Journal of Association of Arab Universities for Tourism and Hospitality (JAAUTH)
journal homepage: http://jaauth.journals.ekb.eg/

The Impact of Airports Bird Hazard Management on Climate Changes and Bird-watching Tourism: Applying to Sharm El-Sheikh International Airport

Usama Mohamed Basiony[1] Zaki Zaki Abou Rfaeii[2] Asmaa Ali Shogaa[3]

[1]Director of the Environment Department and Wildlife & Bird hazard Control at Sharm El-Sheikh Airport and Instructor at United ATS Aviation Technology Service.
[2]Airport duty officer at Sharm El-sheikh Airport And instructor at King Mariott Institute.
[3]Lecturer, Tourism Studies Department -The Higher institute for Tourism and Hotels King Marriott.

ARTICLE INFO

Keywords:

Bird-watching Tourism; bird strike aircraft; Migratory bird hazard; food chain break down; south Sinai Bird-watching tourism; White storks Sharm El-Sheikh.

(JAAUTH) Vol.24 , No.2 , (2023), pp.144–161.

Abstract

An integrated bird risk management system was implemented, including the formation of a database, habitat modification, animal transportation, and breaking down the airport food chain, while promoting safety and environmental culture. The study shows a significant decrease in the number of birds monitored at the airport without adversely affecting their natural environment or places for bird watching, particularly for the two main types of residential and migratory birds, pigeons, and white storks. The implementation of these measures also led to a significant decrease in bird strikes over the study period from 2018 to 2022, including confirmed and unconfirmed cases, even without the impact of bird-watching tourism.

This study provides valuable insights into managing and controlling bird hazards at airports, highlighting the importance of promoting safety and environmental culture while protecting biodiversity and the natural environment.

1- Introduction

Despite thousands of bird strikes occurring each year, airports have implemented a variety of safety and conservation measures to minimize potential harm from these incidents. While most bird strikes do not result in significant damage to the aircraft or pose a threat to passengers, they can have negative impacts on biodiversity and bird-watching tourism. Airport officials remain vigilant in monitoring nearby wildlife to prevent any potential problems.

Successful wildlife conservation efforts in various regions have led to an increase in the number of birds and other wildlife species that can pose a threat to aviation safety. It is also recognized that birds are not the only species that can cause problems for aircraft. Some mammals and reptiles can also be a danger to aviation safety. To effectively address the issue of wildlife aircraft strikes, wildlife and bird control efforts should be expanded to include

flying and terrestrial mammals and reptiles in and around airports.

Despite the increasing number of quieter aircraft and wildlife populations, it is still necessary to control and monitor wildlife movements in and around airports to minimize the risk of bird strikes and other incidents. Additionally, the cost of downtime for aircraft repair or inspection following bird or wildlife damage can be significant(Ntampakis 2014).

Migratory birds face various challenges during their seasonal cycle, such as persecution, collisions with energy structures, and adverse impacts from niche and climate change. One significant challenge for preserving migratory bird populations is identifying critical habitats, including areas of migratory concentration. This is crucial because the survival rates of certain species may depend on events that occur in geographically limited regions(Buechley etal., 2018).

Sirot (2006) The phenomenon of migration has captivated humans throughout history, and the arrival and departure of migratory birds is a fascinating event. Migratory birds serve as a link between people, cultures, and conservation and development issues, providing a unique opportunity for international collaboration, as noted by Sirot.

Airports are frequently located near densely populated areas that have landfills, waste management sites, and refuse dumps. These areas attract various dangerous species, including large water birds, gulls, and raptors, particularly in developing tropical countries, as noted by Dalton et al. On the other hand, some airports are situated near wildlife reserves and expansive rangelands that are abundant in birds and other wildlife, thereby increasing the risks (Dalton et al., 2019).

According to Martín's (2018) research, wind turbine collisions are expected to have a greater impact on birds at specific locations where high concentrations of individuals occur, such as migration bottleneck areas. The Strait of Gibraltar, located in Southern Spain, is a significant bottleneck area for soaring bird migration in Western Europe. However, this region is also one of the most important potential areas for wind energy generation in Spain. To address this, the study examines monthly migratory soaring bird abundance and long-term avian mortality rates at 21 wind farms situated near the Strait of Gibraltar. Zero-inflated hurdle negative binomial and gamma models were used, and the best-fit models included the effect of season on collision mortality rates and the proportion of adult individuals among total deaths.

Despite the seriousness of the issue, bird-aircraft conflicts have not received much attention in ornithological research, as noted by Sodhi (2002). Furthermore, there is a shortage of published studies on bird-aircraft conflicts in developing countries, particularly in Africa and West Africa. A sound understanding of ornithology is necessary to develop effective long-term management solutions to address this increasing problem, as emphasized by Soldatini et al. (2011).

Ning and Chen (2014) stated that over the past decade, radar technology has proven to be a valuable tool for observing birds. Numerous avian radar systems have been developed to support real-time evaluation of bird-strike risk at airports. Additionally, high-definition cameras, often incorporated as a supplementary component of the radar system, can be used to identify bird species.

Mendoca et al. (2017) noted that their study contributes to the existing literature by addressing the lack of published analyses of bird-strike reports at a regional level. They also connected data analysis to general safety management system (SMS) and Wildlife Hazards Management Programs (WHMP). The aviation industry can utilize local bird-strike data and information to develop or improve wildlife hazard management programs, increase pilot

awareness, and advance the development and implementation of integrated research and functional solutions to mitigate the risk of bird strikes.

The primary focus of the study is the challenges involved in creating a safe environment for aircraft to operate, while also protecting and conserving local bird-watching tourism and the global ecological system. The proposed solutions involve implementing an integrated system for managing bird hazards at airports, with a particular emphasis on meeting ICAO safety objectives (ICAO 2012). The first step is to analyze data and identify any gaps in the current system. Next, the system will be applied through a set of main rules, including regulations, training, and technology, which will comply with relevant international and local laws and applications. Officials at the airport, including civil society, will receive awareness, education, and training within a 13-kilometer radius. The last line of defense will involve using tools and equipment to facilitate procedures, including dispersal devices for birds during take-off and landing. It is crucial for airport authorities to demonstrate due diligence by implementing appropriate bird control measures for their particular situations. As emphasized in the study. Overall, the proposed solutions aim to achieve sustainable, environmental, economic, and safe outcomes for managing bird hazards at airports.

It is imperative that they utilize suitable products and methodologies while also being cognizant of the optimal cost-effective approach.

This kind of study is much required. Generally, to cope with both, the international ecological system protection and conservation, bird-watching tourism, climate change, and international civil aviation organization's safety and operational objectives, in addition to creating and introducing a technical guideline to manage and control birds' hazards at airport vicinities.

Research has shown that, aligning with the national and international rules and guidelines and proposing some technological solutions to manage and control bird hazards at airports are considered the most significant approaches to reach our goal, "clean sky to fly. Specifically, this study presents and verifies that old approaches are still effective, however, human resource development that creates super-qualified wildlife controllers, in addition to land-use management are the new approaches we propose to effectively and perfectly manage and control bird hazards at airports, especially after our experience of integrating all previously mentioned trends and approaches. In addition to creating a safe operation at airport vicinities.

This study helps the aerodrome managers to take an operational decision about bird hazards management and control strategy at their airports; such decisions promote the global ecological system protection and conservation strategies; bird-watching tourism and take good steps towards safety operation objectives.

Such a study is significant and important since it integrates the most possible approaches to manage and control bird hazards at airports, and emphasizes the role of both, wildlife controller awareness promotion and land-use planning and management.

The result of this study has taken all relevant audiences, researchers, decision-makers, and takers' and others' attentiveness and interest. That is because this study delivers environmental, economic, bird-watching tourism and social solutions collectively.

Further research, data collection, and data analysis are needed to more clearly categorize, investigate and understand the most suitable approaches to overcome the challenges threatening the safe operation of aerodromes & bird-watching Tourism due to bird strikes.

Definition of Bird Strike

A bird strike is a collision that occurs between a bird and an aircraft that is in flight or on a take-off or landing roll. The term may also encompass strikes with other wildlife species, such as ground creatures and bats. Bird strikes pose a significant threat to aviation safety and have resulted in several serious incidents that have led to deaths.

While most bird strikes cause minor damage to the aircraft, around 65% of cases, collisions with birds in engines or the front glass of the pilot can result in significant damage or loss of thrust, especially for jet engine aircraft. The estimated annual losses from bird strikes are approximately $400 million in the United States and $1.2 billion worldwide for civilian commercial aircraft.

Bird strikes can occur during any phase of flight, but they are most common during take-off, initial climb, approach, and landing due to the lesser numbers of birds in flight at lower levels. Most bird strikes occur during daylight hours since birds tend to be more active during the day. Although most bird strikes occur at lower altitudes, there have been incidents of collisions with birds at high altitudes, with the highest altitude bird collision record being at 11,300 meters (37,000 feet) above ground level.

According to an ICAO report, most bird collisions near airports occur during takeoff, landing, or similar stages, with less than 8% of strikes occurring above 900 meters (3,000 feet) and 61% occurring at heights of less than 30 meters (98 feet), as noted in the FAA's 2005 guide to risk management and wildlife. Bird strikes pose a significant danger to aircraft safety, and their impact can cause fatal accidents, especially for smaller aircraft and those with jet engines.

Main Objective of the Study

The current study's primary goal is to give the Egyptian aerodromes with the preliminary guidelines for the preparation of the relevant ecological studies to avoid any potential problems and to be the 1st step for the preparation of the aerodromes' relevant wildlife hazard management plan (WHMP) to reach and achieve the Acceptable Level of Safety (ALOS).

In other words, the study's ultimate goal is to create a database that briefly enumerates and explains the different bird species and their behavior, respectively. Also, to provide the optimum solutions to manage and control bird hazards at airports that are suitable and convenient for nature, bird-watching tourism, climate change, and the complexity of aerodromes located in Egypt.

The main significant contribution the study will make is achieving the Win-Win situation strategy between both processes, ecological system protection and conservation, bird watching tourism, climate change, and aerodromes safety operation. Simply mitigating the bird hazards at the airports' vicinities not by killing or destroying the environment around the airports, but, by habitat modification, land-use planning and management, and promoting the communication channels between the aviation industry stakeholders and local authorities. Integrating 4 trends and approaches, A) Rules and Regulations, B) Technological solutions, C) Training and human resources development, and D) Land-use planning and management; in such way, this study is different from previous, similar, or reviewed studies. Such a study is significant since it integrates the most possible approaches to manage and control bird hazards at airports, and emphasizes the role of both, wildlife controller awareness promotion and land-use planning and management.

Approach & Proposed Solution

In the current study, an integrated system to watch, monitor, and disperse birds out of airport vicinity to reach the internationally acceptable level of safety (ALOS), without negative impact on bird-watching tourism, climate change through improves mitigation strategy, draft an effective management plan, and apply such pattern at aerodromes.

We proposed the following steps to enforce an effective solution:

a) Personnel assignment;

b) Collecting and recording the data of both observed birds and bird strikes;

c) Data analysis and assessment;

d) Habitat and land management on-airport and in its vicinity;

e) Regular meetings with all stakeholders of the airport's bird strike prevention, in addition to non-airport agencies and local landowners and;

f) Expelling and/or removing hazardous birds.

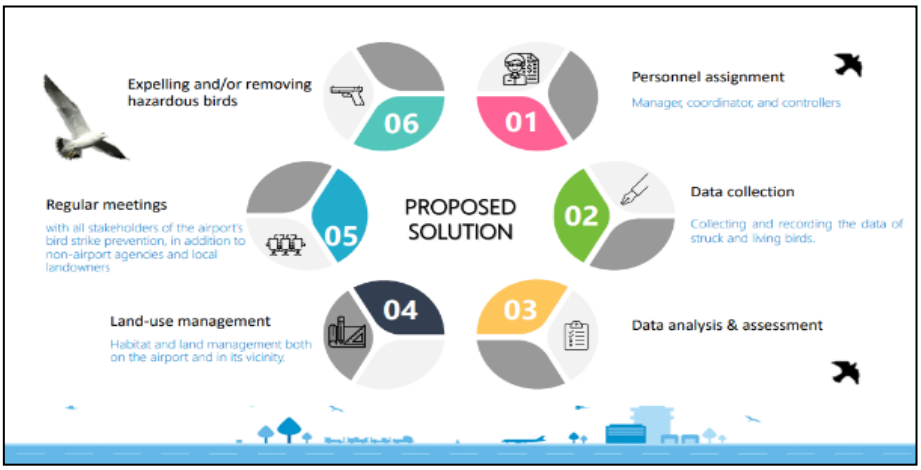


Figure 1: PROPOSED SOLUTION

Literature Review

The purpose of this literature review on bird strikes is to identify suitable sources of bird strike data for analysis, examine trends in bird populations, collect relevant data on bird strike incidents and accidents, compile practical approaches to mitigate bird strikes at airports, and analyze historical data and literature to inform these approaches.

Birds have been a hazard to aviation since the early days of civil aviation, but the increased speed and reduced engine noise of newer-generation aircraft have made bird strikes a more serious threat to aviation safety (Holbech et al.,).

Bird strikes have become more frequent and serious, with significant financial and human costs (2015; Allan, 2000).

The collision between aircraft and wildlife, including birds, has been increasing since it was first recorded in 1905 (DeVault et al., 2014). Bird strikes are rigorously defined as collisions between birds and aircraft that occur during flight, take-off, or landing, but the term is often expanded to include strikes with other wildlife species, such as bats or ground creatures. The cost of examining and repairing aircraft following bird or wildlife damage is significant. Bird strikes have become a serious aviation safety issue, as demonstrated by the

emergency landing of an Airbus 320 in the Hudson River in 2009 after Canada geese were ingested into both engines (Devault et al., 2013).

Furthermore, van Gasteren et al. (2019) noted that billions of birds utilize the atmosphere for various reasons, resulting in increasing conflicts with aviation around airfields and en route. This has become a significant issue, as collisions between birds and aircraft cost billions of euros annually and have resulted in the loss of human lives. The risk of bird strikes is particularly high during avian migration, with low-flying aircraft, including military training flights, being most at risk. However, countries with implemented avoidance systems have experienced 45% fewer bird strikes on average. The authors conclude that operational weather radar networks, forecast models, and international and interdisciplinary collaboration are essential to creating safer skies for both aviation and birds.

Drey et al. (2014) found that the incidence of bird strikes per 1000 aircraft operations (counting take-off and landing as separate operations) increased between 1990 and 2010. The number of reported strikes per 1000 operations per month peaked during July-September, which coincides with the late breeding season and fall migration. Additionally, bird strikes were more likely to occur during runway approach than during take-off and more often at dusk compared to other times of the day. Drey (2014) concluded that daily foraging patterns and seasonal differences affect the frequency of bird strikes, and data collection and analysis can assist airport biologists in prioritizing species management and implementing animal control efforts more effectively based on timing and species.

Regarding migration Riad et al. (2020) noted that it involves two-way journeys, from the home to a new location and back. Birds typically follow the same route and cover long distances, regulated by an internal natural timer. Spring and autumn are the most common times for bird migration, with birds traveling from breeding grounds in the north to wintering grounds in the south during autumn and vice versa during spring. Northern areas provide an abundance of food in summer but little in winter, while southern areas have food available year-round. Birds can either be migratory or sedentary, with around 1800 of the world's 10,000 bird species being long-distance migrants.

Figure 2:- Circle of Bird Immigration

Egyptian migration is among the most significant migration for millions of birds, and Egypt began its experience with civil aviation in the first half of the twentieth century with the beginning of the establishment of the first Egyptian aviation company (currently the Egypt Air Corporation) during 1932, The first Almaza airport was opened in July 1932 till now the number of airports today is 26. Aircraft pathways overlap with bird Flyways in some airports, such As Sharm El Sheikh, Hurghada, and Taba. Several incidents were recorded in Sharm and Hurghada airports, which led to material losses for many Airlines Such accidents distrust airlines and pay a lot of money into aircraft insurance without implementing solutions that reduce the risk potential.

The presence of Egypt and Sudan on one of the most significant migratory flyways of birds coming from south Europe reaching south Africa, the intersection between the migratory birds' flyway and the aircrafts' pathways, having an urban environment in Egypt and Sudan giving the potentiality of having many marvelous attractive points for birds gathering during the breeding seasons, and, the latest technology of providing more efficient and quieter engines, are factors that have contributed to bird strike threat at airports.

According to Ibrahim (2011), K.D. Christensen and F.P. Jensen conducted a study in 2002 on bird migration in the Gulf of Suez area, covering the coastal plains along the western shore of the Gulf of Suez and the adjacent foothills of the Red Sea Mountains between the town of Suez and Port Safaga. The study aimed to provide information on bird migration in the area for future environmental impact assessments of wind farms. The study was conducted in autumn 1998 (1 September - 6 November) and spring and autumn 1999 (1 March - 10 May and 13 August - 12 September, respectively), the study recorded 18 species, mostly raptors, and some nocturnal migrants, including around 17 warblers and other species.

Riad (2020) reported observing 3,121 raptors, including 15 raptor species and some unidentified ones, as well as 8,380 White Storks (Ciconia ciconia), which accounted for 57.86% of all observations. Other observed species included 108 Black Storks (Ciconia nigra), 604 Common Cranes (Grus grus), and 5 Great Cormorants (Phalacrocorax carbo). The most common raptor species observed were the Northern Steppe Buzzard (Buteo b. vulpinus), Black Kite (Milvus migrans), and Steppe Eagle (Aquila nipalensis), accounting for 17.21% of all records. Other raptor species observed included the Lesser Spotted Eagle (Aquila pomarina), Greater Spotted Eagle (Aquila clanga), Short-toed Snake Eagle (Circaetus gallicus), and Long-legged Buzzard (Buteo rufinus).

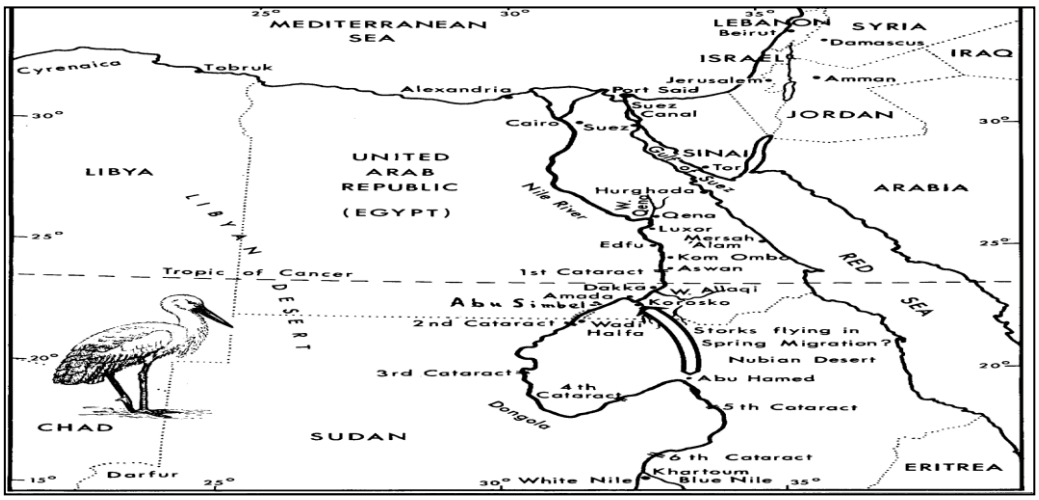


Figure 3: Map of Egypt & Adjacent Area (Sudan)

Arizaga et al. (2018) reported that White Storks passing through and using landfills were ringed in six countries, with France accounting for the majority of sightings (79.1%), followed by the Netherlands, Germany, Spain, Belgium, and Switzerland. There was a slight but significant difference in the proportion of storks from each region of origin between the two landfills, with a slightly higher proportion of storks from France observed at Zaluaga compared to Culebrete.

Nowadays, controlling the risk of bird strikes to aircraft is a crucial aspect of aerodrome

management, and the aviation industry invests significant resources in preventing bird strikes (Zeitlin, 1995). Nevertheless, the aviation industry in the United States alone suffers an estimated loss of US$1.2-1.5 billion per year due to damage and delays resulting from bird strikes. Understanding the conflict between birds and aircraft is critical due to its economic implications and potential threat to human life.

Guida et al. (2013) noted that aircraft leading edges must be certified to withstand a certain level of bird impact. The primary structural requirement is to protect the torsion box and control devices from significant damage caused by bird strikes, allowing the aircraft to land safely.

Blackwell (2014) concluded that collecting and analyzing data can assist airport biologists in prioritizing species management and implementing animal control efforts more effectively by determining the appropriate timing and types of control measures to be taken.

It is known that the challenges of bird strike in Egypt and Sudan Aerodromes are complicated, present problems that should be overcome, discusses specific and general solutions, and conclude that Bird Hazards Management & Integrated System Program (BHM & ISP) are needed for today's and tomorrow's aerodromes' operational safety in MENA region and particularly, Egypt and Sudan. More work is needed to restrict and monitor animal movements in and around an airport because of rising traffic, which is made up of quieter aircraft, and rising wildlife populations. It seems like aerodromes biologists and bird behavior scholars agreed that birds' patterns in foraging and finding suitable habitats attract birds, it is possible to create an alternative integrated environment within at least a 13-kilometer radius far from the aerodrome reference point to keep birds away from the aerodromes' vicinity, especially during aircrafts' take-off and landing simultaneously with promoting bird-watching tourism. No doubt that land-use planning and management improve the current situation of bird strike mitigation measures, especially, if it will be considered on countries level.

Methodology

The following steps have been taken and are still on going to maintain an integrated system to observe, monitor, and be environmentally friendly to disperse birds out of the airport vicinity.

a) Qualified and well-trained personnel;

- Initial training courses and materials;
- Intermediate training course;
- Specific training course;
- Position’s relevant tasks assignment;
- Recurrent training;
- Key performance indicators through the daily inspections and patrolling form (On-Airport & Off-Airport), monthly reports of the wildlife situation at airport vicinity, minutes of meetings that are conducted with internal & external stakeholders, bird strike investigation reports, and the pest control evaluation form.

b) Database formation;

- Different species of birds;
- Number of bird flocks at Sharm El-Sheikh International Airport;

SHARM EL SHEIKH AIRPORT	BIRD OBSERVATION MONTHLY REPORT GLOBAL 2018			Date: 2022.12.31	
ATTRACTANTS / BIRD SPECIES	SEWAGE PONDS	GOLF AREA	LANDFILLS	ON-AIRPORT	TOTAL
PIGEONS	2300	1300	3000	3300	9900
HAWK (FALCON)	13520	8770	11360	1540	35190
CROW (CORVUS)	10050	8400	15100	1920	35470
DUCK HURCAR	13660	2350	1310	160	17480
WHITE STORCK	17700	7530	19300	3850	48380
GULLS	27700	25900	21850	10910	86360
BLACK KITE	7675	3240	9965	2112	22992
CATTLE EGRET	6240	3860	12100	560	22760
OTHERS	6640	2420	11650	800	21510

Figure 4: The number of counted birds (different species) in Global 2018

SHARM EL SHEIKH AIRPORT	BIRD OBSERVATION MONTHLY REPORT GLOBAL 2019			Date: 2020.09.29	
ATTRACTANTS / BIRD SPECIES	SEWAGE PONDS	GOLF AREA	LANDFILLS	ON-AIRPORT	TOTAL
PIGEONS	2500	1600	3200	3000	10300
HAWK (FALCON)	13520	8770	11360	1400	35050
CROW (CORVUS)	10050	8400	15100	1800	35350
DUCK HURCAR	13660	2350	1310	120	17440
WHITE STORCK	20000	8200	18000	2500	48700
GULLS	27700	25900	21850	8000	83450
BLACK KITE	7675	3240	9965	1920	22800
CATTLE EGRET	6240	3860	12100	400	22600
OTHERS	6640	2420	11650	670	21380

Figure 5: The number of counted birds (different species) in Global 2019

SHARM EL SHEIKH AIRPORT	BIRD OBSERVATION MONTHLY REPORT GLOBAL 2020				Date: 2020.09.29
ATTRACTANTS / BIRD SPECIES	SEWAGE PONDS	GOLF AREA	LANDFILLS	ON-AIRPORT	TOTAL
PIGEONS	2600	1700	3300	2200	9800
HAWK (FALCON)	13520	8770	11360	1150	34800
CROW (CORVUS)	10050	8400	15100	1400	34950
DUCK HURCAR	13660	2350	1310	100	17420
WHITE STORCK	19000	8500	22000	2000	51500
GULLS	27700	25900	21850	6500	81950
BLACK KITE	7675	3240	9965	1800	22680
CATTLE EGRET	6240	3860	12100	300	22500
OTHERS	6640	2420	11650	420	21130

Figure 6: The number of counted birds (different species) in Global 2020

SHARM EL SHEIKH AIRPORT	BIRD OBSERVATION MONTHLY REPORT GLOBAL 2021				Date: 2020.09.29
ATTRACTANTS / BIRD SPECIES	SEWAGE PONDS	GOLF AREA	LANDFILLS	ON-AIRPORT	TOTAL
PIGEONS	2500	1700	3500	1800	9500
HAWK (FALCON)	13520	8770	11360	900	34550
CROW (CORVUS)	10050	8400	15100	1200	34750
DUCK HURCAR	13660	2350	1310	90	17410
WHITE STORCK	21000	5000	18000	1700	45700
GULLS	27700	25900	21850	6000	81450
BLACK KITE	7675	3240	9965	1500	22380
CATTLE EGRET	6240	3860	12100	250	22450
OTHERS	6640	2420	11650	400	21110

Figure 7: The number of counted birds (different species) in Global 2021

SHARM EL SHEIKH AIRPORT	BIRD OBSERVATION MONTHLY REPORT GLOBAL 2022				Date: 2020.09.29
ATTRACTANTS / BIRD SPECIES	SEWAGE PONDS	GOLF AREA	LANDFILLS	ON-AIRPORT	TOTAL
PIGEONS	2000	1700	3600	1200	8500
HAWK (FALCON)	13520	8770	11360	700	34350
CROW (CORVUS)	10050	8400	15100	900	34450
DUCK HURCAR	13660	2350	1310	70	17390
WHITE STORCK	25000	4000	15000	1200	45200
GULLS	27700	25900	21850	4000	79450
BLACK KITE	7675	3240	9965	1200	22080
CATTLE EGRET	6240	3860	12100	180	22380
OTHERS	6640	2420	11650	250	20960

Figure 8: The number of counted birds (different species) in Global 2022

SHARM EL SHEIKH AIRPORT	BIRD OBSERVATION MONTHLY REPORT GLOBAL 2022 (bird watching tourism)				Date: 2022.12.31
ATTRACTANTS / BIRD SPECIES	2018	2019	2020	2021	2022	TOTAL
PIGEONS	9900	10300	9800	9700	8800	48500
WHITE STORCK	48380	48700	51500	45700	47200	241480

Figure 9: The TOTAL number of Counted birds (Two species) During 2018~2022

Table 1: The TOTAL number of Counted birds According to Attractants (Two species) During 2018~2022

PIGEONS					
Years / Attractants	SEWAGE PONDS	GOLF AREA	LANDFILLS	ON-AIRPORT	Total
2018	2300	1300	3000	3300	9900
2019	2500	1600	3200	3000	10300
2020	2600	1700	3300	2200	9800
2021	2500	1900	3500	1800	9700
2022	2000	2000	3600	1200	8800
Total	**11900**	**8500**	**16600**	**11500**	48500
WHITE STORCK					
Years / Attractants	**SEWAGE PONDS**	**GOLF AREA**	**LANDFILLS**	**ON-AIRPORT**	**Total**
2018	17700	7530	19000	3850	48080
2019	20000	8200	18000	2500	48700
2020	19000	8500	22000	2000	51500
2021	21000	5000	18000	1700	45700
2022	25000	6000	15000	1200	47200
Total	102700	35230	92000	11250	241180

Monitoring the Attractive points of birds;

Figure 10: All Attractive Points at Sharm El-Sheikh Airport Vicinity.

Migratory birds' flyways and aircrafts' pathways identification;

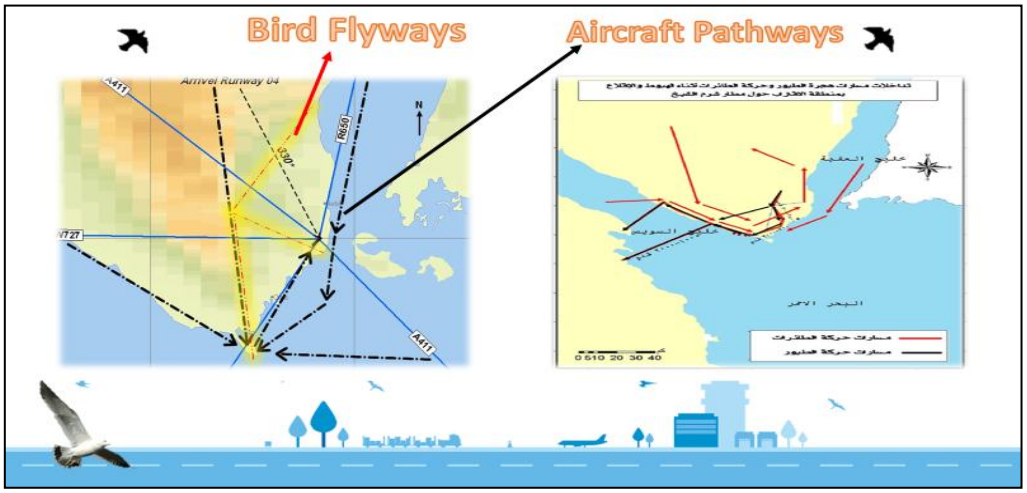


Figure 11: Intersection map between birds' flyways and Aircraft' Pathways

c) Bird control activities

At the southern and northern ends of the runway, two survey teams, each composed of two observers, were set up to count birds at predetermined intervals. The observers were able to concurrently cover the majority of the runway and its surroundings.

Bird counts were conducted twice daily from chosen locations, daylight, and sunset, which allowed identification and counting within the specific risk zone, the especially on-airport zone within 2 km from the ARP. Point counts were done from ground level to 5–30 m above the ground (over the building and from the airport watch tower) with binoculars (16×50) and/or telescopes (as mentioned in the materials section above). Daylight counts were made from around 06:00 to 10:00, whereas sunset counts were conducted between 16:00 and 18:30 for two weeks during seasonal migrations.

The following steps will be considered in bird control activities:

- Bird counting and;
- Habitat modification.

d) Safety and environmental culture promotion.

e) Stakeholders' (internal and external communities) engagement.

f) Workshops & training.

g) Creating a Bird Plugged Zone (BPZ).

Results

a) Significant decrease in the total number of birds in vicinities airport.

The figure below shows a significant decrease in the number of observed birds, particularly, the 2 main species of residential and migratory birds, Pigeons and White storks, respectively, along the study period from 2018 ~ 2022. Such decrease in the total number of observed birds on airport ensures that the current integrated activities are effective.

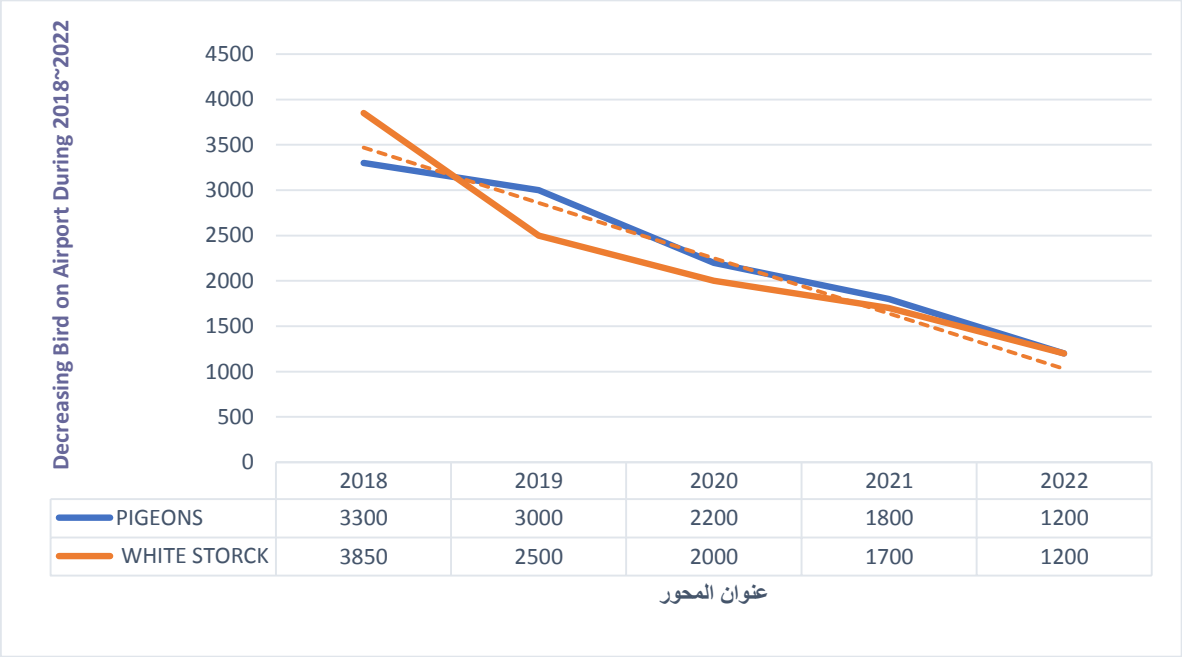


Figure 12: Significant decrease in the total number of birds

b) Decreasing in the number of Strikes During the study Period Comparison in comparison to the Peak Strike From 2018.

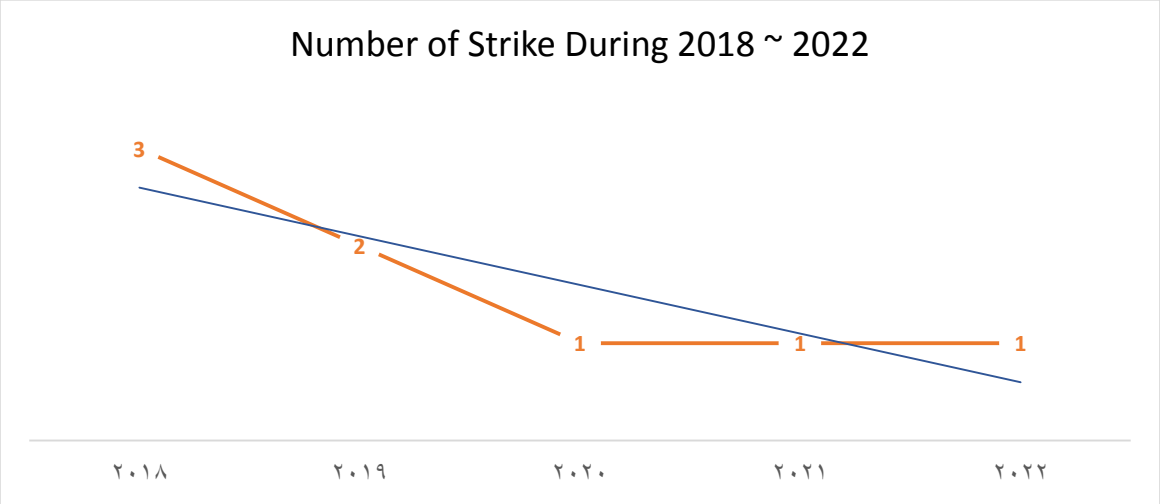
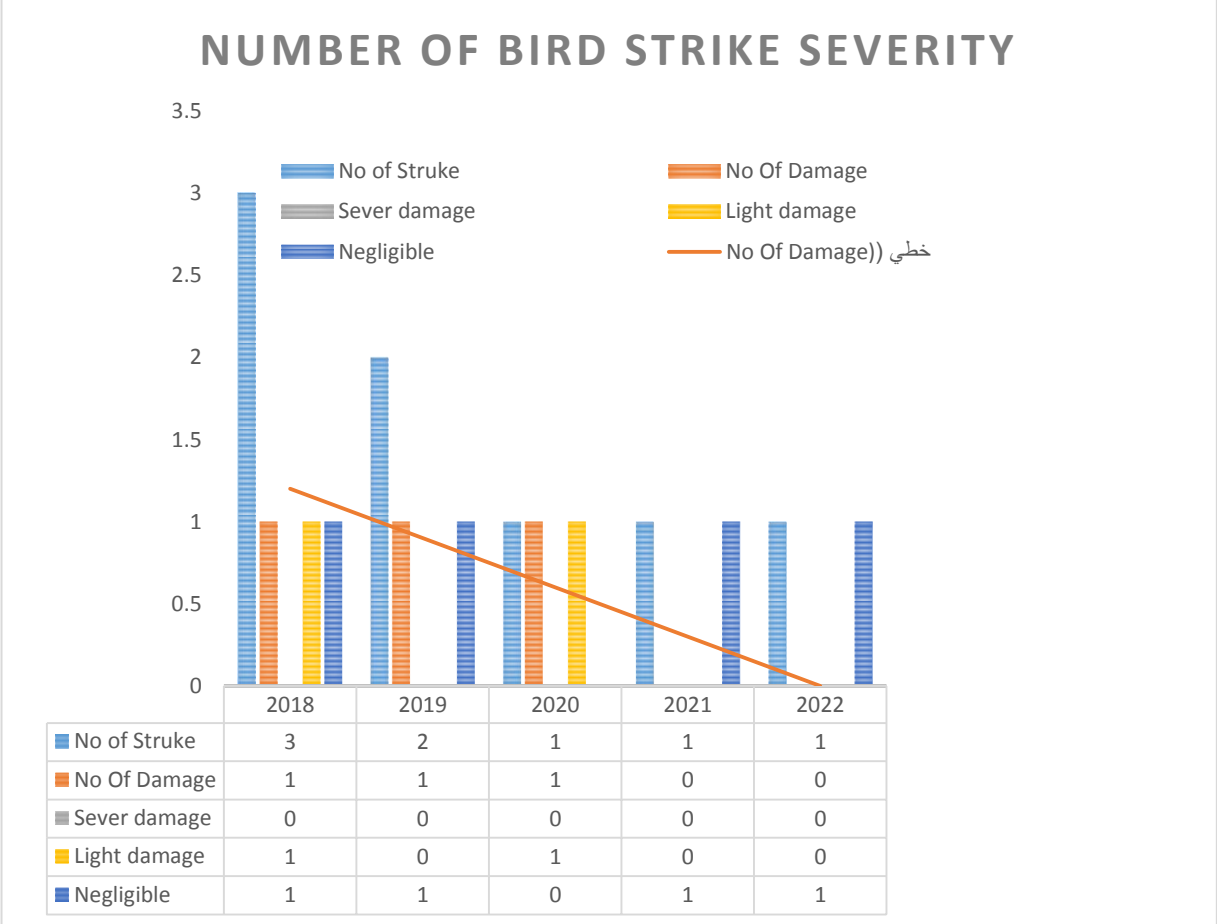


Figure 13: Significant Decrease in the number of strikes During the study Period From 2018~2022, with going down trendline

c) Significant reduction in Bird Strikes' severity.



	2018	2019	2020	2021	2022
No of Struke	3	2	1	1	1
No Of Damage	1	1	1	0	0
Sever damage	0	0	0	0	0
Light damage	1	0	1	0	0
Negligible	1	1	0	1	1

Figure 14: Significant reduction in Bird Strikes' severity During the study Period From 2018~2022with going down trend line

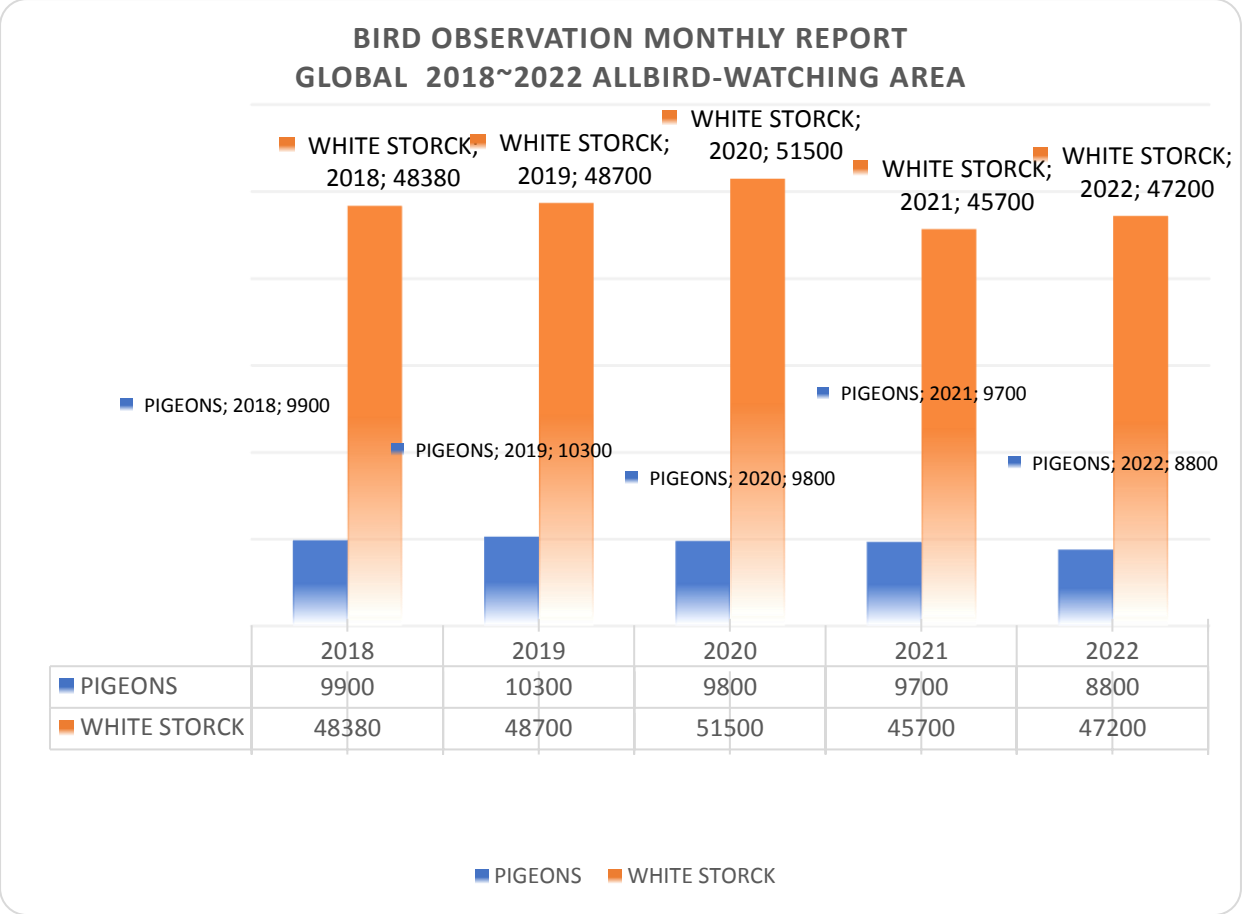


Figure 15: Total number of birds observed in the Bird-watching area

Conclusion & Future Work

After acknowledging the limitations of the current research, it is crucial to explore new perspectives and opportunities for further studies to address the issue of bird strikes and involve a multi-stakeholder ecosystem. In this concluding section, recommendations for future work are provided, focusing on targets, interaction, and vision for the three main stakeholders: bird control management, aircraft operators (airlines), and environmental tourism (specifically bird watching tourism), as well as climate change conferences and research and development efforts.

Recommendations

Bird hazard management and bird watching tourism are both important aspects of aviation and wildlife conservation. Here are some recommendations for each:

Airport Bird Hazard Management:

1. Conduct regular bird surveys to identify species and populations that pose a hazard to aircraft.

2. Develop an integrated bird management plan that includes measures to prevent birds from entering the airport, such as habitat modification and bird-proofing structures.

3. Use non-lethal methods, such as bird repellents and habitat management, to deter birds from airport areas.

4. Implement a wildlife strike reporting system to track bird strikes and analyze data to identify trends and patterns.

5. Train airport staff on bird identification, behavior, and management techniques.

6. Collaborate with local wildlife agencies and bird conservation groups to develop and implement effective bird management strategies.

Bird-Watching Tourism

1. Develop bird watching tours led by knowledgeable guides who are familiar with local bird species and habitats.

2. Promote responsible bird-watching practices, such as staying on designated trails and keeping a safe distance from nesting and roosting areas.

3. Educate tourists about the importance of bird conservation and the impact of human activities on bird populations.

4. Partner with local conservation groups to support bird conservation efforts and promote sustainable tourism practices.

5. Use eco-friendly transportation and accommodations that minimize the impact on local bird habitats and ecosystems.

6. Encourage tourists to report sightings of rare or endangered bird species to local conservation organizations.

By implementing these recommendations, both airports and bird-watching tourism operators can promote safe and sustainable coexistence between birds and humans.

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تأثير إدارة مخاطر الطيور في المطارات على التغيرات المناخية وسياحة مراقبة الطيور بالتطبيق على مطار شرم الشيخ

أسامة محمد بسيوني زكى زكى أبو رفاعي أسماء علي شجاع

[1]مدير إدارة البيئة والتحكم في مخاطر الحياة البرية والطيور بمطار شرم الشيخ ومدرس بشركة المتحدة لتكنولوجيا الطيران

[2]مدير منوب مطار شرم الشيخ و محاضر بمعهد كينج ماريوط

[3]مدرس بقسم الدراسات السياحية المعهد العالي للسياحة والفنادق كينج مريوط

معلومات المقالة

الكلمات المفتاحية

سياحة مراقبة الطيور؛ اصطدام الطيور بالطائرات؛ مخاطر الطيور المهاجرة ؛ كسر السلسلة الغذائية ؛ سياحة مراقبة الطيور في جنوب سيناء ؛ اللقالق البيضاء شرم الشيخ.

(JAAUTH) المجلد ٢٤، العدد٢، (٢٠٢٣)، ص ١٤٤-١٦١.

الملخص

من المعروف أن الاصطدامات بين الطيور والطائرات تسبب خسائر كبيرة لصناعة الطيران وسياحة مراقبة الطيور، وتأثر تغير المناخ حيث أن اصطدام الطيور بجسم الطائرة يسبب خسارة كبيرة في صناعة الطيران والتنوع البيولوجي ومشاهدة الطيور للسياحة، في حين أن الاصطدام بمحركات الطائرات ومقصورة القيادة من المحتمل أن يتسبب في تحطم الطائرة، لذا يجب تزويد المطارات المصرية بالإرشادات الأولية لإعداد الدراسات البيئية، وتوفير الحلول المثلى لإدارة ومراقبة مخاطر الطيور في المطارات هي الأهداف الرئيسية لهذه الدراسة. تم اختيار مطار شرم الشيخ الدولي كمطار نموذجي يقع على نفس الخط لواحد من أهم مسارات الطيور المهاجرة بين أوروبا وأفريقيا. تم اتباع وتنفيذ نظام متكامل لإدارة مخاطر الطيور في المطارات من خلال موظفين مؤهلين ومدربين تدريباً جيداً ، وتشكيل قاعدة بيانات، وأنشطة مراقبة الطيور بما في ذلك (تعديل الموائل ، ونقل الحيوانات وتوقف السلسلة الغذائية بالمطار)، وتعزيز السلامة والثقافة البيئية. مما تلاحظ انخفاض كبير في العدد الإجمالي للطيور المرصودة بالمطار دون تأثر البيئة الطبيعية للطيور وأماكن مشاهدة الطيور، ولا سيما النوعين الرئيسيين من الطيور السكنية والمهاجرة، الحمام واللقالق البيضاء، على التوالي، على طول فترة الدراسة من ٢٠١٨ ~ ٢٠٢٢. أيضاً ، مما أدى إلى انخفاض كبير في العدد الإجمالي لضربات الطيور وشدتها خلال نفس الفترة الزمنية. خلال هذه الفترة دون تأثر سياحة مشاهدة الطيور، لوحظ أن عدد الأضرار المؤكدة لضربات الطيور قد انخفض بشكل كبير على الرغم من التسجيل المستمر لكل من الحالات المؤكدة وغير المؤكدة. ولا تزال الجهود الضخمة بقضايا ضربات الطيور لم تأت بعد. وزيادة جهود البحث والتطوير من أجل إيجاد أفضل الطرق لضمان سماء آمنة للطيران.