Bird Migration Study

for Suez Wind Energy ACWA Power BOO Wind Power Plant 1.1 GW during Spring and Autumn Seasons 2022

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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 52.2 km^2 (Figure 2). At the time of the 2022 bird migration surveys, turbine layouts for Plot 1 and Plot 2 were not available.

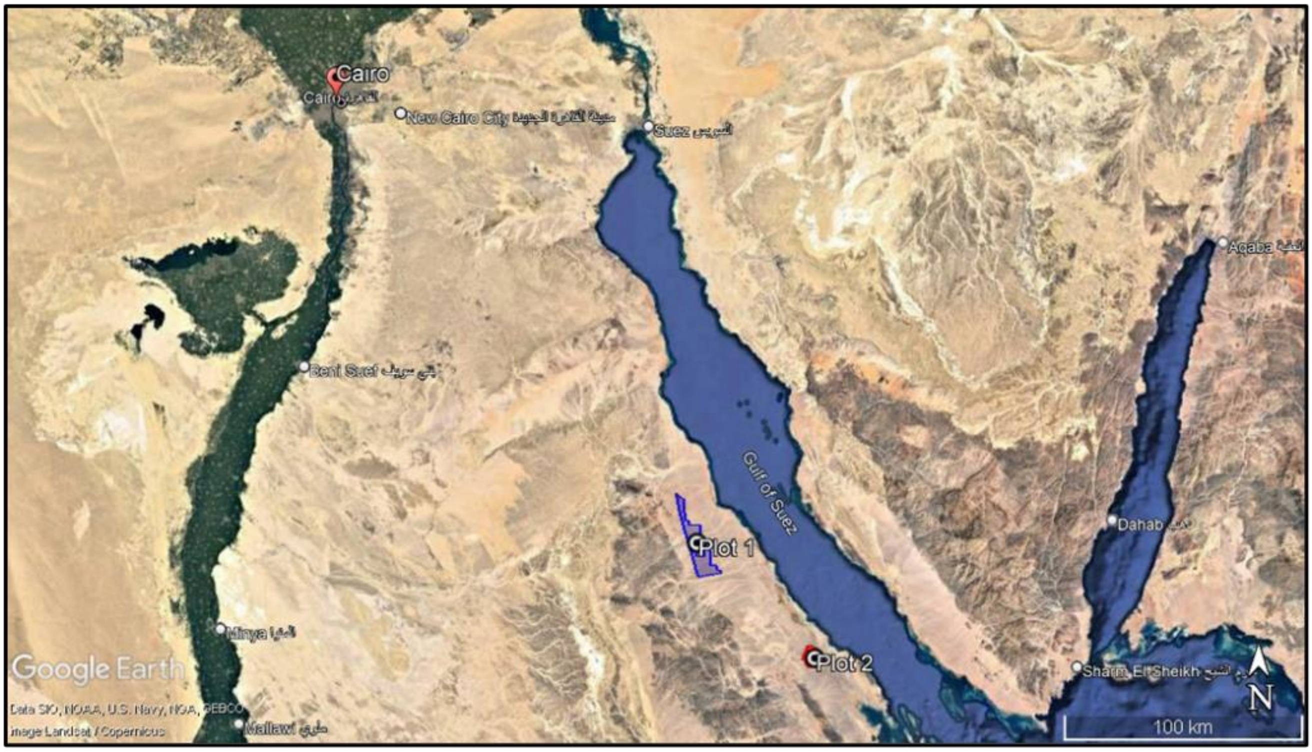


Figure 1: Project Sites in Relation to Cairo the Capital City of Egypt (plot 1: blue and plot 2:red)

[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.

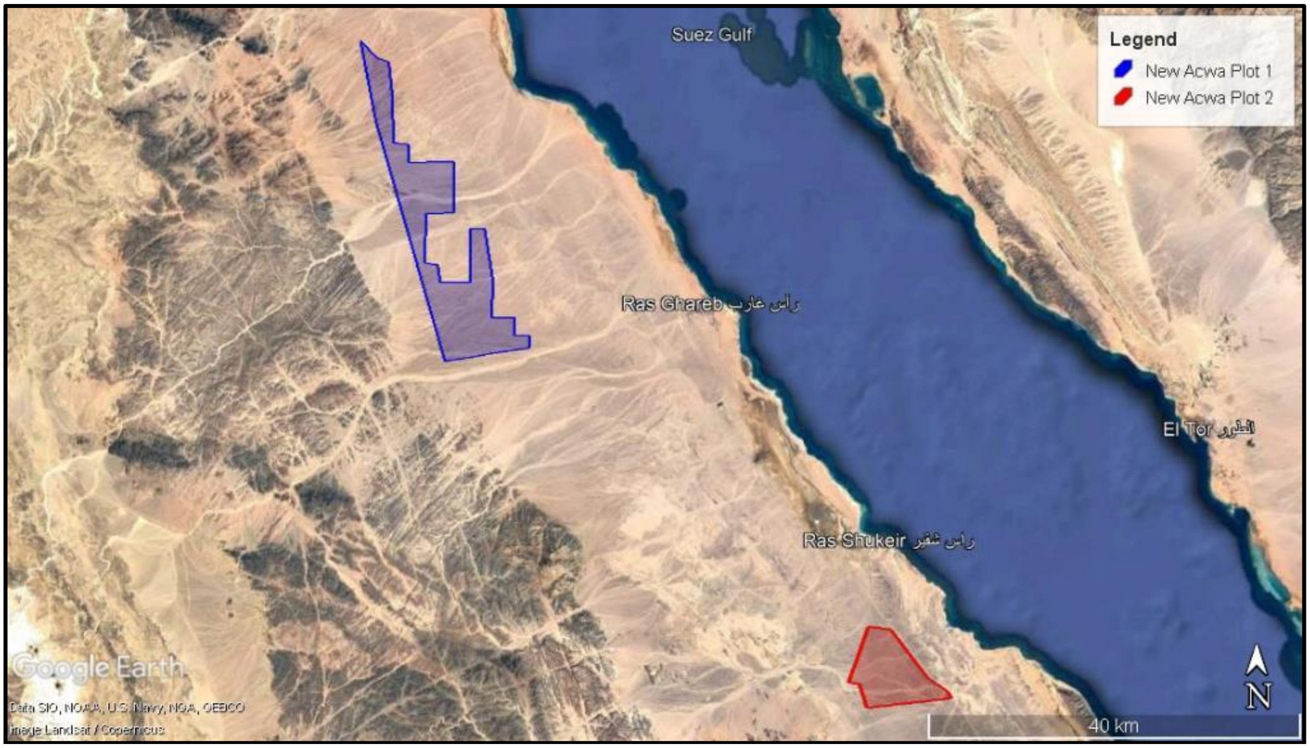


Figure 2: Project Sites (Plot 1 and 2)

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 (1 April – 1 May 2022) 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).

Each OP was 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.

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

Turbine layouts were not available during the migration periods, therefore the locations of the OP aimed to cover the entire project areas, resulting in eighteen (18) OPs for Plot 1, and nine (9) OPs for Plot 2 (Figure 3; Table 1).

The selection of the OPs for a monitoring day attempted to minimise the potential of double counting birds by reducing overlap of OPs selected for each survey day. For example, the OPs selected on Day 1 included OP1, OP3, OP5 and OP7, etc. (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°

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

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°			

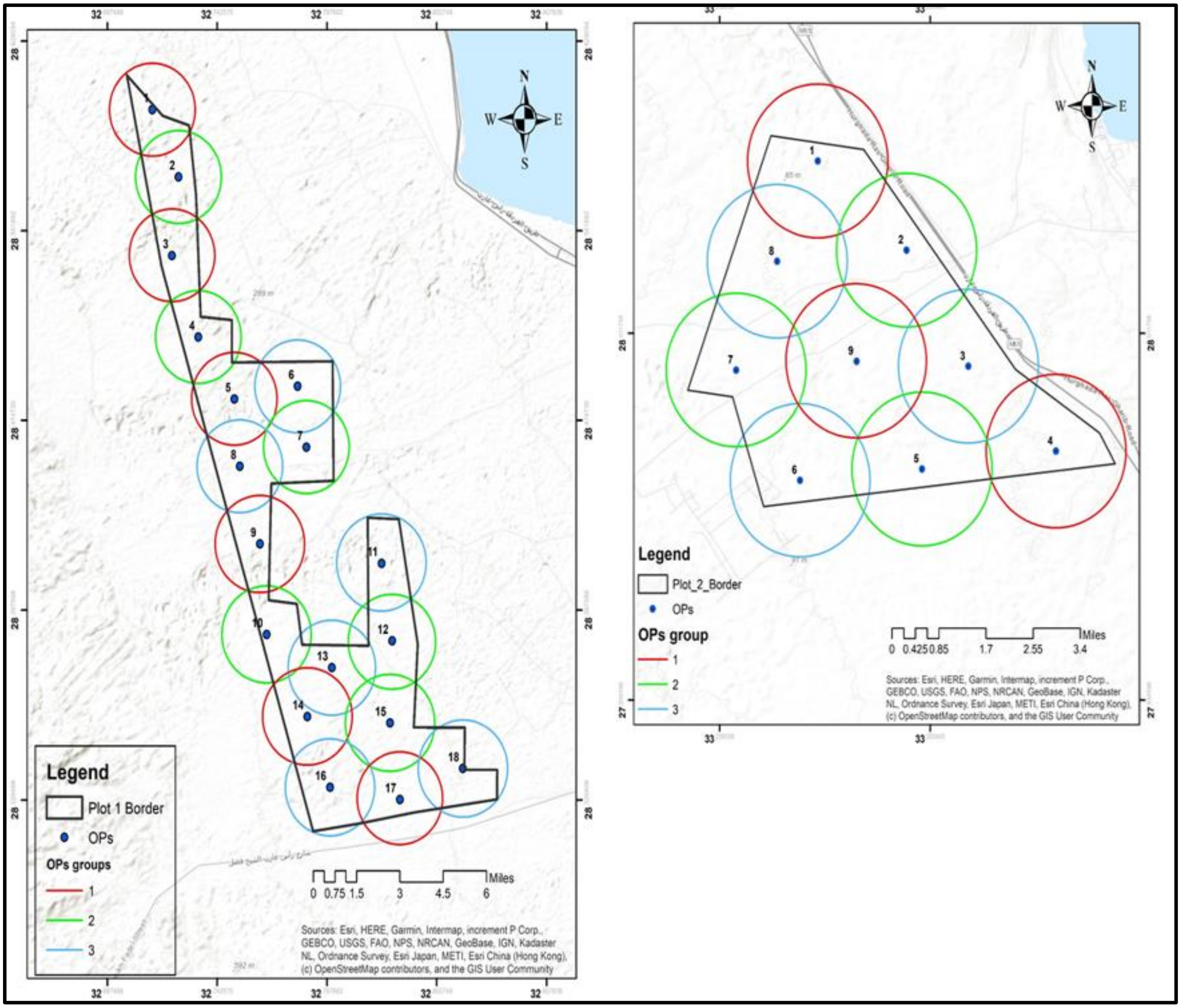


Figure 3: Location of Plots 1 and 2 and Distribution of OPs

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 form, as per template shown below. 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. (2007[4]), 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. 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 specifications*[7], 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; and (iv) above 200m.*

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).

[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.

[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.

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:

- *Accounting for zero bird count days (days with no records of migrating birds):* This parameter helps to understand the interactions of birds and their response to changes in weather conditions and limiting factors of crossing the Gulf of Suez, and determine the favourable and unfavourable weather conditions of migration generally or specifically for a certain species. The data might be used in the future e.g., for cumulative studies despite not daily data have been collated from the met-masts of these two projects because not being available.

- *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 smaller size the probability decreases.

- *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, a passage rate (birds/hour) should be calculated beforehand and used[8]. This may also be misleading if the range of surveys hours at each location is different (ie some targeting peak movement hours) however this allows analysis for each hour of the day which can allow a detailed comparisons an broadly is considered the more representative of the two methods.

- *Correction factors for unidentified bird observations and to estimate passage rates during unsurveyed periods* - A number of flights recorded during the vantage point surveys were not recorded to species level, but to a species-grouping (unidentified buzzard, unidentified eagle, unidentified falcon, unidentified harrier or unidentified raptor species). This is one mechanism by which total numbers of passages by different species through the viewshed areas during surveys will have been underestimated. (Other factors include reduced visibility either as a result of obscurement of part of the viewshed due to topographic/landscape features – viewshed maps are not available to account for this, reduced detectability with distance from the observer, and logistic challenges resulting from a single observer surveying a 360 degree viewshed.) An indication of the magnitude of the effect of individuals not being identified to species level can be derived by understanding what proportion of each species group is unidentified versus identified and calculating correction factors based on that.

  Correction factors can be used to multiply flight or passage rates for any species within each group to get an indication of the total number of flights or passages that may have passed through. The correction factor applied assumes that all species comprising a species-grouping is equally likely to be recorded within the unidentified species grouping which is unlikely to be the case in reality, since some species will be more readily identifiable than others, or may occur under conditions in which they are more or less clearly visible. Therefore, these correction factors should be treated as indicative only.

  The number of observers present during each session was counted. If two or more were present, it was assumed that breaks were covered by other observers and therefore survey effort was continuous during

[8] E.g., see Delgado et al. 2022. Bird migration at Lindus. Temporal patters and relationship with climatic conditions, In Isturiz et al 2022. Terrestrial and Marine birds in the Atlantic Pyrenees: climate change, migration, and population trends.

survey period. If only one observer was present, it was assumed that breaks were taken and therefore the period of the break was subtracted from the total survey period. It should be noted that no break times were provided during autumn surveys at plot 2, and therefore it was assumed that the period surveyed was covered completely.

To provide an indication of the number of passages at each site across the whole season, the proportion of daylight hours that were surveyed was calculated for the entire range of the season, at each vantage point. To achieve this, the number of hours surveyed for at each vantage point was divided by the total number of daylight hours available (sourced using the daylength package in R at latitude 28.598). Due to non-consecutive days being surveyed at each vantage point, a large number of days possessed 0% survey coverage of daylight hours. The aim of investigating the proportion of daylight hours covered by survey effort was to allow the number of recorded animals to be extrapolated up to an estimated number of seasonal passages. As extrapolation could not be done on a day-by-day basis due to the issues surrounding dividing by zero, the mean proportion of daylight hours surveyed across the season was calculated and used for extrapolation. Records for each species were summarized by the number observed per vantage point, and then that total was divided by the proportion of daylight hours surveyed.

- *Correcting for flight height categorization* - Due to there being a disparity between the number of flight height bins used between seasons, 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.

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[9]. 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 long-distance 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:

[9] 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 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.

- *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 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[10].

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°) 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.

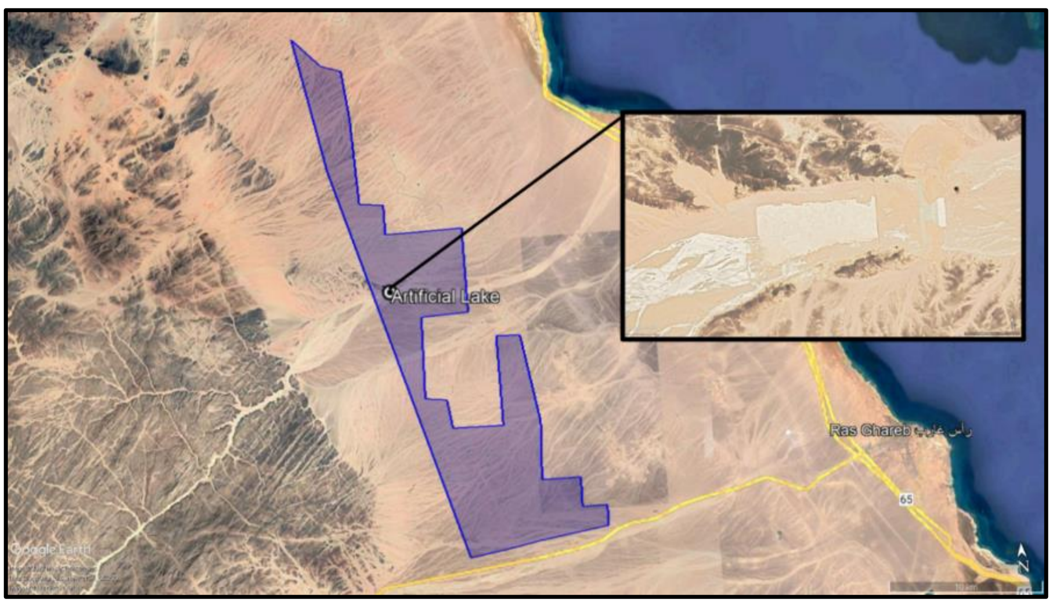
Surveys were completed at these potential environmental constraints during both 2022 spring and fall migration seasons, however, surveys were initiated only partially during spring 2022. Surveys completed during 2022 at the potential environmental constraints are summarised in Table 2.

Table 2: : Summary of bird observation effort and approach for potential environmental constraints.

	Plot 1: dam/artificial pond	Plot 2: dumpsite	Plot 2: Wadi Dara

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

Survey method	Site Specific visits to the pond	Site specific visits to the dumpsite	Site specific visits to Wadi Dara
Spring 2022 dates (from/to)	1 Apr – 18 May	N/A	N/A
Spring 2022 number survey rounds	Total of 17 hours	N/A	N/A
Autumn 2022 dates (from/to)	10 Aug – 10 Nov	10 Aug – 10 Nov	10 Aug – 10 Nov
Autumn 2022 number survey rounds	1 hour per day at various times (e.g. Day 1 1h morning, Day 2 1h midday, Day 3 1h afternoon)	1 hour per day at various times (e.g. Day 1 1h morning, Day 2 1h midday, Day 3 1h afternoon)	1 hour per day at various times (e.g. Day 1 1h morning, Day 2 1h midday, Day 3 1h afternoon)



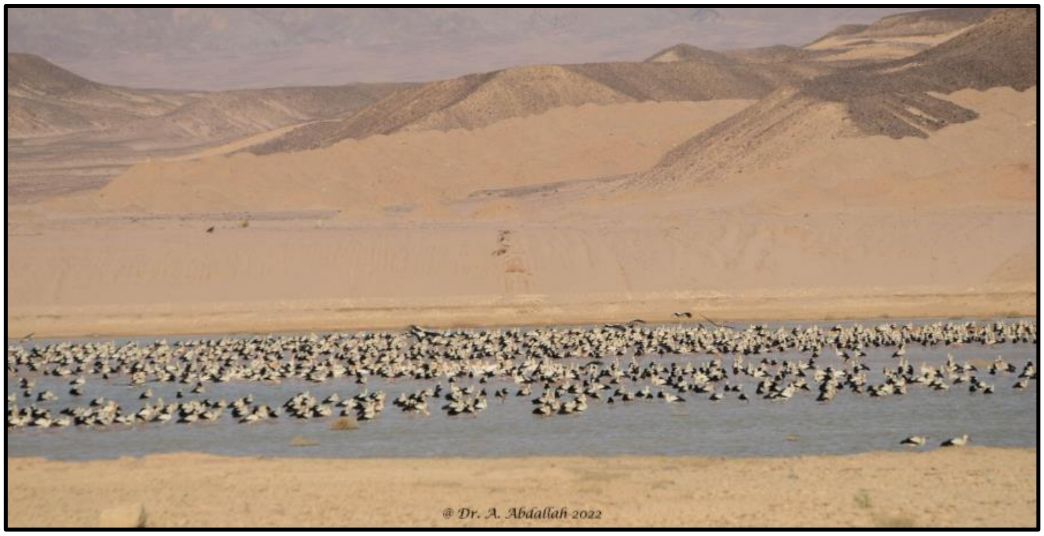


Figure 4: Location and photograph of the dam/artificial pond in Plot 1

Figure 5: Location and photos of the dumpsite in Plot 2

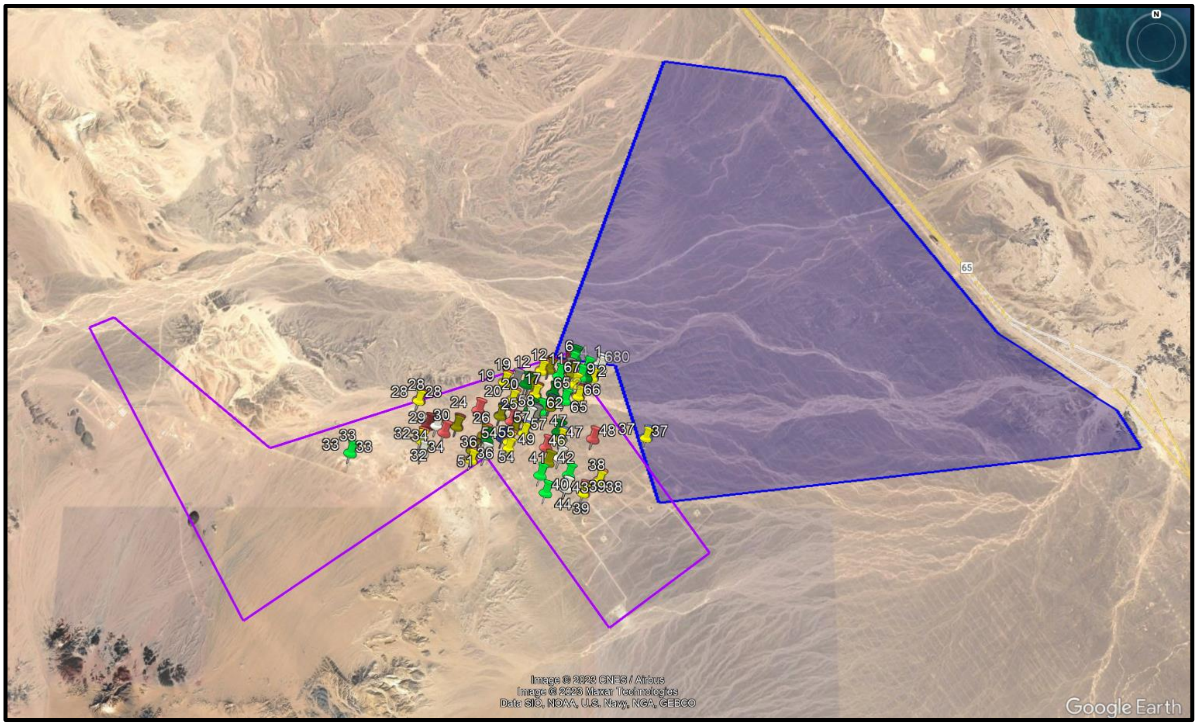


Figure 8: Location and photos of Wadi Dara located near Plot 2

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 Tim	Observation Tim	Species	No.	Hight Duration 1 (<120m	2 (>120m	Duration Inside 2.5 k	Detection	Distance (m)	Flight Directio	In/out	Note	Adult	Sub adu	Juvenile	Male	Female	A	S	G	R
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
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
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
8/15/2020	3	9:15	15:50		No Birds										0	0	0	0	0	0	0	0	0
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
8/15/2020	8	8:45	16:15		No Birds										0	0	0	0	0	0	0	0	0
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
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
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
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
8/17/2020	1	8:05	15:30		No Birds										0	0	0	0	0	0	0	0	0
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
8/17/2020	5	7:30	16:25		No Birds										0	0	0	0	0	0	0	0	0
8/17/2020	8	7:17	16:35		No Birds										0	0	0	0	0	0	0	0	0
8/18/2020	2	8:00	15:32		No Birds										0	0	0	0	0	0	0	0	0
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
8/18/2020	6	7:18	15:42		No Birds										0	0	0	0	0	0	0	0	0
8/18/2020	7	7:03	15:55		No Birds										0	0	0	0	0	0	0	0	0
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
8/19/2020	3	7:28	15:50		No Birds										0	0	0	0	0	0	0	0	0
8/19/2020	5	7:13	16:05		No Birds										0	0	0	0	0	0	0	0	0
8/19/2020	8	7:04	16:07		No Birds										0	0	0	0	0	0	0	0	0
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
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
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
8/20/2020	7	6:57	15:50		No Birds										0	0	0	0	0	0	0	0	0
8/21/2020	1	7:50	15:15		No Birds										0	0	0	0	0	0	0	0	0
8/21/2020	3	7:22	15:27		No Birds										0	0	0	0	0	0	0	0	0
8/21/2020	5	7:05	15:40		No Birds										0	0	0	0	0	0	0	0	0
8/21/2020	8	6:52	15:50		No Birds										0	0	0	0	0	0	0	0	0
8/22/2020	2	7:50	15:17		No Birds										0	0	0	0	0	0	0	0	0
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 6: 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 2022

3.1 Spring 2022 Effort

The overall effort and effort per OP for Plot 1 during spring 2022 is summarised in Table 3.

Table 3: Level of Effort during Avifaunal Assessments for Plot 1 during spring 2022

Season /dates	OP	Monitoring time
	Plot 1	
Spring 2022 69 days (9 March–16 May)	OP-1	90 hr. 55 min
	OP-2	125 hr. 45 min.
	OP-3	85 hr. 15 min.
	OP-4	113 hr. 35 min.
	OP-5	107 hr. 45 min.
	OP-6	95 hr. 45 min.
	OP-7	129 hr. 35 min.
	OP-8	114 hr. 0 min.
	OP-9	109 hr. 0 min.

		OP-10	136 hr. 30 min.
		OP-11	103 hr. 20 min.
		OP-12	129 hr. 50 min.
		OP-13	88 hr. 0 min.
		OP-14	91 hr. 10 min.
		OP-15	139 hr. 5 min.
		OP-16	129 hr. 25 min.
		OP-17	131 hr. 25 min.
		OP-18	114 hr. 55 min.
	Total		**2,035 hr. 15 min.**

3.2 Observed Species Records and Individuals at Plot 1

For the reporting period, 27 species were recorded with a total of 243,031 birds accounting for 5,750 records (Table 4). In addition, observers were not able to identify a total of 9,461 individuals and 777 records – those were classified as raptors, falcons, eagles or unidentified raptor. 88.52% of the birds recorded belonged to only two (2) species; the White Stork and Steppe Buzzard. Only one species (White Stork) exceeded 100,000, while one species (Steppe Buzzard) exceeded 40,000, and the third most counted was the Black Kite with over 9,000 individuals. In addition, another six (6) species accounted for more than 1,000 individuals (Black Stork, Common Crane, European Honey-buzzard, Levant Sparrowhawk, Steppe Eagle and White Pelican). All of those species represent more than 98.98% of the total birds.

Six (6) 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 two (2) Vulnerable-VU species (Eastern Imperial Eagle and Greater Spotted Eagle). In addition, two (2) species are Near Threatened-NT (Dalmatian Pelican and Pallid Harrier). All the remaining species observed were classified as Least Concern-LC.

Table 4: Summary of bird observation records during spring 2022 at Plot 1.

Species Name	Conservation Status [11]	National Status	# records	# individuals
Black Kite *Milvus migrans*	Least Concern	Passage migrant	1,143	9,589
Black Stork *Ciconia nigra*	Least Concern	Passage migrant	120	1,268
Bonelli's Eagle *Aquila fasciata*	Least Concern	Passage migrant/resident	1	1
Booted Eagle *Hieraaetus pennatus*	Least Concern	Passage migrant	262	310
Common Crane *Grus grus*	Least Concern	Passage migrant	12	1,888
Dalmatian Pelican *Pelecanus crispus*	Near Threatened	Passage migrant	1	1
Egyptian Vulture *Neophron percnopterus*	Endangered	Passage migrant	69	84
European Honey-buzzard *Pernis apivorus*	Least Concern	Passage migrant	244	7,905

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

Griffon Vulture *Gyps fulvus*	Least Concern	Passage migrant	1	1
Eastern Imperial Eagle *Aquila heliaca*	Vulnerable	Passage migrant	22	24
Common Kestrel *Falco tinnunculus*	Least Concern	Passage migrant	80	82
Lesser Kestrel *Falco naumanni*	Least Concern	Passage migrant	1	1
Lanner Falcon *Falco biarmicus*	Least Concern	Passage migrant	2	1
Lesser Spotted Eagle *Clanga pomarina*	Least Concern	Passage migrant	348	862
Levant Sparrowhawk Accipiter brevipes	Least Concern	Passage migrant	9	1,128
Long-legged Buzzard *Buteo rufinus*	Least Concern	Passage migrant / winter visitor	150	245
Western Marsh-harrier *Circus aeruginosus*	Least Concern	Passage migrant	40	42
Montagu's Harrier *Circus pygargus*	Least Concern	Passage migrant	13	13
Osprey *Pandion haliaetus*	Least Concern	Passage migrant	15	15
Pallid Harrier *Circus macrourus*	Near Threatened	Passage migrant / winter visitor	21	21
Short-toed Snake-eagle *Circaetus gallicus*	Least Concern	Passage migrant / summer breeder	484	719
Eurasian Sparrowhawk *Accipiter nisus*	Least Concern	Passage migrant	38	44
Greater Spotted Eagle *Clanga clanga*	Vulnerable	Passage migrant	10	12
Steppe Buzzard *Buteo buteo vulpinus*	Least Concern	Passage migrant	1,584	44,285
Steppe Eagle *Aquila nipalensis*	Endangered	Passage migrant / Winter visitor	701	2,081
White Pelican *Pelecanus onocorotalus*	Least Concern	Passage migrant	26	1,553
White Stork *Ciconia ciconia*	Least Concern	Passage migrant	353	17,0855
TOTALS			**5,750**	**243,031**
Unidentified individuals				
buzzard sp.			157	3,239
eagle sp.			265	1,029
harrier sp.			14	15
Raptor sp.			317	5,153
Falcon sp.			24	25
Subtotal			**777**	**9,461**

3.3 Unidentified species

Table 5 and 6 show derived correction factors for both numbers of observations (flights that may comprise one or more individual) and for numbers of passages (individual birds) respectively at Plot 1 in Spring 2022. The purpose of this analysis is to assess the potential influence of reporting unidentified birds on the assessment of species-specific passage rates which occurred at the site during OP surveys.

The largest proportion of unidentified flights was for the falcon species and the analysis indicates that more than a quarter of flights and passages within the falcon group may have been classified within either the falcon species, or raptor species groupings rather than to species level. For the very numerous buzzard group, almost an eighth may have been classified as either unidentified buzzard species, or unidentified raptor species rather than to species level.

Table 5: Indicative correction factors for flights (one or more birds) for species included within unidentified species groupings at Plot 1 in Spring 2022.

Group	Identified flights	Unidentified flights	Proportion unidentified	Correction factor	Species included
Buzzard species	1978	157	0.079	1.139	Honey buzzard; Long-legged buzzard; Steppe buzzard
Eagle species	1828	265	0.145	1.209	Bonelli's eagle; Booted eagle; Greater-spotted eagle; Imperial eagle; Lesser-spotted eagle; Short-toed eagle; Steppe eagle
Falcon species	83	24	0.289	1.361	Kestrel; Lanner falcon; Lesser kestrel
Harrier species	74	14	0.189	1.255	Marsh harrier; Montegu's harrier; Pallid harrier
Raptor species	5698	317	0.056	1.056[12]	All of above, plus Black kite; Egyptian vulture; Griffon vulture; Levant sparrowhawk; Osprey; Sparrowhawk; Buzzard sp.; Eagle sp.; Falcon sp.; Harrier sp.

Table 6: Indicative correction factors for passages (individual birds) for species included within unidentified species groupings at Plot 1 in Spring 2022.

Group	Identified individuals	Unidentified individuals	Proportion unidentified	Correction factor	Species included
Buzzard species	52435	3239	0.062	1.138	Honey buzzard; Long-legged buzzard; Steppe buzzard
Eagle species	4009	1029	0.257	1.347	Bonelli's eagle; Booted eagle; Greater-spotted eagle; Imperial eagle; Lesser-spotted eagle; Short-toed eagle; Steppe eagle
Falcon species	85	25	0.294	1.387	Kestrel; Lanner falcon; Lesser kestrel
Harrier species	76	15	0.197	1.283	Marsh harrier; Montegu's harrier; Pallid harrier
Raptor species	71774	5153	0.072	1.072*	All of above, plus Black kite; Egyptian vulture; Griffon vulture; Levant sparrowhawk; Osprey; Sparrowhawk; Buzzard sp.; Eagle sp.; Falcon sp.; Harrier sp.

[12] This correction factor is only applicable to raptors not included in other groups. For other groups, the contribution of unidentified raptors has been incorporated into the group-specific correction factor.

3.4 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 wind turbine operations on collision risk, as large flocks may cause a large number of fatalities in one single event compared to individuals flying alone. Table 7 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. By far the Common Crane, Great White Pelican, Levant Sparrow Hawk and the White Stork had the largest flock sizes. Generally, most of the remaining species were all estimated at less than 10 individuals per flock (group) with most being single birds. Overall, all of the eagles migrated in small groups, as did the harriers and small falcons. 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. There could be several reasons for this pattern, including the influence of attractants from outside of the OP survey coverage area.

It should be noted that flock size has the potential to change between years for any species as it varies widely based on multiple factors. This has been already recorded in other neighbouring projects in this region (Red Sea North to Ras Gharib) for pelicans, Common Crane and Levant Sparrowhawk.

Table 7: 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 1 in spring 2022.

Species	Mean group	Conf. 95%	Conf. +95%	# records	# Maximum
Steppe Buzzard	27.9	25.3	30.6	1584	900
Black Kite	8.3	7.2	9.5	1143	300
Steppe Eagle	2.9	2.2	3.7	701	200
Sparrowhawk	1.1	1.0	1.3	38	3
Kestrel	1.1	0.9	1.0	80	2
Marsh Harrier	1.6	0.9	1.1	40	2
White Stork	484	399.8	568.2	353	8000
Pallid Harrier	1	-	-	21	1
Honey Buzzard	32.3	26.8	37.9	244	260
Long-legged Buzzard	1.6	1.4	1.8	150	10
Short-toed Eagle	1.4	1.3	1.6	484	30
Lesser Kestrel	1	-	-	1	1
Lesser Spotted Eagle	2.4	2.1	2.7	348	22
Montagu’s Harrier	1	-	-	13	1
Egyptian Vulture	1.2	1.1	1.3	69	3
Booted Eagle	1.1	1.1	1.2	262	6
White Pelican	59.7	-	170.2	26	1400
Levant Sparrowhawk	125.3	-	406.3	9	1100
Black Stork	10.5	7.4	13.6	120	100
Common Crane	157.3	43.5	271.1	12	600
Dalmatian Pelican	1	-	-	1	1
Lanner Falcon	1	-	-	2	1
Osprey	1	-	-	15	1
Imperial Eagle	1.1	0.9	1.2	22	2
Griffon Vulture	1	-	-	1	1
Bonelli's Eagle	1	-	-	1	1
Spotted Eagle	1	0.8	1.5	10	2

3.5 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 extrapolated passage rates to assess relative patterns of bird activity observed during the season within and immediately adjacent to the project area. 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 (i.e. abundance at flight height bands). Groups assessed included: All MSB and target species including unidentified species; all birds of prey (excluding unidentified species), and; storks and pelicans – check figures below. Species-specific plots to assess spatial patterns were drafted for globally threatened species as well as species observed during the season at moderate and high abundance, and are included in Appendix B. The analysis of time spent in individual flight height bands is summarised in the figure below.

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 2022 spring season at Plot 1 are summarised as follows:

3.5.1 Groups

- For all MSB and target species, including unidentified species, the highest extrapolated passage rates were at OP12 in the southeast, with high rates also clustered in the central portion of the site (OP10,8,6,5 and 4).
- For all birds of prey (excluding unidentified species), the southern half of the site exhibited the highest extrapolated passage rates, though relatively high rates were observed throughout the remainder of the site.
- 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).

3.5.2 Species

- Black kites appear to occur in greater numbers in the south-east of the site (OP11,12,15), and potentially spend a greater proportion of time at lower altitudes (0-120m) in the southern area of the plot (OP12, 14, 17, 18 particularly).
- Black storks appear 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.
- 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.
- Honey buzzards occur in the lowest flight band infrequently, with more time spent within 150-200m altitudes. The highest number of passages is expected to occur at OP1 in the north of the site.
- Imperial eagles spend 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 animals were noted north of OP5 (slightly north of the dam).
- Levant sparrowhawks were recorded in a small number of groups at OP17, 16, 14, 4, 3 and 1. Sample sizes of observations were not large enough to identify flight height patterns.

- Spotted eagles were recorded in small numbers.
- 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.
- Steppe eagles spent more time at greater heights (>200m), particularly at OP11, 13, 15, and 16. OP13 had the highest passage rate.
- 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.
- White storks spent a large proportion of time between 0-120m heights. There were fewer passages in the south of the site.

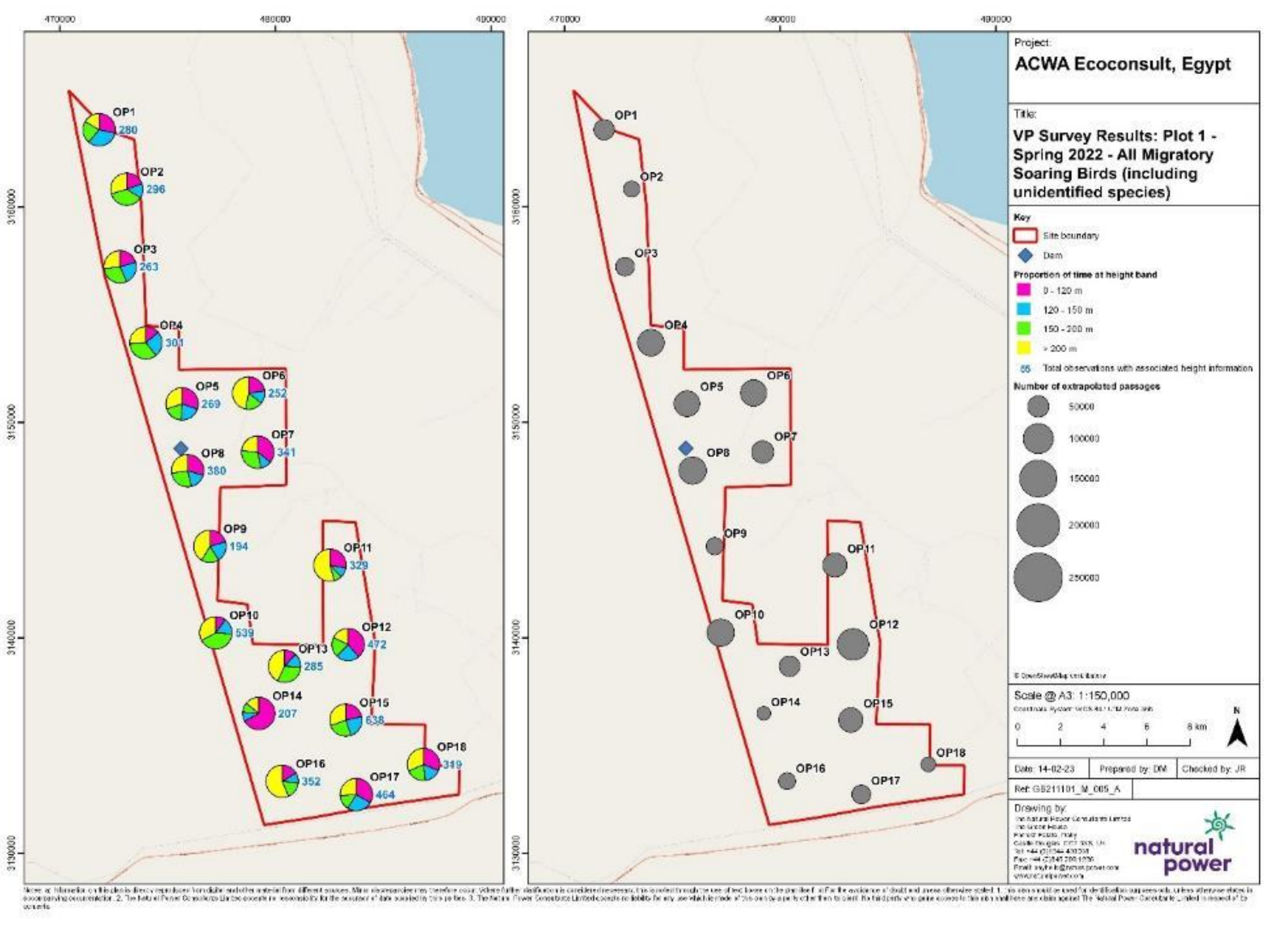


Figure 7: Extrapolated passage rates and proportion of time observed at flight height bands for all MSB and target bird species during spring 2022 migration season at Plot 1.

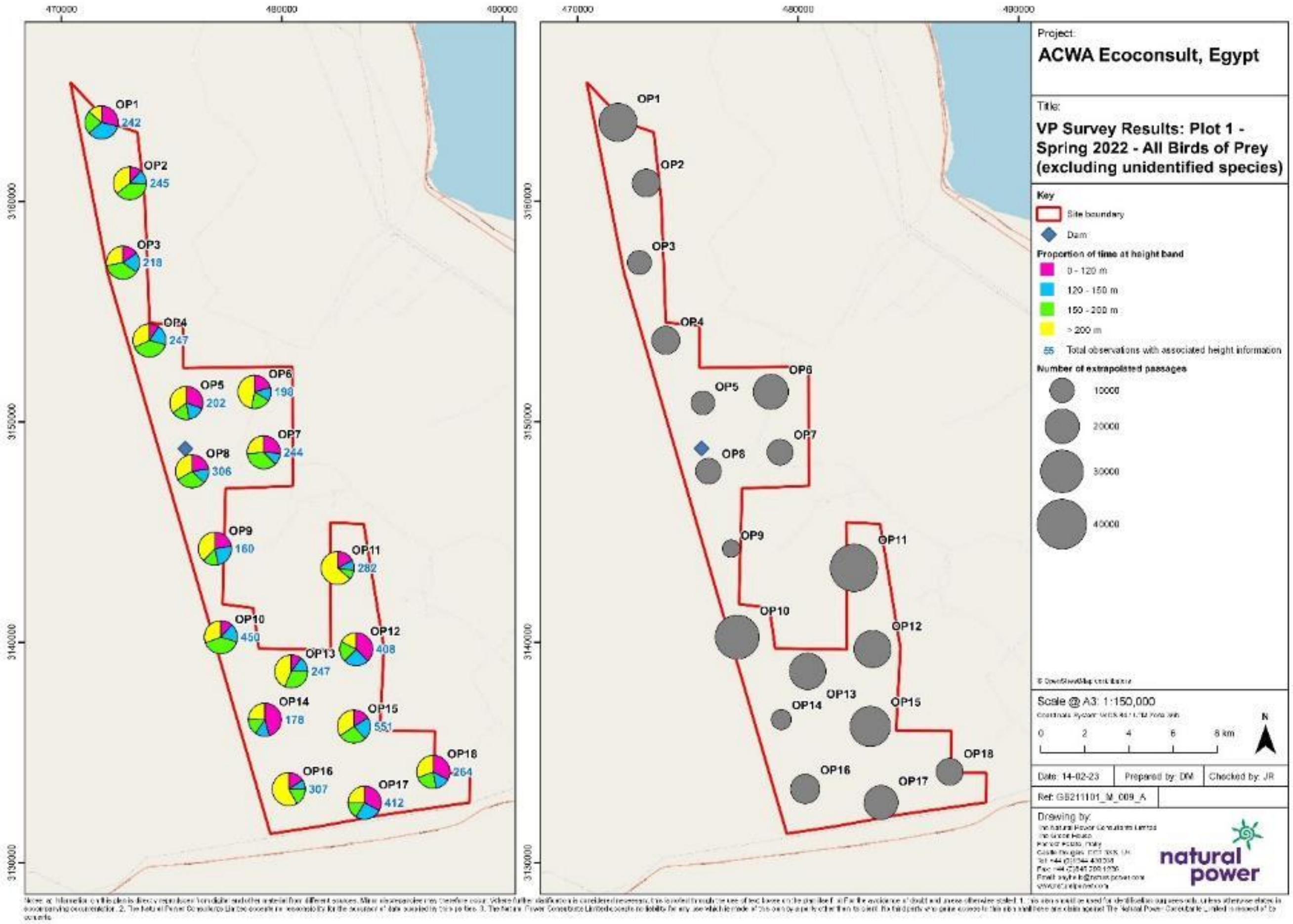


Figure 8: Extrapolated passage rates and proportion of time observed at flight height bands for all birds of prey during spring 2022 migration season at Plot 1.

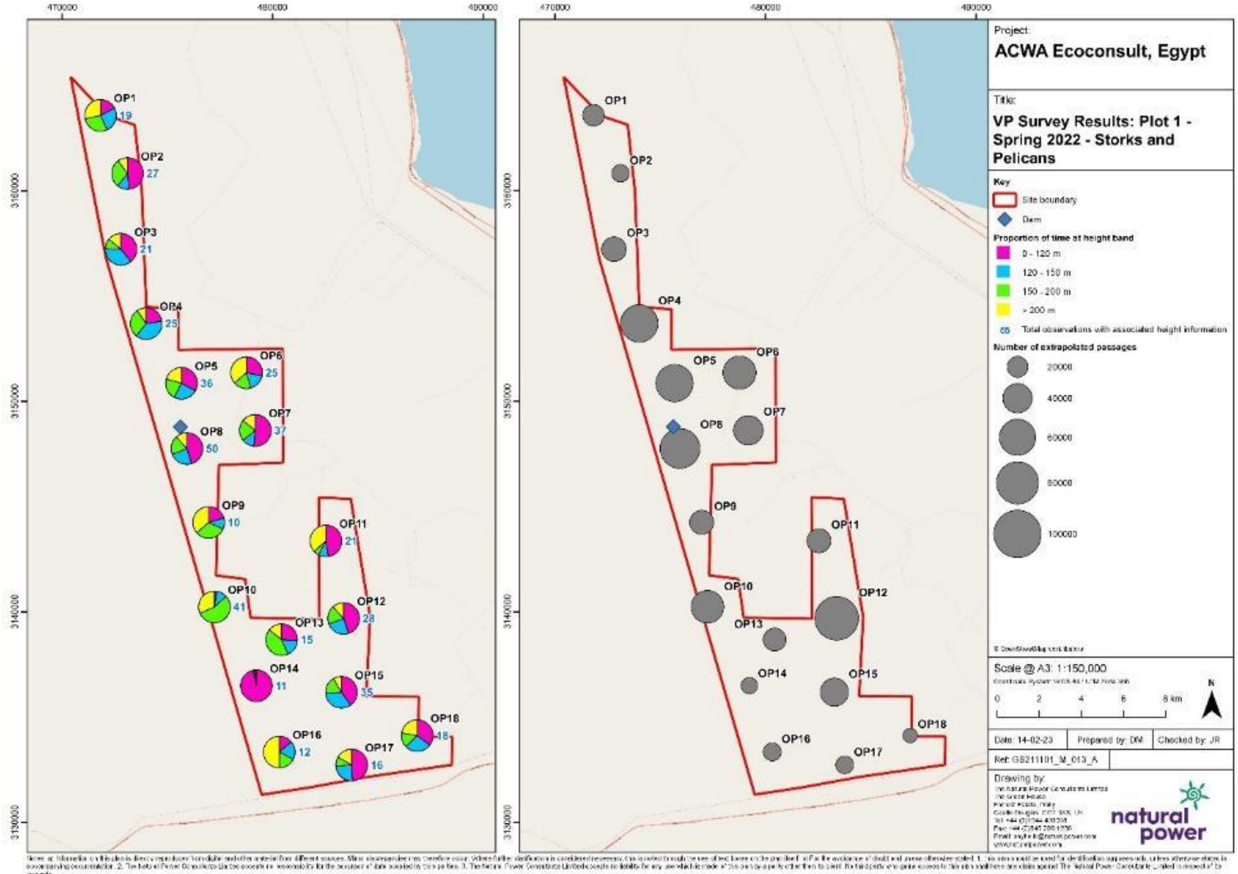


Figure 9: Extrapolated passage rates and proportion of time observed at flight height bands for all storks and pelicans during spring 2022 migration season at Plot 1.

3.5.3 Flight height/bands

The client has not determined turbine specifications nor a turbine layout, therefore, Collision Risk Modelling (CRM) has not been undertaken at this time, and this report only 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 8). A subset (11) of the most abundant, as well as all globally threatened species, have also been 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 57% within the 150-m band and 77% within the 200-m band (Table 8). Risk increases as the flight height band is increased for all species with two exceptions, the Common Crane and the White Pelican, which did not vary much when comparing #individuals/flight height band. These two species usually fly at great height above the turbines and the majority of migration activity over the site likely occurred at significantly higher flight heights[13]. However, when assessing the proportion of time spent at different height bands using the OP data, it should be noted that the vast majority

[13] For example, around 300,000 Common Cranes cross the Iberian Peninsula twice per year from the northern breeding to southwestern wintering grounds; a few of these cross into Africa through the Strait of Gibraltar; as a whole, the number of fatalities occurring at operational wind farms in Spain is only a handful/migration season.

of time observed White Pelican and Common Cranes were recorded at flight heights of <200-m (figure below). This was also true for seven (7) of the other nine (9) species assessed.

Table 8 : Numbers of birds recorded per species and birds at risk height for turbine tip heights of 150 and 200 m at Plot 1 during spring 2022.

Species	Total	At risk150	Risk150%	At risk200	Risk200%
Black Kite	9589	4314	44.99%	6400	66.74%
Black Stork	1268	688	54.26%	934	73.66%
Bonelli's Eagle	1	1	100.00%	1	100.00%
Booted Eagle	310	134	43.23%	228	73.55%
Common Crane	1888	1092	57.84%	1098	58.16%
Dalmatian Pelican	1	1	100.00%	1	100.00%
Egyptian Vulture	84	40	47.62%	58	69.05%
Falcon Species	25	15	60.00%	18	72.00%
Griffon Vulture	1		0.00%	1	100.00%
Honey Buzzard	7905	4035	51.04%	5756	72.81%
Imperial Eagle	24	7	29.17%	11	45.83%
Kestrel	82	64	78.05%	78	95.12%
Lanner Falcon	2	2	100.00%	2	100.00%
Lesser Kestrel	1	1	100.00%	1	100.00%
Lesser Spotted Eagle	862	360	41.76%	587	68.10%
Levant Sparrowhawk	1128	3	0.27%	1105	97.96%
Long-legged Buzzard	245	95	38.78%	155	63.27%
Marsh Harrier	42	32	76.19%	38	90.48%
Montagu's Harrier	13	10	76.92%	12	92.31%
Osprey	15	7	46.67%	12	80.00%
Pallid Harrier	21	20	95.24%	21	100.00%
Short-toed Eagle	719	296	41.17%	446	62.03%
Sparrowhawk	44	21	47.73%	29	65.91%
Spotted Eagle	12	2	16.67%	5	41.67%
Steppe Buzzard	44285	15718	35.49%	28161	63.59%
Steppe Eagle	2081	447	21.48%	878	42.19%
White Pelican	1553	1510	97.23%	1511	97.30%
White Stork	170855	109261	63.95%	138830	81.26%
Total general	**243,056**	**138,176**	**56.85%**	**186,377**	**76.68%**
Unidentified falcon	25	15	60.00%	18	72.00%
Unidentified raptor	5153	933	18.11%	1466	28.45%
Unidentified Buzzard	3239	728	22.48%	1263	38.99%
Unidentified Eagle	1029	105	10.20%	213	20.70%
Unidentified Harrier	15	14	93.33%	15	100.00%
Subtotal	**9,461**	**1,795**	**18.97%**	**2,975**	**31.44%**

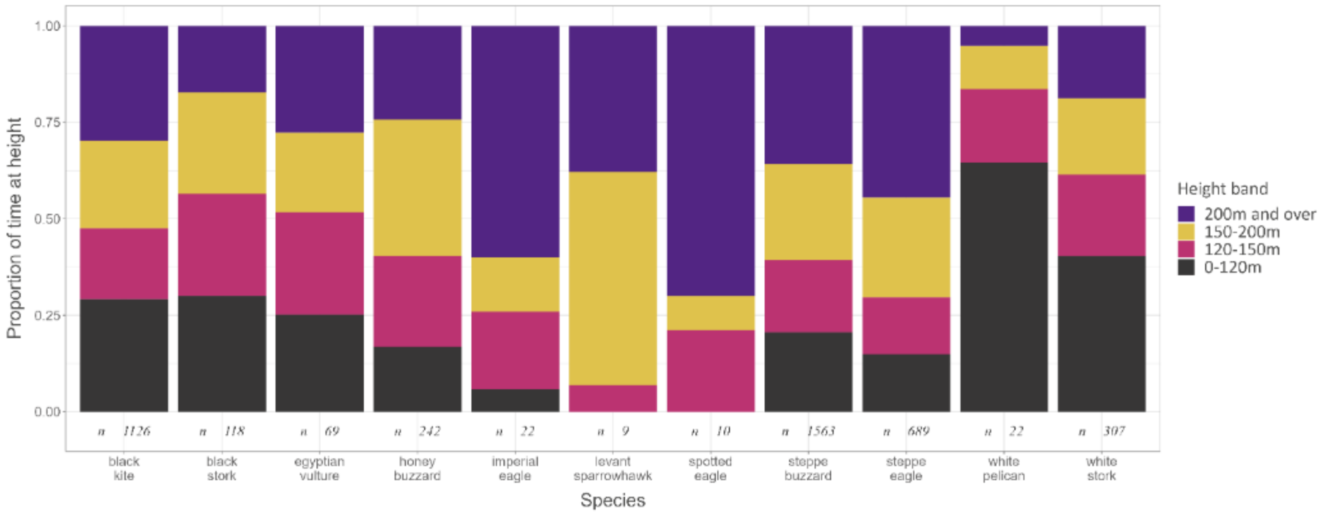


Figure 10: Proportion of time spent within flight height bands for selected species observed at Plot 1 during Spring 2022.

3.6 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.

3.6.1 Groups

For all MSB and target birds. Figure below illustrates low initial overall activity during late February-mid-March until a sharp increase in 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 the GoS, this overall temporal trend is commonly observed and was highly driven by the large number of White Storks migrating over the site during this period. Cumulative analysis (figure below) indicated the majority of the birds recorded occurred between week #13 (late March) and #19 (late April-early May), accounting for the 97% of the total birds recorded during OP surveys.

In respect to daily activity patterns, overall for all MSB and target species 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.

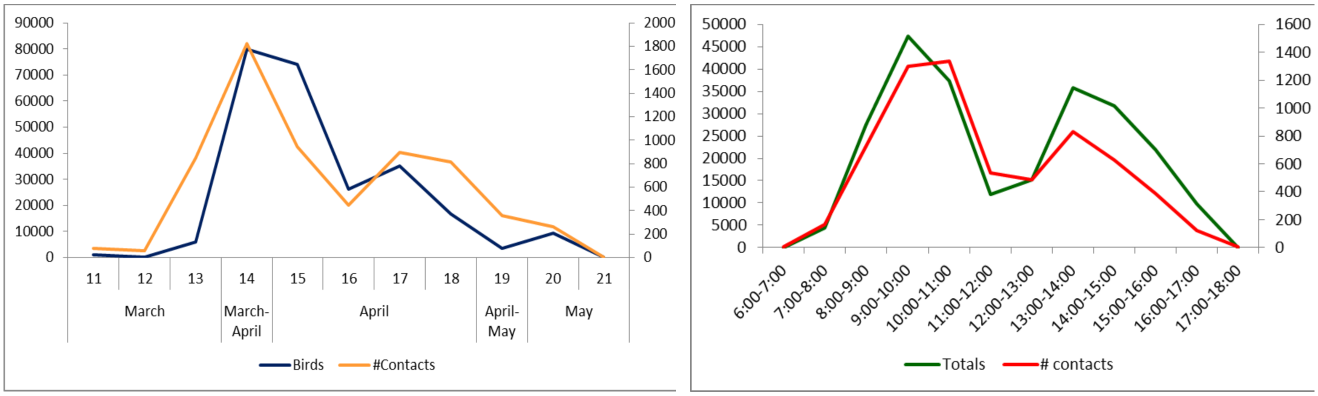


Figure 11: Temporal analysis of all MSB and target birds, excluding unidentified species, at Plot 1 during spring 2022. Weekly (left) and daily plots are included (right).

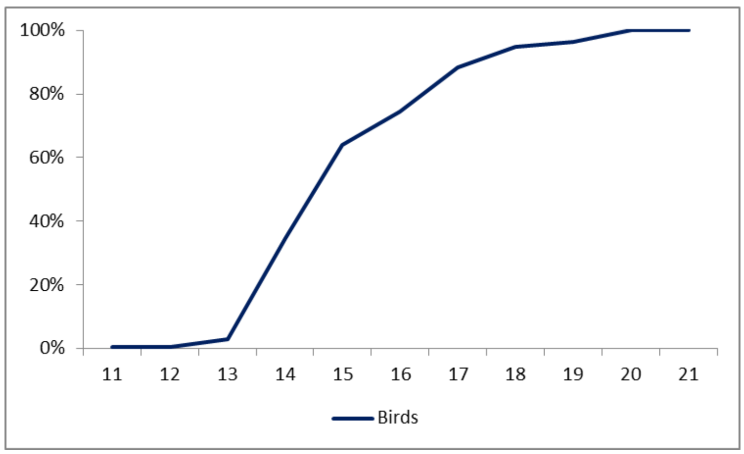


Figure 12: Cumulative percentage of all MSB and target birds, excluding unidentified species, observed per week at Plot 1 during spring 2022.

Median passage rates (birds/hour) were assessed for all birds of prey (figure below), indicating a peak between mid-March and mid-April, which is coincident with the bulk period for Steppe Buzzard and Steppe Eagle passage, and a second peak in April-May, driven by Honey Buzzard migration activity. The highest median passing rates observed were 0.15-0.18 birds per hour, equivalent to 1.8-2.16 birds per day assuming a twelve-hour monitoring period/observation day.

Eight eagle species were observed during the season, with only three of these observed in numbers large enough to show meaningful temporal analysis at the site. March-April is the time of migration for the Steppe Eagle, but also the booted and short-toed eagles (figure below). Hourly passage rates increased towards the evening for birds of prey other than eagles, but eagle species were highest during mid-day – largely driven by steppe eagle activity (figure below).

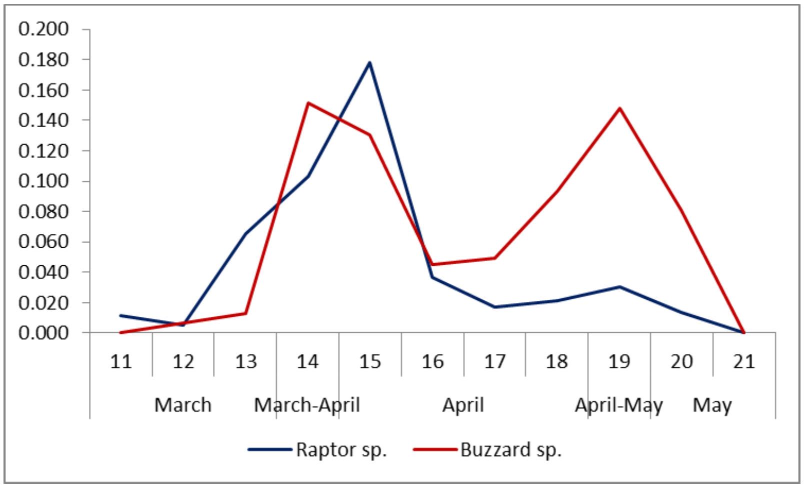


Figure 13: : Median passing rates (birds/hour) for birds of prey observed at Plot 1 during spring 2022.

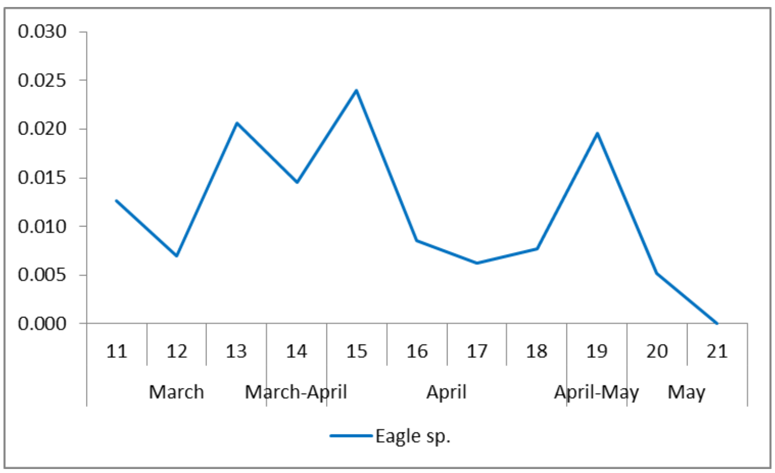


Figure 14: Median passing rates (birds/hour) for eagles observed at Plot 1 during spring 2022.

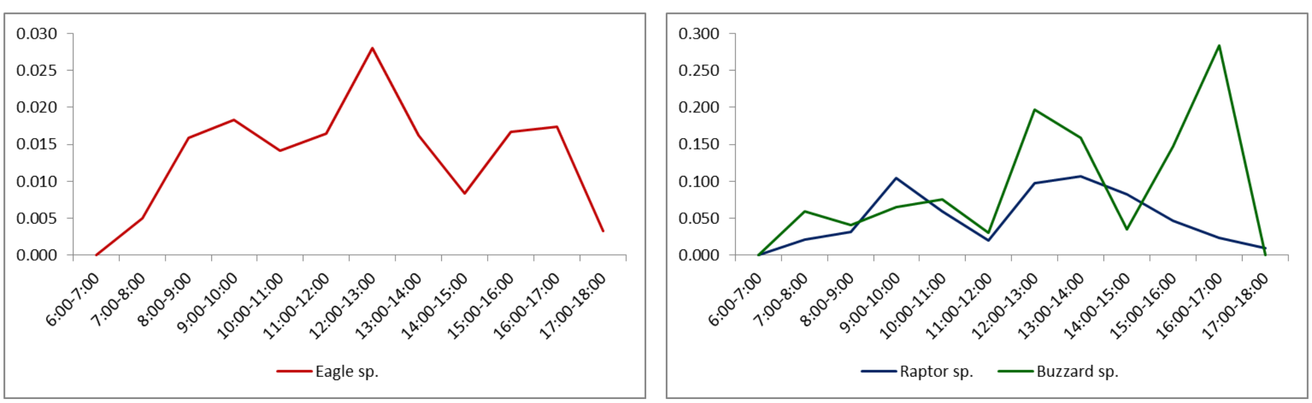


Figure 15: Passage rates of Eagles, raptors, and buzzards observed per hour at Plot 1 during spring 2022

Median passage rates (birds/hour) were assessed for all falcons and harriers (figure below), and for these two groups the passing rates were much lower compared to other species or groups. Falcons and harriers tend to migrate irregularly and are facultative soaring birds, which combined challenge the capacity to produce meaningful species-specific analysis in the context of project-scale wind energy migration studies. Overall, only 0.000 to 0.008 for falcons/hour were observed during spring 2022 monitoring at Plot 1, which is equivalent to 0-8 birds every 1,000 hours of monitoring. Similar values were found for the harriers.

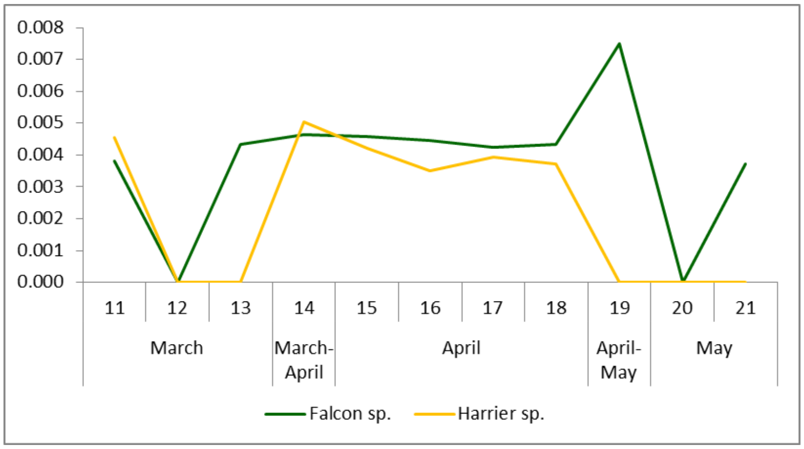


Figure 16: Median passing rates (birds/hour) for falcons and harriers observed at Plot 1 during spring 2022.

3.6.2 Species

Species-specific patterns of migration vary temporally within migratory seasons. Published information from the flyway[14] was compared with species observed at the site during the season (with sufficient numbers of observations made to allow for meaningful comparisons) to assess generally whether the temporal patterns of activity at the site during the season were typical or atypical. This information is included in Appendix B.

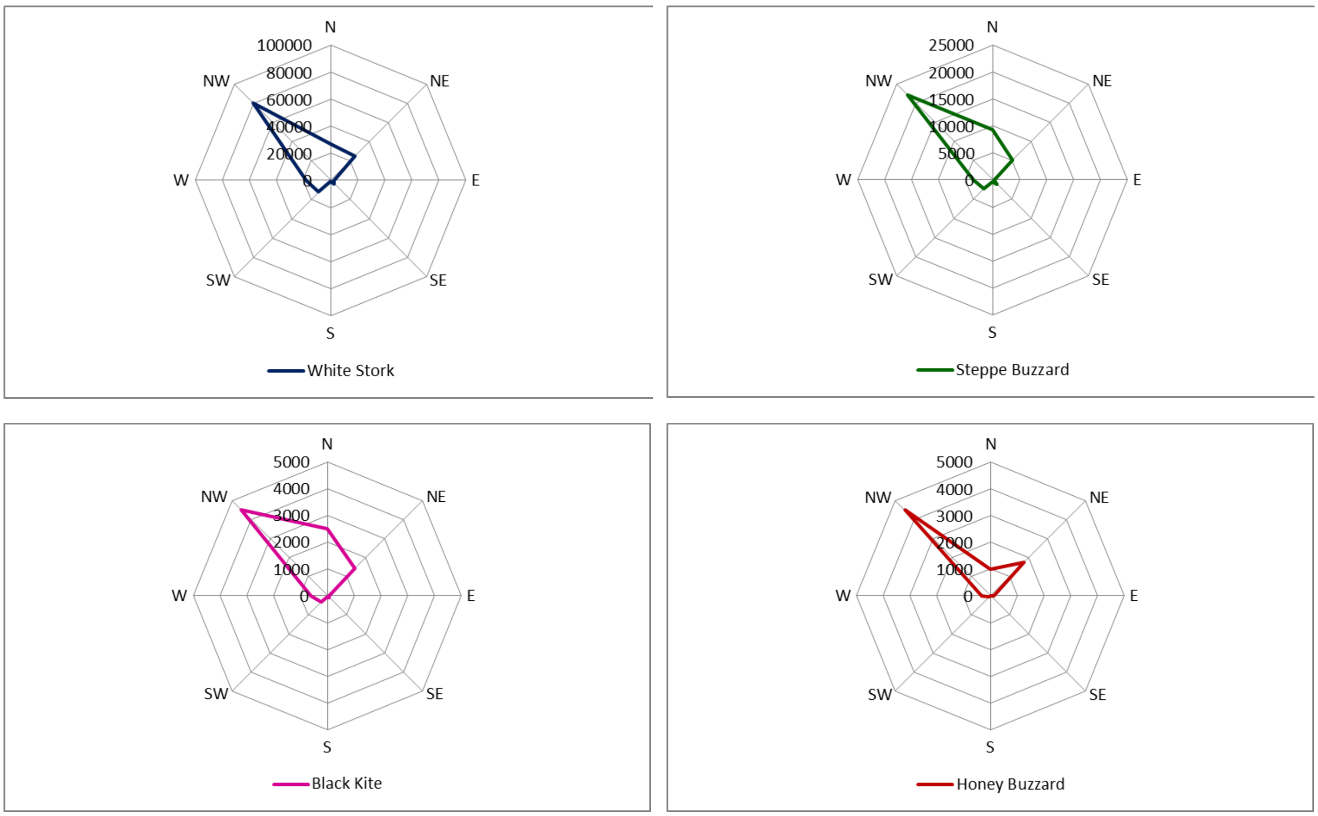
In addition, the following should be noted:

- Some species migrate along broad fronts, and which are not exclusively soaring birds, but soar from time to time, and these species are able to fly over the sea. Within this heterogeneous group falcons, harriers and osprey were observed in very low numbers and therefore, species-specific analysis was not performed for the season.
- Common Crane, and the Levant Sparrowhawk, accounted for a small number of observations but a large number of birds per observation. Patterns cannot be achieved, as a few counts could be considered incidental. The high numbers of the Levant Sparrowhawk suggest the global population estimates for this species should be revised as soon as possible. Many projects in the Red Sea region have recorded numbers much higher than the overall population itself. Many Common cranes remain wintering in northern latitudes without crossing the Gulf of Suez, and inter-annual variation in migration rates for the species are highly variable. Therefore, the relatively low numbers observed during spring 2022 may increase substantially in other spring seasons during the life of the project.

[14] Further information on patterns may be found, for example, in: Shirihai et al. (2000) “Raptor Migration in the Middle East. A summary of 30 years of field research”. As the title says, it includes more than thirty years of established monitoring. The authors explain that counts at the Gulf of Suez of migratory birds in both autumn and spring were observed and recorded already in the 80´s and 90`s with specific references there such as Biljsma (1982, 1983), Wimpfheimer et al. (1983), Meininger & Atta (1994), or other counts in the Southern Red Sea Area (Sorensen 1982, Grieve 1996). The authors describe how migration occurs both in spring and winter along the entire Middle East, from Djibouti to Jordan and Lebanon, from Egypt to Yemen, providing also data from latitudes further north like Bosphorus. The assessment below compared the results with the Shirihai et al. (2000) study in order to understand and compare the migratory patterns recorded within the Project site since it is more focused in the Middle East.

3.7 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[15]. 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.



[15] This is so-called slope soaring.

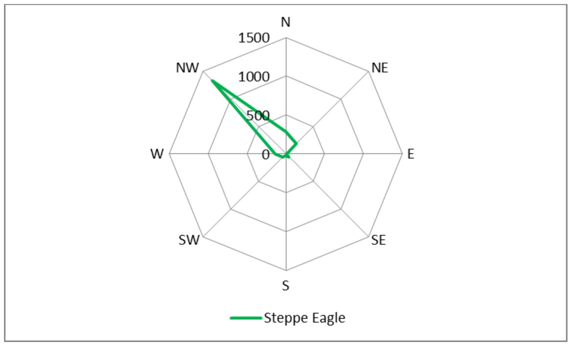


Figure 17: Observed flight direction of the five most abundant migratory soaring birds observed at Plot 1 during spring 2022.

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

As noted in the Table 9, twelve (12) species of MSBs and other target species, excluding passerines were recorded throughout the monitoring undertaken of the artificial pond/dam site. The most abundant species recorded at the location was White Stork, with 6,000 individuals recorded on a single observation day (figure below), and over 15,000 recorded during all surveys of the location performed during the spring 2022 survey period. All remaining species had less than 160 individuals recorded throughout this period.

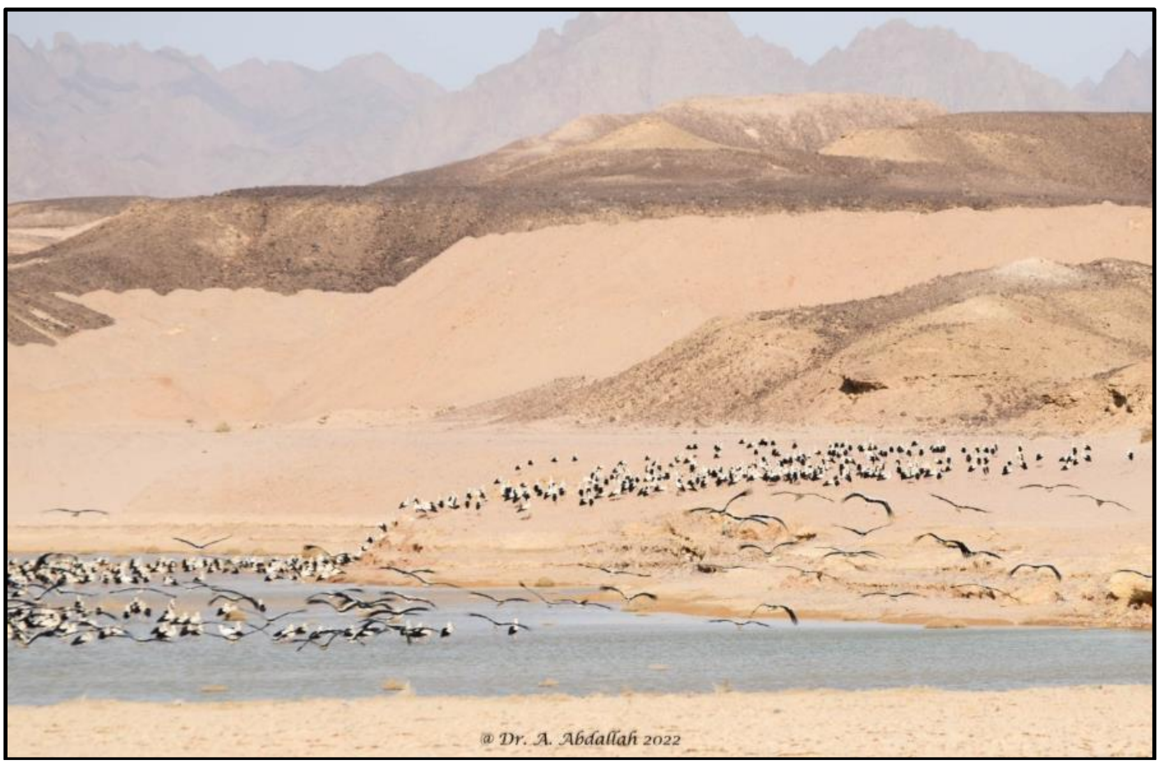


Figure 18: Photo of White Storks in the water and the surrouding area to the artificial pond/dam located within Plot 1 during spring 2022.

Table 9: Bird species, number of individuals and maximum daily count/species recorded during surveys perfomed of the artificial pond/dam located within Plot 1 during spring 2022.

Common Name	Scientific name	Number of Individuals	Max count/day
White Stork	*Ciconia ciconia*	15,076	6,000

Black Stork	*Ciconia nigra*	64	37
White Pelican	*Pelecanus onocorotalus*	59	32
Common Crane	*Grus grus*	1	1
Egyptian Vulture	*Neophron percnopterus*	2	1
Black Vulture	*Aegypius monachus*	1	1
Osprey	*Pandion haliaetus*	2	1
Steppe Eagle	*Aquila nipalensis*	11	5
Booted Eagle	*Hieraaetus pennatus*	3	3
Short-toed Snake-eagle	*Circaetus gallicus*	11	6
Black Kite	*Milvus migrans*	160	70
Western Marsh-harrier	*Circus aeruginosus*	4	1
Pallid Harrier	*Circus macrourus*	1	1
Montagu’s Harrier	*Circus pygargus*	1	1
Steppe Buzzard	*Buteo buteo vulpinus*	3	3
Grey Heron	*Ardea cinerea*	22	17
Squacco Heron	*Ardeola ralloides*	3	3
Cattle Egret	*Bubulcus ibis*	7	4
Little Stint	*Calidris minuta*	12	12
Black-winged Stilt	*Himantopus himantopus*	7	8
Brown Necked Raven	*Corvus ruficollis*	10	2

4 PLOT 1: RESULTS FOR AUTUMN 2022

The overall effort and effort per OP for Plot 1 during autumn 2022 is summarised in Table 10.

Table 10: Level of Effort during Avifaunal Assessments for Plot 1 during autumn 2022.

Season /dates		OP	Monitoring time
		Plot 1	
Autumn 2022 **92 days** **15 Aug–08 Nov)**		OP-1	262 hr
		OP-2	266 hr 15 min
		OP-3	262 hr 15 min
		OP-4	266 hr 15 min
		OP-5	262 hr 15 min
		OP-6	266 hr 15 min
		OP-7	266 hr 15 min
		OP-8	266 hr 15 min
		OP-9	262 hr
		OP-10	266 hr 15 min
		OP-11	266 hr 15 min
		OP-12	266 hr 15 min
		OP-13	266 hr 15 min
		OP-14	262 hr 15 min
		OP-15	266 hr 15 min
		OP-16	266 hr 15 min

		OP-17 OP-18	262 hr 15 min 266 hr 15 min
	Total		**4,767 hr. 45 min.**

4.1 Observed Species Records and Individuals at Plot 1

For the reporting period, 20 species were recorded with a total of 10,537 individual birds from 518 records (Table 11). In addition, observers were not able to identify a total of 283 individuals and 122 records – those were classified as raptors, falcons, eagles or unidentified raptor. 87.38% of the birds recorded belonged to only two (2) species; the European honey buzzard and the white stork. The great white pelican accounted for 5.9% of individuals observed, while another four species (black kite, marsh harrier, Levant sparrowhawk, and steppe buzzard) accounted for 1% of the total number of individuals observed. Cumulatively, these seven species represent more than 98% of the total birds observed during the season at the site.

Four (4) of the species recorded (Table 4) are globally threatened according to the IUCN Red List (https://www.iucnredlist.org/): including one Endangered-EN (steppe eagle), and two (2) Vulnerable-VU species (sooty falcon and red-footed falcon). In addition, one species is Near Threatened-NT (Pallid Harrier). All the remaining species observed were classified as Least Concern-LC.

Table 11: Summary of Bird Observation Records during Reporting Period (autumn 2022) at Plot 1

Species Name	Conservation Status [16]	National Status	# records	# individuals
Black Kite *Milvus migrans*	Least Concern	Passage migrant	39	190
Black Stork *Ciconia nigra*	Least Concern	Passage migrant	1	2
Booted Eagle *Hieraaetus pennatus*	Least Concern	Passage migrant	5	7
European Honey-buzzard *Pernis apivorus*	Least Concern	Passage migrant	148	5,195
Common Kestrel *Falco tinnunculus*	Least Concern	Passage migrant	74	80
Peregrine Falcon *Falco peregrinus*	Least Concern	Resident/ Passage migrant	1	1
Sooty Falcon *Falco concolor*	Vulnerable	Passage migrant	18	20
Red-footed Falcon *Falcon vespertinus*	Vulnerable	Passage migrant	3	3
Levant Sparrowhawk Accipiter brevipes	Least Concern	Passage migrant	6	117
Long-legged Buzzard *Buteo rufinus*	Least Concern	Passage migrant / winter visitor	4	4
Western Marsh-harrier *Circus aeruginosus*	Least Concern	Passage migrant	96	108
Montagu's Harrier *Circus pygargus*	Least Concern	Passage migrant	20	20
Osprey *Pandion haliaetus*	Least Concern	Passage migrant	2	2
Pallid Harrier *Circus macrourus*	Near Threatened	Passage migrant / winter visitor	19	21

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

Short-toed Snake-eagle *Circaetus gallicus*	Least Concern	Passage migrant / summer breeder	2	2
Eurasian Sparrowhawk *Accipiter nisus*	Least Concern	Passage migrant	6	6
Steppe Buzzard *Buteo buteo vulpinus*	Least Concern	Passage migrant	56	157
Steppe Eagle *Aquila nipalensis*	Endangered	Passage migrant / Winter visitor	2	2
White Pelican *Pelecanus onocorotalus*	Least Concern	Passage migrant	9	588
White Stork *Ciconia ciconia*	Least Concern	Passage migrant	7	4,012
Unidentified species			122	283
TOTALS			**640**	**10,820**
Unidentified birds				
Buzzard sp.			27	111
Eagle sp.			3	3
Falcon sp.			32	43
Harrier sp.			33	37
Raptor sp.			27	89
SUBTOTAL			**122**	**283**

4.2 Unidentified species

Table 12 and 13 show derived correction factors for both numbers of observations (flights that may comprise one or more individual) and for numbers of passages (individual birds) respectively at Plot 1 in autumn 2022. The purpose of this analysis is to assess the potential influence of reporting unidentified birds on the assessment of species-specific passage rates which occurred at the site during OP surveys.

The largest proportion of unidentified flights was for the falcon species, and the analysis indicates that almost a third of flights and more than a quarter of passages within the falcon group may have been classified as unidentified falcon or unidentified raptor. For the very numerous buzzard group, almost an eighth may have been classified as either unidentified buzzard species, or unidentified raptor species rather than to species level. Overall, proportions of flights assigned to species groupings rather than to species level was slightly higher in the autumn 2022 migration season compared to the spring 2022 migration season, but the number of individual passages assigned to groupings rather than species level was generally lower.

Table 12: Indicative correction factors for flights (one or more birds) for species included within unidentified species groupings at Plot 1 in autumn 2022.

Group	Identified flights	Unidentified flights	Proportion unidentified	Correction factor	Species included
Buzzard species	208	27	0.130	1.183	Honey buzzard; Long-legged buzzard; Steppe buzzard
Eagle species	9	3	0.333	1.396	Booted eagle; Short-toed eagle; Steppe eagle
Falcon species	96	32	0.333	1.396	Kestrel; Peregrine falcon; Red-footed falcon; Sooty falcon
Harrier species	135	33	0.244	1.303	Marsh harrier; Montegu's harrier; Pallid harrier

Raptor species	596	28	0.047	1.047*	All of above, plus Black kite; Levant sparrowhawk; Osprey; Sparrowhawk; Buzzard sp.; Eagle sp.; Falcon sp.; Harrier sp.

Table 13: Indicative correction factors for passages (individual birds) for species included within unidentified species groupings at Plot 1 in autumn 2022

Group	Identified individuals	Unidentified individuals	Proportion unidentified	Correction factor	Species included
Buzzard species	5356	111	0.021	1.036	Honey buzzard; Long-legged buzzard; Steppe buzzard
Eagle species	11	3	0.273	1.292	Booted eagle; Short-toed eagle; Steppe eagle
Falcon species	104	43	0.413	1.434	Kestrel; Peregrine falcon; Red-footed falcon; Sooty falcon
Harrier species	149	37	0.248	1.267	Marsh harrier; Montegu's harrier; Pallid harrier
Raptor species	6129	91	0.015	1.015*	All of above, plus Black kite; Levant sparrowhawk; Osprey; Sparrowhawk; Buzzard sp.; Eagle sp.; Flacon sp.; Harrier sp.

4.3 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 wind turbine operations on collision risk, as large flocks may cause a large number of fatalities in one single event compared to individuals flying alone. Table 14 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. for all species, the number of records, and their minimum and the maximum values, median and 5-95% percentiles. As noted, by far the Great White Pelican, Levant Sparrow Hawk and the White Stork had the largest flock sizes. Overall, most observations during the autumn 2022 season were of individuals and small flocks.

It should be noted that migration patterns vary between spring and autumn seasons within the flyway, including the overall magnitude of the migration flux (higher in spring in comparison to autumn), and the propensity of conspecifics to aggregate in flocks (higher in spring in comparison to autumn).

Table 14: 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 1 in autumn 2022.

Species	Mean gr size	N	Min	Max	Median	Percentile 5%	Percentile 95%
Common Kestrel	1.08	74	1	2	1	1	2
Marsh Harrier	1.13	96	1	3	1	1	2
Pallid Harrier	1.11	19	1	2	1	1	2
Honey Buzzard	35.10	148	1	450	11	1	150
Black Kite	4.87	39	1	50	1	1	44
Sooty Falcon	1.11	18	1	2	1	1	2
Montagu's Harrier	1.00	20	1	1	1	1	1

Steppe Buzzard	2.80	56	1	20	2	1	12
Sparrowhawk	1.00	6	1	1	1	1	1
White Pelican	65.33	9	4	200	53	4	200
Red-Footed Falcon	1.00	3	1	1	1	1	1
Osprey	1.00	2	1	1	1	1	1
White Stork	573.14	7	1	2500	200	1	2500
Long-legged Buzzard	1.00	4	1	1	1	1	1
Booted Eagle	1.40	5	1	3	1	1	3
Peregrine Falcon	1.00	1	1	1	1	1	1
Levant Sparrowhawk	19.50	6	3	45	18	3	45
Short-toed Eagle	1.00	2	1	1	1	1	1
Black Stork	2.00	1	2	2	2	2	2

4.4 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 extrapolated passage rates to assess relative patterns of bird activity observed during the season within and immediately adjacent to the project area. 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 (i.e. abundance at flight height bands). Groups assessed included: All MSB and target species including unidentified species; all birds of prey (excluding unidentified species), and; storks and pelicans – check figure below. Species-specific plots to assess spatial patterns were drafted for globally threatened species as well as species observed during the season at moderate and high abundance, and are included in Appendix C. The analysis of time spent in individual flight height bands is summarised in the figure below.

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 2022 autumn season at Plot 1 are summarised as follows:

4.4.1 Groups

- For all MSB and target species, including unidentified species, the highest extrapolated passage rates were in the northern half of the site, with the exeption of OP10. Similarly, flight heights were also higher for birds of this species assemblage observed at northern OPs in comparison to those observed at southern OPs.
- For all birds of prey (excluding unidentified species), the northern half of the site had much higher extrapolated passage rates in comparison to the southern half of the site. Similarly, flight heights were also higher for birds of this species assemblage at northern OPs in comparison to those observed at southern OPs.
- For storks and pelicans, extrapolated passage rates were notably highest at OP10, with few southern OPs detecting birds from this species assemblage. Flight height patterns were fairly consistently at heights >200m, with the exception of the lower overall flight heights observed at OP10 and OP18.

4.4.2 Species

- Black kites spent over 50% of their time at heights greater than 200m overall. The occurred throughout the site in relatively low numbers, with greater number of passages at OP4, 6 and 11 in more central latitudes.
- There was a single observation of a black stork, at over 200m in the south of the site (OP16).

- Honey buzzard spent the majority of their time over 200m, with potentially greater proportions of time at higher altitudes in the northern areas of the site where there were also higher numbers of passages.
- Levant sparrowhawks were recorded only at 3 Ops (6,7,16).
- Steppe buzzards were recorded across the site, with little clear spatial patterns of occurrence; however, it appears that flight heights were lower towards the southern extent of the plot.
- Steppe eagles were recorded at two OPs only (8,15).
- White pelicans were recorded primarily at heights greater than 200m, yet in low numbers of observations.
- White storks were only recorded at Ops 2, 4,6, 10 and 18, with the majority of time flying at heights greater than 200m.

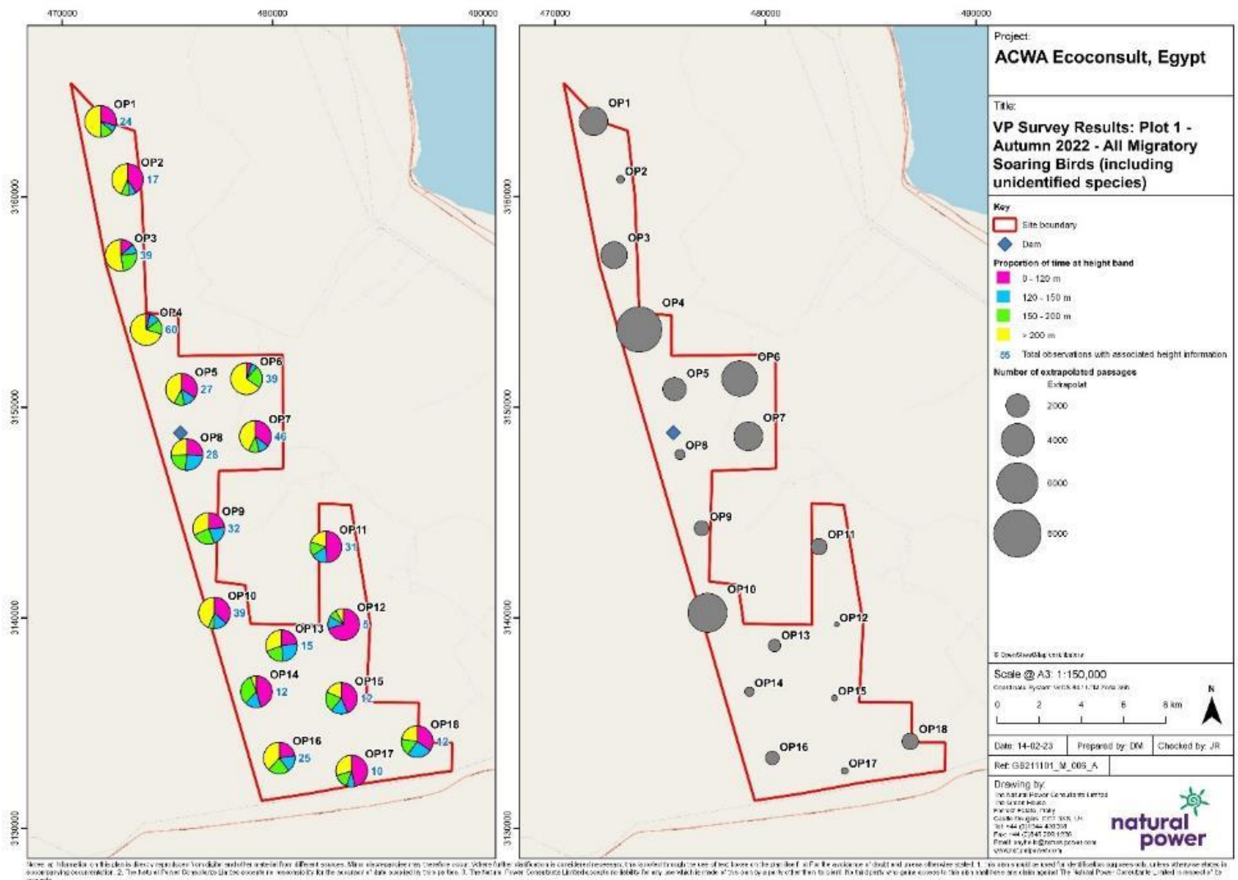


Figure 19: Extrapolated passage rates and proportion of time observed at flight height bands for all MSB and target bird species during autumn 2022 migration season at Plot 1.

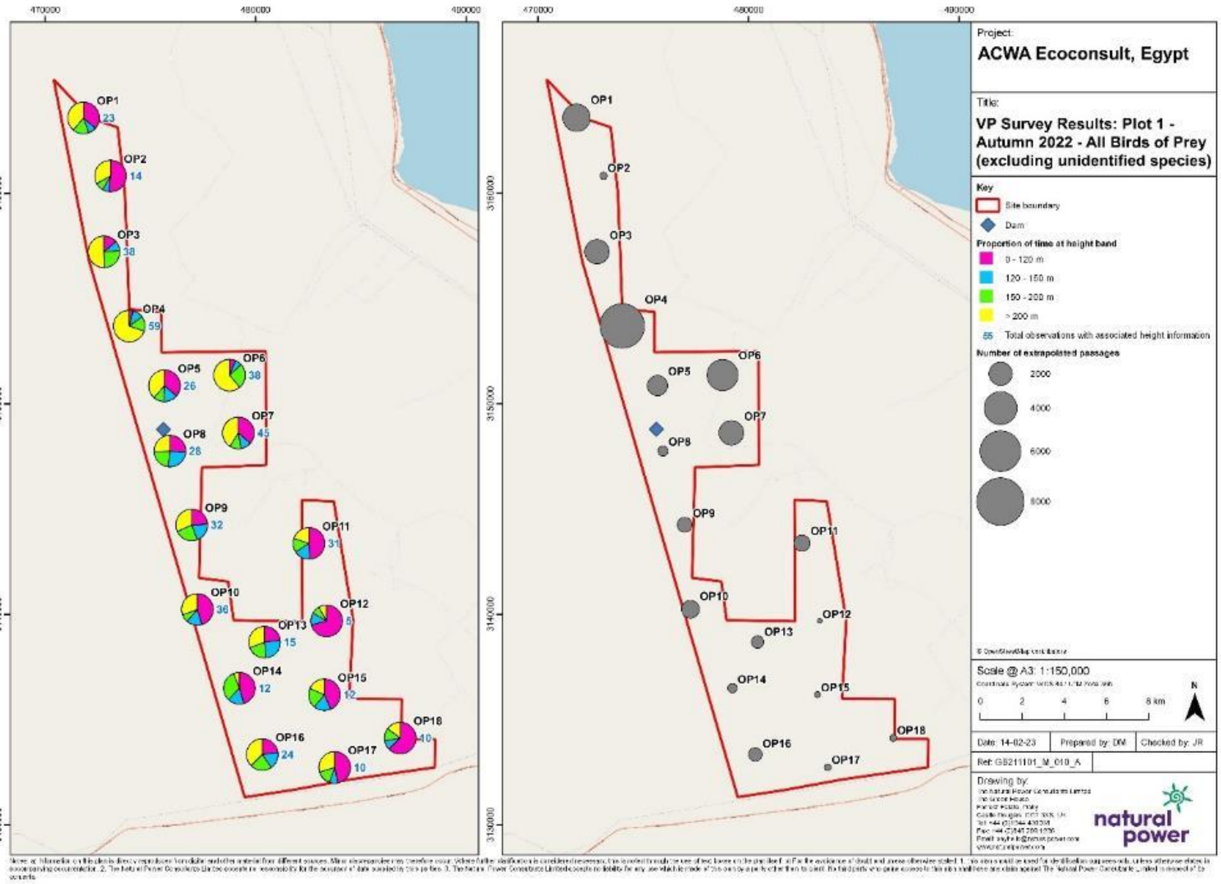


Figure 20: Extrapolated passage rates and proportion of time observed at flight height bands for all birds of prey during autumn 2022 migration season at Plot 1

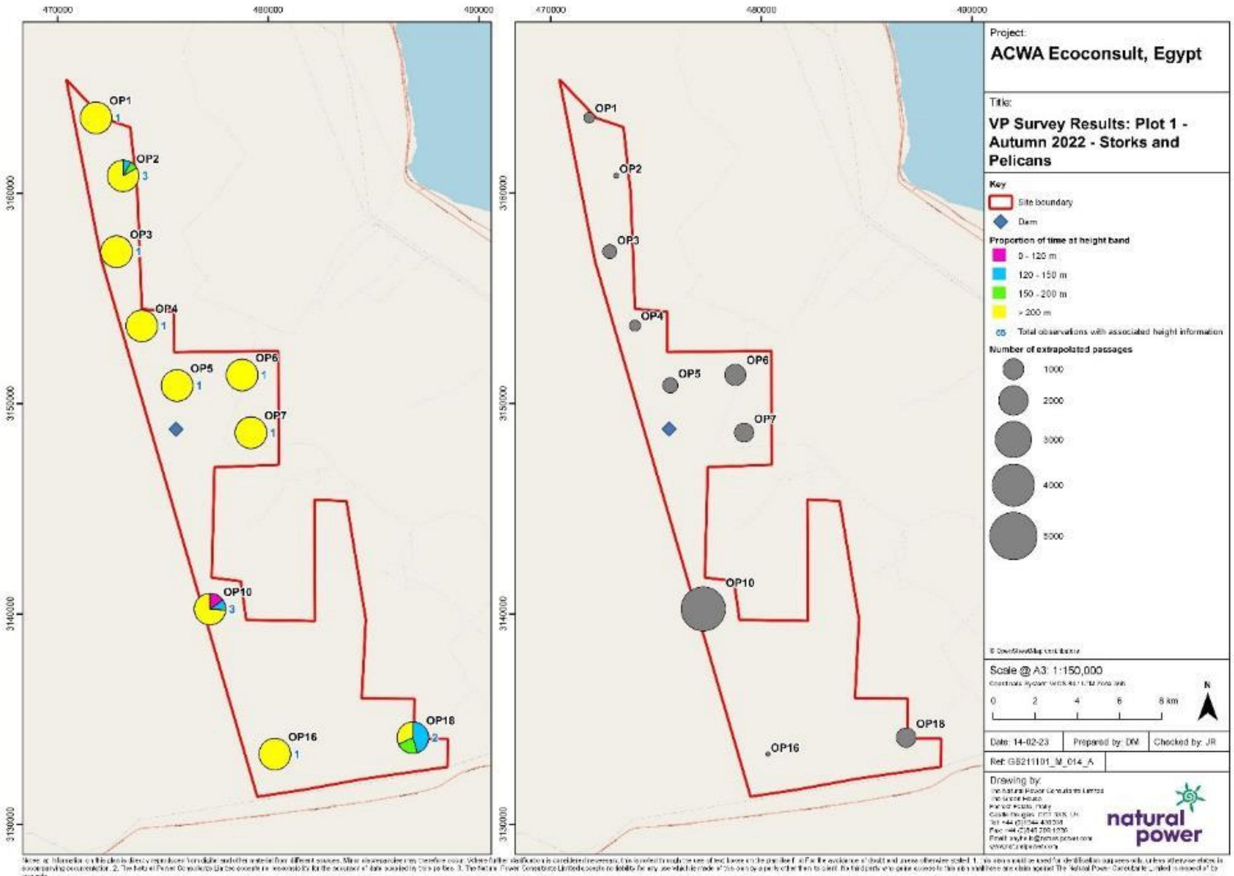


Figure 21: Extrapolated passage rates and proportion of time observed at flight height bands for all storks and pelicans during autumn 2022 migration season at Plot 1.

4.4.3 Flight height/bands

The client has not determined turbine specifications nor a turbine layout, therefore, Collision Risk Modelling (CRM) has not been undertaken at this time, and this report only 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 15). A subset (8) of the most abundant, as well as all globally threatened species, have also been 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 identified species combined - the percentage of birds flying at risk height was 11% within the 150-m band and 17% within the 200-m band (Table 8). These percentages roughly double for unidentified species, however, so caution should be made in the interpretation of species-specific flight height distribution assessments, and correction factors described in Section 4.3 should be considered. The percentage of honey buzzard flying at 200-m was almost double of those observed flying at 150-m, however, there was no variation between flight height band use for white stork. When assessing the proportion of time spent at different height bands using the OP data, only one species assessed (levant sparrowhawk) spent more than 50% of observed time at <200-m.

It should be noted that flight height recorded for birds observed during migration can be highly influenced by environmental factors such as thermal conditions, cloud cover, wind speed and direction.

Table 15: Numbers of birds recorded per species and birds at risk height for turbine tip heights of 150 and 200 m at Plot 1 during autumn 2022.

Species	Total	risk 150	% at risk 150	risk 200	% at risk 200
Black Kite	190	57	30.00%	78	41.05%
Black Stork	2		0.00%		0.00%
Booted Eagle	7	2	28.57%	2	28.57%
Common Kestrel	80	65	81.25%	78	97.50%
Honey Buzzard	5,195	596	11.47%	1,081	20.81%
Levant Sparrowhawk	117	48	41.03%	77	65.81%
Long-legged Buzzard	4		0.00%	3	75.00%
Marsh Harrier	108	76	70.37%	96	88.89%
Montagu's Harrier	20	18	90.00%	19	95.00%
Osprey	2		0.00%	1	50.00%
Pallid Harrier	21	19	90.48%	19	90.48%
Peregrine Falcon	1	1	100.00%	1	100.00%
Red-Footed Falcon	3	3	100.00%	3	100.00%
Short-toed Eagle	2	1	50.00%	2	100.00%
Sooty Falcon	20	20	100.00%	20	100.00%
Sparrowhawk	6	6	100.00%	6	100.00%
Steppe Buzzard	157	49	31.21%	90	57.32%
Steppe Eagle	2		0.00%	2	100.00%
White Pelican	588	4	0.68%	4	0.68%
White Stork	4,012	201	5.01%	201	5.01%
Total general	**10,537**	**1,166**	**11.07%**	**1,783**	**16.92%**
			Unidentified birds		
Buzzard sp.	111	14	12.61%	28	25.23%
Eagle sp.	3	1	33.33%	2	66.67%
Falcon sp.	43	17	39.53%	31	72.09%
Harrier sp.	37	27	72.97%	30	81.08%
Raptor sp.	89	9	10.11%	21	23.60%
Subtotal	**283**	**68**	**24.02%**	**112**	**39.57%**

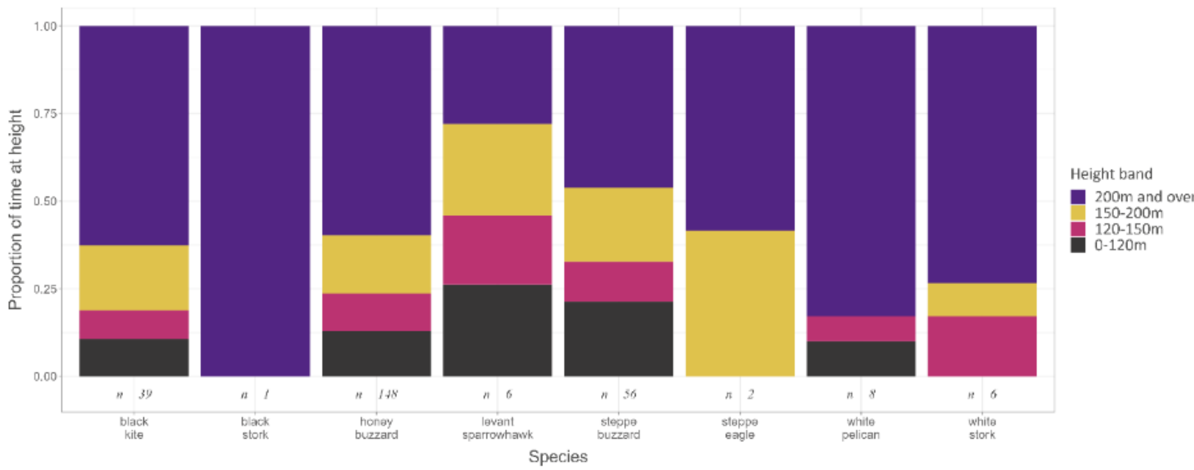


Figure 22: Proportion of time spent within flight height bands for selected species observed at Plot 1 during autumn 2022.

4.5 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.

For all MSB and target birds. Figure below illustrates a peak in the number of individuals of all MSB and target species observed from late August through September. This peak was largely the function of white stork and honey buzzard migration. When assessing the number of records, or discreet observations made by observers, two peaks were documented – this initial late-August through September peak and then a second peak in activity in early October. This second peak was the function of many single-individual observations of marsh harrier, steppe buzzard and sooty falcon. Week 41 in October also represented the peak for unidentified bird observations.

In respect to daily activity patterns (figure below), overall for all MSB and target species, the highest passage rates (birds/hr) were recorded in the afternoon - early evening (large flocks of honey buzzard and white stork), when analysing the data in respect to passage rate of number of individuals observed. However, when assessing the data in respect to passage rates calculated per observation record the daily peak occurred in the early morning (species migrating singly or very small groups).

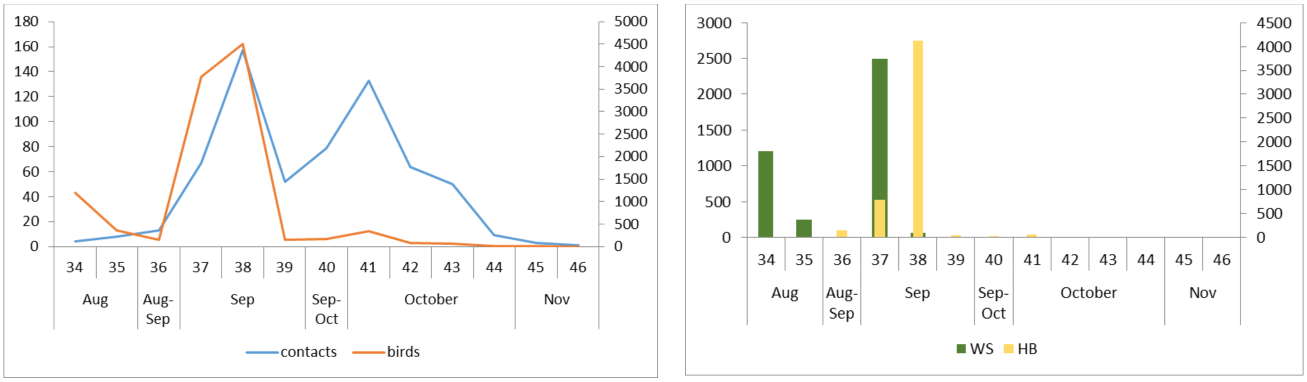


Figure 23: Temporal analysis (weekly) of all MSB and target birds, excluding unidentified species, at Plot 1 during autumn 2022 (left). Weekly activity rates for the White Stork(WS) and Honey Buzzard (HB) at Plot 1 during autumn 2022 (right).

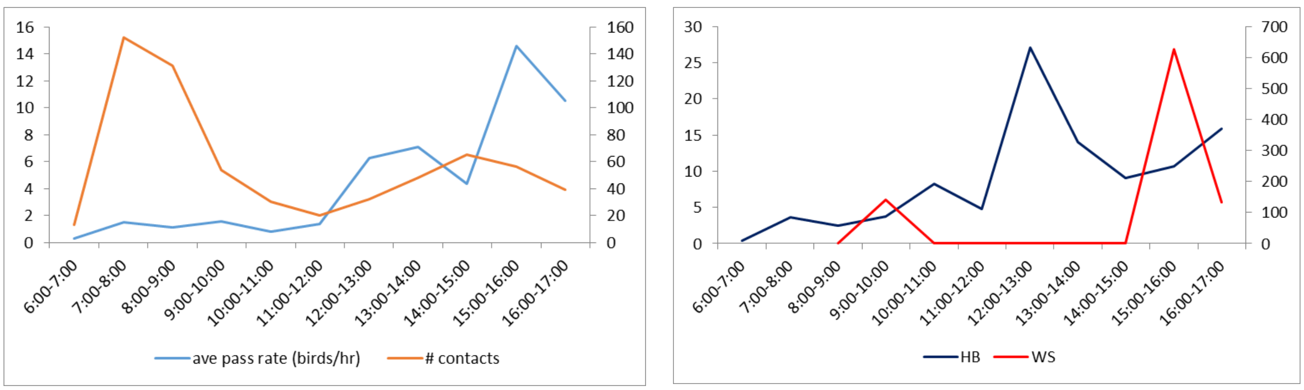


Figure 24: Temporal analysis (daily) of all MSB and target birds, excluding unidentified species, at Plot 1 during autumn 2022 (left); Temporal analysis (daily) of honey buzzard (hb) and white stork (ws) at Plot 1 during autumn 2022 (right)

Temporal analysis patterns were not assessed for other species aggregations or specific species other than for honey buzzard and white stork, presented above.

4.6 Flight direction

Prevailing flight direction during autumn 2022 was assessed for all MSB and target species combined (figure below) and for honey buzzard and white stork (figure below). For this group and species prevailing flight direction was to the southwest.

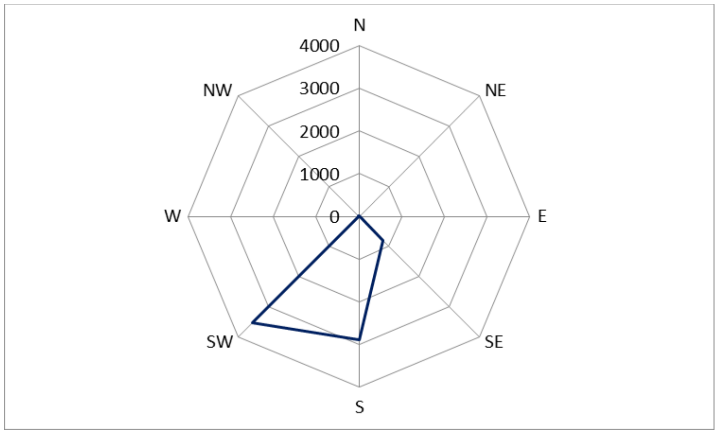


Figure 25: Observed flight direction of MSB and target species observed at Plot 1 during autumn 2022.

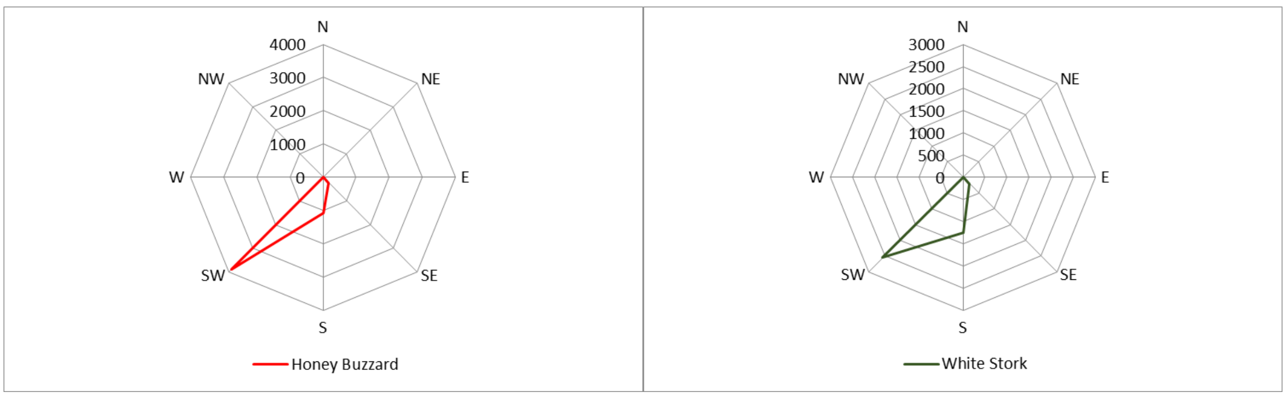


Figure 26: Observed flight direction of honey buzzard and white stork observed at Plot 1 during autumn 2022.

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

93 monitoring intervals were completed at the artificial pond/dam site during the autumn migration season, resulting in 93 hr and 10 minutes of censuses. Between August[17] and November, there was no water present at this site (figure below). Only isolated observations of Red-footed falcon, Osprey, and Western Marsh Harrier were recorded during this season's surveys.

[17] It is not clear wen water fully evaporated from this site, but it is likely evaporation of winter rainfall occurred earlier than August.

Figure 27: Photo of the empty artificial pond/dam located within Plot 1 during autumn 2022.

5 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. However, viewshed mapping of OPs was not completed by the survey team prior to authoring this report mainly due to unavailability of topography data or Digital Elevation Model (DEM) for the site. It is recommended that this is completed prior to authoring the Environmental and Social Impact Assessment (ESIA) so that accurate representation of viewshed coverage is presented, rather than the maximum theoretical viewsheds presented here[18].

3. Daily effort at the site was increased for the 2022 migration studies, compared with previously completed migratory bird studies of wind energy projects elsewhere in the region, allowing for improved temporal coverage of early morning and late afternoon/early evening. 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. Prior to providing overall conclusions and recommendations on the primary findings of the OP studies at Plot 1 for spring and autumn 2022, below, the following general comments should be considered:

    a. 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:

[18] Viewshed mapping may be completed by the Team Leader or Assistant Team Leaders by marking up a map in the field of areas not fully visible from the OP location, and this information may then be transposed into GIS. It should be noted that visibility of very low flight heights may be partially obscured by terrain features, while higher heights may be fully visible, and such information should be noted as this information is extremely useful for the planning and conduct of observer-led shut down on demand mitigation.

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 a single season 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. However, given the extensive amount of migratory bird study effort already completed at other nearby (proposed, under construction or in operations) wind energy facilities, means that the capacity to assess the relative characteristics of migration patterns at this site during a single study year is possible for project planning. Such analyses can enable determinations of whether atypical migratory patterns were observed during either 2022 season and assist in the overall characterisation of risk of project construction and operations on migratory birds. Such analyses were outside the scope of this report but are recommended to be completed prior to drafting the ESIA[19]. The completion of a second year of OP surveys prior to the operations phase could be focused on enhancing the baseline assessment (partially addressing inter-annual variation), but more importantly, aid in developing the planning for implementation of minimisation or mitigation strategies for the operational phase, such as shut down on demand effort required, optimised locations for OPs, etc.

b. The analysis included in this report highlights the importance of accounting for unidentified species when assessing risks to migratory birds in the region, as for certain aspects – such as flight height characteristics in autumn 2022 – different interpretations can be made when characterising risk if unidentified birds are included or excluded from a given analysis. Similarly, if correction factors are not applied to unidentified birds/group, characterisation of the potential risk to particular bird species may be under-represented. This report included extrapolation methods to account for gaps in survey coverage/OP within seasons and provide enhanced characterisation of the estimated passage of MSB and target species, and not simply as a function of effort/OP.

5. The total number of individual birds and species recorded during spring and autumn 2022 seasons - 252,492 individuals of 27 species during spring 2022, and 10,537 individuals of 20 species during autumn 2022 – are within the ranges reported and available to the authors at other wind energy studies performed in the region during previous years. Assessing the relative magnitude of migratory passage rates at this site in comparison with adjacent studies within 2022 seasons is recommended but was outside the scope of this report.

6. Species recorded included six (6) and four (4) species classified as Globally Threatened on the IUCN Red List at Plot 1 during spring and autumn 2022, respectively. The species recorded in the highest abundance during each season - white stork and steppe buzzard during spring, and honey buzzard and white stork during autumn – have also been the dominant species observed during migration studies reported and available to the authors at other wind energy studies performed in the region. Additional analysis of species/wind energy migration study in the region for the 2022 seasons is recommended to be completed prior to drafting the ESIA as such an analysis will validate considerations of the species composition within the same seasons and validate the finding reported here. This analysis was outside the scope of this report.

7. Spatial analysis of MSB and target bird activity and flight height data suggests that certain areas of Plot 1 experience higher migratory flight activity in comparison to other portions within each season for particular

[19] Access to data and statistical, analytical and GIS effort is required. It is recommended that analytical approaches would include smoothing data collected at different sites, as otherwise factors such as observer effort can lead to perceived variation in biological patterns and perceived risks. Approaches which calculate adjusted passage rates, extrapolation for unsurveyed periods/OPs are recommended.

species assemblages and the specific species analysed for this report. Overall, however, no portions of Plot 1 present low risk to MSB and target species in either spring or autumn 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 substantially more MSB and target bird species activity occurs at 200-m compared to 150-m in spring 2022, but little difference was evident for identified species during autumn 2022. CRM was not performed for this report as no WTG model or layout is yet available. CRM is recommended to be completed prior to drafting 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 autumn 2022 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 was present – but not during the autumn, 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 are made:

    a. 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.

    b. To inform the baseline assessment and validate the importance of the potential environmental constraint, additional monitoring is recommended for spring 2023. Monitoring of this site is recommended for the entire migration period and at a frequency/level of effort consistent with the effort expended per survey week during the 2022 spring season. If standing water is not present at the site prior to or during the autumn 2023 season, then additional survey effort at this site is not warranted.

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.

6 PLOT 2: RESULTS FOR SPRING 2022

6.1 Spring 2022 Effort

The overall effort and effort per OP for Plot 1 during spring 2022 is summarised in Table 16.

Table 16: Level of Effort during Avifaunal Assessments for Plot 2 during spring 2022

Season /dates	OP		Monitoring time
Spring 2022 **69 days** **(9 March–16 May)**	**Plot 2**		
		OP-1	125 hr. 50 min.
		OP-2	119 hr. 30 min.
		OP-3	110 hr. 10 min.
		OP-4	124 hr. 10 min.
		OP-5	130 hr. 55 min.
		OP-6	133 hr. 40 min.
		OP-7	89 hr. 30 min.
		OP-8	110 hr. 10min.
		OP-9	108 hr. 45min.
	Total		**1,052 hr. 40 min.**

6.2 Observed Species Records and Individuals at Plot 2

For the reporting period, 25 species were recorded with a total of 281,147 birds accounting for 2,666 records (Table 17). In addition, observers were not able to identify a total of 4,116 individuals and 98 records – those were classified as raptors, falcons, eagles or unidentified raptor. Around 96% of the birds identified to species belonged to only six (6) species: white stork (72.39%), great white pelican (8.23%), Levant sparrowhawk (8.57%), steppe buzzard (5.49%); honey buzzard (2.22%), and; black kite (1.95%).

Six (6) of these species (Table 17) 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 classified as Near Threatened-NT (pallid harrier). All the remaining species observed were classified as Least Concern-LC.

Table 17: Summary of bird observation records during spring 2022 at Plot 2.

Species Name	Conservation Status [20]	National Status	# records	# individuals
Black Kite *Milvus migrans*	Least Concern	Passage migrant	559	5,475
Black Stork *Ciconia nigra*	Least Concern	Passage migrant	56	900
Booted Eagle *Hieraaetus pennatus*	Least Concern	Passage migrant	52	55
Common Kestrel *Falco tinnunculus*	Least Concern	Passage migrant	81	93
Eastern Imperial Eagle *Aquila heliaca*	Vulnerable	Passage migrant	26	30

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

Egyptian Vulture *Neophron percnopterus*	Endangered	Passage migrant	44	51
Eurasian Sparrowhawk *Accipiter nisus*	Least Concern	Passage migrant	14	19
European Honey-buzzard *Pernis apivorus*	Least Concern	Passage migrant	197	6,230
Greater Spotted Eagle *Clanga clanga*	Vulnerable	Passage migrant	18	21
Griffon Vulture *Gyps fulvus*	Least Concern	Wintering Resident/passage migrant	2	2
Lanner Falcon *Falco biarmicus*	Least Concern	Passage migrant	2	2
Lesser Spotted Eagle *Clanga pomarina*	Least Concern	Passage migrant	46	69
Levant Sparrowhawk *Accipiter brevipes*	Least Concern	Passage migrant	10	24,085
Eurasian Hobby *Falco subbuteo*	Least Concern	Passage migrant	1	1
Sooty Falcon *Falco concolor*	Vulnerable	Passage migrant/Resident	2	2
Long-legged Buzzard *Buteo rufinus*	Least Concern	Passage migrant / winter visitor	97	179
Montagu's Harrier *Circus pygargus*	Least Concern	Passage migrant	9	10
Osprey *Pandion haliaetus*	Least Concern	Passage migrant	14	14
Pallid Harrier *Circus macrourus*	Near Threatened	Passage migrant / winter visitor	16	16
Short-toed Snake-eagle *Circaetus gallicus*	Least Concern	Passage migrant / summer breeder	91	123
Steppe Buzzard *Buteo buteo vulpinus*	Least Concern	Passage migrant	685	15,430
Steppe Eagle *Aquila nipalensis*	Endangered	Passage migrant / Winter visitor	368	1592
Western Marsh-harrier *Circus aeruginosus*	Least Concern	Passage migrant	47	69
White Pelican *Pelecanus onocorotalus*	Least Concern	Passage migrant	52	23,149
White Stork *Ciconia ciconia*	Least Concern	Passage migrant	177	203,530
Total			**2,666**	**281,147**
Unidentified birds				
Falcon sp.			12	15
Raptor sp.			36	2,353
Buzzard sp.			11	71
Eagle sp.			37	1,675
Harrier sp.			2	2
Subtotal			**98**	**4,116**

6.3 Unidentified species

Table 18 and 19 show derived correction factors for both numbers of observations (flights that may comprise one or more individual) and for numbers of passages (individual birds) respectively at Plot 2 in Spring 2022. The purpose of this analysis is to assess the potential influence of reporting unidentified birds on the assessment of species-specific passage rates which occurred at the site during OP surveys.

The largest proportion of unidentified flights was for the falcon species and the analysis indicates that more than an eighth of flights and more than a sixth of passages within the falcon group may have been classified within either the falcon species, or raptor species groupings rather than to species level. For the eagle group, the proportion of flights that were recorded as a species grouping was relatively low but almost 50% of the individual birds were classified as either unidentified eagle species, or unidentified raptor species rather than to species level, due to an observation of 1500 unidentified eagles on 23rd April.

Table 18: Indicative correction factors for flights (one or more birds) for species included within unidentified species groupings at Plot 2 in Spring 2022.

Group	Identified flights	Unidentified flights	Proportion unidentified	Correction factor	Species included
Buzzard species	979	11	0.011	1.026	Honey buzzard; Long-legged buzzard; Steppe buzzard
Eagle species	603	37	0.061	1.077	Booted eagle; Greater-spotted eagle; Imperial eagle; Lesser-spotted eagle; Short-toed eagle; Steppe eagle
Falcon species	86	12	0.140	1.156	Hobby; Kestrel; Lanner falcon; Sooty falcon
Harrier species	72	2	0.028	1.043	Marsh harrier; Montegu's harrier; Pallid harrier
Raptor species	2447	36	0.015	1.015[21]	All of above, plus Black kite; Egyptian vulture; Griffon vulture; Levant sparrowhawk; Osprey; Sparrowhawk; Buzzard sp.; Eagle sp.; Falcon sp.; Harrier sp.

Table 19: Indicative correction factors for passages (individual birds) for species included within unidentified species groupings at Plot 2 in Spring 2022.

Group	Identified individuals	Unidentified individuals	Proportion unidentified	Correction factor	Species included
Buzzard species	21839	71	0.003	1.046	Honey buzzard; Long-legged buzzard; Steppe buzzard
Eagle species	1892	1675	0.885	1.965	Booted eagle; Greater-spotted eagle; Imperial eagle; Lesser-spotted eagle; Short-toed eagle; Steppe eagle
Falcon species	98	15	0.153	1.202	Hobby; Kestrel; Lanner falcon; Sooty falcon
Harrier species	95	2	0.021	1.064	Marsh harrier; Montegu's harrier; Pallid harrier
Raptor species	55337	2353	0.043	1.043[22]	All of above, plus Black kite; Egyptian vulture; Griffon vulture; Levant sparrowhawk; Osprey; Sparrowhawk; Buzzard sp.; Eagle sp.; Falcon sp.; Harrier sp.

[21] This correction factor is only applicable to raptors not included in other groups. For other groups, the contribution of unidentified raptors has been incorporated into the group-specific correction factor.

[22] This correction factor is only applicable to raptors not included in other groups. For other groups, the contribution of unidentified raptors has been incorporated into the group-specific correction factor.

6.4 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 wind turbine operations on collision risk, as large flocks may cause a large number of fatalities in one single event compared to individuals flying alone. Table 20 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. Levant sparrowhawk, white stork and white pelican had the largest flock sizes. Generally, most of the remaining species were all estimated at less than 10 individuals per flock (group) with most being single birds. Overall, all of the eagles migrated in small groups, as did the harriers and small falcons. Steppe eagle observations included one relatively large observation of 120 individuals on March 31st at OP3.

Table 20: 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 2022.

Species	No. Means	Conf. -95%	Conf. +95%	N records	Max flock size
Black Kite	9.79	8.00	11.58	559	300
Long-legged Buzzard	1.85	1.43	2.26	97	16
Steppe Buzzard	22.53	18.43	26.62	685	600
Steppe Eagle	4.33	3.40	5.25	368	120
Short-toed Eagle	1.35	1.22	1.48	91	3
White Pelican	445.17	121.89	768.46	52	5000
Kestrel	1.15	1.05	1.25	81	4
Lanner Falcon	1.00	-	-	2	1
White Stork	1149.89	834.20	1465.57	177	16000
Montagu's Harrier	1.11	0.85	1.37	9	2
Spotted Eagle	1.17	0.98	1.36	18	2
Marsh Harrier	1.47	0.95	1.99	47	13
Griffon Vulture	1.00	-	-	2	1
Imperial Eagle	1.15	1.01	1.30	26	2
Osprey	1.00	-	-	14	1
Pallid Harrier	1.00	-	-	16	1
Black Stork	16.07	9.87	22.27	56	100
Booted Eagle	1.06	0.99	1.12	52	2
Egyptian Vulture	1.16	1.01	1.30	44	3
Honey Buzzard	31.62	23.83	39.41	197	500
Lesser Spotted Eagle	1.50	1.13	1.87	46	9
Sparrowhawk	1.36	0.87	1.84	14	4
Levant Sparrowhawk	2408.50	249.30	4567.70	10	8000
Sooty Falcon	1.00	-	-	2	1
Hobby	1.00			1	1

6.5 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 extrapolated passage rates to assess relative patterns of bird activity observed during the season within and immediately adjacent to the project area. 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 (i.e. abundance at flight height bands). Groups assessed included: All MSB and target species including unidentified species; all birds of prey (excluding unidentified species), and; storks and pelicans – check figures below. Species-specific plots to assess spatial patterns were drafted for globally threatened species as well as species observed during the season at moderate and high abundance, and are included in Appendix B. The analysis of time spent in individual flight height bands is summarised in the figure below.

Key findings from the 2022 spring season at Plot 2 are summarised as follows:

6.5.1 Groups

- For all MSB and target species, including unidentified species, the highest extrapolated passage rates were at OP8 and 3, and relatively high passage observed at OP9, 6 and 4; these results suggest overall migratory patterns were relatively even from west-east across the project area. Overall, all MSBs and target species appeared to fly at lower flight heights in the west and southwest of the project area.
- For all birds of prey (excluding unidentified species), the western half of the site exhibited the highest extrapolated passage rates, with the highest rates observed at OP6, 8 and 9. The southwestern and western OPs had the lowest flight heights observed.
- For storks and pelicans, extrapolated passage rates were highest at OP8 and 3, but overall, extrapolated rates were high throughout the project area. Flight heights were relatively low in the west and central portions of the project area.

6.5.2 Species

- 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.
- Black storks 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.
- Egyptian vultures spent over 50% of their time at low altitudes (0-120m). No clear spatial patterns were identified.
- 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.
- 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.
- Levant sparrowhawks were observed at only 5 OPs; however, showed no clear preference for an area. While sample sizes of flight height records was low, over 75% of the time was spent at heights over 150m.
- Spotted eagles showed a slight preferenace for the south-east corner of the plot (OPS 3 and 4). No flights were recorded above 200m, with the majority below 150m.
- 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.
- 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.

- 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.
- 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.

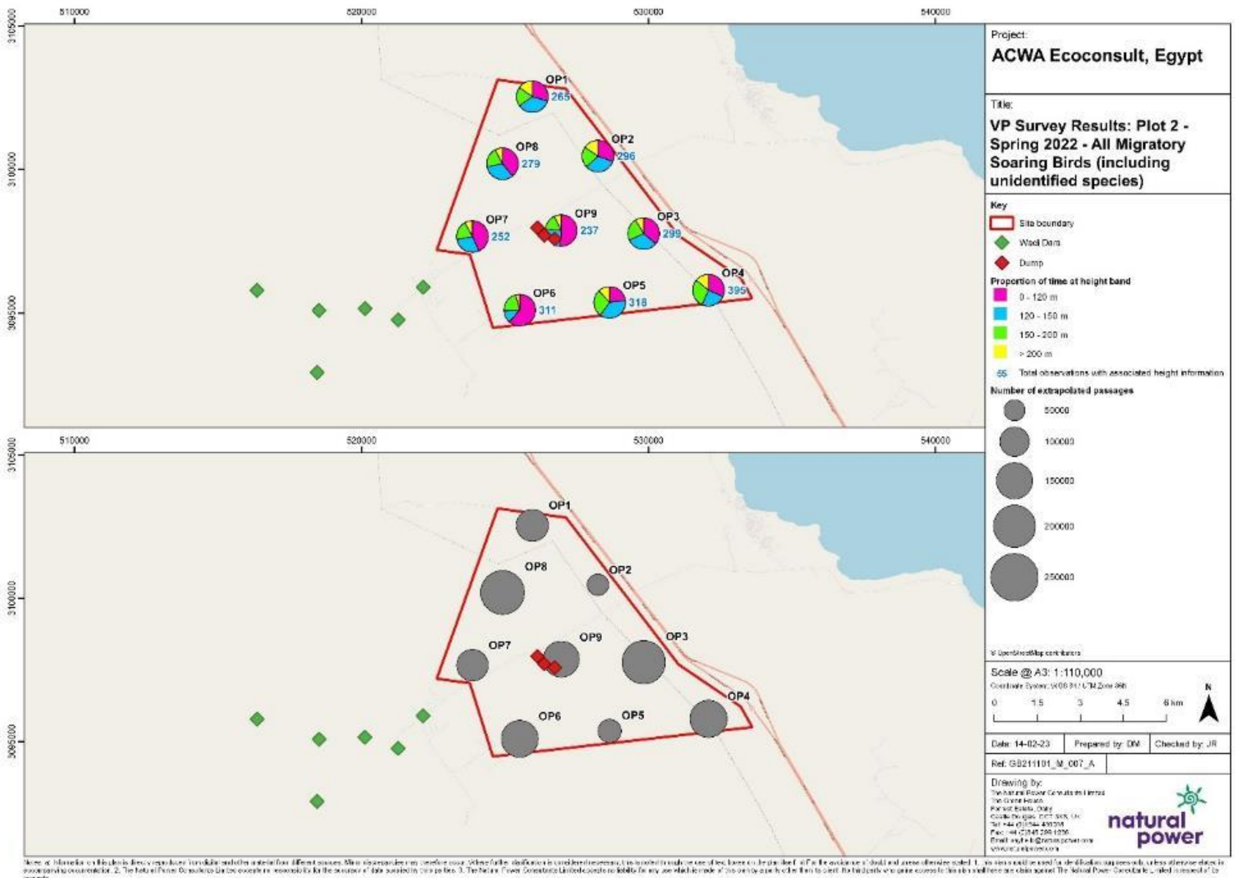


Figure 28: Extrapolated passage rates and proportion of time observed at flight height bands for all MSB and target bird species during spring 2022 migration season at Plot 2.

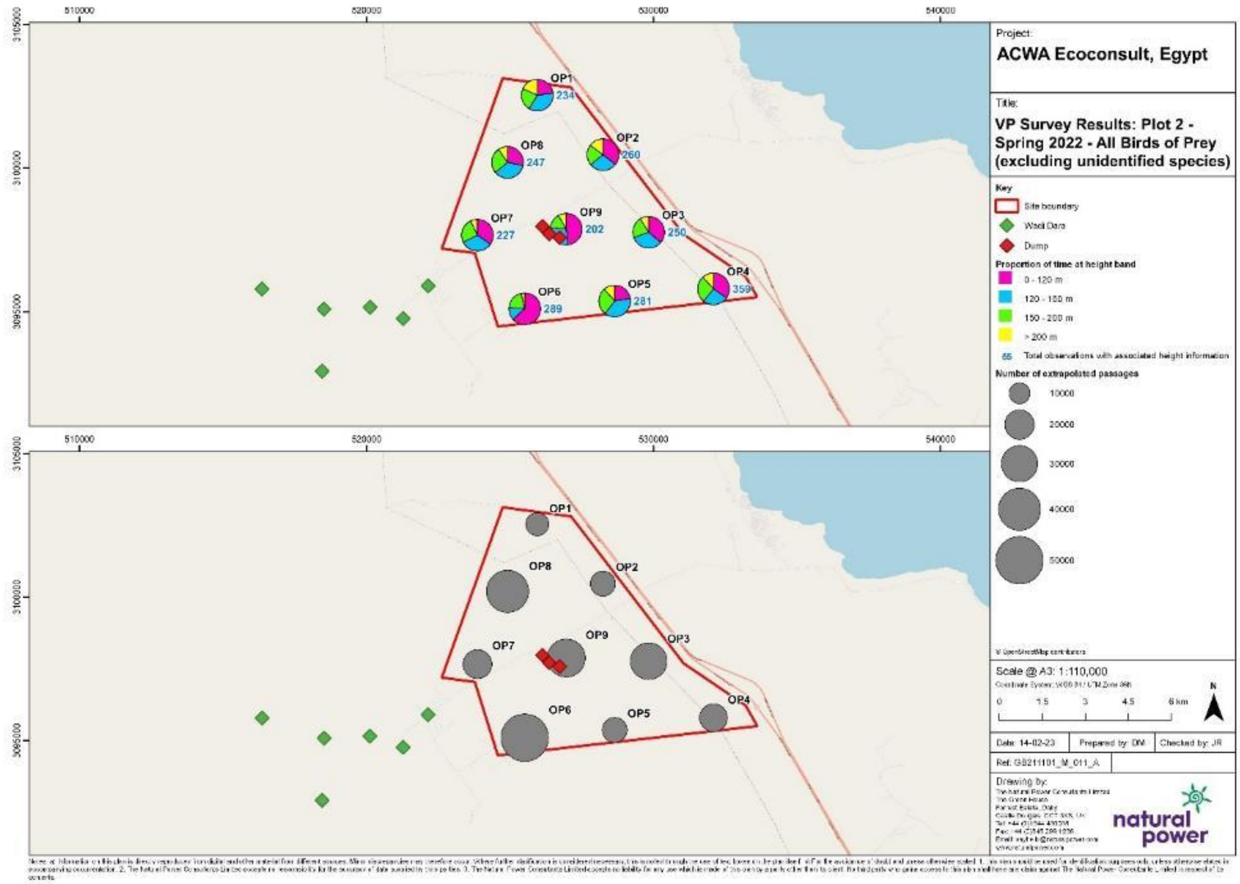


Figure 29: Extrapolated passage rates and proportion of time observed at flight height bands for all birds of prey during spring 2022 migration season at Plot 2.

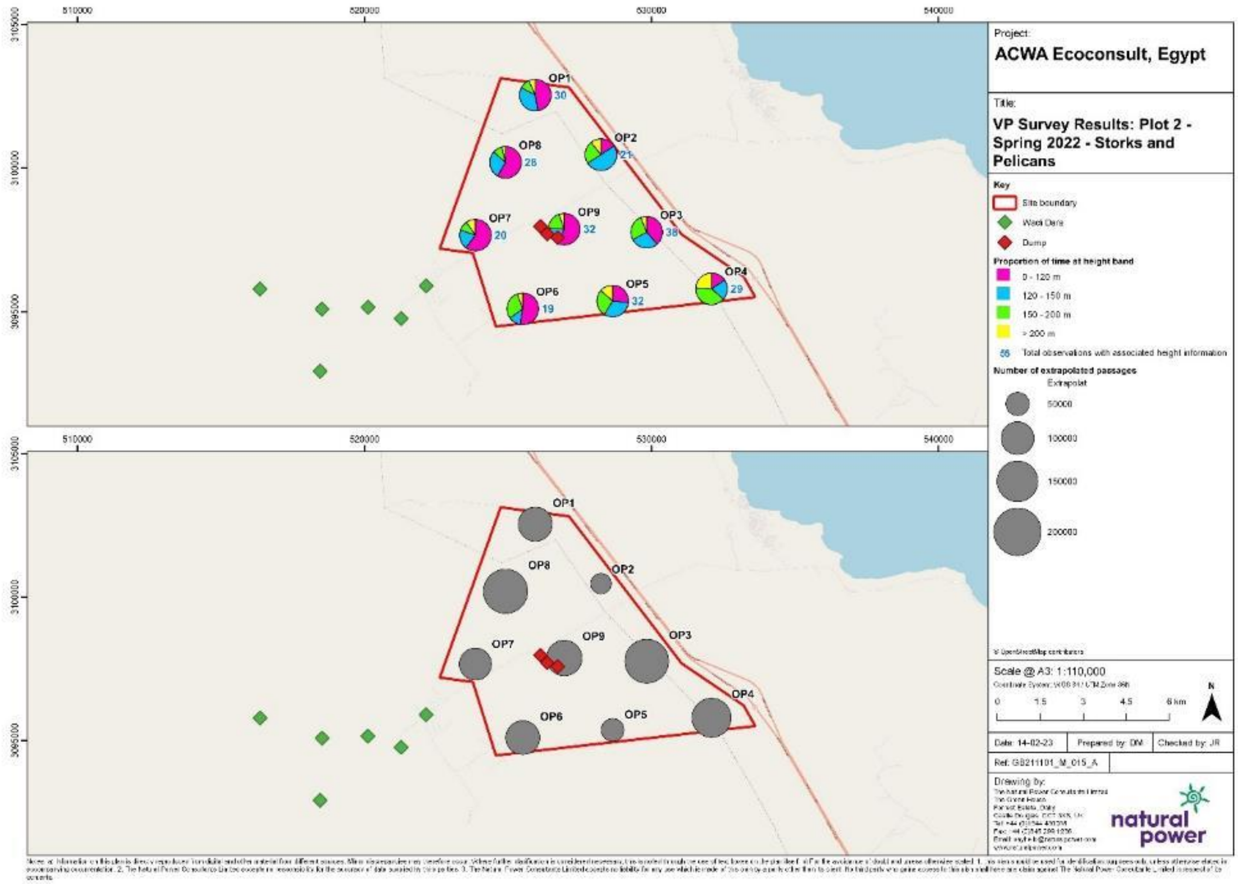


Figure 30: Extrapolated passage rates and proportion of time observed at flight height bands for all storks and pelicans during spring 2022 migration season at Plot 2.

6.5.3 Flight height/bands

The client has not determined turbine specifications nor a turbine layout, therefore, Collision Risk Modelling (CRM) has not been undertaken at this time, and this report only 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 21). A subset (11) of the most abundant, as well as all globally threatened species, have also been 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 61% within the 150-m band and 91% within the 200-m band (Table 21). Risk increases as the flight height band is increased for all identified species which occurred in numbers > two (2) with the exception of greater spotted eagle, of which 100% were observed at or below 150-m flight height. Interestingly, the proportion of unidentified birds did not increase substantially for the 200-m band (61%) compared to the 150-m band (53%).

When assessing the proportion of time spent at different height bands using the OP data, it should be noted that all 11 species assessed (figure below) spent >50% of flight time observed at flight heights <200-m, with species including Egyptian vulture, white pelican, black kite, greater spotted eagle and white pelican observed for high proportions of flight time observed at flight heights of <120-m.

Table 21: Numbers of birds recorded per species and birds at risk height for turbine tip heights of 150 and 200 m at Plot 2 during spring 2022.

Species	Total general	At risk150	Risk150%	At risk200	Risk200%
Black Kite	5475	4520	82.56%	5011	91.53%
Black Stork	900	690	76.67%	781	86.78%
Booted Eagle	55	36	65.45%	54	98.18%
Egyptian Vulture	51	36	70.59%	49	96.08%
Griffon Vulture	2	2	100.00%	2	100.00%
Hobby	1	1	100.00%	1	100.00%
Honey Buzzard	6230	3634	58.33%	5106	81.96%
E. Imperial Eagle	30	16	53.33%	30	100.00%
Common Kestrel	93	87	93.55%	93	100.00%
Lanner Falcon	2	2	100.00%	2	100.00%
L. Spotted Eagle	69	36	52.17%	67	97.10%
Levant Sparrowhawk	24085	11018	45.75%	18085	75.09%
Long-legged Buzzard	179	109	60.89%	175	97.77%
Marsh Harrier	69	66	95.65%	69	100.00%
Montagu`s Harrier	10	10	100.00%	10	100.00%
Osprey	14	13	92.86%	14	100.00%
Pallid Harrier	16	16	100.00%	16	100.00%
Short-toed Eagle	123	80	65.04%	117	95.12%
Sooty Falcon	2	2	100.00%	2	100.00%
Sparrowhawk	19	15	78.95%	19	100.00%
G. Spotted Eagle	21	19	90.48%	21	100.00%
Steppe Buzzard	15430	11643	75.46%	14629	94.81%
Steppe Eagle	1592	765	48.05%	1153	72.42%
G. White Pelican	23149	21304	92.03%	22204	95.92%
White Stork	203530	128421	63.10%	188615	92.67%
Total general	**283,500**	**183,149**	**64.60%**	**257,140**	**90.70%**
Unidentified Falcon	15	8	53.33%	13	86.67%
Unidentified Raptor	2353	608	25.84%	815	34.64%
Unidentified Buzzard	71	38	53.52%	46	64.79%
Unidentified Eagle	1675	1529	91.28%	1617	96.54%
Unidentified Harrier	2	2	100%	2	100%
Subtotal	**4,116**	**2,185**	**53.09%**	**2,493**	**60.57%**

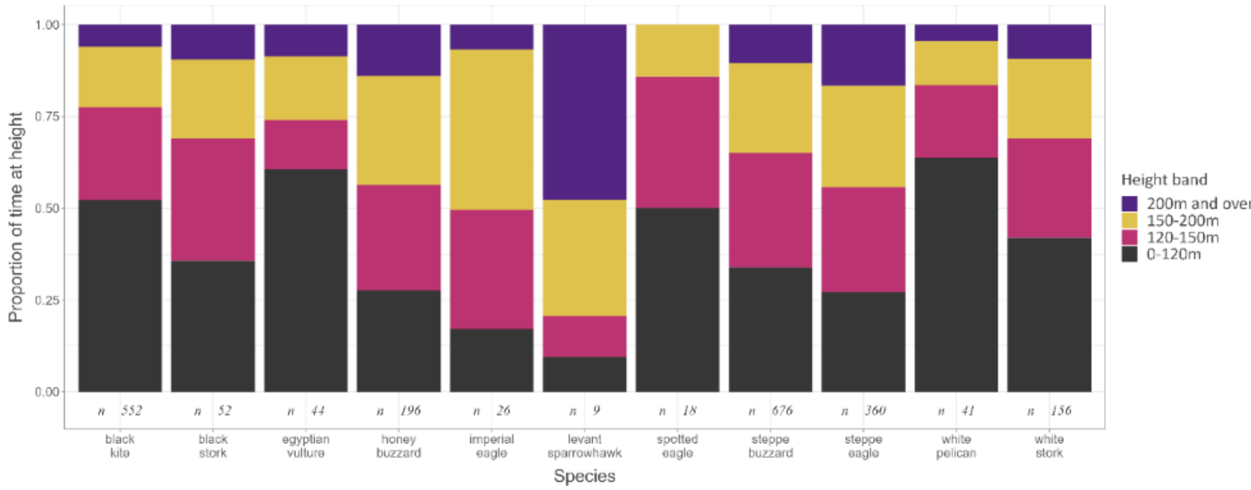


Figure 31: Proportion of time spent within flight height bands for selected species observed at Plot 2 during Spring 2022.

6.6 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.

6.6.1 Groups

For all MSB and target birds. Figure below illustrates low initial overall activity during late February-mid-March until a sharp increase in activity in week 14, with the peak activity period from the end of March-late April, followed by a gradual tailing off until mid-May. In respect to daily activity patterns, overall for all MSB and target species activity peaks in late morning based on the frequency of bird groups observed (contacts), with a second peak in activity in mid-day also observed based on the passage rate.

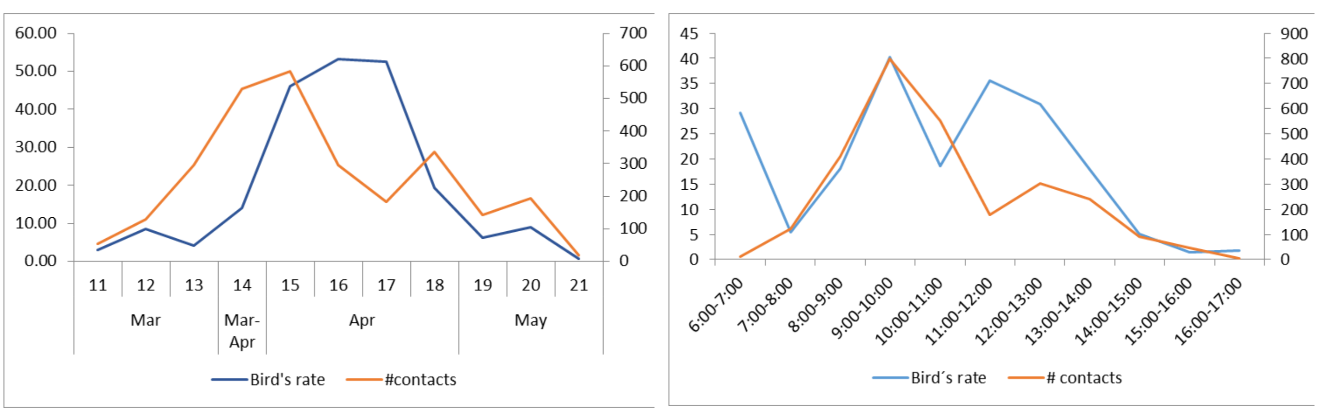


Figure 32: Temporal analysis of all MSB and target birds, excluding unidentified species, at Plot 2 during spring 2022. Weekly (left) and daily plots are included (right).

6.6.2 Species

Species-specific patterns of migration vary temporally within migratory seasons. Published information from the flyway[23] was compared with species observed at the site during the season (with sufficient numbers of observations made to allow for meaningful comparisons) to assess generally whether the temporal patterns of activity at the site during the season were typical or atypical. This information is included in Appendix D.

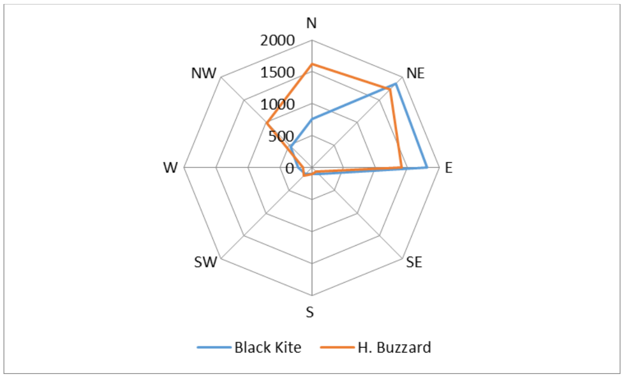
6.6.3 Flight direction

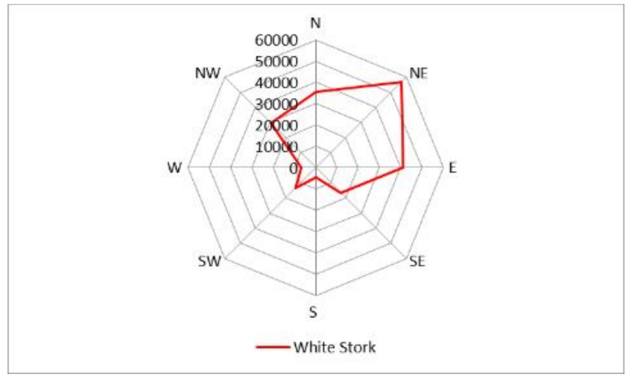
Prevailing flight direction during spring 2022 for the five (5) most abundant MSB species (white stork, steppe buzzard, black kite, honey buzzard, and steppe eagle; cumulatively representing 96% of the observations made during the season) is shown in the figure below. There was a clear orientation for all five species flying north, northeast and east.

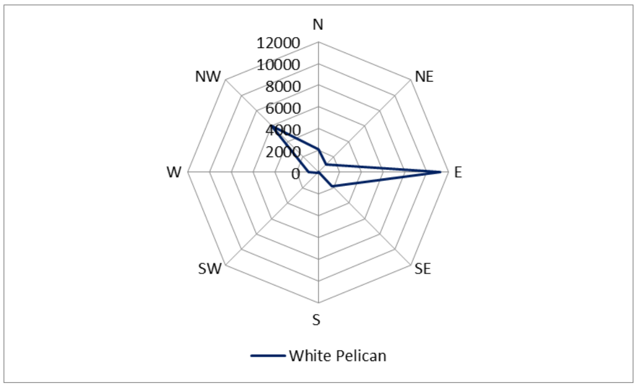
6.7 Bird observations at potential environmental constraint – dump site

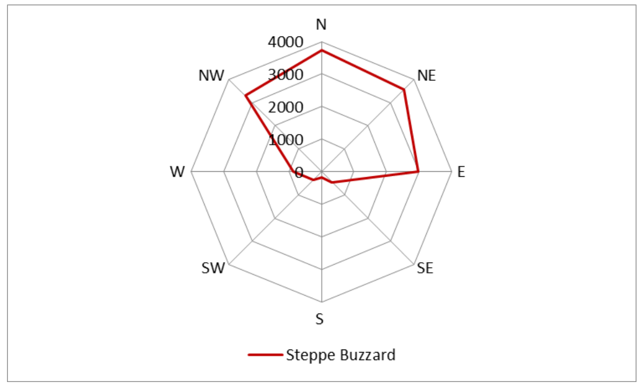
Eight (8) species of MSBs and target species, excluding passerines, were recorded throughout the monitoring undertaken of the dump site (figure below). The most abundant species recorded at the location was White Stork, though it is the raptor use of the site which is of greatest potential concern, given these species are foraging on carcass remains disposed of a the site from poultry and livestock farms located at Wadi Dara (figure below).

[23] Further information on patterns may be found, for example, in: Shirihai et al. (2000) "Raptor Migration in the Middle East. A summary of 30 years of field research". As the title says, it includes more than thirty years of established monitoring. The authors explain that counts at the Gulf of Suez of migratory birds in both autumn and spring were observed and recorded already in the 80´s and 90`s with specific references there such as Biljsma (1982, 1983), Wimpfheimer et al. (1983), Meininger & Atta (1994), or other counts in the Southern Red Sea Area (Sorensen 1982, Grieve 1996). The authors describe how migration occurs both in spring and winter along the entire Middle East, from Djibouti to Jordan and Lebanon, from Egypt to Yemen, providing also data from latitudes further north like Bosphorus. The assessment below compared the results with the Shirihai et al. (2000) study in order to understand and compare the migratory patterns recorded within the Project site since it is more focused in the Middle East.









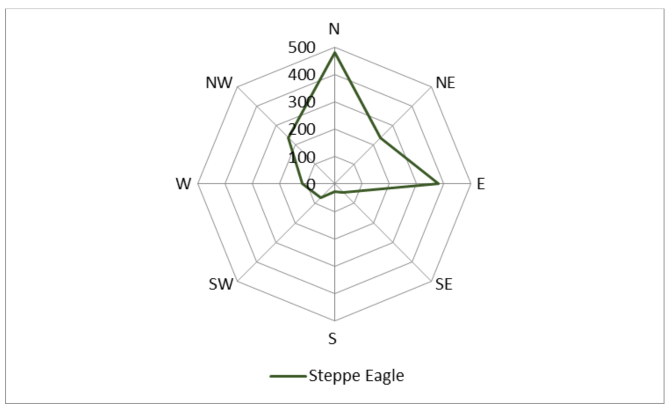


Figure 33: Observed flight direction of the five most abundant migratory soaring birds observed at Plot 2 during spring 2022.

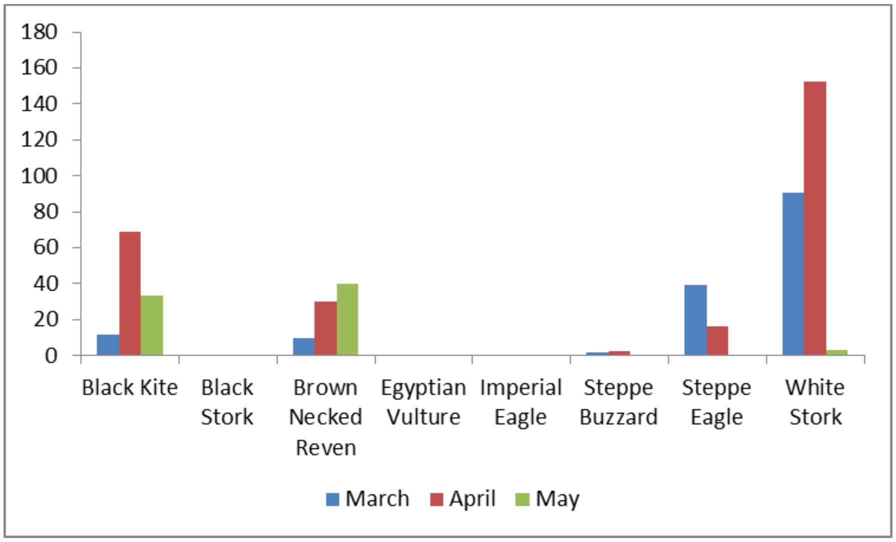


Figure 34: Average numbers of each species in March, April, and May 2022 at the dump site located in Plot 2.

Figure 35: Photos of birds present and carcass remains disposed at the dump site located within Plot 2 during spring 2022.

7 PLOT 2: RESULTS FOR AUTUMN 2022

The overall effort and effort per OP for Plot 2 during autumn 2022 is summarised in Table 22.

Table 22: Level of Effort during Avifaunal Assessments for Plot 2 during autumn 2022.

Season /dates	OP		Monitoring time
Autumn 2022	**Plot 2**		
92 days		OP-1	271 hr 30 min
16 Aug–09 Nov)		OP-2	271 hr 30 min
		OP-3	283 hr 30 min

		OP-4	271 hr 30 min
		OP-5	271 hr 30 min
		OP-6	271 hr 30 min
		OP-7	271 hr 30 min
		OP-8	271 hr 30 min
		OP-9	271 hr 30 min
	Total		**2,455 hr 30 min**

7.1 Observed Species Records and Individuals at Plot 2

For the reporting period, 20 species were recorded with a total of 323,246 individual birds from 972 records (Table 23). In addition, observers were not able to identify a total of 680 individuals from 91 records – those were classified as raptors, falcons, eagles or unidentified raptor. White stork (89.42%) was by far the most commonly observed, followed by *w*hite pelican (8.04%), and honey buzzard (2.19%) buzzard.

Three (3) of the species recorded (Table 23) are globally threatened according to the IUCN Red List (https://www.iucnredlist.org/): including two (2) Endangered-EN (steppe eagle and Egyptian vulture), and one (1) Near Threatened-NT (Pallid Harrier). All the remaining species observed were classified as Least Concern-LC.

Table 23: Summary of Bird Observation Records during Reporting Period (autumn 2022) at Plot 2

Species Name	Conservation Status [24]	National Status	# records	# individuals
Black Kite *Milvus migrans*	Least Concern	Passage migrant	107	322
Black Stork *Ciconia nigra*	Least Concern	Passage migrant	23	451
Booted Eagle *Hieraaetus pennatus*	Least Concern	Passage migrant	15	17
Common Kestrel *Falco tinnunculus*	Least Concern	Passage migrant	35	35
Egyptian Vulture *Neophron percnopterus*	Endangered	Passage migrant	6	8
Eurasian Sparrowhawk *Accipiter nisus*	Least Concern	Passage migrant	8	9
European Honey-buzzard *Pernis apivorus*	Least Concern	Passage migrant	295	7,094
Lanner Falcon *Falco biarmicus*	Least Concern	Passage migrant	1	1
Lesser Spotted Eagle *Clanga pomarina*	Least Concern	Passage migrant	1	1
Levant Sparrowhawk *Accipiter brevipes*	Least Concern	Passage migrant	1	40
Long-legged Buzzard *Buteo rufinus*	Least Concern	Passage migrant / winter visitor	3	3
Montagu's Harrier *Circus pygargus*	Least Concern	Passage migrant	25	32
Osprey *Pandion haliaetus*	Least Concern	Passage migrant	6	6

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

Pallid Harrier *Circus macrourus*	Near Threatened	Passage migrant / winter visitor	11	11
Short-toed Snake-eagle *Circaetus gallicus*	Least Concern	Passage migrant / summer breeder	4	4
Steppe Buzzard *Buteo buteo vulpinus*	Least Concern	Passage migrant	40	59
Steppe Eagle *Aquila nipalensis*	Endangered	Passage migrant / Winter visitor	19	28
Western Marsh-harrier *Circus aeruginosus*	Least Concern	Passage migrant	68	85
White Pelican *Pelecanus onocorotalus*	Least Concern	Passage migrant	128	25,993
White Stork *Ciconia ciconia*	Least Concern	Passage migrant	176	289,047
Total			**972**	**323,246**
Unidentified birds				
Buzzard sp.			26	490
Eagle sp.			2	2
Harrier sp.			31	32
Raptor sp.			23	147
Falcon sp.			9	9
Subtotal			**91**	**680**

7.2 Unidentified species

Table 24 and 25 show derived correction factors for both numbers of observations (flights that may comprise one or more individual) and for numbers of passages (individual birds) respectively at Plot 2 in autumn 2022. The purpose of this analysis is to assess the potential influence of reporting unidentified birds on the assessment of species-specific passage rates which occurred at the site during OP surveys.

The largest proportion of unidentified flights was for harrier species, and the analysis indicates that more than a quarter of flights and more than a fifth of passages within the harrier group may have been classified within either the falcon species, or raptor species groupings rather than to species level. Overall, proportions of flights and individuals assigned to species groupings rather than to species level was slightly higher in the Autumn compared to the Spring.

Table 24: Indicative correction factors for flights (one or more birds) for species included within unidentified species groupings at Plot 2 in autumn 2022.

Group	Identified flights	Unidentified flights	Proportion unidentified	Correction factor	Species included
Buzzard species	338	26	0.077	1.112	Honey buzzard; Long-legged buzzard; Steppe buzzard
Eagle species	39	2	0.051	1.085	Booted eagle; Lesser-spotted eagle; Short-toed eagle; Steppe eagle
Falcon species	36	9	0.250	1.290	Kestrel; Lanner falcon
Harrier species	104	31	0.298	1.340	Marsh harrier; Montegu's harrier; Pallid harrier

Raptor species	713	23	0.032	1.032[25]	All of above, plus Black kite; Egyptian vulture; Levant sparrowhawk; Osprey; Sparrowhawk; Buzzard sp.; Eagle sp.; Falcon sp.; Harrier sp.

Table 25: Indicative correction factors for passages (individual birds) for species included within unidentified species groupings at Plot 2 in autumn 2022.

Group	Identified individuals	Unidentified individuals	Proportion unidentified	Correction factor	Species included
Buzzard species	7156	490	0.068	1.087	Honey buzzard; Long-legged buzzard; Steppe buzzard
Eagle species	50	2	0.040	1.058	Booted eagle; Lesser-spotted eagle; Short-toed eagle; Steppe eagle
Falcon species	36	9	0.250	1.272	Kestrel; Lanner falcon
Harrier species	128	32	0.250	1.272	Marsh harrier; Montegu's harrier; Pallid harrier
Raptor species	8288	147	0.018	1.018[26]	All of above, plus Black kite; Egyptian vulture; Levant sparrowhawk; Osprey; Sparrowhawk; Buzzard sp.; Eagle sp.; Falcon sp.; Harrier sp.

7.3 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 wind turbine operations on collision risk, as large flocks may cause a large number of fatalities in one single event compared to individuals flying alone. Table 26 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. for all species, the number of records, and their minimum and the maximum values, median and 5-95% percentiles. White stork, followed by white pelican and Levant sparrowhawk had the largest flock sizes, with honey buzzard and black stork having moderately sized mean flock sizes. Overall, most observations during the autumn 2022 season were of individuals and small flocks.

Table 26: 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 autumn 2022.

Species	Mean	N	Minimum	Maximum	Median	Percentile - 5%	Percentile - 95%
White Stork	1642.31	176	1	10000	300	1	7000
Common Kestrel	1.00	35	1	1	1	1	1
Black Kite	3.01	107	1	35	1	1	12
Honey Buzzard	24.05	295	1	450	7	1	90
White Pelican	203.07	128	1	1500	150	11	600
Marsh Harrier	1.25	68	1	3	1	1	2
Black Stork	19.61	23	1	87	8	1	87

[25] This correction factor is only applicable to raptors not included in other groups. For other groups, the contribution of unidentified raptors has been incorporated into the group-specific correction factor.
[26] This correction factor is only applicable to raptors not included in other groups. For other groups, the contribution of unidentified raptors has been incorporated into the group-specific correction factor.

Montagu's Harrier	1.28	25	1	5	1	1	2
Booted Eagle	1.13	15	1	2	1	1	2
Steppe Eagle	1.47	19	1	4	1	1	4
Pallid Harrier	1.00	11	1	1	1	1	1
Short-toed Eagle	1.00	4	1	1	1	1	1
Long-legged Buzzard	1.00	3	1	1	1	1	1
Levant Sparrowhawk	40.00	1	40	40	40	40	40
Steppe Buzzard	1.48	40	1	5	1	1	3.5
Egyptian Vulture	1.33	6	1	2	1	1	2
Sparrowhawk	1.13	8	1	2	1	1	2
Osprey	1.00	6	1	1	1	1	1
Lesser Spotted Eagle	1.00	1	1	1	1	1	1
Lanner Falcon	1.00	1	1	1	1	1	1

7.4 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 extrapolated passage rates to assess relative patterns of bird activity observed during the season within and immediately adjacent to the project area. 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 (i.e. abundance at flight height bands). Groups assessed included: All MSB and target species including unidentified species; all birds of prey (excluding unidentified species), and; storks and pelicans - check figures below. Species-specific plots to assess spatial patterns were drafted for globally threatened species as well as species observed during the season at moderate and high abundance, and are included in Appendix E. The analysis of time spent in individual flight height bands is summarised in the figure below.

Key findings from the 2022 autumn season at Plot 1 are summarised as follows:

7.4.1 Groups

- For all MSB and target species, including unidentified species, the highest extrapolated passage rates were observed at OP9 (adjacent to the dump site), but were also high at OP7, 1 and 2. No clear pattern in flight height spatial distributions were noted.
- For all birds of prey (excluding unidentified species), extrapolated passage rates were highest at OP 1, 2 and 4, indicating the eastern edge of the project area had the highest migratory overflight of this species assembalage. Birds of this group tended to fly lower in the northern two-thirds of the project area compared to the southernmost third.
- For storks and pelicans, extrapolated passage rates were notably highest at OP9 and 7, but were also high at OP7, 1 and 2 (these observations drove the spatial patterns noted for all MSB and target species). Flight height patterns were fairly low throughout all OPs, with rates of circa 60% of observations at many OPs below 200-m.

7.4.2 Species

- White storks showed no clear spatial patterns – extrapolated passage rates were high throughout the OPs.

- Black storks spent very little time overall lower than 120m, with a large proportion of time spent above 200m – particularly in the south of the plot.
- White pelicans flew at lower heights (0-120m) a greater proportion of the time than other species except black kites which were present at this height relatively equally. It appears that this species flies at greater heights at the southern extent of the plot.
- Egyptian vultures were recorded in small numbers around the edge of the plot boundary. Due to the small numbers recorded it is difficult to determine whether this could be avoidance of an area to the west of the plot, or of the dump. The vast majority (~90%) of flight time was spent above 150m.
- Honey buzzard spent over 75% of the time above 150m. There was no clear spatial pattern in occurrence.
- Black kites spent the majority of time that they were observed above 150m. There were no clear spatial patterns, with the exception that all flights at OP4 were above 150m.
- Only one record of levant sparrowhawk was noted at OP8, with 50% of the time within 150-200m and 50% over 200m.
- Approximately 75% of Steppe buzzard flight time was at heights greater than 150m. Small sample sizes make spatial patterns difficult to decipher with confidence; however, all three OPs with flights within the 0-120m band were on the west side of the plot (OP6,7,8).
- Steppe eagles were not recorded within 0-120m heights. No clear spatial patterns were apparent; however, no observations were recorded from OP1 at the north extent.

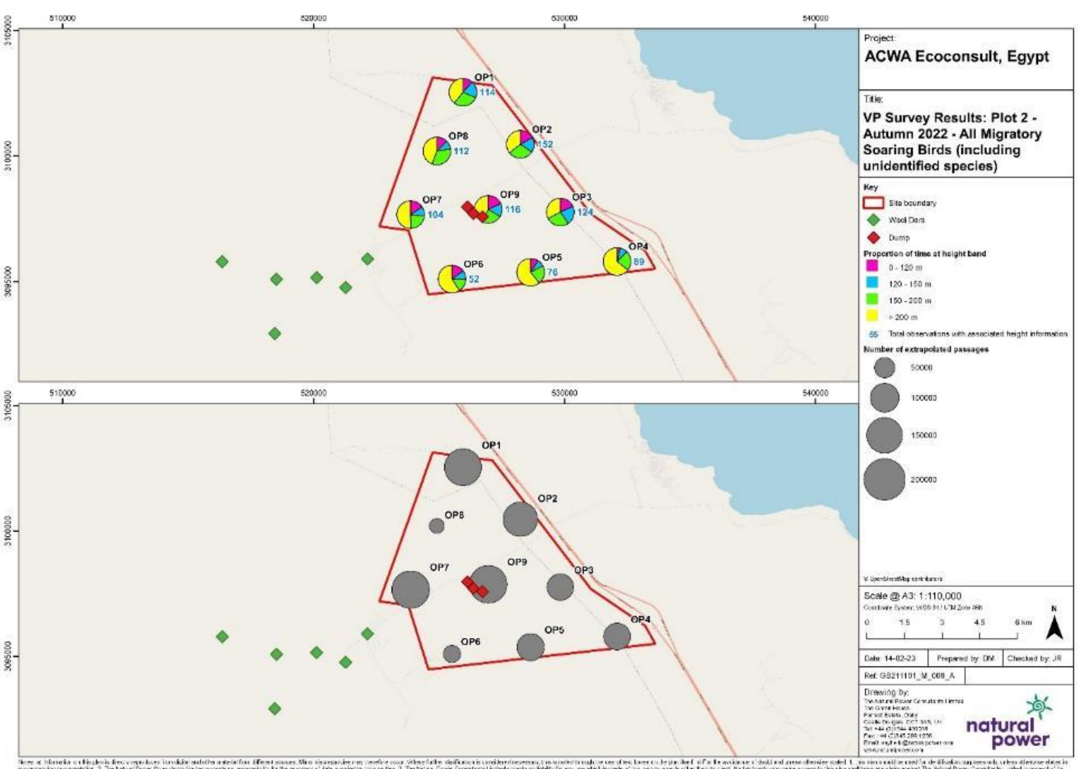


Figure 36: Extrapolated passage rates and proportion of time observed at flight height bands for all MSB and target bird species during autumn 2022 migration season at Plot 2.

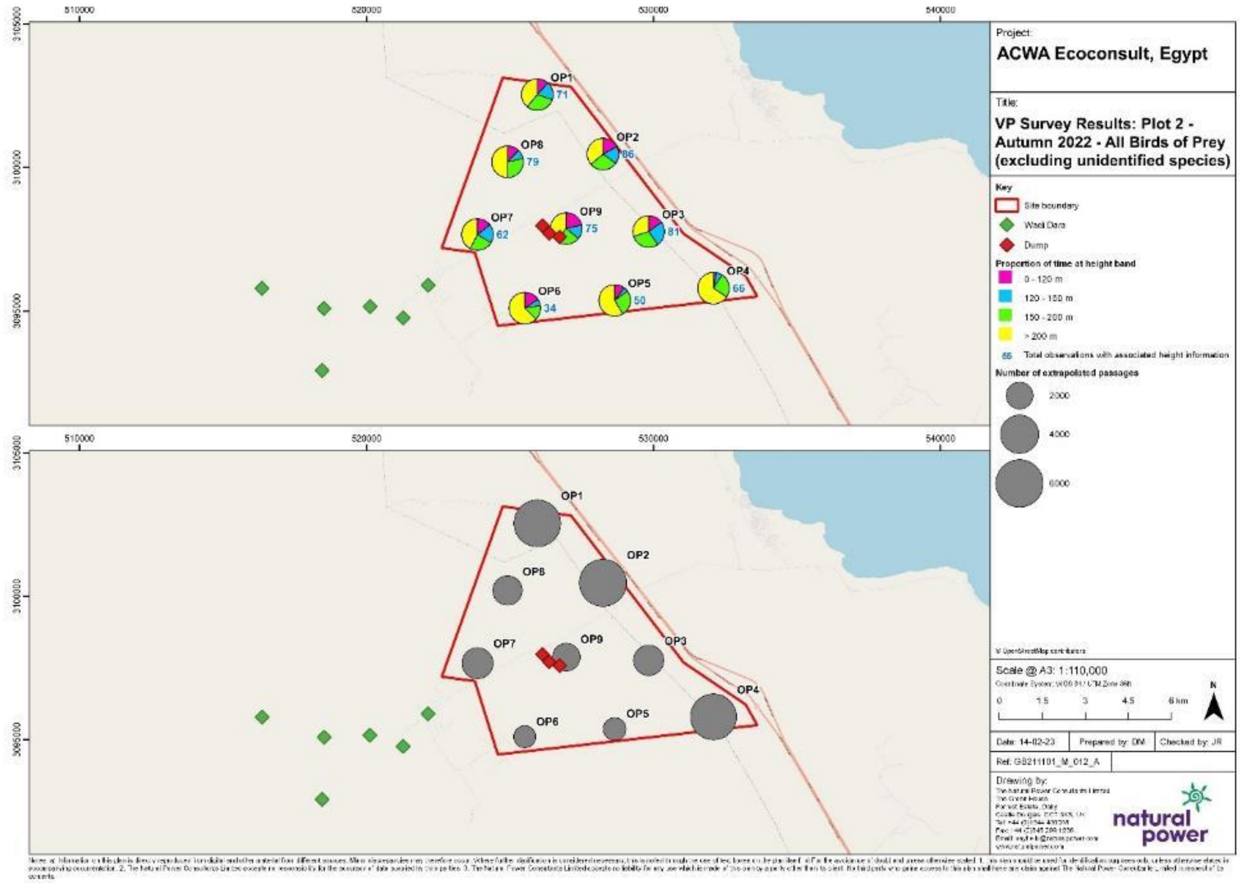


Figure 37: Extrapolated passage rates and proportion of time observed at flight height bands for all birds of prey during autumn 2022 migration season at Plot 2.

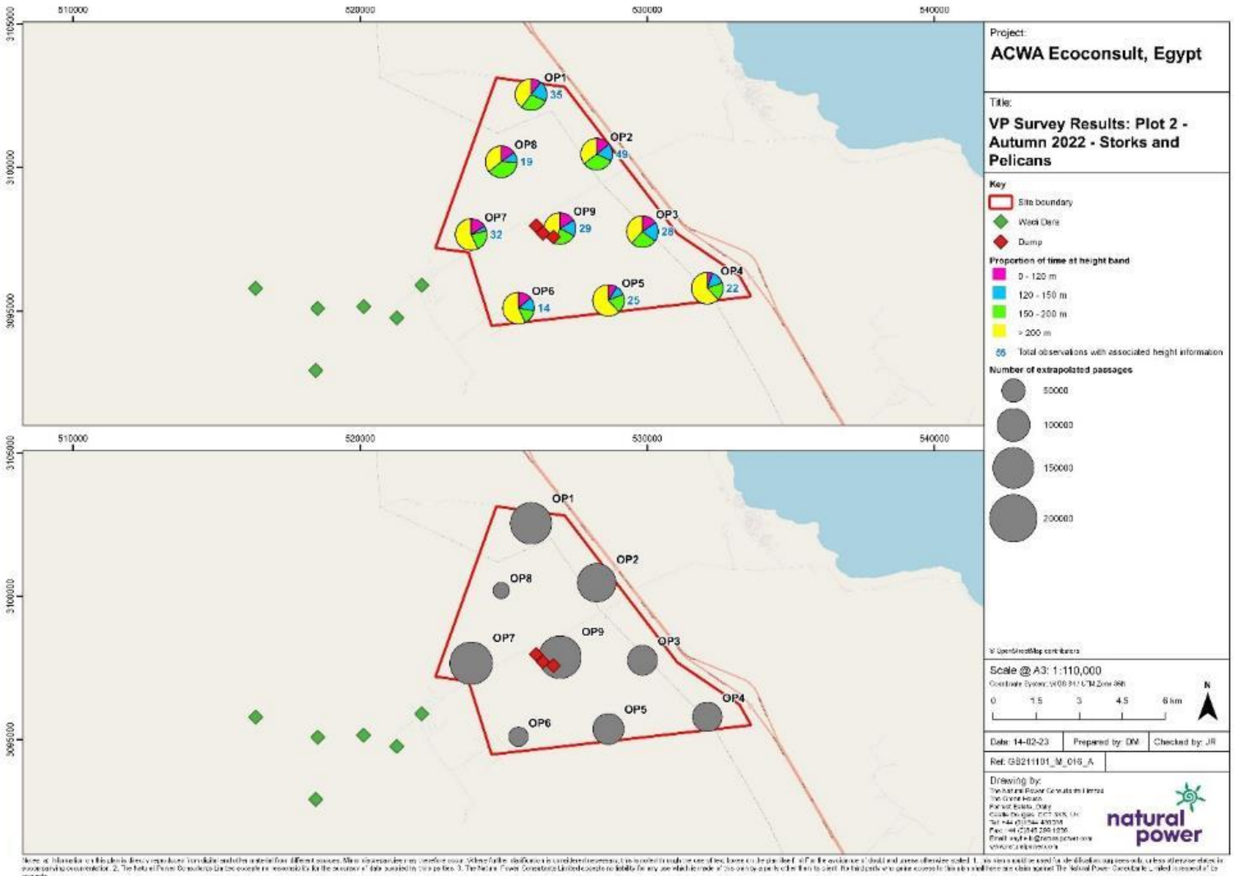


Figure 38: Extrapolated passage rates and proportion of time observed at flight height bands for all storks and pelicans during autumn 2022 migration season at Plot 2.

7.4.3 Flight height/bands

The client has not determined turbine specifications nor a turbine layout, therefore, Collision Risk Modelling (CRM) has not been undertaken at this time, and this report only 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 27). A subset (11) of the most abundant, as well as all globally threatened species, have also been 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 identified species combined - the percentage of birds flying at risk height was 53% within the 150-m band and 79% within the 200-m band, and this was largely driven by white stork flight activity patterns (Table 27). The percentage of honey buzzard flying at 200-m was almost double of those observed flying at 150-m, and white pelicans showed a 25% increase at 200-m compared to 150-m.

Table 27: Numbers of birds recorded per species and birds at risk height for turbine tip heights of 150 and 200 m at Plot 1 during autumn 2022.

Species	Total general	#Risk 150	% at risk150	#Risk 200	% at Risk200
Black Kite	322	127	39.44%	219	68.01%
Black Stork	451	247	54.77%	305	67.63%
Booted Eagle	17	5	29.41%	10	58.82%

Common Kestrel	35	19	54.29%	23	65.71%
Egyptian Vulture	8	1	12.50%	4	50.00%
Honey Buzzard	7,094	2,572	36.26%	4,673	65.87%
Lanner Falcon	1	-	0.00%	-	0.00%
Lesser Spotted Eagle	1	-	0.00%	-	0.00%
Levant Sparrowhawk	40	-	0.00%	40	100.00%
Long-legged Buzzard	3	1	33.33%	2	66.67%
Marsh Harrier	85	58	68.24%	73	85.88%
Montagu’s Harrier	32	27	84.38%	32	100.00%
Osprey	6	2	33.33%	3	50.00%
Pallid Harrier	11	9	81.82%	10	90.91%
Short-toed Eagle	4	1	25.00%	3	75.00%
Sparrowhawk	9	6	66.67%	6	66.67%
Steppe Buzzard	59	24	40.68%	46	77.97%
Steppe Eagle	28	6	21.43%	12	42.86%
White Pelican	25,993	13,159	50.63%	19,441	74.79%
White Stork	289,047	153,699	53.17%	231,769	80.18%
TOTALS	**323,926**	**170,173**	**52.53%**	**257,121**	**79.38%**
			Unidentified birds		
Falcon sp.	9	6	66.67%	6	66.67%
Raptor sp.	147	9	6.12%	140	95.24%
Buzzard sp.	490	171	34.90%	276	56.33%
Eagle sp.	2	0	0.00%	1	50.00%
Eagle sp.	32	24	75.00%	27	84.38%
Subtotal	**680**	**210**	**30.88%**	**450**	**66.18%**

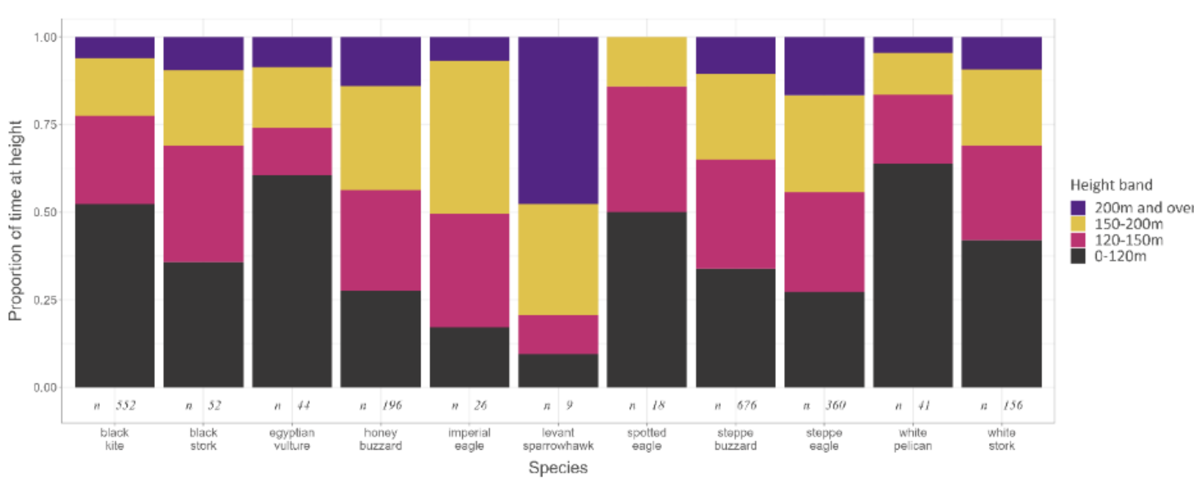


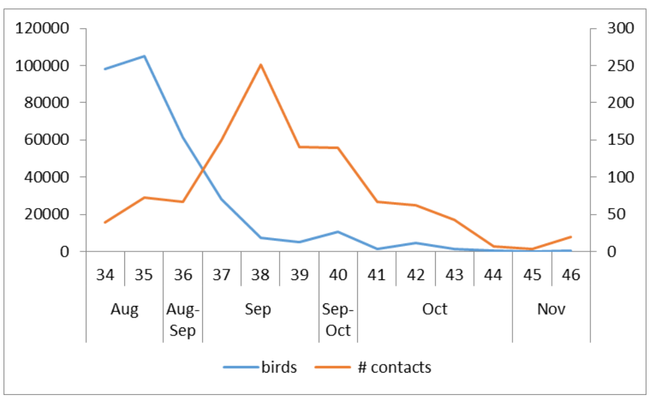
Figure 39: Proportion of time spent within flight height bands for selected species observed at Plot 2 during autumn 2022.

7.5 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.

For all MSB and target birds. Figure below illustrates a peak in the number of individuals of all MSB and target species observed from in late August (Week 35). When assessing the number of records, or discreet observations made by observers, peak occurred in mid-September (Week 39). Looking individually at the three dominant species for the season, white stork passage was greatest in late August (Week 35), honey buzzard passage was greatest in mid-September (50% of all records in Week 38 were honey buzzards), while white stork passage was elongated from early September through October (Weeks 36-43), showing a high spike in late September (Week 40). Cumulative passage rate analysis indicates nearly 100% of migration activity was documented by Week 40 (figure below).

In respect to daily activity patterns (figure below), overall, for all MSB and target species, the highest passage rates (birds/hr) were recorded in the afternoon - early evening (large flocks of honey buzzard and white stork), when analysing the data in respect to passage rate of number of individuals observed. However, when assessing the data in respect to passage rates calculated per observation record passage rates were fairly high through most of the day, excepting mid-day and evening dips.



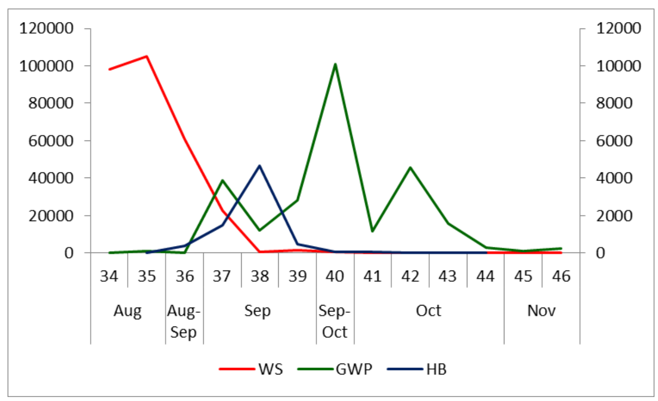


Figure 40: Temporal analysis (weekly) of all MSB and target birds, excluding unidentified species, at Plot 2 during autumn 2022 (left). Weekly activity rates for the White Stork(WS), Great White Pelican (GWP) and Honey Buzzard (HB) at Plot 2 during autumn 2022 (right).

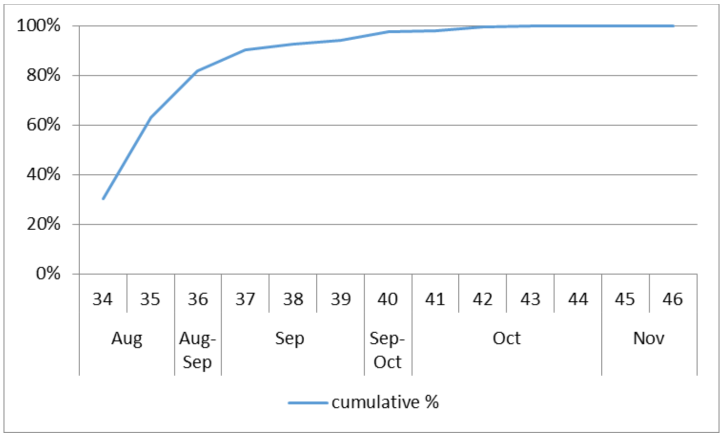


Figure 41: Cumulative passage rates (weekly) of all MSB and target birds, excluding unidentified species, at Plot 2 during autumn 2022 (left).

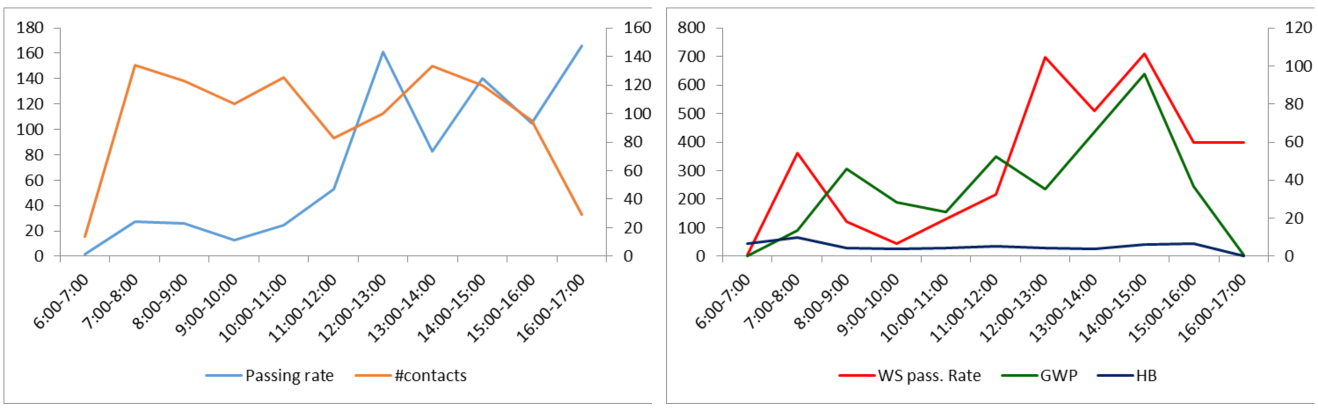


Figure 42: Temporal analysis (daily) of all MSB and target birds, excluding unidentified species, at Plot 2 during autumn 2022 (left). Temporal analysis (daily) for White Stork(WS), Great White Pelican (GWP) and Honey Buzzard (HB) at Plot 2 during autumn 2022 (right).

Temporal analysis patterns were not assessed for other species aggregations or specific species other than for honey buzzard and white stork, presented above.

7.6 Flight direction

Prevailing flight direction during autumn 2022 was assessed for all MSB and target species other than honey buzzard, white stork and white pelican – these latter three were assessed individually (figure below). White stork showed a notable south-westerly prevailing flight direction, while the remaining species/group analysis indicated a strong southerly trajectory.

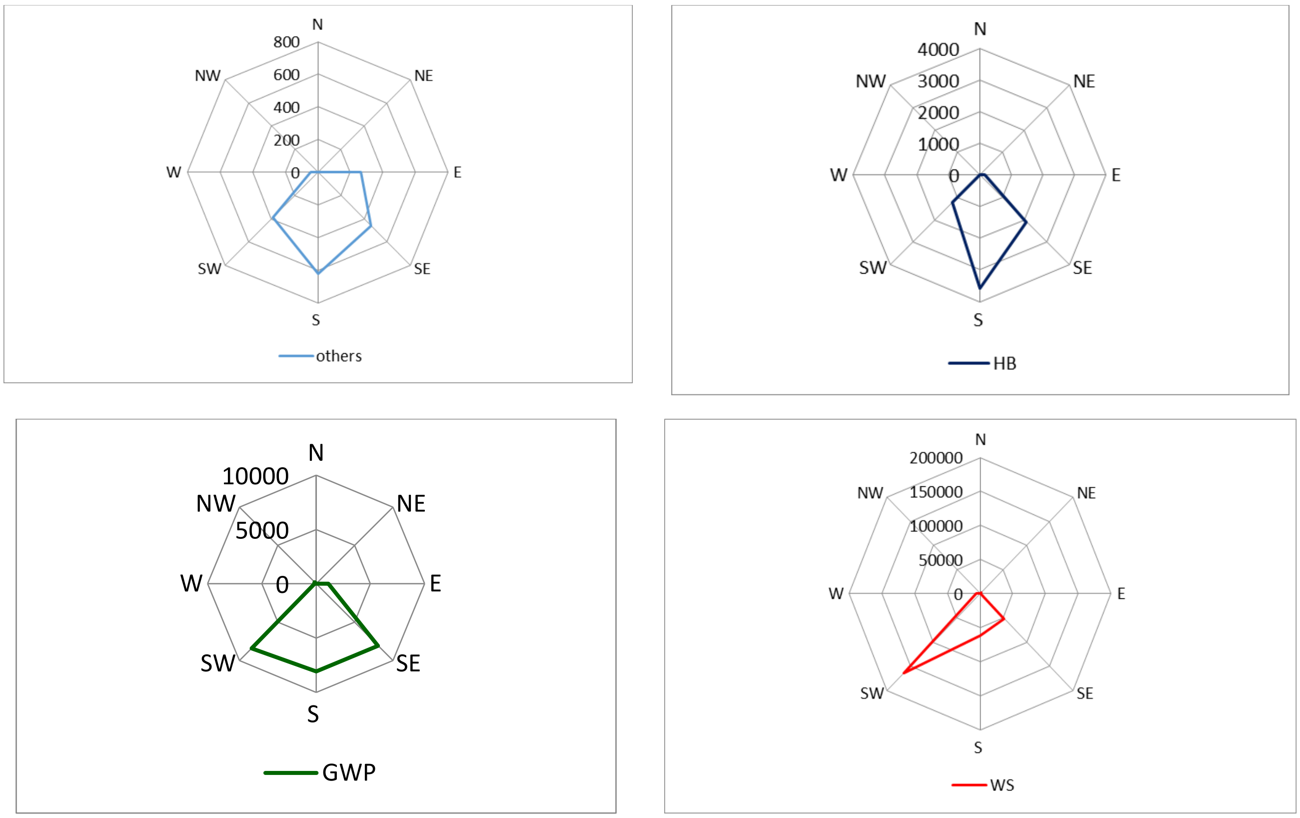


Figure 43: Observed flight direction of MSB and target species (others) excluding white stork (WS), great white pelican (GWP) and honey buzzard (HB) observed at Plot 2 during autumn 2022.

7.7 Bird observations at potential environmental constraint – dump site

There were 95 monitoring days between August and November at this site. Among MSB and target species, only white stork were recorded during the season, with 2,422 birds counted overall. Additional information on the reasons why white stork are using this site is needed; in particular to ascertain whether they may be using the site purely as a resting area along migration, or whether they might be feeding on insects associated with carcass decay/waste left at the site.

7.8 Bird observations at potential environmental constraint – Wadi Dara

White storks were recorded in relatively high numbers at Wadi Dara (11,300 birds), though the distribution of these observations roosting or overflying the settlement is not clear from the data provided for this report.

8 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.
    a. The survey spatial coverage of the project areas and the immediate area around the site boundary was broadly considered good.

b. However, viewshed mapping of OPs was not completed by the survey team prior to authoring this report due to unavailability of a topography survey or Digital Elevation Model (DEM) for the site. It is recommended that this is completed prior to authoring the Environmental and Social Impact Assessment (ESIA) so that accurate representation of viewshed coverage is presented, rather than the maximum theoretical viewsheds presented here[27].

c. Further, we recommend that OP surveys include flight path mapping to enable better assessment of how MSB and target birds utilise the aerospace during migration, as well as resting and roost sites, including potential environmental constraints.

3. Daily OP effort at the site was increased for the 2022 migration studies, compared with previously completed migratory bird studies of wind energy projects elsewhere in the region, allowing for improved temporal coverage of early morning and late afternoon/early evening – however, please see comment 29 below.

    a. 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.

    b. These gaps are recommended to be addressed prior to drafting the ESIA.

4. Prior to providing overall conclusions and recommendations on the primary findings of the OP studies at Plot 2 for spring and autumn 2022, below, the following general comments should be considered:

    a. 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.

    b. As such, reliance on a single season 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 and a second year of OP surveys is recommended to include complete spring and autumn bird migration seasons at a level of effort comparable to that undertaken in 2022 – please see 9, below.

    c. Given the extensive amount of migratory bird study effort already completed at other nearby (proposed, under construction or in operations) wind energy facilities, means that the capacity to assess the relative characteristics of migration patterns at this site during a single study year is possible for project planning if it is not possible to complete the second study year prior to completing planning and permitting. Additional analysis can enable determinations of whether atypical migratory patterns were observed during either 2022 season and assist in the overall characterisation of risk of project construction and operations on migratory birds. Such analyses were outside the scope of this report but are recommended to be completed prior to drafting

[27] Viewshed mapping may be completed by the Team Leader or Assistant Team Leaders by marking up a map in the field of areas not fully visible from the OP location, and this information may then be transposed into GIS. It should be noted that visibility of very low flight heights may be partially obscured by terrain features, while higher heights may be fully visible, and such information should be noted as this information is extremely useful for the planning and conduct of observer-led shut down on demand mitigation.

the ESIA[28]. The completion of a second year of OP surveys prior to the operations phase could be focused on enhancing the baseline assessment (partially addressing inter-annual variation), but more importantly, aid in developing the planning for implementation of minimisation or mitigation strategies for the operational phase, such as shut down on demand effort required, optimised locations for OPs, etc.

d. The analysis included in this report highlights the importance of accounting for unidentified species when assessing risks to migratory birds in the region, as for certain aspects – such as flight height characteristics in autumn 2022 – different interpretations can be made when characterising risk if unidentified birds are included or excluded from a given analysis. Similarly, if correction factors are not applied to unidentified birds/group, characterisation of the potential risk to particular bird species may be under-represented. This report included extrapolation methods to account for gaps in survey coverage/OP within seasons and provide enhanced characterisation of the estimated passage of MSB and target species, and not simply as a function of effort/OP.

5. The total number of individual birds and species recorded during spring and autumn 2022 seasons - 281,147 individuals of 25 species during spring 2022, and 323,246 individuals of 20 species during autumn 2022 – are considered by the authors as *high* compared to other wind energy studies performed in the region during previous years, particularly given the level of effort at Plot 2 compared with other studies. In particular, the autumn observations – number of individuals sighted as well as number of unique observation records – are considered *high* and may reflect the location of the project area within the Gebel El Zeit IBA.

    a. Assessing the relative magnitude of migratory passage rates at this site in comparison with adjacent studies within 2022 seasons is recommended but was outside the scope of this report. This gap should be addressed for the ESIA.

6. Species recorded included six (6) and two (2) species classified as Globally Threatened on the IUCN Red List at Plot 1 during spring and autumn 2022, respectively. The species recorded in the highest abundance during each season - white stork and steppe buzzard during spring, and white stork, white pelican and honey buzzard during autumn – have also been the dominant species observed during migration studies reported and available to the authors at other wind energy studies performed in the region.

    a. Additional analysis of species/wind energy migration study in the region for the 2022 seasons is recommended to be completed prior to drafting the ESIA as such an analysis will validate considerations of the species composition within the same seasons and validate the finding reported here. This analysis was outside the scope of this report.

7. 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. Overall, no portions of Plot 2 present low risk to MSB and target species in either spring or autumn seasons without the implementation of minimisation and mitigation strategies including shut down on demand.

    a. 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.

[28] Access to data and statistical, analytical and GIS effort is required. It is recommended that analytical approaches would include smoothing data collected at different sites, as otherwise factors such as observer effort can lead to perceived variation in biological patterns and perceived risks. Approaches which calculate adjusted passage rates, extrapolation for unsurveyed periods/OPs are recommended.

8. The flight height analysis completed for this report indicates that substantially more MSB and target bird species activity occurs at 200-m compared to 150-m in spring and autumn 2022. CRM was not performed for this report as no WTG model or layout is yet available. The findings included in this report suggest that taller turbines will result in increased risk exposure to MSB and target birds.
    a. CRM is recommended to be completed prior to drafting the ESIA.
9. Temporal analysis of the activity patterns observed in spring and autumn were completed and the patterns are within the ranges reported and available to the authors at other wind energy studies performed in the region during previous years.
    a. Analysis of simultaneous studies within the study years for the region is recommended to be undertaken to assess whether any important intra-year temporal trends are apparent, (these are not anticipated). In addition, consideration should be made for modifying the starting date for spring and autumn migration studies in the future, as the dates used did not provide any buffer around key species activity periods: during spring 2022, winter weather likely contributed to early passage of some key species, notably steppe eagle, which may be under-represented as a result in the 2022 findings, and; immediately upon starting autumn 2022 migration studies there were high passage rates of white storks, which may also be under-represented in the analysis as a result.
    b. Each migration monitoring season should encompass the entirety of the likely migration period for species known to be at risk of collision during these seasons with operational wind turbines and include buffering of early seasonal periods of high activity observed during 2022.
    c. Similarly, daily temporal activity analysis suggests that observations should continue later than those completed in 2022, as autumn 2022 included fairly high levels of activity of MSBs late in the day.
    d. Critically, daily and weekly temporal activity data provide key information for planning effective minimisation and mitigation measures such as shut down on demand.
10. A potential environmental constraint was documented at Plot 2 in the form of a dump site. This site was surveyed for part of the spring 2022 season and for all of the autumn 2022 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 presence of this stopover habitat within the project area increases the risk profile for the spring and the autumn migration periods and the following recommendations are made:
    a. It is strongly recommended that the dump site is completely removed, with the area remediated and wastes collected, and a fit-for-purpose, regulated and environmentally friendly dump site constructed for Wadi Dara at least 2-km away from any WTG proposed for this or other wind projects. This site should include environmental protection measures recommended by Birdlife International[29]. Siting of this facility should be informed by specific pre-construction surveys encapsulating biodiversity, environmental and social aspects.
    b. If removal and relocation of the dump site, the Plot 2 WTG layout and OHTL siting should avoid the dump site by a two (2) km or greater distance.
    c. To inform the baseline assessment and validate the importance of the potential environmental constraint, additional monitoring is recommended for spring and autumn 2023. Monitoring of

29

this site is recommended for the entire migration period and at a frequency/level of effort consistent with the effort expended per survey week during the autumn 2022 season.

11. A potential environmental constraint was identified for Plot 2 for the Wadi Dara community. However, additional monitoring of this site should be undertaken during spring and autumn 2023 similar to the effort completed in 2022 to determine if the site serves as an important stopover site for some birds of prey, and whether it increases the risk profile for the spring and the autumn migration periods. At this point, and as a precautionary requirement, a 2-km buffer from Wadi Dara is proposed. This could revised upon completion of the additional monitoring during spring and autumn 2023.

12. 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.

    a. Plot 2 is located within Gebel El Zeit IBA, and as such, analysis of the relative risk of this project area a Critical Habitat Assessment (CHA) will be required to meet International Finance Corporation (IFC) Performance Standard (PS) 6, and/or European Bank for Reconstruction and Development (EBRD) Performance Requirement (PR) 6, and/or alternative development finance lender environmental and social standards or requirements, should the sponsor seek development finance institutional financing for this site. **The sponsor should be advised of relatively recent changes made to PR6 in respect to achieving *<u>net gain</u>* in this context**.

    b. It is recommended that such analysis account for both the wind park infrastructure components, as well as for associated overhead electrical transmission lines.

Appendix A: Viewshed Maps of OPs and Data Sheets used during OP Surveys

A

NIAT Wind Power Plant, Egypt
500 MW
Avifaunal Assessment
Spring 2021

Hour	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00
Cloud Cover (%)										
Wind Speed (Beaufort)										
Wind Direction										
Precipitation[1]										
Visibility (km)[2]										
Temperature (C)										

Notes

[1] Precipitation: Yes/No, Heavy (H)/Moderate (M)/Light (L)
[2] 1 = 2.5 km, 2 = 5 km, 3 = 7.5 km, 4 = 10 km

B

NIAT Wind Power Plant, Egypt
500 MW
Avifaunal Assessment
Spring 2021

Site: NIAT, Egypt Date: OP#: Observer:

Date	OP	Time	Species	No	Flight Direction	In/out	Notes*

*(sex, age status, behaviour ...etc.)

C

NIAT Wind Power Plant, Egypt
500 MW
Avifaunal Assessment
Spring 2021

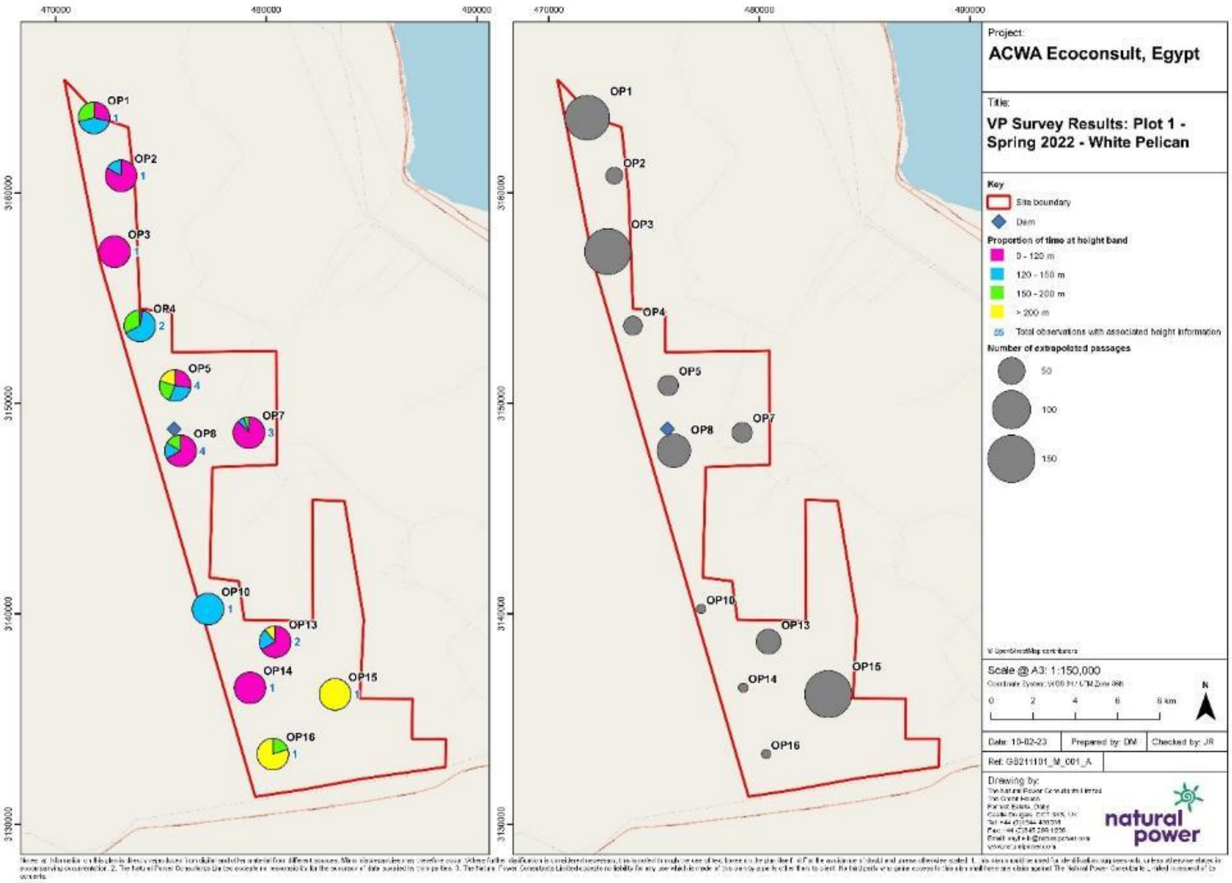
Site: NIAT, Egypt Date: OP#: Start time: End time: Observer:

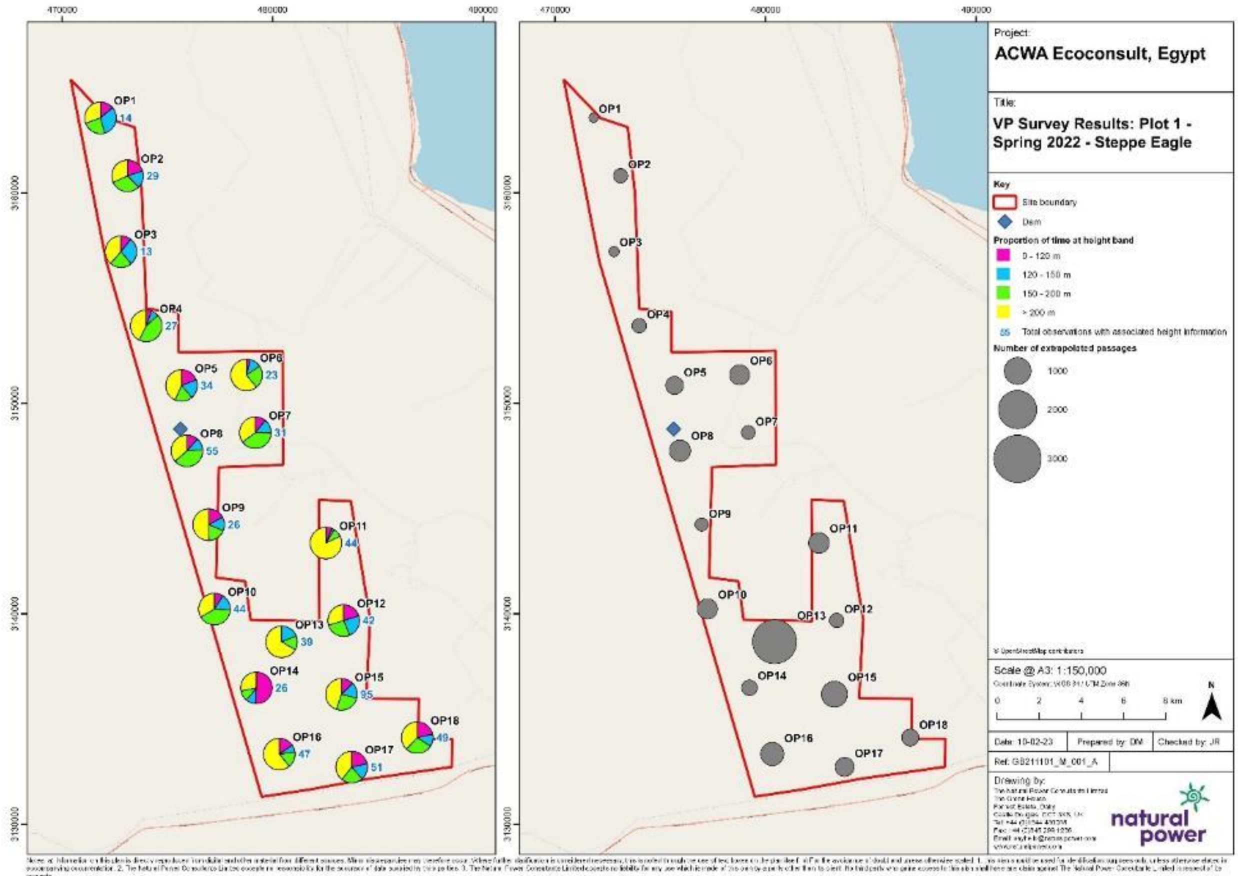
Rec#	time	Species	No	Height duration		Duration inside 2.5km	Detection	Distance (m)	Flight Direction	In/ out	Notes*
				1	2						

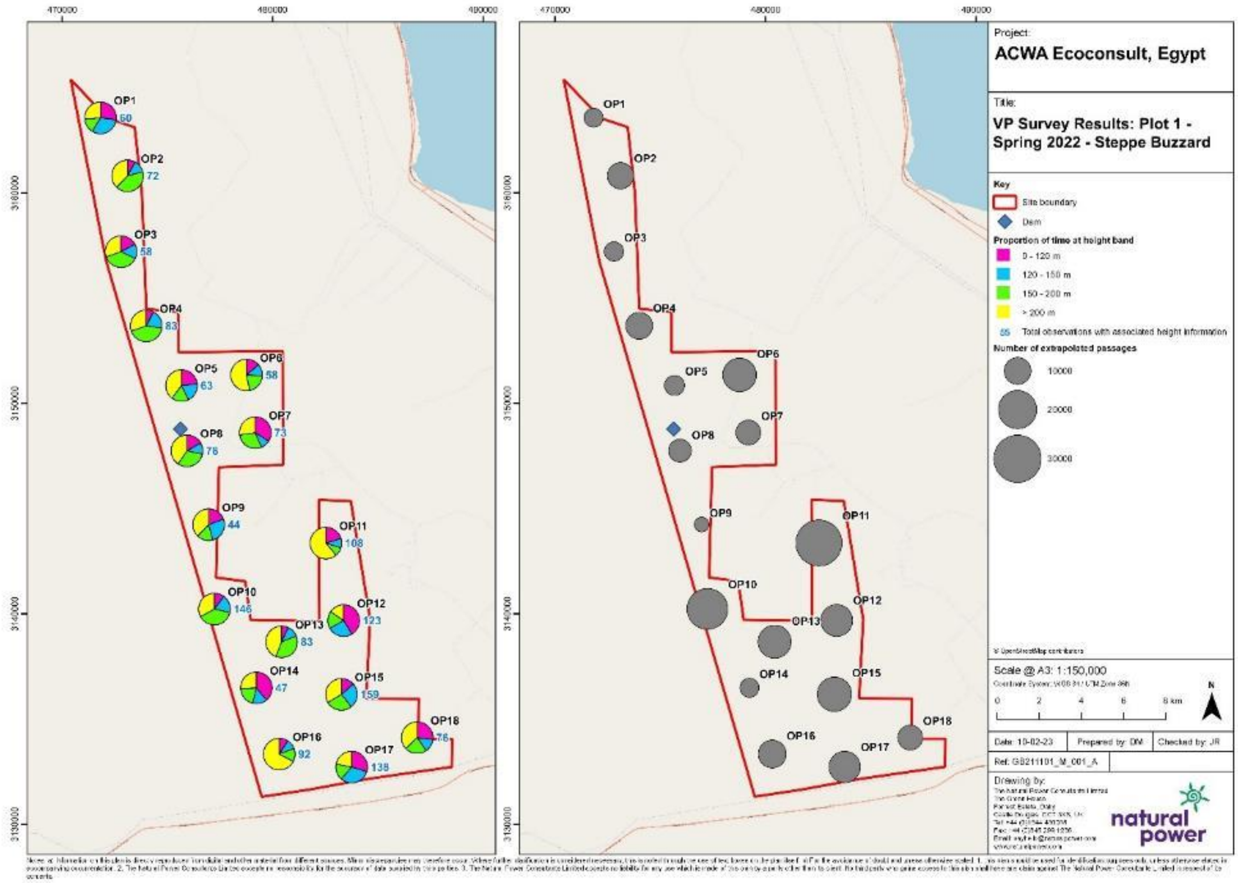
*(sex, age status, behaviour ...etc.)

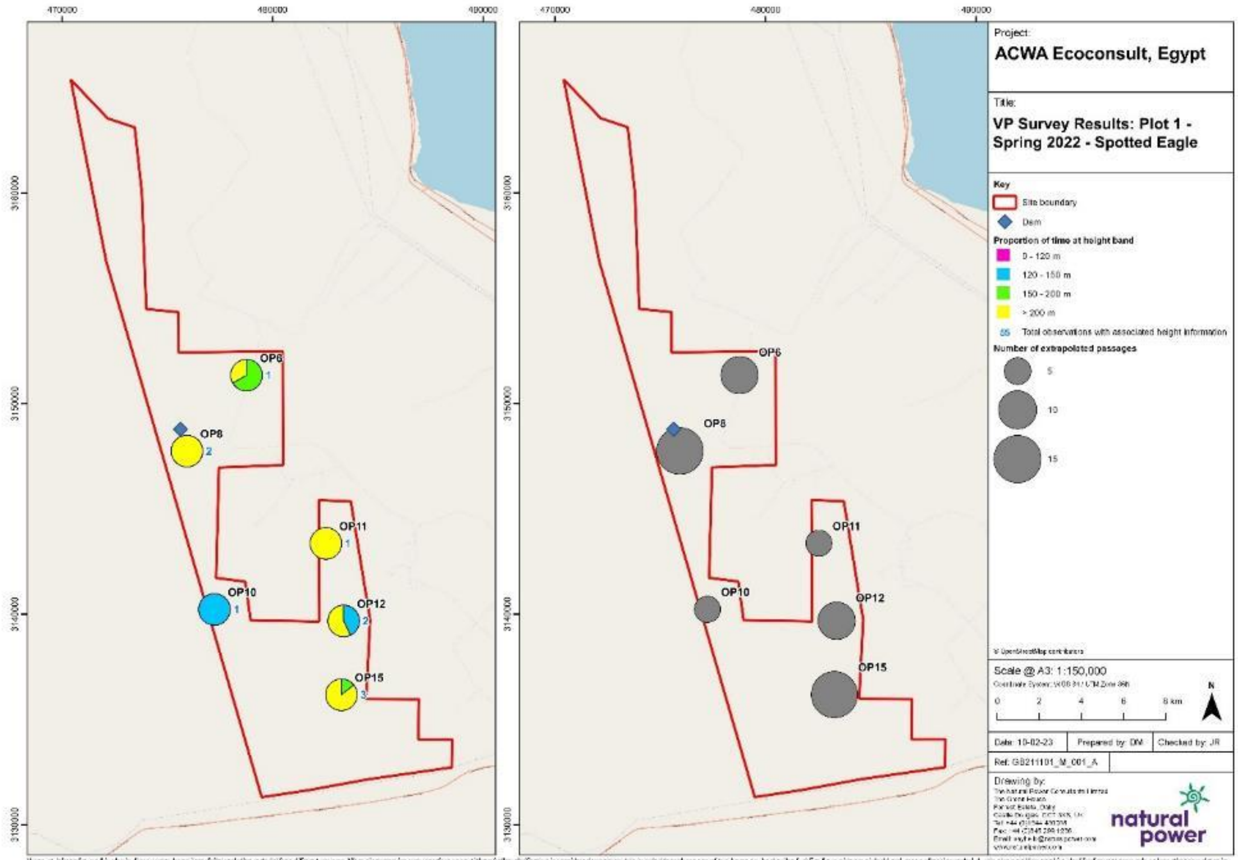
Figure 44: Proposed Field Datasheets for Project

Appendix B: Plot 1 Spring 2022 Species-specific data

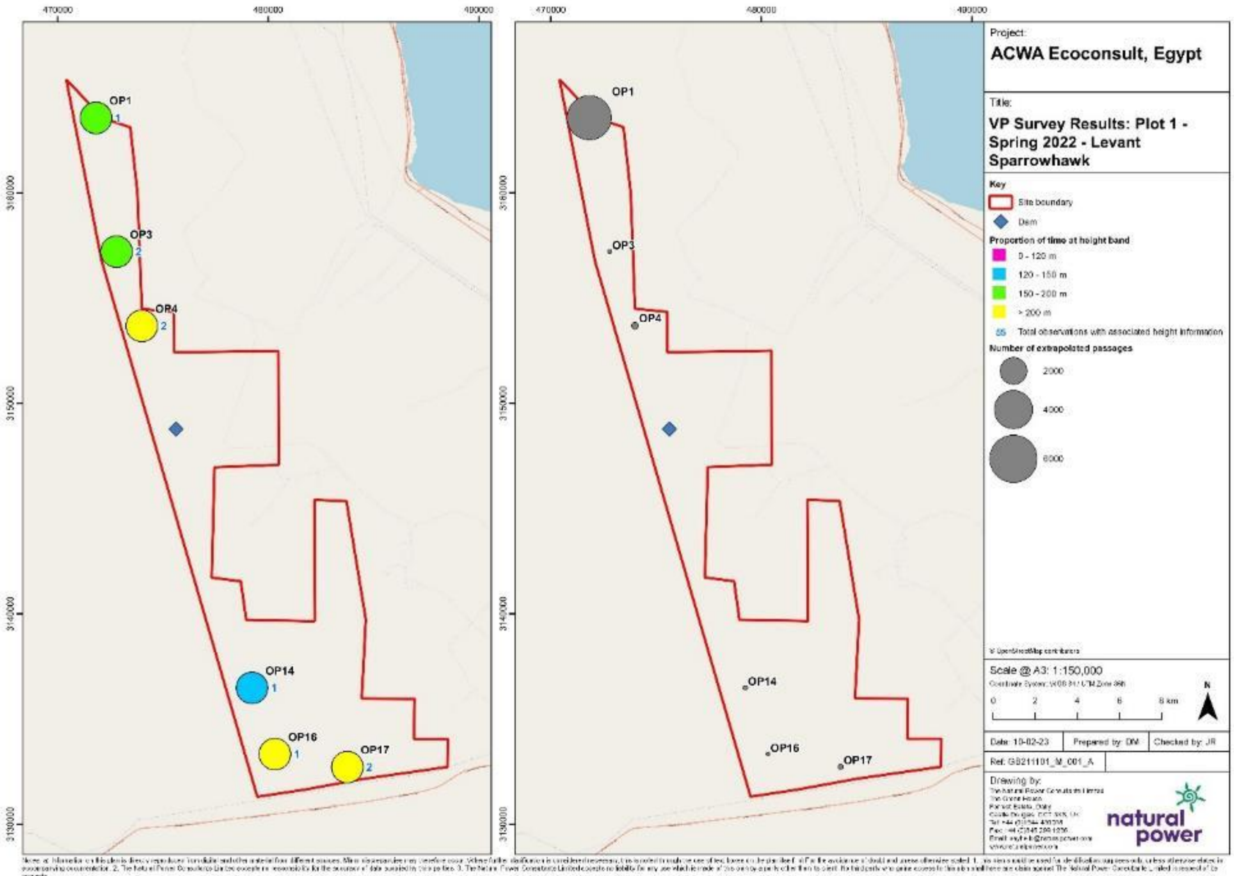

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - White Pelican
Key
Site boundary
Dem
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
50
100
150
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power
OP1
OP2
OP3
OP4
OP5
OP7
OP8
OP10
OP13
OP14
OP15
OP16
470000
480000
490000
3130000
3140000
3150000
3160000


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Steppe Eagle
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
1000
2000
3000
Scale @ A3: 1:150,000
Coordinate System: WGS 84 / UTM Zone 36N
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power
OP1 14
OP2 29
OP3 13
OP4 27
OP5 34
OP6 23
OP7 31
OP8 55
OP9 26
OP10 44
OP11 44
OP12 42
OP13 39
OP14 26
OP15 95
OP16 47
OP17 51
OP18 49
470000
480000
490000
3160000
3150000
3140000
3130000

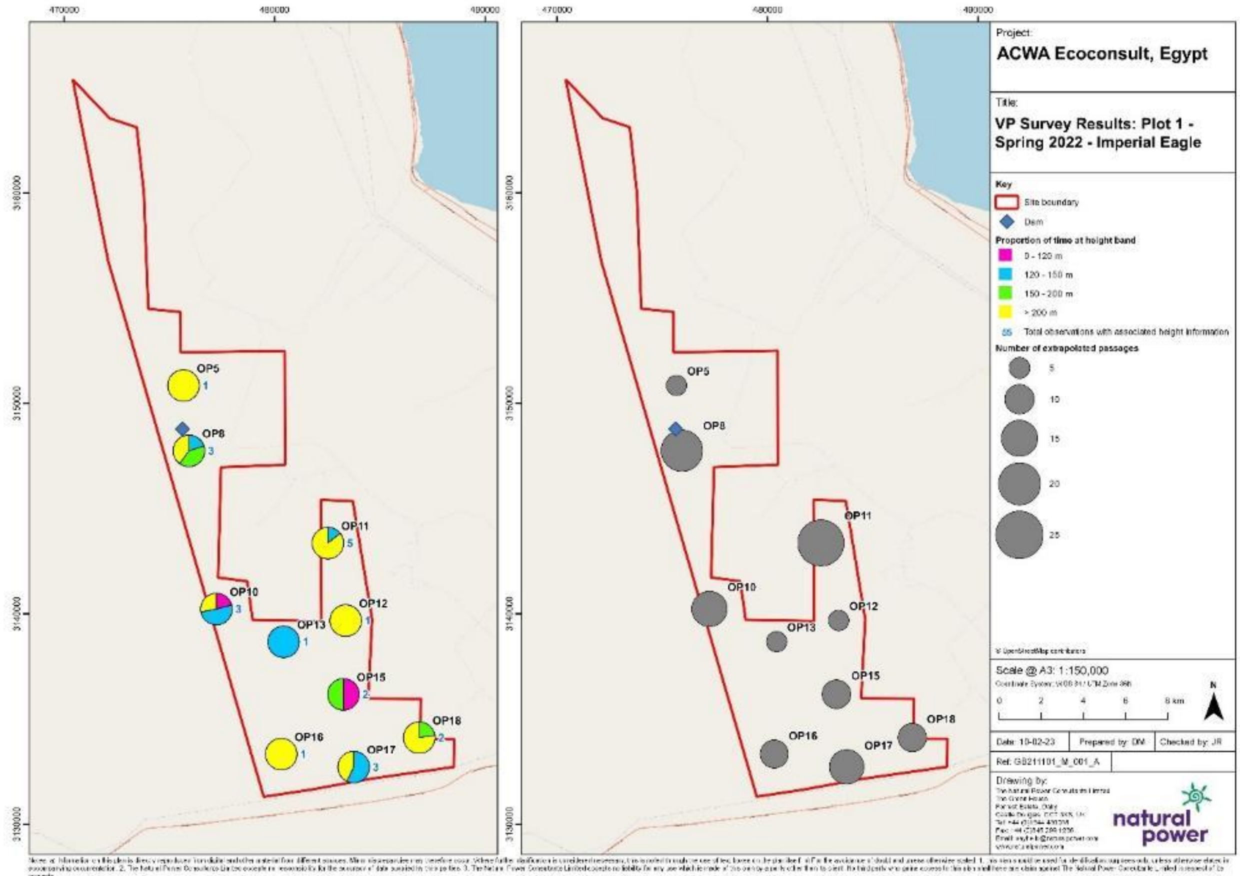

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Steppe Buzzard
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
10000
20000
30000
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power
470000
480000
490000
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
OP10
OP11
OP12
OP13
OP14
OP15
OP16
OP17
OP18

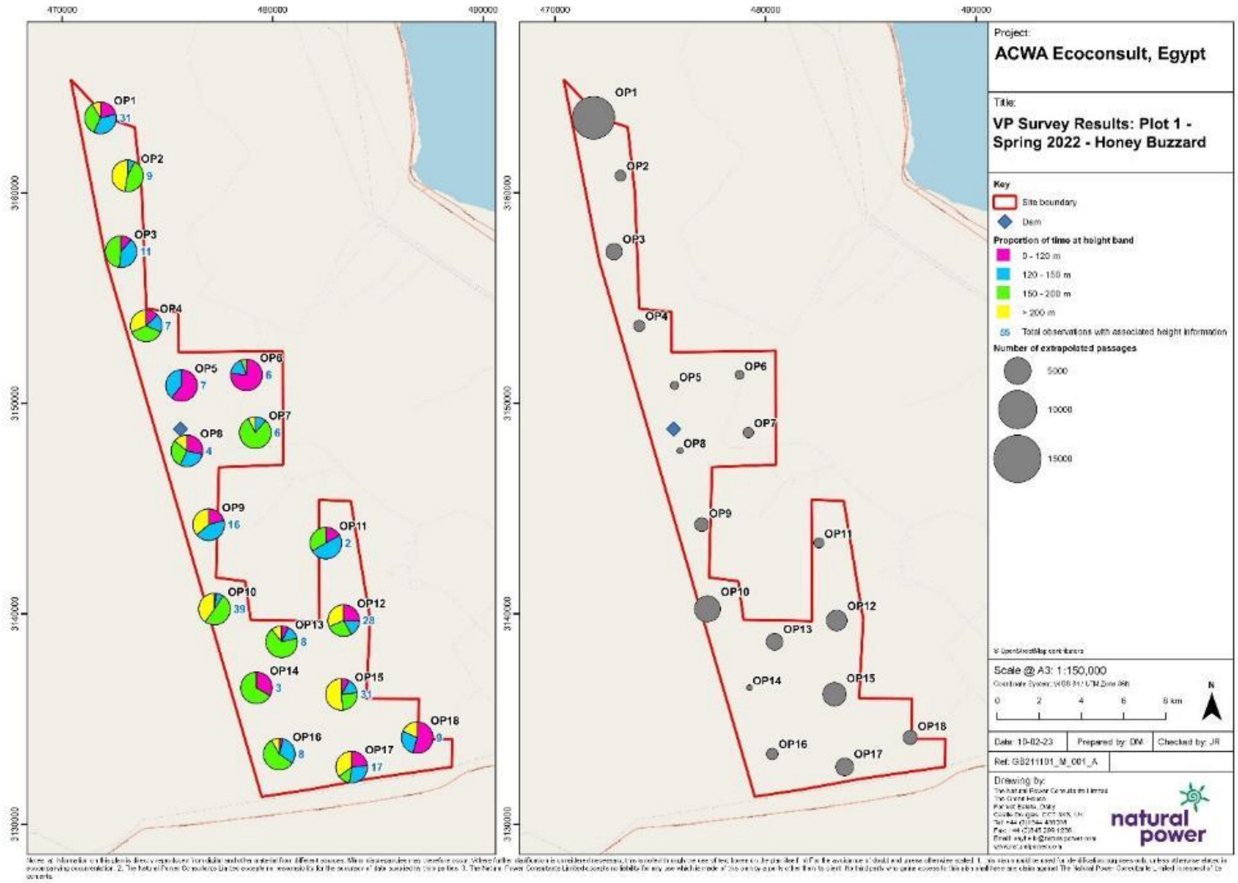


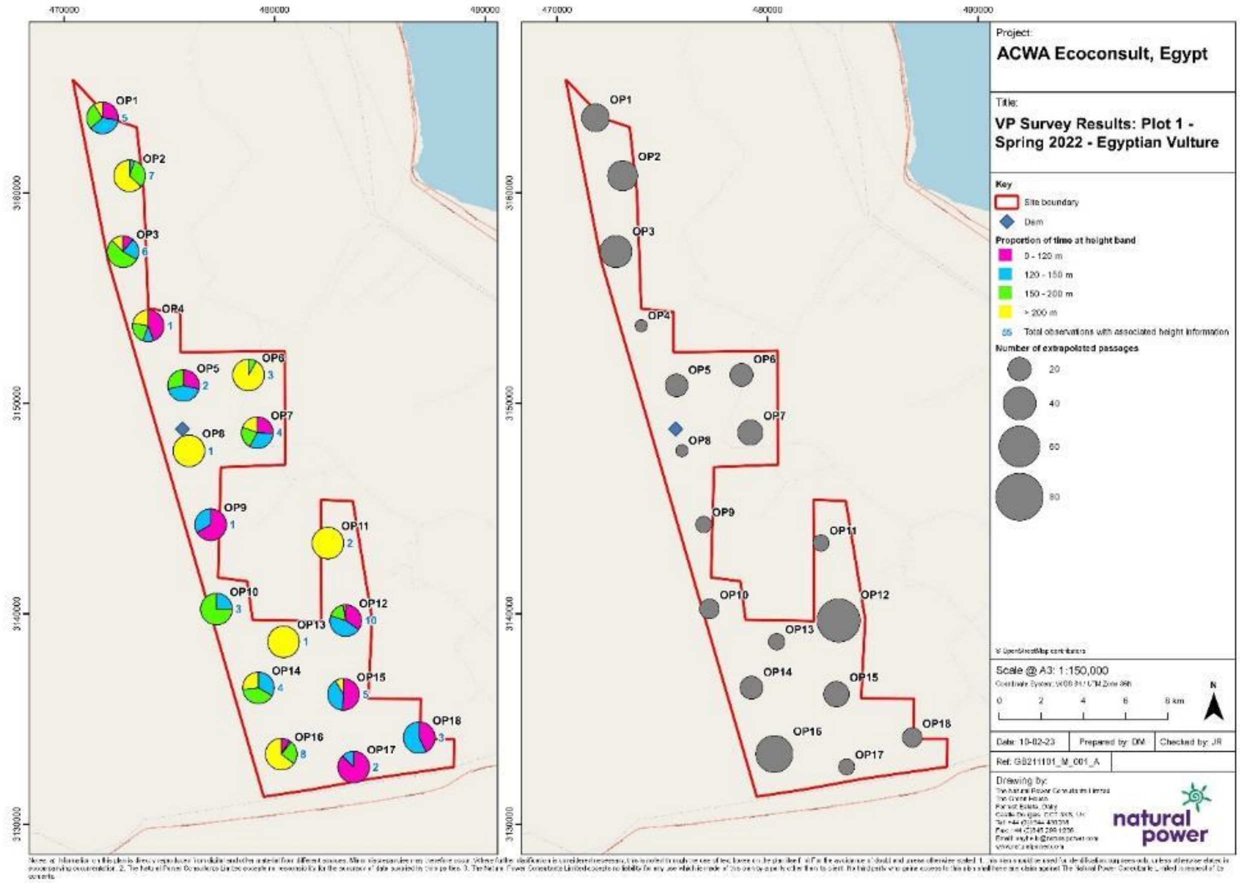
470000
480000
490000
3160000
3150000
3140000
3130000
OP6
OP8
OP10
OP11
OP12
OP15
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Spotted Eagle
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
5
10
15
Scale @ A3: 1:150,000
Date: 10-02-23
Prepared by: DM
Checked by: JR
Drawing by:
natural power



470000
480000
490000
3160000
3150000
3140000
3130000
OP1
OP3
OP4
OP14
OP16
OP17
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Levant Sparrowhawk
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
2000
4000
6000
© OpenStreetMap contributors
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Imperial Eagle
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
5
10
15
20
25
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power
OP5
OP8
OP10
OP11
OP12
OP13
OP15
OP16
OP17
OP18
470000
480000
490000
3130000
3140000
3150000
3160000


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Honey Buzzard
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
5000
10000
15000
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
OP10
OP11
OP12
OP13
OP14
OP15
OP16
OP17
OP18
470000
480000
490000
3160000
3150000
3140000
3130000


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Egyptian Vulture
Key
Site boundary
Dem
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
20
40
60
80
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211191_M_001_A
Drawing by:
natural power
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
OP10
OP11
OP12
OP13
OP14
OP15
OP16
OP17
OP18
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480000
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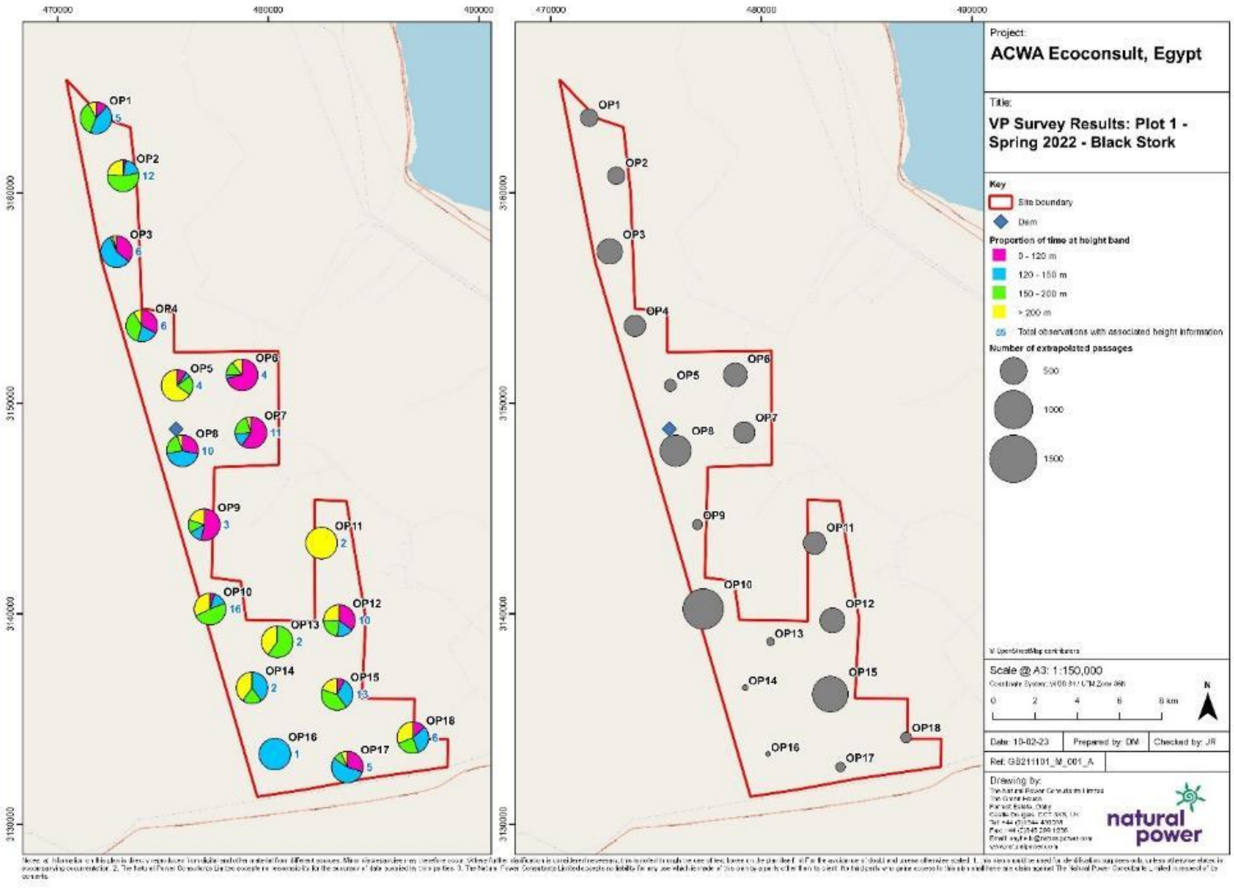
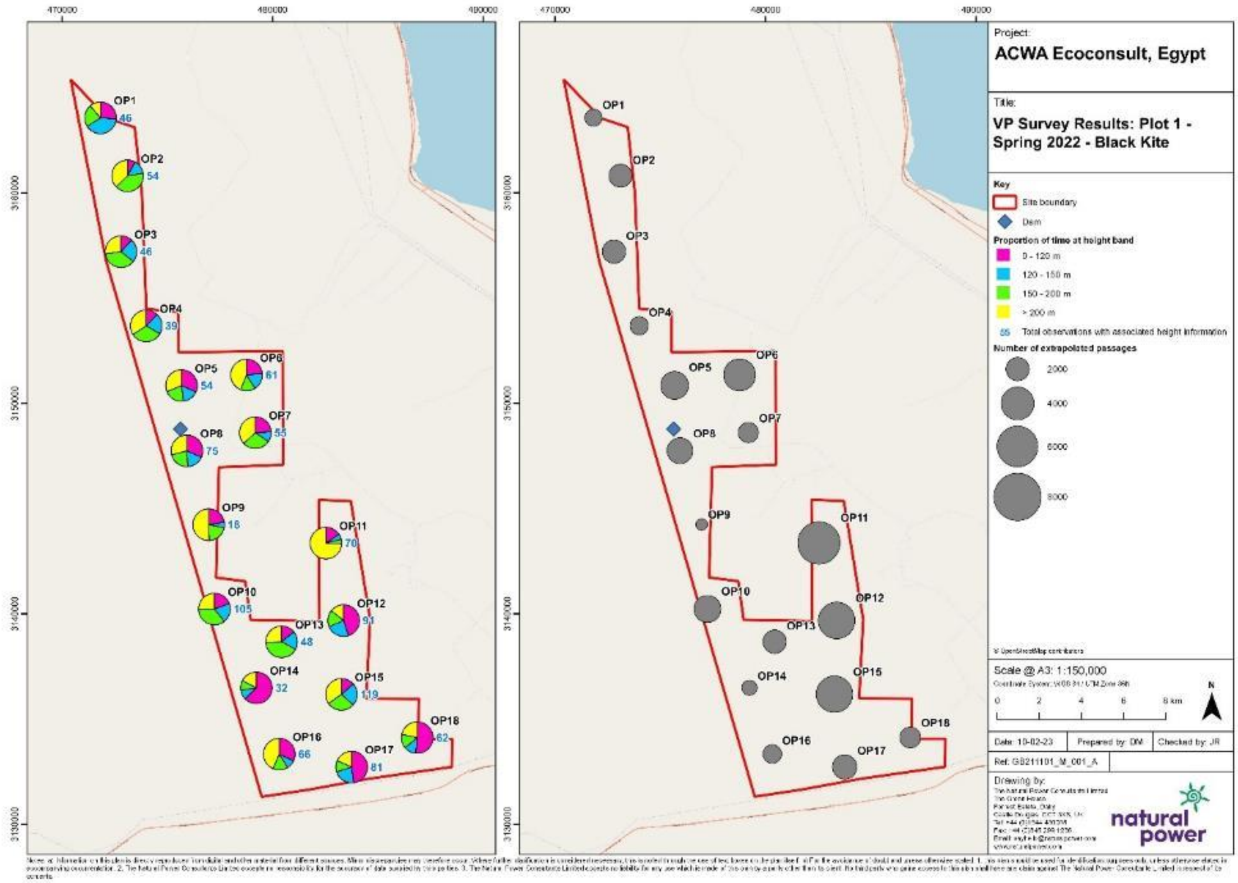
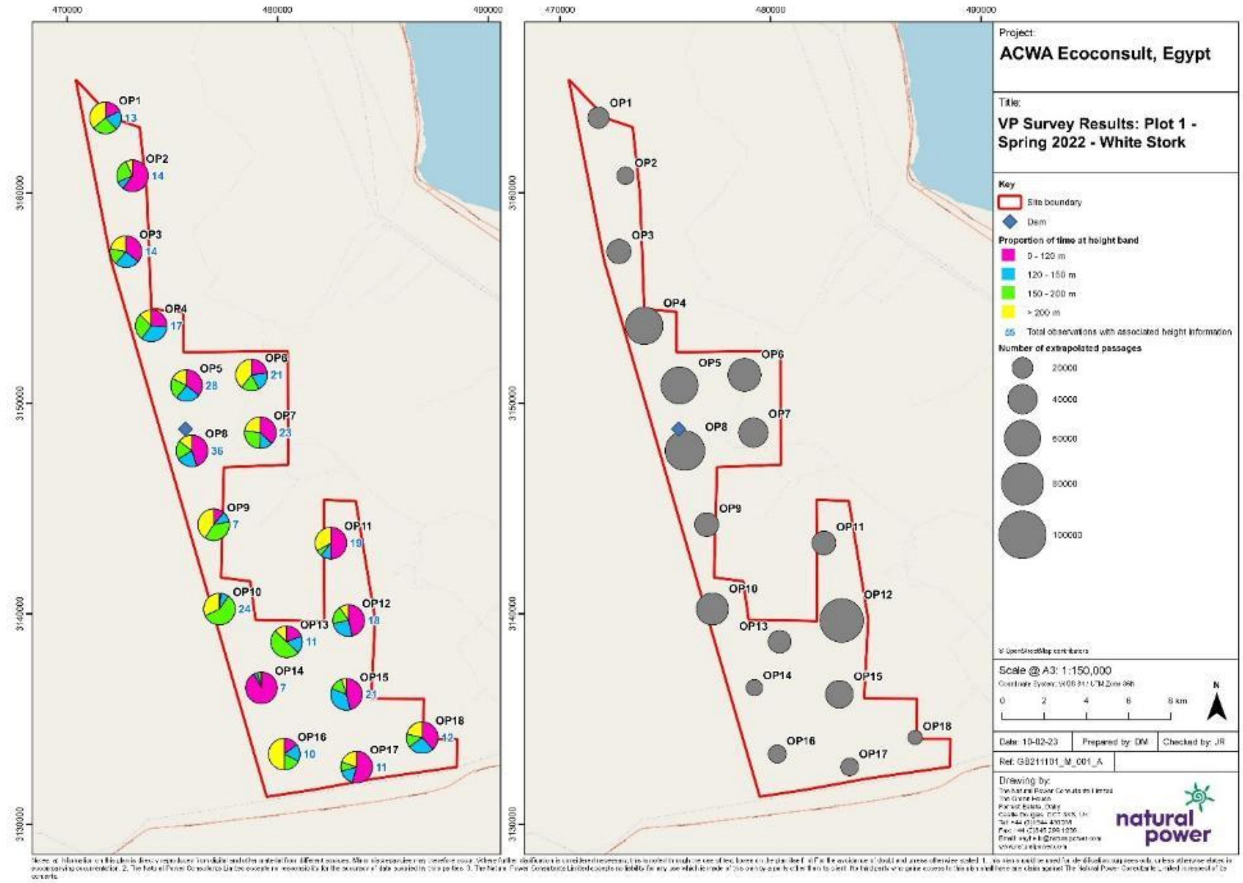
3160000
3150000
3140000
3130000


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Black Stork
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
500
1000
1500
Scale @ A3: 1:150,000
0
2
4
6
8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
OP10
OP11
OP12
OP13
OP14
OP15
OP16
OP17
OP18
470000
480000
490000
3160000
3150000
3140000
3130000

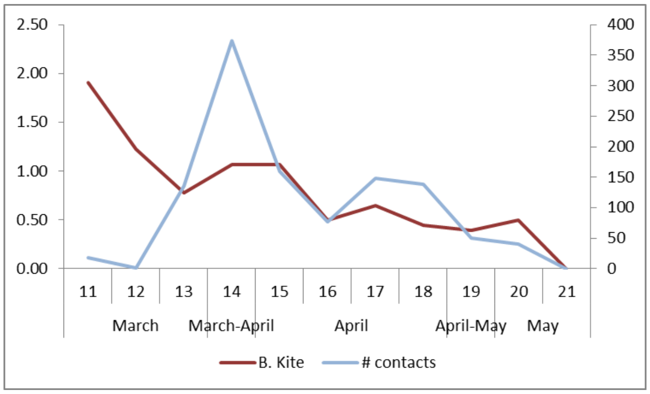


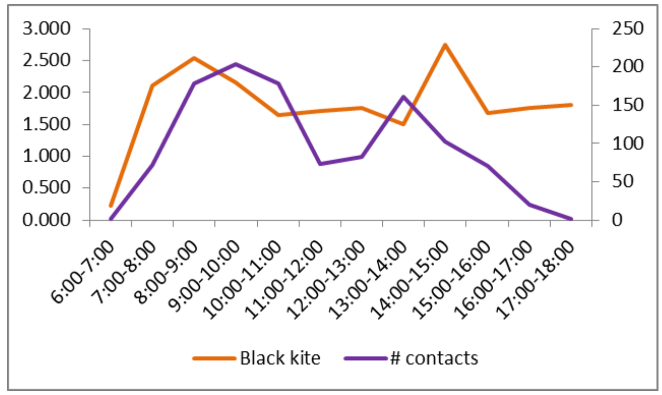
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - Black Kite
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
2000
4000
6000
8000
© OpenStreetMap contributors
Scale @ A3: 1:150,000
N
0 2 4 6 8 km
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power
OP1 46
OP2 54
OP3 46
OP4 39
OP5 54
OP6 61
OP7 55
OP8 75
OP9 18
OP10 105
OP11 70
OP12 91
OP13 48
OP14 32
OP15 119
OP16 66
OP17 81
OP18 62
470000
480000
490000
3160000
3150000
3140000
3130000


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Spring 2022 - White Stork
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
20000
40000
60000
80000
100000
Scale @ A3: 1:150,000
0
2
4
6
8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_001_A
Drawing by:
natural power
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
OP10
OP11
OP12
OP13
OP14
OP15
OP16
OP17
OP18
470000
480000
490000
3160000
3150000
3140000
3130000

Black Kite

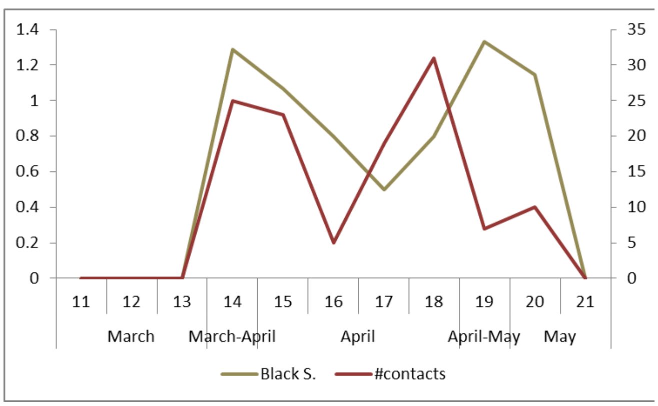
This species appeared from March to May (a total of 10 weeks) with the highest pass rate occurring between late-March and mid-April. This pattern differs lightly in comparison to Shirihai et al. (2000), as they do not mention so many kites in the second fortnight of April as here recorded. For these authors the peak was noted in the last week of March and first week of April.

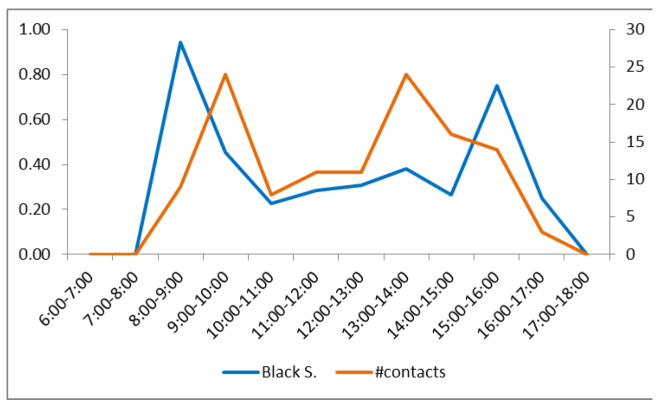




Black Kite: Passing rates and contacts during the spring 2022 at Plot 1 according to months and weeks (left) and daily hour interval (right)

Black Stork

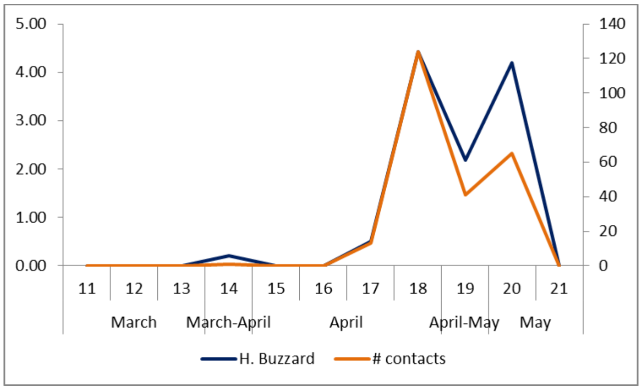


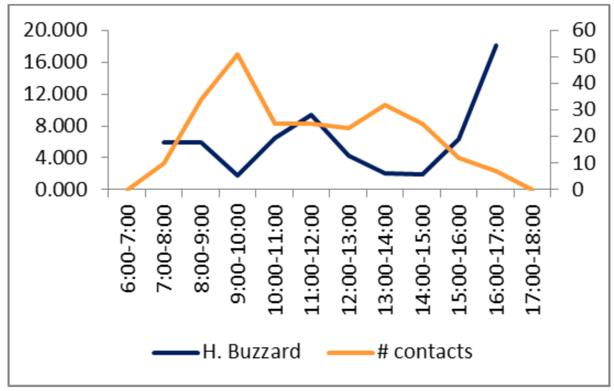


Black Stork: Passing rates (birds/hr) –left axis- and contacts –right axis- for the spring 2022 at Plot 1 according to months and weeks (left) and daily hour interval (right)

European Honey Buzzard

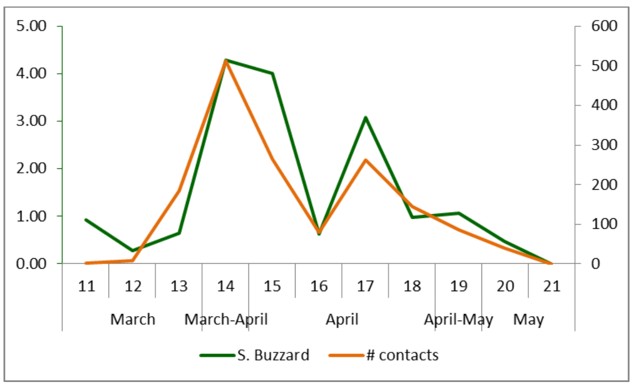
European Honey Buzzard peaked in May, despite an incipient migration in the last week of April. Shirihai et al. (2000) refers to the European Honey Buzzard with a migration period which extends from mid-March to mid-June and recorded the peak between late April and late May – which corresponds well with the data noted for the project site.

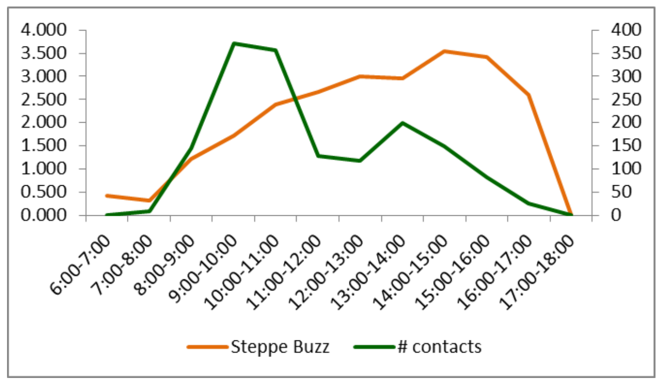




Honey Buzzard: Passing rates and contacts during the spring 2022 at Plot 1 according to months and weeks (left) and daily hour interval (right)

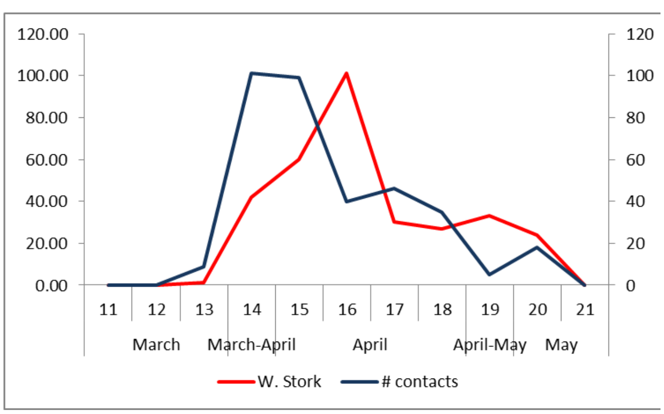
Steppe Buzzard

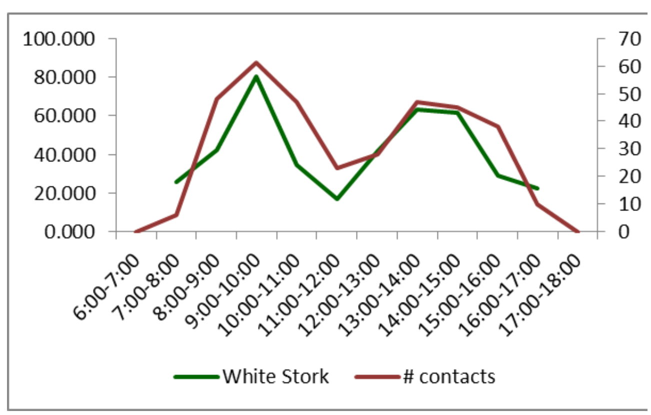




Steppe Buzzard: Passing rates and contacts during the spring 2022 at Plot 1 according to months and weeks (left) and daily hour interval (right)

White Stork





White Stork: passing rates and contacts during the spring 2022 at Plot 1 according to months and weeks (left) and daily hour interval (right)

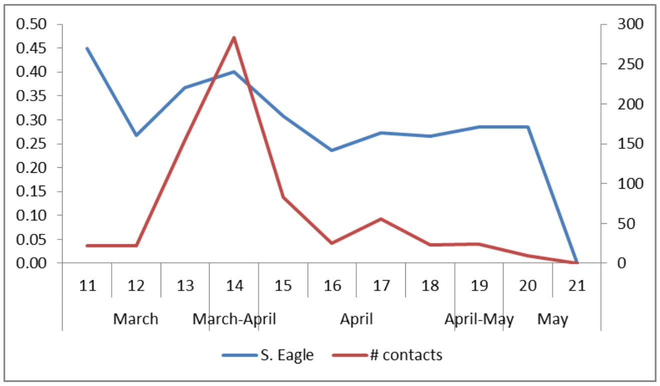
Short-Toed and Booted Eagles

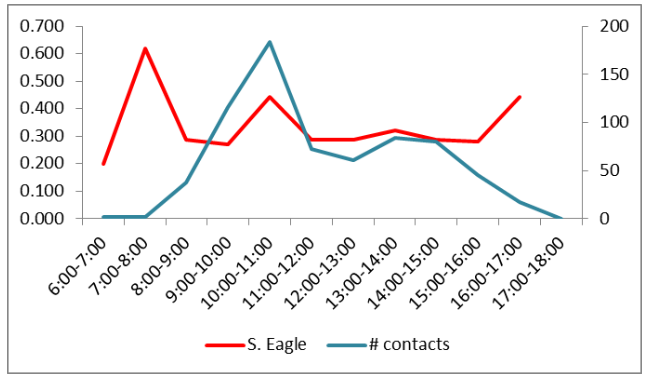
Short-toed eagle exhibited two peaks in late March and late April, with the latter potentially related to migration of immature individuals. Booted eagle peak occurred at the end of March-beginning of April. The daily passage (hours) were well synchronized with a bimodal figure. Another peak occurs as for other raptors around 10:00-11:00 am and a second one in the afternoon (14:00). These results are not unexpected for two eagles which are true soaring birds. Both species do not migrate in large numbers, and passage rates were quite stable and similar driven by observations of single migrants.

Short-toed (up) and Booted (down) eagles: Passing rates and contacts during the spring 2022 at Plot 1 according to months and weeks (left) and daily hour interval (right)

Steppe Eagle

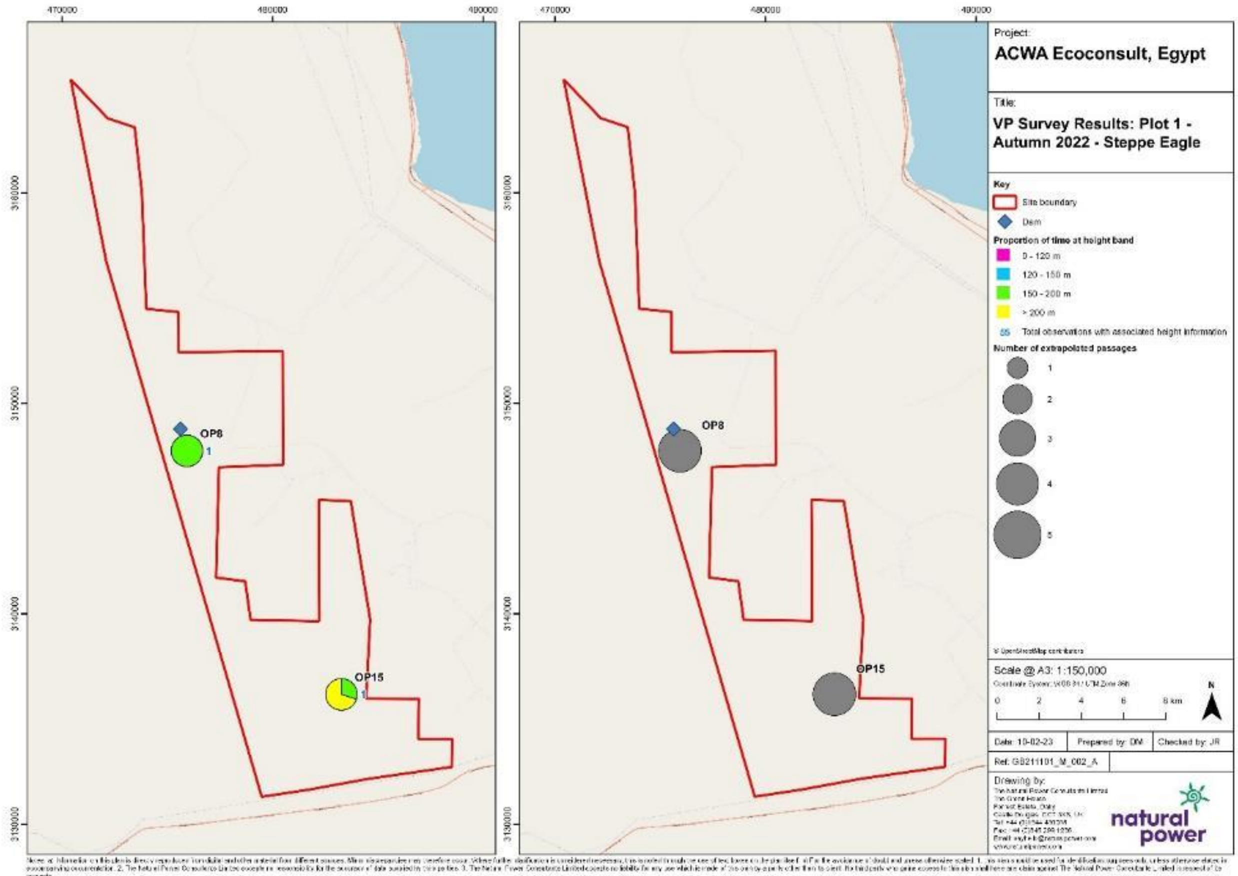
Steppe eagle was observed between mid-February and May (a total of 12 weeks), showing its peak between mid-March and early April. In general, the pattern here is similar to Shirihai et al. (2000). The daily passage is also concentrated with most of the birds passing in the morning window at 10:00-11:00 am. The birds start migration early in the day, with a higher passing rate which then descends and remains similar for the rest of the day. However, most of the contacts (usually single birds or two to three at a maximum) occurred by mid-day.

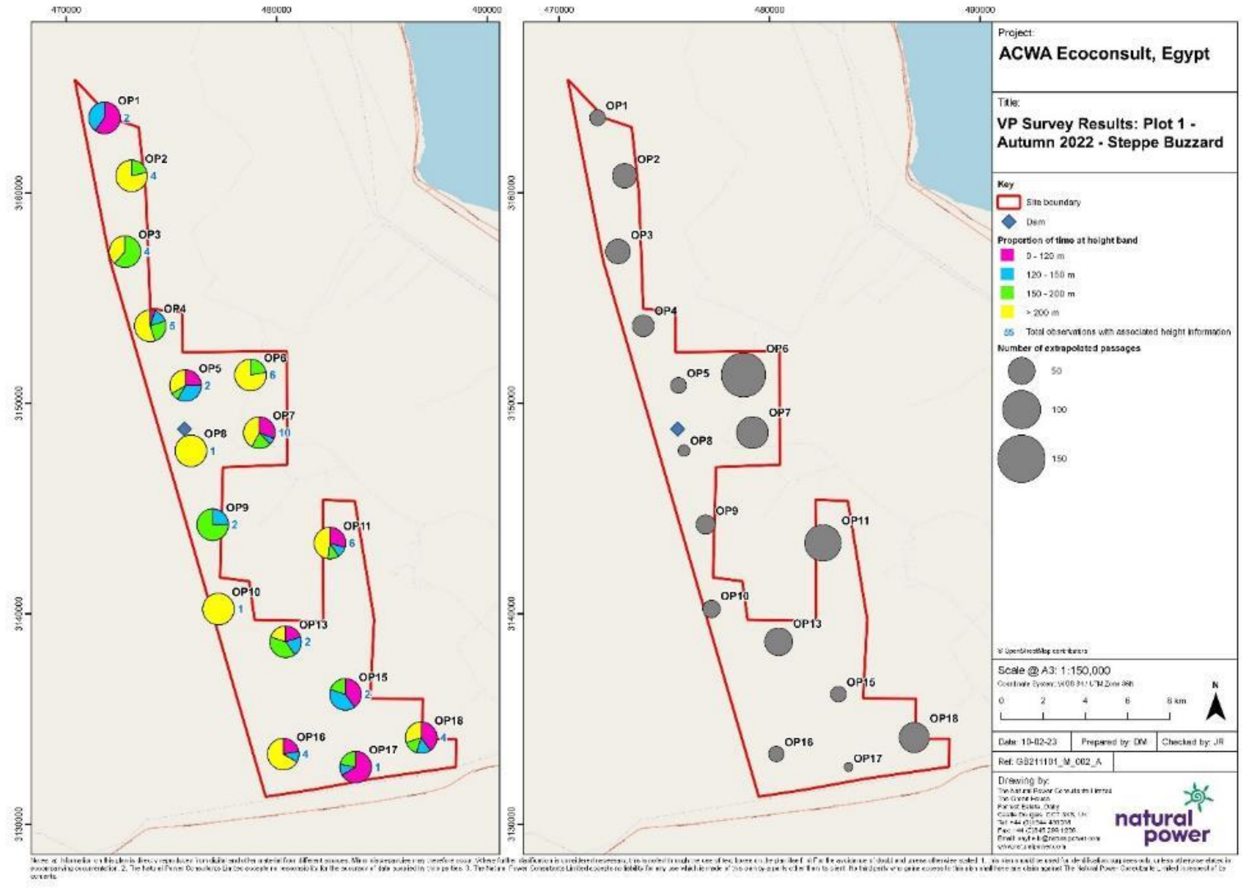


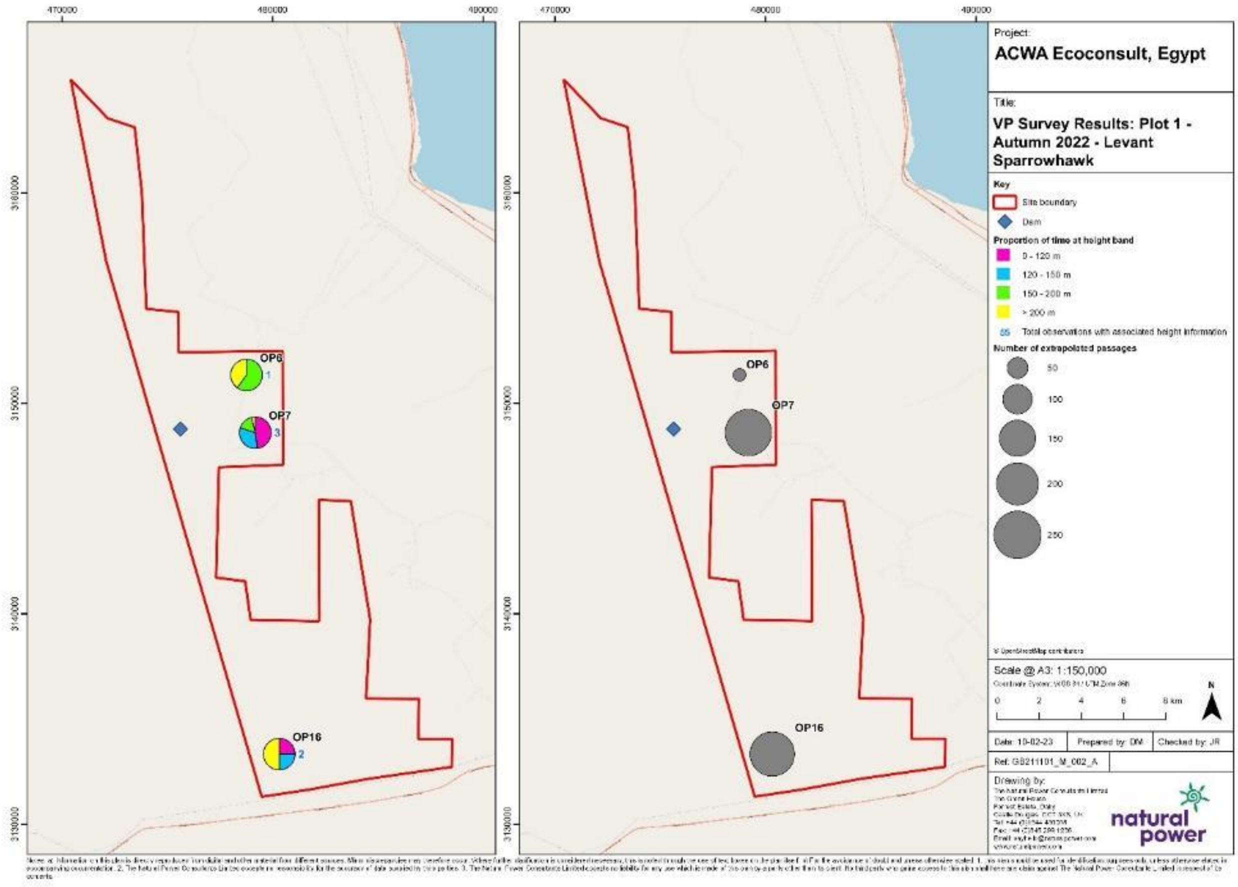


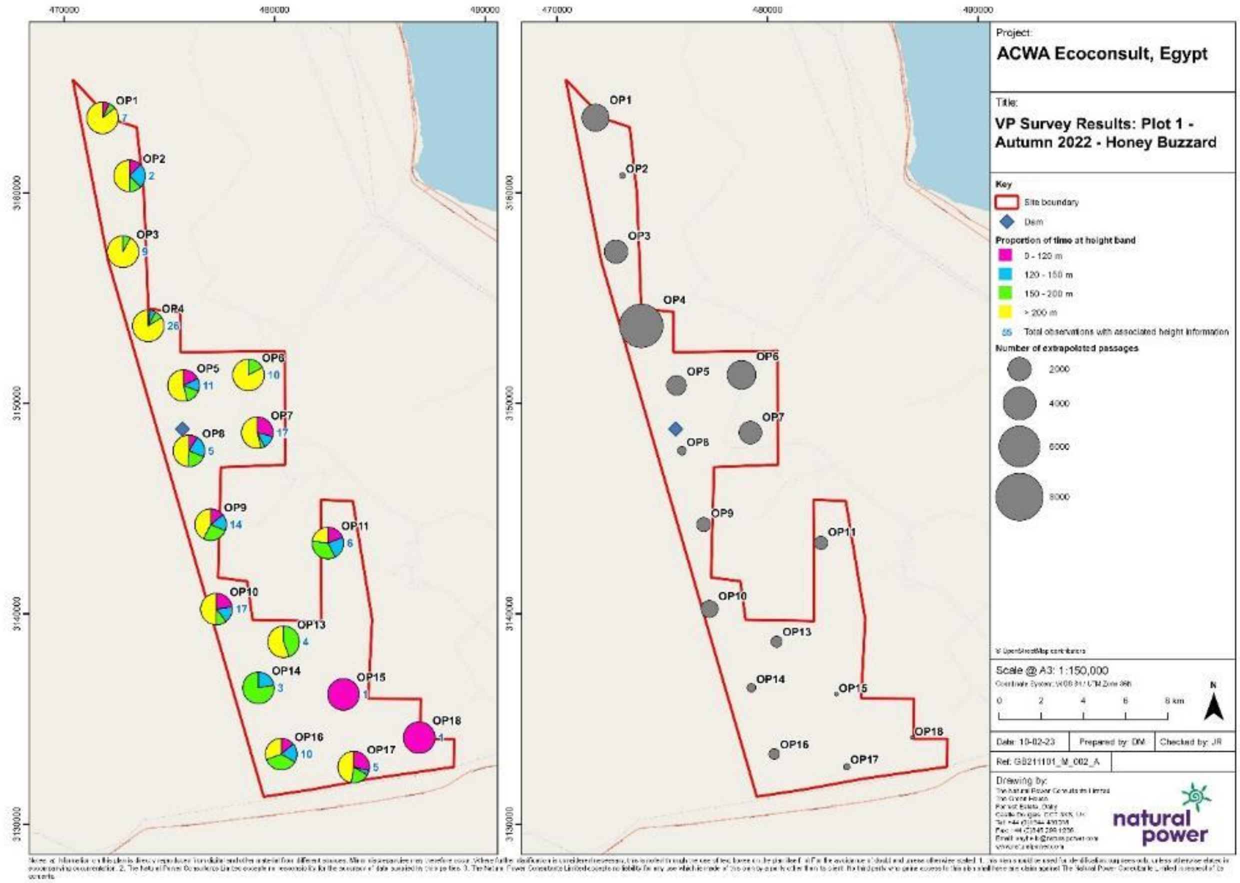
Steppe eagle: Pasisng rates and contacts during the spring 2022 at Plot 1 according to months and weeks (left) and daily hour interval (right)

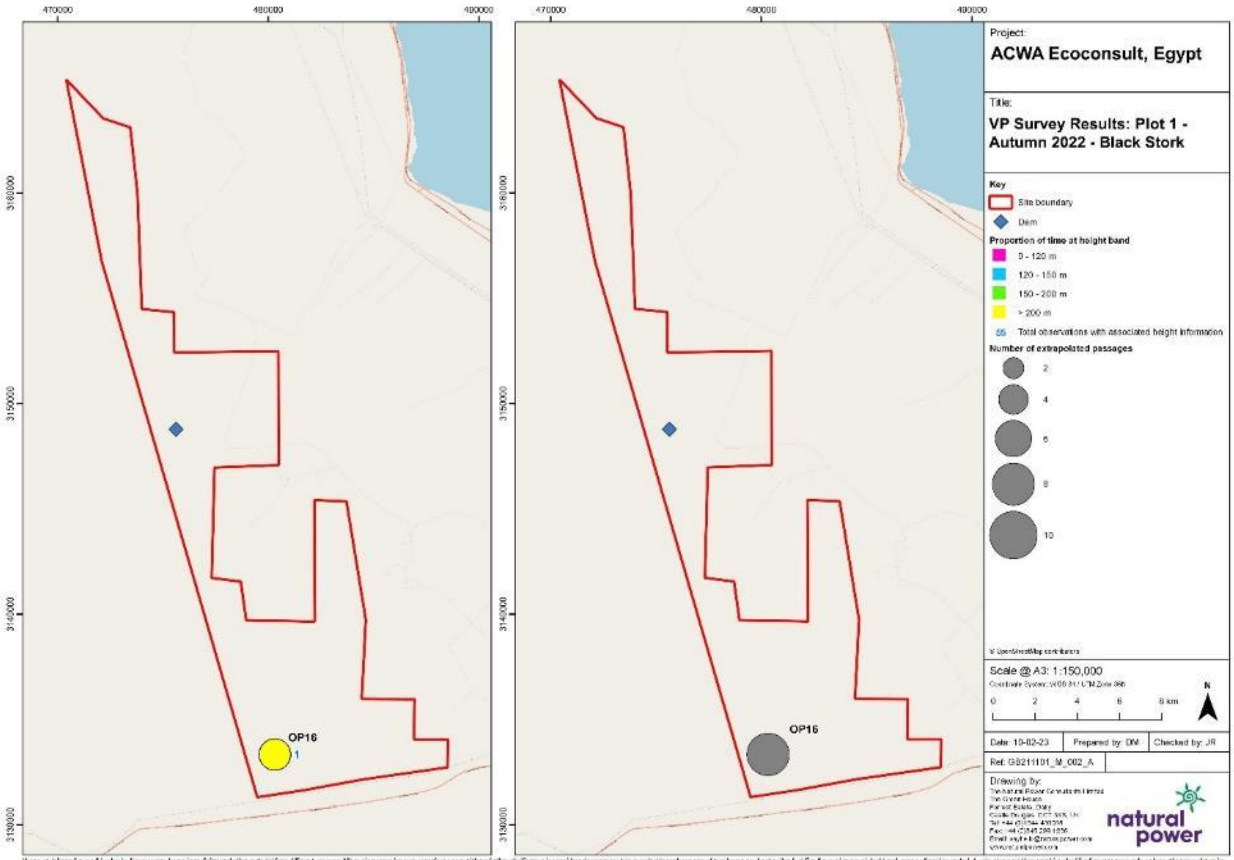
Appendix C: Plot 1 Autumn 2022 Species-specific data


470000
480000
490000
3160000
3150000
3140000
3130000
OP8
1
OP15
1
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Autumn 2022 - Steppe Eagle
Key
Site boundary
Dem
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
1
2
3
4
5
© OpenStreetMap contributors
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_002_A
Drawing by:
natural power

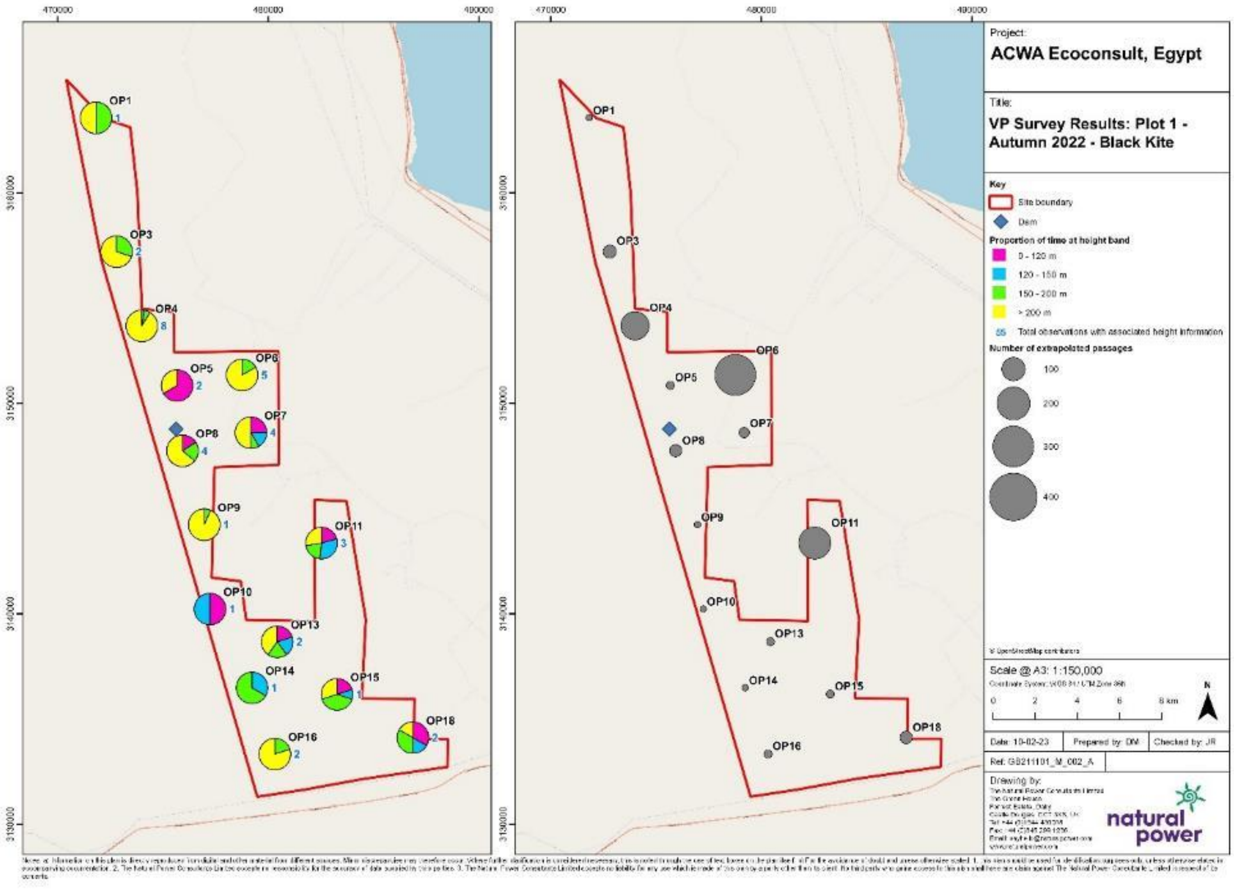

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Autumn 2022 - Steppe Buzzard
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
50
100
150
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
OP10
OP11
OP13
OP15
OP16
OP17
OP18
Scale @ A3: 1:150,000
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211191_M_002_A
Drawing by:
natural power

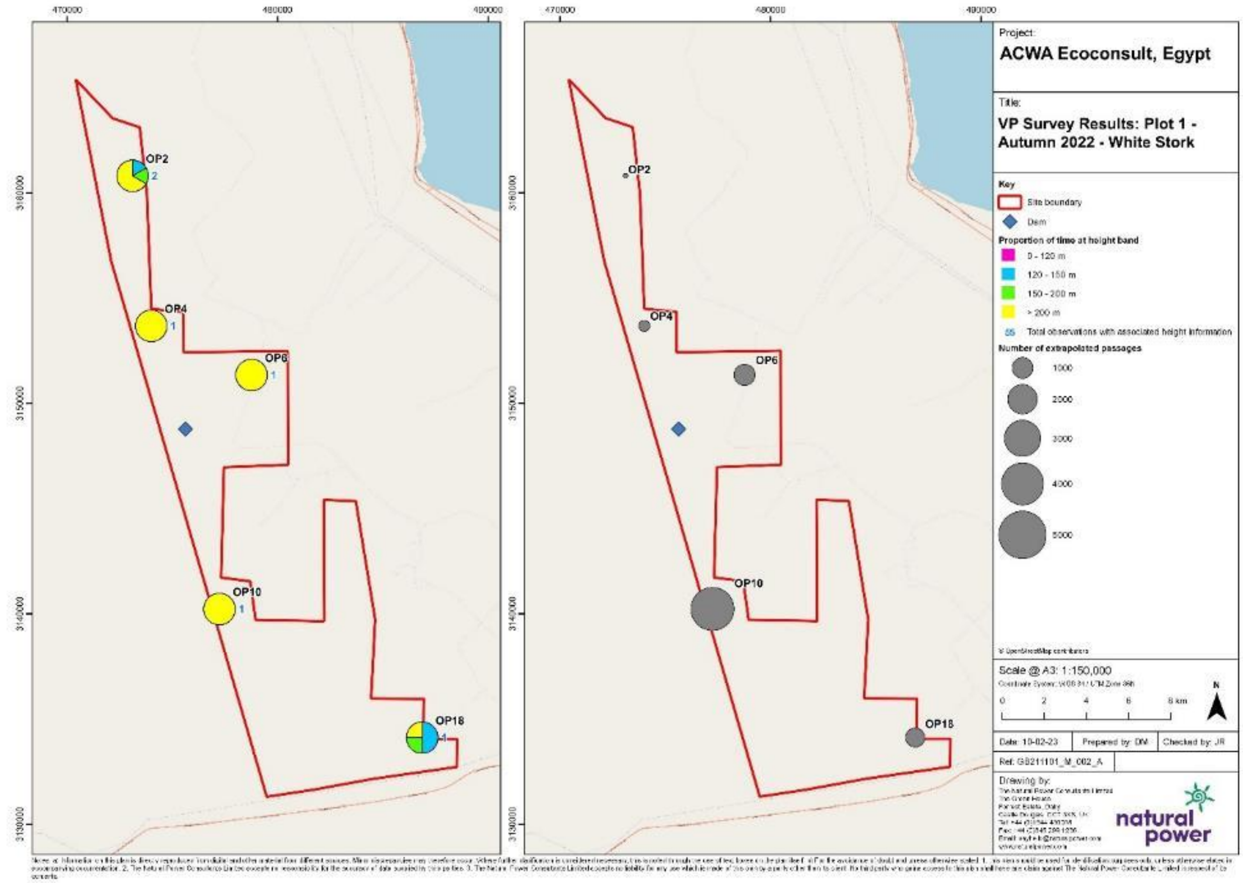

470000
480000
490000
3160000
3150000
3140000
3130000
OP6
1
OP7
3
OP16
2
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Autumn 2022 - Levant Sparrowhawk
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
50
100
150
200
250
Scale @ A3: 1:150,000
0
2
4
6
8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_002_A
Drawing by:
natural power

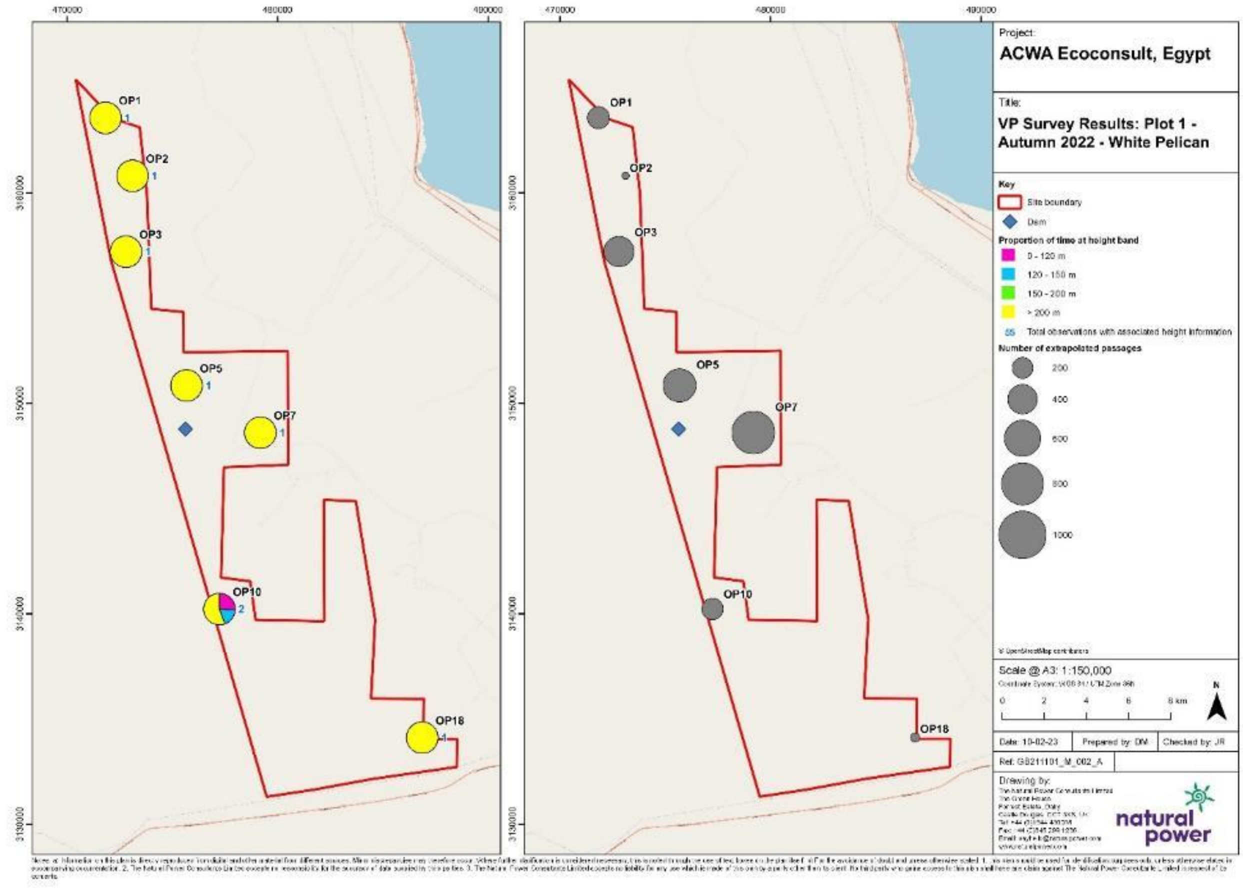

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Autumn 2022 - Honey Buzzard
Key
Site boundary
Dem
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
2000
4000
6000
8000
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_002_A
Drawing by:
natural power
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
OP10
OP11
OP13
OP14
OP15
OP16
OP17
OP18
470000
480000
490000
3160000
3150000
3140000
3130000



470000
480000
490000
3160000
3150000
3140000
3130000
OP16
1
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Autumn 2022 - Black Stork
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
2
4
6
8
10
Scale @ A3: 1:150,000
0
2
4
6
8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211191_M_002_A
Drawing by:
natural power

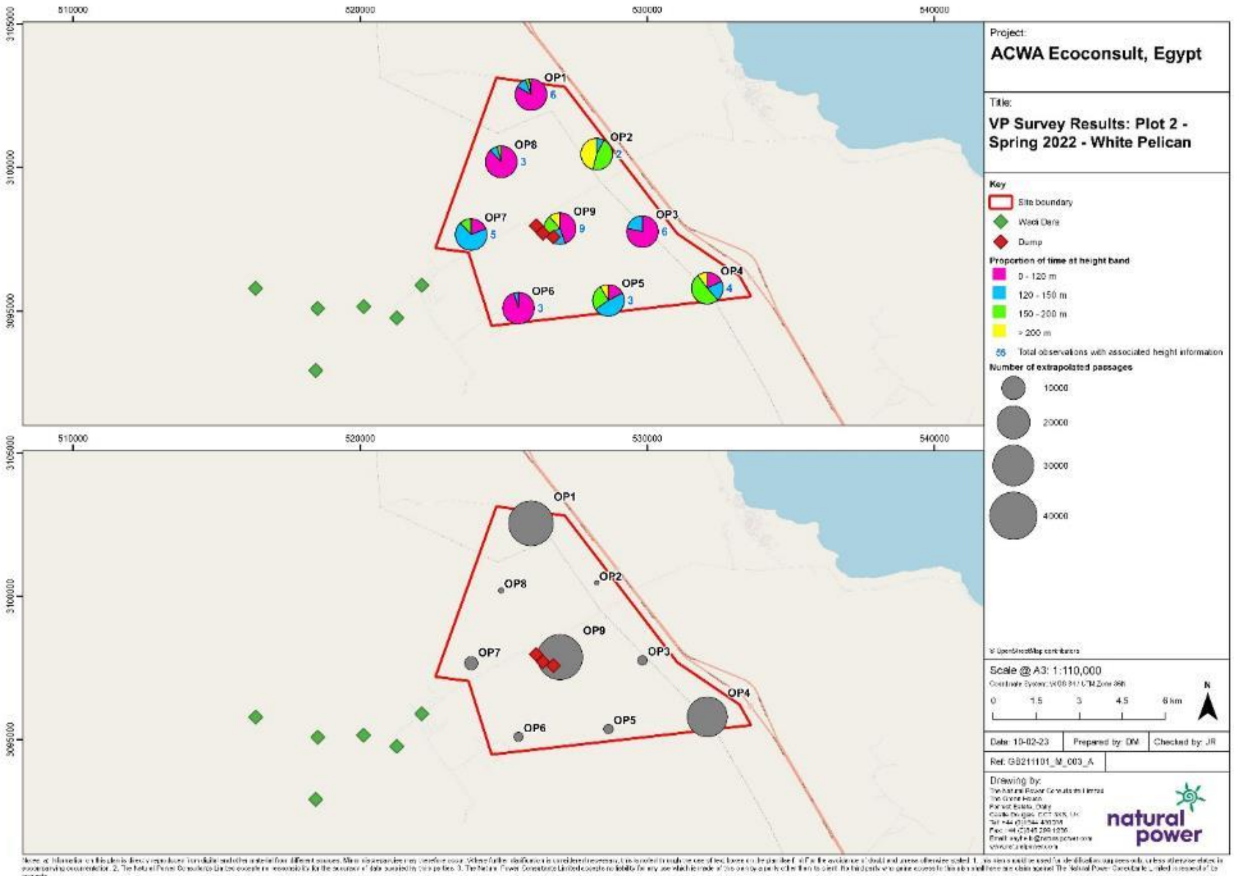

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Autumn 2022 - Black Kite
Key
Site boundary
Dem
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
100
200
300
400
Scale @ A3: 1:150,000
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211191_M_002_A
Drawing by:
natural power
OP1
OP3
OP4
OP5
OP6
OP7
OP8
OP9
OP10
OP11
OP13
OP14
OP15
OP16
OP18


470000
480000
490000
3160000
3150000
3140000
3130000
OP2
2
OP4
1
OP6
1
OP10
1
OP18
4
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Autumn 2022 - White Stork
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
1000
2000
3000
4000
5000
Scale @ A3: 1:150,000
0 2 4 6 8 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_002_A
Drawing by:
natural power

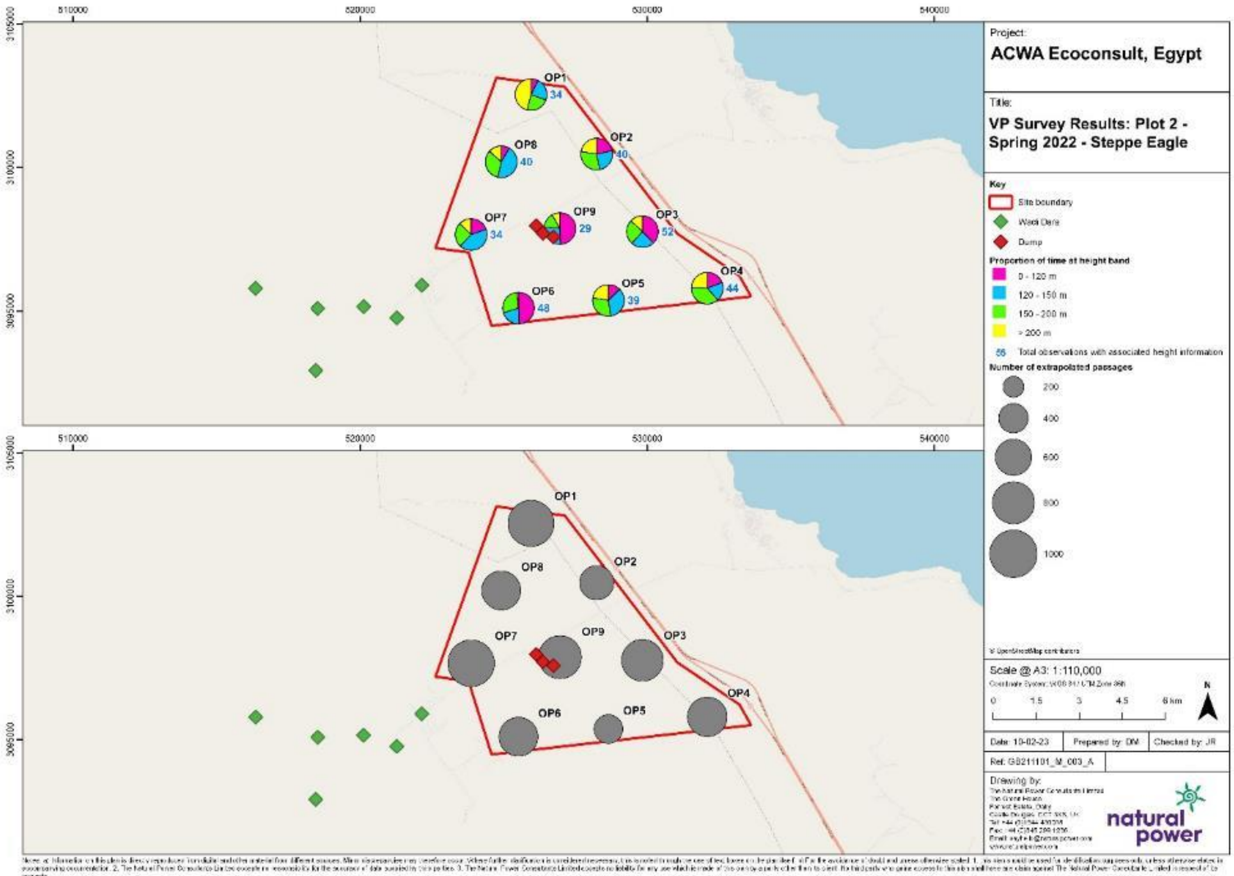


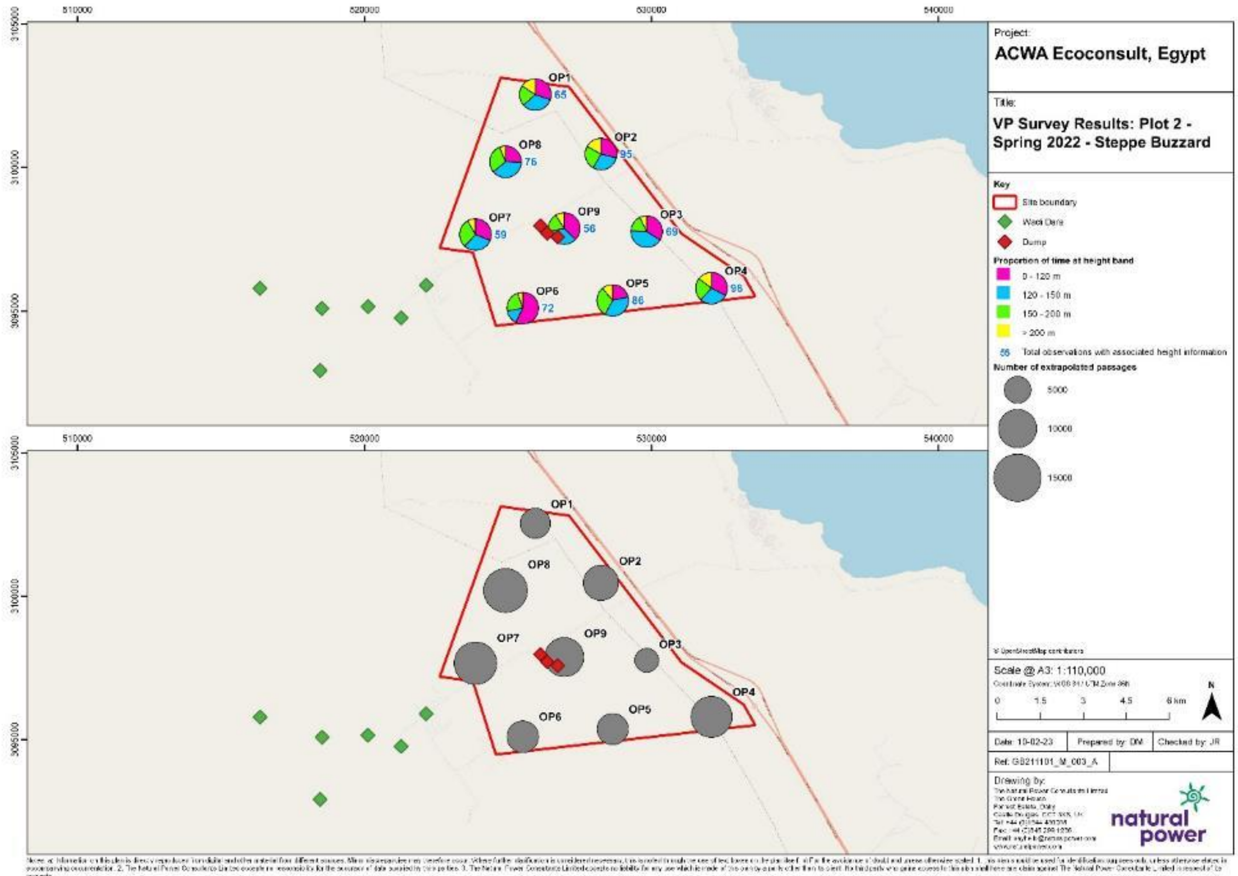
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 1 - Autumn 2022 - White Pelican
Key
Site boundary
Dam
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
200
400
600
800
1000
Scale @ A3: 1:150,000
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_002_A
Drawing by:
natural power
OP1
OP2
OP3
OP5
OP7
OP10
OP18
470000
480000
490000
3160000
3150000
3140000
3130000

Appendix D: Plot 2 Spring 2022 Species-specific data

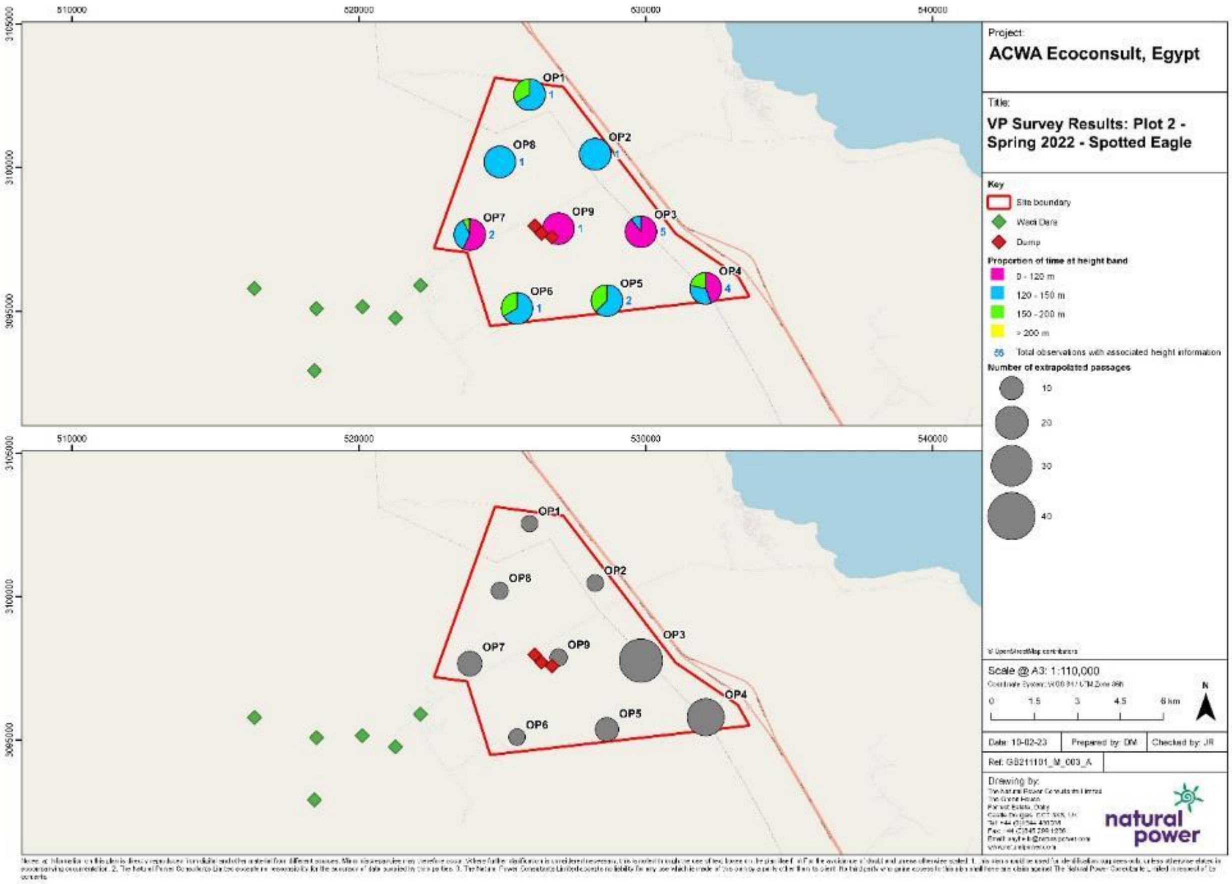


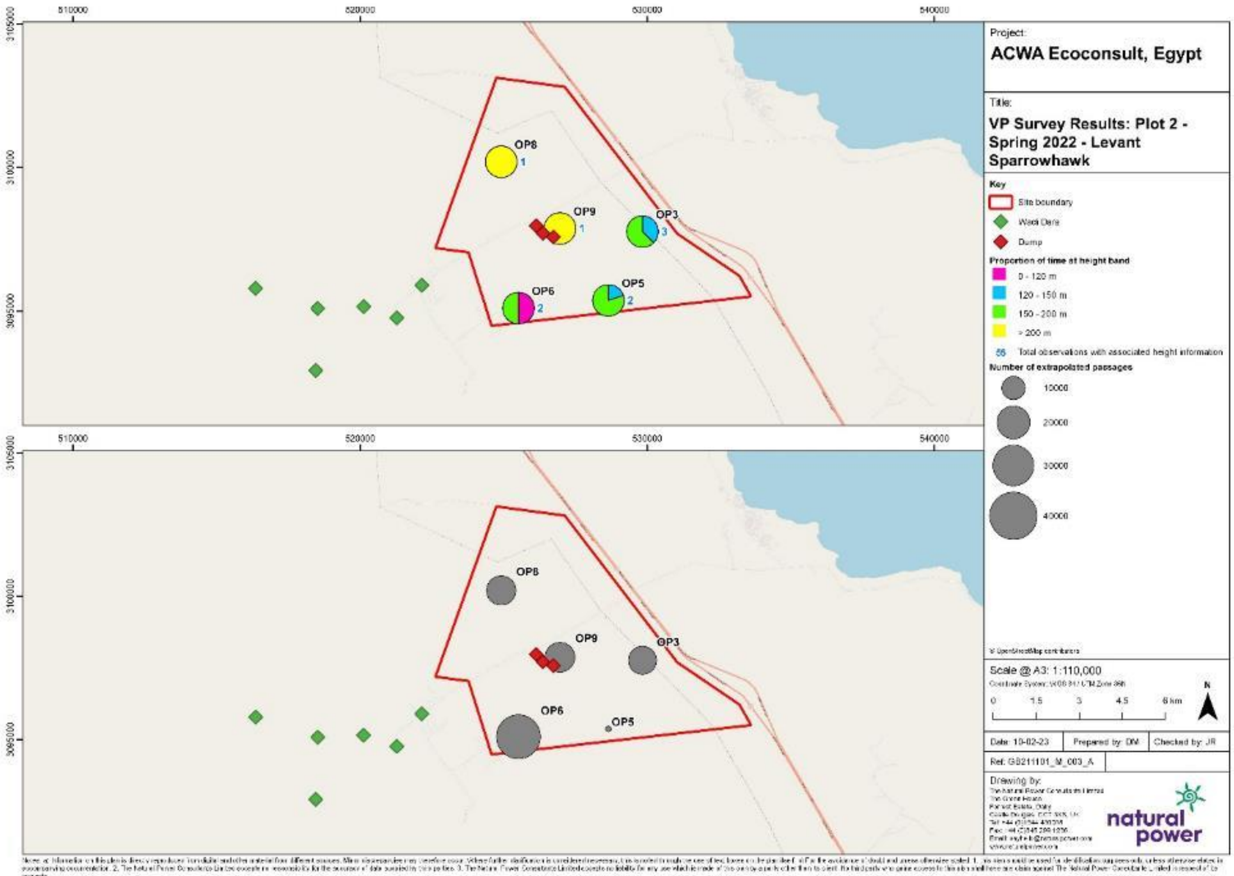
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - White Pelican
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
56 Total observations with associated height information
Number of extrapolated passages
10000
20000
30000
40000
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power
510000
520000
530000
540000
3105000
3100000
3095000
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9

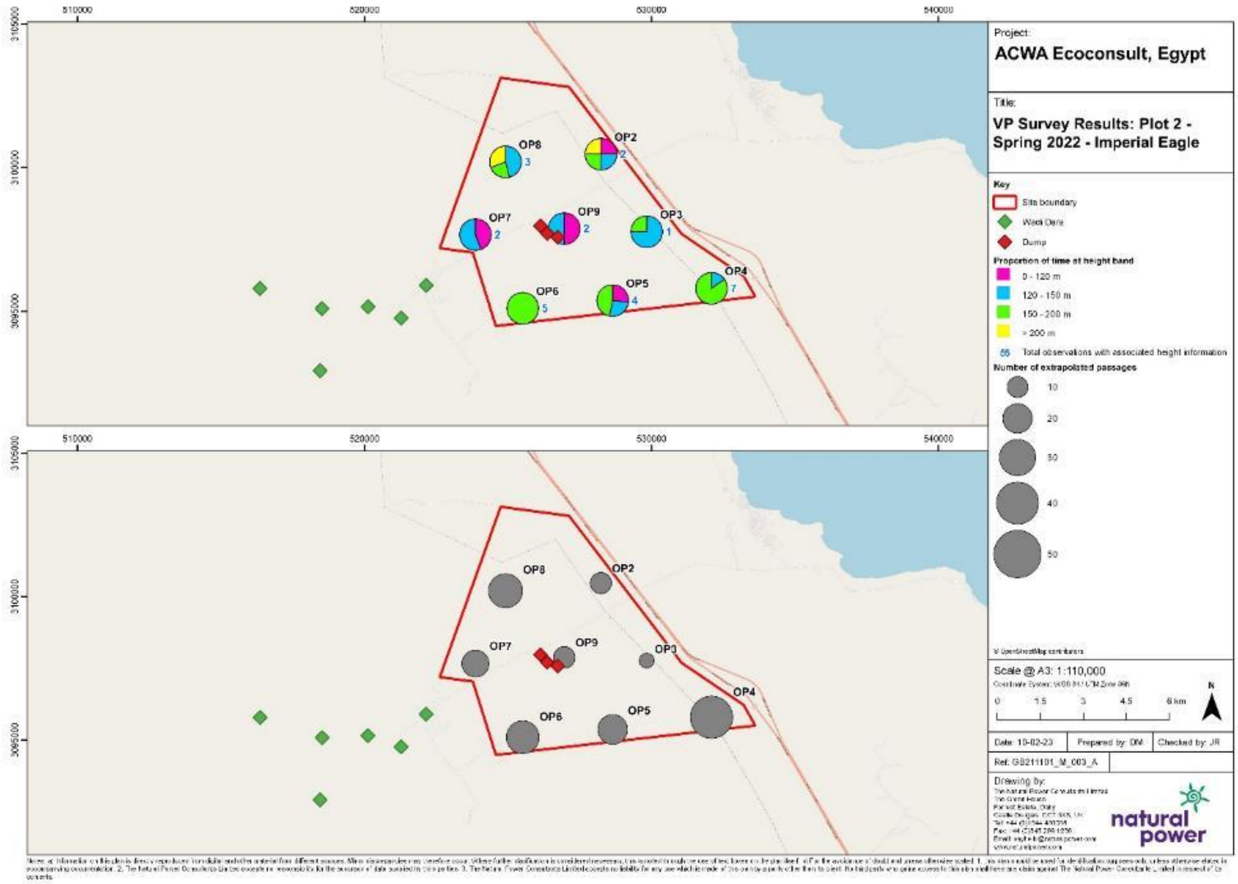

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Steppe Eagle
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
200
400
600
800
1000
Scale @ A3: 1:110,000
0 1.5 3 4.5 6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power
OP1
34
OP2
40
OP3
52
OP4
44
OP5
39
OP6
48
OP7
34
OP8
40
OP9
29
510000
520000
530000
540000
3105000
3100000
3095000

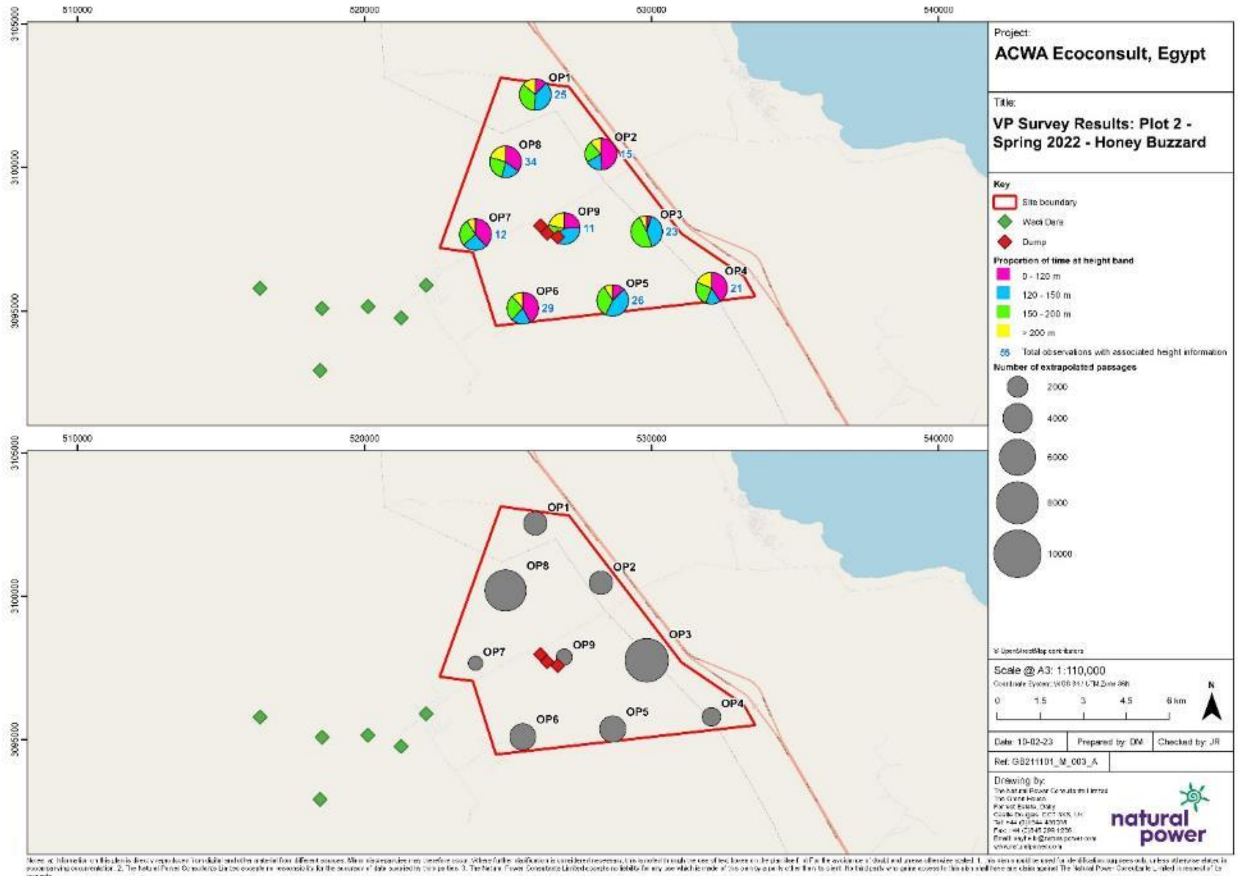


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Steppe Buzzard
Key
Site boundary
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
5000
10000
15000
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
65
95
69
98
86
72
59
76
56
510000
520000
530000
540000
3105000
3100000
3095000
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power

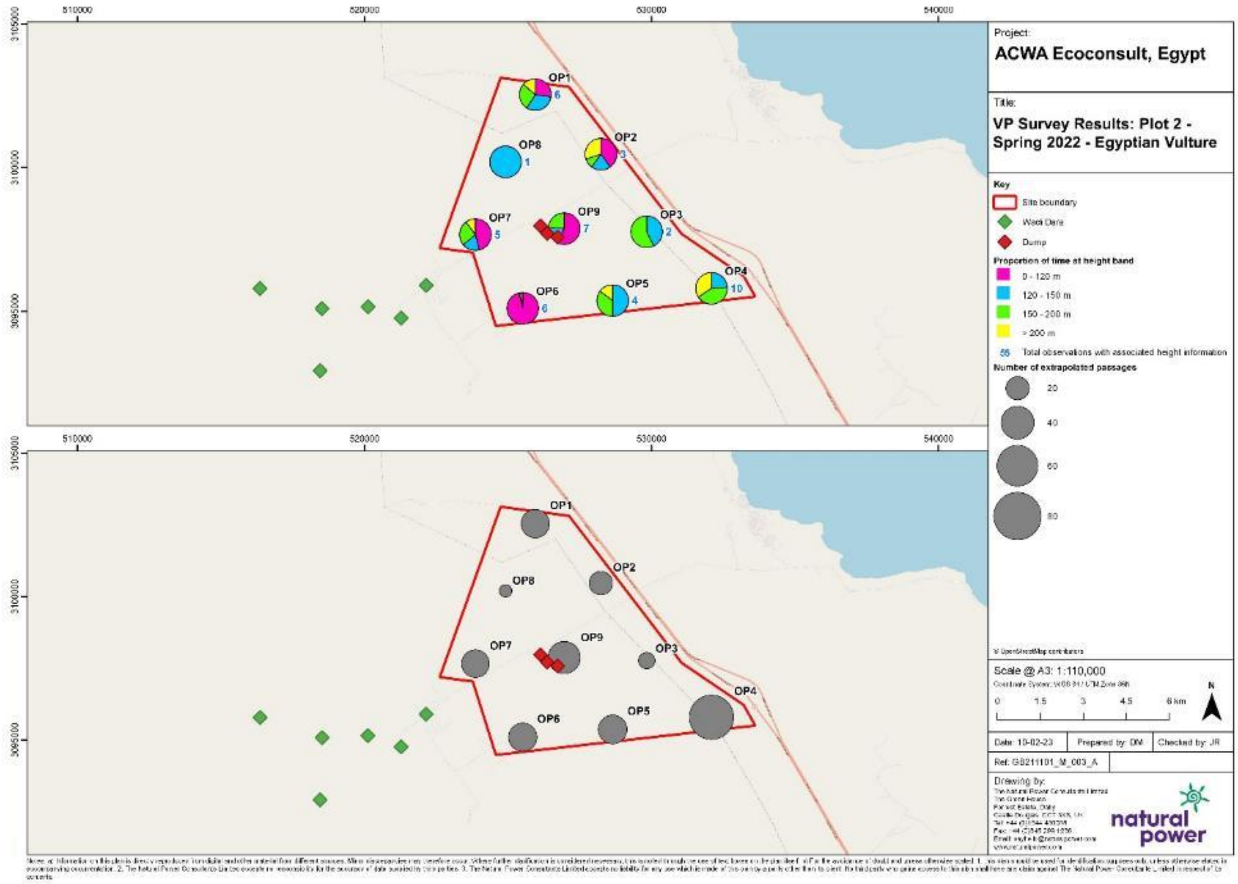

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Spotted Eagle
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
10
20
30
40
Scale @ A3: 1:110,000
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
510000
520000
530000
540000
3105000
3100000
3095000


510000
520000
530000
540000
3105000
3100000
3095000
OP8
1
OP9
1
OP3
3
OP6
2
OP5
2
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Levant Sparrowhawk
Key
Site boundary
Wadi Dare
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
10000
20000
30000
40000
© OpenStreetMap contributors
Scale @ A3: 1:110,000
0 1.5 3 4.5 6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power

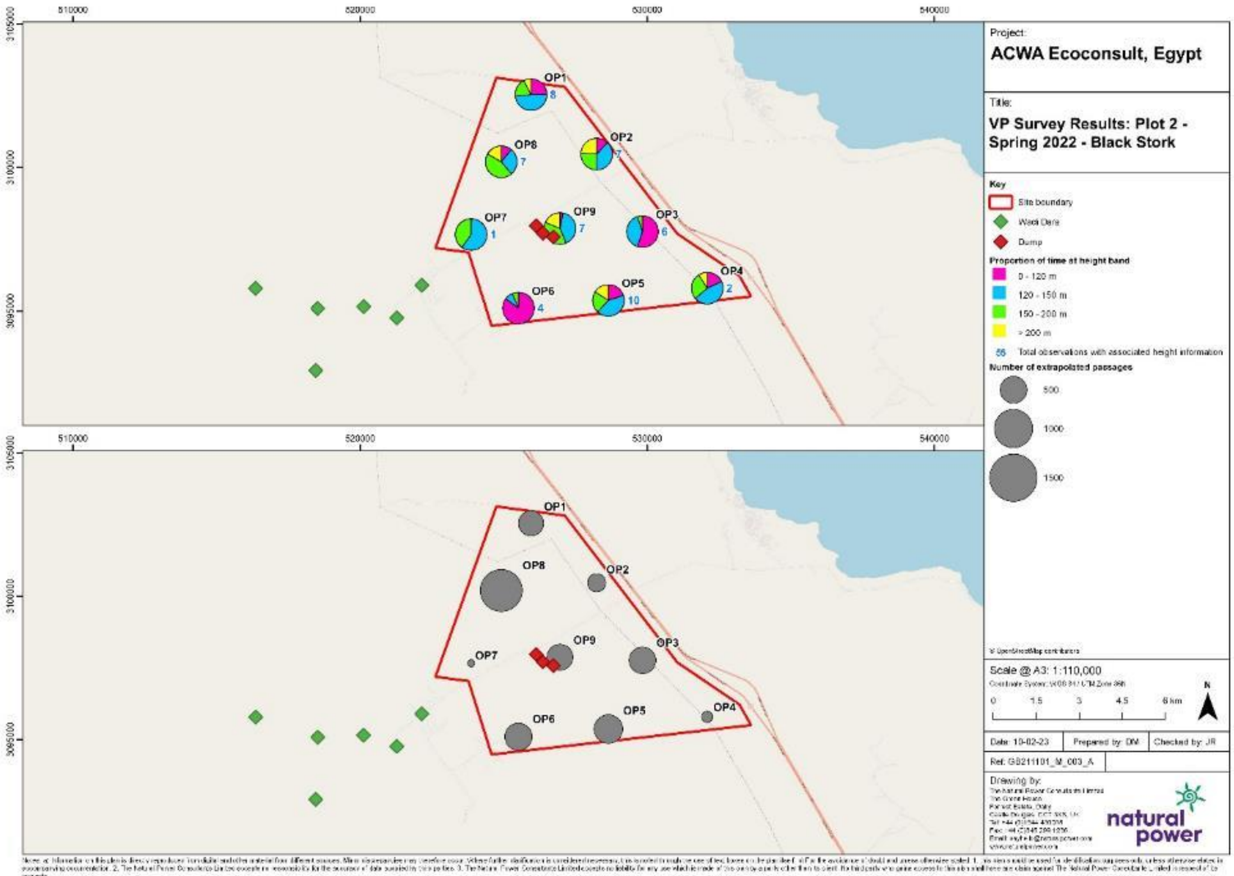

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Imperial Eagle
Key
Site boundary
Wadi Dens
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
10
20
30
40
50
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
Scale @ A3: 1:110,000
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power

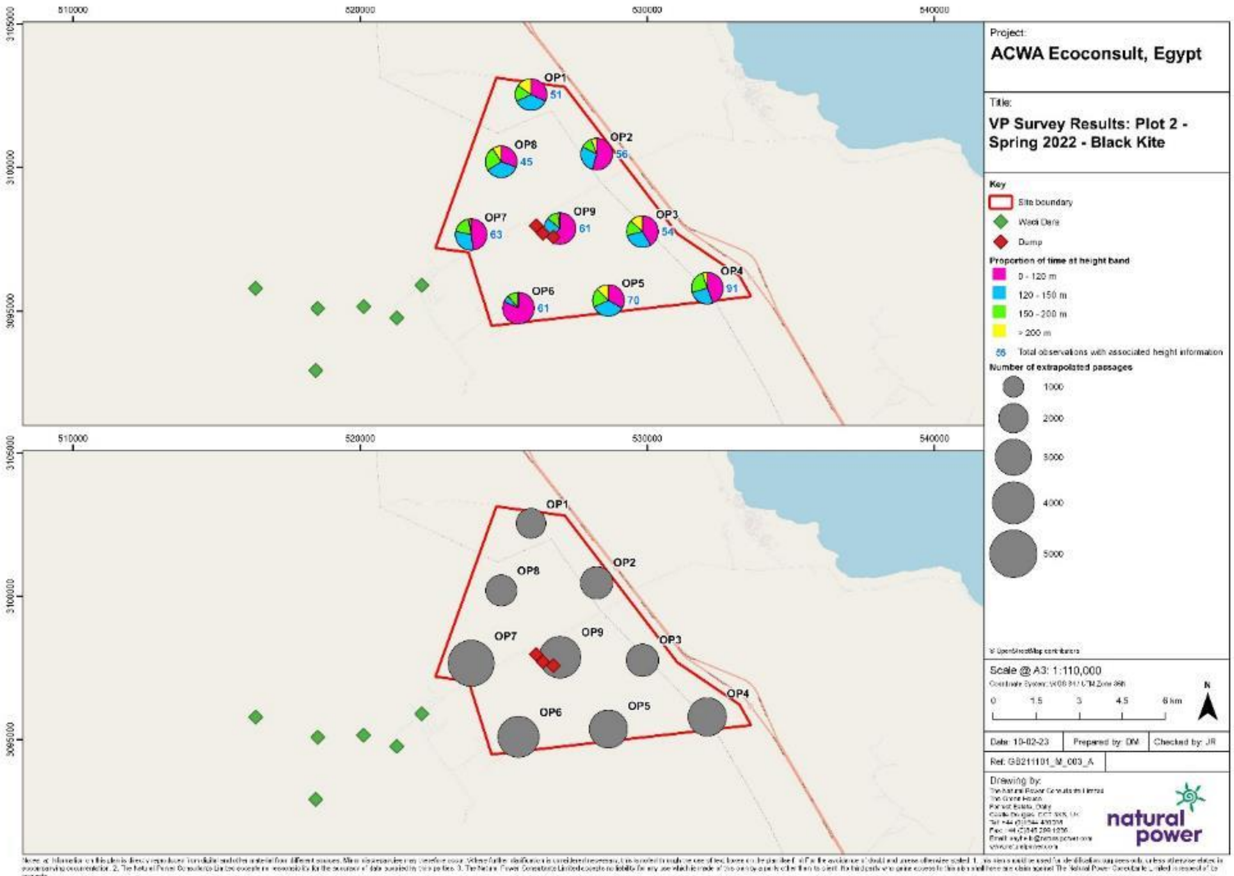


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Honey Buzzard
Key
Site boundary
Wadi Dens
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
2000
4000
6000
8000
10000
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
25
15
34
11
12
23
21
26
29
510000
520000
530000
540000
3105000
3100000
3095000
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power

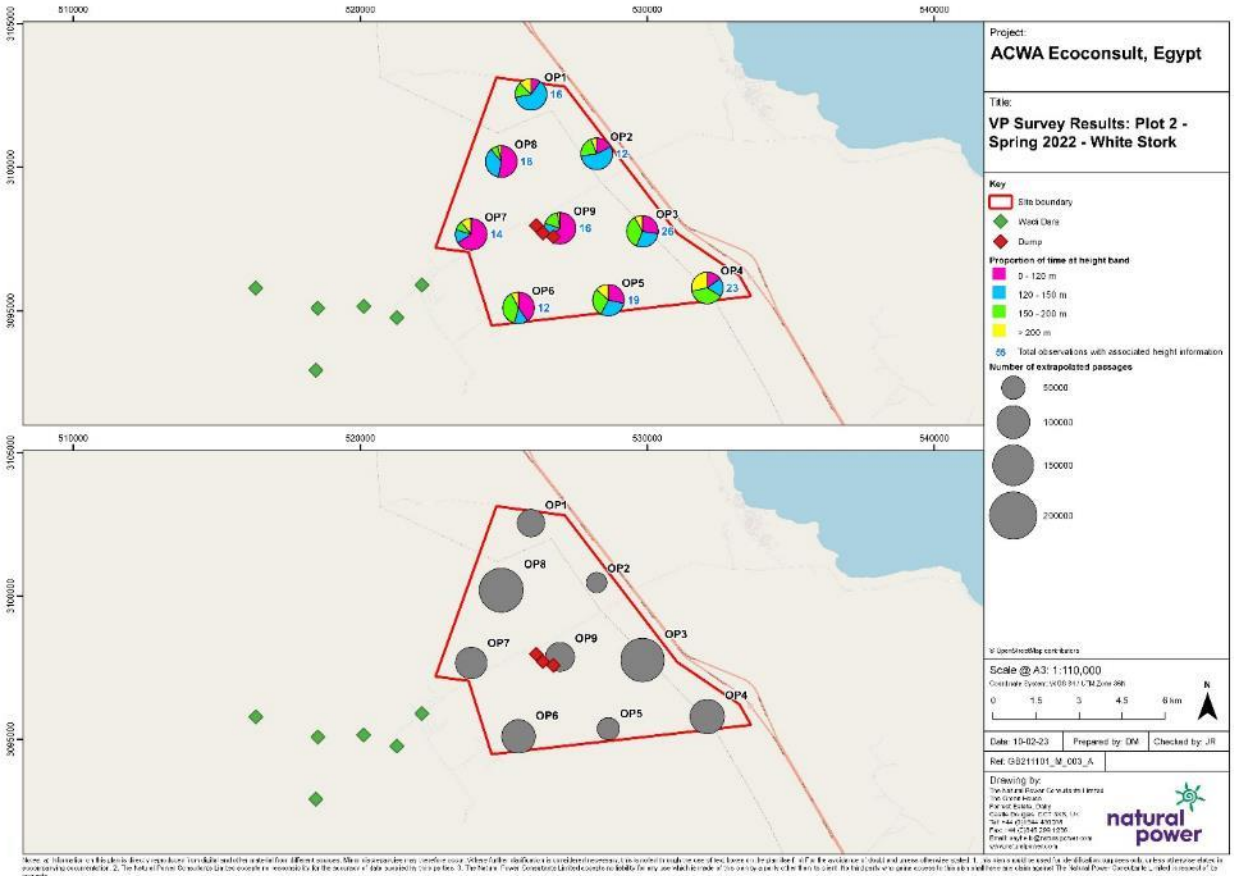


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Egyptian Vulture
Key
Site boundary
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
20
40
60
80
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
510000
520000
530000
540000
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Black Stork
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
500
1000
1500
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
510000
520000
530000
540000
3105000
3100000
3095000
Scale @ A3: 1:110,000
0 1.5 3 4.5 6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power

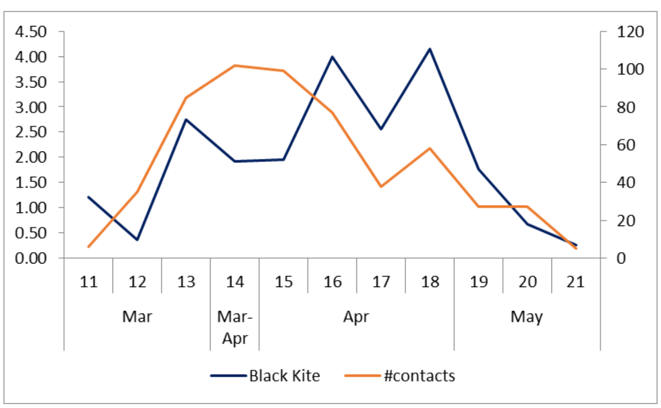


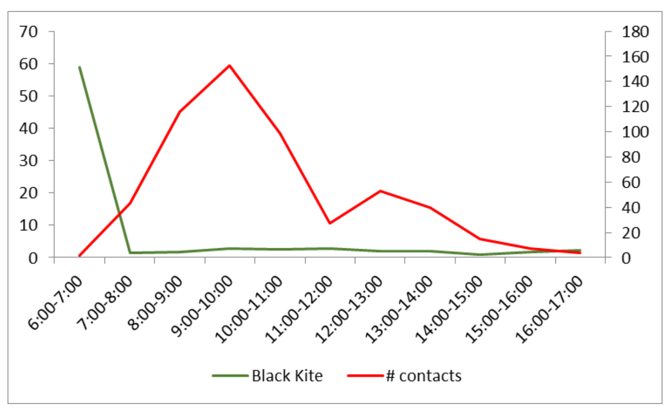
510000
520000
530000
540000
3105000
3100000
3095000
OP1
51
OP2
56
OP3
54
OP4
91
OP5
70
OP6
61
OP7
63
OP8
45
OP9
61
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Spring 2022 - Black Kite
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
56 Total observations with associated height information
Number of extrapolated passages
1000
2000
3000
4000
5000
Scale @ A3: 1:110,000
0 1.5 3 4.5 6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_003_A
Drawing by:
natural power



Black Kite

Black Kite appeared from March to May (a total of 10 weeks) with high numbers all the time. This pattern differs a little bit when compared to what is referenced by Shirihai et al. (2000) and to other studies in the region, where peaks were over a shorter period of time. However, the overall number of birds is low compared to other sites in the Red Sea area. The hourly interval is the same as the overall pattern observed before, with most of the birds crossing around 9:00-10:00 am.

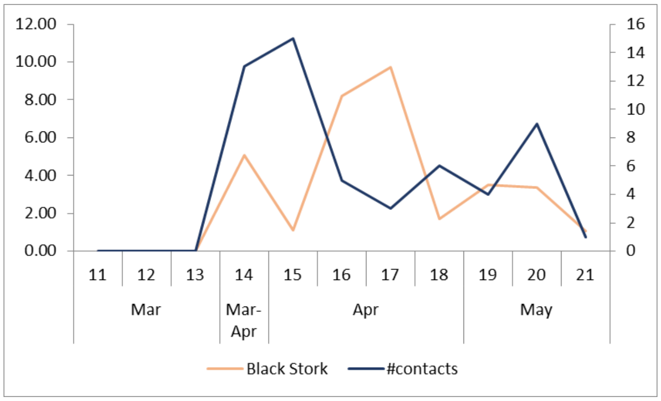


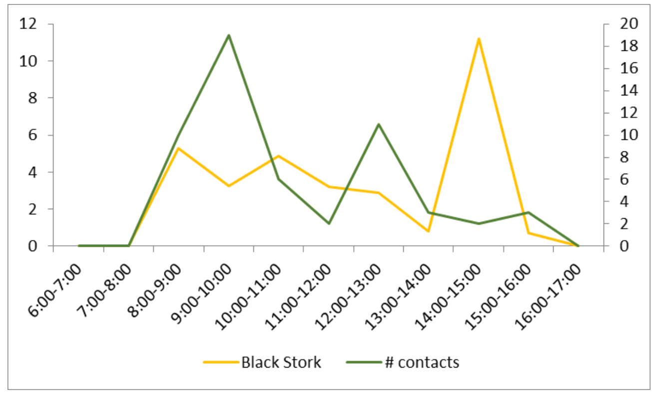


Black Kite passing rates and contacts during the spring 2022 at Plot 2 according to months and weeks (left) and daily hour interval (right).

Black Stork

Black Stork exhibits high inter-annual variable related to migration, during spring 2022 at Plot 2 it showed an extended passage time between late-March and mid-May with two peaks in March-April and the second in May. Black stork activity peaked in the morning (9:00-11:00), passing in numerous small groups during this period, while infrequent but large groups were sighted in the afternoon.

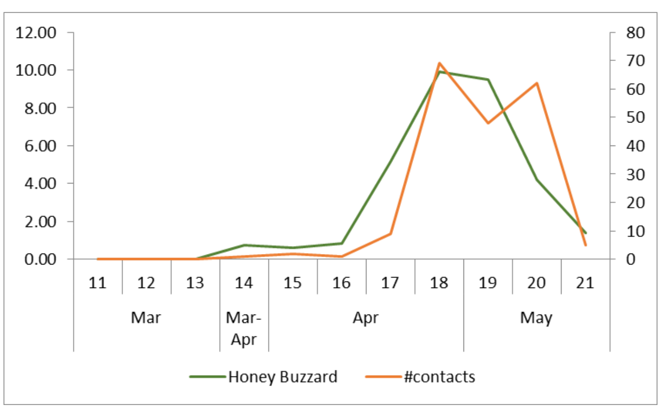


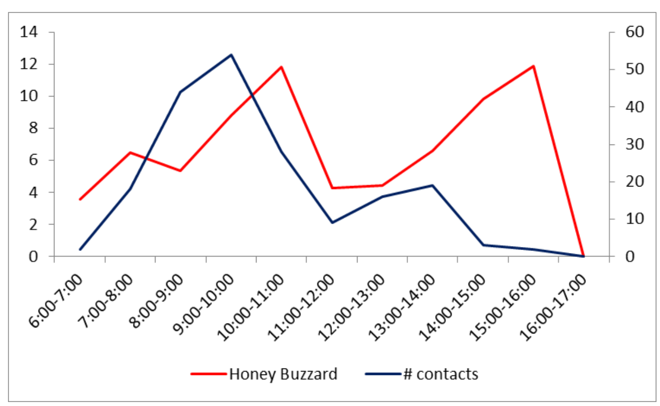


Black Stork passing rates and contacts during the spring 2022 at Plot 2 according to months and weeks (left) and daily hour interval (right).

European Honey Buzzard

The European honey buzzard peaks in May, despite an incipient migration in the last week of April. Shirihai et al. (2000) refers to the European Honey Buzzard with a migration period which extends from mid-March to mid-June and recorded the peak between late April and late May – which corresponds well with the data noted for the project site. Activity peaked 9:00-10:00 am, while afternoon activity was negligible.

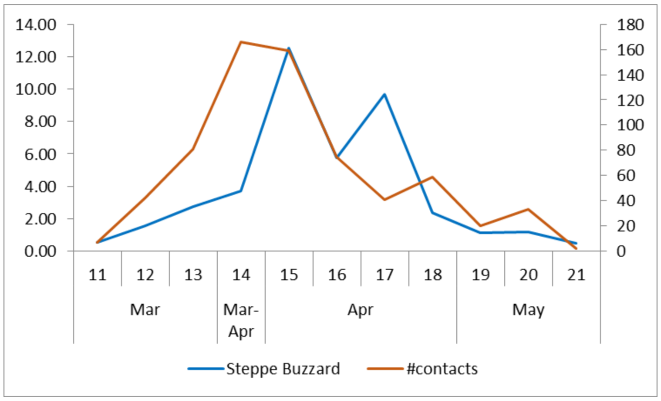


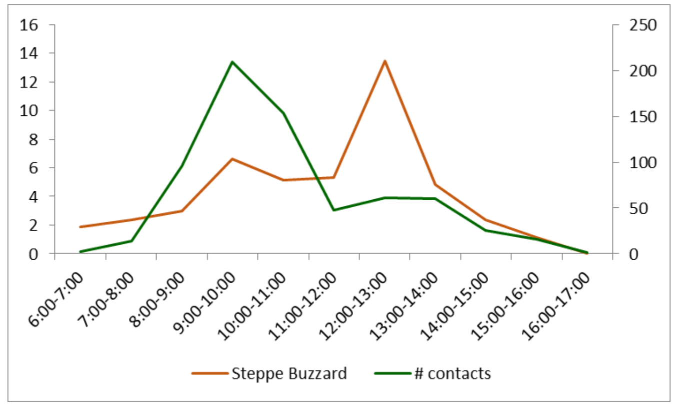


Honey Buzzard passing rates and contacts during the spring 2022 at Plot 2according to months and weeks (left) and daily hour interval (right)

Steppe Buzzard

The steppe buzzard had a migration peak in late March and early April, with lower numbers until the end of April – which matches quite well with the migration patterns noted by Shirihai et al. (2000). On a daily basis, the major peak of contacts but fewer birds occurred around 9:00 am but larger passing rates (larger groups) occured in the afternoon.

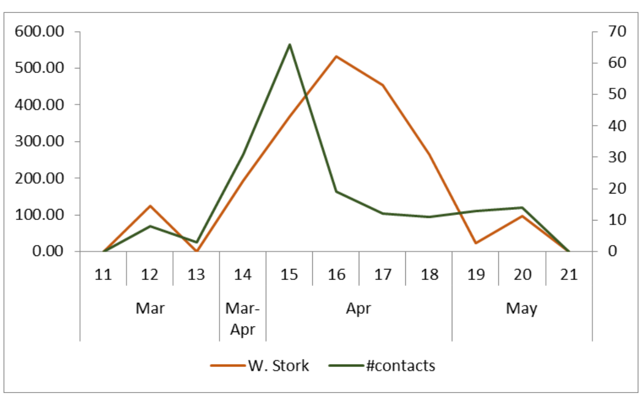


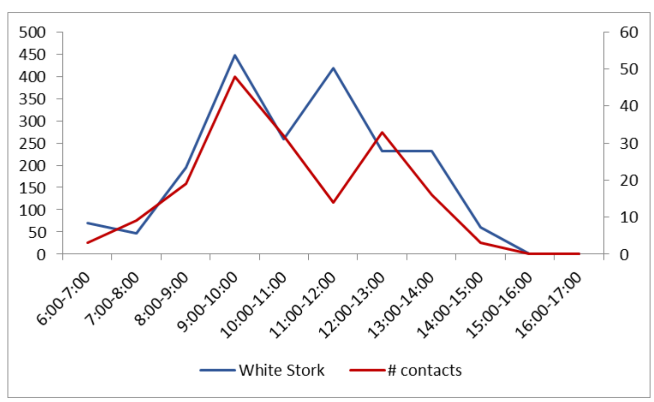


Steppe Buzzard passing rates and contacts during the spring 2022 at Plot 2 according to months and weeks (left) and daily hour interval (right)

White Stork

White stork was recorded from late March to early May, with peaks in the first half of April in 2022 – which corresponds with the migration pattern noted by Shirihai et al. (2000). The major peak occurred around 9:00 am but also a smaller one in the afternoon. The "valley" between 10:00-11:00 am also occurs with other species like the steppe buzzard and honey buzzards. These ups and downs could be related with a "wave" migration effect; birds migrate intermitently.





White Stork passing rates and contacts during the spring 2022 at Plot 2 according to months and weeks (left) and daily hour interval (right)

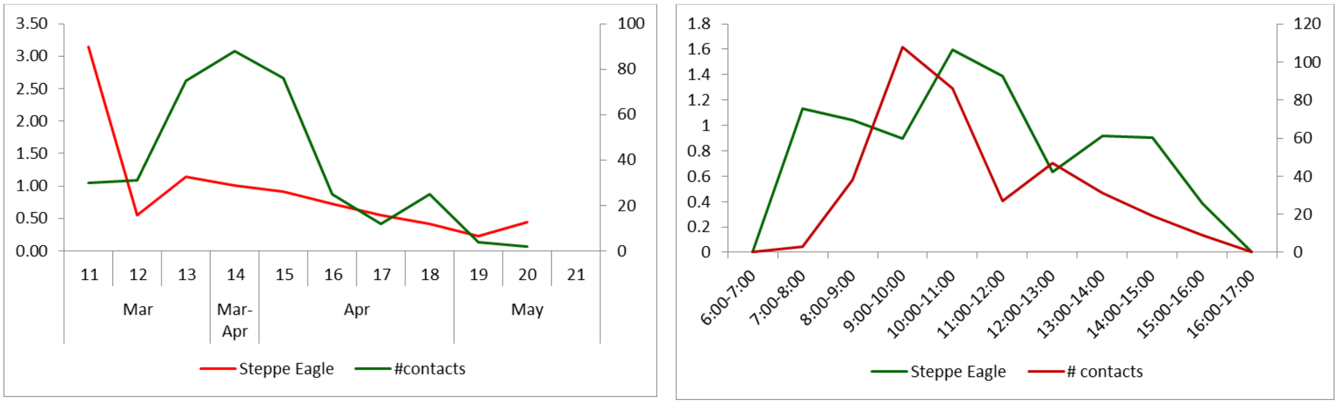
Short-toed and Booted eagles

For these two eagles the trend is almost the same, showing two peaks in early and late April, and the latter one not so marked for the Booted. The same occurs for both species on the daily passage. It synchronized suing both species the "window time" where the most favourable conditions for soaring flight happen. These results are not unexpected for two eagles which are true soaring birds. Overall, and compared to other species, they do not migrate in large numbers, being mostly individual observations.

Short-toed and Booted eagles: passing rates and contacts during the spring 2022 at Plot 2 according to months and weeks (left) and daily hour interval (right)

Steppe Eagle

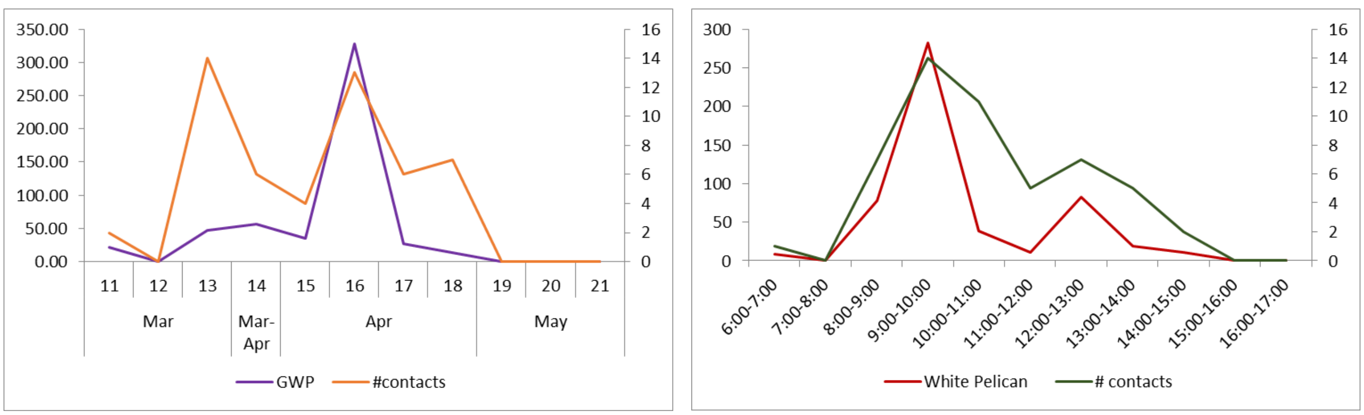
Steppe eagle migrated between mid-February and May (a total of 12 weeks), peaking between mid-March and April. In general, the pattern here is similar to Shirihai et al. (2000). The daily passage is also concentrated with most of the birds overhead at 10:00-11:00 am. It is important to know this as it is an endangered species which migrates almost "alone" (single birds passing continuously).



Steppe eagle passing rates and contacts during the spring 2022 at Plot 2 according to months and weeks (left) and daily hour interval (right)

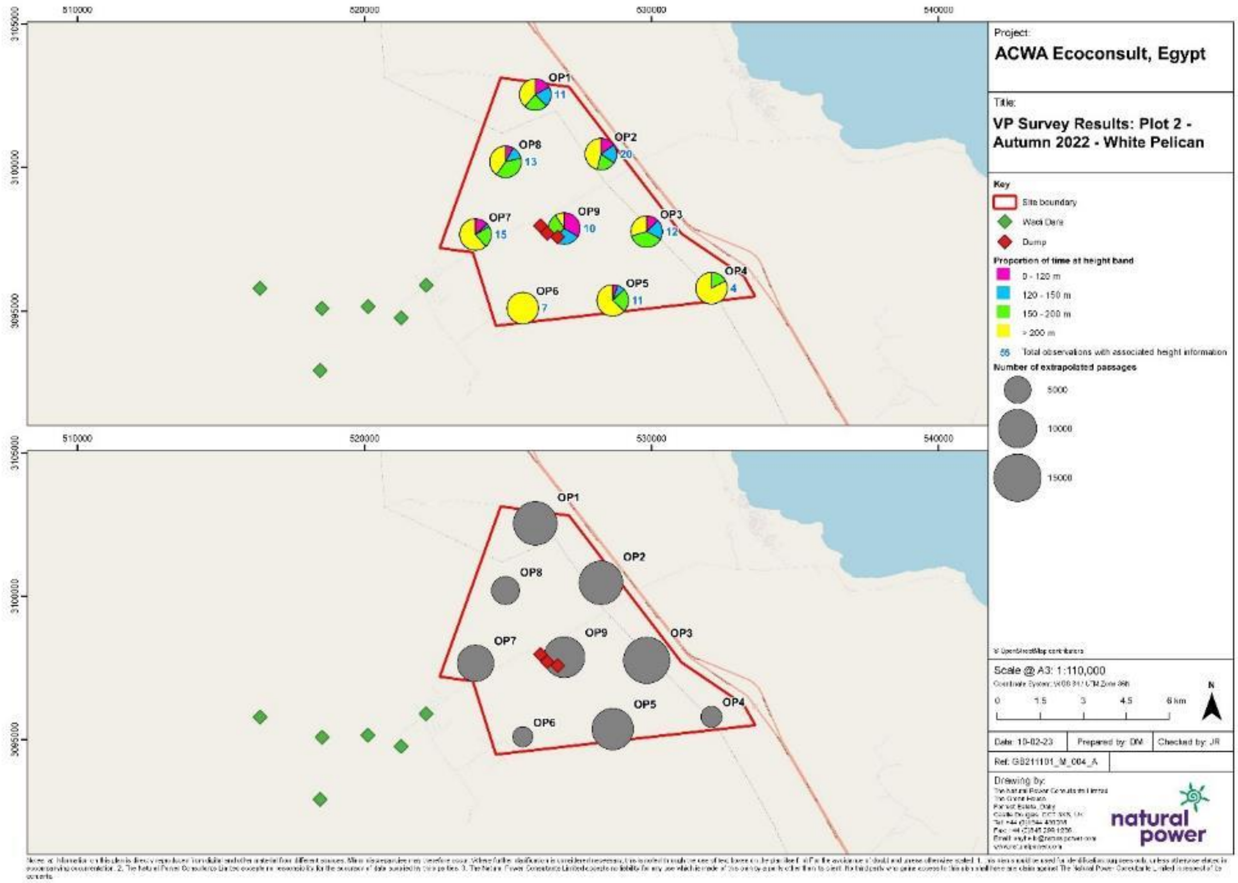
Great White Pelican

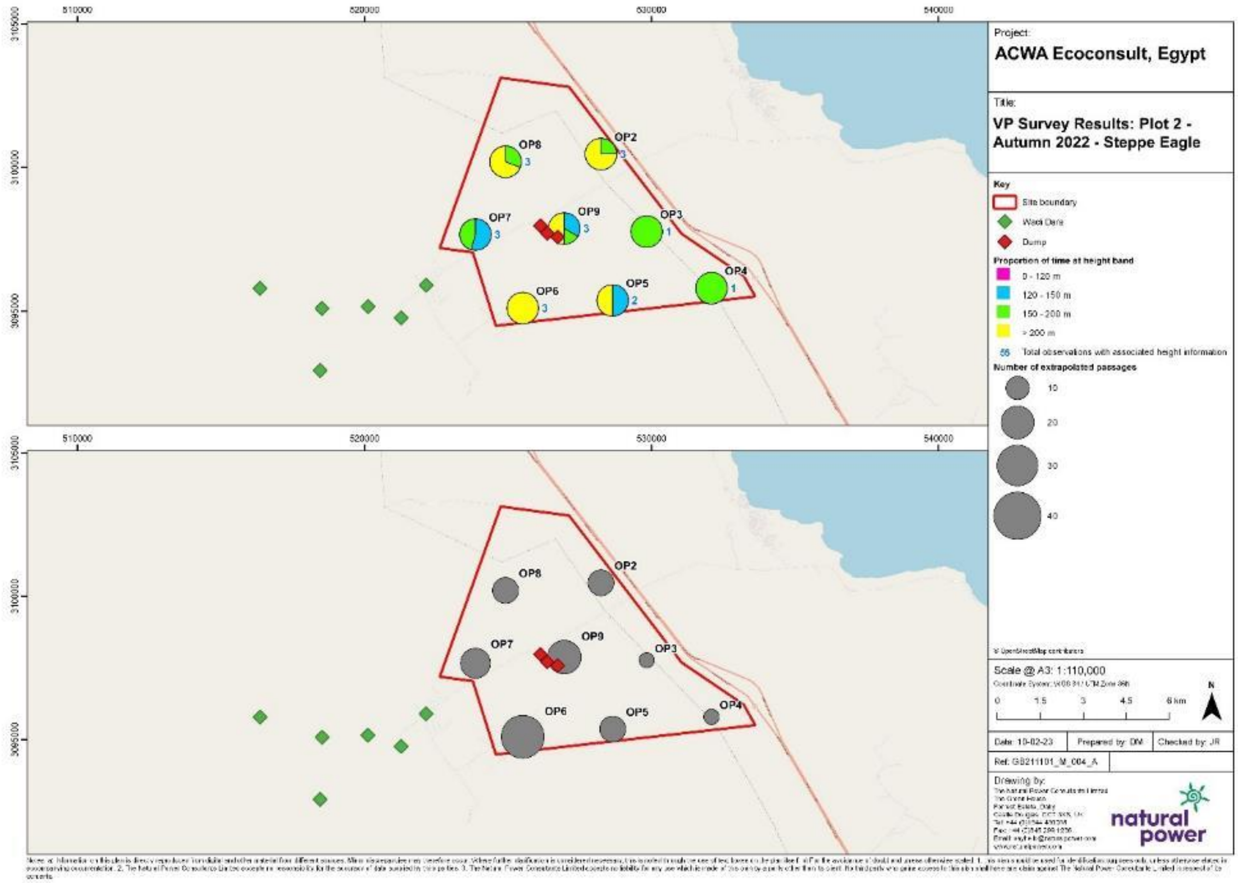
There are no studies for the region about the migration of this species. A great influx of birds was detected in half-April, with some large numbers but much lower (involving small numbers) in the end of March. The daily passage it was the same as for the all the above-mentioned species, with clear preference between 9:00-10:00 am.



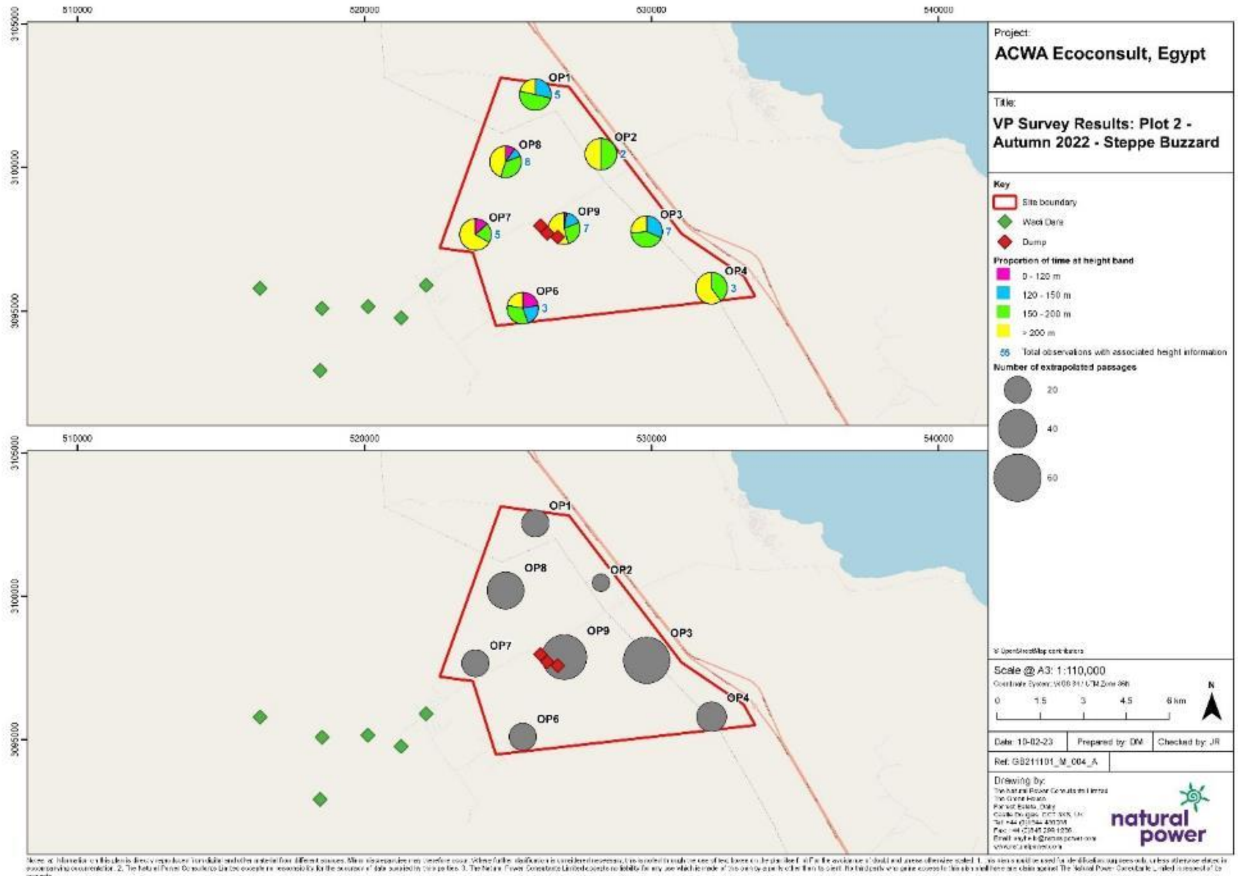
Great White Pelican passing rates and contacts during the spring 2022 at Plot 2 according to months and weeks (left) and daily hour interval (right)

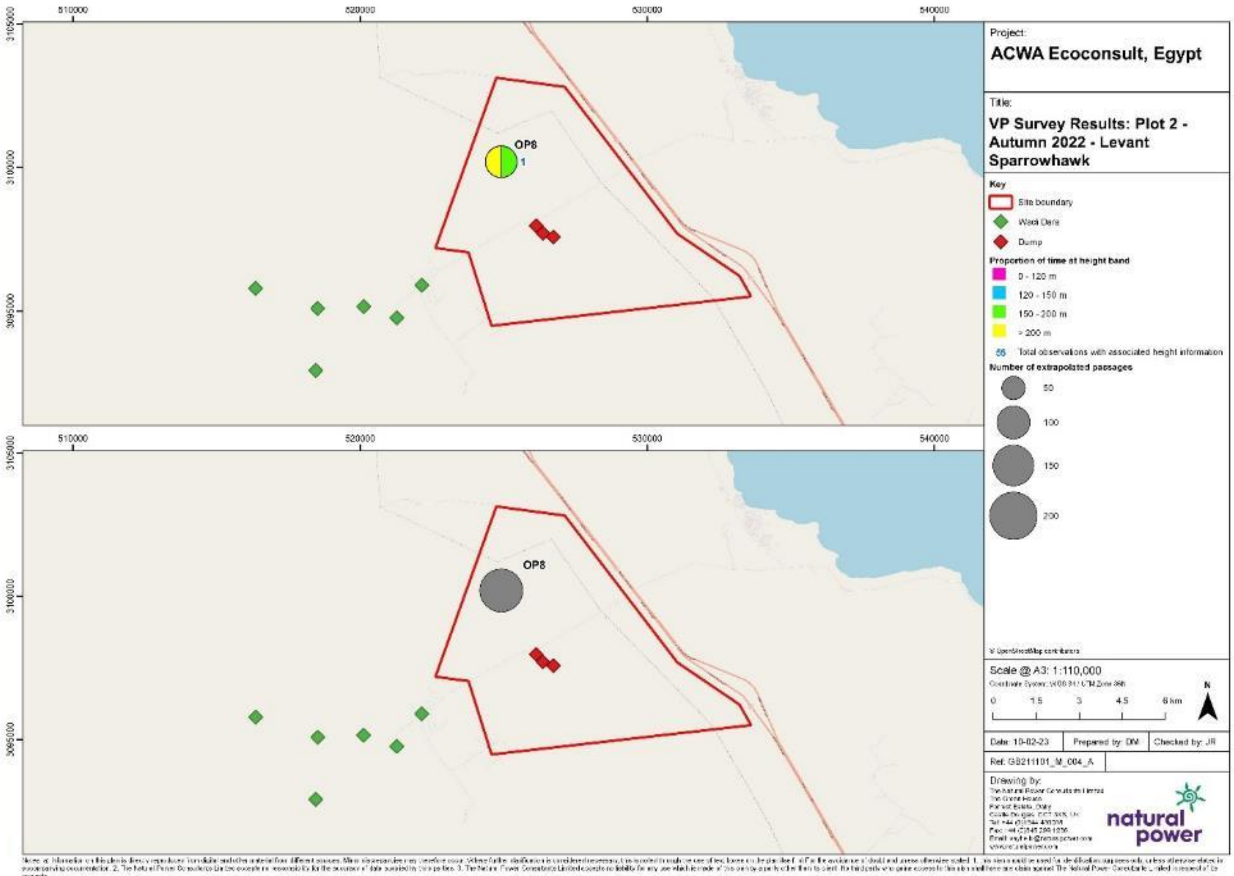
Appendix E: Plot 2 Autumn 2022 Species-specific data


510000
520000
530000
540000
3105000
3100000
3095000
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
11
20
12
4
11
7
15
13
10
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - White Pelican
Key
Site boundary
Wadi Dens
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
5000
10000
15000
Scale @ A3: 1:110,000
0 1.5 3 4.5 6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_004_A
Drawing by:
natural power

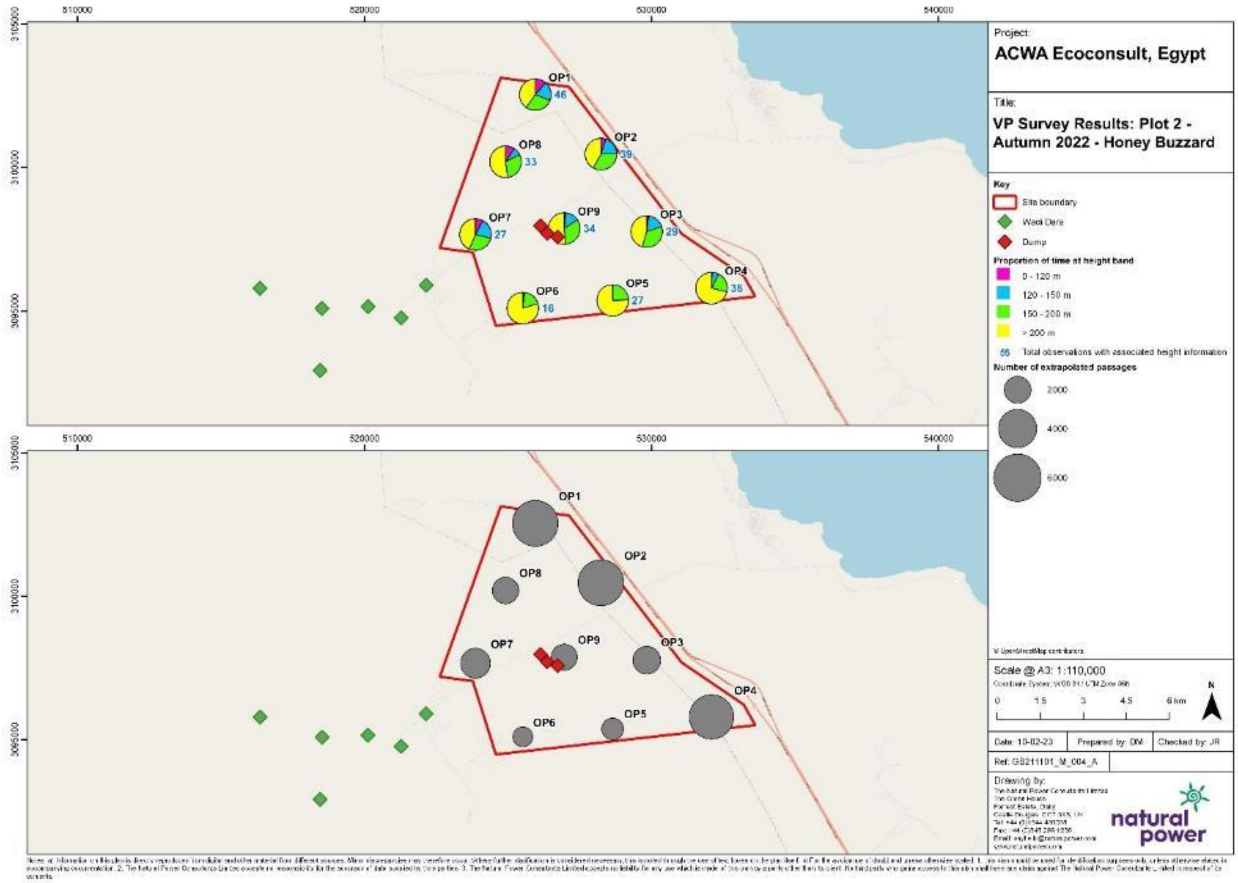


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - Steppe Eagle
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
10
20
30
40
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_004_A
Drawing by:
natural power
510000
520000
530000
540000
3105000
3100000
3095000
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9

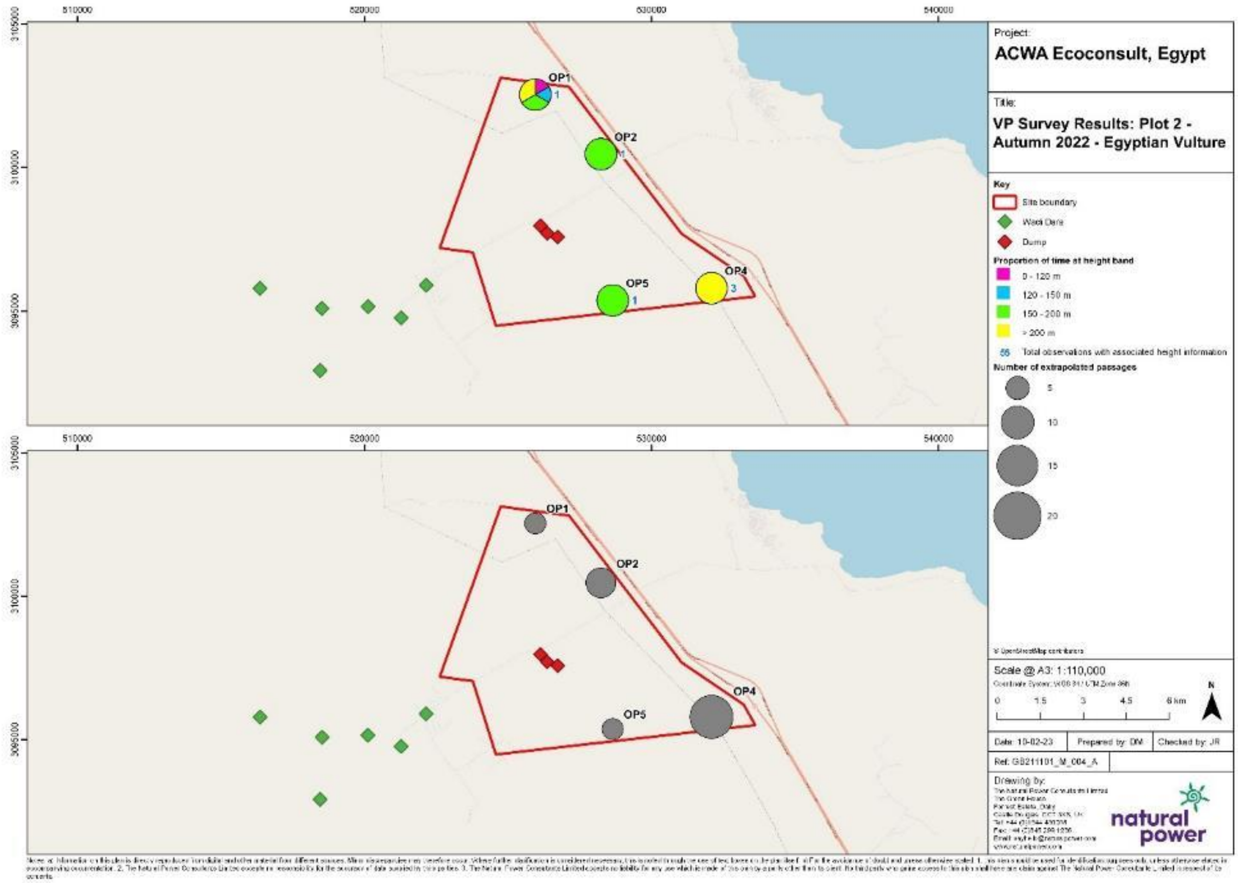

Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - Steppe Buzzard
Key
Site boundary
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
20
40
60
OP1
OP2
OP3
OP4
OP6
OP7
OP8
OP9
Scale @ A3: 1:110,000
Prepared by: DM
Checked by: JR
Drawing by:
natural power

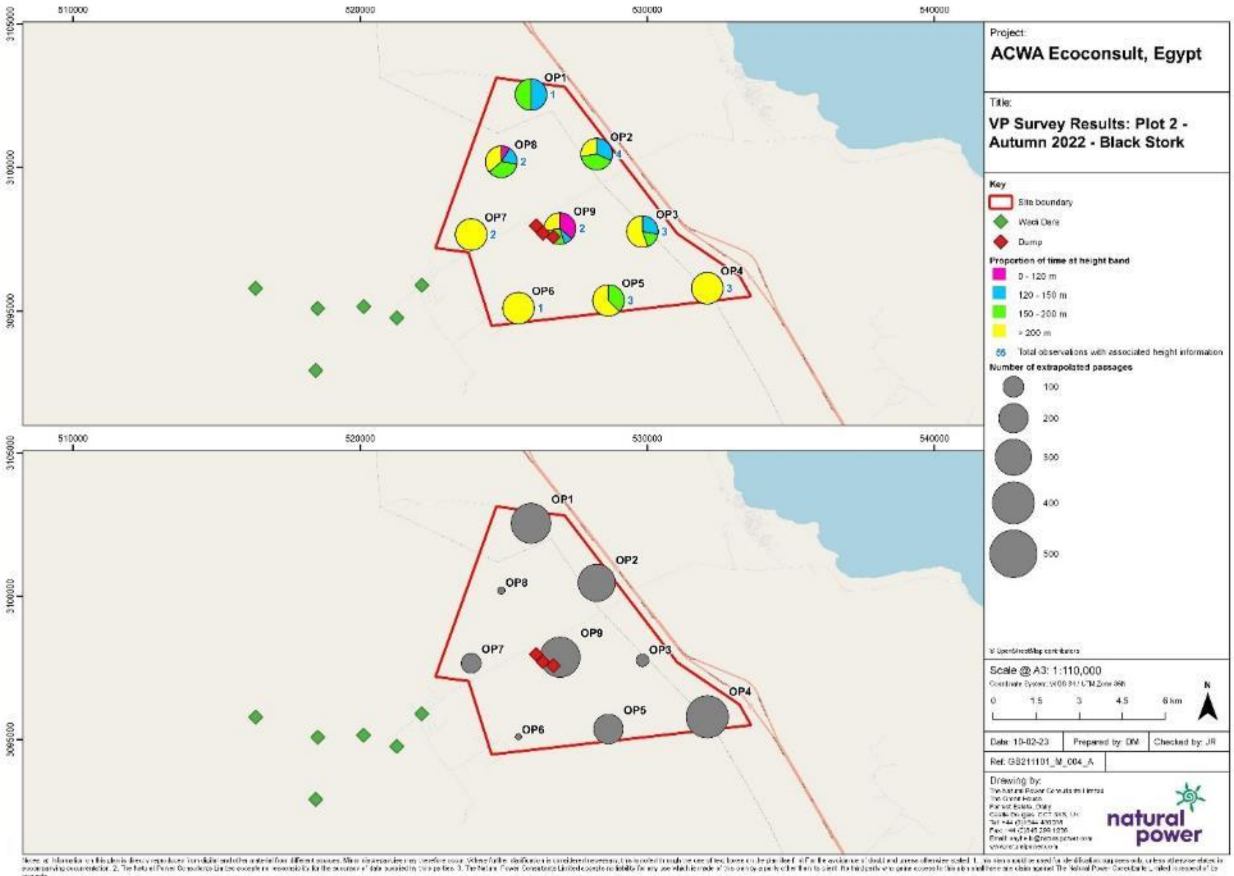


510000
520000
530000
540000
3105000
3100000
3095000
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - Levant Sparrowhawk
Key
Site boundary
Wadi Dens
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
50
100
150
200
OP8
1
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_004_A
Drawing by:
natural power

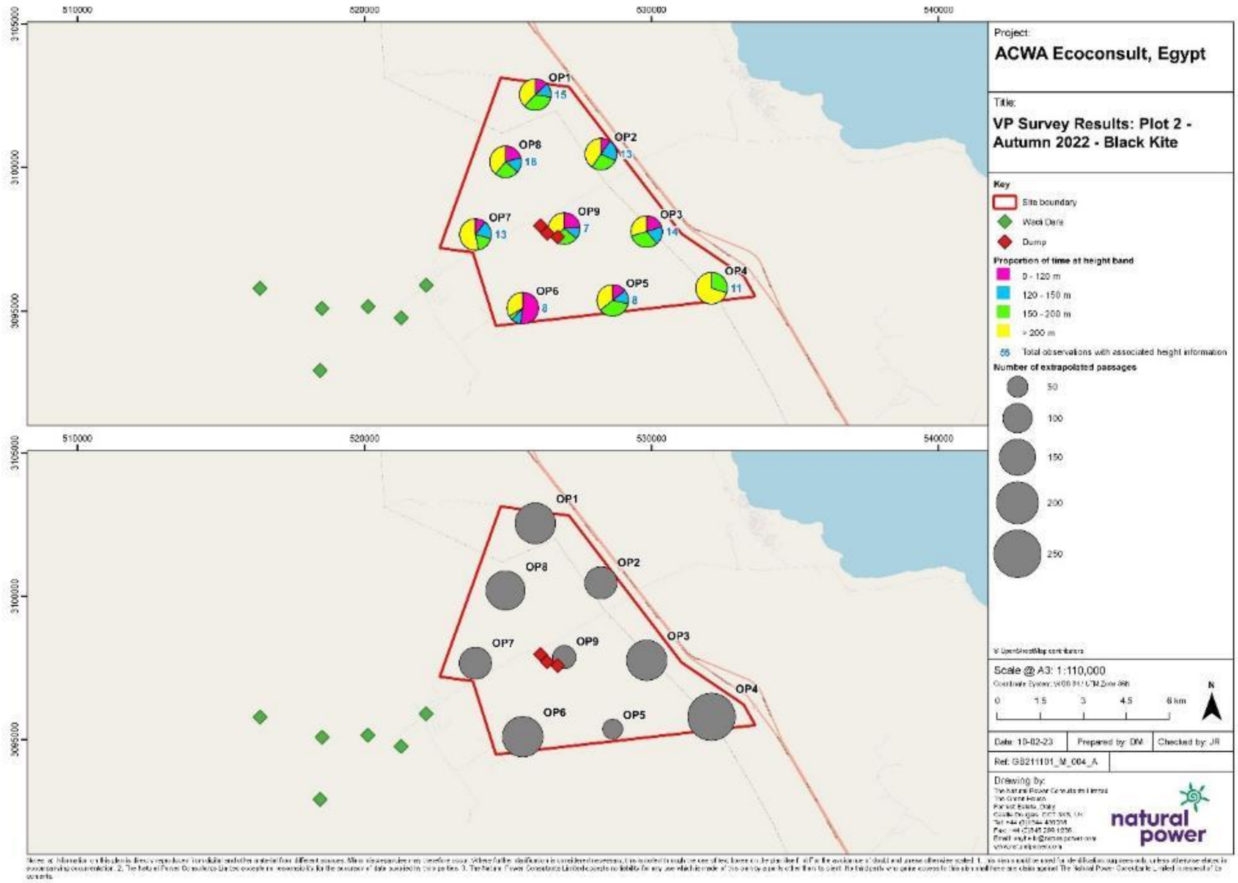


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - Honey Buzzard
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
2000
4000
6000
Scale @ A3: 1:110,000
0 1.5 3 4.5 6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_004_A
Drawing by:
natural power
OP1 46
OP2 39
OP3 29
OP4 38
OP5 27
OP6 16
OP7 27
OP8 33
OP9 34
510000
520000
530000
540000
3105000
3100000
3095000


Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - Egyptian Vulture
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
Total observations with associated height information
Number of extrapolated passages
5
10
15
20
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_004_A
Drawing by:
natural power
OP1
OP2
OP4
OP5
510000
520000
530000
540000
3105000
3100000
3095000



Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - Black Stork
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
55 Total observations with associated height information
Number of extrapolated passages
100
200
300
400
500
Scale @ A3: 1:110,000
0 1.5 3 4.5 6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_004_A
Drawing by:
natural power
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
510000
520000
530000
540000
3105000
3100000
3095000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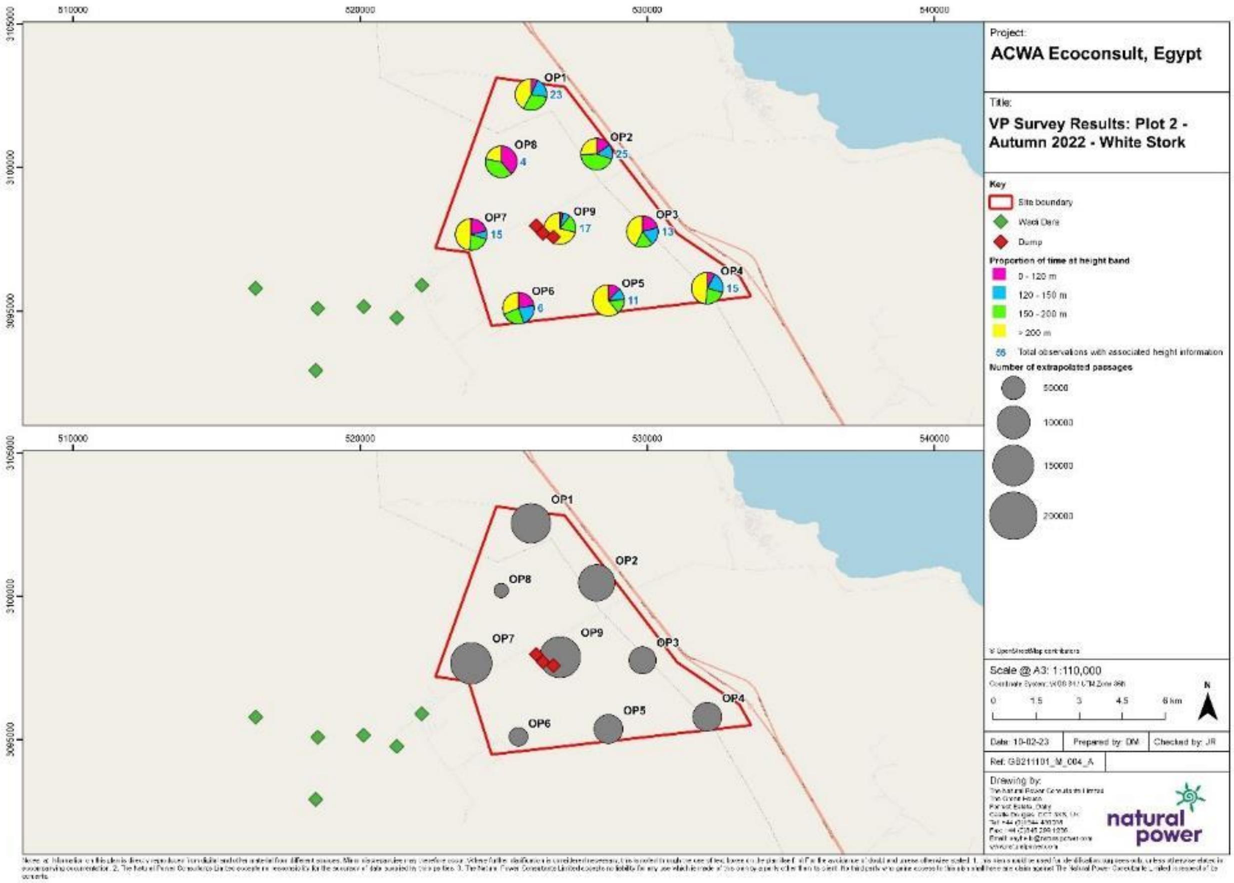
OP1
OP2
OP3
OP4
OP5
OP6
OP7
OP8
OP9
15
13
14
11
8
8
13
18
7
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - Black Kite
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
56 Total observations with associated height information
Number of extrapolated passages
50
100
150
200
250
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_004_A
Drawing by:
natural power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520000
530000
540000
3105000
3100000
3095000
OP1
23
OP2
25
OP8
4
OP7
15
OP9
17
OP3
13
OP4
15
OP5
11
OP6
6
Project:
ACWA Ecoconsult, Egypt
Title:
VP Survey Results: Plot 2 - Autumn 2022 - White Stork
Key
Site boundary
Wadi Dara
Dump
Proportion of time at height band
0 - 120 m
120 - 150 m
150 - 200 m
> 200 m
56 Total observations with associated height information
Number of extrapolated passages
50000
100000
150000
200000
Scale @ A3: 1:110,000
0
1.5
3
4.5
6 km
N
Date: 10-02-23
Prepared by: DM
Checked by: JR
Ref: GB211101_M_004_A
Drawing by:
natural power