

RESEARCH ARTICLE

**RECORDING OF THE SPRING MIGRATION OF SOARING BIRDS
THROUGH GEBEL EL ZEIT, EASTERN DESERT, EGYPT**

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ABSTRACT

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Egypt is an important pass for the soaring birds' migration, as it is situated on the mainland connection between the Eurasian and African landmasses that connects breeding grounds in Eurasia with wintering zones in Africa. In the current study, the spring migration of soaring birds was studied along a narrow corridor "bottleneck site" located within the Red Sea/Rift Valley bird migration flyway, Gulf of Suez, Egypt. Over a period of four weeks from April 19th to 17th of May 2019, 89949 soaring birds of 27 species were counted during an eight-hour daily observation window. In total, 47511 raptors of 24 species were recorded. The most common were the group of Levant sparrowhawk "*Accipter brevipes*", European honey buzzard "*Pernis apivorus*", and Northern steppe buzzard "*Buteo buteo vulpinus*" forming 33.16%, 32.08%, and 24.91% of all raptors, respectively; while combined black kite "*Milvus migrans*", lesser spotted eagle "*Aquila pomarine*", steppe eagle "*Aquila nipalensis*", short-toed eagle "*Circaetus gallicus*", booted eagle "*Aquila pennata*", and Egyptian vulture "*Neophron percnopterus*" recorded more than 6% of the raptor assemblage. In addition, 15 greater spotted eagle "*Aquila clanga*", 6 pallid harrier "*Circus macrourus*", and 5 Eurasian griffon vulture "*Gyps fulvus*" were recorded during the observations. Other soaring birds were recorded during the study-time, the most common were: 36700 white stork "*Ciconia Ciconia*", 4230 great white pelican "*Pelecanus onocrotalus*", and 1500 black stork "*Ciconia nigra*".

INTRODUCTION

Egypt covers an enormous zone of the Great Rift Valley, as a few nations in this flyway, and characterized with diversity in geology and temperatures. Furthermore, the nation contacts a few distinct civic establishments, religions, and societies^[1,2]. Egypt benefits enormously from this biodiversity, it is an important pass for the soaring birds'

migration, as it is situated on the mainland connection between the Eurasian and African landmasses that connects breeding grounds in Eurasia with wintering zones in Africa^[3]. The Gulf of Suez territory lies at the core of the Rift Valley/Red Sea flyway; at its tightest areas that incorporate a few bottlenecks contain Gebel El Zeit, Suez, Ain Sukhna, and Qaa' plain, which are

universally perceived as important areas for birds and biodiversity^[4]. Hundreds of thousands of migrating raptors, storks, and pelicans pass each autumn and spring from their breeding areas in Eurasia to sub-Saharan Africa, where they spend the winter, returning in the next spring^[5]. These vagrants face extremely cruel conditions, as they cross enormous regions of ominous living spaces; for example, deserts and untamed oceans, with little chances of taking care or drinking. The greater part of the species, especially littler ones, perform immediate and active flights, choosing the most direct ways between breeding and wintering ranges^[6].

Soaring birds are almost entirely dependent on the updraft of air to sustain their migration trip, which reduces their choice of migration routes. The lack of updrafts over large areas of water prevents them from flight over water except at the narrowest of straits. Among these straits are Bab El-Mandeb, the Straits of Gibraltar, and the Bosphorus^[7]. Many of the soaring birds migrating to/from East Africa avoid crossing the Gulf of Suez and convolute *via* Suez instead, but others migrating to Sinai in spring converge at Zait Bay because it is the narrowest crossing point in the southern part of the Gulf of Suez. Globally threatened species such as Eastern imperial eagle "*Aquila heliaca*" (Vulnerable), greater spotted eagle "*Aquila clanga*" (Vulnerable), Egyptian vulture "*Neophron percnopterus*" (Endangered), and the near threatened pallid harrier "*Circus macrourus*" are known to migrate through this area. The most numerous species reported to be over the eastern desert of Egypt were white stork "*Ciconia ciconia*" and Levant sparrowhawk "*Accipiter brevipes*"^[4]. The entire world populations of Levant sparrowhawks "*Accipiter brevipes*" migrate through this area, usually in large flocks^[5]. The main route of white stork "*Ciconia ciconia*" migrating along the eastern flyway passes through the site of Zait Bay^[8].

The main migration corridors through Egypt are still not precisely identified

because there have been no synchronous migration studies across the whole width of the flyway, the total number of soaring birds that fly through Egypt is still to be determined accurately, a few publications were published on the pattern of a flight of migrating birds, and even fewer about soaring birds over Egypt. In the present study, we gathered data on the species, number, altitude, and direction of soaring birds during spring migration in the Great Rift Valley flyway between the African and Eurasian over Egypt.

MATERIAL AND METHODS

Study area

The study area is situated on the western bank of the Gulf of Suez, the west of the port and town of Ras Shukeir and Ras Ghareb, the closest fundamental urban communities are Ras Ghareb (*circa* 20-30 km toward the north and north east), and Hurghada (*circa* 120 km to south-southeast) (Figure 1). The landscape is for the most part level, undulating on the eastern side (where least elevation above sea level is *circa* 100 m), yet progressively rough towards the west and northwest, where elevation arrives at 300 m. A few elevations uneven edges (300-400 m) separate the investigation zone from the Red Sea mountain chain, where the most conspicuous mountain in the locale, Gharib mountain, remains at a height of 1453 m around 20 km west of the study site. The study area is in an area surrounding three wind stations, two of which are operating and the other under construction, three fixed observation points (VP) were selected: (a) VP1 (28.086739N, 33.248717E) is 5.5 Km from the Gulf Coast, one-kilometer northeast of the nearest windfarm, altitude 237 m; (b) VP2 (28.103094N, 33.162408E) is 13 Km from the Gulf Coast, located in the southwestern part of a windfarm, altitude 750 m; (c) VP3 (28.178072N, 33.032889E) is 17.5 Km from the Gulf Coast, 7.5 km northwest of the nearest windfarm, 13 km east of Gharib mountain, altitude 204 m (Figure 1).

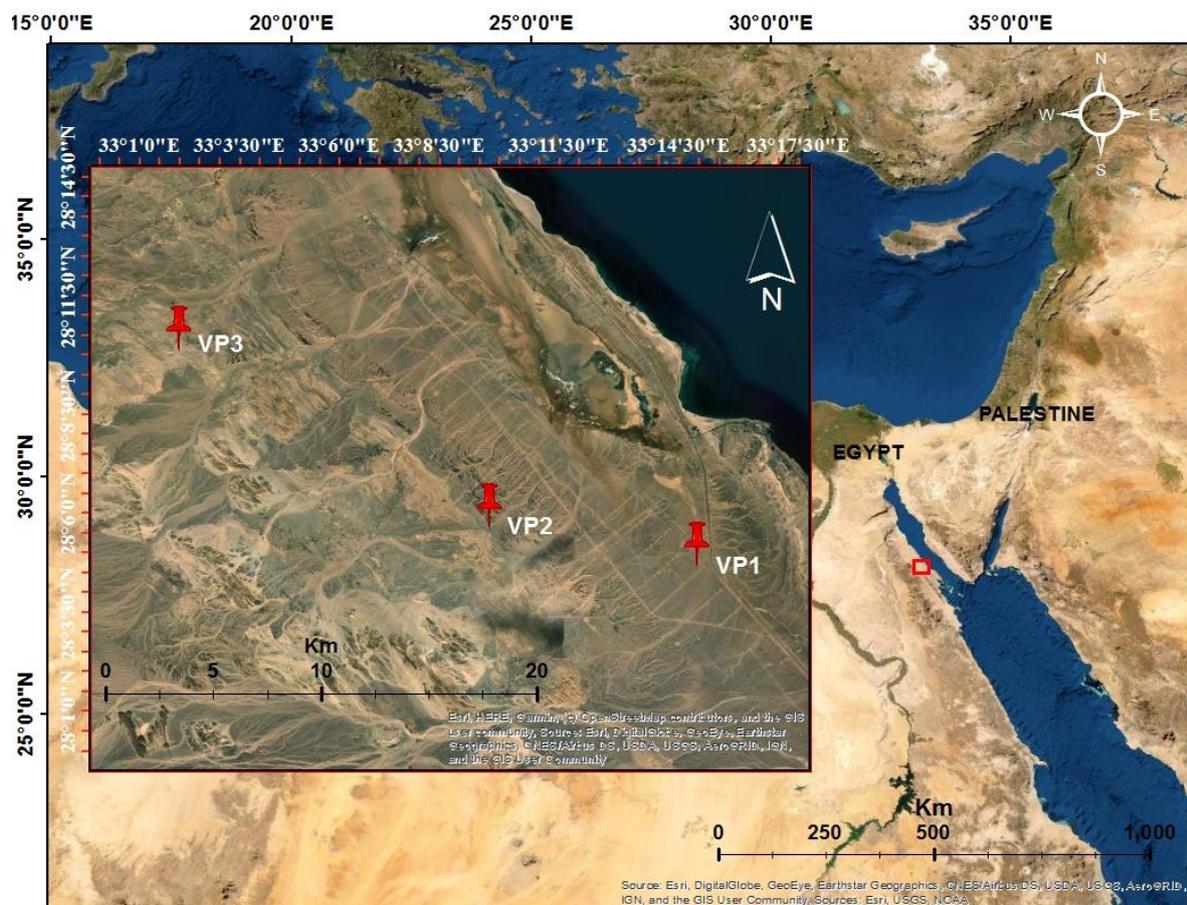


Figure 1: Location of the study area near Ras Shukeir, Eastern desert, Egypt. VP: observation point.

Visual observations were achieved during light hours day by day between April 19th and May 17th, 2019 covering four weeks of the peak spring migration season through Egypt. The bird enumeration was performed according to standard technique described in Scutherland^[9], bird monitoring was conducted through three fixed observation points, observation posts strategically positioned to provide the best visual coverage of the bird's movements, each vantage point almost complete coverage about 2500 m view scope within each selected point in the study area. The survey covered all points' watches for eight hours/day, seven days/weekly, from 7:30 am to 16:00 pm, with 30 minutes break (except two days cancelled due to a bad weather).

Bird altitude was recorded at time intervals with 15 seconds, weather conditions (wind direction and speed, temperature, cloud/mist, rains, and visibility) were recorded hourly according to Riad^[1]. Each point supplied by professional binoculars, digital cameras, bird identification filed guides, clipboards, compass, and recording sheets and maps.

A sum of 208 survey hours for every vantage point (624 observation hours for the whole study area) were performed in the field during the survey time, generally 4 hours in morning session and 4 in the evening. To avoid repeated counting, observers met after fieldwork and analyzed every record collected during the day. This thorough analysis considered the exact minute of every observation, bird

movements' directions and altitudes and the existence of clues that the same bird/flock had been recorded by different vantage points. In this way, records that had been possibly or confirmedly double-counted were eliminated from the

calculation. To disentangle weather information, wind course estimations were changed over into eight fundamental directions, and wind speed estimations were likewise changed over into four main classes (Table 1).

Table 1: Wind direction, wind speed, and categories used during data collection.

Wind direction (Degrees)	Wind direction (Category)	Wind speed (m/s)	Wind speed (Category)
337.5-22.5	North	Less than 5	Calm
22.5-67.5	Northeast	5 -10	Low
67.5-112.5	East	10 – 15	Medium
112.5-157.5	Southeast	More than 15	High
157.5-202.5	South		
202.5-247.5	Southwest		
247.5-292.5	West		
292.5-337.5	Northwest		

RESULTS

Exactly 47518 raptors belonging to twenty-four raptors species and some unidentified raptors species, plus 36700 white storks "*Ciconia ciconia*" comprised 40.80% of all observations, 4230 great white pelicans "*Pelecanus onocrotalus*" (4.70%), and 1500 black storks "*Ciconia nigra*" were recorded in the current study (Table 2). The most common raptors species were 15753 Levant sparrowhawk "*Accipter brevipes*" (33.15% of all raptor species), 15243 European honey buzzard "*Pernis apivorus*" (32.08%), 11834 Northern steppe buzzard "*Buteo buteo vulpinus*" comprised 24.90%, 1924 black kite "*Milvus migrans*" comprised about 4.05%, and 583 lesser spotted eagle "*Aquila pomarine*" comprised about 1.23%. While steppe eagle "*Aquila nipalensis*", short-toed eagle "*Circaetus gallicus*", booted eagle "*Aquila pennata*", greater spotted eagle "*Aquila clanga*", long-legged buzzard "*Buteo rufinus*" combined recorded more than 2.5% of the raptor assemblage.

Considering the maximum birds (%) and records (%) through the study area were during 2nd week of the study (68% and 47% respectively), absolute minimum without duplication with the other points, while

the fourth week was the lowest in count individuals and records of all migration rates (2% and 7%, respectively, Figure 2). Most observations were recorded for one individual record 37%, but only form 1% of all birds (Figure 3). On the other hand, the observations composed of 11-100 bird were recorded 17% of birds and formed 19% of all records, and the flocks comprised of 3-10 individuals recorded 26% of all observation records, but were forming only 4% of all birds. Most of the records over 200 individual were white storks and white pelicans and recorded more than 68% of all migration birds (Figure 3).

Both the number of records and the number of soaring birds were highest during the morning, namely between 10:00 and 11:00 am (with 33% of the number of records and 46% of birds being recorded in this period; Figure 4). During the late morning and in the afternoon these values were lower, being particularly low in early morning and afternoon. The VP3 was the most recorded for birds (49%), representing 62% of all records, followed by the first VP1 (31%) of birds, representing more than 19% of records (Figure 5).

Table 2: Raptors and other soaring birds recorded during spring migration from 19 April to 17 May, 2019, Eastern desert, Egypt.

Name	Number of Birds	Birds (%)	Number of records	Records (%)
White stork (<i>Ciconia Ciconia</i>)	36,700	40.80	86	3.72
Levant sparrowhawk (<i>Accipiter brevipes</i>)	15,753	17.51	28	1.21
European honey buzzard (<i>Pernis apivorus</i>)	15,243	16.95	516	22.32
Steppe buzzard (<i>Buteo buteo vulpinus</i>)	11,834	13.16	575	24.87
White pelican (<i>Pelecanus onocrotalus</i>)	4,230	4.70	23	0.99
Black kite (<i>Milvus migrans</i>)	1,924	2.14	387	16.74
Black stork (<i>Ciconia nigra</i>)	1,500	1.67	46	1.99
Unidentified buzzard	1,242	1.38	58	2.51
lesser spotted eagle (<i>Aquila pomarine</i>)	583	0.65	165	7.14
Raptors species	342	0.38	37	1.60
Steppe eagle (<i>Aquila nipalensis</i>)	148	0.16	80	3.46
Short-toed eagle (<i>Circaetus gallicus</i>)	107	0.12	65	2.81
Booted eagle (<i>Aquila pennata</i>)	69	0.08	50	2.16
Eurasian sparrowhawk (<i>Accipiter nisus</i>)	50	0.06	38	1.64
Egyptian vulture (<i>Neophron percnopterus</i>)	47	0.05	28	1.21
Common kestrel (<i>Falco tinnunculus</i>)	34	0.04	19	0.82
<i>Aquila</i> sp.	32	0.04	21	0.91
Long-legged buzzard (<i>Buteo rufinus</i>)	27	0.03	21	0.91
Western marsh harrier (<i>Circus aeruginosus</i>)	23	0.03	22	0.95
Eastern imperial eagle (<i>Aquila heliaca</i>)	17	0.02	13	0.56
Greater spotted eagle (<i>Aquila clanga</i>)	15	0.02	14	0.61
Osprey (<i>Pandion haliaetus</i>)	5	0.01	5	0.22
<i>Falco</i> sp.	3	0.00	3	0.13
Montagu's harrier (<i>Circus cyaneus</i>)	3	0.00	3	0.13
Elenora's falcon (<i>Falco eleonora</i>)	2	0.00	1	0.04
Eurasian griffon vulture (<i>Gyps fulvus</i>)	5	0.01	2	0.09
Lanner falcon (<i>Falco biarmicus</i>)	2	0.00	2	0.09
Pallid harrier (<i>Circus macrourus</i>)	6	0.01	2	0.09
Eurasian hobby (<i>Falco subbuteo</i>)	1	0.00	1	0.04
Peregrine falcon (<i>Falco peregrinus</i>)	1	0.00	1	0.04

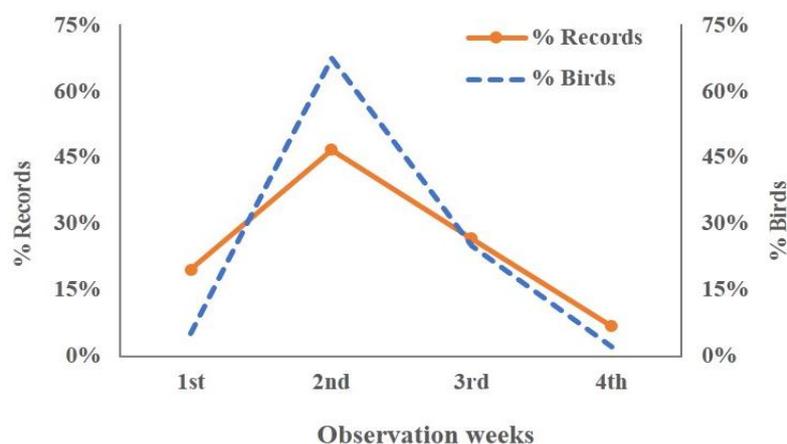


Figure 2: Relative weekly distribution of individuals and records for all observation during the study.

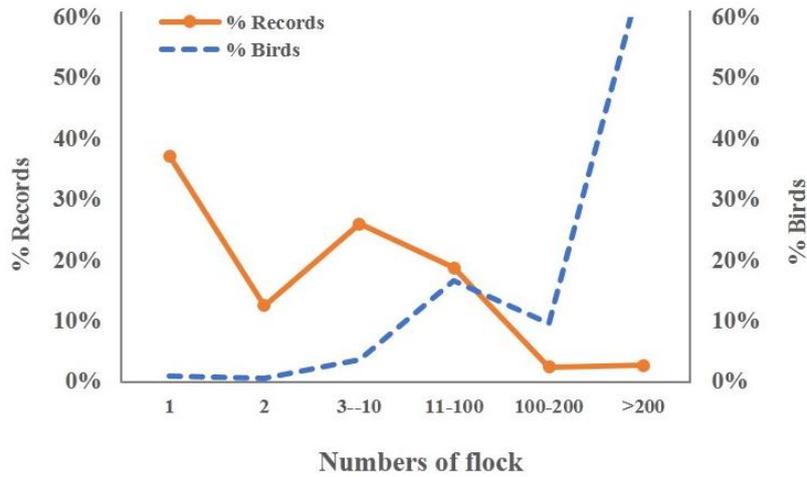


Figure 3: Relative frequency of individuals and records for numbers of the flocks.

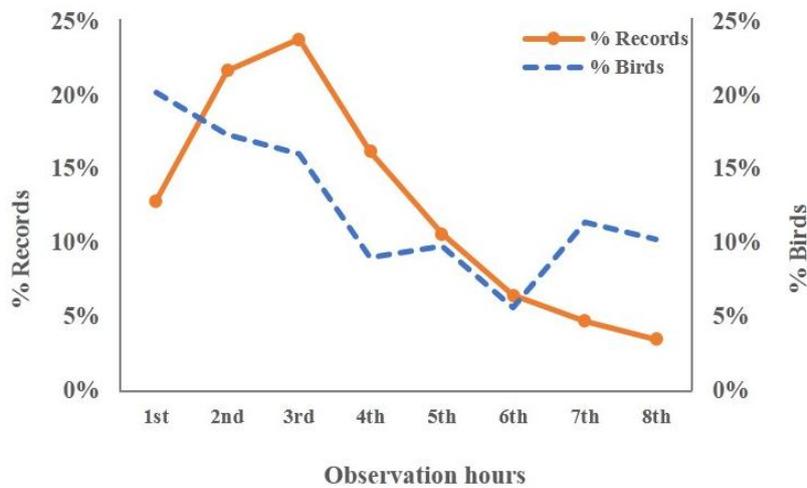


Figure 4: Relative hourly distribution of individuals and records for all observations.

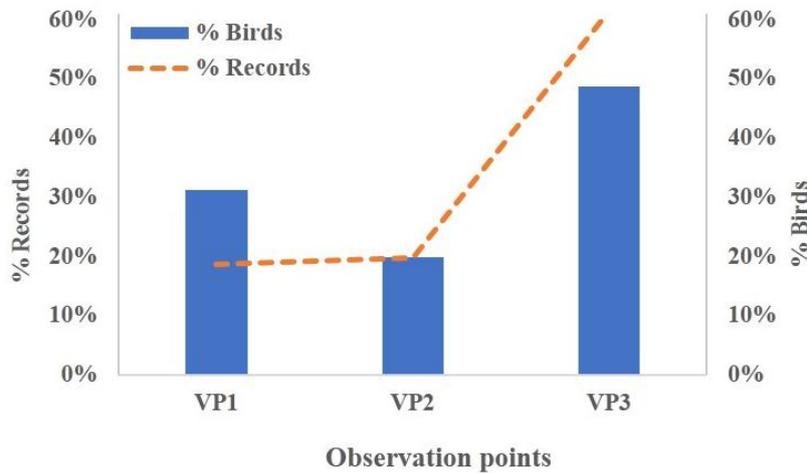


Figure 5: Relative frequency of individuals and records for each vantage point during study time. VP: observation point.

The flight altitude of all observations in the study area was classified into five classes (0-100, 100-200, 200-300, 300-400, and >400 m), the majority of the most observations was recorded in the altitudes in the category of more than 400 m (36% of birds form 18% of all records), while was more than 25% from records that form 32%

of all birds numbers between 100 to 200 m altitude, and 34% from records that form about 26% of all birds at category over 200 and less than 400 m (Figure 6). Flight direction of most observations revealed an expected northerly pattern (between the northwest and the northeast quadrants) (Figure 7).

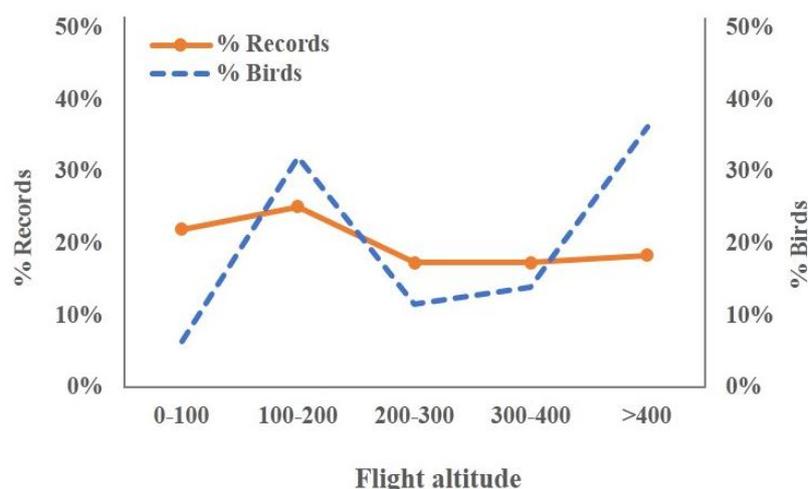


Figure 6: Percentage of flight altitudes of individuals and records observed in the study area.

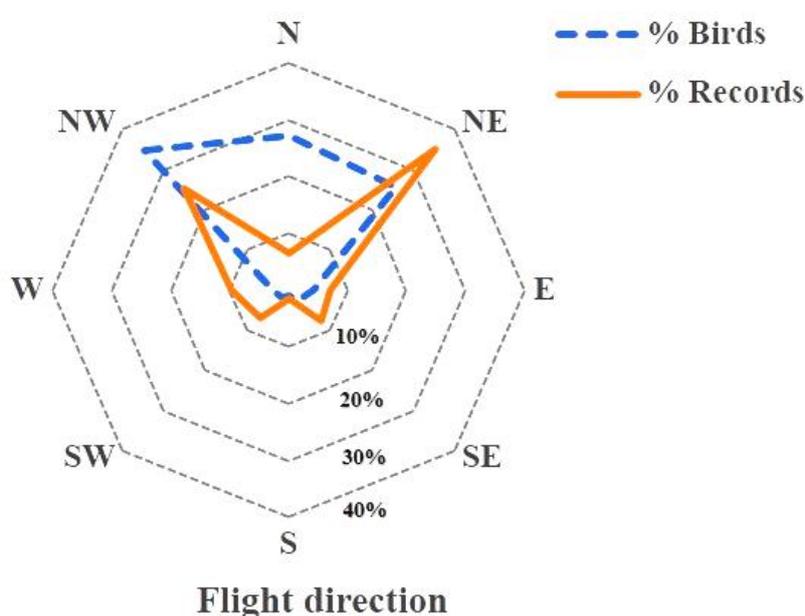


Figure 7: Distribution of flight directions for all observations during the study. E: east, N: north, NE: northeast, NW: north-west, S: south, SE: south-east, SW: southwest, W: West.

When comparing the observed bird heights at each vantage point, most of the birds observed above 400 m in the VP3, while most of the birds were at altitudes below 200 m in the VP1 one km from the windfarm under construction, as well as VP2 inside the operated windfarm (Figure 8). Also, when comparing the observed bird directions at each vantage point, most bird observations revealed an expected northerly pattern (between the northwest and the northeast quadrants) at all observation points (Figure 9).

DISCUSSION

The study provides evidence of a generally very substantial migration through the

eastern desert of Egypt. In the spring the migratory birds are under great time pressure, as they must reach their summer dwellings early enough to successfully compete for a suitable breeding site so they can raise their young before leaving again for Africa. Birds arriving too late or too exhausted will not breed and reproduce unsuccessfully^[10]. In each study, the number of birds in each season and location is deduced, assuming that observations were made in each site throughout the entire season. Since double observation is unavoidable, it is not permissible to collect the stable numbers of birds in several sites^[10].

There was no detectable preference by migratory birds for any route through the

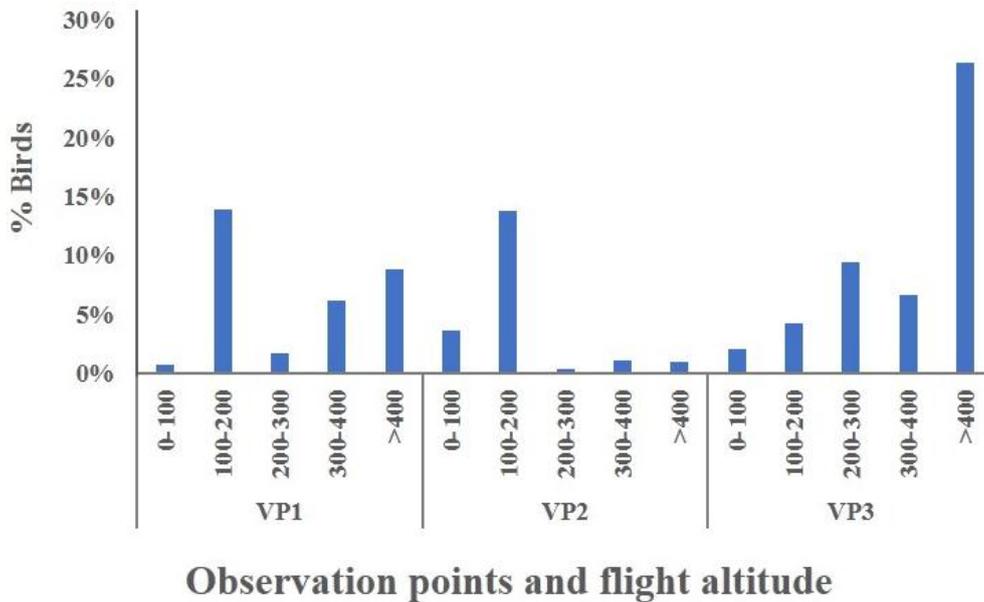


Figure 8: Distribution of flight altitude of birds over each observation point. VP: observation point.

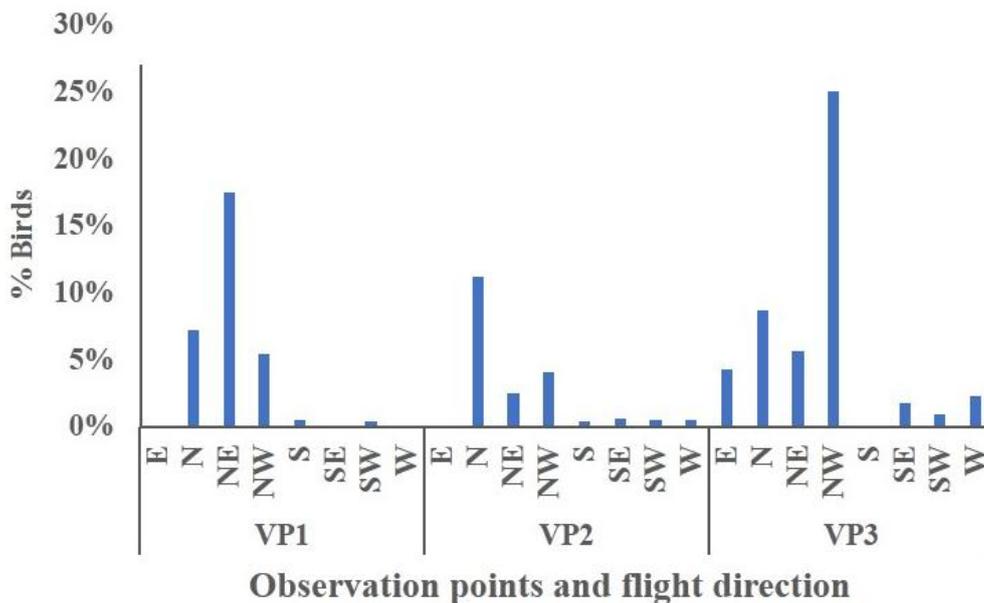


Figure 9: Distribution of flight bird directions over each observation point. E: east, N: north, NE: northeast, NW: northwest, S: south, SE: southeast, SW: southwest, W: West, VP: observation point.

study area. Migratory raptors migrated mostly individually or in small groups and showed a somewhat regular pattern. By contrast, storks, pelicans, and Levant sparrowhawk mostly migrating in massive herds, produced very distinct regional fluctuations^[11-13]. The storks, pelicans, and

cranes that were concentrated in the VP3 site area attracted a great distance from the coast to get the time to rise to a great distance and the ability to cross the bay easily at the narrowest point in the bay Ras Shukeir or Ras Ghareb. In general, there was no significant effect on the altitudes and

directions of bird migration as a result of windfarms. It is evident from the birds recorded in the VP2 and compared to the other two points that extensive studies of this matter are needed in the upcoming migration seasons. The results revealed that many threatened and near threatened species steppe eagle "*Aquila nipalensis*", Egyptian vulture "*Neophron percnopterus*", greater spotted eagle "*Aquila clanga*", Eastern imperial eagle "*Aquila heliaca*" and pallid harrier "*Circus macrourus*" use this pathway migrations from Africa to Eurasia.

Many recorded numbers were seen flying at altitudes less than 200 meters, which suggests that they will continue to migrate north and cross the Gulf from Ras Ghareb or may continue to the end of the Gulf at the city of Suez. Given these results, some numbers of migrants observed to the south of the study area migrants often head to Sinai at the latitude of El-Gouna and the location of the Malaha Valley rest area, the only freshwater valley. Migrants heading to Suez mainly concentrate along the mountain range west of the Gulf. Most white storks that reached the southern end of Sinai continue northwest of the country along the coast of Sinai before starting to cross the sea, thus reaching the mainland of Egypt between Ras Ghareb and Ras Gamasa^[14]. However, notes are needed to review their limits^[4,15].

Our observations revealed that migrants fly along the foothills of the Red Sea Mountains and then head for the coastal mountain chain Gebel El Zeit or the coast adjacent to the north. Especially in those species such as white stork^[7,8,16], sparrowhawk^[4,15] and common crane, large portions of the population regularly cross the Gulf of Suez. Consequently, many options have no choice, but to cross the study area. Others, such as lesser spotted eagle "*Aquila pomarina*", a species that avoids any sea crossing, continue to migrate to Suez^[15,17].

Migration patterns are highly variable from one year to another, namely regarding its number, phenology, and flight behavior during flyway, as they are highly dependent

on weather conditions among other factors. This way, variation in weather conditions in the upcoming years may cause changes in the migratory patterns compared to what was recorded in studied time. Future studies should clarify the areas that the soaring birds fly near the current study area and that they use to cross the Suez Canal to South Sinai, as well as to explore the complex migration patterns during different weather conditions of soaring birds especially storks, pelicans, and cranes that migrate through the Rift Valley/Red Sea flyway.

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AUTHORS' CONTRIBUTIONS

SAR planned the study and designed all experiments, summarized, discussed and interpreted the results, and drafted the manuscript. AA performed the statistical analysis. ME and EIA carried out the experiments.

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تسجيل هجرة الربيع للطيور الحوامة عبر منطقة جبل الزيت، الصحراء الشرقية، مصر

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تعد مصر ممراً مهماً لهجرة الطيور الحوامة، حيث تقع على البر الرئيسي الرابط بين كتل اليابسة الأوروبية الآسيوية والأفريقية التي تربط مناطق التكاثر في أوراسيا بمناطق الشتاء في أفريقيا. في الدراسة الحالية، تم دراسة هجرة الربيع للطيور المحلقة عبر ممر ضيق "موقع عنق الزجاجة" الواقع داخل ممر البحر الأحمر/الوادي المتصدع لهجرة الطيور، خليج السويس، مصر. وعلى مدار أربعة أسابيع من 19 أبريل إلى 17 مايو 2019، تم إحصاء 89949 طائرًا محلقة من 27 نوعًا خلال فترة مراقبة يومية مدتها ثمان ساعات. في المجموع، تم تسجيل 47511 طائرًا جارحًا تمثل 24 نوعًا. وكان الأكثر شيوعًا البيدق "*Accipiter brevipes*"، وحوام العسل الأوروبي "*Pernis apivorus*"، وحوام السهول "*Buteo buteo vulpinus*" والتي شكلت 33.16% و 32.08% و 24.91% من جميع الطيور الجارحة، على التوالي. بينما الحدأة السوداء "*Milvus migrans*"، والعقاب الأرقط الصغير "*Aquila pomarine*"، وعقاب السهول "*Aquila nipalensis*"، وعقاب صرارة "*Circaetus gallicus*"، وعقاب المسيرة "*Aquila pennata*"، والنسر المصري "*Neophron percnopterus*" مجتمعين سجلوا أكثر من 6% من تجمع الطيور الجارحة. بالإضافة إلى ذلك، تم تسجيل 15 عقاب أرقط كبير "*Aquila clanga*"، و 6 مرزات باهتة "*Circus macrourus*"، و 5 نسور سُمر "*Gyps fulvus*" أثناء المشاهدات. وتم تسجيل طيور حوامة أخرى غير جارحة خلال فترة الدراسة، وكان أكثرها شيوعًا: 36700 طائر لقلق أبيض "*Ciconia Ciconia*"، و 4230 طائر من البجع الأبيض "*Pelecanus onocrotalus*"، و 1500 طائر لقلق أسود "*Ciconia nigra*".