SPRING BIRD MIGRATION STUDY 2023

SUEZ Wind Energy BOO Wind Power Plant 1.1. GW – SWE PLOTS 1 & 2

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المركز الإقليمي للطاقة المتجددة وكفاءة الطاقة

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LIST OF ACRONYMS

BOO	Build, Own, Operate
CRM	Collision Risk Model
EETC	Egyptian Electricity Transmission Company
ESIA	Environmental and Social Impact Assessment
GDP	Gross Domestic Product
GoE	Government of Egypt
GoS	Gulf of Suez
GW	Gigawatt
GZ	Gabal El Zeit
IRENA	International Renewable Energy Agency
ISES	Integrated Sustainable Energy Strategy
IUCN	International Union for Conservation of Nature
MSBs	Migratory Soaring Birds
NREA	New and Renewable Energy Authority
OP	Observation Points
QA	Quality Assurance
QC	Quality Control
RCREEE	Regional Centre for Renewable Energy and Energy Efficiency
RVRSF	Rift Valley - Red Sea Flyway
VP	Vantage Point

1. INTRODUCTION

1.1 Background

The energy sector is a key driver for the socio-economic development of Egypt, representing around 13% of current GDP and thus making economic growth in the country contingent upon the security and stability of energy supply. Since 2007, Egypt has experienced an energy supply deficit due to the rapid increase in energy consumption and the depletion of domestic oil and gas resources, shifting its position as a net hydrocarbon exporter for the last three decades to that of a net importer. This has brought a set of challenges to the energy sector, including electricity shortages, caused in part by the decline of domestic gas production, as natural gas is the main source of electricity, accompanied by highly subsidized energy prices, with negative financial implications for already dwindling government revenues.

In response, the Government of Egypt (GoE) has taken bold steps to adopt an energy diversification strategy with increased development of renewable energy and implementation of energy efficiency, including assertive rehabilitation and maintenance programs in the power sector (IRENA, 2018). To this extent, in 2013, the Arab Republic of Egypt (through the Ministry of Electricity and Renewable Energy) had developed and adopted the Integrated Sustainable Energy Strategy (ISES) 2015 – 2035, which provides an ambitious plan to increase the contribution of renewable energy to 20% of the electricity generated by the year 2022, of which 12% of wind power plants is foreseen, mostly in the Gulf of Suez (GoS) due to the wind characteristics in the area.

In that respect, the GoE issued the Renewable Energy Law (Decree Law 203/2014) to support the creation of a favourable economic environment for a significant increase in renewable energy investment in the country. The law sets the legal basis for the Build, Own and Operate (BOO) scheme to be implemented. Through the BOO mechanism, the Egyptian Electricity Transmission Company (EETC) invites private investors to submit their offers for solar and wind development projects, for specific capacities and the award will be made to that bidder with the lowest Kilowatt Hour (kWh) price. In addition, the GoE (through the New and Renewable Energy Authority (NREA)) provides the land for the investors. In accordance with this Law, the Egyptian Government has made land available for investors in the GoS to install wind power plants. Therefore, the Consortium is composed of ACWA Power Company and Hassan Allam Utilities B.V (hereafter referred to as '**the Developer'**) is proceeding with developing a project comprised of separate wind power plants with a combined capacity of 1,100MW Suez Wind Energy (SWE) under the BOO scheme[1].

The Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) is managing the environmental process for the wind power plants on behalf of the Developer. RCREEE commissioned EcoConServ and ECO Consult with subcontractor (Safe Soar) for carrying out a bird migration monitoring (hereafter referred to as **'the Consultant'**), to undertake Bird Migration Studies for the projects during spring 2022 and autumn 2022, and this report presents the results of these studies. \

1.2 Location of the Projects and Components

The Projects: **Plot 1** (*also referred to as Gharb Bakr)* and **Plot 2** (*also referred to as Gebel-El-Zyat),* are located in the Red Sea Governorate of Egypt, at a rough distance of around 220km and 270km, respectively, to the southeast of the capital city of Cairo (Figure 1). The two Projects occupy a total combined area of 197.5 km^2

[1] The combined Project is comprised of two separate projects referred to as Plot 1 and Plot 2. Plot 1 and Plot 2 are located approximately 50km apart, therefore, biodiversity assessment and analysis has been undertaken (including the avifaunal assessment included in this report) separately. This report presents information on Plots 1 and 2 separately.

within the Rift Valley - Red Sea Flyway (RVRSF[2]). Plot 1 is located approximately 15km to the west of the town of Ras Ghareb, in the Gulf of Suez (GoS) and occupies an area of 145.3 km^2 (Figure 2). Plot 2 is located approximately 10k south of the settlement of Ras Shukeir in Gabal Zeit (GZ) with an area of 50 km^2 (Figure 2).

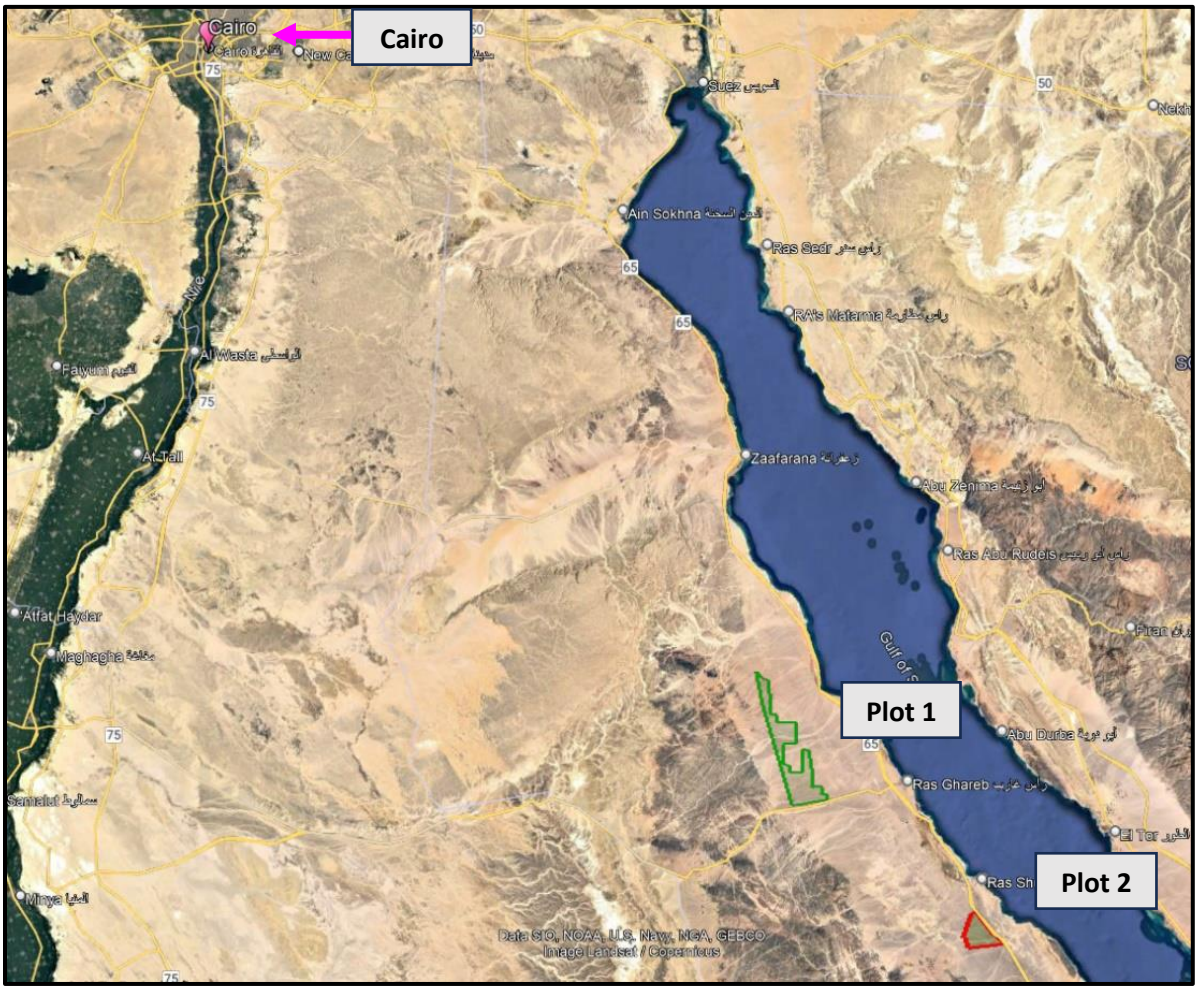


Figure 1 : Project Sites in Relation to Cairo the Capital City of Egypt

[2] A map of the RVRSF along with requirements for Environmental Impact Assessment Guidelines for Wind Energy Developments in Egypt may be found in: Sarhan, Mahmoud & Uffe, Soerensen & Abdeldayem, Omar. (2013). Environmental Impact Assessment Guidelines for Wind Energy Developments in Egypt. 10.13140/RG.2.1.1867.6883.

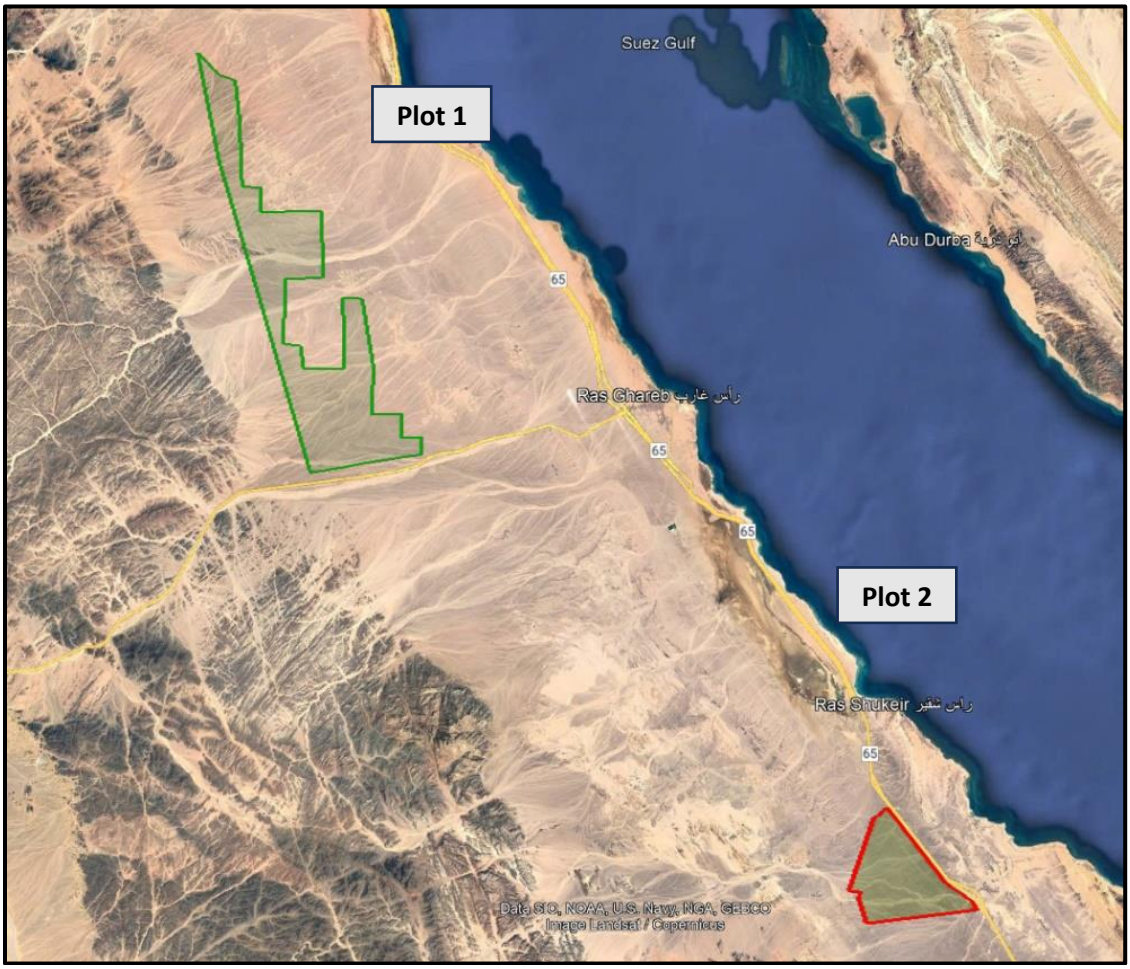


Figure 2: Project Sites

At the time of the 2022 bird migration surveys, turbine layouts for Plot 1 and Plot 2 were not available. The turbine layouts respective of Plots 1 and 2 were provided in 2023 and are included in the figures below.

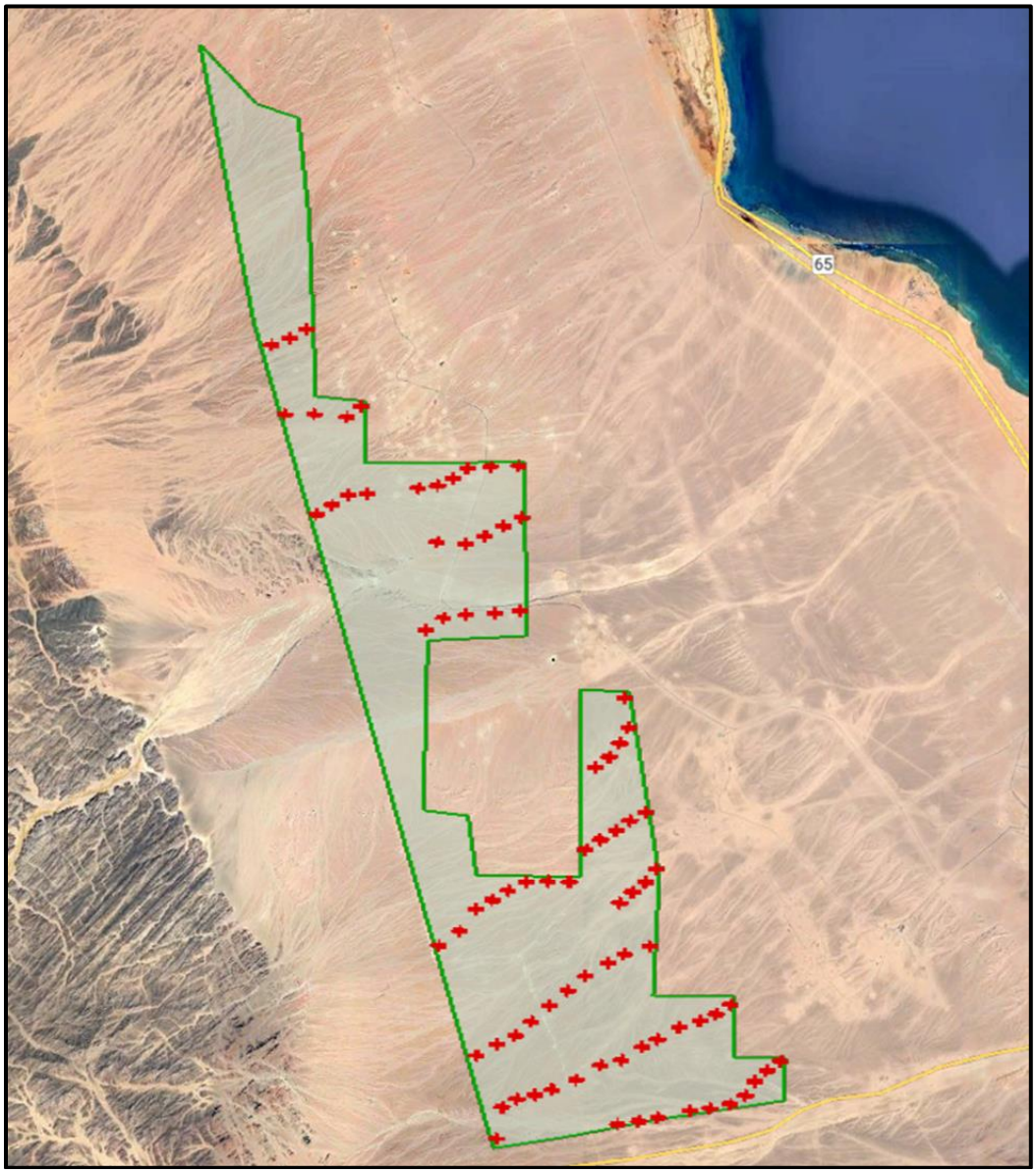


Figure 3: Turbine Layout for Plot 1

Figure 4: Turbine Layout for Plot 2

2. OVERVIEW OF METHODOLOGY FOR AVI-FAUNA SURVEYS

2.1 Observation Point Assessment

According to the methodology outlined in the "Environmental Impact Assessment Guidelines and Monitoring Protocols for Wind Energy Development Projects along the RVRSF with a particular reference to wind energy in support of the conservation of Migratory Soaring Birds (MSBs)" (2013), the "Strategic Environmental and Social Impact Assessment (ESIA) for an Area of 300 km² of potential wind farms at the Gulf of Suez (2013)", and the methodology applied in the "Strategic and Cumulative Environmental and Social Assessment Active Turbine Management Program for Wind Power Projects in the Gulf of Suez (2019)", the assessment used specific pre-assigned Vantage Points (VPs) [also referred to as Observation Points (OPs)] in order to achieve the objectives of the monitoring.

The objective of the surveys was to provide an assessment of the use of the migratory and resident soaring birds in the project sites while providing a detailed analysis of the durations that these species use the project site and the elevations at which they are present. This helps understanding of the potential predicted impacts of the projects on bird species. This monitoring also highlighted any globally or regionally threatened species that are present and the frequency of their use of the sites.

2.1.1 Observation Hours and Timings

Unlike previous methodologies that undertook eight (8) hours of observations, the methodology for the avifauna assessment for these sites has been updated and expanded to ensure monitoring is undertaken to start *a minimum of 1-hour after sunrise until 1-hour before sunset.* This means around ten (10) hours (due to changes in sunrise-sunset timings) of monitoring per day at each OP was performed outside of Ramadan. During Ramadan monitoring was undertaken for eight (8) hours/day because of health and safety considerations for bird observers.

The bird survey team included a qualified backup team of observers at all times in case of any needs for any observer replacement to ensure the stability of maximum quality of observation time. In addition, the monitoring program provided survey coverage regardless of public holidays (e.g. Eid) or unexpected events. The only reason that entailed suspension of monitoring was any potential extremely serious situations which might affect health and safety impacts on observers (e.g. sandstorms).

OP's were covered by a single observer (i.e. for a total of nine (9) observers per day) that is qualified with adequate previous experience in avifaunal assessments for wind farms. Due to the large-scale nature of the sites, a rotational system was employed to provide the targeted temporal coverage, with each monitoring day divided into *morning* and *evening* shifts (5-6 hours each). Although in general a one (1)-hour break was provided between each two (2) observation periods (morning and evening observation period), the breaks were timed for periods when two observers were present to ensure the continuity of observations, i.e. the first observer takes a break for example from 1pm-2pm while the second observer keeps watching, then the second observer takes a break while the first observer is watching. The transportation of observers from the morning to the evening shift occurred during this one-hour break. Where significant bird activity was noted during a break of one observer survey effort was resumed during the flight to ensure full data coverage.

2.1.2 Vantage Point Selection

A view-shed analysis was developed to determine the number of OPs required for each site. Each OP covered a view of 360 degrees extending for a maximum distance between 1.8 - 2.2 km[3]. This distance is considered the

[3] Previous bird observation methods in the GoS included maximum viewsheds of 2.5km.

most suitable and sufficient for a qualified bird observer to identify birds to species level in good visibility conditions.

Turbine layouts were not finalised during the migration period, therefore the locations of the OP aimed to cover the entire project areas, resulting in eighteen (18) OPs for Plot 1 (Figure 5), and nine (9) OPs for Plot 2 (Figure 6; Table 1).

The selection of the OPs for a monitoring day attempted to minimise the potential of double counting birds by ensuring no overlap of OPs selected for each survey day. For example, the OPs selected on Day 1 included OP1, OP3, OP5 and OP7, etc. each having (instead of OP1, OP2, OP3, etc.).

Some other key points that our methodology accounted for included the following:

- *Equal distribution of spatiotemporal effort*- the selected location of OPs and the shift system ensured equal distribution of spatiotemporal effort (equal distribution of observation points and observation time) across each project site.
- *Maximum study area coverage* - the OP selection was designed to provide as much coverage of buffer areas (i.e. areas located outside of the Project boundary) as possible to ensure to the greatest extent possible that alternative surrounding areas which could be utilized for turbine placement were surveyed, minimising the need to undertake new surveys to cover such areas, if required, in the future.

Table 1: Coordinates of OPs at each site (Plot 1 and 2)

OP	Latitude	Longitude	OP	Latitude	Longitude
Plot 1			**Plot 2**		
VP1	28.598820°	32.711800°	VP1	28.047967°	33.264053°
VP2	28.573960°	32.724990°	VP2	28.029219°	33.287277°
VP3	28.541430°	32.721890°	VP3	28.004803°	33.303428°
VP4	28.509620°	32.734230°	VP4	27.986955°	33.326338°
VP5	28.484060°	32.751430°	VP5	27.983198°	33.291307°
VP6	28.488637°	32.782984°	VP6	27.980825°	33.259443°
VP7	28.463896°	32.787319°	VP7	28.003991°	33.242739°
VP8	28.456060°	32.754130°	VP8	28.026864°	33.253451°
VP9	28.424400°	32.764750°	VP9	28.005845°	33.274209°
VP10	28.388200°	32.767620°			
VP11	28.416580°	32.821640°			
VP12	28.383350°	32.830305			
VP13	28.374200°	32.800240°			
VP14	28.354430°	32.788060°			
VP15	28.351698°	32.829276°			
VP16	28.326020°	32.799180°			
VP17	28.320520°	32.834290°			
VP18	28.333170°	32.866050°			

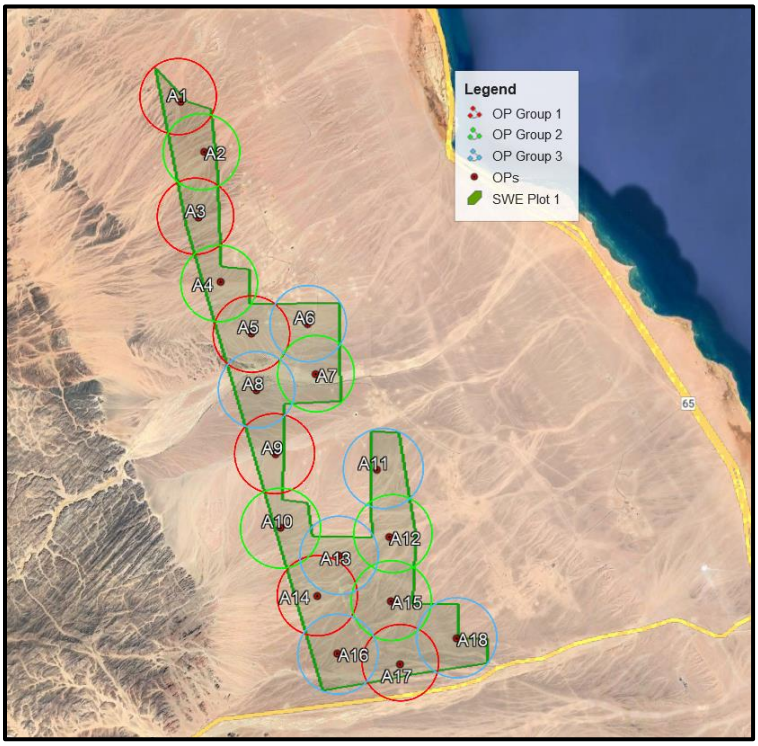


Figure 5 Location of Plot 1 and Distribution of Ops

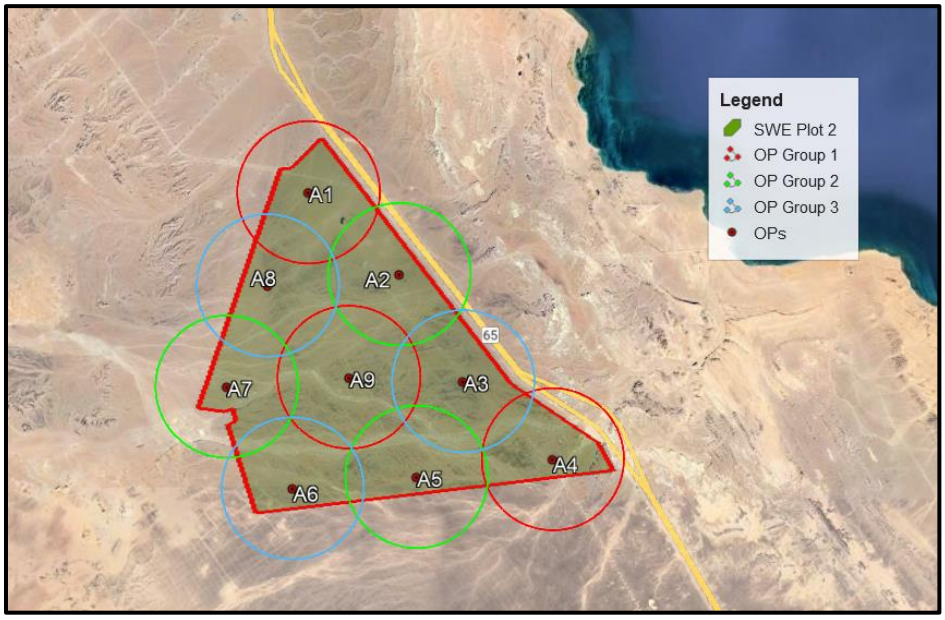


Figure 6 Location of Plot 2 and Distribution of Ops

2.1.3 Overall Team Management

Due to the huge project sites and number of required OPs, the methodology accounted for an approach that ensured optimal effectiveness and quality for the overall surveys. One (1) *Main Team Leader* was assigned for Plot 1 and Plot 2. He was not responsible for performing any observation/monitoring at OPs in any way or under any circumstance. His key roles and responsibilities included the following:

- Overall quality assurance/control on observer and observations undertaken

- Developing schedule for observers/OP
- Overall management of observers to include but not limited to assignment, daily checks on OP to ensure they are onsite, ensure observations are done and completed properly, ensure transitions from morning to evening OP is complete successfully considering rest periods, etc.
- Collection of data from observers and undertake quality control review
- Respond/resolve any issues within the site /observers
- Other

The Main Team Leader was assisted by two (2) onsite *Supportive Team Leaders* that were assigned OP areas and observer teams as applicable. The Supportive Team Leaders undertook monitoring at OPs but in parallel also supported the Main Team Leader in carrying out the duties identified above.

2.2 Data Collection

Data were recorded on spreadsheets. These spreadsheets were filled on a daily basis by the Bird Observers. Information on bird flight activity was collected from OPs. The recording of observations largely follows the methods described by Band et al. (20074), which are summarized below.

Observers at OPs positioned themselves to minimize their effects on bird behaviour. Shelters were constructed for observers to protect them from weather, which also served to partially disguise observers on the landscape.

Before starting observations, cardinal directions (North, South, East and West) and landmarks of reference in the field were defined. To make this easier, and more consistent for observers a VP map showing location of, and distance to, landmarks (Figure 4) a physical north arrow (Figure 8) is present at each OP station.

[4] Band, W., Madders, M. & Whitfield, D.P. (2007) Developing field and analytical methods to assess avian collision risk at wind farms. In: de Lucas, M., Janss, G.F.E. & Ferrer, M. (Eds.) Birds and Wind Farms: Risk Assessment and Mitigation, pp 259-275. Quercus, Madrid.

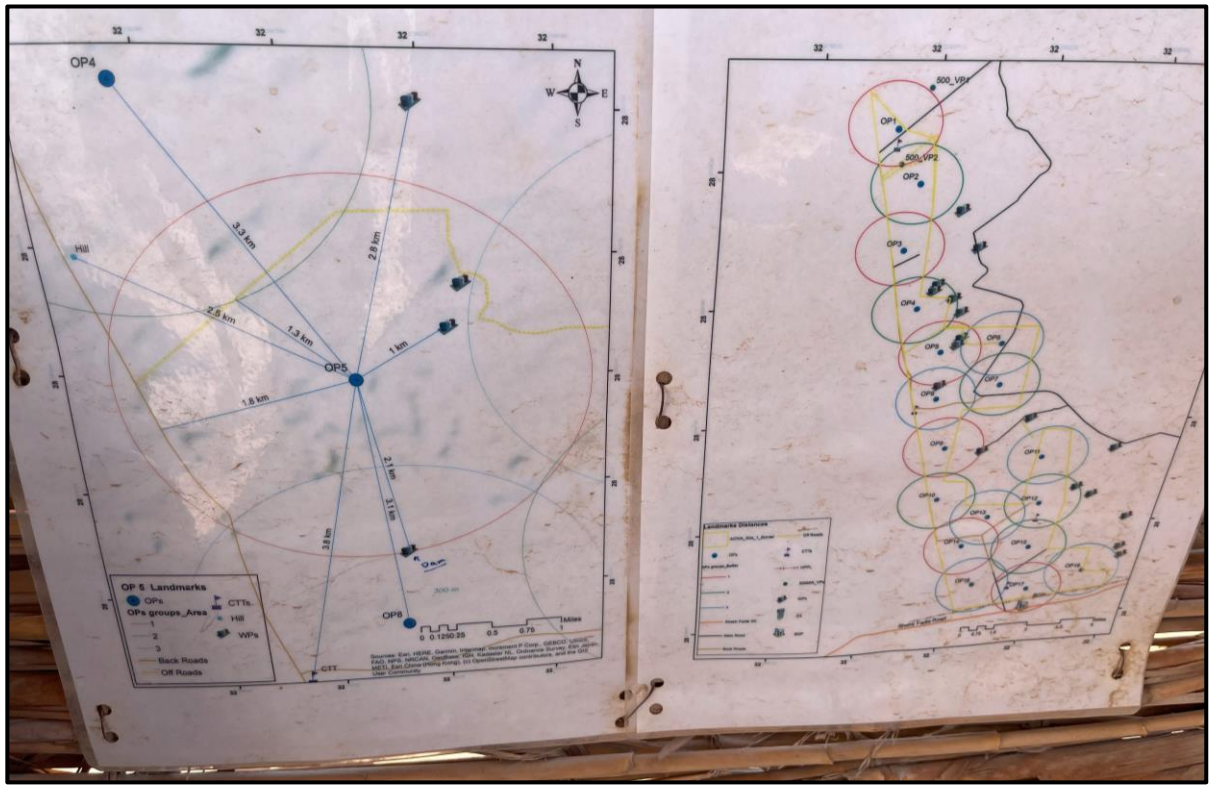


Figure 7: Example of landmark map at OP

Figure 8: Example of North Arrow at OP

Weather conditions (such as wind speed, wind direction, visibility, cloud cover and precipitation) were recorded at start time of monitoring activities. During observations, observers constantly scanned, using a combination

of naked-eye and binoculars, covering the 360 degrees viewshed from each OP. If a target species[5] was detected, it was observed until it ceased flying or was lost from view[6]. For each observation of a target species, data collected included the following:

- The time the species was detected;
- The flight duration of the species to the nearest 15-second interval;
- Estimate of the bird's flight height above ground level at the point of first detection and thereafter at 15-second intervals, with flight heights classified based on likely turbine specifications7, and;
- Risk heights - data collection covered various risk height bands to account for potential changes in turbine heights in the future. This minimises the need to repeat surveys if turbine changes occur. The following risk height bands were used: (i) 0-120m; (ii) 120m-150m; (iii) 150m-200m; (iv) 200-240m and (v) above 240m. Note that this adds an additional height band from surveys in 2022, which stopped at (iv) above 200m, and leads to some small differences in interpretation between the two years.

It is important to note that complete information on all records including the records detected outside the buffer radius around the OP were collected, this including number of birds and distance. Also, the distance between the detected record and the observer was documented on the datasheets. Flight direction as well as heights of all records was among the basic information collected. One data sheet for targeted species and another datasheet for accidental observations of passerines and non-targeted species were used (Appendix A).

Based on the biodiversity team's extensive experience in pre-construction surveys, the methodology was adjusted for data collection to reflect some key improvements on previous methodologies employed on all pre- and post-construction surveys performed by various consultants.

Such improvements were considered crucial and critical for the statistical analysis of the bird migration patterns. These included the following:

- *Ensure observations considered to be out of the Observation Point Radius recorded the number of birds and distances from observers.* This helps to analyse the detectability of observers for migratory birds. The longest distance from the observers the less probability of a bird being detected, also the probability of detection decreases for birds of smaller size.
- *Every project in the GoS utilises different monitoring times, either per season or per OP within a season.* For this reason, the analysis *is misleading if it uses raw bird counts* as the higher the amount of time spent monitoring is likely to result in higher probability to record more birds. Comparative analysis between and within projects have shown the significant relationship between bird counts and time of monitoring. Therefore, for certain analysis, a passage rate (birds/hour) is used.
- During Spring 2023 breaks were undertaken to ensure that observers remained focussed during the survey hours. However, during breaks if high migration was recorded this was noted on survey records. Whilst this

[5] For this monitoring target birds included all Migratory Soaring Birds (MSB) as well as other target species such as Globally Threatened bird species as determined based on the IUCN Red List (https://www.iucnredlist.org/). Accidental observations of passerines and non-target species were also recorded.

[6] It should be noted that Good International Industry Practice (GIIP) methods for Vantage Point (VP) surveys (classified here as OP surveys) commonly recommend 180 degree viewsheds. In the GoS, OP surveys commonly utilise 360 degree viewsheds. It should also be noted that GIIP for VP surveys includes flight path mapping of target species to allow for improved characterisation of spatial use of the project area and the surrounding area. Flight pat mapping was not performed for this monitoring, nor is it commonly utilised in the GoS for OP surveys and it is recommended that future OP surveys performed at these sites includes flight path mapping.

[7] Likely turbine specifications were determined by the project sponsor.

moves away from the purest of survey methods it was believed to be appropriate given the fluctuating nature of migration and the importance of not missing crucial data. By incorporating any such data within the typical hours of survey (i.e. assuming no birds survey took place during breaks) a precautionary assessment of levels of bird activity is achieved in terms of overall flight activity through site.

- In previous years a precautionary approach to how gaps in hours at each OP was employed. However, given the spread of OP's, and the recording of incidences of double counting, it is considered that this would lead to an overly precautionary approach. Whilst neither approach is perfectly correct the assumption that all birds are recorded at one OP across site is considered to lead to a smaller likely error in overall flight activity. When a Collision Risk Model is used to assess collision risk in future work this impact will be factored out within the model and such data will be used to forecast individual species risk.
- *Correcting for flight height categorization* – In 2022 there was a disparity between the number of flight height bands used between seasons, and these were standaridzed to be 0-120m; 120-150m; 150-200m; over 200m. The proportion of time that each species spent within each flight height band was calculated by dividing the length of time in that band by the total time in all bands. This was repeated overall for the plot and season for each species, and separately for each vantage point. For the 2023 assessment the actual recorded bands were maintained for the majority of assessment as this provides better detail on flight activity. For comparative band risk analysis the same bands were also used as in 2022 to provide an appropriate comparison.

2.3 Study Design - Accounting for Roosting & Resting of Birds

Many birds must utilise roosting and resting sites during migration to/from overwintering and breeding ranges, and identifying roost sites/habitat features is an important aspect of migratory bird studies for proposed wind energy projects within migratory flyways. MSB and other target species and groups exhibit different migratory strategies, and such strategies are also influenced by bottleneck sites, topography, weather, behaviour, and other factors which influence the location of roost and rest sites[8]. Migration timing, coupled with the condition of individual birds and their level of exhaustion during migration, can also influence the location of roosting or resting sites along migratory routes, especially in cases where over-water crossings are involved, such as across the Red Sea between the Sinai Peninsula and the western GoS coast, where the proposed sites are located. This can result in dynamic spatial use of an area for roosting/resting, even for the same species. For example: one flock of birds undertakes the over-water crossing at a similar time to another, but the first encounters more difficult conditions or requires rest earlier then the second. While the second group passes through an area during the daytime, the first group stops for rest and roosts overnight.

Therefore, the study design aimed to document and characterise the extent to which migratory soaring birds rested or roosted in the proposed project areas and the immediate surrounding areas using the following approach:

- *Recording resting/roosting birds during OP observations* - visible ground was scanned thoroughly for any birds, and any birds identified resting or roosting on the ground were documented using the appropriate data sheet.

[8] E.g. Porter (2006) stated: "In the case of birds of prey the vast majority will pass overhead and not stop unless to roost as most do not feed on migration. The species that do are mainly those which migrate on a broad front, notably the harriers and falcons (especially Lesser Kestrel and Red-footed Falcon), but these are not known to gather in any concentration at the bottleneck" and "Storks are known to gather to feed on migration if the habitat is suitable; similarly White Pelicans will congregate on lakes where fish are abundant".

- *Recording roosting/resting birds outside of OP surveys* – During travel to/from OPs or between OPs and within 2-km of the sites, observers recorded any resting or roosting migratory soaring birds. These observations were recorded on a data sheet and roosting/resting sites were mapped.

2.4 Study Design - Accounting for potential environmental constraints

Some MSB and target species may be attracted to particular landscape features as they migrate. Such features may be attractive because they provide a concentrated source of food, such as carcass dump sites for many raptor and vulture species or a water body (permanent or ephemeral) for storks. Such features have the potential to be routinely used by these species and/or serve as an *attractant* within the landscape, altering individual bird behaviour during migration, and/or concentrating bird flight activity to/from this feature. Such features could elevate long term risks to these target species if the projects are constructed and, therefore, may be considered potential environmental constraints when assessing risks as part of the planning and consenting process[9].

The Team Manager considered any nearby site-specific conditions that could influence the behaviour of those species which could make use them for feeding constituting a constraint or which may require further specific mitigation and mapped these features, which included:

- *Plot 1 dam-formed artificial pond* – the artificial pond (Latitude 28.465359° Longitude 32.750984°) was previously formed as a result of the accumulation of rainfall during the 2021/2022 overwinter rainy period which was impounded behind a dam. This feature has the potential to act as a source of attraction for some migratory birds, particularly storks, pelicans and other waterbirds when water is present during the migration seasons.
- *Plot 2 dumpsite* – this illegal dumpsite spread alongside the road to Wadi Dara is used for carcass disposal unofficially by livestock and poultry farms located within Wadi Dara. This feature has the potential to attract birds of prey and vultures throughout the year, and in particular during migration seasons, as birds stopover at this site for feeding/scavenging.
- *Plot 2 Wadi Dara* - poultry farms, the poultry processing facility, livestock farms, residences, landscaped vegetation and other features located in and around the community of Wadi Dara have the potential to attract migratory birds drawn to these landscape features for resting/roosting and/or feeding/scavenging. Wadi Dara is largely situated southwest of the Plot 2 boundary.

Two (2) hours long survey visits were completed at these potential environmental constraints during the 2023 spring migration season with one day missed due to poor weather conditions. Surveys completed during Spring 2023 at the potential environmental constraints are summarised in Table 2.

Table 1: Summary of bird observation effort and approach for potential environmental constraints.

	Plot 1: dam/artificial pond	Plot 2: dumpsite	Plot 2: Wadi Dara
Survey method	Site Specific visits to the pond	Site specific visits to the dumpsite	Site specific visits to Wadi Dara
Spring 2023 dates (from/to)	20 Feb – 20 May	20 Feb – 20 May	20 Feb – 20 May
Spring 2023 number survey rounds	89 visits (daily through season excluding 1 bad weather day)	89 visits (daily through season excluding 1 bad weather day)	89 visits (daily through season excluding 1 bad weather day)

[9] It should be noted that such environmental constraints should be considered in the context of both wind turbine and overhead electrical line siting.

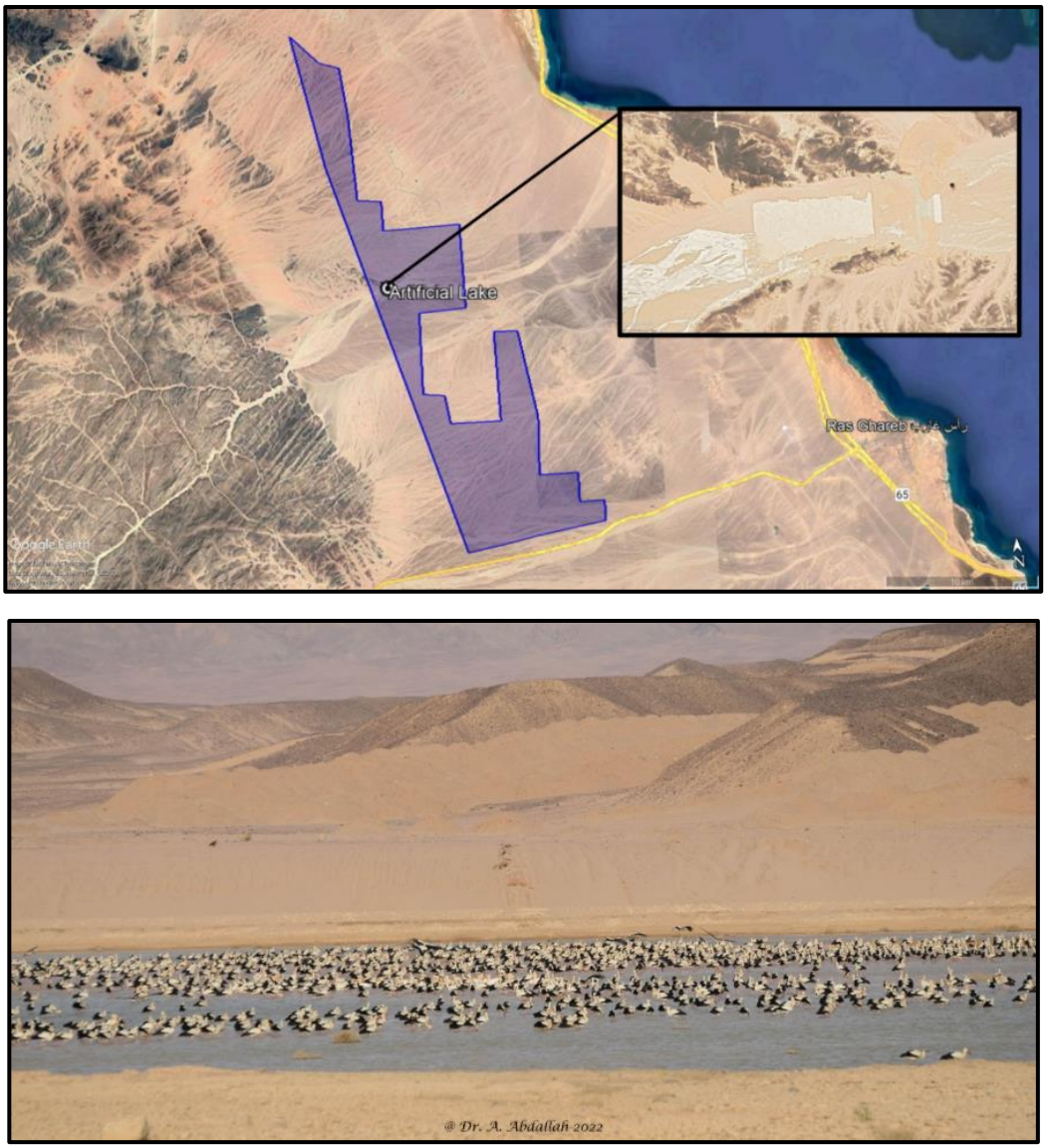


Figure 9: Location and photograph of the dam/artificial pond in Plot 1 during a previous rainy season

Figure 10: Location and photograph of the dry dam/artificial pond area in Plot 1 taken during 2023 when no water was present

Figure 11: Location and photos of the dumpsite in Plot 2

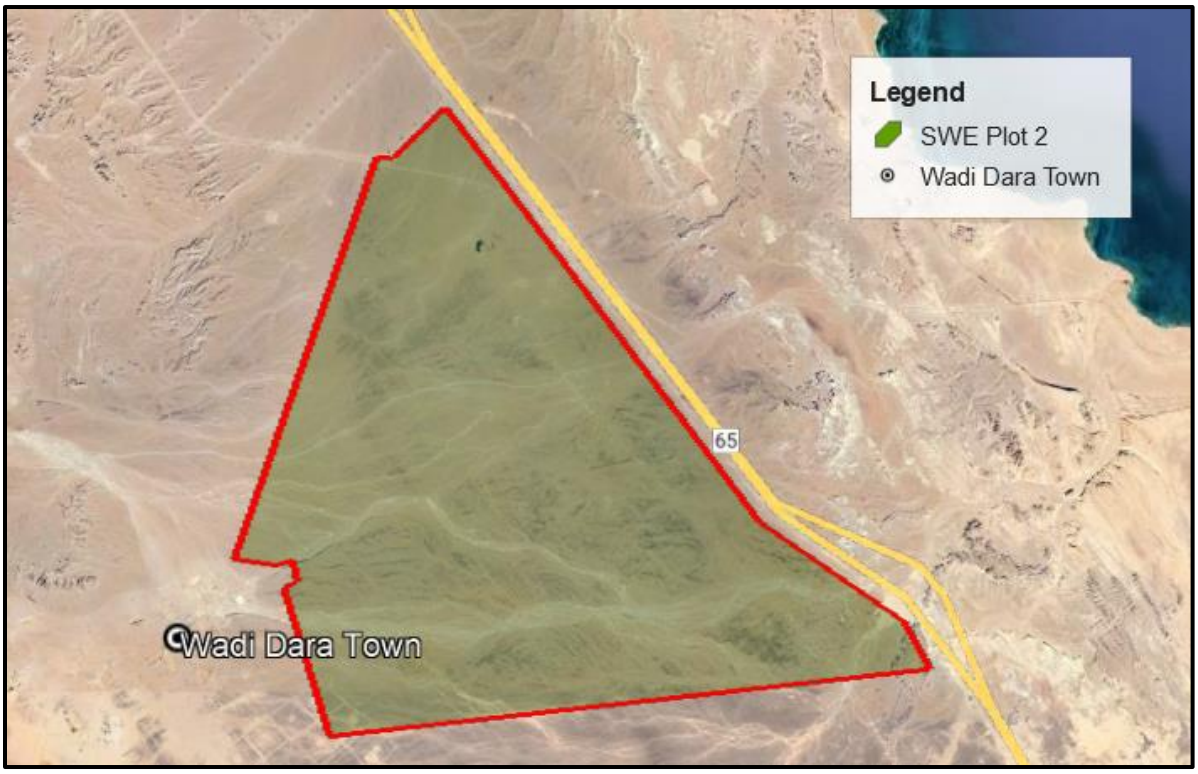
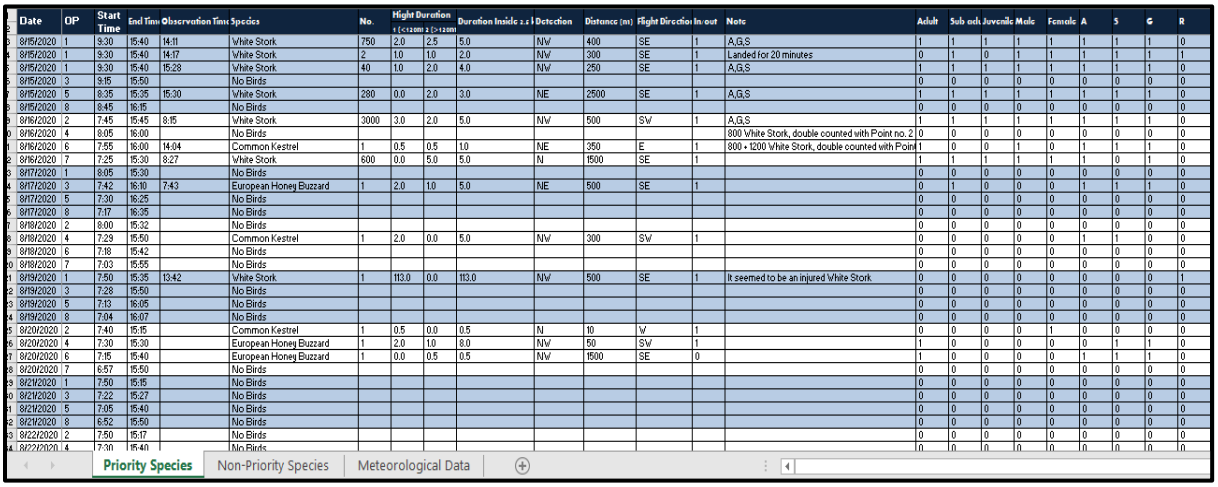


Figure 12: Location of Wadi Dara located near Plot 2

2.4.1 Data Management and Quality Control (QC)/ Quality Assurance (QA)

- Each observer had sufficient data sheets throughout the migration season. Each observer filled out the sheets on a daily basis.
- At the end of each day, each bird observer was required to thoroughly check the data sheet to ensure all inputs were included. In addition, at the end of each day, the observer performed a quality check to ensure the data is reasonable, factual, complete, accurate and representative. Any missing items were filled and any detected problems were resolved within the submitted data sheet.
- Through random and periodical inspections, the Team Leader undertook inspections on submitted data sheet by Observers to ensure all required inputs were included in a reasonable, factual, complete, accurate and representative manner. Any missing items or problems were solved and explained accordingly with the observer responsible for filling the sheet. Any changes were documented for future reference.
- The Team Leader designated one of the bird observers as a "Data Controller". The Data Controller was responsible for: (i) collection of the data sheets from the bird observer team on a daily basis; and (ii) entering the data into a master database (see example in figure below).
- Upon completion of data entry for the day, the Team Leader reviewed the data and checked for Quality Control and Assurance purposes on the data including data entry errors. Any discrepancies were identified, highlighted and doubled checked with the Data Controller and bird observer accordingly to e.g., double counts of the same species/groups. Given the size of the project area the chance of having birds passing through several points successively is high. This exercise was performed on a daily basis. Changes were documented for future reference.



	Date	OP	Start Time	End Time	Observation Time	Species	No.	Flight Duration		Duration Inside 2 x 2	Detection	Distance (m)	Flight Direction	In-out	Note	Adult	Sub adult	Juvenile	Male	Female	A	S	G	R
								1 (<=120m)	2 (>120m)															
3	8/15/2020	1	9:30	15:40	14:11	White Stork	750	2.0	2.5	5.0	NW	400	SE	1	A,G,S	1	1	1	1	1	1	1	1	0
4	8/15/2020	1	9:30	15:40	14:17	White Stork	2	1.0	1.0	2.0	NW	300	SE	1	Landed for 20 minutes	0	1	0	1	1	1	1	1	1
5	8/15/2020	1	9:30	15:40	15:28	White Stork	40	1.0	2.0	4.0	NW	250	SE	1	A,G,S	1	1	1	1	1	1	1	1	0
6	8/15/2020	3	9:15	15:50		No Birds										0	0	0	0	0	0	0	0	0
7	8/15/2020	5	8:35	15:35	15:30	White Stork	280	0.0	2.0	3.0	NE	2500	SE	1	A,G,S	1	1	1	1	1	1	1	1	0
8	8/15/2020	8	8:45	16:15		No Birds										0	0	0	0	0	0	0	0	0
9	8/16/2020	2	7:45	15:45	8:15	White Stork	3000	3.0	2.0	5.0	NW	500	SW	1	A,G,S	1	1	1	1	1	1	1	1	0
10	8/16/2020	4	8:05	16:00		No Birds									800 White Stork, double counted with Point no. 2	0	0	0	0	0	0	0	0	0
11	8/16/2020	6	7:55	16:00	14:04	Common Kestrel	1	0.5	0.5	1.0	NE	350	E	1	800 + 1200 White Stork, double counted with Point	1	0	0	1	0	1	1	1	0
12	8/16/2020	7	7:25	15:30	8:27	White Stork	600	0.0	5.0	5.0	N	1500	SE	1		1	1	1	1	1	1	0	1	0
13	8/17/2020	1	8:05	15:30		No Birds										0	0	0	0	0	0	0	0	0
14	8/17/2020	3	7:42	16:10	7:43	European Honey Buzzard	1	2.0	1.0	5.0	NE	500	SE	1		0	1	0	0	0	1	1	1	0
15	8/17/2020	5	7:30	16:25		No Birds										0	0	0	0	0	0	0	0	0
16	8/17/2020	8	7:17	16:35		No Birds										0	0	0	0	0	0	0	0	0
17	8/18/2020	2	8:00	15:32		No Birds										0	0	0	0	0	0	0	0	0
18	8/18/2020	4	7:29	15:50		Common Kestrel	1	2.0	0.0	5.0	NW	300	SW	1		0	0	0	0	0	1	1	0	0
19	8/18/2020	6	7:18	15:42		No Birds										0	0	0	0	0	0	0	0	0
20	8/18/2020	7	7:03	15:55		No Birds										0	0	0	0	0	0	0	0	0
21	8/19/2020	1	7:50	15:35	13:42	White Stork	1	113.0	0.0	113.0	NW	500	SE	1	It seemed to be an injured White Stork	0	0	0	0	0	0	0	0	1
22	8/19/2020	3	7:28	15:50		No Birds										0	0	0	0	0	0	0	0	0
23	8/19/2020	5	7:13	16:05		No Birds										0	0	0	0	0	0	0	0	0
24	8/19/2020	8	7:04	16:07		No Birds										0	0	0	0	0	0	0	0	0
25	8/20/2020	2	7:40	15:15		Common Kestrel	1	0.5	0.0	0.5	N	10	W	1		0	0	0	0	1	0	0	0	0
26	8/20/2020	4	7:30	15:30		European Honey Buzzard	1	2.0	1.0	8.0	NW	50	SW	1		1	0	0	0	0	0	1	1	0
27	8/20/2020	6	7:15	15:40		European Honey Buzzard	1	0.0	0.5	0.5	NW	1500	SE	0		1	0	0	0	0	1	1	1	0
28	8/20/2020	7	6:57	15:50		No Birds										0	0	0	0	0	0	0	0	0
29	8/21/2020	1	7:50	15:15		No Birds										0	0	0	0	0	0	0	0	0
30	8/21/2020	3	7:22	15:27		No Birds										0	0	0	0	0	0	0	0	0
31	8/21/2020	5	7:05	15:40		No Birds										0	0	0	0	0	0	0	0	0
32	8/21/2020	8	6:52	15:50		No Birds										0	0	0	0	0	0	0	0	0
33	8/22/2020	2	7:50	15:17		No Birds										0	0	0	0	0	0	0	0	0
34	8/22/2020	4	7:30	15:40		No Birds										0	0	0	0	0	0	0	0	0

Priority Species | Non-Priority Species | Meteorological Data

Figure 13: Master Database Template

2.5 Communication

All team members were provided with mobile phones including internet connection and WhatsApp phone application. The team in the field was in contact during the monitoring period via mobile phones and a dedicated WhatsApp group for immediate communication for any key issues to include for example: (i) follow up on the migrating flocks and individuals over the project area; (ii) avoiding double count of same flocks/individuals.

2.6 Required Resources and Equipment

Basic bird monitoring equipment was used throughout the period to include: binoculars, camera, and anemometer. Bird identification books/guides were available to observers especially during the periods of the junior training. For safety, vehicle/s remained onsite to ensure that the observers have access to first aid kits, water, and a transportation mean to the nearest medical care of any emergencies.

3. PLOT 1: RESULTS FOR SPRING 2023

3.1 Spring 2023 Effort

The overall effort and effort per OP for Plot 1 during spring 2023 is summarised in Table 3.

Table 2: Level of Effort during Avifaunal Assessments for Plot 1 during spring 2023

Season /dates	OP		Monitoring time
Plot 1			
Spring 2023 90 days (20 Feb–20 May)		OP-1	247 hr. 30 min
		OP-2	247 hr. 30 min.
		OP-3	247 hr. 30 min.
		OP-4	247 hr. 30 min.
		OP-5	247 hr. 30 min.
		OP-6	247 hr. 30 min.
		OP-7	247 hr. 30 min.
		OP-8	247 hr. 30 min.
		OP-9	247 hr. 30 min.
		OP-10	247 hr. 30 min.
		OP-11	247 hr. 30 min.
		OP-12	247 hr. 30 min.
		OP-13	247 hr. 30 min.
		OP-14	247 hr. 30 min.
		OP-15	247 hr. 30 min.
		OP-16	247 hr. 30 min.
		OP-17	247 hr. 30 min.
		OP-18	247 hr. 30 min.
	Total		**4,455 hr. 00 min.**

3.2 Observed Species Records and Individuals at Plot 1

For the reporting period, 27 MSB species were recorded with a total of 282,622 birds accounting for 10,768 records (Table 4). In addition, observers were not able to identify a total of 8,870 individuals and 590 records – those were classified as raptors or unidentified falcon, eagle, buzzard or harrier. 76.61% of the birds recorded belonged to only two (2) species; the White Stork and Steppe Buzzard. Only one species (White Stork) exceeded 100,000 individuals, while one species (Steppe Buzzard) exceeded 80,000 individuals, and Steppe Eagle, White Pelican, European Honey Buzzard and Black Kite all recorded over 12,000 individuals.

Seven (7) of these species (Table 4) are globally threatened according to the IUCN Red List (https://www.iucnredlist.org/): including two (2) Endangered-EN (Steppe Eagle and the Egyptian Vulture), and four (4) Vulnerable-VU species (Eastern Imperial Eagle, Greater Spotted Eagle, Red-footed Falcon and Sooty Falcon). In addition, one (1) species is Near Threatened-NT (Pallid Harrier). All the remaining MSB species observed were classified as Least Concern-LC.

Table 3: Summary of bird observation records during spring 2023 at Plot 1.

Species Name	Conservation Status [10]	National Status	# individuals	# records
Black Kite *Milvus migrans*	Least Concern	Passage migrant	12117	1560
Black Stork *Ciconia nigra*	Least Concern	Passage migrant	1113	92
Booted Eagle *Hieraaetus pennatus*	Least Concern	Passage migrant	315	278
Common Crane *Grus grus*	Least Concern	Passage migrant	626	11
Common Kestrel *Falco tinnunculus*	Least Concern	Passage migrant	244	235
Eastern Imperial Eagle *Aquila heliaca*	Vulnerable	Passage migrant	41	41
Egyptian Vulture *Neophron percnopterus*	Endangered	Passage migrant	261	207
Eurasian Hobby *Falco Subbuteo*	Least Concern	Passage migrant	1	1
Eurasian Sparrowhawk *Accipiter nisus*	Least Concern	Passage migrant	29	24
European Honey-buzzard *Pernis apivorus*	Least Concern	Passage migrant	12869	302
Greater Spotted Eagle *Clanga clanga*	Vulnerable	Passage migrant	16	16
Griffon Vulture *Gyps fulvus*	Least Concern	Passage migrant	3	3
Lanner Falcon *Falco biarmicus*	Least Concern	Passage migrant	5	4
Lesser Spotted Eagle *Clanga pomarina*	Least Concern	Passage migrant	649	329
Levant Sparrowhawk Accipiter brevipes	Least Concern	Passage migrant	999	15
Long-legged Buzzard *Buteo rufinus*	Least Concern	Passage migrant / winter visitor	123	104
Montagu's Harrier *Circus pygargus*	Least Concern	Passage migrant	10	10
Osprey *Pandion haliaetus*	Least Concern	Passage migrant	22	22
Pallid Harrier *Circus macrourus*	Near Threatened	Passage migrant / winter visitor	16	16
Red-footed Falcon *Falco vespertinus*	Vulnerable	Passage migrant	1	1
Short-toed Snake-eagle *Circaetus gallicus*	Least Concern	Passage migrant / summer breeder	1738	1029
Sooty Falcon *Falco concolor*	Vulnerable	Passage migrant / summer breeder	1	1
Steppe Buzzard *Buteo buteo vulpinus*	Least Concern	Passage migrant	83966	2940

[10] EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern

Species Name	Conservation Status [10]	National Status	# individuals	# records
Steppe Eagle *Aquila nipalensis*	Endangered	Passage migrant / Winter visitor	18835	2611
Western Marsh-harrier *Circus aeruginosus*	Least Concern	Passage migrant	40	39
White Pelican *Pelecanus onocorotalus*	Least Concern	Passage migrant	16321	57
White Stork *Ciconia ciconia*	Least Concern	Passage migrant	132261	230

3.3 Migration Patterns: Flocking behaviour

Flocking behaviour has a large influence on migratory patterns. There are species which migrate solitary or in small groups, whilst others form very large flocks. Both variables have implications for potential mitigation measures to reduce collision risk of operational wind turbine, as large flocks may cause a large number of fatalities in one single event compared to individuals flying alone. Table 4 presents the average flock size (individuals/group) for all species along with confidence intervals (± 95%), the number of records, and their minimum and the maximum values. Common Crane, European Honey Buzzard, White Pelican, and White Stork had the largest flock sizes and whilst Steppe Buzzard had lower flock sizes they were still above the remaining species. Generally, most of the remaining species were all estimated at less than 10 individuals per flock (group) with most being single birds.

Steppe Eagle observations were atypically small during spring 2022 at the site (with the exception of observations of 200 and 150 individuals on March 31st near OP13) as they normally migrate in loose groups. Again in 2023 generally small groups were recorded with few registrations of larger flocks peaking at 350 with only five records above 200. There could be several reasons for this pattern, including the influence of attractants from outside of the OP survey coverage area.

Table 4: Mean group size (flock size), the 95% confidence intervals, number of records and maximum group size (all lower confidence intervals are capped at 1 – see italics) for Plot 1 in spring 2023.

Species	Mean group	Conf. Lower 95%	Conf. Upper 95%	# records	# Maximum
Black Kite	7.77	7.01	8.52	1560.00	180.00
Black Stork	12.10	8.16	16.03	92.00	85.00
Booted Eagle	1.13	1.09	1.17	278.00	2.00
Common Crane	56.91	18.19	95.62	11.00	150.00
Common Kestrel	1.69	1.60	1.78	235.00	3.00
Egyptian Vulture	1.26	1.17	1.35	207.00	4.00
Eurasian Hobby	1.00	1.00	1.00	1.00	1.00
Eurasian Sparrowhawk	1.21	1.03	1.38	24.00	2.00
European Honey Buzzard	42.61	29.65	55.57	302.00	1000.00
Greater Spotted Eagle	1.00	1.00	1.00	16.00	1.00
Griffon Vulture	1.00	1.00	1.00	3.00	1.00
Imperial Eagle	1.00	1.00	1.00	41.00	1.00
Lanner Falcon	1.25	*1.00*	2.05	4.00	2.00
Lesser Spotted Eagle	1.97	1.70	2.25	329.00	24.00
Levant Sparrowhawk	66.60	*1.00*	152.75	15.00	600.00
Long-legged Buzzard	1.18	1.06	1.31	104.00	5.00
Marsh Harrier	1.03	*1.00*	1.08	39.00	2.00

Species	Mean group	Conf. Lower 95%	Conf. Upper 95%	# records	# Maximum
Montagu's Harrier	1.00	1.00	1.00	10.00	1.00
Osprey	1.00	1.00	1.00	22.00	1.00
Pallid Harrier	1.00	1.00	1.00	16.00	1.00
Red-footed Falcon	1.00	1.00	1.00	1.00	1.00
Short-toed Eagle	1.69	1.60	1.78	1029.00	21.00
Sooty Falcon	1.00	1.00	1.00	1.00	1.00
Steppe Buzzard	28.56	26.60	30.52	2940.00	450.00
Steppe Eagle	7.21	6.41	8.02	2611.00	350.00
White Pelican	348.84	240.70	456.98	57.00	1400.00
White Stork	593.96	450.19	737.73	230.00	8000.00

3.4 Distribution of Groups and Species over Observation Points, including analysis of flight height

Spatial analysis of the distribution of bird groups and species observed per OP was perfomed using the time spent within each area to assess relative patterns of bird activity observed during the season. Time in this case was the time spent by flocks/registrations rather than all individuals as this provides a more realistic insight in to the likely requirements of shutdown of turbines during windfarm operation. Figures were produced for key groups and species alongside analysis of flight height distribution of observations to allow for side by side comparisons and more resolution for assessing patterns of flight activity. Groups assessed included: All MSB and target species including unidentified species; all birds of prey (including unidentified species), and; storks and pelicans.

It should be noted that spatial patterns of bird flight activity may vary from one year to another based on environmental, ecological or other factors.

Key findings from the 2023 spring season at Plot 1, along with note on comparison to spring season 2022, are summarised as follows:

3.4.1 Groups

- For all MSB and target species, including unidentified species, the highest extrapolated passage rates (the total number of birds passing through each VP) were at OP11, with high rates also clustered in the central portion of the site (OP's 10,8,6,5 and 4). During Spring 2023 OP12 showed the highest amount of activity, by time, of all MSB and target species flocks, including unidentified species. The central areas of OP 10, 9 and 7 followed the next highest level of activity. OP3 in the northern section of site also showed high levels of activity
- In 2022, for all birds of prey (excluding unidentified species), the southern half of the site exhibited the highest extrapolated passage rates. In 2023 the highest amount of activity, by time, of all MSB and target species flocks, including unidentified species was through the southern portion of the centre of the site around OP's 12, 10 and 9, though relatively high rates were observed throughout the remainder of the site.
- In 2022 for storks and pelicans, extrapolated passage rates were highest in the southern half of the site, but were also high at the northern most OP (OP1). During 2023 the highest amount of activity, by time, of all MSB and target species flocks, including unidentified species was through the centre of the site at OP's 5, 7 and 11.

3.4.2 Species

- In 2022 Black Kites were recorded in greater numbers in the south-east of the site (OP11,12,15), and spent a greater proportion of time at lower altitudes (0-120m) in the southern area of the plot (OP12, 14, 17, 18 particularly). During 2023 the highest activity of this species in the southern part of the centre of site at OP's 11, 7 and 8. Black Kite spent a similar proportion of time above and below 240m during this season with the greatest time spent below 240m at the southern central section.

- During 2022 Black Storks appeared to occur in smaller numbers at the southern extent. Flight height patterns are unclear – partially due to some small sample sizes; however, it appears that a greater proportion of time is spent within low altitudes (0-120m) near the dam. During 2023 the highest activity of this species was in the central section, OP's 5 and 7 along with 8, 7 and 4. Again during 2023 greater activity at lower flight bands was recorded near the dam Wadi.

- During 2022 Egyptian Vultures were recorded in relatively low numbers in the middle of the site, with larger numbers of extrapolated passages patchily distributed towards the north and south extents. Flight height patterns are unclear due to low sample sizes. During 2023 the highest activity was at OP 11 in the centre of the site however activity was spread throughout the different areas. Higer levels of activity were recorded above 240m across the site.

- During 2022 Honey Buzzards occurred in the lowest flight band infrequently, with more time spent within 150-200m altitudes. The highest number of passages is expected to occurred at OP1 in the north of the site. Activity in 2023 was highest in the southern portion of site with OP's 14, 15 and 16 having the highest activity with more activity at the band above 240m.

- During 2022 Imperial Eagles spent a very small proportion of time within the 0-120m band, with the majority spent at altitudes over 200m. Spatial patterns between VPs where this species was recorded are unclear; however, no individuals were noted north of OP5 (slightly north of the dam). During 2023 records were spread throughout the site but highest activity present in the central section. The highest level of activity was between 150-200m.

- During 2022 and 2023 Levant Sparrowhawks were recorded in a small number of groups at a range of OP's. During 2023 more birds were recorded in the southern section however, sample sizes of observations were not large enough to identify flight height patterns.

- During both 2022 and 2023 Greater Spotted Eagle were recorded in small numbers.

- During 2022 Steppe Buzzards were recorded across the site, with no clear spatial patterns. Across the site, flight heights were relatively evenly spread across the height bands, with no clear spatial patterns in flight height. In 2023 higher activity was recorded in the central portions of site with the highest level of activity above 240m.

- During 2022 Steppe Eagles spent more time at greater heights (>200m), particularly at OP11, 13, 15, and 16. OP13 had the highest passage rate. During 2023 higher activity was recorded in the centre of the site around OP 11, 8 and 7 with the highest level of activity generally above 240m. High activity was also recorded between 150-200m at OP's 11 and 8.

- During 2022 White Pelicans spent the majority of time at low altitudes (0-120m), with highest passage rate at OP1, 3, and 15. Sample sizes were too low to investigate spatial variation in flight heights. During 2023 again there were no clear spatial patterns and there was a good spread of height bands used.

- During 2022 White Storks spent a large proportion of time between 0-120m heights. There were fewer passages in the south of the site. During 2023 the highest activity was in the centre of the site and a range of flight bands were used.

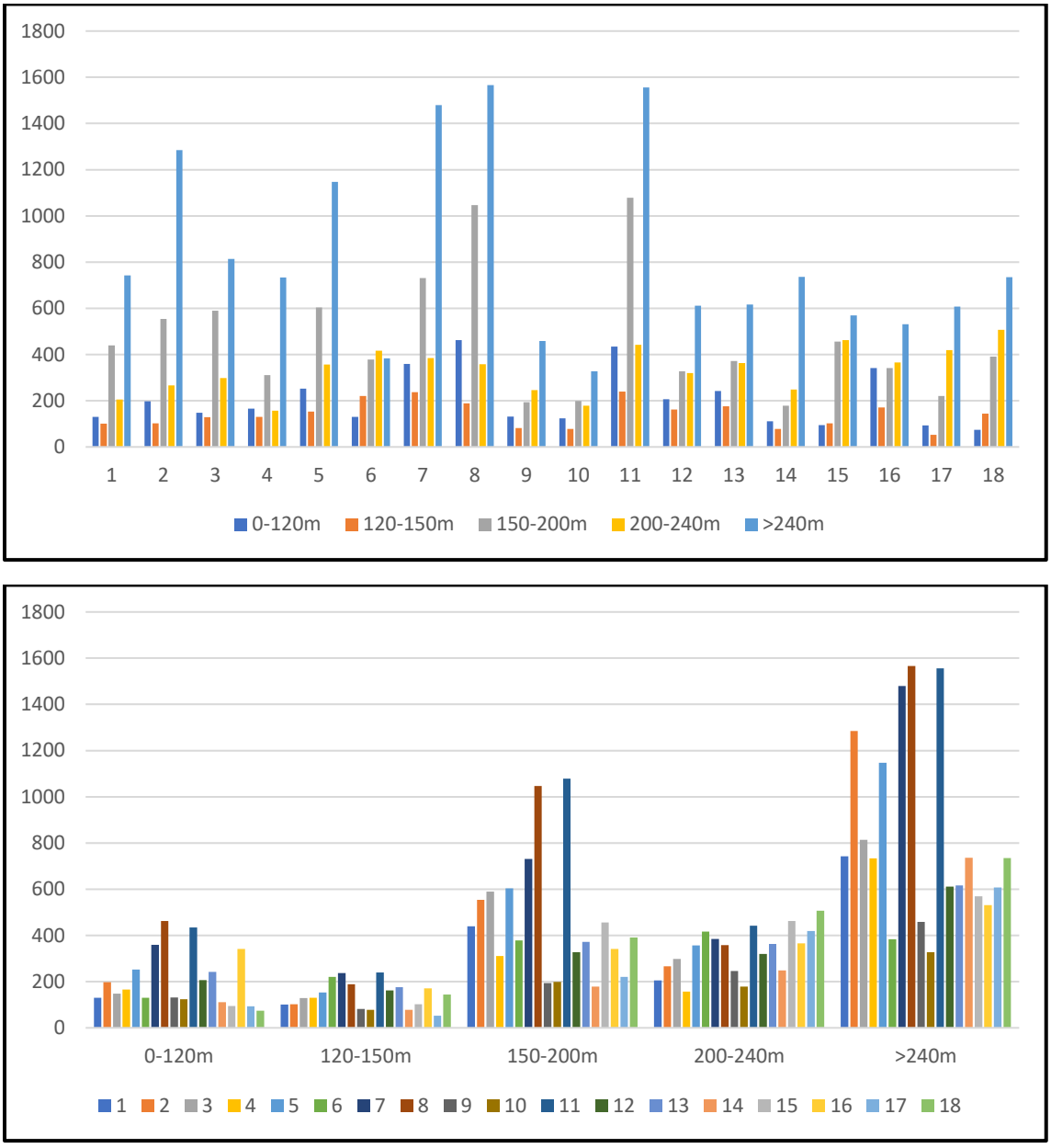


Figure 14: Time in minutes observed at flight height bands for all MSB and target bird species during spring 2023 migration season at Plot 1 . Shown by height band above and by VP below.

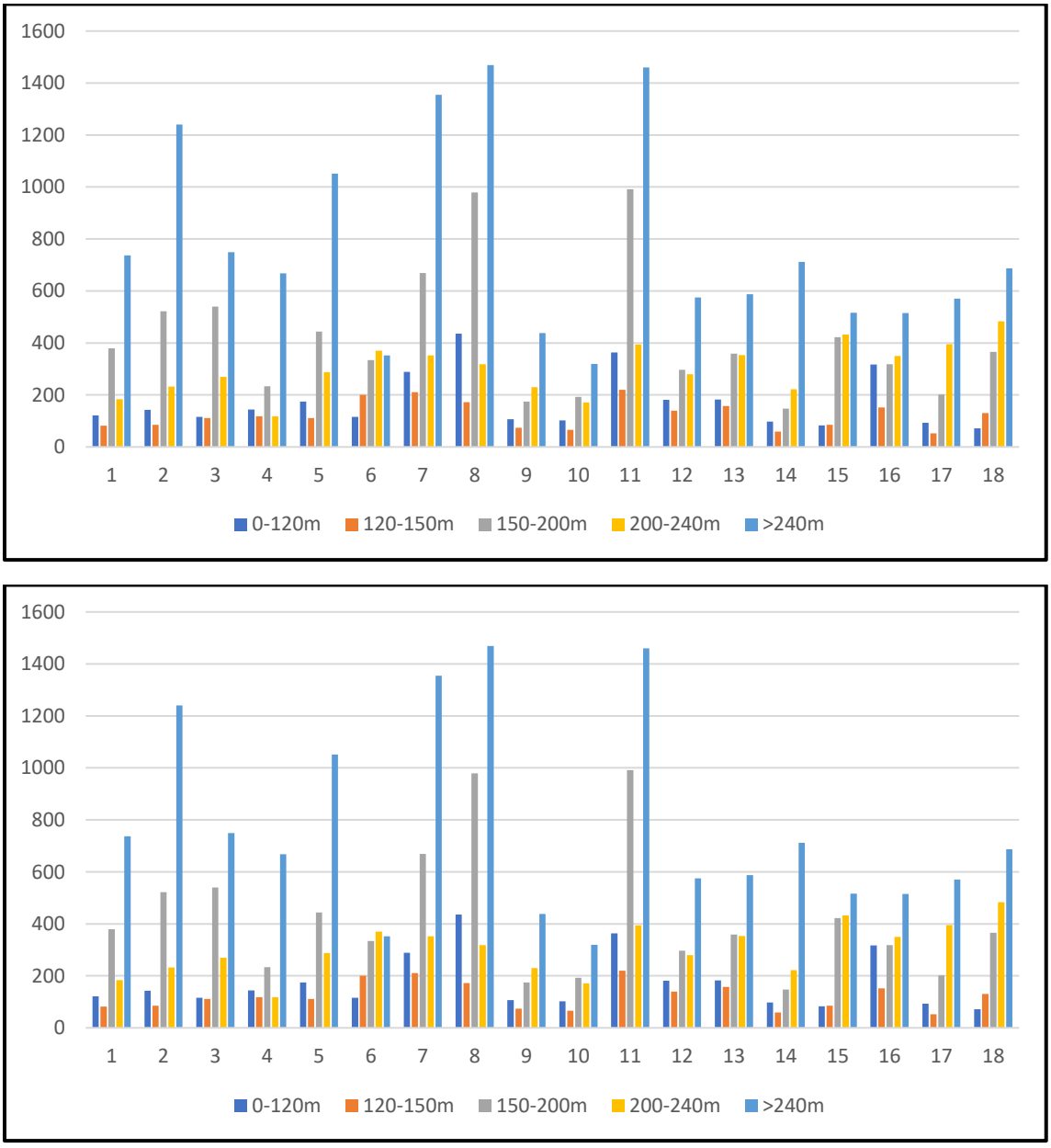


Figure 15: Time in minutes observed at flight height bands for all birds of prey during spring 2023 migration season at Plot 1. Shown by height band above and by VP below

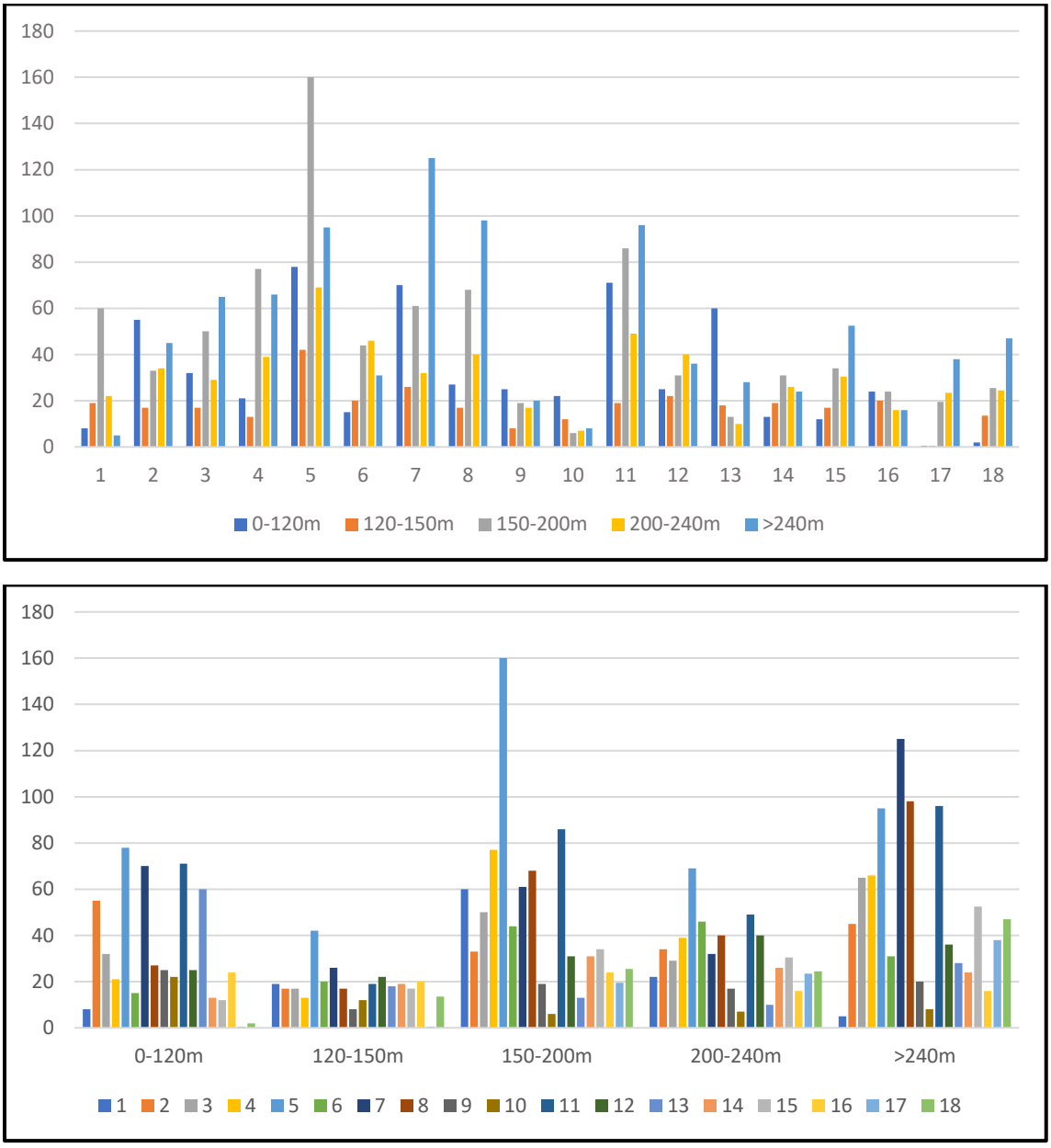


Figure 16: Time observed in minutes at flight height bands for all storks, cranes and pelicans during spring 2023 migration season at Plot 1. Shown by height band above and by VP below.

3.4.3 Flight height/bands

The client had not determined turbine specifications nor a turbine layout ahead of the development of the avi-fauna assessment; therefore, a Collision Risk Modelling (CRM) was not conducted. As a result, this report describes patterns of activity at the flight height bands used during the OP surveys. Number and percentages of all target bird species observed (individuals) were tabulated (Table 4Table 5) and plotted (figure below) to present proportion of the overall time spent within each height band, based on the data recorded at 15 second intervals during OP surveys.

Overall – for all species combined - the percentage of birds flying at risk height was 30% within the 150-m band and 59% within the 200-m band and 72% within the 250m band (Table 5). Overall this represents generally higher recorded flights than spring 2022. For species other than those with very low numbers of records, risk

increases as the flight height band is increased with one exception; the Common Crane risk increased above 200m however still over 50% of flights are above 240m showing a high use of this band. In 2022 White Pelican also showed high flight band use but that was not replicated in 2023

Table 5: Numbers of birds recorded per species and birds at risk height for turbine tip heights of 150, 200 and 240 m at Plot 1 during spring 2023.

Species	Total	At risk 150	At risk 150 %	At risk 200	At risk 200 %	At risk 240	At risk 240 %
Black Kite	12117	1774	14.64	4602	37.98	7256.00	59.88
Black Stork	1113	392	35.22	680	61.10	845.00	75.92
Booted Eagle	315	62	19.68	162	51.43	225.00	71.43
Common Crane	626	8	1.28	8	1.28	289.00	46.17
Common Kestrel	244	144	59.02	191	78.28	207.00	84.84
Egyptian Vulture	261	43	16.48	119	45.59	183.00	70.11
Eurasian Sparrowhawk	29	11	37.93	25	86.21	27.00	93.10
European Honey Buzzard	12869	888	6.90	2931	22.78	6996.00	54.36
Greater Spotted Eagle	16	3	18.75	10	62.50	12.00	75.00
Griffon Vulture	3	0	0.00	2	66.67	3.00	100.00
Hobby	1	1	100.00	1	100.00	1.00	100.00
Imperial Eagle	41	9	21.95	26	63.41	36.00	87.80
Lanner Falcon	5	2	40.00	2	40.00	3.00	60.00
Lesser Spotted Eagle	649	51	7.86	302	46.53	424.00	65.33
Levant Sparrowhawk	999	1	0.10	317	31.73	335.00	33.53
Long-legged Buzzard	123	36	29.27	82	66.67	108.00	87.80
Marsh Harrier	40	25	62.50	32	80.00	36.00	90.00
Montagu's Harrier	10	10	100.00	10	100.00	10.00	100.00
Osprey	22	5	22.73	13	59.09	19.00	86.36
Pallid Harrier	16	12	75.00	14	87.50	14.00	87.50
Raptor species	3982	191	4.80	483	12.13	777.00	19.51
Red-footed Falcon	1	0	0.00	1	100.00	1.00	100.00
Short-toed Eagle	1738	250	14.38	725	41.71	1037.00	59.67
Sooty Falcon	1	1	100.00	1	100.00	1.00	100.00
Steppe Buzzard	83966	9920	11.81	28662	34.14	38761.00	46.16
Steppe Eagle	18835	5140	27.29	10762	57.14	14511.00	77.04
White Pelican	19884	11810	59.39	15068	75.78	18740.00	94.25
White Stork	136611	54562	39.94	107776	78.89	121760.00	89.13
Total	**294517**	**85351**	**28.97999**	**173007**	**58.74261927**	**212617**	**72.19176**
Falcon species	8	1	12.50	3	37.50	5.00	62.50
Unidentified buzzard	3732	90	2.41	240	6.43	875.00	23.45
Unidentified eagle	1142	34	2.98	104	9.11	516.00	45.18
Unidentified harrier	6	4	66.67	5	83.33	6.00	100.00

Species	Total	At risk 150	At risk 150 %	At risk 200	At risk 200 %	At risk 240	At risk 240 %
Total	4888	129	2.64	352	7.201309329	1402	28.68249

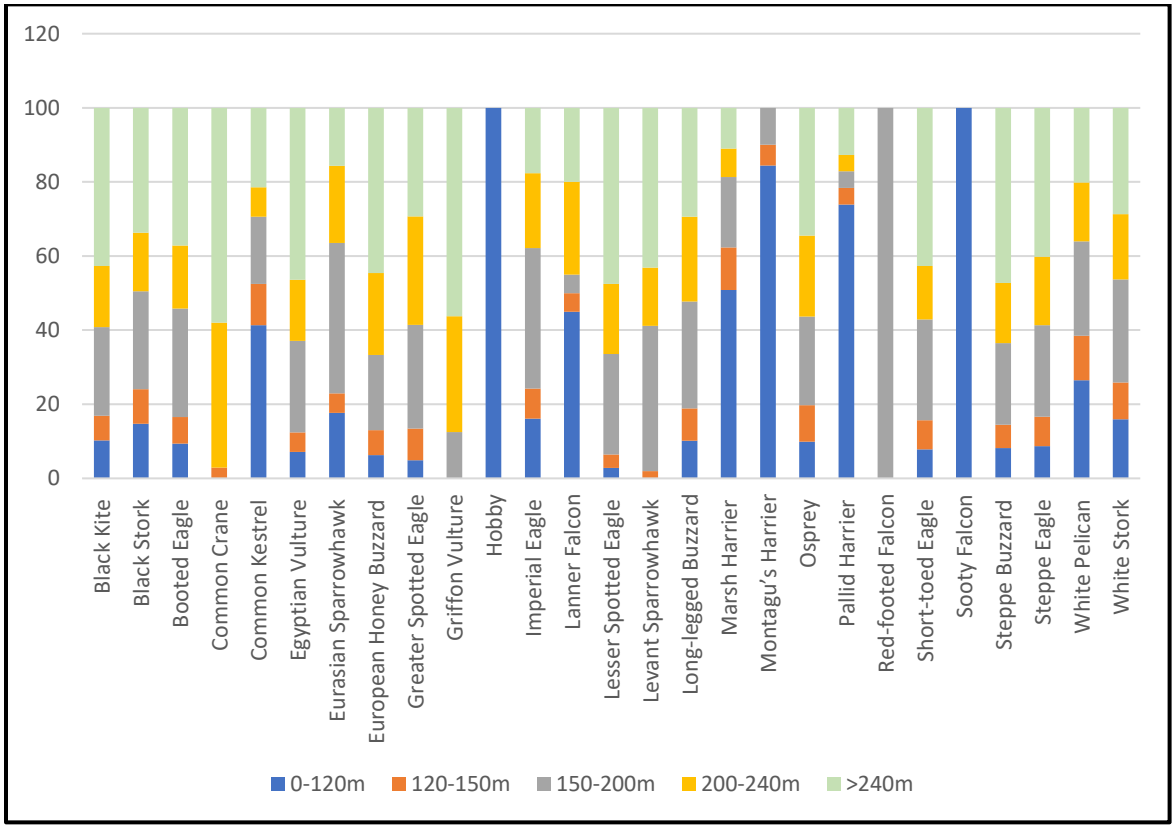


Figure 17: Proportion of time spent within flight height bands for selected species observed at Plot 1 during Spring 2023.

3.5 Temporal analysis – Weekly & Daily – Distribution of Records and Individuals

To assess temporal patterns of activity within the migration periods, passage rates per week of observation was analysed to shed light on the highest weekly periods of overall and species-specific migration patterns within the observation period. Cumulative migration activity was also assessed. In addition, the observations per hour of the day for groups and species were assessed to assess daily patterns of activity to aid the assessment of which times of day experience the highest migration flight activity.

3.5.1 Groups

For all MSB and target birds in 2023 the Figure below illustrates low initial overall activity during late February-mid-March until a sharp increase in activity at the end of March. Following this peak activity spikes in migratory movements were recorded throughout April and then only one late spike in activity just after mid-May. During 2022 activity peaked at a similar time, albeit very slightly later from late March into very early April. Activity then slowly reduced until the end of the survey season and did not have the late peak of 'held up' migration activity. In week 13 to the peak activity period from the end of March-early April, followed by a gradual tailing off until mid-May. In both years the early peak of activity is led by high levels of White Stork activity.

In respect to daily activity patterns, overall, for all MSB and target species activity peaked between 13:00 and 14:00. Activity broadly increased and decreased either side of this peak although higher activity was recorded between 09:00 and 10:00 and 17:00 and 18:00 which is likely based around activity of birds associated with

roosting behaviour at the start and end of the day. This is in contrast to results from 2022 which showed there were two daily peaks in activity – one in the mid-morning and another in the early afternoon, which coincides with the pattern observed in other similar seasonal migration monitoring studies completed in the region.

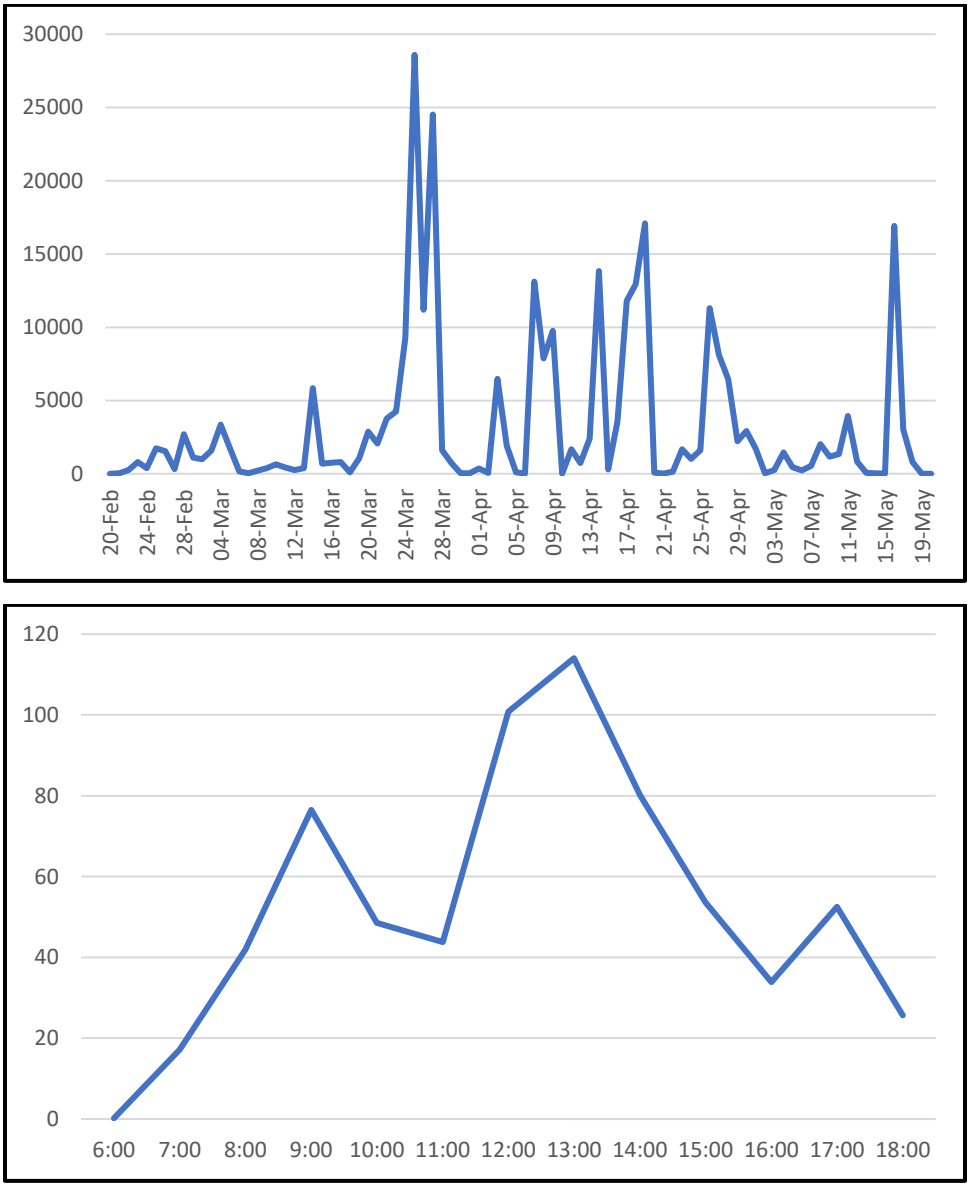


Figure 18: Temporal analysis of all MSB and target birds, excluding unidentified species, at Plot 1 during spring 2023. Daily and hourly plots are included.

The number of birds was assessed for all birds of prey (figure below), showing intermittent peaks throughout the season. The peaks in March and April are attributed to high levels of Steppe Buzzard activity and the mid-May peak attributed to late Honey Buzzard movements. This activity aligns with 2022 activity which showed a peak between mid-March and mid-April, which is coincident with the bulk period for Steppe Buzzard and Steppe Eagle passage. During 2022 the Honey Buzzard peak was in April to May which is more typical for this species.

Activity of Steppe Eagle in 2023 showed peaks from late February to early March which is slightly earlier than the 2022 peak for the species.

Harriers and Falcons were typically recorded in lower numbers such that analysis of their activity across the day or season provided less valuable clear results.

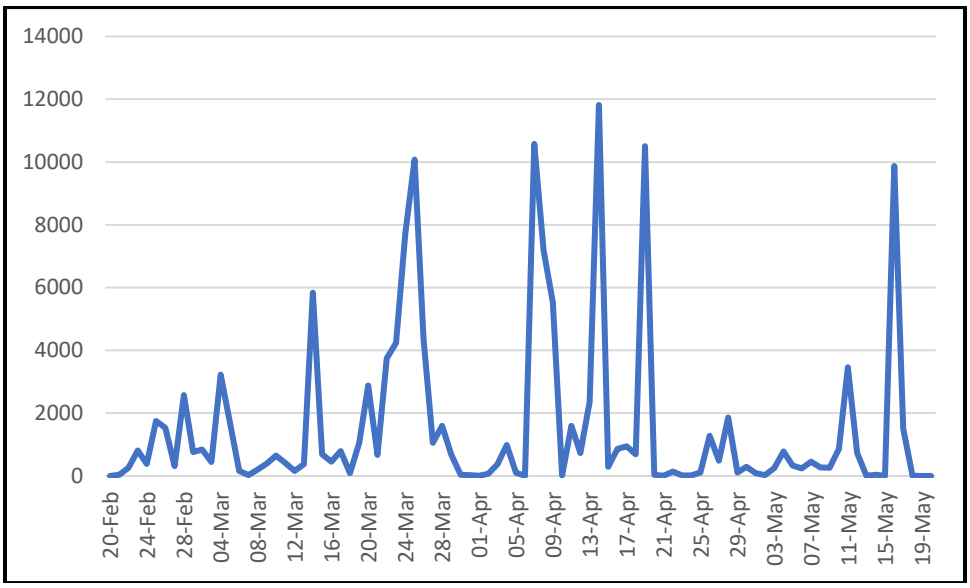


Figure 19: Birds of prey observed at Plot 1 during spring 2023.

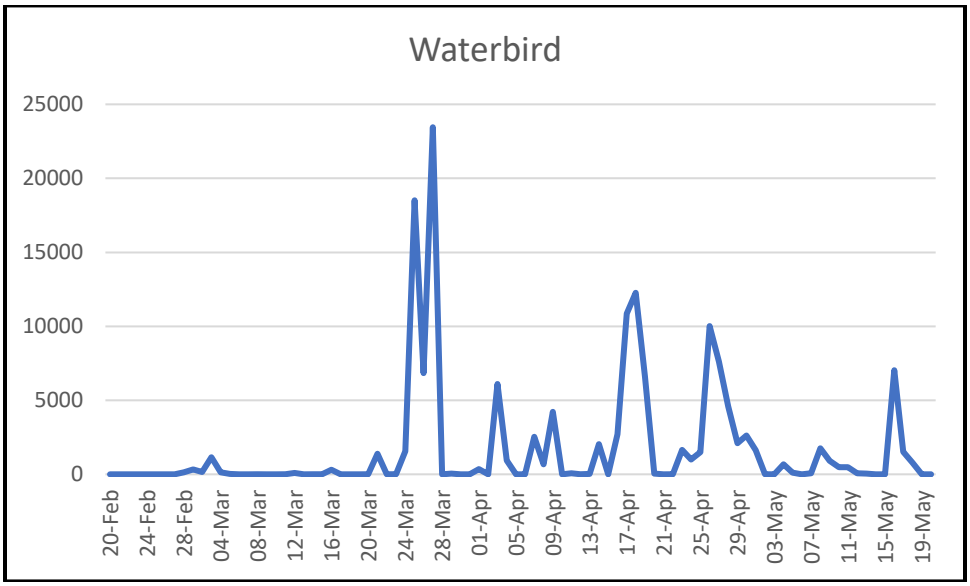


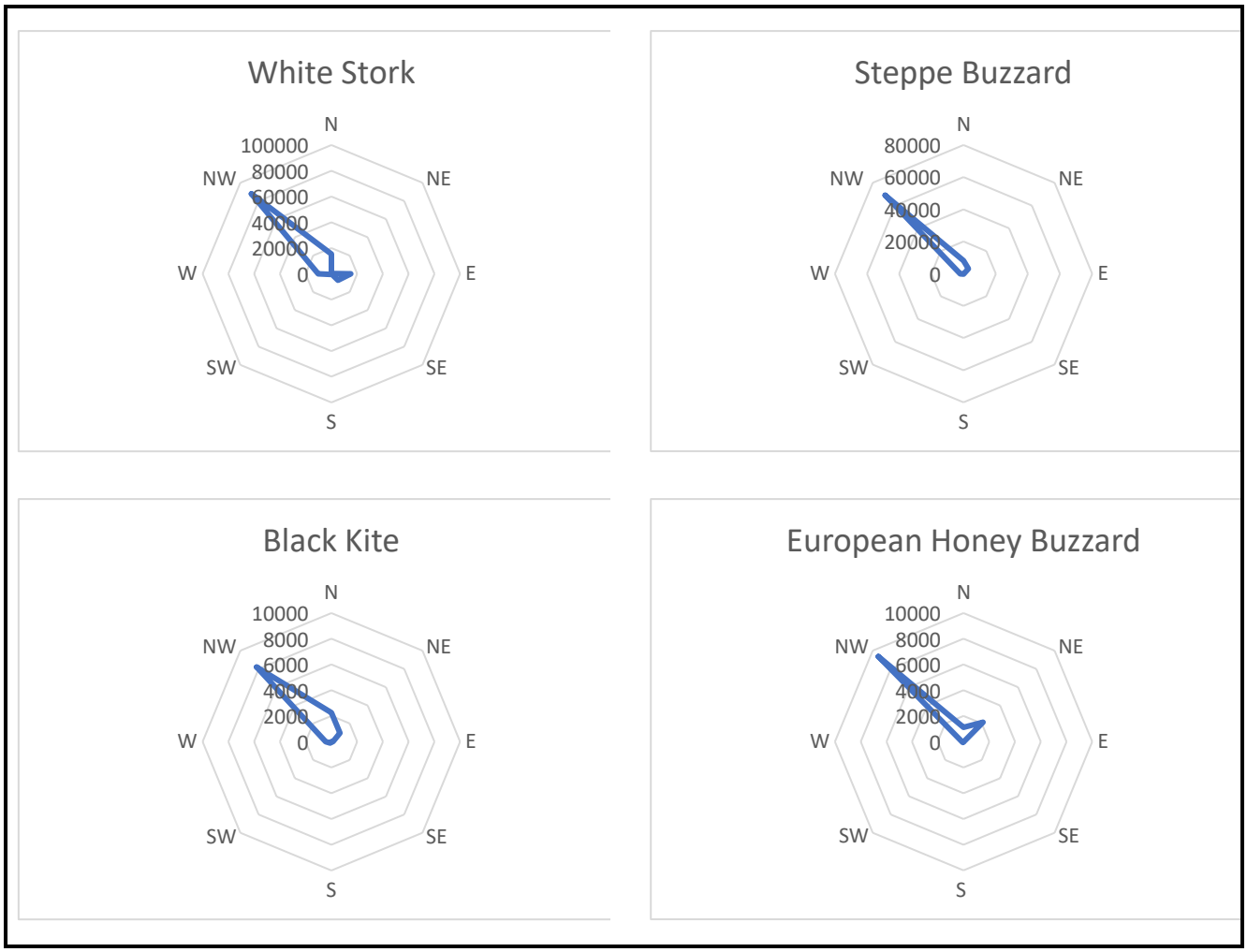
Figure 20: Stork, Crane and Pelican observed at Plot 1 during spring 2023.

Harriers and Falcons were typically recorded in lower numbers such that analysis of their activity across the day or season provided less valuable clear results.

3.6 Flight direction

Prevailing flight direction during spring 2022 for the five (5) most abundant MSB species (white stork, steppe buzzard, black kite, honey buzzard, and steppe eagle; cumulatively representing 97% of the observations made during the season) is shown in the figure below. There was a clear orientation for all five species to the

northwest, which could be associated with birds utilising the ridgeline of the mountains to the west of the Red Sea. The mountains at variable distance from the coast would help the birds to migrate in an easier way, relying on the up-air currents which appear when a mountain slope diverts the winds, causing air currents to climb[11]. Following the mountain range, birds would reach the Gulf of Suez in a much easier way compared to flying over the open desert, where they primarily benefit from only thermal soaring - despite the good conditions of the region for such kind of flight.



[11] This is so-called slope soaring.

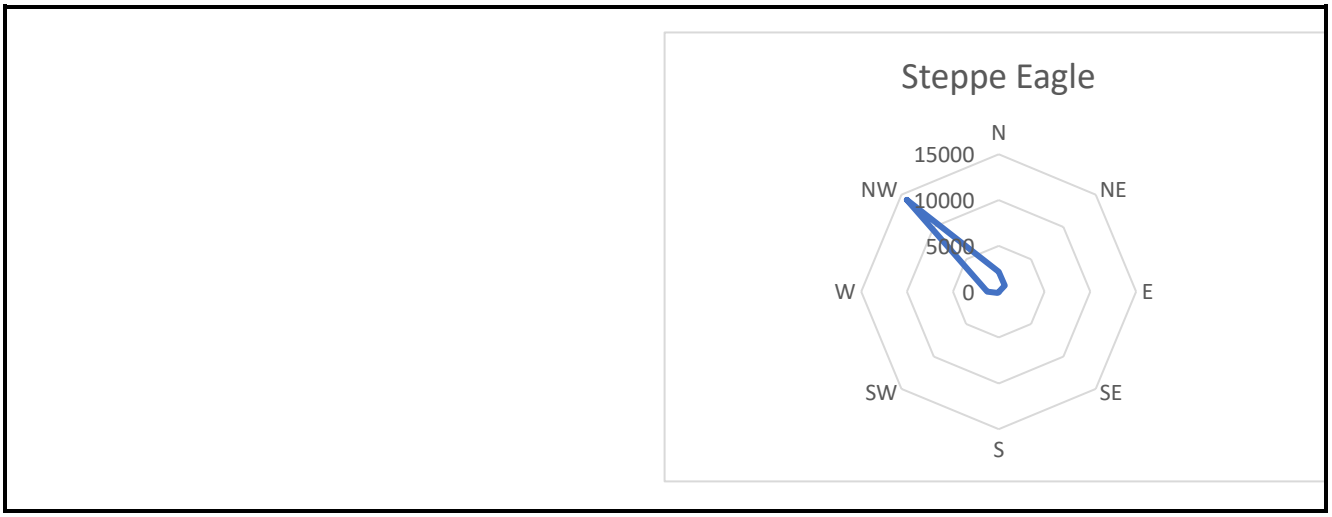


Figure 21: Observed flight direction of the five most abundant migratory soaring birds observed at Plot 1 during spring 2023.

3.7 Bird observations at potential environmental constraint – artificial pond/dam

As noted, no water was present in the dam location during spring 2023 which is different to spring 2022 where water was recorded. It is believed to hold water approximately once every 4 years. The clear difference between 2022 and 2023 was the number of White Stork recorded. Records in 2022 saw 6,000 individuals recorded on a single observation day (figure below), and over 15,000 recorded during all surveys at the dam location performed during the spring 2022 survey period. No individuals were recorded at the dam location (e.g. on the ground) during 2023. The clear driver for this activity is the presence of water at the dam and so this is an influx that could happen around every 4 years depending upon weather conditions.

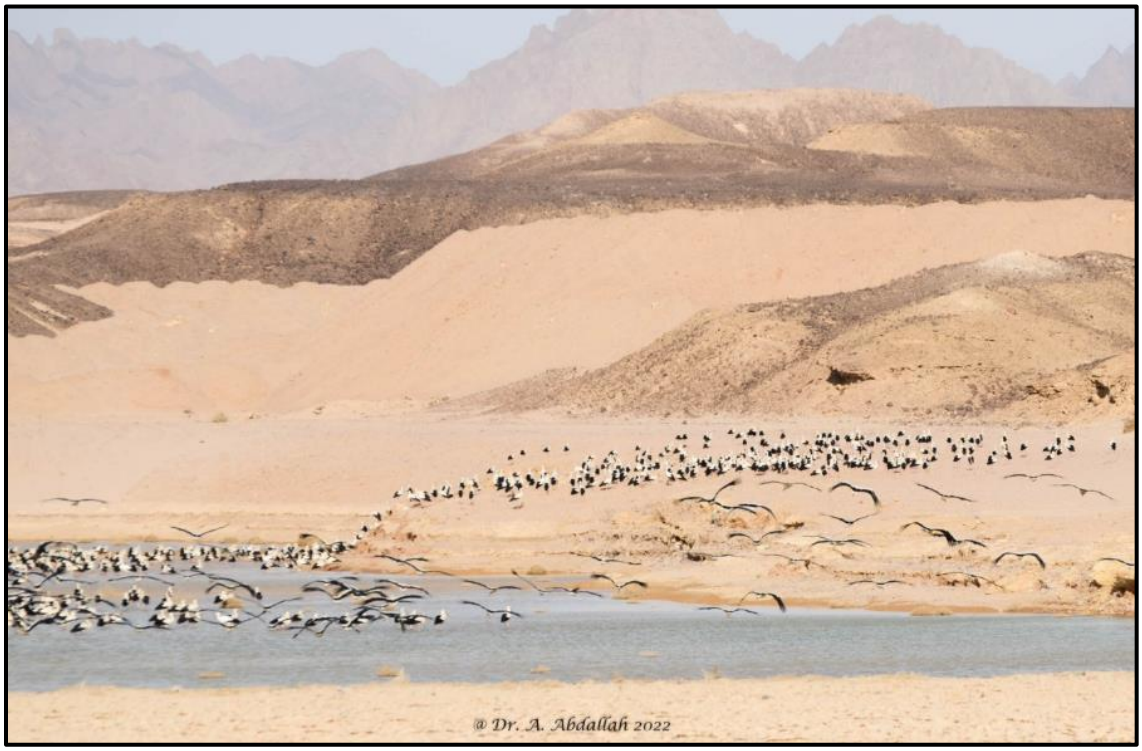


Figure 22: Photo of White Storks in the water and the surrouding area to the artificial pond/dam located within Plot 1 during spring 2022.

Table 6: Bird species, number of individuals and peak count/species recorded during surveys performed of the artificial pond/dam located within Plot 1 during spring 2023.

Species	Peak Count	Total Count
Barn Swallow	7	58
Bar-Tailed Lark	10	19
Bee Eater	25	98
Black Kite	1	2
Chiffchaff	6	58
Collared Dove	1	1
Collared flycatcher	1	1
Crowned Sandgrouse	46	83
Desert Lark	7	58
Desert Wheatear	1	4
Eastern Orphean Warbler	1	1
Golden Oriole	5	18
Gull sp.	1	1
Honey Buzzard	1	1
Hoopee Lark	3	4
Hoopoe	2	11
House Martin	10	45
Isabelline Wheatear	2	3
Kestrel	2	9
Lark sp.	6	6
Lesser White Throat	15	200
Marsh Harrier	1	2
Masked Shrike	1	3
Mourning Wheatear	2	31
Northern Wheatear	3	17
Red-throated pipit	5	10
Rufous Bush Robin	1	1
Ruppell's Warbler	1	2
Sandgrouse sp.	10	19
Savi's Warbler	4	4
Short toed Eagle	1	1
Sparrowhawk	2	8
Spotted flycatcher	5	32
Spotted Sandgrouse	8	9
Squacco Heron	7	7
Steppe Buzzard	4	4
Swift	1	1
Tawny Pipit	12	75
Turtle Dove	2	4
White Wagtail	2	10
Willow Warbler	1	1
Wood Warbler	3	9
Woodchat shrike	1	5
Yellow Wagtail	5	5

4. PLOT 1: CONCLUSIONS AND RECOMMENDATIONS

1. The observation effort of the OP surveys at Plot 1 during both seasons was in line with GIIP for migratory bird studies and consistent with recommended methods used in Egypt.

2. The data collection, survey management, and data QA/QC procedures are considered to be of GIIP standards. The survey spatial coverage of the project areas and the immediate area around the site boundary was broadly considered good.

3. Daily effort at the site was increased for the 2022 migration studies and a comparative effort undertaken in 2023. Gaps in the available data for assessing risks to MSB and target species include: the absence of a WTG layout or model, precluding Collision Risk Modelling (CRM); the absence of information on project-associated overhead electrical transmission lines, precluding the characterisation of risk associated with this infrastructure component of the project. These gaps are recommended to be addressed prior to drafting the ESIA.

4. Inter-annual variation in the migration patterns of birds in the region is commonly documented during multi-annual migration studies performed at wind energy facilities. These variations include: the number of individuals recorded overall, and per species within seasons; the spatial patterns of activity within and near the proposed project area; the flight height characteristics of birds flying through the area, the temporal patterns of migration activity; the flight directions (typically minor, not major) of species and species assemblages; as well as resting and roosting activity. All of these aspects may be influenced by environmental and ecological factors at the site scale, the regional scale, the flyway scale or at the breeding and overwintering scales. As such, reliance on even two seasons worth of data collection to represent migratory bird activity and risk at a proposed wind project for the *proposed life* of the project may be misleading given the known possible shift in activity over time. However, the two years of extensive survey effort certainly provide a suitable level of background data to present the risks to birdlife at this proposed site within an ESIA.

5. The total number of individual birds and species recorded during spring 2022 and 2023 seasons - 252,492 individuals of 27 species during spring 2022, and 282,622 individuals of 27 species during spring 2023 – are within the ranges reported and available to the authors at other wind energy studies performed in the region during previous years.

6. During 2023 species recorded included seven (7) globally threatened species according to the IUCN Red List (https://www.iucnredlist.org/), an increase from the 6 of 2022: including two (2) Endangered-EN (Steppe Eagle and the Egyptian Vulture), and four (4) Vulnerable-VU species (Eastern Imperial Eagle, Greater Spotted Eagle, Red-footed Falcon and Sooty Falcon). In addition, one (1) species is Near Threatened-NT (Pallid Harrier). All the remaining MSB species observed were classified as Least Concern-LC

7. Spatial analysis of MSB and target bird activity and flight height data suggest that certain areas of Plot 1 experience higher migratory flight activity in comparison to other portions within each season for particular species assemblages and the specific species analysed for this report. Whilst the centre of site appears to have a higher likely risk no portions of Plot 1 present low risk to MSB and target species in either spring 2022 or 2023 seasons without the implementation of minimisation and mitigation strategies including shut down on demand. It is recommended that minimisation and mitigation approaches are developed for the site as part of the ESIA consistent with those developed for other nearby wind energy facilities.

8. The flight height analysis completed for this report indicates that broadly birds were recorded flying higher across site in 2023 than 2022. However over 70% of records were below 240m and high numbers of birds in each year are a consideration for the requirements of mitigation. CRM was not performed for this report as no WTG model or layout is yet available. CRM is recommended to be completed as part of the ESIA.

9. A potential environmental constraint was documented at Plot 1 in the form of an artificial pond/dam site. This site was surveyed for part of the spring 2022 season and for all of the spring 2023 season. The data recorded during these surveys strongly indicates that the site serves as an important stopover site for some MSB/target species in the spring when water is present, but not when water is absent. The presence of this stopover habitat within the project area increases the risk profile for the spring migration period and the following recommendations were previously made. Whilst no water was recorded at this site in spring 2023 it is considered appropriate that the recommendation of appropriate mitigation remains. For siting, the WTG layout should avoid any turbine in a 2 km radius around the site unless management measures are undertaken to remove the dam and prevent water from pooling in the artificial pond area. If the pooling water is removed, then the source of attraction for MSB and target species is likely to be eliminated. If the existing dam is removed, an alternate site for an artificial pond should be provided within the flyway but outside proposed or under-development wind energy facilities, as standing water features are critical features for many migratory birds.

10. Additional monitoring, avoidance, minimisation, and mitigation methods are recommended to be developed following the production of additional analyses described in this section, as well as the production of cumulative effects analysis and critical habitats assessment. It is recommended that such analysis account for both the wind energy facility, as well as for associated overhead electrical transmission lines.

5. PLOT 2: RESULTS FOR SPRING 2023

5.1 Spring 2023 Effort

The overall effort and effort per OP for Plot 2 during spring 2023 is summarised in the table below.

Table 7: Level of Effort during Avifaunal Assessments for Plot 1 during spring 2023

Season /dates	OP		Monitoring time
Plot 1			
Spring 2023 90 days (20 Feb–20 May)		OP-1	245 hr. 30 min
		OP-2	251 hr. 00 min.
		OP-3	237 hr. 30 min.
		OP-4	245 hr. 30 min
		OP-5	249 hr. 30 min
		OP-6	237 hr. 30 min.
		OP-7	251 hr. 00 min.
		OP-8	236 hr. 30 min.
		OP-9	245 hr. 00 min.
	Total		**2,199 hr. 00 min.**

5.2 Observed Species Records and Individuals at Plot 2

For the reporting period, 26 MSB species were recorded with a total of 330,820 birds accounting for 3,667 records (Table 8). In addition, observers were not able to identify a total of 710 individuals and 98 records – those were classified as raptors or unidentified falcon, eagle, buzzard or harrier. Over 85% of the birds recorded belonged to only three species; the White Stork, European Honey Buzzard and Steppe Buzzard with the majority of these being White Stork. Only one species (White Stork 242,258) exceeded 25,000 individuals, while European Honey Buzzard and Steppe Buzzard exceeded 20,000 individuals. Steppe Eagle, White Pelican, Levant Sparrowhawk, Black Kite and Common Crane all recorded over 6,000 individuals.

Six (6) of these species (Table 8) are globally threatened according to the IUCN Red List (https://www.iucnredlist.org/): including two (2) Endangered-EN (Steppe Eagle and the Egyptian Vulture), and three (3) Vulnerable-VU species (Eastern Imperial Eagle, Greater Spotted Eagle and Sooty Falcon). In addition, one (1) species is Near Threatened-NT (Pallid Harrier). All the remaining MSB species observed were classified as Least Concern-LC.

Table 8: Summary of bird observation records during spring 2022 at Plot 1.

Species Name	Conservation Status[12]	National Status	# individuals	# records
Black Kite *Milvus migrans*	Least Concern	Passage migrant	6214	632
Black Stork *Ciconia nigra*	Least Concern	Passage migrant	1108	82
Booted Eagle *Hieraaetus pennatus*	Least Concern	Passage migrant	69	64
Common Crane *Grus grus*	Least Concern	Passage migrant	7697	65
Common Kestrel *Falco tinnunculus*	Least Concern	Passage migrant	97	91
Eastern Imperial Eagle *Aquila heliaca*	Vulnerable	Passage migrant	14	14
Egyptian Vulture *Neophron percnopterus*	Endangered	Passage migrant	51	38
Eurasian Hobby *Falco Subbuteo*	Least Concern	Passage migrant	1	1
Eurasian Sparrowhawk *Accipiter nisus*	Least Concern	Passage migrant	24	20
European Honey-buzzard *Pernis apivorus*	Least Concern	Passage migrant	21157	342
Greater Spotted Eagle *Clanga clanga*	Vulnerable	Passage migrant	6	6
Griffon Vulture *Gyps fulvus*	Least Concern	Passage migrant	2	2
Lanner Falcon *Falco biarmicus*	Least Concern	Passage migrant	1	1
Lesser Spotted Eagle *Clanga pomarina*	Least Concern	Passage migrant	200	109
Levant Sparrowhawk Accipiter brevipes	Least Concern	Passage migrant	8565	10
Long-legged Buzzard *Buteo rufinus*	Least Concern	Passage migrant / winter visitor	53	45
Montagu's Harrier *Circus pygargus*	Least Concern	Passage migrant	6	6
Osprey *Pandion haliaetus*	Least Concern	Passage migrant	5	5
Pallid Harrier *Circus macrourus*	Near Threatened	Passage migrant / winter visitor	1	1
Short-toed Snake-eagle *Circaetus gallicus*	Least Concern	Passage migrant / summer breeder	143	116
Sooty Falcon *Falco concolor*	Vulnerable	Passage migrant / summer breeder	1	1
Steppe Buzzard	Least Concern	Passage migrant	22645	934

[12] EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern

Species Name	Conservation Status[12]	National Status	# individuals	# records
Buteo buteo vulpinus				
Steppe Eagle *Aquila nipalensis*	Endangered	Passage migrant / Winter visitor	6872	747
Western Marsh-harrier *Circus aeruginosus*	Least Concern	Passage migrant	45	42
White Pelican *Pelecanus onocorotalus*	Least Concern	Passage migrant	13585	75
White Stork *Ciconia ciconia*	Least Concern	Passage migrant	242258	218

5.3 Migration Patterns: Flocking behaviour

Table 10 presents the average flock size (individuals/group) for all species along with confidence intervals (± 95%), the number of records, and their minimum and the maximum values. White Stork, White Pelican and Levant Sparrowhawk had the largest flock sizes. Common Crane, European Honey Buzzard and Steppe Buzzard were the next highest group sizes. Generally, most of the remaining species were all estimated at around or less than 10 individuals per flock (group) with most being close to single birds. In 2022 Levant Sparrowhawk White Stork and White Pelican again had the larger sizes so this shows a continued pattern. Again overall, the eagles harriers and small falcons migrated in small groups.

Table 9: Mean group size (flock size), the 95% confidence intervals, number of records and maximum group size (all species had a minimum group size of 1) for Plot 2 in spring 2023.

Species	Mean group	Conf. Lower 0.95	Conf. Upper 0.95	# records	# Maximum
Black Kite	9.83	8.30	11.36	632.00	200.00
Black Stork	14.21	10.02	18.39	82.00	83.00
Booted Eagle	1.08	1.01	1.15	64.00	2.00
Common Crane	135.22	107.25	163.18	65.00	450.00
Common Kestrel	1.07	1.01	1.12	91.00	2.00
Egyptian Vulture	1.37	1.03	1.71	38.00	5.00
Eurasian Sparrowhawk	1.20	1.01	1.39	20.00	2.00
European Honey Buzzard	61.86	48.05	75.67	342.00	1300.00
Greater Spotted Eagle	1.00	1.00	1.00	6.00	1.00
Griffon Vulture	1.00	1.00	1.00	2.00	1.00
Hobby	1.00	1.00	1.00	1.00	1.00
Imperial Eagle	1.00	1.00	1.00	14.00	1.00
Lanner Falcon	1.00	1.00	1.00	1.00	1.00
Lesser Spotted Eagle	1.83	1.48	2.18	109.00	12.00
Levant Sparrowhawk	856.50	159.98	1872.98	10.00	4000.00
Long-legged Buzzard	1.18	1.06	1.29	45.00	2.00
Marsh Harrier	1.07	1.96	1.18	42.00	3.00
Montagu's Harrier	1.00	1.00	1.00	6.00	1.00
Osprey	1.00	1.00	1.00	5.00	1.00
Pallid Harrier	1.00	1.00	1.00	1.00	1.00
Short-toed Eagle	1.23	1.13	1.33	116.00	4.00
Sooty Falcon	1.00	1.00	1.00	1.00	1.00
Steppe Buzzard	24.25	21.48	27.01	934.00	350.00
Steppe Eagle	9.39	7.96	10.83	747.00	150.00

White Pelican	235.20	133.79	336.61	75.00	3000.00
White Stork	1460.28	1202.56	1718.00	218.00	8000.00

5.4 Distribution of Groups and Species over Observation Points, including analysis of flight height

Spatial analysis of the distribution of bird groups and species observed per OP was perfomed using the time spent within each area to assess relative patterns of bird activity observed during the season. Time in this case was the time spent by flocks/registrations rather than all individuals as this provides a more realistic insight in to the likely requirements of shutdown of turbines during windfarm operation. Figures were produced for key groups and species alongside analysis of flight height distribution of observations to allow for side by side comparisons and more resolution for assessing patterns of flight activity. Groups assessed included: All MSB and target species including unidentified species; all birds of prey (including unidentified species), and; storks and pelicans.

It should be noted that spatial patterns of bird flight activity may vary from one year to another based on environmental, ecological or other factors.

Key findings from the 2023 spring season at Plot 2, along with note on comparison to spring season 2022, are summarised as follows:

5.4.1 Groups

- For all MSB and target species, including unidentified species, the highest extrapolated passage rates were at OP's 7, 8 and 9 in the centre and west of the site. During Spring 2022 OP's 8 and 3 showed highest activity showing a slight change in the areas of highest use.
- In 2022, for all birds of prey (excluding unidentified species), the southern half of the site exhibited the highest extrapolated passage rates. In 2023 the highest amount of activity, by time, of all MSB and target species flocks, including unidentified species was through the western central section of the site (OP's 7, 8 and 9).
- In 2022 for storks and pelicans, extrapolated passage rates were highest in the southern half of the site, but were also high at the northern most OP (OP1). During 2023 the highest amount of activity, by time, of all MSB and target species flocks, including unidentified species was through the western centre of the site at OP's 7, 8 and 9.

5.4.2 Species

- In 2022 Black Kites spent approximately 50% of their time below 120m heights. They were present at each VP with a relatively uniform distribution of passages. Very little time was spent in the highest height band. During 2023 the higher use of the site was in the central western part (OP 7 followed by 8 and 9). During this time Black Kite spent a similar proportion of time at each band meaning a far higher amount of time below 240m than above 240m but not specifically below 120m as in 2022.
- During 2022 Black Stork were observed at each OP, with fewer passages at OPs 7, 2 and 4. Only a small proportion of time was spent within the highest height band, with a relatively even distribution of time between the other bands. During 2023 the higher use by this species was in the central west section, OP's 7, 8 and 9. Again during 2023 activity was spread with the great proportion of activity between 150-240m.

- During 2022 Egyptian Vultures spent over 50% of their time at low altitudes (0-120m). In 2023 the majority of flight activity was above 200m. No clear spatial patterns were identified.
- During 2022 Honey Buzzards did not show any clear spatial distribution of passages or flight heights, and time between height bands was relatively evenly split, with less time at highest altitudes. Activity in 2023 was highest on the western portion of site with OP's 14, 15 and 16 having the highest activity with the majority of activity above 150m.
- During 2022 Imperial Eagles spent a small proportion of time between 0-120m and over 200m heights compared to other height bands, although showed no clear spatial pattern in occurrence. During 2023 records were spread in low number across the site with the highest level of activity was above 200m.
- During 2022 Levant Sparrowhawks were observed at only 5 OPs; however, showed no clear preference for an area. While sample sizes of flight height records were low, over 75% of the time was spent at heights over 150m. In 2023 Levant sparrowhawks were recorded in a small number again and across the site with no clear pattern of site or heigh use.
- During 2022 Greater Spotted Eagle showed a slight preference for the south-east corner of the plot (OPS 3 and 4). No flights were recorded above 200m, with the majority below 150m. In 2023 Greater Spotted Eagle were recorded in small numbers although again showed a preference for the eastern side of the site.
- During 2022 Steppe Buzzards were recorded approximately equally between 0 and 200m, with less time spent at greater heights. There was no clear spatial pattern in the number of passages, or flight heights. In 2023 higher activity was recorded in the central west portions of site with the majority of activity above 150m.
- During 2022 Steppe Eagles showed no clear spatial preference, however spent a smaller proportion of time at heights greater than 200m at OP6 and OP9, compared to OP1 where almost half of time was spent at these higher altitudes. During 2023 higher activity was recorded in the centre west of the with the highest level of activity above 200m.
- During 2022 White Pelicans are expected to pass through OP1, OP9 and OP4 in great numbers compared to the other locations observed. A large proportion of overall flight time was within 0-120m. A very small proportion of time was spent in excess of 200m. During 2023 there was a preference for the centre west of site and there was a good spread of height bands used.
- During 2022 White Storks showed no clear spatial preference; although may spend a greater proportion of time flying at lower altitudes (0-120m) on the west side of the plot. During 2023 the highest activity was in the centre west of the site and a range of flight bands were used at these points. Around the rest of the site little activity was recorded below 150m.

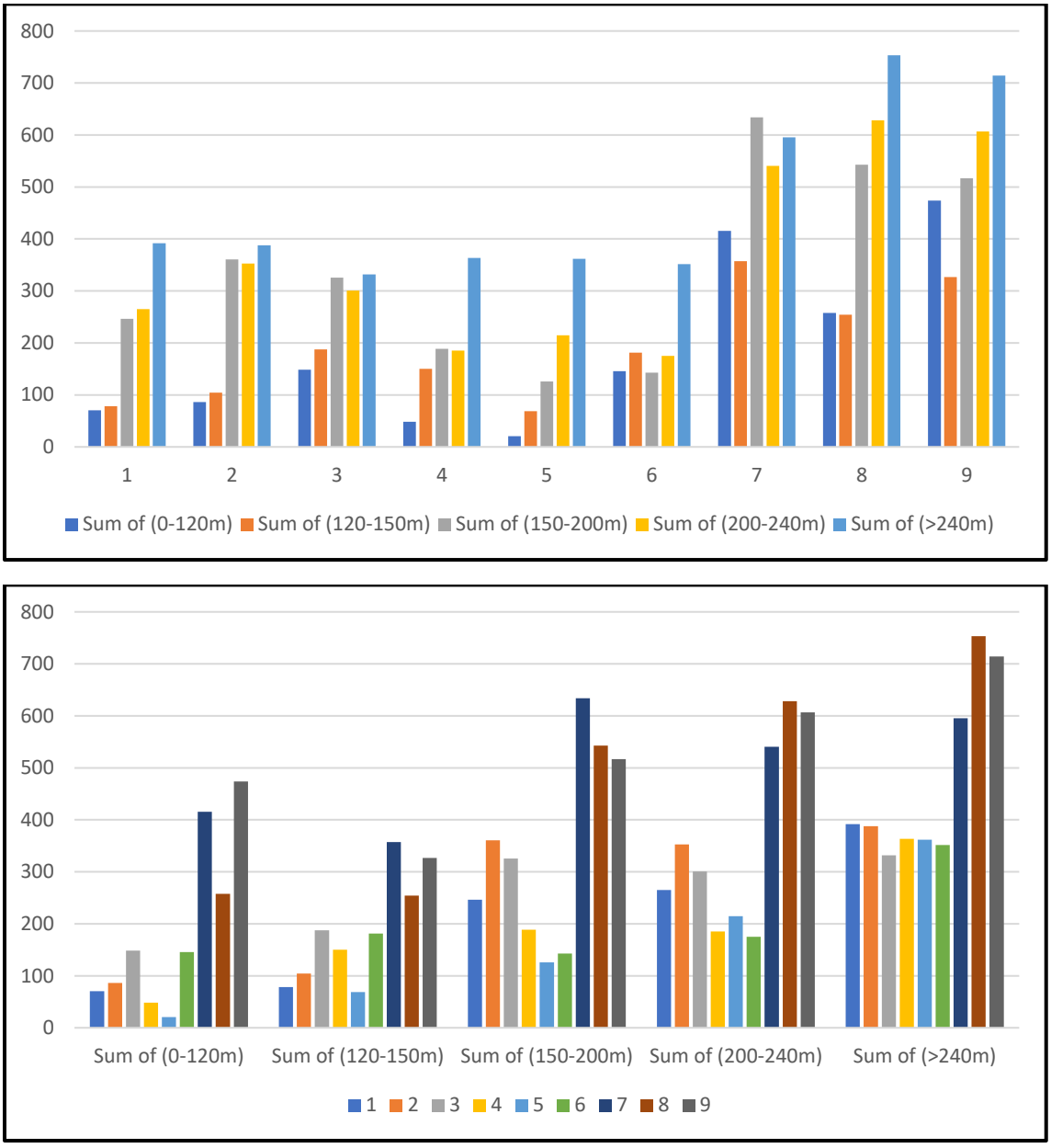


Figure 23: Time observed at flight height bands for all MSB and target bird species during spring 2023 migration season at Plot 2. Shown by height band above and by VP below.

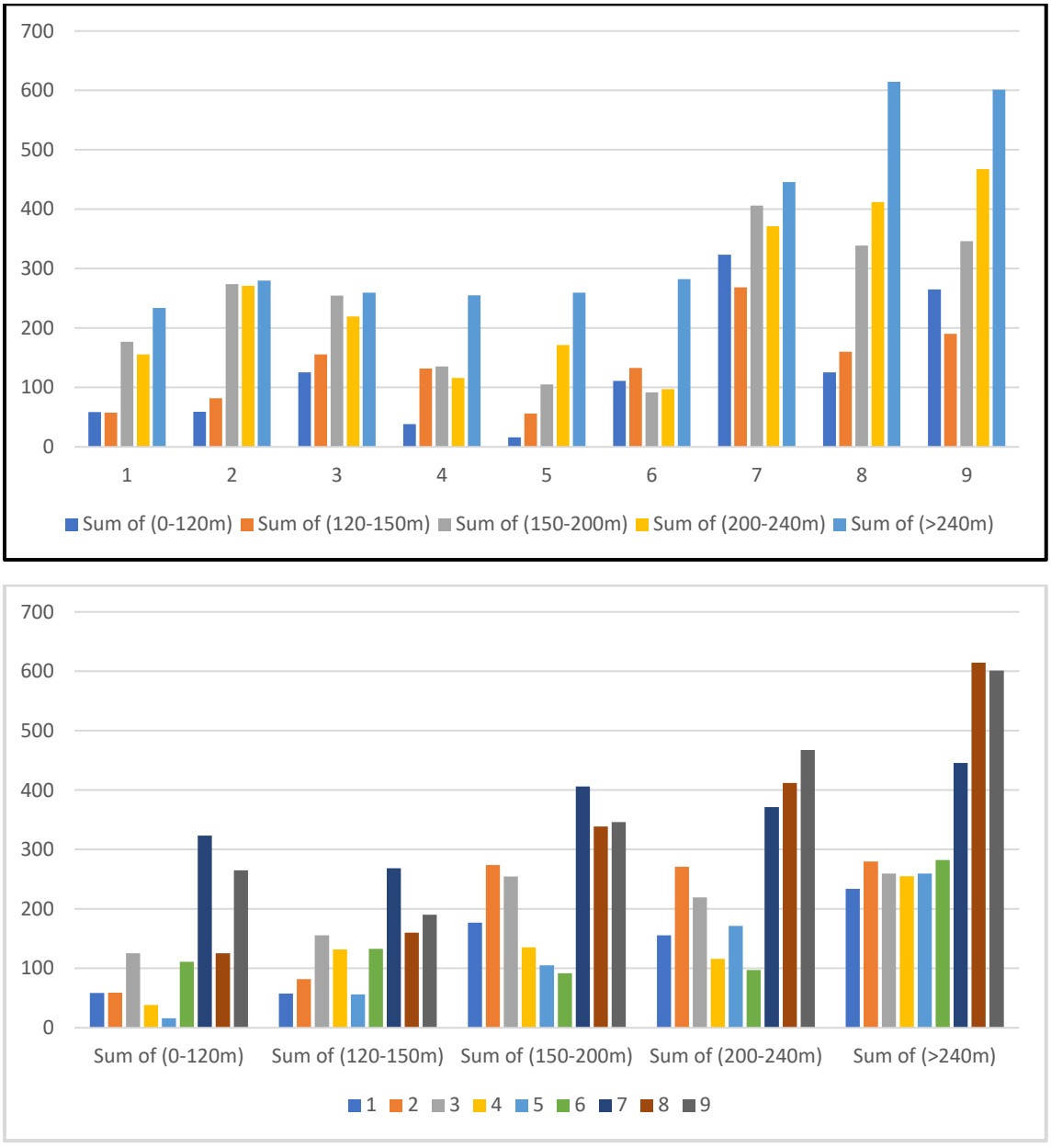


Figure 24: Time observed at flight height bands for all birds of prey during spring 2023 migration season at Plot 2. Shown by height band above and by VP below.

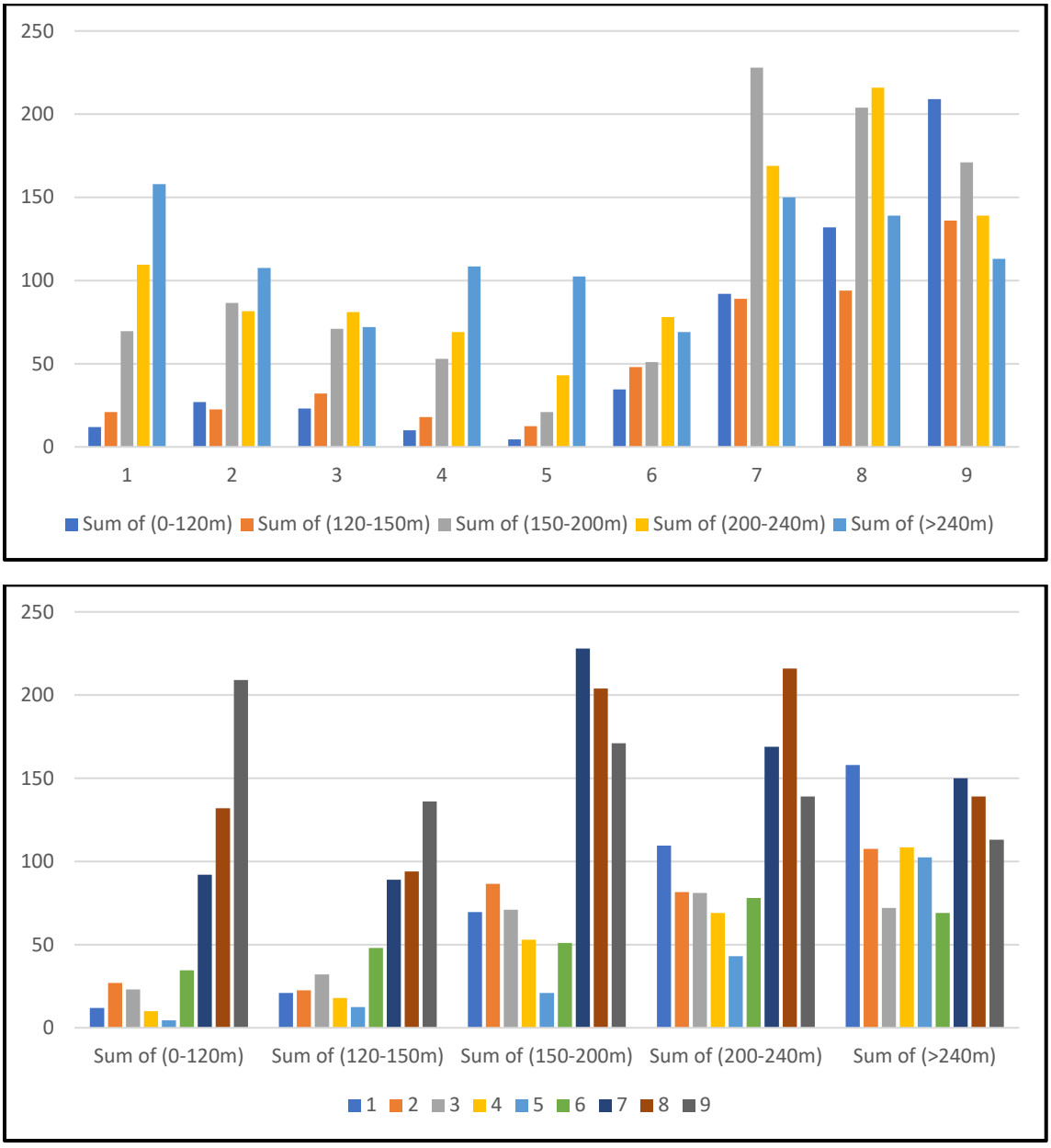


Figure 25: Time observed at flight height bands for all Cranes, Stork and Pelicans during spring 2023 migration season at Plot 2. Shown by height band above and by VP below.

5.4.3 Flight height/bands

The client had not determined turbine specifications nor a turbine layout ahead of the development of the avi-fauna assessment; therefore, a CRM was not conducted. As a result, this report describes patterns of activity at the flight height bands used during the OP surveys. Number and percentages of all target bird species observed (individuals) were tabulated (Table 10) and plotted (figure below) to present proportion of the overall time spent within each height band, based on the data recorded at 15 second intervals during OP surveys.

Overall – for all species combined - the percentage of birds flying at risk height was 29% within the 150-m band and 59% within the 200-m band and 72% within the 240m band (Table 10). This is almost identical to the heights recorded in this season at Plot 1. Overall, this represents generally higher recorded flights

at lower altitude than during spring 2022. For species other than those with very low numbers of records, risk increases as the flight height band is increased with one exception, the Common Crane risk increased only when above 240m with the majority of flights above this figure.

Table 10: Numbers of birds recorded per species and birds at risk height for turbine tip heights of 150, 200 and 240 m at Plot 2 during spring 2023.

Species	Total	At risk 150	At risk 150 %	At risk 200	At risk 200 %	At risk 240	At risk 240 %
Black Kite	12117	1774	14.64	4602	37.98	7256.00	59.88
Black Stork	1113	392	35.22	680	61.10	845.00	75.92
Booted Eagle	315	62	19.68	162	51.43	225.00	71.43
Common Crane	626	8	1.28	8	1.28	289.00	46.17
Common Kestrel	244	144	59.02	191	78.28	207.00	84.84
Egyptian Vulture	261	43	16.48	119	45.59	183.00	70.11
Eurasian Sparrowhawk	29	11	37.93	25	86.21	27.00	93.10
European Honey Buzzard	12869	888	6.90	2931	22.78	6996.00	54.36
Greater Spotted Eagle	16	3	18.75	10	62.50	12.00	75.00
Griffon Vulture	3	0	0.00	2	66.67	3.00	100.00
Hobby	1	1	100.00	1	100.00	1.00	100.00
Imperial Eagle	41	9	21.95	26	63.41	36.00	87.80
Lanner Falcon	5	2	40.00	2	40.00	3.00	60.00
Lesser Spotted Eagle	649	51	7.86	302	46.53	424.00	65.33
Levant Sparrowhawk	999	1	0.10	317	31.73	335.00	33.53
Long-legged Buzzard	123	36	29.27	82	66.67	108.00	87.80
Marsh Harrier	40	25	62.50	32	80.00	36.00	90.00
Montagu's Harrier	10	10	100.00	10	100.00	10.00	100.00
Osprey	22	5	22.73	13	59.09	19.00	86.36
Pallid Harrier	16	12	75.00	14	87.50	14.00	87.50
Raptor species	3982	191	4.80	483	12.13	777.00	19.51
Red-footed Falcon	1	0	0.00	1	100.00	1.00	100.00
Short-toed Eagle	1738	250	14.38	725	41.71	1037.00	59.67
Sooty Falcon	1	1	100.00	1	100.00	1.00	100.00
Steppe Buzzard	83966	9920	11.81	28662	34.14	38761.00	46.16
Steppe Eagle	18835	5140	27.29	10762	57.14	14511.00	77.04
White Pelican	19884	11810	59.39	15068	75.78	18740.00	94.25
White Stork	136611	54562	39.94	107776	78.89	121760.00	89.13
Total	**294517**	**85351**	**28.98**	**173007**	**58.74**	**212617.00**	**72.19**
Falcon species	8	1	12.50	3	37.50	5.00	62.50
Unidentified buzzard	3732	90	2.41	240	6.43	875.00	23.45
Unidentified eagle	1142	34	2.98	104	9.11	516.00	45.18
Unidentified harrier	6	4	66.67	5	83.33	6.00	100.00
Total	**4888**	**129**	**2.64**	**352**	**7.2**	**1402**	**28.68**

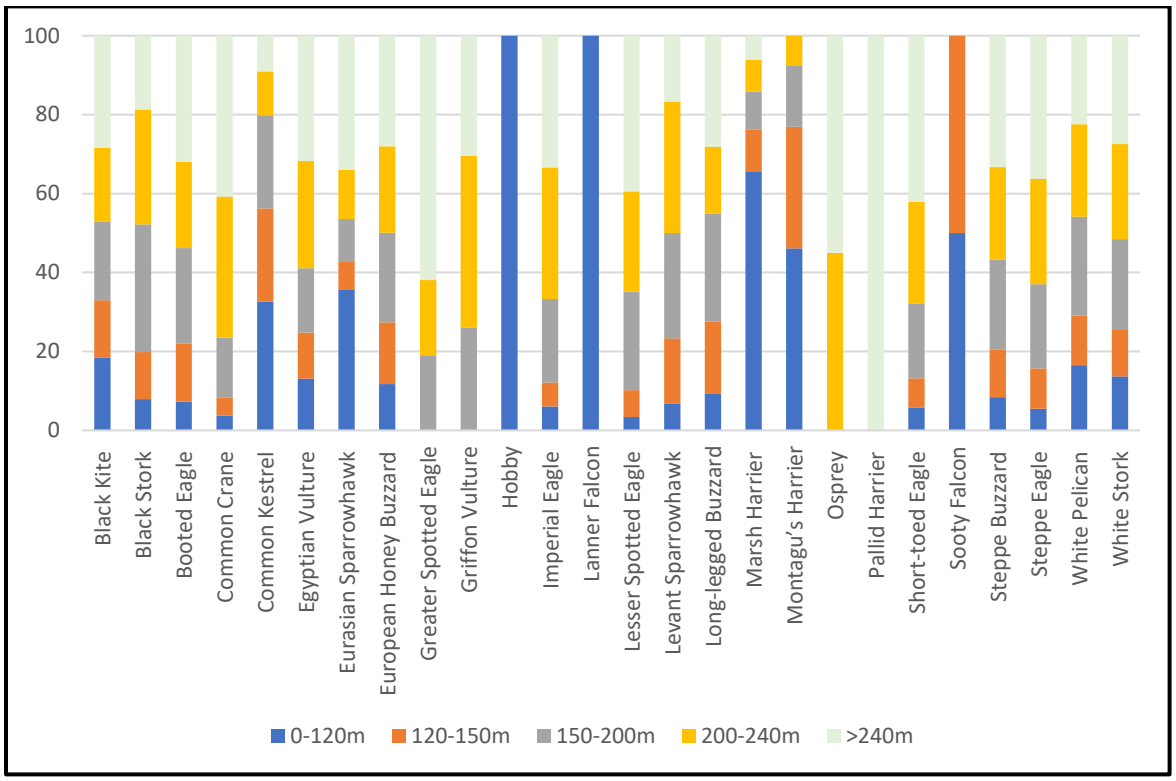


Figure 26: Proportion of time spent within flight height bands for selected species observed at Plot 2 during Spring 2023.

5.5 Temporal analysis – Weekly & Daily – Distribution of Records and Individuals

To assess temporal patterns of activity within the migration periods, passage rates per week of observation was analysed to shed light on the highest weekly periods of overall and species-specific migration patterns within the observation period. Cumulative migration activity was also assessed. In addition, the observations per hour of the day for groups and species were assessed to assess daily patterns of activity to aid the assessment of which times of day experience the highest migration flight activity.

5.5.1 Groups

For all MSB and target birds in 2023 the Figure below illustrates low initial overall activity during February followed by intermittent small spikes throughout the migration season until mid-May. High peaks of activity are found around the end of March and a smaller peak in mid-April. During 2022 activity peaked at a similar time with highest peaks from early to mid-April. In both years the early peak of activity is led by high levels of White Stork activity (which was represented again in the waterbird specific analysis).

In respect to daily activity patterns, overall, for all MSB and target species activity peaked between 08:00 and 10:00. Activity broadly increased and decreased either side of this peak although higher activity was recorded between 13:00 and 14:00. This is similar to results from 2022 which showed a peak at 09:00 to 10:00 and a drop off from this point through the day.

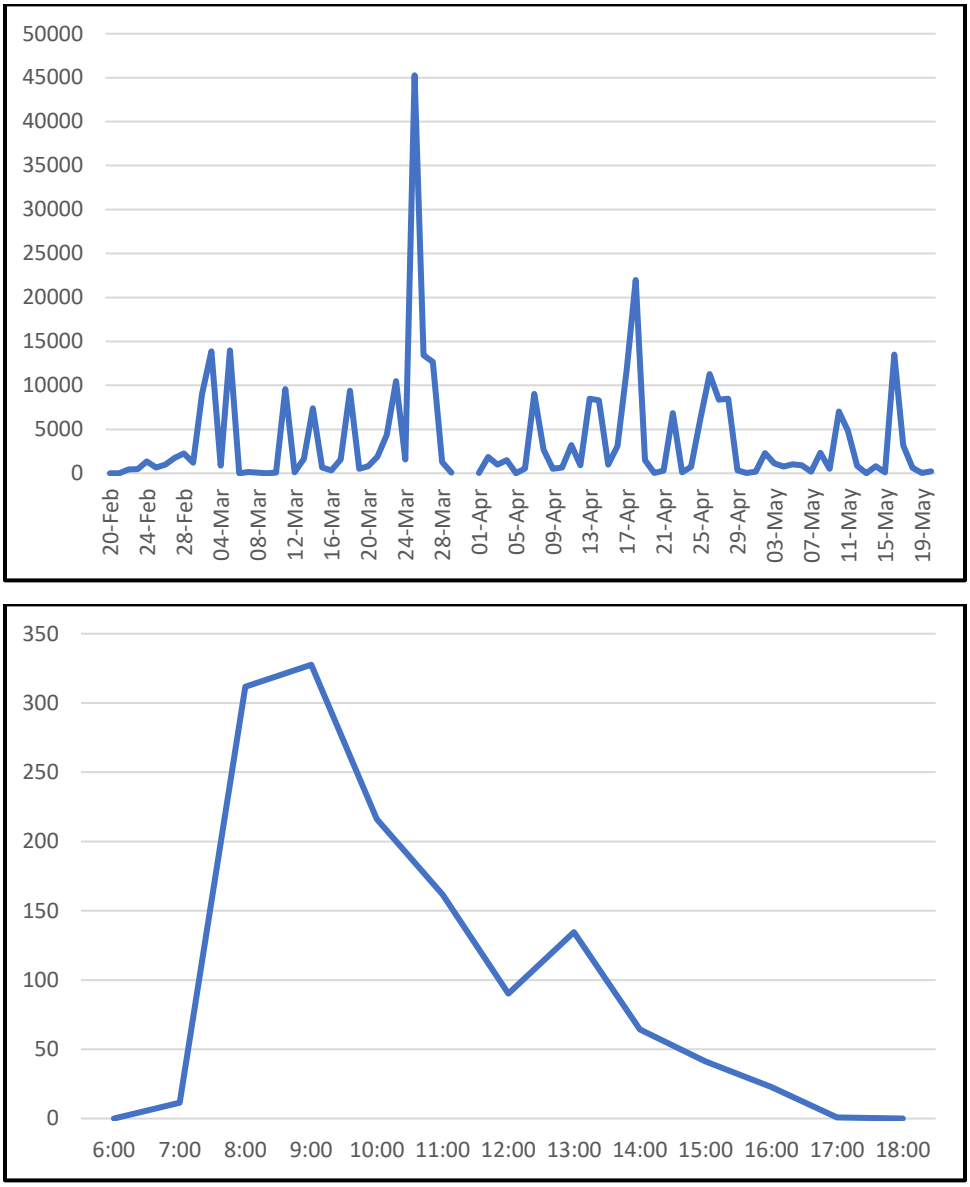


Figure 27: Temporal analysis of all MSB and target birds, excluding unidentified species, at Plot 2 during spring 2023. Daily and hourly plots are included.

The number of birds was assessed for all birds of prey (figure below), showing intermittent peaks throughout the season. The peak in late April is attributed to high levels of Levant Sparrowhawk activity along with Steppe Buzzard activity and the early-May peak attributed to Honey Buzzard movements.

Activity of Steppe Eagle in 2023 showed a peak through late February.

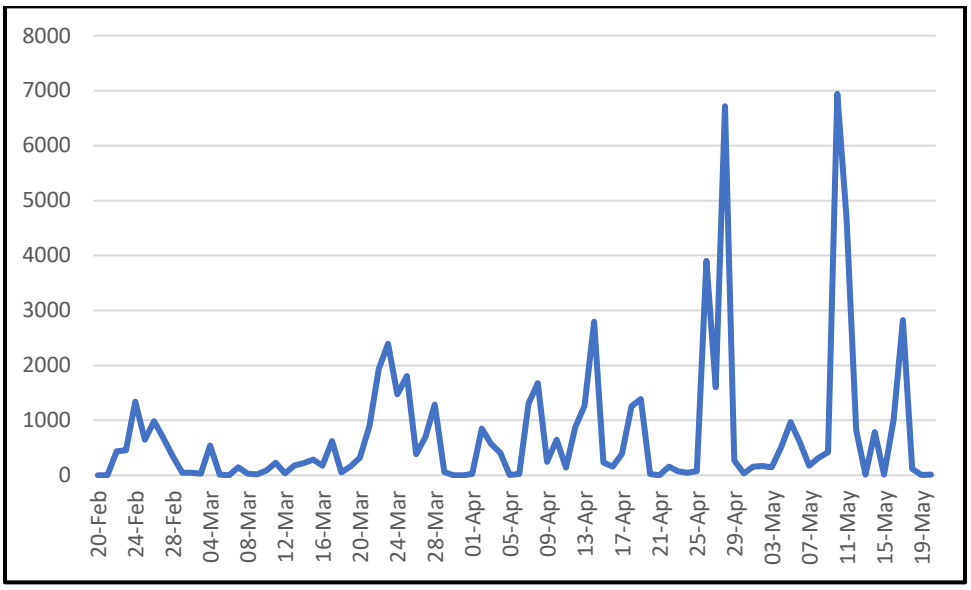


Figure 28: Birds of prey observed at Plot 1 during spring 2023.

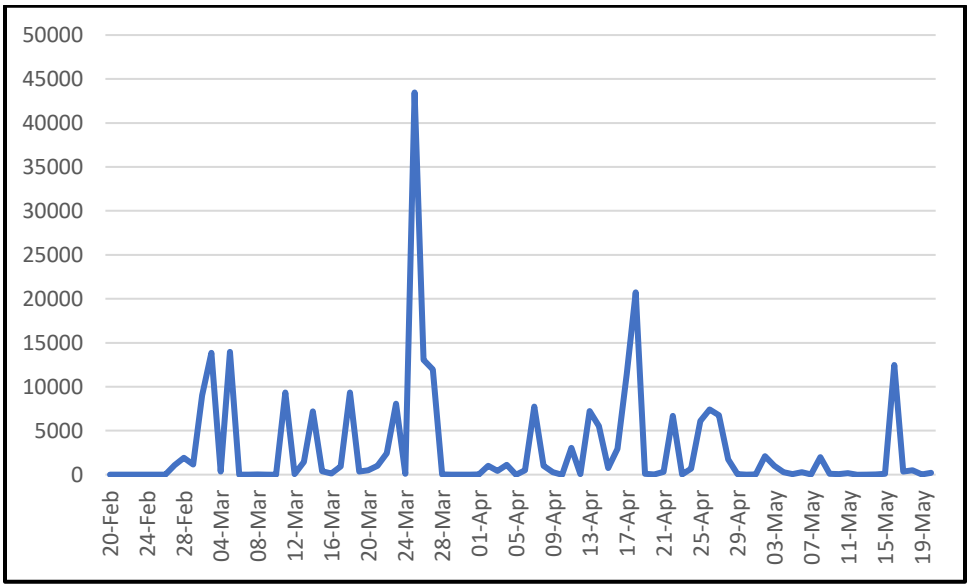


Figure 29: Stork, Crane and Pelican observed at Plot 1 during spring 2023.

Harriers and Falcons were typically recorded in lower numbers such that analysis of their activity across the day or season provided less valuable clear results.

5.6 Flight direction

Prevailing flight direction during spring 2022 for the five (5) most abundant MSB species (white stork, steppe buzzard, black kite, honey buzzard, and steppe eagle showed a clear orientation for all five species flying north, northeast and east. During 2023 there is a slight change showing the main flight directions as northeast or northwest. Of these species, despite the broad change, Honey Buzzard remained predominantly travelling northeast.

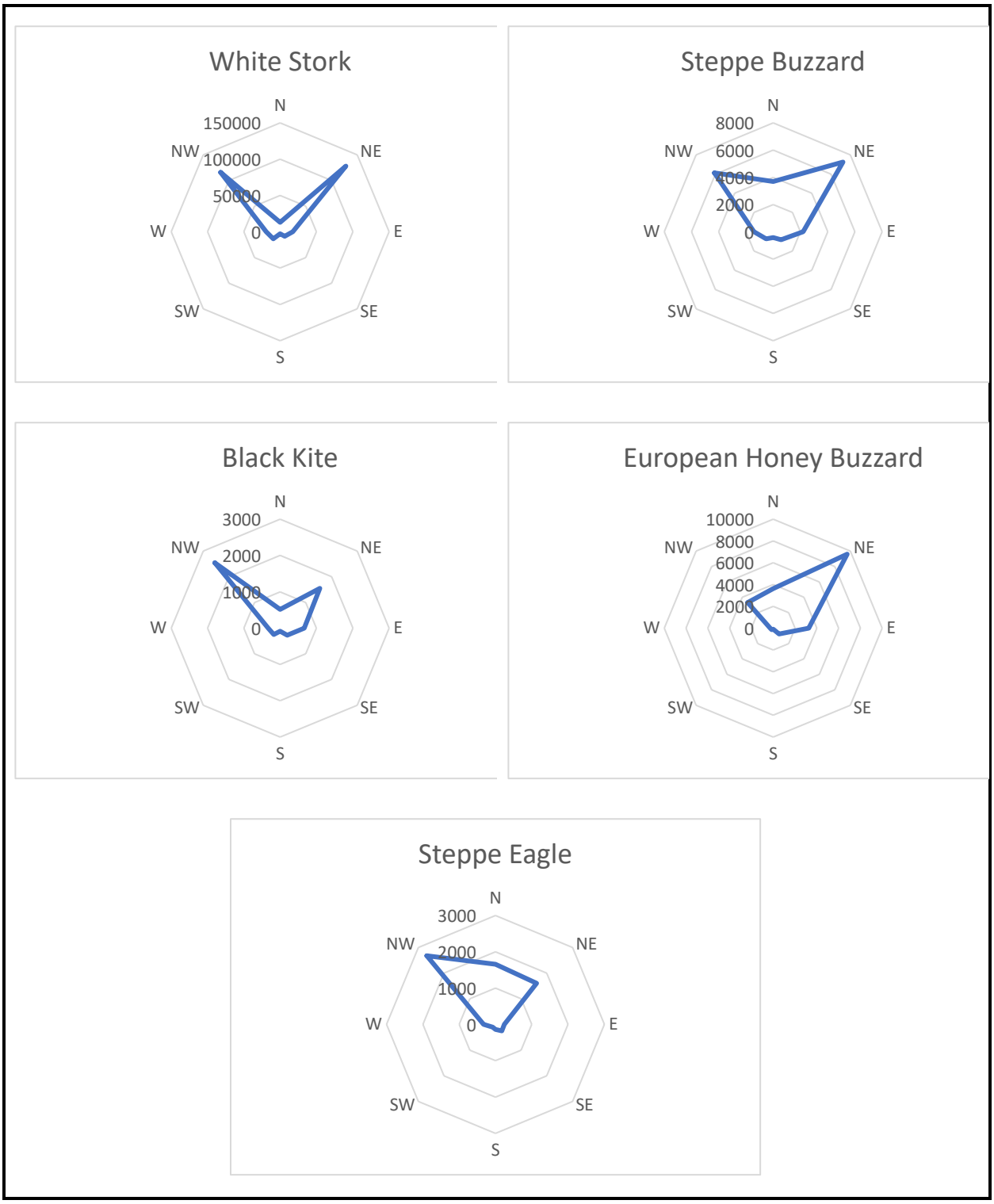


Figure 30: Observed flight direction of the five most abundant migratory soaring birds observed at Plot 1 during spring 2023.

5.7 Bird observations at potential environmental constraint – dump site

Thirteen species of MSBs and target species, excluding passerines, were recorded throughout the monitoring undertaken of the carcass dump site (figure below). The most abundant species recorded at the location in 2022 was White Stork however none were recorded in 2023 and this is likely to do with the lack of water at the nearby dam site. During 2023, 4193 registrations of Steppe Eagle were noted with a peak count of 300 birds. Raptor use of the site is of great concern, given these species are foraging on carcass remains disposed of the site from poultry and livestock farms located at Wadi Dara (figure below).

However it is important to note that since these surveys were undertaken the site is no longer used as a carcass dump site with waste taken routinely elsewhere and no dumping (or associated use by raptors) noted later in the year.

Table 11: Numbers of birds recorded per species and peak count of each species at the dump site during Spring 2023

Species	Total Count	Peak Count
Egyptian Vulture	3	2
Black Vulture	1	1
Steppe Eagle	4193	300
Imperial Eagle	2	1
Booted Eagle	3	2
Short-toed Eagle	3	2
Black Kite	293	38
Western Marsh Harrier	3	1
Pallid Harrier	1	1
Steppe Buzzard	12	4
European Honey Buzzard	1	1
Lanner Falcon	21	20
Red-footed Falcon	6	1
European Bee-eater	8	4
Grey Heron	6	6
White Wagtail	554	30
Yellow Wagtail	1	1
Little Stint	1	1
Brown-necked Reven	184	40
Mourning Wheatear	2	2
Short-toed lark	200	33
Desert Lark	150	19
Crowned Sandgrouse	147	25
Willow Warbler	1	1
Spotted Flycatcher	1	1
Chiffchaff	1	1
Redstart	128	25
Spanish Sparrow	4	2
Barn swallow	236	33
Rock Dove	148	10
Rock martin	12	9
Creamed Coloured Courser	63	8
House Martin	9	5
Hoopoe	12	7
Desert wheatear	16	2

Figure 31: Photos of birds present and carcass remains disposed at the dump site located within Plot 2 during spring 2022.

6. PLOT 2: CONCLUSIONS AND RECOMMENDATIONS

1. The observation effort of the OP surveys at Plot 2 during both seasons was in line with GIIP for migratory bird studies and consistent with recommended methods used in Egypt.

2. The data collection, survey management, and data QA/QC procedures are considered to be of GIIP standards. The survey spatial coverage of the project areas and the immediate area around the site boundary was considered good.

3. Daily effort at the site was increased for the 2022 migration studies and a comparative effort undertaken in 2023. Gaps in the available data for assessing risks to MSB and target species include: the absence of a WTG layout or model, precluding Collision Risk Modelling (CRM); the absence of information on project-associated overhead electrical transmission lines, precluding the characterisation of risk associated with this infrastructure component of the project. These gaps are recommended to be addressed prior to drafting the ESIA.

4. Inter-annual variation in the migration patterns of birds in the region is commonly documented during multi-annual migration studies performed at wind energy facilities. These variations include: the number of individuals recorded overall, and per species within seasons; the spatial patterns of activity within and near the proposed project area; the flight height characteristics of birds flying through the area, the temporal patterns of migration activity; the flight directions (typically minor, not major) of species and species assemblages; as well as resting and roosting activity. All of these aspects may be influenced by environmental and ecological factors at the site scale, the regional scale, the flyway scale or at the breeding and overwintering scales. As such, reliance on even two seasons worth of data collection to represent migratory bird activity and risk at a proposed wind project for the proposed life of the project may be misleading given the known possible shift in activity over time. However, the two years of extensive survey effort certainly provide a suitable level of background data to present the risks to birdlife at this proposed site within an ESIA.

5. The total number of individual birds and species recorded during spring 2022 and 2023 seasons - 281,147 individuals of 25 species during spring 2022, and 330,820 individuals of 26 species during 2023 – are considered by the authors as *high.*

6. During both spring 2022 and 2023 Six (6) of the recorded species were globally threatened according to the IUCN Red List (https://www.iucnredlist.org/): including two (2) Endangered-EN (Steppe Eagle and the Egyptian Vulture), and three (3) Vulnerable-VU species (Eastern Imperial Eagle, Greater Spotted Eagle and Sooty Falcon). In addition, one (1) species is Near Threatened-NT (Pallid Harrier).

11. Spatial analysis of MSB and target bird activity and flight height data suggest that certain areas of Plot 2 experience higher migratory flight activity in comparison to other portions within each season for particular species assemblages and the specific species analysed for this report. However, there were slight changes between spring 2022 and 2023. For all MSB and target species, including unidentified species, the highest extrapolated passage rates were at OP's 7, 8 and 9 in the centre and west of the site in 2023. During Spring 2022 OP's 8 and 3 showed highest activity showing a slight change in the areas of highest use. It is considered that there are no particular features within the site that are driving the migration pattern and it is likely that changes in distribution will continue during the lifetime of the project. It is also important to note that no portions of Plot 2 present low risk to MSB and target species in either spring 2022 or 2023 seasons without the implementation of minimisation and mitigation strategies including shut down on demand. It is recommended that minimisation and mitigation approaches are developed for the site as part of the ESIA consistent with those developed for other nearby wind energy facilities.

7. During 2022 the flight height analysis completed indicated that substantially more MSB and target bird species activity occurs at 200-m compared to 150-m. This is true again of 2023 however generally lower flight heights were recorded. CRM was not performed for this report as no WTG model or layout is yet available however this will be performed as part of the ESIA.

8. Temporal analysis of the activity patterns observed in spring 2023 showed a peak of activity around 8:00 to 10:00 am which corresponded approximately with that of spring 2022. This highlights a key time for mitigation within the daily cycle however there are no clear periods of daylight that present low risk to MSBs.

9. A potential environmental constraint was documented at Plot 2 in the form of a carcass dump site. This site was surveyed for part of the spring 2022 season and for all of the spring 2023 season. The data recorded during these surveys strongly indicates that the site serves as an important stopover site for some birds of prey and for White Storks. The total lack of White Stork activity at the carcass dump site is likely to correlate to the absence of water at the dam site. It is important to note that the feeding site has now been removed and waste is being taken elsewhere which will remove this potential risk factor from consideration within the ESIA. Monitoring of the location remains appropriate to ensure that dumping of carcasses does not resume.

10. Additional monitoring, avoidance, minimisation, and mitigation methods are recommended to be developed following the production of additional analyses described in this section, as well as the production of cumulative effects analysis and critical habitats assessment. It is recommended that such analysis account for both the wind energy facility, as well as for associated overhead electrical transmission lines.