1 Scope and objectives

This report presents a Cumulative Effects Assessment (CEA) of biodiversity for the Gebel el Zeit 580 MW Wind Farm (the Project) and other wind energy operations in the Gulf of Suez, Egypt. It aims to identify priority Valued Environmental Components[1] (VECs) for the Gebel el Zeit Wind Farm which are most at risk from the combined impacts of all the existing and potential wind developments identified within the study area (see Section 2), and sets impact thresholds for adaptive management of mitigation measures. The report presents the following information for the Project:

- A list of potential biodiversity VECs;
- Identification of biodiversity VECs with 'sensitivity' to wind farm developments;
- A list of priority biodiversity VECs assessed to be at highest risk of cumulative effects from wind farm development in the study area;
- Impact thresholds for priority bird VECs; and
- Mitigation, monitoring and other management opportunities for Alcazar Energy Partners (Alcazar Energy, the Client) relevant to priority biodiversity VECs, including identifying opportunities where the Project can contribute to the management of cumulative effects.

This assessment broadly follows the approach developed in the equivalent CEA reports for the Tafila Region Wind Power Projects in Jordan and the Lekela North Ras Ghareb wind farm (IFC 2017; TBC 2019) on Egypt's Red Sea Coast, along with the International Finance Corporation's (IFC) and The International Union for Conservation of Nature's (IUCN) guidance on cumulative impact assessment (IFC 2013; Bennun *et al.* 2024). The approach has been adapted to the local context, particularly to account for the variation in quality and quantity of baseline data which have been collected by different developers in the landscape.

1.2 Project description

The Project is located in the western coast of the Gulf of Suez, within the administrative boundary of the Red Sea Governorate and administratively under the Ras Ghareb City Council, at approximately 280 km southeast of Cairo, 20 km south of Ras Ghareb and 3 km from Ras Shukeir (Figure 1).

The Project covers approximately 10,683 ha and comprises three adjacent operational wind farms:

[1] This analysis focuses only on globally significant biodiversity values, species and ecosystems. The analysis does not include any evaluation of potential ecosystem service VECs. In addition, consultation with Egyptian stakeholders has not been feasible, and therefore VECs which might be considered as a priority by local experts, but not readily identifiable with global data sets, might be missed. A stakeholder review and input process is recommended to address this gap (see Section **Error! Reference source not found.**)

- KfW 240 MW wind farm, with 120 turbines
- JICA 220 MW wind farm with 110 turbines, and
- FIEM 120 MW wind farm with 60 turbines

Associated infrastructure includes cables connecting the turbines to an onsite substation, a substation, the portion of the Overhead Transmission Line (OHTL) located within the Project site, offices and a warehouse, and a network of access roads.

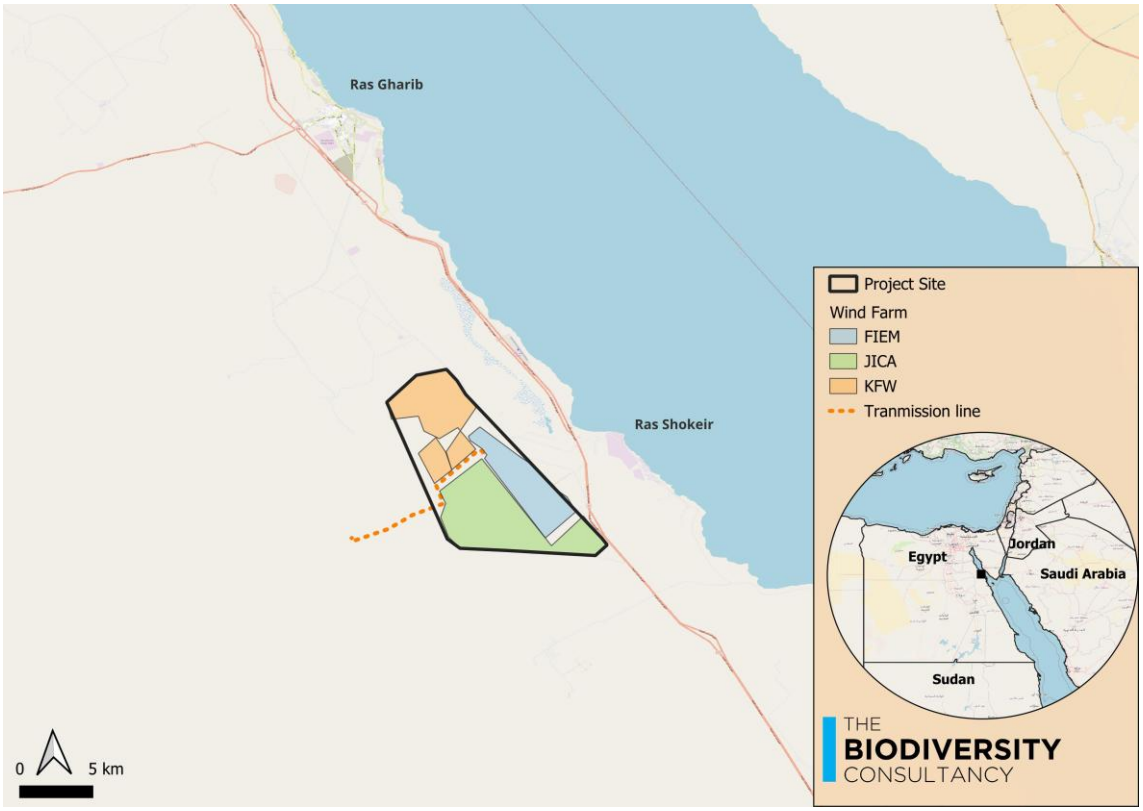

Figure 1. Project location and boundaries, showing the three adjacent wind farms (KfW 240 MW, FIEM 120 MW and JICA 220 MW). Note that only the portion of the OHTL located within the Project site boundary is considered an associated facility.

1.3 Biodiversity context

The Project is located in the Red Sea Coastal Desert Ecoregion (Dinerstein *et al.* 2017), that extends along the Red Sea coast of Egypt and Sudan, characterized by its arid climate. This region represents a transition zone between the hyper-arid Sahara Desert and the marine environment of the Red Sea, consisting of a desert area of sand and gravel plains, bisected by several shallow wadis. Land cover consists primarily of bare ground with very scattered low-growing vegetation, supporting a low diversity and abundance of terrestrial fauna (Zahran & Willis 2008).

The Project occurs within the Red Sea/Rift Valley flyway for migratory soaring birds which connects breeding grounds in Europe with wintering areas in Africa (BirdLife International 2015). This flyway is used by over 1.5 million individuals from 37 species of migratory soaring birds, as well as a suite of migratory passerines and other bird groups (Porter 2005; BirdLife International 2015; Jobson *et al.* 2021).

Due to the Project's location and potential interaction with migratory birds, systematic bird migration monitoring, associated with the implementation of the Project Active Turbine Management Program (ATMP), was initiated in spring 2016, with the start of the operation phase of the first individual wind farm within the Project, the KfW wind farm (STRIX 2018; Ehab Ameen No date). In Autumn 2020, a wider monitoring program started, involving all three wind farms within the Project and the monitoring of both Spring and Autumn migratory periods (Ehab Ameen No date).

The number of migratory soaring birds crossing the Project area is very high during both the spring (northward) and autumn (southward) migration periods, exceeding 400,000 individuals (e.g., STRIX 2018, GreenPlus 2022, NREA & SafeSoar 2023). Most abundant species include White Stork (*Ciconia ciconia*), European Honey Buzzard (*Pernis apivorus*), Eurasian (Steppe) Buzzard (*Buteo buteo vulpinus*), Black Kite (*Milvus migrans*), Levant Sparrowhawk (*Accipiter brevipes*), Great White Pelican (*Pelecanus onocrotalus*) and Steppe Eagle (*Aquila nipalensis*).

The Project overlaps with the Gebel El Zeit Key Biodiversity Area[2] (KBA) and Important Bird Area[3] (IBA). This IBA is a very important migration corridor for soaring migrants, particularly birds of prey and storks, and forms an important stop-off point in the Red Sea/Rift Valley flyway. The IBA is the narrowest point in the southern part of the Gulf of Suez and migratory birds using this flyway are funnelled through the area during both spring and autumn journeys. The northern section of the IBA is a wide coastal plain with several areas of sabkha (coastal mudflat in which evaporite-saline minerals accumulate), containing pools of hyper-saline water and large patches of saltmarsh[4].

The Gebel El Zeit Wind Farm Project has completed a Critical Habitat Assessment (CHA) which determined that the Project is located in an area of Critical Habitat (CH) for six migratory soaring bird species (Table 2) following IFC Performance Standard 6 (IFC PS6), the European Bank for Reconstruction and Development Environmental and Social Requirement 6 (EBRD ESR6) and the European Investment Bank Environmental and Social Standard 4 (EIB ESS4).

Additionally, 19 Priority Biodiversity Features (PBFs) (EBRD 2024, 2025) have been identified for the Project (TBC 2026) (Table 3). The CHA also found that the Project is in an area of primarily Natural Habitat as defined by IFC (IFC 2012, 2019).

[2] https://www.keybiodiversityareas.org/site/factsheet/6217

[3] https://datazone.birdlife.org/site/factsheet/gebel-el-zeit-iba-egypt

[4] https://www.keybiodiversityareas.org/site/factsheet/6217

Table 2. Species considered to be Critical Habitat-qualifying

Species	Scientific name	IUCN Red List status
Black Stork	*Ciconia nigra*	LC
European Honey-buzzard	*Pernis apivorus*	LC
Great White Pelican	*Pelecanus onocrotalus*	LC
Levant Sparrowhawk	*Accipiter brevipes*	LC
Steppe Eagle	*Aquila nipalensis*	EN
White Stork	*Ciconia ciconia*	LC

Table 3. Species considered to be Priority Biodiversity Features (EBRD ESR6, October 2024)

Common Name	Scientific Name	IUCN Red List Category*	EBRD ESR6 Criterion
Birds			
Eurasian Sparrowhawk	*Accipiter nisus*	LC	4a
Eastern Imperial Eagle	*Aquila heliaca*	VU	2b, 4a
Eurasian (Steppe) Buzzard	*Buteo buteo vulpinus*	LC	4a
Long-legged Buzzard	*Buteo rufinus*	LC	4a
Short-toed Snake-Eagle	*Circaetus gallicus*	LC	4a
Western Marsh-Harrier	*Circus aeruginosus*	LC	4a
Pallid Harrier	*Circus macrourus*	NT	4a
Montagu's Harrier	*Circus pygargus*	LC	4a
Greater Spotted Eagle	*Clanga clanga*	VU	2b
Lesser Spotted Eagle	*Clanga pomarina*	LC	4a
Booted Eagle	*Hieraaetus pennatus*	LC	4a
Black Kite	*Milvus migrans*	LC	4a
Osprey	*Pandion haliaetus*	LC	4a
Sooty Falcon	*Falco concolor*	VU	2b
Common Kestrel	*Falco tinnunculus*	LC	4a
Common Crane	*Grus grus*	LC	4a
Egyptian Vulture	*Neophron percnopterus*	EN	2b, 4a
Mammals			
Greater Mouse-tailed Bat	*Rhinopoma microphyllum*	LC	4a
Reptiles			
Egyptian Spiny-tailed Lizard	*Uromastyx aegyptia*	VU	2b

The Project must demonstrate a Net Gain (NG) for each CH-qualifying species in accordance with lender standards (following IFC 2012; EBRD 2019; EIB 2022). EBRD ESR6 also requires No Net Loss (NNL) and preferably a net gain (NG) of PBFs over the long term, to achieve

measurable conservation outcomes, while IFC PS6 also requires NNL of Natural Habitat and associated significant biodiversity, where feasible.

1.4 Potential impacts and on-site management of biodiversity risk

One of the main negative impacts caused by wind farm developments is bird mortality from collisions with turbines and associated power lines (Bennun *et al.* 2021). The Project area is crossed by over 290 thousand soaring birds in spring and 500 thousand in autumn (Camina *et al.* 2025).

The Project's Power Purchase Agreement (PPA) includes a 'Bird Migration Protocol'. This requires implementation of an Active Turbine Management Program (ATMP) during the spring and autumn migration periods. The ATMP will consist of a shutdown on demand program and Post-construction Fatality Monitoring (PCFM).

1.5 Periodic review of the CEA

This CEA will be reviewed every two years by Alcazar Energy and updated in response to any new or changed information that has become available since the initial document or previous update. Changes which may affect the findings of this CEA include the following information:

- Conclusions of the ongoing Strategic Environmental and Social Assessment and Cumulative Effects Assessment for wind energy projects in the Gulf of Suez, sponsored by the EBRD.
- Results from ongoing monitoring at the site: e.g. higher counts for a species than used in the priority VEC identification process, a lesser proportion of a species flying at collision risk altitudes; or
- About the regional or global threat status of a species: e.g. a species being upgraded from Vulnerable to Endangered, a species' population trend changing from 'declining' to 'stable'.

Any implications for the Project from changes to the findings of this CEA in response to an update of this document (e.g. either the species which are considered as priority VECs or the thresholds defined for a priority VEC) will only apply from the time that such an update is published and will not be applied retrospectively.

2 Study area

The region where the Project is located has been assigned by the Government of Egypt to the Egyptian New and Renewable Energy Authority (NREA) for wind energy development. Several clusters of individual wind farm plots have been developed or are planned to be developed within the area. To appropriately capture all projects in the vicinity of the Project that could result in cumulative impacts on the priority biodiversity VECs, RCREEE provided information on the current (operational and in development) and planned projects in the region (Figure 2). The

study area consisted of a 10 km buffer around these projects' areas (Figure 2), as well as the Gebel El Zeit KBA/IBA.

As a rule of thumb on how to set geographical boundaries for a CEA, IFC (2020) suggests including the area that will be directly affected by the project or activity. A 10 km buffer was selected as conservative buffer to account for home ranges of some resident desert bird species (Kemp *et al.* 2024). It is also based on evidence from a neighbouring population of Dorcas Gazelle (*Gazella dorcas*) in Wadi El Gemal National Park, where individuals were observed to avoid the coastal road up to 10 km (Nagy *et al.* 2022), indicating the spatial extent at which direct disturbance effects may be felt. A 10 km buffer is also considered a conservative buffer to encompass disturbance or barrier effects caused by the turbines. The entire Gebel El Zeit KBA/IBA was included in the study area, so that the potential cumulative effects on species relevant to its integrity could be considered, following the IFC (2017) guidance.

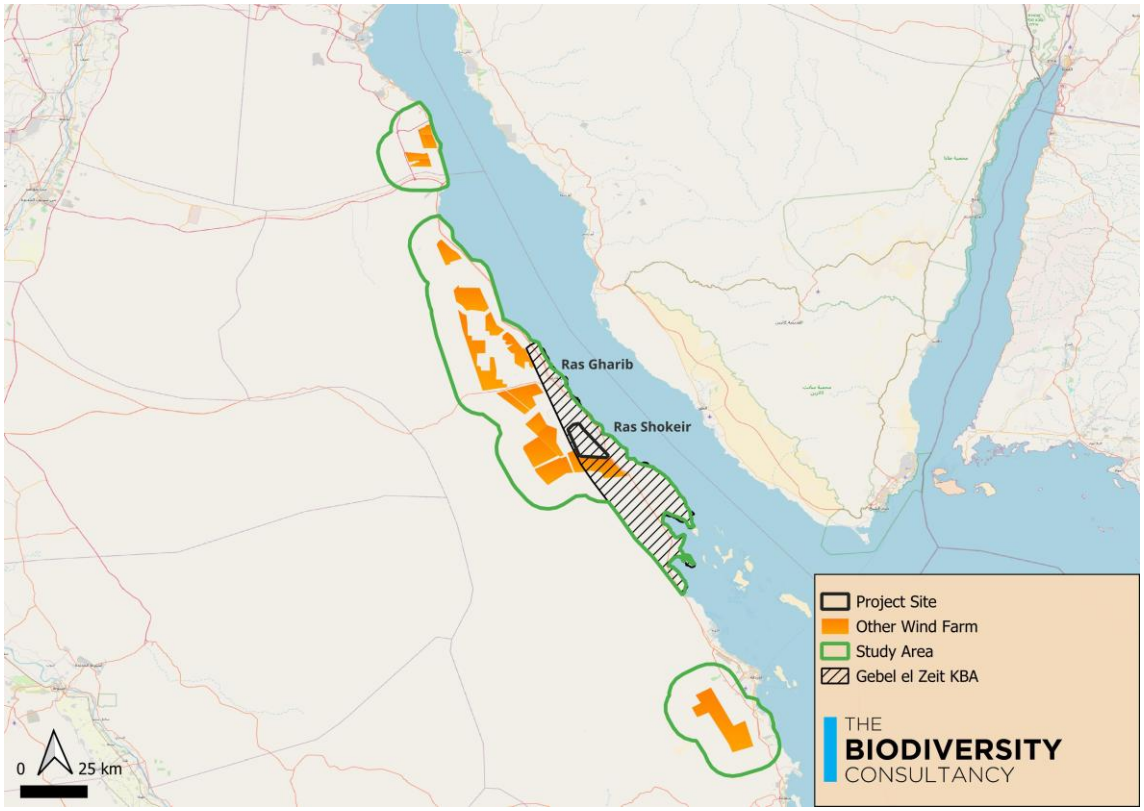

Figure 2. Location of the study area for this CEA.

3 The VEC screening process

VECs are attributes, both environmental and social, that are considered important in assessing the risks that a project, or suite of projects poses to the environment. VECs may include (IFC 2013):

- Physical features, habitats, wildlife populations (e.g., biodiversity);

- Ecosystem services;
- Natural processes (e.g., water and nutrient cycles, microclimate);
- Social conditions (e.g., health, economics); or
- Cultural aspects (e.g., traditional spiritual ceremonies).

Identification of VECs in this assessment is restricted to flora and fauna species and habitats. The analysis was carried out via a desk-based exercise using published and grey literature, and available spatial databases (accessed under licence from the Integrated Biodiversity Assessment Tool (IBAT)[5]. The need for rapid identification of risks to meet the project development timeline precluded the opportunity to carry out additional field work and stakeholder consultation, which might have led to additional VECs being identified.

The process for identifying VECs and the framework for assessing cumulative effects was different for birds, other animals and habitats, and this is described in the following separate sections.

4 The Cumulative Assessment framework for birds

4.1 Overview of the framework for birds

The assessment framework for birds has two objectives: to identify bird species at highest risk from the potential impacts of developments in the study area; and to propose mitigation, monitoring and other management activities to address risks to those bird species. This framework follows a five-step process (Figure 3):

- **Step 1**: Develop a preliminary list of potential bird VECs comprising species potentially at risk from developments in the study area, because they are either known or predicted to occur in the study area (see Section 4.2).
- **Step 2**: Determine the relative *sensitivity* of the species, being a combination of the:
  - *Vulnerability* of the species; and
  - *Relative Importance* of the species' population in relation to the appropriate Unit of Analysis (UoA), i.e. the flyway population or global distribution (see Section 4.3).

Species which were determined to have negligible *sensitivity* were dropped from analysis before proceeding to Step 3. For species where the flyway population comprised <1% of the global population, and for which any impact would be negligible for the species at a global level, were also dropped at this stage.

[5] IBAT is a global biodiversity dataset setup by a partnership between BirdLife International, Conservation International, the International Union for Conservation of Nature (IUCN) and United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC). It enables the access to key biodiversity datasets, such as the IUCN Red List, IUCN/UNEP-WCMC Protected Planet, IUCN-BirdLife Key Biodiversity Areas, etc. Integrated Biodiversity Assessment Tool (IBAT).

- **Step 3:** Determine the *overall risk* to the species from the cumulative effects of wind farm developments within the study area, being a combination of the:
  - *Sensitivity* of the species, as identified in Step 2; and
  - Cumulative *Likelihood of Effect* (LoE) rating for each species (see Section 4.4).

Those species with an *overall risk* of Major or Moderate are considered to be priority bird VECs for the project. All species that were considered to qualify as CH or PBF (TBC 2026, see Tables 2 and 3) are also considered to be VECs.

- **Step 4:** Determine an impact threshold for each priority bird VEC (see Section 4.5); and,
- **Step 5:** Propose a range of mitigation, monitoring and management actions, to avoid fatalities of priority bird VECs, and to accurately estimate priority bird VEC fatalities to facilitate compliance with thresholds and inform adaptive management responses (see Section 4.6).

4.2 Step 1 – Develop the bird species population list and identify the Units of Analysis

The purpose of Step 1 is to identify all bird species or populations that could potentially be at risk from the cumulative effects of wind energy developments in the study area and to determine a relevant UoA by which any effects on each species or population should be measured.

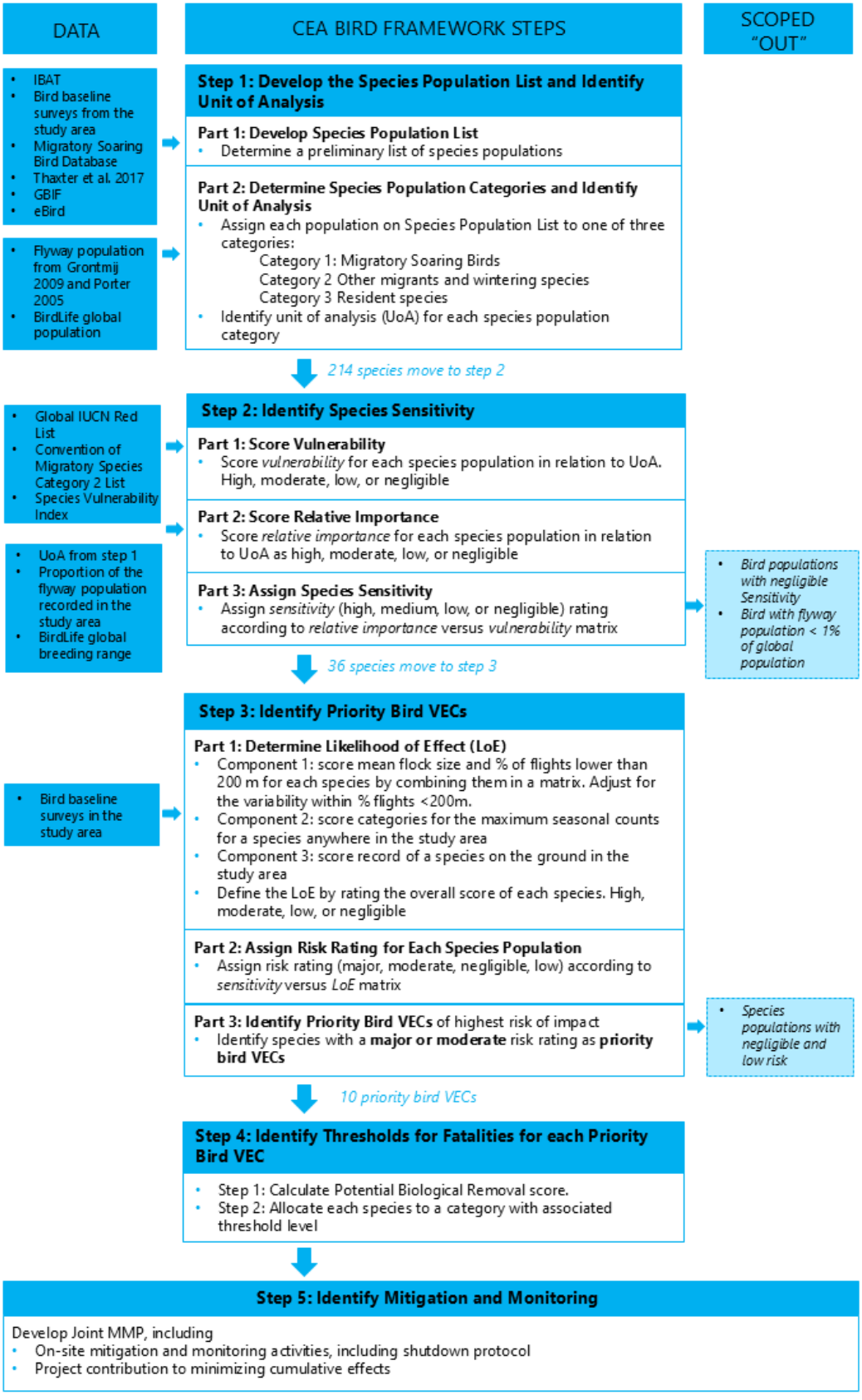

Figure 3. Process for cumulative effects analysis for priority bird VECs (adapted from IFC (2017))

4.2.1 Methods

A species list of all bird species known or likely to be present in the study area was extracted from IBAT, supplemented with any additional species recorded in the following studies:

- The bird monitoring reports for the KfW, JICA and FIEM wind farms, which present bird migration data from spring and autumn 2018 – 2024 (GreenPlus Environmental Solutions 2018a, 2018b, 2018c, 2020a, 2020b, 2020c, 2021a, 2021b, 2022a, 2022b, 2022c, 2022d, 2022e, 2022f, 2023a, 2023b, 2023c, 2023d, 2023e, 2024a, 2024b, 2024c, 2024d, 2024e, 2024f; Baha El Din 2019a, 2019b; Environics 2019a, 2019b);
- The Bird Migration Study (BMS), Environmental & Social Impact Assessment (ESIA) and CHA for the Suez Wind Energy (SWE) wind farm Plot 2, which present bird baseline studies from spring and autumn 2022 and 2023 (EcoConServ *et al.* 2023, 2024a, 2024b, 2024c, 2024d);
- Migration of Soaring Birds at Gebel el Zeit (IBA) in relation to wind energy developments (Camina *et al.* 2024);
- RCREEE Strategic and Cumulative Environmental and Social Assessment Active Turbine Management Program (ATMP) for Wind Power Projects in the Gulf of Suez (Lahmeyer International & Ecoda 2018);
- The ESIA of Alfa Wind Project (EcoConServ 2016);
- Italgen Gabal El-Zeit 320 MW bird baseline studies in autumn 2008, spring 2009, autumn 2013, spring 2014 and autumn 2016 (Grontmij 2009; EcoConServ 2014, 2017);
- Infinity 200 MW spring 2021 and 2023, and autumn 2021 avifaunal assessments (2021) a total of 3 seasons;
- NIAT 500MW spring and autumn 2021, 2022, 2025 and 2026 avifaunal and biodiversity assessments (2021) a total of 6 seasons;
- AMUNET 500MW spring and autumn avifaunal and biodiversity assessments (2020 – 2021) a total of four seasons;
- RSWE 500 MW spring and autumn avifaunal and biodiversity assessments (2019 – 2021) a total for 4 seasons;
- Lekela 250MW Wind Farm (2015 – 2021) a total of 8 seasons
- RGWE 250MW Wind Farm (2018 – 2021) a total of 7 seasons
- CEA for Lekela Wind Farm (2015-2018) involving 8 seasons
- CEA for RSWE Wind Farm (2019-2021) involving four seasons
- A survey in autumn 2006 in Gebel El Zeit Important Bird Area (Hilgerloh *et al.* 2011);
- Species qualifying the listing of Gebel El Zeit as an Important Bird and Biodiversity Area (BirdLife International 2024a);
- The Migratory Soaring Birds Tool (BirdLife International 2023), filtered by species mapped as occurring in the project area;
- The list of bird species included in the assessment of global vulnerability to wind power development compiled by Thaxter *et al.* (2017), filtered by species mapped in IBAT as occurring in the project area;
- The Global Biodiversity Information Facility (GBIF), filtered by records in the study area; and,

- eBird, filtered by records in the study area.

These species were then allocated to one of three categories, and an appropriate UoA determined for each category:

- **Category 1**: Migratory Soaring Bird populations (as per BirdLife International 2018), with the UoA being the Rift Valley / Red Sea flyway population. Data on populations of these species were sourced from Grontmij (2009), supplemented with information from Porter (2005) and Jobson *et al.* (2021) as needed;
- **Category 2**: Other migrants and wintering species' populations, with the UoA being the global breeding range extent (taken from BirdLife International 2024b), as no national or regional estimates exist which would allow definition of a smaller UoA; or,
- **Category 3**: Resident species populations, with the UoA being the same as for Category 2 species.

4.2.2 Results

Step 1 produced a species population list of 214 bird species (Table 4, Appendix 1).

Table 4. List of bird species known or likely to be present in the study area

Order		Unit of Analysis			Number of potential VECs
Common Name	Order	Category 1 – MSB populations	Category 2 - Other migrants and wintering populations	Category 3 - Resident populations	
Diurnal birds of prey	*Accipitriformes*	19	0	3	**22**
Waterbirds	*Anseriformes*	0	7	0	**7**
Swifts, tree swifts and hummingbirds	*Apodiformes*	0	3	0	**3**
Hornbills, hoopoes, wood hoopoes	*Bucerotiformes*	0	1	0	**1**
Nightjars	*Caprimulgiformes*	0	1	0	**1**
Shorebirds	*Charadriiformes*	0	51	3	**54**
Storks	*Ciconiiformes*	2	0	0	**2**
Pigeons and doves	*Columbiformes*	0	2	3	**5**
Kingfishers and related species	*Coraciiformes*	0	5	0	**5**
Cuckoos	*Cuculiformes*	0	2	0	**2**

Order		Unit of Analysis			Number of potential VECs
Common Name	Order	Category 1 – MSB populations	Category 2 - Other migrants and wintering populations	Category 3 - Resident populations	
Falcons and Caracaras	*Falconiformes*	9	0	0	**9**
Ground feeding birds	*Galliformes*	0	1	1	**2**
Cranes, crakes and rails	*Gruiformes*	2	3	0	**5**
Perching birds	*Passeriformes*	0	70	11	**81**
Ibises, herons and pelicans	*Pelecaniformes*	1	9	0	**10**
Flamingos	*Phoenicopteriformes*	0	1	0	**1**
Sandgrouse	*Pteroclidiformes*	0	0	2	**2**
Nocturnal birds of prey	*Strigiformes*	0	1	0	**1**
Cormorants, gannets and boobies	*Suliformes*	0	1	0	**1**
	Totals	33	158	23	**214**

4.3 Step 2 – identify bird species' sensitivity

The purpose of Step 2 is to determine the *sensitivity* of each species or population identified in Step 1 based on its *vulnerability* at a national, regional, or international scale, depending on the UoA, and the *relative importance* of the study area to the population.

4.3.1 Methods

Sensitivity as considered here relates to the species' population known or likely to be present in the study area, and combines two components:

- **Vulnerability** was determined using; IUCN global threat status (IUCN 2024); IUCN North African threat status (Garrido *et al.* 2021); Category 2 of Annex 3 of the Convention of Migratory Species (CMS), reflecting species considered to have an unfavourable conservation status at a regional level within the Range States and territories, and also the Species Vulnerability Index (SVI) for species, mainly soaring birds, where this has been assessed (BirdLife International 2018). The guidance and associated ratings used to assess vulnerability are summarised in Table 5;
- **Relative importance** for Migratory Soaring Birds (MSBs) is the proportion of the Rift Valley / Red Sea flyway population recorded in the study area, and for other migrants/wintering populations and for resident species the global breeding range. The scoring and associated ratings used to assess relative importance for (1) MSBs

and, (2) other migrants/wintering, and resident populations are summarized in Table 5 and Table 6 respectively. For the population recorded in the study area, this number was taken as the maximum count recorded in any season for any survey.

- The *sensitivity* of the species is subsequently assigned based on a matrix (Table 8) that accounts for the combined *vulnerability* and *relative importance* ratings for each species. Species with a negligible *sensitivity* did not progress to Step 3. Additionally, species where the estimated flyway population was <1% of the total estimated global population were discounted, to reflect the very low importance of the Rift Valley / Red Sea flyway population at a global level[6].

[6] This resulted in the exclusion of Eurasian Sparrowhawk and Oriental Honey Buzzard.

Table 5. Vulnerability rating criteria

Vulnerability	Migratory Soaring Birds (and other species where an SVI has been designated)	Other migrants and Resident species *
Negligible	• LC on IUCN Global Red List, and SVI of 6 or below	LC on IUCN Global Red List, or LC on North African Red List (for resident species)
Low	• VU or NT on IUCN Global Red List and SVI 6 or below; • LC on IUCN Global Red List and SVI of 7 or 8; or • CMS Category 2 Species and SVI of 6 or below	NT on IUCN Global Red List, or NT on North African Red List (for resident species)
Moderate	• VU or NT on IUCN "Global" Red List and SVI of 7 or 8; • LC on IUCN Global Red List and SVI of 9 or 10; or • CMS Category 2 Species and SVI of 7 or 8	VU on IUCN Global Red List, or VU on North African Red List (for resident species)
High	• CR or EN on IUCN Global Red List; • VU or NT on the IUCN Global Red List and SVI of 9 or 10; or • CMS Category 2 Species and SVI 9 or 10	CR or EN on IUCN Global Red List, or CR/EN on North African Red List (for resident species)
Note: * LC – Least Concern, NT – Near Threatened, VU – Vulnerable, EN – Endangered, CR – Critically Endangered		

Table 6. Relative importance rating for Migratory Soaring Birds

Relative Importance	Maximum total count for a species within a single season from any one project in the study area as a percentage of flyway population
Negligible	≤ 1%
Low	>1% and ≤ 5%
Moderate	>5% and ≤10%
High	>10%

Table 7. Relative importance rating for other migrants and resident species

Relative Importance	Global Extent of Occurrence (km2)
Negligible	>10,000,000
Low	>100,000 and <10,000,000
Moderate	>50,000 and <100,000
High	<50,000

Table 8. Sensitivity rating matrix

Sensitivity		Relative Importance			
		Negligible	Low	Moderate	High
Vulnerability	Negligible	Negligible	Negligible	Low	Low
	Low	Negligible	Low	Low	Medium
	Moderate	Low	Low	Medium	High
	High	Low	Medium	High	High

4.3.2 Results

Step 2 produced a list of 36 bird species with greater than negligible *sensitivity* (Table 9)[7], of which six were assessed as High sensitivity.

[7] Species that were initially rated above a negligible sensitivity (and were included in the list of 36 species) but were not carried through to Step 3 include the Oriental Honey-buzzard (*Pernis ptilorhynchus*) due to the low importance of the flyway, and Bateleur (*Terathopius ecaudatus*) and Golden Eagle (*Aquila chrysaetos*) as they are vagrants in the area. These three species are therefore not shown in Table 9.

Table 9. Rating at Step 2 for species with greater than negligible sensitivity

Species	Scientific name	Rating		
		Vulnerability	Relative importance	Sensitivity
Bar-tailed Godwit	*Limosa lapponica*	Low	Low	Low
Black Kite	*Milvus migrans*	Low	High	Medium
Black Stork	*Ciconia nigra*	Moderate	High	High
Black-winged Pratincole	*Glareola nordmanni*	Low	Low	Low
Bonelli's Eagle	*Aquila fasciata*	Moderate	Negligible	Low
Booted Eagle	*Hieraaetus pennatus*	Moderate	Moderate	Medium
Broad-billed Sandpiper	*Calidris falcinellus*	Moderate	Low	Low
Common Crane	*Grus grus*	Moderate	High	High
Curlew Sandpiper	*Calidris ferruginea*	Moderate	Low	Low
Cyprus Warbler	*Curruca melanothorax*	Negligible	High	Low
Cyprus Wheatear	*Oenanthe cypriaca*	Negligible	High	Low
Demoiselle Crane	*Anthropoides virgo*	Moderate	Negligible	Low
Eastern Imperial Eagle	*Aquila heliaca*	High	Low	Medium
Egyptian Vulture	*Neophron percnopterus*	High	Low	Medium
Eurasian Buzzard	*Buteo buteo*	Low	Low	Low
Eurasian Spoonbill	*Platalea leucorodia*	Low	Low	Low
European Honey-buzzard	*Pernis apivorus*	Low	Moderate	Low
European Turtle-dove	*Streptopelia turtur*	Moderate	Low	Low
Great White Pelican	*Pelecanus onocrotalus*	Moderate	High	High
Greater Spotted Eagle	*Clanga clanga*	High	Low	Medium
Grey Plover	*Pluvialis squatarola*	Moderate	Negligible	Low
Griffon Vulture	*Gyps fulvus*	Moderate	Negligible	Low
Lanner Falcon	*Falco biarmicus*	Low	Low	Low
Lesser Spotted Eagle	*Clanga pomarina*	Moderate	Low	Low
Levant Sparrowhawk	*Accipiter brevipes*	Low	High	Medium
Long-legged Buzzard	*Buteo rufinus*	Low	Low	Low

Species	Scientific name	Rating		
		Vulnerability	Relative importance	Sensitivity
Montagu's Harrier	*Circus pygargus*	Moderate	Negligible	Low
Pallid Harrier	*Circus macrourus*	Moderate	Low	Low
Saker Falcon	*Falco cherrug*	High	Negligible	Low
Short-toed Snake-eagle	*Circaetus gallicus*	Low	Low	Low
Sooty Falcon	*Falco concolor*	Low	Low	Low
Steppe Eagle	*Aquila nipalensis*	High	High	High
White Stork	*Ciconia ciconia*	Moderate	High	High

4.4 Step 3 – Conduct the ecological risk assessment and identify priority bird VECs

The purpose of Step 3 is to identify priority bird VECs from the 36 species populations scoped in at Step 2. This is done by combining each species' *sensitivity* score with an estimate of the *Likelihood of Effect* (LoE) which represents the site-specific risk, to identify those populations most at risk from adverse effects of the wind developments in the study area.

4.4.1 Methods

The LoE for each population was scored using three different collision risk components from the study area specific baseline dataset. The scores relate to; flight behaviour (component 1), abundance (component 2), and landing within the study area (component 3):

- **Component 1**. A matrix-derived score combining (i) the percent of individuals recorded flying below 200 m and (ii) the mean flock size (Table 10). This component is based on the reasoning that (i) those populations with a higher percentage of migrating individuals flying at approximately turbine rotor /powerline height (<200 m) will be at greater risk of collision, and (ii) populations with larger mean flock sizes will potentially have a higher risk of multiple fatality collision events. For each species population the proportion of individuals recorded flying below 200 m was calculated using the total number of individuals where flight height above/below 200 m was recorded[8]. Species with no data for calculating the percent of records <200 m, were scored as having 50% of records <200 m. Mean flock size was derived

[8] Due to the limited data from the Project site, flight height data were sourced from migration studies for the Suez Wind Energy (SWE) wind farm Plot 2, adjacent to this Project to the southeast (EcoConServ et al. 2023, 2024c, 2024d), and cross-checked against the limited data for this Project.

from the average flock sizes reported during each survey period: no weighting was applied as not all surveys covered the full migration period for all species, and flocking behaviour might vary throughout this period. Species with no data on mean flock size were conservatively scored as having a maximum flock size equal to the maximum count recorded in a season. For species with values for both percent of individuals below 200 m and mean flock size, the resulting matrix score was increased by one for those species with variability (taken as the standard deviation of all reported values for that species) greater than the median for all species percentage of flights <200 m. This additional precautionary step was added to account for situations where flight height behaviour was very variable and the average percent below 200 m was potentially less informative as a risk predictor;

- **Component 2**. A score based on the maximum total count for a species within a single season from any one project in the study area (Table 11) to reflect the reasoning that species with higher counts in the study area are more likely to be affected by wind developments; and,
- **Component 3**. A score to indicate whether a species had been recorded on the ground within the study area, irrespective of the numbers of individuals involved (species with records of landing scored 1, those without 0). Those species recorded on the ground must pass through the collision risk zone and hence are at greater risk of collision than those species for which landing on the ground has not been recorded.

Table 10. Matrix for scoring mean flock size and % of flights less than 200 m for each species.

Mean flock size	% of flights <200m			
	0-25	25-50	50-75	75-100
<10	1	1	2	2
10-50	1	2	2	3
50-100	2	2	3	4
>100	2	3	4	4

These three components were summed to arrive at a final LoE score for each species (theoretical range 2-10), which was separated into quartiles to derive a LoE rating for that species (Table 12). This LoE rating was then combined with the *sensitivity* rating from Step 2 to derive an *overall risk* rating (Table 13). Species which had an *overall risk* of major or moderate were considered priority bird VECs for the study area.

Table 11. Score categories for the maximum seasonal counts for a species in the study area.

Maximum season count	
Range	**Score**
0 to 10	1
10 to 1000	2
1000 to 10000	3
> 10000	4

Table 12. LoE rating based on overall score for each species evaluated at Step 3

LoE	
Overall score (based on quartiles)	**Level of Effect**
≤2	Negligible
>2 and ≤4	Low
>4 and ≤6	Medium
>6	High

Table 13. Overall project risk matrix

Overall risk	**Likelihood of effect**			
Sensitivity	**Negligible**	**Low**	**Medium**	**High**
Low	Negligible	Minor	Minor	Moderate
Medium	Minor	Minor	Moderate	Major
High	Minor	Moderate	Major	Major

4.4.2 Results

Step 3 identified 10 species with an *overall risk* of major or moderate from the project, and these species are considered priority bird VECs for this analysis (Table 14)[9]. Therefore, the total list of 214 potential VECs has been filtered to 10 species (Table 15), which add to the CH and PBF qualifying species identified in the CHA (TBC 2026, see table 2 and 3). All CH-qualifying bird species are also priority bird VECs. There are an additional four priority bird VECs that do not qualify as CH (Black Kite, Common Crane, Eurasian Buzzard and Greater Spotted Eagle) (see Table 16).

[9] Note that this list is derived from existing reports and a desk-top analysis. No in-country expert consultation has been carried out for this rapid assessment. Local stakeholder review may identify additional species of particular concern, or provide additional data which could affect the findings.

Table 14. Details of scores and ratings allocated to the 10 species identified as priority bird VECs

Species	Scientific name	Category	Red List status	CMS Category 2	SVI	Vulnerability	Highest count	Flyway population	% of UoA	Relative importance	Sensitivity	% flights <200m	Mean flock size	Highest count	Landing in Area	LoE	Overall risk
Black Kite	*Milvus migrans*	1	LC	No	8	Low	27,662	132,700	21	High	*Medium*	59	14	27,662	Yes	*High*	*Major*
Black Stork	*Ciconia nigra*	1	LC	No	10	Moderate	2,693	19,500	14	High	*High*	62	19	2,693	Yes	*Medium*	*Major*
Common Crane	*Grus grus*	1	LC	No	10	Moderate	14,844	35,000	42	High	*High*	1	186	14,844	Yes	*High*	*Major*
Eurasian Buzzard	*Buteo buteo*	1	LC	No	7	Low	43,302	1,250,000	3	Low	*Low*	60	118	43,302	Yes	*High*	*Moderate*
European Honey-buzzard	*Pernis apivorus*	1	LC	No	7	Low	96,898	1,000,000	10	Moderate	*Low*	51	86	96,898	Yes	*High*	*Moderate*
Great White Pelican	*Pelecanus onocrotalus*	1	LC	No	10	Moderate	51,840	70,000	74	High	*High*	71	308	51,840	Yes	*High*	*Major*
Greater Spotted Eagle	*Clanga clanga*	1	VU	No	9	High	39	2,180	1.8	Low	*Medium*	81	26	39	No	*Medium*	*Moderate*
Levant Sparrowhawk	*Accipiter brevipes*	1	LC	Yes	6	Low	28,120	75,000	37	High	*Medium*	60	415	28,120	No	*High*	*Major*
Steppe Eagle	*Aquila nipalensis*	1	EN	No	9	High	13,104	37,500	35	High	*High*	53	11	13,104	No	*Medium*	*Major*
White Stork	*Ciconia ciconia*	1	LC	No	10	Moderate	445,794	450,000	99	High	*High*	71	730	445,794	Yes	*High*	*Major*

Table 15. Scoping of species populations in steps 1 to 3 of the Cumulative Effects Analysis

Group	Number of species		
	Step 1	Step 2	Step 3
All birds	**214**	**36**	**10**
Category 1: Migratory Soaring Birds	33	25	10
Category 2: Other migrants and wintering species	158	8	0
Category 3: Resident species	23	3	0
Filtered out	-	*178*	*204*

4.5 Step 4 – The threshold setting process

This step establishes a fatality threshold for each priority bird VEC from wind farm impacts, being the point at which further losses would be a risk to long-term viability of the population. Exceeding threshold values triggers a requirement for adaptive management, and this will lead to a review of wind farm operations and improvements to mitigation measures.

Species with a global IUCN status of EN or CR were automatically assigned a threshold of zero (see Table 16) as existing losses are already likely to have exceeded the level which would pose a risk to long-term viability of the population. For all other species (LC, NT, VU), thresholds were assessed relative to the population size determined by their UoA, which was the Red Sea / Rift Valley flyway population for all species.

4.5.1 Methods

Stage 1: For each priority VEC (that is not globally EN or CR), the Potential Biological Removal (PBR) value was calculated, representing the annual number of fatalities that could be sustained without compromising long-term population viability. This precautionary approach is appropriate where there is only limited information on a species' population biology and uses species-specific rates of adult survival rate and year of first breeding to calculate an annual rate of human-caused mortality that, in the long term, would likely lead to a nonviable population. The PBR is calculated as:

$$PBR = \frac{1}{2} R_{max}\, N_{min} f$$

Where:

R_{max} is the annual recruitment rate, which can be calculated from the maximum annual population growth rate via $R_{max} = Y_{max} - 1$. Y_{max} is calculated as:

$$Y_{max} = \frac{(sa - s + a + 1) + \sqrt{(s - sa - a - 1)^2 - 4sa^2}}{2a}$$

with s as the mean annual adult survival and a as the mean age at first breeding (Niel & Lebreton 2005). Information on s and a were sought for each priority VEC, however where this was not available, parameters from a closely-related surrogate species were used (Table 16).

N_{min} is a conservative estimate of population size, and is calculated as:

$$N_{min} = \hat{N}e^{(Z_p CV_{\hat{N}})}$$

with $\hat{N}$ as the population estimate from the UoA, Z_p as the p^{th} standard normal variate (set at -0.842) and $CV_{\hat{N}}$ is the coefficient of variation for $\hat{N}$ (set at 10%) (Wade 1998; Dillingham & Fletcher 2008) ; and,

f is the recovery factor, applied as per Dillingham and Fletcher (2008), with f = 0.5 for LC species, 0.3 for VU species and 0.1 for CR or EN species.

Stage 2: The PBR values provide an indication of the potential significance of additional impacts, and were not used to set the thresholds, but rather to assign the species into management categories. Species with a PBR <1,000 were assigned to Category 1, with a PBR 1,000-10,000 were assigned to Category 2 and those with a PBR >10,000 were assigned to Category 3 (Table 16). The rationale behind the categorisation is that for the species with the lowest PBRs any additional impact will have a population-level effect, while those with higher PBRs can cope with some additional mortality.

Potential stakeholder concerns, and the project aim of Net Gain / No Net Loss, have also been considered in setting the thresholds and result in conservative thresholds well below the PBR.

4.5.1.1 Thresholds

During operations, the Project will undertake systematic fatality monitoring at all turbines and along all OHTL within the project concession. Each confirmed priority-species fatality will be reported and investigated promptly according to instructions in the Biodiversity Action Plan (BAP)/Biodiversity Monitoring Plan (BMP). Corrected PCFM results will be reported after each migration season and consolidated annually for comparison with the applicable thresholds.

The annual thresholds for each species have been set as follows:

- Zero fatalities
  - Category 1 species
  - All priority VECs, CHA and PBF species with a global conservation status EN or CR

    - Precautionarily, all species with zero threshold in neighbouring projects, as a result of their Cumulative Effects Assessment.
- Three fatalities
    - Category 2 species (unless listed above)
- Five fatalities
    - Category 3 species (unless listed above)

An additional threshold for 'extreme events' is defined as a single fatality event of >5 individuals, irrespective of the priority species involved. Exceedance of this threshold would trigger an adaptive management response.

4.5.2 Results

4.5.2.1 Thresholds for priority VECs

One globally EN priority VEC (also CH-qualifying), the Steppe Eagle, was automatically assigned a fatality threshold of zero (see Table 16). One other priority VEC, the Greater Spotted Eagle, was assigned a fatality threshold of zero based on PBR value, along with an additional three species (Black Stork, Common Crane and Great White Pelican) that were assigned a threshold of zero to align with the CEAs of neighbouring projects. For these species, adaptive management actions are required if any fatalities are recorded. Two species were assigned to Category 2 (threshold of 3) and three species to Category 3 (threshold of 5). Species-specific PBR values ranged from 44 (Greater Spotted Eagle) to approximately 43,700 (Eurasian Steppe Buzzard) (Table 16).

4.5.2.2 Thresholds for CH-qualifying species

The six species considered as CH-qualifying (as identified in the CHA: TBC 2026) were also considered priority VECs and were assigned thresholds to inform adaptive management. Thresholds for these species were developed following the same approach as described above for the priority VECs. This led to the Steppe Eagle, Black Stork and Great White Pelican being automatically assigned a zero fatality threshold, the Levant Sparrowhawk being assigned a fatality threshold of three and the European Honey-buzzard and White Stork being assigned a fatality threshold of five.

4.5.2.3 Thresholds for PBFs

Thresholds for the additional PBFs (as identified in the CHA: TBC 2026) were developed following the same approach as for priority VECs and CH-qualifying species. The globally EN Egyptian Vulture was automatically assigned a zero fatality threshold, and an additional seven PBFs were assigned a zero fatality threshold based on PBR values. The remaining species were assigned thresholds of either three or five based on PBR values.

Table 16. Input parameters, sources and results for the calculation of the fatality threshold for each bird VEC, CH-qualifying species and PBF.

Species	Scientific name	Unit of analysis	Flyway population	Red List status	Recovery factor	Mean adult survival	Mean age at first breeding	Source for demographic parameters	PBR value	Threshold category	Fatality threshold
Priority VECs and CH-qualifying species (in bold)											
Black Kite	*Milvus migrans*	Red Sea / Rift Valley flyway	132,700	LC	0.5	0.96	4	_[10]	2,626	2	3
Black Stork	***Ciconia nigra***		19,500	LC	0.5	0.838	3	Tamás (2011) in eastern Europe	1,804	2	0[11]
Common Crane	*Grus grus*		35,000	LC	0.5	0.90	4	Mathews and Macdonald (2000) in the UK	1,005	2	0[11]
Eurasian Buzzard	*Buteo buteo*		1,250,000	LC	0.5	0.90	3	Kenward et al. (2000) in the UK	43,739	3	5
European Honey-buzzard	***Pernis apivorus***		1,000,000	LC	0.5	0.86	3	BTO (2018a) for adult survival, and Jais (2018) for age at first breeding	40,066	3	5
Great White Pelican	***Pelecanus onocrotalus***		70,000	LC	0.5	0.78	3	_[12]	3,334	2	0[11]
Greater Spotted Eagle	*Clanga clanga*		2,180	VU	0.3	0.85	4	Bird *et al.* (2020)	44	1	0
Levant Sparrowhawk	***Accipiter brevipes***		75,000	LC	0.5	0.69	1	_[13]	9,597	2	3
Steppe Eagle	***Aquila nipalensis***		37,500	EN	Globally Endangered						0
White Stork	***Ciconia ciconia***		450,000	LC	0.5	0.78	3	Barbraud *et al.* (1999) in France	21,430	3	5
PBFs											
Egyptian Vulture	*Neophron percnopterus*		4,535	EN	Globally Endangered						0
Booted Eagle	*Hieraaetus pennatus*		3,169	LC	0.5	0.96	4	_[14]	63	1	0
Common Kestrel	*Falco tinnunculus*		325,000	LC	0.5	0.69	1.37	Bird *et al.* (2020)	32,763	3	5

[10] No demographic parameters exist for Black Kite, so information from Red Kite (Newton et al. 1989) was used as a surrogate

[11] Precautionarily attributed a zero-threshold since this threshold had been attributed before for a neighbouring project applying a similar methodology (ECOConsult *et al.* 2023)

[12] No demographic parameters exist for Great White Pelican, so information from American Brown Pelican (Walter *et al.* 2013) was used as a surrogate

[13] No demographic parameters exist for Levant Sparrowhawk, so information from Eurasian Sparrowhawk (BTO 2018b) was used as a surrogate

[14] No demographic parameters exist for Booted Eagle, so information from Red Kite (Newton et al. 1989) was used as a surrogate, as per IFC (2017)

Species	Scientific name	Unit of analysis	Flyway population	Red List status	Recovery factor	Mean adult survival	Mean age at first breeding	Source for demographic parameters	PBR value	Threshold category	Fatality threshold
Eastern Imperial Eagle	*Aquila heliaca*	Red Sea / Rift Valley flyway	2,125	VU	0.3	0.87	4.5	Bird et al. (2020)	70	1	0
Eurasian Sparrowhawk	*Accipiter nisus*		4,000	LC	0.5	0.65	2	Bird *et al.* (2020)	312	1	0
Lesser Spotted Eagle	*Clanga pomarina*		50,000	LC	0.5	0.92	5	Meyberg *et al.* (2005) in Germany and Slovakia, Väli & Bergmanis (2017) in Baltic Europe	1,132	2	3
Long-legged Buzzard	*Buteo rufinus*		21,750	LC	0.5	0.83	2.5	Bird et al. (2020)	1,087	2	3
Montagu's Harrier	*Circus pygargus*		50,500	LC	0.5	0.72	2.5	Bird et al. (2020)	3,029	2	3
Osprey	*Pandion haliaetus*		17,500	LC	0.5	0.83	3	Bird et al. (2020)	736	1	0
Pallid Harrier	*Circus macrourus*		1,505	NT	0.3	0.71	2.5	Bird *et al.* (2020)	55	1	0
Short-toed Snake-Eagle	*Circaetus gallicus*		8,783	LC	0.5	0.86	4	Bird *et al.* (2020)	283	1	0
Sooty Falcon	*Falco concolor*		2,800	VU	0.3	0.68	1.6	Bird *et al.* (2020)	148	1	0
Western Marsh-harrier	*Circus aeruginosus*		96,843	LC	0.5	0.74	2.6	Bird *et al.* (2020)	5,500	2	3

4.5.3 Adaptive management

The Project will implement a robust Post Construction Fatality Monitoring (PCFM, refer to the BAP). The observed bird fatalities will be corrected with GenEst following good international practice (IFC *et al.* 2023) and compared with the fatality thresholds. As fatalities may vary significantly among years, mortality thresholds will be assessed using average annual mortality estimates derived from multiple years of monitoring. This allows for rare mortality events without necessarily triggering adaptive management or, in extreme cases, the need for offsets (Frick *et al.* 2026).

Adaptive-management thresholds will be applied using the average annual mortality estimated from PCFM data over the first three years of operation (Years 1-3). From Year 4 onwards, mortality thresholds will be assessed using the average annual mortality across all operational years to date. If the average annual mortality exceeds the adaptive-management threshold for any species, additional mitigation or operational adjustments will be implemented.

Exceeding thresholds should trigger a set of clear sequential actions. Specifically:

- Review the threshold value to establish if NNL compliance has been compromised or if the threshold has been set to trigger an adaptive management review;
- Conduct a review to determine the reasons why fatalities occurred;
- Review effectiveness of existing mitigation;
- Update and implement an optimized mitigation strategy based on findings from the mitigation review; and
- Design and implement a credible offset strategy for species populations where NNL compliance has been compromised.

Possible mitigation improvements may include extending shutdown on demand coverage periods; increasing or strategically reallocating observers; refresher observer training; and reviewing and optimising the existing radar system and its integration with observer alerts and turbine-shutdown decisions.

If improved mitigation proves insufficient, offsets or additional conservation actions may need to be considered to compensate for any losses above the thresholds.

An additional element of adaptive management is the periodic review of the CEA. This is necessary because increased information from the study area and from elsewhere along the flyway alter the level of risk to priority bird VECs or result in the identification of new priority species. Such information may include changes in species' Red List status, improved flyway population estimates, updated study area data (and therefore revised estimates of the proportion of flyway populations passing through the project area of influence), and improved understanding of the likelihood and magnitude of Project impacts. Additionally, for the non-soaring migratory bird PBFs that do not currently have fatality thresholds set, if significant mortality is detected of any of these species at any point during operation, stakeholders should be consulted and a decision should be made to define fatality thresholds for the relevant species, triggering a revision of the CEA.

In addition, a regional SESA and CIA is currently being undertaken for the entire Gulf of Suez region. This SESA will address external stressors which are challenging to estimate at this stage (poisoning, illegal hunting and falconry, mortality from other wind farms and powerlines, etc.) The results of this assessment which are expected to be available before the end of 2026, may influence both the selection of bird VECs and especially a revision of mortality thresholds. The new regional SESA is expected to provide guidance regarding mitigation for all projects operating in the region.

4.6 Step 5 – Identify a mitigation and monitoring approach for priority bird VECs

Section 7 presents the broad mitigation and monitoring actions that the Project will undertake or support to address their contribution to the cumulative effects from wind farm developments to priority bird VECs.

5 The Cumulative Assessment framework for other vertebrates

5.1 Overview of the framework for other terrestrial species

The assessment framework for vertebrate species (i.e. mammals and reptiles) has two objectives: to identify species at highest risk from the potential cumulative effects of developments in the study area, and to propose mitigation, monitoring and other management activities if species are identified to be at risk. This framework comprises a four-step process (Figure 4):

- **Step 1:** Develop a preliminary list of mammal and reptile species potentially at risk from developments in the study area, because they are known or predicted to occur in the study area (see Section 5.2);
- **Step 2:** Determine the relative *sensitivity* of each species, being a combination of the following:
    a. *Vulnerability* of the species; and
    b. *Relative Importance* of the species in relation to the appropriate UoA, i.e. the extent of occurrence (EOO) for each terrestrial species within Egyptian national boundaries (see Section 5.3).

Species which were determined to have negligible *sensitivity* were dropped from analysis before proceeding to Step 3.

- **Step 3:** Determine the *overall risk* to each species from the cumulative effects of wind farm developments within the study area, being a combination of the:
    c. *Sensitivity* of the species, as identified in Step 2; and
    d. Cumulative *likelihood of effect* (LoE) rating for each species (see Section 5.4).

Species with an *overall risk* of Major or Moderate were considered as priority VECs for the project.

- **Step 4:** Propose a range of mitigation, monitoring and management actions for priority mammal and reptile VECs to, if necessary, minimise collision risk for bats, habitat loss for other terrestrial vertebrates, and to inform any adaptive management responses (see Section 0).

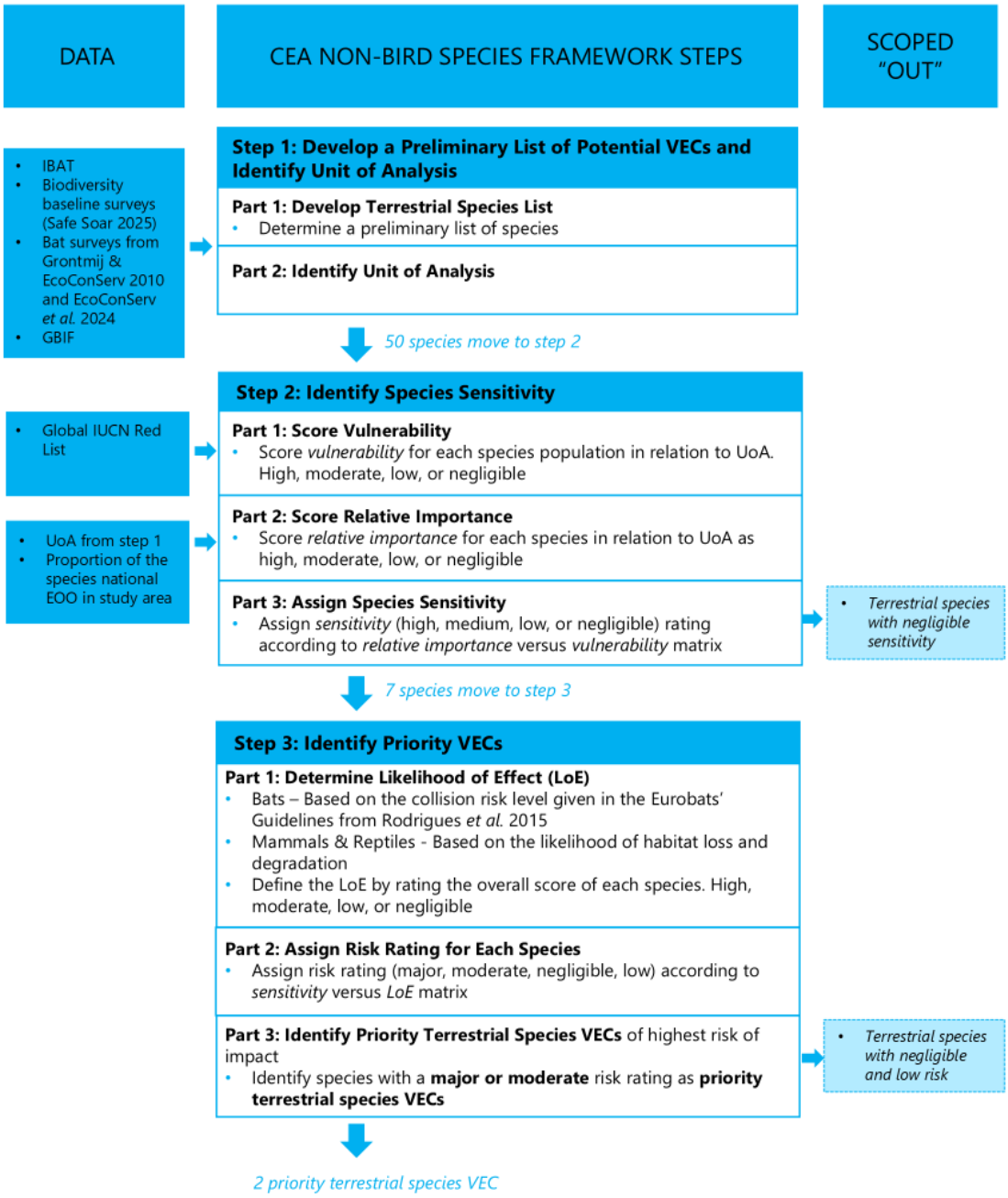

Figure 4. Process to identify priority non-bird species VECs

5.2 Step 1 – Develop the non-bird species list and identify the Unit of Analysis

The purpose of Step 1 is to identify all non-bird vertebrate species that could potentially be at risk from the cumulative effects of impacts from actions in the study area and to determine a relevant UoA by which any effects on each species should be considered.

5.2.1 Methods

A list of mammal and reptile species predicted to be present in the study area were extracted from IBAT and supplemented with any additional mammal/reptile species recorded in the area on GBIF. For bats, the list was cross-checked with species listed in the field surveys for the nearby SWE site and the Italgen Gabal El-Zeit 320 MW EIA study in 2010 (Grontmij & EcoConServ 2010; EcoConServ *et al.* 2024e).

The UoA was identified based on a review of any available information on terrestrial species populations in Egypt and the wider Middle East region. The UoA identified for mammals and reptile species was the species' Extent of Occurrence (EOO) within Egyptian national boundaries, based on IUCN global species distribution maps (IUCN 2024). Due to limited baseline data, no population estimates of any species known or likely to occur in the study area could be derived for the purpose of this analysis. Therefore, terrestrial species EOO in Egypt served as the best available information to be used for this study.

5.2.2 Results

A list of 23 mammal species and 27 reptile species was identified as occurring, or potentially occurring in the study area.

5.3 Step 2 – Identify species sensitivity

The purpose of Step 2 is to determine the *sensitivity* of each species identified in Step 1 based on its *vulnerability* at the international and regional scale and the *relative importance* of the study area to the species.

5.3.1 Methods

The *sensitivity* of each species takes into account a combination of two components:

- **Vulnerability** of the species using IUCN threat categories (IUCN 2024) and, for mammals, the National (Egyptian) threat categories (Basuony *et al.* 2010). The rating system is summarised in Table 17.
- **Relative importance** of the study area in relation to the UoA was identified for each species. This was calculated using the equation below with the rating system summarised in Table 18

$$\frac{Species\ EOO\ in\ study\ area}{Species\ EOO\ in\ Egypt\ (UoA)} \times 100 = Relative\ Importance\ (\%)$$

The range of three bat species, the Botta's Serotine (*Eptesicus bottae*), Desert Pipistrelle (*Hypsugo ariel*) and Rüppel's Pipistrelle (*Pipistrellus rueppellii*), were not predicted to overlap with the study area from the IBAT consultation. However, bat surveys in the region (TBC unpub. data.) have indicated that these species can possibly be found within the study area. Since the IUCN range map is clearly underestimating these species range in Egypt, the equation above was not used and the study area was considered as having a low relative importance. If new data regarding the actual distribution of these species in Egypt becomes available, this classification may need to be updated.

The *sensitivity* of the species was subsequently assigned based on a matrix (Table 19) that accounts for the combined *vulnerability* and *relative importance* ratings for each species. Terrestrial species with a negligible sensitivity did not progress to Step 3.

Table 17. Vulnerability rating criteria for non-bird vertebrate species

Vulnerability	IUCN Global Red List of Threatened Species*
Negligible	LC on IUCN Global Red List, or LC on the National Red List of mammals
Low	NT or DD on IUCN Global Red List, or NT on the National Red List of mammals
Moderate	VU on IUCN Global Red List, or VU on the National Red List of mammals
High	CR or EN on IUCN Global Red List, or CR/EN on the National Red List of mammals
* LC – Least Concern, NT – Near Threatened, VU – Vulnerable, EN – Endangered, CR – Critically Endangered	

Table 18. Relative importance rating criteria for non-bird vertebrate species

Relative Importance	Percentage of Species EOO present within Study Area
Negligible	≤ 1%
Low	>1% and ≤ 5%
Moderate	>5% and ≤10%
High	>10%

Table 19. Sensitivity matrix for non-bird vertebrate species

Sensitivity		Relative Importance			
		Negligible	**Low**	**Moderate**	**High**
Vulnerability	**Negligible**	Negligible	Negligible	Low	Low
	Low	Negligible	Low	Low	Medium
	Moderate	Low	Low	Medium	High
	High	Low	Medium	High	High

5.3.2 Results

Of the 50 species analysed in Step 2, one species has a *sensitivity* rating of medium, and six species had a *sensitivity* rating of low (Table 20). All other mammal and reptile species had a negligible rating and are not considered in subsequent steps (Appendix 2).

*Table 20. Summary of rankings assigned at Step 2 for terrestrial species with a ranking above negligible. *range of these bat species in Egypt is considered to be underestimated[15], so the Relative importance was not calculated as a result of the % of the range in the study area, but considered to be low*

Species	Scientific name	Vulnerability			Relative importance				Sensitivity
		IUCN Red List	National Red List	Score	Egyptian range (km²)	Study area (km²)	% of range in study area	Score	
Botta's Serotine	*Eptesicus bottae*	LC	VU	Moderate	16,200	6801	42*	Low	Low
Desert Pipistrelle	*Hypsugo ariel*	DD	VU	Moderate	14,100	6801	48*	Low	Low
Rüppel's Pipistrelle	*Pipistrellus rueppellii*	LC	VU	Moderate	250,005	6801	2.7	Low	Low
Greater Mouse-tailed Bat	*Rhinopoma microphyllum*	LC	VU	Moderate	608,347	6801	1.1	Low	Low
Rough Bent-toed Gecko	*Cyrtopodion scabrum*	LC	-	Negligible	21,183	6801	32	High	Low
Desert agama	*Trapelus mutabilis*	LC	-	Negligible	109,133	6801	6.2	Moderate	Low
Egyptian Spiny-tailed Lizard	*Uromastyx aegyptia*	VU	-	Moderate	130,082	6801	5.2	Moderate	Medium

[15] The IUCN Red List range maps for Botta's Serotine and Desert Pipistrelle do not include the Gulf of Suez coast. In Egypt, Botta's Serotine is mapped only in the Nile Delta, while Desert Pipistrelle is mapped in South Sinai and as possibly extant in the Gebel Elba region near the Sudanese border. These mapped distributions therefore indicate relatively restricted national ranges. However, the confirmed occurrence of both species within the Project area, together with the limited availability of bat field studies and published records from Egypt, suggests that their national distributions may be substantially broader than currently represented on the IUCN Red List maps.

Table 21. Details of scores allocated to the non-bird vertebrate species identified as priority terrestrial species VECs

Species	Scientific name	Sensitivity	Collision risk	LoE	Overall risk
Botta's Serotine	*Eptesicus bottae*	Low	Medium	Medium	Minor
Desert Pipistrelle	*Hypsugo ariel*	Low	High	High	Moderate
Rüppel's Pipistrelle	*Pipistrellus rueppellii*	Low	High	High	Moderate
Greater Mouse-tailed Bat	*Rhinopoma microphyllum*	Low	Unknown	Low	Minor
Rough Bent-toed Gecko	*Cyrtopodion scabrum*	Low	NA	Low	Minor
Desert agama	*Trapelus mutabilis*	Low	NA	Low	Minor
Egyptian Spiny-tailed Lizard	*Uromastyx aegyptia*	Medium	NA	Low	Minor

5.4 Step 3 – Conduct the ecological risk assessment and identify priority non-bird vertebrate species VECs

The purpose of Step 3 is to identify priority non-bird vertebrate species VECs from the seven species carried through from Step 2, i.e. the four bat species (Botta's Serotine, Desert Pipistrelle, Rüppel's Pipistrelle, Greater Mouse-tailed Bat) and three reptile species (Rough Bent-toed Gecko, Desert agama and Egyptian Spiny–tailed Lizard). This was carried out by combining each species' *sensitivity* rating with an estimate of site-specific risk, i.e. the *Likelihood of effect* (LoE), to identify species that were most at risk from potential adverse effects of the wind developments in the study area.

5.4.1 Methods

5.4.1.1 LoE for bat species

The LoE for each bat species was identified using the level of collision risk in Eurobats' *Guidelines for consideration of bats in wind farm projects – Revision 2014* (Rodrigues *et al.* 2015) (Table 22) and further informed by global collision rates given in Thaxter *et. al* (2017), as there was no available information on the collision risk of bat species in the study area. or at the country or regional level.

5.4.1.2 LoE for terrestrial species

The LoE for the three reptiles was based on the likelihood of habitat loss and degradation occurring from the cumulative effects of the potential wind farm developments in the study area (Table 23). The LoE rating was decided based on expert knowledge of the CEA team on the likely effects that are expected to occur from these developments.

5.4.1.3 Overall risk rating for non-birds

The LoE rating was then combined with the *sensitivity* rating from Step 2 to derive an *overall risk* rating (Table 24). Species which had an *overall risk* of major or moderate were considered priority VECs for the study area.

Table 22. LoE rating criteria for bat species

LoE Rating	Level of Bat Collision Risk (based on Eurobats' Guideline)
Negligible	Species and/or genus with low level of collision risk
Low	Species and/or genus with unknown level of collision risk
Medium	Species and/or genus with medium level of collision risk
High	Species and/or genus with high level of collision risk

Table 23. LoE rating criteria for terrestrial species

LoE Rating	Criteria
Negligible	Negligible risk from habitat loss and degradation due to the cumulative effects of the developments.
Low	Low risk from habitat loss and degradation due to the cumulative effects of the developments.
Medium	Medium risk from habitat loss and degradation due to the cumulative effects of the developments.
High	High risk from habitat loss and degradation due to the cumulative effects of the developments.

Table 24. Overall project risk matrix for non-bird vertebrate species

Overall risk		LoE			
		Negligible	Low	Medium	High
Sensitivity	Low	Negligible	Minor	Minor	Moderate
	Medium	Minor	Minor	Moderate	Major
	High	Minor	Moderate	Major	Major

5.4.2 Results

Of the seven non-bird species carried through from Step 2, the Desert Pipistrelle and Rüppel's Pipistrelle are identified as having on *overall risk* rating of Moderate (Table 19). These two bat species are considered priority VECs for the study area. The presence of these bat species is yet to be confirmed in the Project area, as bat surveys have not been conducted for the Project to data. Continued monitoring of bats through Post-Construction Fatality Monitoring (PCFM) is required to assess impacts.

The remaining five species are identified as having an *overall risk* rating of Minor and are not considered priority VECs.

5.5 Step 4 – Identify a potential mitigation and monitoring approach for priority terrestrial VECs

The broad mitigation and monitoring actions that Alcazar Energy will undertake or support to address their contribution to the cumulative effects from wind farm developments to priority terrestrial species VECs, is presented in Section 7.

6 The Cumulative Assessment for ecosystems

A qualitative approach to identifying priority ecosystem VECs has been followed as data on land cover in the study area is limited and a quantitative approach was not feasible. Additionally, there has been no Red List Assessment of Ecosystems within Egypt. In this context, the approach was to review what features in the landscape are likely to be valued as important for supporting the biodiversity of the region.

The study area is not considered to contain particularly unique or highly threatened ecosystems (discussed further in the CHA: TBC 2026). The Project area lies in the Red Sea Coastal Desert Ecoregion (Dinerstein *et al.* 2017) in an area of sand and gravel plains crossed by several shallow wadis, consisting primarily of bare ground with very scattered low-growing vegetation. No caves (potential bat roosting sites) have been identified in the Project area (AL AMAR Consulting Group & Energy & Environment Consultant (E&E) 2008).

Vegetation in the eastern desert region, in which the Project occurs, is largely restricted to salt marshes (sabkhas, which do not occur in the Project area itself) and wadis (AL AMAR Consulting Group & Energy & Environment Consultant (E&E) 2008; Ministry State of Environment Affairs 2014). Wadis with permanent vegetation are known to have biodiversity value in their own right, and are also known to support mammal and reptile species in the region (EcoConsult & Safe Soar 2025). They are also of potential importance for other priority VECs, e.g. bats are likely to use wadis for foraging when they flood intermittently with water (Korine *et al.* 2016). Wadis with permanent vegetation are therefore considered a priority ecosystem VEC.

7 The mitigation and monitoring approach for priority VECs

All species and other values considered VECs for the Project will require mitigation and monitoring actions to be adopted by Alcazar Energy for the Project, as well as actions that address the Project's contribution to the cumulative effects to priority VECs from wind farm developments in the study area. These mitigation and monitoring actions focus on the VECs, as identified in this document, and will also deliver benefits for other bird species migrating through the wind farms. In all cases, mitigation and monitoring actions should follow Good International Industry Practice (GIIP) and will be captured in a Project specific Biodiversity Action Plan (BAP), which should be operationalised through a Biodiversity Management Plan (BMP). The mitigation and monitoring approach will focus on two areas:

- **On-site mitigation and monitoring methods,** to minimise collision risk, validate the effectiveness of the proposed mitigation methods once they have been implemented, allow estimation of residual impacts and provide information to allow adaptive management of the monitoring and mitigation implemented; and,
- **Collaborative efforts with other wind farm entities,** to minimise the cumulative effects of all the proposed wind farm developments in the study area.

By adopting the proposed approach, Alcazar Energy will be able to reduce its impact as far as practicable for the identified VECs, adhering to an approach that will facilitate alignment with PS6/ESR6/ESS4, and particularly be pursuing a goal of Net Gain and No Net Loss as appropriate. By doing this, Alcazar Energy sets a benchmark for other wind projects in the study area and provides an example of successful best-practice implementation for others to follow.

8 Next steps

To maximise the effectiveness of this CEA, the following actions should be undertaken:

1. Publicly disclose the CEA.
2. Develop a BAP detailing the mitigation strategy for the Project to achieve NNL and NG for the relevant biodiversity values.
3. Develop a BMP to operationalise the BAP, providing a clear set of actions with detailed roles and responsibilities, timeline and key performance indicators.

9 References

AL AMAR Consulting Group & Energy & Environment Consultant (E&E) (2008) Gulf of El Zayt 220 MWe Wind Power Plant Project – Environmental and Social Impact Assessment (Executive Summary). JICA; NREA, Egypt.

Baha El Din, S. (2019a) Shutdown on Demand and Bird Monitoring at FIEM Wind Farm – Spring 2019. Environics; NREA, Egypt.

Baha El Din, S. (2019b) Shutdown on Demand and Bird Monitoring at FIEM Wind Farm – Autumn 2019. Environics; NREA, Egypt.

Barbraud, C., Barbraud, J.-C. & Barbraud, M. (1999) Population dynamics of the White Stork *Ciconia ciconia* in western France. *Ibis* 141: 469–479.

Basuony, M.I., Gilbert, F. & Zalat, S. (2010) Mammals of Egypt. Atlas, red data listing and conservation.

Bennun, L., Fletcher, C., Cook, A., Wilson, D., Jobson, B., Asante-Owusu, R., Dakmejian, A. & Liu, Q. (2024) *Guidance on biodiversity cumulative impact assessment for wind and solar developments and associated infrastructure*. IUCN, International Union for Conservation of Nature.

Bennun, L., van Bochove, J., Ng, C., Fletcher, C., Wilson, D., Phair, N. & Carbone, G. (2021) *Mitigating biodiversity impacts associated with solar and wind energy development*. IUCN International Union for Conservation of Nature and The Biodiversity Consultancy, Gland, Switzerland and Cambridge, UK.

Bird, J.P., Martin, R., Akçakaya, H.R., Gilroy, J., Burfield, I.J., Garnett, S.T., Symes, A., Taylor, J., Şekercioğlu, Ç.H. & Butchart, S.H.M. (2020) Generation lengths of the world's birds and their implications for extinction risk. *Conservation Biology* 34: 1252–1261.

BirdLife International (2015) BirdLife is working to mainstream soaring bird conservation along the Rift Valley/Red Sea flyway. https://datazone.birdlife.org/birdlife-is-working-to-mainstream-soaring-bird-conservation-along-the-rift-valley/red-sea-flyway

BirdLife International (2018) The Migratory Soaring Birds project. http://migratorysoaringbirds.undp.birdlife.org/

BirdLife International (2023) Migratory Soaring Birds Tool V3. https://maps.birdlife.org/MSBtool/

BirdLife International (2024a) Important Bird Area factsheet: Gebel El Zeit. https://datazone.birdlife.org/site/factsheet/gebel-el-zeit-iba-egypt

BirdLife International (2024b) IUCN Red List for birds. Downloaded from https://datazone.birdlife.org/species/search on 12/11/2024.

BTO (2018a) BTO BirdFacts | European Honey-buzzard. https://app.bto.org/birdfacts/results/bob2310.htm

BTO (2018b) BTO BirdFacts | Eurasian Sparrowhawk. https://app.bto.org/birdfacts/results/bob2690.htm

Camina, A., Ceballos, P. & Vicente, N. (2024) Migration of Soaring Birds at Gebel el Zeit (IBA) in relation to wind energy developments (Report for EcoConsult on behalf of RCREEE). ACRENASL, Madrid, Spain.

Camina, A., Vicente, N., Martin, J. & Garrido, J.R. (2025) Gebel El Zeit WPP and IBA: Due Diligence - Wind farm operation and MSBs conservation. ACRENASL.

Dillingham, P. & Fletcher, D. (2008) Estimating the ability of birds to sustain additional human-caused mortalities using a simple decision rule and allometric relationships. *Biological Conservation* 141: 1783–1792.

Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N.D., Wikramanayake, E., Hahn, N., Palminteri, S., Hedao, P., Noss, R., Hansen, M., Locke, H., Ellis, E.C., Jones, B., Barber, C.V., Hayes, R., Kormos, C., Martin, V., Crist, E., Sechrest, W., Price, L., Baillie, J.E.M., Weeden, D., Suckling, K., Davis, C., Sizer, N., Moore, R., Thau, D., Birch, T., Potapov, P., Turubanova, S., Tyukavina, A., de Souza, N., Pintea, L., Brito, J.C., Llewellyn, O.A., Miller, A.G., Patzelt, A., Ghazanfar, S.A., Timberlake, J., Klöser, H., Shennan-Farpón, Y., Kindt, R., Lillesø, J.-P.B., van Breugel, P., Graudal, L., Voge, M., Al-Shammari, K.F. & Saleem, M. (2017) An ecoregion-based approach to protecting half the terrestrial realm. *BioScience* 67: 534–545.

EBRD (2019) EBRD Performance Requirement 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources. European Bank for Reconstruction and Development, London, UK.

EBRD (2024) Environmental and Social Policy 2024 - Environmental and Social Requirement 6.

EBRD (2025) EBRD Performance Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. Guidance Note. March 2023. European Bank for Reconstruction and Development, London, UK.

EcoConServ (2014) Environmental and Social Impact Assessment Italgen 140-200MW Wind Farm at Gabal El Zayt (Phase 2) (Report for Italgen). EcoConServ, Cairo, Egypt.

EcoConServ (2016) Alfa Wind Project: Environmental and Social Impact Assessment 2nd draft report (Report for Alfanar Energy). EcoConServ, Cairo, Egypt.

EcoConServ (2017) Ornithological Study for ITALGEN Wind Farm Project, Gebel El Ziet Autumn, 2016 (Report for Italgen). EcoConServ, Cairo, Egypt.

EcoConServ, EcoConsult & Safe Soar (2024a) Environmental & Social Impact Assessment (ESIA): Suez Wind Energy BOO Wind Power Plant 1.1 GW - SWE South (Plot 2). RECREEE, Cairo, Egypt.

EcoConServ, EcoConsult & Safe Soar (2024b) Critical Habitat Assessment (CHA): Suez Wind Energy BOO Wind Power Plant 1.1 GW - SWE South (Plot 2). RECREEE, Cairo, Egypt.

EcoConServ, EcoConsult & Safe Soar (2024c) Autumn bird migration study 2023. SUEZ Wind Energy BOO Wind Power Plant 1.1. GW – SWE PLOTS 1 & 2.

EcoConServ, EcoConsult & Safe Soar (2024d) Spring bird migration study 2023. SUEZ Wind Energy BOO Wind Power Plant 1.1. GW – SWE PLOTS 1 & 2.

EcoConServ, EcoConsult, Safe Soar & Natural Power (2023) Bird Migration Study for Suez Wind Energy BOO Wind Power Plant 1.1 GW during Spring and Autumn seasons 2022. RECREEE, Cairo, Egypt.

EcoConServ, Safe Soar & EcoConsult (2024e) Site-Specific Environmental and Social Impact Assessment (ESIA) Suez Wind Energy BOO Wind Power Plant 1.1 GW – SWE North (PLOT 2) *draft* Bat Addendum Report (Report for RCREEE, the Regional Centre for Renewable Energy and Energy Efficiency). EcoConServ, Safe Soar and EcoConsult, Cairo, Egypt and Amman, Jordan.

ECOConsult, EcoConServ & RCREEE (2023) Masdar Infinity Power Holding 200 MW Wind Power Project in Gulf of Suez.

EcoConsult & Safe Soar (2025) Environmental & Social Impact Assessment, Scatec Shadwan 900 MW Wind Farm (Draft).

Ehab Ameen (No date) NREA Wind Farm Projects & Birds conservation in Egypt.

EIB (2022) Environmental and Social Sustainability Framework Standards. European Investment Bank.

Environics (2019a) Shutdown on Demand and bird monitoring at KFW 240 MW Wind Farm in Gebel El Zeit Autumn 2019 Final Report.

Environics (2019b) Shutdown on Demand and Bird Monitoring at JICA 120 MW Wind Farm in Gebel El Zeit – Autumn 2019 Final Report. Environics, Cairo, Egypt.

Frick, W.F., Whitby, M., Wilson, D., MacEwan, K.L., Hulka, S., Akre, K.L. & O'Mara, M.T. (2026) A global decision framework for reducing bat fatalities at wind energy facilities. *Ecological Solutions and Evidence* 7: e70189.

Garrido, J., Numa, C., Barrios, V., Qninba, A., Riad, A., Haitham, O., Hasnaoui, H., Buirzayqah, S., Onrubia, A., Fellous-Djardini, A., Saheb, M., Rousellon, K., Cherkaoui, S., Essetti, I., Noaman, M., Radi, M., Cuzin, F., Irizi, A., Monchaux, G., Hamdi, N., Monti, F., Bergier, P., Ouni, R., Etayeb, K., Chokri, M., Azafzaf, H., Gyenge, P., Si Bachar, A. & Bakass, B. (2021) The conservation status and distribution of the breeding birds of prey of North Africa. International Union for Conservation of Nature, Gland, Switzerland.

GreenPlus Environmental Solutions (2018a) Bird Monitoring and Shutdown on Demand – FIEM Wind Farm, Autumn 2018. NREA, Egypt.

GreenPlus Environmental Solutions (2018b) Shutdown on Demand Criteria for JICA and Spanish FIEM Wind Farms, Gebel El Zeit – Spring 2018. Green Plus Environmental Solution Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2018c) Birds Monitoring and Shutdown on Demand, JICA Wind Farm at Gebel El Zeit – Autumn 2018 Final Report. Green Plus Environmental Solution Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2020a) Shutdown on Demand and Bird Monitoring, KFW Wind Farm – Autumn 2020 Final Report. Green Plus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2020b) Birds Monitoring and Shutdown on Demand, JICA Wind Farm at Gabel El Zeit – Autumn 2020 Final Report. Green Plus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2020c) Birds Monitoring and Shutdown on Demand, FIEM Wind Farm at Gabel El Zeit – Autumn 2020 Final Report. Green Plus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2021a) Shutdown on demand and bird monitoring. NREA wind farm complex. Final collective report spring 2021 (Report for the New and Renewable Energy Agency). GreenPlus Environmental Solutions, Maadi, Egypt.

GreenPlus Environmental Solutions (2021b) Shutdown on Demand & Bird Monitoring NREA wind farm complex Final Collective Report Autumn 2021.

GreenPlus Environmental Solutions (2022a) Shutdown on Demand and Bird Monitoring, KFW Wind Farm – Autumn 2022 Draft Report. Green Plus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2022b) Shutdown on demand and bird monitoring. KFW wind farm - Gebel El Zeit. Draft report spring 2022 (Report for the New and Renewable Energy Agency). GreenPlus Environmental Solutions, Maadi, Egypt.

GreenPlus Environmental Solutions (2022c) Shutdown on demand and bird monitoring. JICA wind farm - Gebel El Zeit. Draft report spring 2022 (Report for the New and Renewable Energy Agency). GreenPlus Environmental Solutions, Maadi, Egypt.

GreenPlus Environmental Solutions (2022d) Shutdown on demand and bird monitoring. FIEM wind farm - Gebel El Zeit. Draft report spring 2022 (Report for the New and Renewable Energy Agency). GreenPlus Environmental Solutions, Maadi, Egypt.

GreenPlus Environmental Solutions (2022e) Shutdown on demand and bird monitoring. JICA wind farm - Gebel El Zeit. Final Draft report autumn 2022 (Report for the New and Renewable Energy Agency). GreenPlus Environmental Solutions, Maadi, Egypt.

GreenPlus Environmental Solutions (2022f) Shutdown on demand and bird monitoring. FIEM wind farm - Gebel El Zeit. Draft report autumn 2022 (Report for the New and Renewable Energy Agency). GreenPlus Environmental Solutions, Maadi, Egypt.

GreenPlus Environmental Solutions (2023a) Shutdown on Demand & Bird Monitoring – KFW Wind Farm – Gebel El Zeit (1) – Spring 2023 (Draft Report). GreenPlus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2023b) Shutdown on Demand and Bird Monitoring, JICA Wind Farm – Gebel El Zeit – Spring 2023 (Draft Report). GreenPlus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2023c) Shutdown on Demand and Bird Monitoring, FIEM Wind Farm – Spring 2023 Draft Report. GreenPlus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2023d) Shutdown on Demand and Bird Monitoring, FIEM Wind Farm – Autumn 2023 Draft Report. GreenPlus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2023e) Shutdown on Demand and Bird Monitoring, KFW Wind Farm – Autumn 2023 Draft Report. Green Plus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2024a) Shutdown on Demand and Bird Monitoring, KFW Wind Farm – Autumn 2024 Draft Report. Green Plus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2024b) Shutdown on Demand and Bird Monitoring, FIEM Wind Farm – Autumn 2024 Draft Report. Green Plus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2024c) Shutdown on Demand and Bird Monitoring, JICA Wind Farm – Autumn 2024 Draft Report. GreenPlus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2024d) Shutdown on Demand & Bird Monitoring: KFW Wind Farm - Gebel El Zeit (Spring 2024). Cairo, Egypt.

GreenPlus Environmental Solutions (2024e) Shutdown on Demand & Bird Monitoring: FIEM Wind Farm - Gebel El Zeit, Spring 2024. GreenPlus Environmental Solutions Company, Cairo, Egypt.

GreenPlus Environmental Solutions (2024f) Shutdown on Demand & Bird Monitoring: JICA Wind Farm - Gebel El Zeit, Spring 2024. GreenPlus Environmental Solutions Company, Cairo, Egypt.

Grontmij (2009) Bird Migration Study El Zayt, Egypt (Report for Italgen). Aarhus University, Aarhus, Denmark.

Grontmij & EcoConServ (2010) EIA study for a 120-400MW wind farm El Zayt, Egypt (Report for Italgen). Grontmij | Carl Bro and EcoConServ, Aarhus, Denmark and Cairo, Egypt.

Hilgerloh, G., Michalik, A. & Raddatz, B. (2011) Autumn migration of soaring birds through the Gebel El Zeit Important Bird Area (IBA), Egypt, threatened by wind farm projects. *Bird Conservation International* 21: 365–375.

IFC (2012) Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. International Finance Corporation (IFC), Washington DC, USA. https://www.ifc.org/content/dam/ifc/doc/2010/20190627-ifc-ps-guidance-note-6-en.pdf

IFC (2013) Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets. International Finance Corporation, Washington D.C., USA.

https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_cumulativeimpactassessment

IFC (2017) Tafila Region Wind Power Projects Cumulative Effects Assessment. International Finance Corporation, Washington D.C.

IFC (2019) Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. International Finance Corporation (IFC), Washington DC, USA.

IFC, EBRD & KFW (2023) Post-construction bird and bat fatality monitoring for onshore wind energy facilities in emerging market countries. International Finance Corporation, European Bank for Reconstruction and Development and Kreditanstalt für Wiederaufbau.

IUCN (2024) The IUCN Red List of Threatened Species. Version 2024-2. *IUCN Red List of Threatened Species*. https://www.iucnredlist.org/en

Jais, M. (2018) European Raptors: European Honey-buzzard. http://www.europeanraptors.org/raptors/european_honey_buzzard.html

Jobson, B., Allinson, T., Sheldon, R., Vansteelant, W., Oppel, S. & Jones, V.R. (2021) Monitoring of migratory soaring birds in the East African-Eurasian flyway: a review and recommendations for future steps. *Sandgrouse* 43: 1–23.

Kemp, R., Colyn, R., Freeman, M.T. & McKechnie, A.E. (2024) Population status of the range-restricted Red Lark *Calendulauda burra* in a conservation area stronghold. *Ostrich* 95: 140–151.

Kenward, R., Walls, S., Hodder, K., Pahkala, M., Freeman, S. & Simpson, V. (2000) The prevalence of non-breeders in raptor populations: evidence from rings, radio-tags and transect surveys. *Oikos* 91: 271–279.

Korine, C., Adams, R., Russo, D., Fisher-Phelps, M. & Jacobs, D. (2016) Bats and water: anthropogenic alterations threaten global bat populations. pp. 215–241 in: Voigt, C.C., Kingston, T. (Eds) *Bats in the Anthropocene: conservation of bats in a changing world*. Springer International Publishing, Cham, Switzerland.

Lahmeyer International & Ecoda (2018) Strategic and Cumulative Environmental and Social Assessment Active Turbine Management Program (ATMP) for Wind Power Projects in the Gulf of Suez. Final report (D-8) on the Strategic Environmental and Social Assessment for an Area of 284km^2 at the Gulf of Suez (Report for RCREEE, the Regional Centre for Renewable Energy and Energy Efficiency). JV Lahmeyer International GmbH & ecoda Environmental Consultants GbR, Bad Vilbel, Germany.

Mathews, F. & Macdonald, D. (2000) The sustainability of the common crane (*Grus grus*) flock breeding in Norfolk: insights from simulation modelling. *Biological Conservation* 100: 323–333.

Meyberg, B.-U., Belka, T., Danko, S., Wójciak, J., Heise, G., Blohm, T. & Matthes, H. (2005) Geschlechtsreife, Ansiedlungsentfernung, Alter und Todesursachen beim Schreiadler *Aquila pomarina*. *Limicola* 19: 153–179.

Ministry State of Environment Affairs (2014) Egypt's Fifth National Report to the Convention on Biological Diversity. Ministry State of Environment Affairs, Cairo, Egypt.

Nagy, A., Mohallal, E.M.E., El-Kafrawy, S. & Saber, S.A. (2022) Which is a stronger predictor of the abundance of Dorcas Gazelle, *Gazella dorcas* in the Eastern desert of Egypt: human or natural factors? *Zoology in the Middle East* 68: 189–197.

Newton, I., Davis, P. & Davis, J. (1989) Age of first breeding, dispersal and survival of Red Kites *Milvus milvus* in Wales. *Ibis* 131: 16–21.

Niel, C. & Lebreton, J.-D. (2005) Using demographic invariants to detect overharvested bird populations from incomplete data. *Conservation Biology* 19: 826–835.

Porter, R. (2005) Soaring Bird Migration in the Middle East and North-East Africa: the bottleneck sites. pp. 127–167 in: *Mainstreaming Conservation of Migratory Soaring Birds into Key Productive Sectors Along the Rift Valley/ Red Sea Flyway*. UNDP.

Rodrigues, L., Bach, L., Dubourg-Savage, M.-J., Karapandža, B., Rnjak, D., Kervyn, T., Dekker, J., Kepel, A., Bach, P., Collins, J., Harbusch, C., Park, K., Micevski, B. & Minderman, J. (2015) *Guidelines for consideration of bats in wind farm projects Revision 2014*.

STRIX (2018) Wind turbine shutdown on demand operations and bird migration monitoring in the Gabal el Zayt Wind Farm (200 MW), Egypt. Unpublished Report, Carcavelos.

Tamás, E.A. (2011) Longevity and survival of the black stork *Ciconia nigra* based on ring recoveries. *Biologia* 66: 912–915.

TBC (2019) Lekela North Ras Gharib 250 MW: Analysis of cumulative effects to biodiversity (Unpublished report prepared on behalf of Lekela Power Ltd). The Biodiversity Consultancy Ltd, Cambridge.

TBC (2025) Revised final Critical Habitat Assessment for the Scatec wind farm, Egypt (Report for RCREEE, the Regional Centre for Renewable Energy and Energy Efficiency). The Biodiversity Consultancy Ltd, Cambridge, UK.

Thaxter, C.B., Buchanan, G.M., Carr, J., Butchart, S.H.M., Newbold, T., Green, R.E., Tobias, J.A., Foden, W.B., O'Brien, S. & Pearce-Higgins, J.W. (2017) Bird and bat species' global vulnerability to collision mortality at wind farms revealed through a trait-based assessment. *Proceedings of the Royal Society B: Biological Sciences* 284: 20170829.

Väli, Ü. & Bergmanis, U. (2017) Apparent survival rates of adult Lesser Spotted Eagle *Clanga pomarina* estimated by GPS-tracking, colour rings and wing-tags. *Bird Study* 64: 104–107.

Wade, P. (1998) Calculating limits to the allowable human-caused mortality of cetaceans and pinnipeds. *Marine Mammal Science* 14: 1–37.

Walter, S., Carloss, M., Hess, T., Athrey, G. & Leberg, P. (2013) Movement patterns and population structure of the brown pelican. *The Condor* 115: 788–799.

Zahran, M.A. & Willis, A.J. (2008) *The Vegetation of Egypt*. Springer Dordrecht.

Appendix 1 Detailed results for steps 1-3 for bird VECs

Appendix 1 provided in the embedded excel workbook.

Bird VECs for GEZ WF.xlsx

Appendix 2 Non-bird VECs at Step 2

Scientific name	Common name	IUCN status	National status (mammals)	Vulnerability	Egypt EOO	Study area	% in area	Relative importance	Sensitivity
Acanthodactylus boskianus	Bosc's Fringe-toed Lizard	LC		Negligible	819762	6801	0.83	Negligible	Negligible
Acanthodactylus scutellatus		LC		Negligible	890173	6801	0.76	Negligible	Negligible
Acomys cahirinus	Cairo Spiny Mouse	LC	LC	Negligible	939457	6801	0.72	Negligible	Negligible
Asellia tridens	Geoffroy's Trident Leaf-nosed Bat	LC	LC	Negligible	985919	6801	0.69	Negligible	Negligible
Canis lupaster	African Wolf	LC	LC	Negligible	968108	6801	0.7	Negligible	Negligible
Cerastes cerastes	Desert Horned Viper	LC		Negligible	971726	6801	0.7	Negligible	Negligible
Cerastes vipera	Sahara Sand Viper	LC		Negligible	729340	6801	0.93	Negligible	Negligible
Chalcides ocellatus	Ocellated Skink	LC		Negligible	903705	6801	0.75	Negligible	Negligible
Cyrtopodion scabrum	Rough Bent-toed Gecko	LC		Negligible	21183	6801	32.1	High	Low
Echis coloratus		LC		Negligible	210452	6801	3.23	Low	Negligible
Eptesicus bottae	Botta's Serotine	LC	VU	Moderate	16200	6801	41.99	Low[16]	Low
Felis lybica	Afro-Asiatic Wildcat	LC	LC	Negligible	199002	6801	3.42	Low	Negligible
Gerbillus gerbillus	Lesser Egyptian Gerbil	LC	LC	Negligible	967188	6801	0.7	Negligible	Negligible
Gerbillus henleyi	Pygmy Gerbil	LC	LC	Negligible	253933	6801	2.68	Low	Negligible
Gerbillus pyramidum	Greater Egyptian Gerbil	LC	LC	Negligible	713126	6801	0.95	Negligible	Negligible
Hemidactylus turcicus	Turkish Gecko	LC		Negligible	172093	6801	3.95	Low	Negligible
Herpestes ichneumon	Egyptian Mongoose	LC	LC	Negligible	450969	6801	1.51	Low	Negligible
Hyaena hyaena	Striped Hyaena	NT	LC	Low	985642	6801	0.69	Negligible	Negligible
Hypsugo ariel	Desert Pipistrelle	DD	VU	Moderate	14100	6801	48.23	Low[1]	Low

[16] range of these bat species in Egypt is considered to be underestimated, so the Relative importance was not calculated as a result of the % of the range in the study area, but considered to be low

Scientific name	Common name	IUCN status	National status (mammals)	Vulnerability	Egypt EOO	Study area	% in area	Relative importance	Sensitivity
Jaculus jaculus	Lesser Egyptian Jerboa	LC	LC	Negligible	959716	6801	0.71	Negligible	Negligible
Lepus capensis	Cape Hare	LC	LC	Negligible	422748	6801	1.61	Low	Negligible
Lytorhynchus diadema	Crowned Leaf-nosed Snake	LC		Negligible	964285	6801	0.71	Negligible	Negligible
Malpolon moilensis	Moila Snake	LC		Negligible	961014	6801	0.71	Negligible	Negligible
Meriones crassus	Sundevall's Jird	LC	LC	Negligible	831908	6801	0.82	Negligible	Negligible
Mesalina guttulata	Small-spotted Desert Racer	LC		Negligible	779956	6801	0.87	Negligible	Negligible
Mesalina olivieri		LC		Negligible	210787	6801	3.23	Low	Negligible
Mesalina rubropunctata	Red-spotted Desert Racer	LC		Negligible	908184	6801	0.75	Negligible	Negligible
Pipistrellus rueppellii	Rüppel's Pipistrelle	LC	VU	Moderate	250005	6801	2.72	Low	Low
Pipistrellus kuhlii	Kuhl's Pipistrelle	LC	LC	Negligible	250005	6801	2.72	Low	Negligible
Platyceps saharicus		LC		Negligible	247073	6801	2.75	Low	Negligible
Procavia capensis	Rock Hyrax	LC	LC	Negligible	272889	6801	2.49	Negligible	Negligible
Psammophis aegyptius	Saharan Sand Snake	LC		Negligible	879938	6801	0.77	Negligible	Negligible
Psammophis schokari	Forskål's Sand Snake	LC		Negligible	961077	6801	0.71	Negligible	Negligible
Pseudotrapelus chlodnickii		LC		Negligible	631767	6801	1.08	Low	Negligible
Ptyodactylus guttatus	Fan-footed Gecko	LC		Negligible	628639	6801	1.08	Low	Negligible
Ptyodactylus hasselquistii		LC		Negligible	168006	6801	4.05	Low	Negligible
Rattus rattus	House Rat	LC	-	Negligible	474636	6801	1.43	Low	Negligible
Rhinopoma cystops	Egyptian Mouse-tailed Bat	LC	LC	Negligible	486754	6801	1.4	Low	Negligible
Rhinopoma hardwickii	Lesser Mouse-tailed Bat	LC	-	Negligible	978842	6801	0.69	Negligible	Negligible
Rhinopoma microphyllum	Greater Mouse-tailed Bat	LC	VU	Moderate	608347	6801	1.12	Low	Low
Sekeetamys calurus	Bushy-tailed Jird	LC	LC	Negligible	152394	6801	4.46	Low	Negligible
Spalerosophis diadema	Diadem Snake	LC		Negligible	985635	6801	0.69	Negligible	Negligible

Scientific name	Common name	IUCN status	National status (mammals)	Vulnerability	Egypt EOO	Study area	% in area	Relative importance	Sensitivity
Stenodactylus petrii	Anderson's Short-fingered Gecko	LC		Negligible	928317	6801	0.73	Negligible	Negligible
Stenodactylus sthenodactylus	Elegant Gecko	LC		Negligible	953468	6801	0.71	Negligible	Negligible
Trapelus mutabilis		LC		Negligible	109133	6801	6.23	Moderate	Low
Tropiocolotes steudneri	Algerian Sand Gecko	LC		Negligible	795530	6801	0.85	Negligible	Negligible
Uromastyx aegyptia	Egyptian Spiny-tailed Lizard	VU		Moderate	130082	6801	5.23	Moderate	Medium
Varanus griseus	Desert Monitor	LC		Negligible	735910	6801	0.92	Negligible	Negligible
Vulpes rueppellii	Rüppell's Fox	LC	LC	Negligible	915546	6801	0.74	Negligible	Negligible
Vulpes vulpes	Red Fox	LC	LC	Negligible	598326	6801	1.14	Low	Negligible