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Assessment Of Black Kite (Milvus Migrans) Activity Patterns And Bird Strike Risks At An Urban Airport In Nigeria

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Abstract
Bird-aircraft collisions pose significant risks to aviation safety, often resulting in severe damage, flight disruptions, and, in extreme cases, fatalities. The Black Kite (Milvus migrans), a medium-sized scavenging raptor, is frequently observed in airport environments due to its opportunistic feeding behavior and tendency to form large communal roosts. Despite the implementation of bird control measures, frequent bird strikes involving Black Kites have been reported at the Samuel Ladoke Akintola Airport in Ibadan, Nigeria. This study aims to assess the distribution, abundance, and flight behavior of Black Kites across different airport sectors to inform effective wildlife management strategies. Point transect sampling was used to monitor Black Kite activity within three airport sectors: airside, landside, and terminal building exterior. Observations were conducted from November to December 2024 at 15 designated observation points, covering morning and evening periods. Data were analyzed using descriptive statistics, Chi-Square tests, and one-way Analysis of Variance (ANOVA). Results indicated a total of 1,529 Black Kite sightings, with the highest abundance recorded in the airside sector (595 observations). Flight behavior analysis revealed that 68.9% of kites engaged in gliding, while 21.8% were observed circling, behaviors that increase collision risk. The use of pyrotechnics as a deterrent proved minimally effective, prompting further investigation into alternative mitigation measures.Given the significant presence of Black Kites, particularly in high-risk areas, interventions such as habitat modification, enhanced waste management, and advanced deterrent technologies should be explored to mitigate bird strike risks and enhance aviation safety.

Keywords: Bird Strikes, Black Kite (*Milvus Migrans*), Aviation Safety, Wildlife Management, Airport Ecology

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INTRODUCTION

Bird-aircraft collisions pose a serious threat to aviation safety, often leading to severe damage, flight disruptions, and, in extreme cases, loss of human lives [1]. The likelihood of bird strikes increases with factors such as bird size, aircraft speed, and impact location [2]. Additionally, avian behaviors like flocking and specific flight patterns further heighten the risk. The Federal Aviation Administration (FAA) records over 14,000 bird strikes annually in the United States alone [3] (Raptors, particularly the Black Kite (*Milvus migrans*), are of concern due to their size, flight behavior, and frequent presence in open landscapes, including airport environments [2]. The Black Kite is a medium-sized scavenging raptor belonging to the family Accipitridae. It has a wingspan of approximately 150 cm and is one of the most widespread and successful birds of prey, found across Europe, Australia, Africa, and Asia [4]. Its opportunistic feeding behavior, which includes scavenging on carrion and human waste, enables it to thrive in human-altered environments [5]. The species exhibits gregarious behavior, often forming large communal roosts and breeding colonies. Although classified as Least Concern by the IUCN [6], its increasing presence in urban areas, including airports, presents a growing challenge for aviation safety.

Black Kites are commonly found around airports, attracted by food waste and open spaces, which pose a significant risk to aircraft operations. Their tendency to fly in large flocks at low altitudes increases the probability of bird strikes, particularly during critical flight phases such as takeoff and landing. These collisions have severe economic and safety consequences, costing the civil aviation industry billions of dollars annually in damages and operational disruptions [2, 7]. Given these risks, understanding the behavior and movement patterns of Black Kites is essential for implementing effective mitigation strategies to enhance aviation safety [8]. At the Samuel Ladoke Akintola Airport in Ibadan, Nigeria, frequent

bird strikes involving Black Kites have been reported, despite existing bird control measures [9]. The airport's proximity to urban areas and waste disposal sites serves as an attraction, increasing the presence of these birds and elevating the risk of collisions. However, there is a lack of comprehensive studies on Black Kite activity at Nigerian airports. While global research on bird strikes exists [2, 7, 10], site-specific investigations focusing on Black Kites in Nigerian aviation contexts remain limited.

This study seeks to address the knowledge gap by investigating the activity patterns of black kite across different sectors of the airport. By analyzing these aspects, the research will offer critical insights into aviation safety, enabling the development of evidence-based strategies to reduce bird strike risks and enhance wildlife management at airports. Also, it will contributes to inclusive sustainable development by integrating environmental science with practical business and management applications that support both biodiversity conservation and operational safety.

MATERIALS AND METHODS

Study Area

Samuel Ladoke Akintola Airport is in Egbeda Local Government Area, Ibadan, Oyo State, Nigeria. Geographically, it lies at latitude 7.362°N and longitude 3.9780°E, with an average elevation of 1,103 meters (3,619 feet) above sea level (fig 1). The airport features a single runway measuring 2,600 meters (8,530 feet) in length and 45 meters (148 feet) in width [9]. Designed to accommodate both passenger and cargo operations, the airport's terminal building has undergone multiple infrastructural upgrades to enhance its service capacity. Currently, it serves a limited number of domestic airlines, including Overland Airways, Green Africa Airways, and Air Peace, offering connections to major cities such as Lagos and Abuja. Arik Air, formerly operational at the airport, has suspended its services.

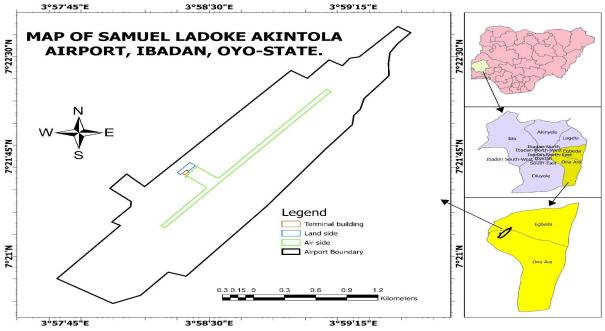

Figure 1: Map of Samuel Ladoke Akintola Airport with the sectors

Data Collection

Point transect sampling was used to assess the distribution and abundance of Black Kites (*Milvus migrans*) at Samuel Ladoke Akintola Airport. To ensure comprehensive coverage, the airport was stratified into three main sectors based on its existing components: the airside, landside, and terminal building exterior. This approach allowed for a systematic assessment of the species' presence across different areas of the airport. Various materials were used during the survey, including binoculars for visual observations, an acoustic recorder to capture vocalizations, and a camera trap to document activity. Additional tools such as a stopwatch, meter rule, and recording sheets were employed to ensure accurate data collection. We established five fixed observation points within each of the three sectors, with a minimum distance of 100 meters between points, resulting in a total of fifteen observation points. Observations at each point lasted for ten minutes, during which sightings and vocalizations of Black Kites were recorded. Additionally, two observation points in each sector were specifically designated to monitor flight patterns, including flying and perching behaviors, over a one-hour period. Direct observations were also conducted to document feeding behavior, feeding sites, and peak feeding times. Data collection was carried out three times a week, covering both morning (07:00–10:00 hrs) and evening (15:00–18:00 hrs) observation periods. The study was conducted for two months, from November to December in 2024, to capture variations in activity patterns and habitat use.

Data Analysis

The total number of estimated individuals of the Black kite for each sector was pooled together after the period of two (2) months. Statistical analysis was performed to assess frequency distribution and abundance of Black Kites within each sector, as well as their flight pattern and behaviour. Data collected during this study was subjected to descriptive analysis with the use of frequency, percentage, crosstabulation, bar charts. Chi-Square Test, and one-way Analysis of variance (ANOVA) was used to analyse the differences.

RESULT

A total of 1529 Black Kite species were encountered, and a single Black Kite was recorded most frequently (725 times), followed by sightings of two birds (436 times). Larger groups were observed less frequently, with the largest recorded flock consisting of 30 individuals. The highest number of sightings was recorded in the Airside sector (595), followed by Landside (469) and Terminal Building Exterior (465). The most frequently observed were single kites (725 occurrences), with occasional sightings of larger groups, up to 30 individuals (figure 1). Table 3 shows Black Kites across three airport sectors: Landside, Airside, and Terminal Building Exterior. The highest mean abundance was recorded in the Airside sector (2.60 ± 2.698), while the lowest was in the Landside sector

(1.98 ± 2.046). A significant difference exist in the abundance of black kites across the different sectors of the airport. The observed flight behavior of Black Kites at Samuel Ladoke Akintola Airport indicates that the majority (68.9%) spend time gliding, while 21.8% engage in circling, both of which pose potential risks to aircraft operations. A smaller proportion (3.4%) were seen flocking together, while only 0.2% were flying individually or combining gliding and circling. Perching behavior was also noted, with 4.4% resting on various structures and 0.6% on wires. Notably, only 0.1% responded to pyrotechnics, suggesting limited effectiveness of this deterrence method (table 3). Gliding was the most common flight behavior of Black Kites, occurring most frequently at the Airside (16.5%), followed by the Landside (14.8%) and Terminal Building (13.8%). Perching was also prevalent, particularly at the Terminal Building (8.0%), while circling was most observed at the Airside (6.6%). Flocking together was rare but more frequent at the Airside (1.4%) compared to other locations. Flying individually, perching on wires, and soaring were minimal. Additionally, the use of pyrotechniques caused some birds to disperse at the Terminal Building (0.1%), indicating a potential deterrent effect. These results highlight higher Black Kite activity in the Airside and Terminal Building areas, emphasizing the need for targeted wildlife management (table 4).

Table 1: Frequency of Black Kite Observations at Samuel Ladoke Akintola Airport

Number of Black Kites Observed	Frequency
1	725
2	436
3	161
4	52
5	49
6	23
7	24
8	8
9	10
10	8
11	4
12	1
13	4
14	1
15	12
16	5
20	4
26	1
30	1

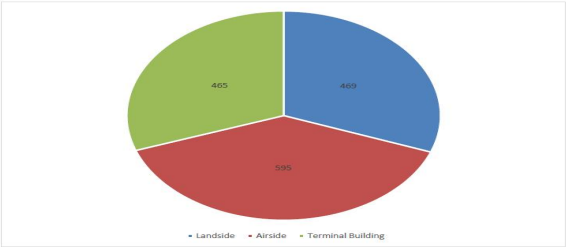

Figure 1: Number of Black kites sighted across the different sector

Table 2: Black Kite Abundance Across Different Sectors

Sector / Location	N (Sample Size)	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean
Landside	470	1.98	2.046	0.094	1.79 – 2.16
Airside	595	2.60	2.698	0.111	2.39 – 2.82
Terminal Building	465	2.39	2.915	0.135	2.12 – 2.65
Total	1,530	2.35	2.600	0.066	2.22 – 2.48

Table 3: Flight Behaviour of Black Kites at Samuel Ladoke Akintola Airport

Flight Behaviour	Frequency	Percentage (%)
Circling	334	21.8
Flocking Together	59	3.4
Flying Individually	3	0.2
Gliding	1053	68.9
Gliding and Circling	3	0.2
Perching	67	4.4
Perching on Wire	9	0.6
Running from Airside Due to the Use of Pyrotechnics	1	0.1
Soaring	2	0.1

Table 4: Cross-tabulation of Flight Behaviour of Black Kites and Location

Flight Behaviour	Landside	Airside	Terminal Building
Circling	97 (4.1%)	154 (6.6%)	96 (4.1%)
Flocking together	11 (0.5%)	31 (1.4%)	17 (0.8%)
Flying individually	0 (0.0%)	0 (0.0%)	3 (0.1%)
Gliding	347 (14.8%)	388 (16.5%)	324 (13.8%)
Gliding and circling	1 (0.0%)	1 (0.0%)	1 (0.0%)
Perching	170 (7.2%)	141 (6.0%)	188 (8.0%)
Perching on electric wire	0 (0.0%)	0 (0.0%)	2 (0.1%)
Perching on wire	1 (0.0%)	4 (0.2%)	4 (0.2%)
Running from airside due to pyrotechniques	0 (0.0%)	0 (0.0%)	2 (0.1%)
Soaring	0 (0.0%)	2 (0.1%)	0 (0.0%)

DISCUSSION

A total of 1530 Black Kite species were encountered with the most frequent sighting involving a single Black Kite (725 occurrences), followed by two individuals (436 times) and three individuals (161 times), suggesting that they are commonly observed in smaller groups. Although larger flocks were less frequent, sightings of up to 30 individuals demonstrate that Black Kites occasionally form sizable gatherings. Their total count (1,529) was significantly higher, reinforcing their dominance in the airport environment. This finding is consistent with Cleary and Dolbeer (1), which notes that airports with nearby water features, grasslands, food sources, and waste disposal facilities are known to attract bird populations.

The study reveals a variation in Black Kite abundance across different sectors of Samuel Ladoke Akintola Airport, with the highest concentration observed in the Airside. This sector provides an open landscape with minimal human disturbance, making it an attractive

habitat for foraging and perching [13]. However, the significant presence of Black Kites in this critical aviation zone poses a serious bird strike risk, emphasizing the need for mitigation strategies.

The Terminal Building exterior also recorded a notable presence of Black Kites, likely due to food waste and suitable perching structures. While this area does not directly interfere with aircraft movement, it necessitates improved waste management and deterrence measures to reduce bird attraction. The Landside sector had the lowest abundance, likely due to higher human activity and limited food availability, though occasional sightings indicate some level of usage.

To enhance aviation safety, targeted management strategies such as habitat modification, waste control, and bird deterrent techniques must be implemented in high-risk areas. Understanding species distribution within airport environments is essential for developing effective wildlife management strategies that minimize bird strike risks while maintaining ecological balance.

The higher abundance of Black Kites in the Airside and Terminal Building sectors underscores the need for proactive mitigation strategies to reduce the risk of bird strikes. Black Kites are opportunistic feeders, often scavenging for food near human settlements. Their predominant gliding and circling behavior suggest they are likely scanning for food sources, which may include waste or prey attracted to the airport environment. Effective management should focus on improving waste disposal practices to eliminate food attractants, modifying habitats to make them less suitable for perching and roosting, and implementing bird deterrent techniques such as falconry, bio-acoustic deterrents, or laser technology.

Our study mirrors that of Naoroji (14), with high occurrence of gliding (68.9%) and circling (21.8%) suggests that Black Kites spend a significant amount of time in the airspace, which poses a bird-aircraft collision risk. This also supports the fact that black Kites are masters of energy-efficient flight, using thermal updrafts to achieve altitude with minimal energy expenditure [13]. Birds that glide and circle tend to remain at higher altitudes, potentially overlapping with aircraft flight paths during takeoff and landing. The presence of even small numbers of birds flying individually (0.2%) or in flocks (3.4%) could also pose a hazard for aircraft operations.

The low frequency of birds responding to pyrotechnics (0.1%) suggests that deterrent measures such as loud noises may not be very effective in dispersing them from the airside. This could indicate habituation to control measures, requiring the introduction of alternative or more aggressive deterrence strategies [8,15].

The fact that 4.4% of birds were observed perching and 0.6% were perching on wires indicates that some Black Kites remain in the airport environment rather than just passing through. This could be due to the availability of food resources, such as waste from airport operations or nearby landfills, as well as the presence of suitable structures for perching. The presence of perching birds suggests that modifying the airport landscape (e.g., reducing perching sites and food availability) could help discourage kites from settling in the area.

Only one Black Kite (0.1%) was observed running from the airside due to the use of pyrotechnics. This low response rate suggests that pyrotechnic deterrents may not be a highly effective method for controlling bird presence at the airport. Black Kites may have adapted to these disturbances over time, indicating a need for more integrated bird control measures, such as habitat modification, falconry, or the use of trained dogs to scare birds away.

The findings from this research also emphasized the importance of understanding ecological adaptability of Black Kites. Krüger and Amar (13) note that Black Kites show exceptional adaptability in urban environments, swooping down to scavenge food scraps or scavenging at trash sites. The results from this study also reveal variations in the movement patterns of Black Kites influenced by the environment, with gliding being the most frequent behavior across all sectors.

This study provides critical insights into the behavior, abundance, and spatial distribution of Black Kites within the Samuel Ladoke Akintola Airport environment. It highlights the species' dominance in key airport zones, particularly the Airside and Terminal Building areas, emphasizing their preference for open spaces and proximity to food sources. The identification of high-risk sectors for bird activity contributes significantly to aviation safety by informing the development of targeted bird strike strategies, such as habitat modification, improved waste management, and alternative deterrence methods. Moreover, the behavioral observations, particularly the prevalence of gliding and circling—underscore the potential overlap between bird flight patterns and aircraft operations, reinforcing the need for continuous ecological monitoring and adaptive management practices in airport settings.

Despite its valuable contributions, the major focus was on Black Kites which overlook the interactions with or influence from other bird species that might also contribute to bird strike risks. In addition, while the

research documents the inefficacy of pyrotechnic deterrents, it does not experimentally test or compare the effectiveness of alternative control measures such as falconry or habitat manipulation. Lastly, the findings are site-specific, and while they reflect broader ecological behaviors, generalizing the results to other airports or regions may require caution and further comparative studies. As a result, we encourage future research to explore these areas.

CONCLUSION

The high Black Kite activity, particularly in the Airside and Terminal Building areas, poses a significant risk to aviation safety due to potential bird strikes. The frequent gliding and perching behaviors suggest that these locations provide suitable conditions for the birds, which may necessitate habitat modifications such as reducing perching structures and food sources. The observed response to pyrotechniques indicates that deterrent measures can be effective in certain areas, but sustained management strategies are needed to minimize bird presence in critical flight zones. Implementing targeted wildlife control measures and addressing habitat and food availability around the airport, along with alternative deterrent measures, could help reduce the presence of Black Kites and minimize risks to aviation safety. The paper contributes to inclusive sustainable development by integrating environmental science with practical business and management applications that support both biodiversity conservation and operational safety.

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