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Bird Strike Prevention Systems: The Case of Istanbul Airport*

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Abstract

Throughout history, humans have desired to fly. To achieve flight, they have observed birds and taken them as models. With the advancement of technology, airplanes have become one of the most commonly used modes of transportation today. The incident known as bird strike has taken its place in the literature as one of the factors endangering flight safety. While bird strikes have various causes, various measures are taken to minimize this incident. This study attempts to explain the reasons for bird strikes. Additionally, the methods implemented by Istanbul Airport, one of the busiest airports in Europe, to prevent bird strikes are explained. Following a comprehensive literature review, interviews were conducted with the Operations Director and appointed Ornithologists at Istanbul Airport to gather information about the methods employed. Various methods for deterring birds have been identified at Istanbul Airport. These methods are explained in detail.

Keywords: *Bird Strikes, Aviation Safety, Istanbul Airport, Wildlife Management*

Kuş Çarpması Önleme Sistemleri: İstanbul Havalimanı Örneği

Özet

Tarih boyunca insanlar uçmak istemişlerdir. Uçmak için ise kuşları izleyerek, kendilerine örnek almışlardır. Teknolojinin gelişmesiyle birlikte de günümüzde uçaklar en çok kullanılan ulaşım araçlarından birisi haline gelmiştir. Kuş çarpması olarak adlandırılan olay ise uçuş emniyetini tehlikeye sokan faktörlerden birisi olarak literatürde yerini almıştır. Kuş çarpmasının türlü sebepleri bulunmakla beraber bu olayı en düşük seviyede tutmak için çeşitli önlemler alınmaktadır. Bu çalışmada kuş çarpmalarının sebepleri açıklanmaya çalışılmıştır. Aynı zamanda Avrupa'nın en yoğun havalimanlarından birisi olan İstanbul Havalimanının kuş çarpmalarını önlemeye yönelik gerçekleştirmiş olduğu yöntemler açıklanmıştır. Çalışmada kapsamlı bir literatür taramasının ardından İstanbul Havalimanı Operasyon Direktörü ve görevli Ornitologlar ile görüşme yapılmış yöntemleri hakkında bilgiler alınmıştır. İstanbul Havalimanında kuşların uzaklaştırılması için çeşitli yöntemlerin kullanıldığı tespit edilmiştir. Bu yöntemler ayrıntılı şekilde açıklanmaya çalışılmıştır.

Anahtar Kelimeler: *Kuş Çarpmaları, Havacılık Emniyeti, İstanbul Havalimanı, Yaban Hayatı Yönetimi*

Jel Classification: *R40, Q57*

JEL Sınıflandırması: *R40, Q57*

Araştırma ve Yayın Etiği Beyanı: *Bu çalışmada, araştırma ve yayın etiği kurallarına uyulduğu yazarlar tarafından taahhüt edilmektedir.*
Yazar Katkı Oranları: *Birinci yazarın katkı oranı %60; İkinci yazarın katkı oranı %40*
Çıkar Beyanı: *Yazarlar açısından ya da üçüncü taraflar açısından çalışmadan kaynaklı çıkar çatışması bulunmamaktadır.*
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*** Sorumlu Yazar*

1. Introduction

Throughout history, humans have sought to emulate birds to fly. In the earliest attempts at flight, systems resembling the wing structure of birds were used. However, despite all these efforts, one of the most significant factors jeopardizing flight safety today is the phenomenon known as bird strikes. It is a contradiction that while humans have learned from observing birds to master aviation, birds now pose a threat to flight safety. When we consider it, it's a great injustice to birds. We collide with a living creature in its natural habitat at high speed and then claim that the creature hit us (Çoban, 2017: 46). However, while bird strikes cause considerable damage to aircraft, they have also resulted in the loss of human lives (Hedayati, Sadighi, & Aghdam, 2014: 260). In the English literature, bird strike is the term used to describe bird aircraft collisions (Metz et al., 2020: 2).

The first motorized flight known to history was accomplished by the Wright brothers in 1903 (Vos et al., 2002: 604), and in 1908, during Orville Wright's flight tests in Ohio, USA, a collision occurred between an airplane and a bird, which is now referred to as the first recorded bird strike incident. The first known fatal collision occurred in 1912. On April 3, 1912, in Long Beach, California, Calbraith Perry Rodgers, the first person to fly across the United States by plane, crashed into the sea, drowning after his aircraft's controls jammed due to a collision with a seagull (ICAO, 2012: 1-1). The first major fatal accident occurred on October 4, 1960, at the Boston Logan International Airport. A Lockheed Electra L188 aircraft collided with a flock of starlings during takeoff, with birds entering three of the aircraft's four engines, causing it to lose power, stall, and crash into the sea. Of the 72 passengers and crew on board, 62 lost their lives (ICAO, 2012: 1-1). Another notable incident resulting from a bird strike, which entered the literature, is the US Airways Flight 1549 crash, which is famously depicted in movies. On January 15, 2009, an Airbus A320 aircraft belonging to US Airways, shortly after taking off from New York's LaGuardia Airport, collided with a flock of geese, causing both engines to catch fire, leading to a forced landing on the Hudson River. Due to the skill of the crew, there were no fatalities in this crash, but the aircraft suffered damage (Marra et al., 2009: 297). As seen from these accidents, bird strikes result in incidents causing either material damage or loss of life. Among accidents involving wildlife, bird strikes are the most common. Globally, nearly 450 people and thousands of birds have lost their lives due to bird strikes, with many aircraft suffering material damage (Sarı et al., 2022: 375-376). It is estimated that the global aviation industry loses approximately 1.2 billion US dollars annually due to bird strikes (Allan & Orosz, 2001: 219).

Collisions occur at various stages of flight, with 96% of collisions occurring during takeoff, climb, approach, and landing. Collisions in flight are much less common, but 34% of them result in damage when they occur (Bird Strike Damage & Windshield Bird Strike Final Report, 2008: 4). According to the Federal Aviation Administration (FAA) report, the number of collisions caused by wildlife has been increasing in recent years in the United States and other regions (FAA, 2023). There are various reasons for this dramatic increase in collisions from the 1960s to the present. First, the emergence of turbine-powered passenger aircraft in the 1960s was significant. The piston-powered aircraft used earlier were very noisy and slow, but modern jet aircraft are much faster and quieter, eliminating opportunities for birds to escape. Second, the ingestion of bird flocks by multi-engine aircraft became more significant as these aircraft suffered more damage, leading to concerns. As a result, commercial airlines replaced their fleets with two-engine, quieter aircraft (Dolbeer, 2013: 1-2). Third, increasing air traffic is a contributing factor. There has been a constant increase in air traffic since the 1950s. Paid passenger kilometers are shown in Figure 1 according to ICAO data (ICAO, 2023).

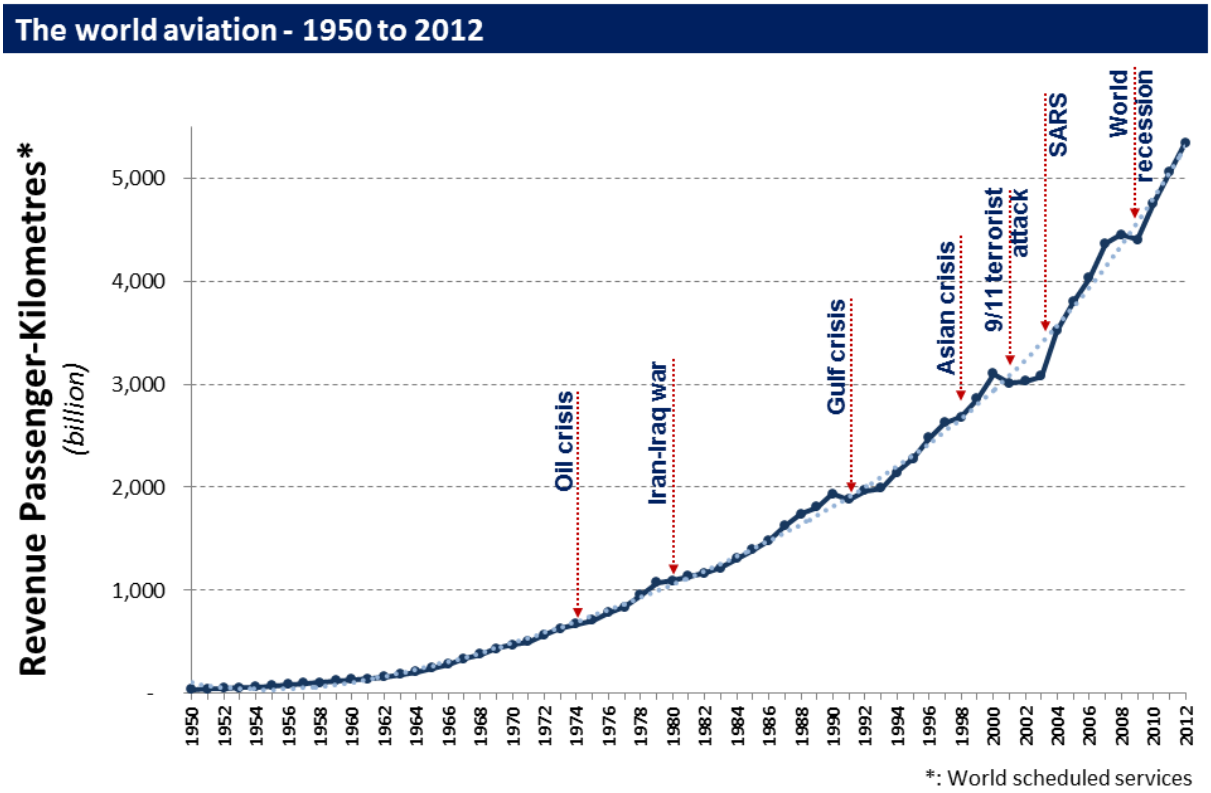

Figure 1: World Aviation (https://www.icao.int/sustainability/pages/facts-figures_worldeconomydata.aspx)

As seen in Figure 1, despite occasional crises during certain periods, aviation has been continuously developing since the 1950s, and air traffic has been increasing. Because of the increase in air traffic, despite sharing the same space with birds, the increasing number of aircraft in this area leads to more collisions. When examining bird collisions with aircraft, it is necessary to consider the behavioral characteristics of birds. Although it varies by species, birds are likely to flee from aircraft that they perceive as threats. Birds are highly skilled at detecting sound and color, but changes in feeding habits, diseases, and environmental conditions have made it difficult for them to distinguish sounds and colors, hindering their avoidance of aircraft. Recent studies have shown that bird strikes could decrease if carriers paint their aircraft in darker colors rather than white. In addition, in cases of reduced traffic at airports, birds may be less vigilant against aircraft, leading to an increase in bird strike incidents in those areas (Çoban, 2017: 48-49). Especially during the COVID-19 pandemic, many airports suspended their operations. As a result, birds may become accustomed to these areas and no longer perceive aircraft as a threat. In such cases, the relevant airports must take necessary precautions. The increase in bird strikes results in an increase in accidents, leading to more loss of life, financial losses for airlines, and a faster approach to extinction for bird species. To prevent all of these, both airlines and airports must take various measures.

This study examines bird strike prevention systems used worldwide and at Istanbul Airport. Turkey hosts birds of different species because of its diverse climatic regions. Approximately 465 bird species are found within the borders of Turkey. Approximately one-fourth of these species consist of migratory birds that do not breed in Turkey and only come during the winter months. Among these birds, 11 species are listed on the International Union for Conservation of Nature (IUCN) Red List. The number of birds in Istanbul exceeds three hundred, with over two hundred species breeding in Istanbul. Many areas in Istanbul are important feeding and nesting areas for birds. These areas include the Terkos Basin, Büyükçekmece Lake, Küçükçekmece Basin, Bosphorus, Princes' Islands, and the shores of Şile (Wikiwand, 2023). The number of birds in Istanbul exceeds three hundred, with over two hundred species breeding in Istanbul. Many areas in Istanbul serve as important feeding and nesting grounds for birds. These areas include the Terkos Basin, Büyükçekmece Lake, Küçükçekmece Basin, Bosphorus, Princes' Islands, and the shores of Şile (Howtoistanbul, 2023).

2. Attractions for Birds at Airports

There are certain places at airports that attract birds. When considering the possible factors that attract birds to airports, these include: water sources, food sources, and shelter (ICAO, 2012: 7-1).

Food Sources

It is known that wildlife and birds come to these areas to feed on grasses, fruits, seeds, invertebrates, small mammals, rodents, and waste from catering companies found at airports. Eliminating these food sources at airports is quite challenging because the vegetation cover of most airports consists of grasslands. Due to the difficulty in removing these vegetation covers, it is challenging to prevent birds from coming to these areas (ICAO, 2012: 7-1).

Water Sources

Just as food sources attract wildlife, water sources can also attract these animals. Surface waters often catch the attention of birds. Large masses of water, such as drainage ditches at airports, should be enclosed with fences or nets to prevent birds from landing. For water bodies that cannot be removed, there should be access roads for personnel to intervene in bird situations. Moreover, water bodies that cannot be removed may attract insects and other aquatic creatures to the area, thus serving as a food source for birds. To solve these problems, water channels or ditches should be covered with grates or similar covers (ICAO, 2012: 7-2).

Shelter

Birds and other wildlife typically seek shelter and breeding areas in hangars, beams of other structures, recesses, trees, and bushes at airports. Some waterfowls, such as geese, also seek safe open areas to rest (ICAO, 2012: 7-2). In particular, in airports with lower density, relatively open areas and quiet environments may attract wildlife and birds. Unused areas in airports also draw the attention of these creatures.

Istanbul Airport

Istanbul Airport is on the migration route of birds traveling from Africa to Europe. This situation poses a risk to flight safety. The risks that birds pose to flight safety are also included in the assessment reports prepared by İstanbul Grand Airport (İGA). According to the assessment, there is local bird activity throughout the year, with fewer migratory birds. It is noted that bird species such as seagulls, crows, pigeons, and sparrows, which pose a risk to flight safety, are present in the residential areas around the

airport (Köken, 2018). Although the exact numbers of migratory birds cannot be determined, it has been found that the number of storks counted during autumn migration is between 250,000 and 500,000. In surveys conducted in spring and autumn, approximately 80,000 birds, including 30,000 hawks, 20,000 buzzards, and 20,000 small forest eagles, were counted. In summary, the bird counts from previous studies indicate a minimum of 500,000 storks and 25,000 black storks, as well as a minimum of 250,000 birds of prey (Environmental Impact Assessment Report for Istanbul Airport, 2013:162). The safety bulletin prepared by Istanbul Airport also specifies what needs to be done to combat bird movements and wildlife that could pose a danger to the airport. The bulletin mentions the times when birds are observed and migration periods. According to this report, the spring migration period is March-April-May. It is noted that there is a potential to encounter large flocks of storks, eagles, and hawks moving in the west-northwest direction between March 1 and May 31, from 10:00 to 18:00. During the autumn migration period, bird movement is observed from August to November. Again, according to this report, there is a potential to encounter large flocks of storks, eagles, and hawks moving in the east-southeast direction between September 5 and October 31, from 10:00 to 18:00 (Istanbul Airport Safety Bulletin, 2019: 1).

One of the factors attracting birds to airports was water sources, as indicated in the Environmental Impact Assessment reports. It is stated in the reports that there are approximately 70 small and large water accumulations near Istanbul Airport. Among these water accumulations, Terkos Lake is located 2.5 km northwest of the airport (Environmental Impact Assessment Report for Istanbul Airport, 2013:42). With an area of 41.7 km², Terkos Lake is the most important wetland in the region and a point where water birds are frequently seen (Tolunay, 2015:233). Additionally, the garbage collection center near Istanbul Airport meets the food needs of birds and has increased their visits to this area, leading to the closure of this area (Keskin vd., 2021).

Deterrent Techniques

Bird strikes generally occur at airports and their surrounding areas. The distribution of bird strikes according to flight phases between 2008 and 2015, as expressed in Figure 2, is as indicated (ICAO, 2017: B-4).

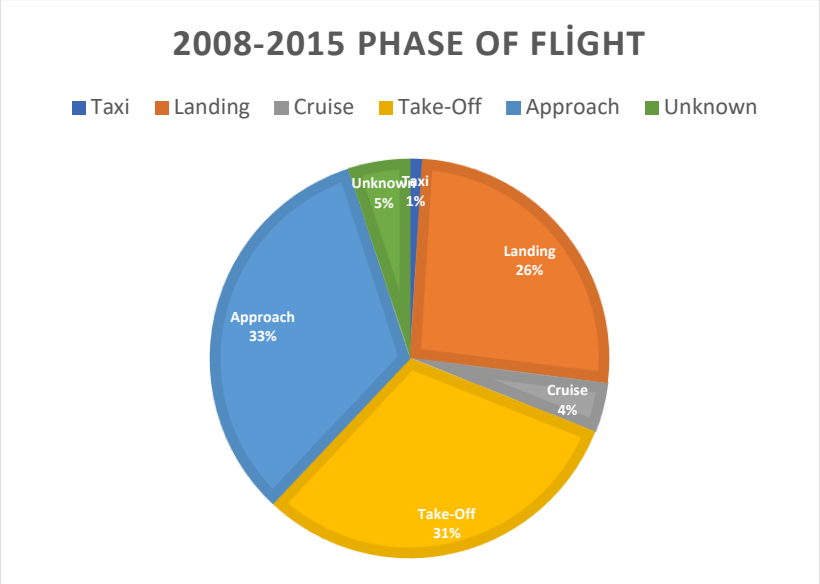

Figure 2: Distribution of bird strikes according to flight phases (ICAO, 2017: B-4).

As illustrated in Figure 2, between 2008 and 2015, 33% of bird strikes occurred during approach, 31% during take-off, and 26% during landing. Considering these statistics, it becomes evident that preventive measures should primarily focus on areas in and around airports.

For the safety of both birds and flights, all elements that attract birds to airports and their surroundings should be eliminated. In addition, various repellent techniques should be employed to deter birds that have habituated to these areas and perceive them as shelters.

Repellent techniques constitute a crucial element in wildlife control at airports. These techniques functions by influencing animals' senses through chemical, auditories, or visual means. However, a significant challenge arises because many birds and mammals can become accustomed to mechanical repellent techniques. With repeated use, wildlife quickly learns that these repellents or techniques pose no threat, leading them to ignore the deterrents. There are several factors to consider when using repellent techniques (ICAO, 2012: 8-1):

• There is no one-size-fits-all solution to all problems.
• There are no best procedures or standard protocols for all situations. Wildlife management is both a science and an artform.
• Each wildlife species is unique and often responds differently to various measures. It is necessary to adapt techniques according to the species.

The methods generally used to deter birds are outlined in ICAO Document 9137 as follows: patrols, chemical repellents (some nations do not permit this method), auditory repellents, visual repellents, the use of trained falcons or dogs, radio-controlled model aircraft, and the use of non-lethal ammunition. Balicki et al. listed methods for bird deterrence as fireworks, automatic gas guns, firearms, sounds of predatory animals, sounds of animal distress, chemicals, trained predatory birds and dogs, and the use of motorized equipment to drive away flocks (Balicki et al., 2021: 105).

3. Methodology

Interviews are a frequently used data collection method in qualitative research (Punch, 2005). Semi-structured interviews, on the other hand, represent an open-ended interview technique (Creswell, 2021). In this study, the semi-structured interview method was adopted. Within the scope of the interviews, Istanbul Airport was visited. A visit was made to Istanbul Airport on January 19, 2023, to obtain information through discussions with the Wildlife Management team, which frequently comes into discussion due to bird migration paths during construction. The meeting was conducted with the Istanbul Airport Operations Directorate and the assigned ornithologists.

4. Results

This section discusses the findings that emerged as a result of the investigations carried out. Based on the discussion, it was noted that one of the most significant features that sets Istanbul Airport apart from other airports is the presence of four full-time ornithologists dedicated to these tasks. Additionally, it was indicated that all 32 Follow-me and Safety vehicles are equipped with the necessary gear for bird deterrence. It was stated that there is always one vehicle ready at each runway 24/7, with two vehicles mobilized for immediate intervention. They also mentioned closely monitoring developments at airports worldwide and implementing new methods as they emerge. They expressed their contribution as authors to the Wildlife Management Guide published by ACI and renewed in 2022, indicating the position of

the Istanbul Airport Wildlife Management Unit. Furthermore, activities such as environmental management and bird monitoring within a 13-km radius around the airport, perimeter fence and drain inspections, risk assessments, habitat management, wildlife control records, pyrotechnic methods, hazard calls, laser, vehicle chasing/dispersal, manual dispersal, bird balls, lethal control, and other wildlife dispersal methods were mentioned. As observed, multiple methods are employed for bird control. The methods used are summarized below on the basis of discussions and observations.

Pyrotechnics (Signal Pistol)

The pyrotechnic method should be applied with particular consideration for the possibility of fire, especially during hot weather. Only trained individuals wearing personal protective equipment should use this method. Air traffic controllers should be informed when this method is being used, and attention should be paid to the surrounding environment. There should be no aircraft in the area where this method is used. It is particularly effective for bird species gathered in flocks. It has been observed that firing a signal flare in a specific direction can drive bird flocks in that direction.

Hazard Calls

Hazard calls are particularly effective for gull, crow, and swift flocks. Birds hearing these sounds tend to fly from their location to where the call originates. The volume of the sound is crucial; excessively loud sounds can cause birds from outside the airport area to migrate to the designated zone, posing a problem. Hazard calls should be sounded within a timeframe in which birds have the opportunity to investigate the source of the sound, but this should not exceed 90 s in a single instance. To make hazard calls more convincing to birds, some deceptive traps can be used in conjunction with these calls, suggesting that a bird of the species is injured. When employing this method, the positions of aircraft during take-off or landing should be considered, and flight safety should not be compromised.

Laser

Before using lasers at the airport, both the airport and surrounding units should be notified. It should always be kept in mind that laser beams can spread up to 1500 m and even farther, and the manufacturer’s recommendations should be followed in this regard. Directing the laser beam in the desired direction can help drive away birds. Birds generally tend to fly in the opposite direction of the laser beam. If the birds do not respond to the laser, alternative methods should be applied. Some lasers have an automatic shutdown feature when the beams are raised from the horizontal to a certain degree upward. The lasers used by IGA have this feature. Especially in low light conditions and over long distances where it is not possible to scare birds away by other means due to aircraft movements, lasers are a very effective deterrent method.

Vehicle Chase/Harassment

In some cases, it may be necessary to chase birds with a vehicle. Care must be taken to observe the surrounding safety precautions during these maneuvers. In certain situations, the use of sirens and horn systems on vehicles can be an effective method of harassment. However, vehicles may create depressions in their areas, and attention should be paid to this because these areas may become attractive to birds if filled with water.

Manual Disturbance

Personnel exiting vehicles can attempt to deter birds from the airport by waving their arms in the air. In addition, clapping hands can be a fast and effective method. It is important to pay attention to environmental conditions and prioritize personal safety when using this method.

Bird Bangers

This system operates on the basis of the sound of the compressed gas producing an explosion. It can be installed in open areas around the runway where birds are frequently present. The installation should be adjusted according to bird densities, and the frequency of explosion sounds should be controlled.

Lethal Control

Lethal control is generally used when other methods fail. The primary weapons used for lethal control at the airport are air rifles/pistols and shotguns. The firearms used for lethal control are stored in accordance with the regulations outlined in Law No. 2521 on the Manufacture, Acquisition, Sale, and Possession of Rifles, Pistols, and Hunting Knives Used in Hunting and Sports, published in Official Gazette numbers 17629 and 27208. This method should be implemented by Gendarmerie personnel who have received proficiency training and training on the use of firearms in airspace.

Other Wildlife Dispersal Methods

Especially during certain months, bees that give birth can nest in areas such as under aircraft, jet bridges, and locations where materials are stored for extended periods. In the event of such occurrences being noticed, external beekeepers should be brought in to remove the bees from the area. In cases of potential increases in locust populations during summer months, chemical dispersal should be conducted with the assistance of relevant units to remove them from the area. Additionally, bat populations typically increase during the late autumn season, requiring their removal from these areas. In such cases, support should be sought from the relevant units. Occasionally, snakes may be observed in parking and taxiway areas, and in such instances, assistance should be sought from the relevant units. Moreover, mammals such as cats, dogs, and foxes are also encountered in certain areas. When these animals are identified, wildlife control personnel should facilitate their exit through an appropriate opening, if available, or capture them using trapping devices.

Bird Radar

Bird radar positioned at an appropriate location enables the determination of the locations and movement patterns of birds. By monitoring and collecting data 24/7, this method aims to understand the routines of birds, although it may not directly assist in bird dispersal. Nevertheless, it can serve as a precursor to measures in wildlife and risk management.

Environmental Management and Bird Monitoring within 13 km of the airport

Wildlife monitoring personnel will monitor key points around the airport, such as garbage dumps, wetlands, and catering waste disposal areas. The Airside Operations Directorate will report to higher authorities and request recommendations or restrictions for the airport and surrounding areas to prevent bird attraction. Bird species and average numbers around the airport will be regularly recorded and used for analysis when necessary. The observation data obtained from monitoring will be entered into the IGA.ASOP.OPR01.F07 Wildlife and Bird Control Report Form and reported regularly.

Habitat Management

Habitat management plays a crucial role in preventing bird feeding and nesting activities at airports. Landscape activities are crucial in this regard and should be implemented under the leadership of the Environmental and Landscape Directorate. When conducting landscaping work, factors such as plant species that provide suitable habitat and food sources for wildlife and appropriate grass length, etc., should be considered. If there are plants in the area that increase wildlife activity, activities such as spraying and pruning should be implemented.

Wildlife Control Records

All observations of wildlife within and around the airport must be recorded by the Wildlife Control Personnel. Following the recommendations of the ICAO International Bird Strike Committee, wildlife records should be recorded every 30 min using the Wildlife and Bird Control Report Form. If no control activity or bird activity is observed within a 30-min period, it should be recorded as "no birds" in the form. This form should include the following:

- ✓ Name and surname of Wildlife Control Personnel / Operation personnel
- ✓ Start and end times of the shift
- ✓ Weather conditions
- ✓ Observation time
- ✓ Observation area
- ✓ Species
- ✓ Number
- ✓ Behavior (feeding, flying, resting, etc.)
- ✓ Method of control
- ✓ Number of shots fired (in conditions where pyrotechnic and/or lethal control techniques are used)
- ✓ Response to the control method (outcome)
- ✓ Direction of escape
- ✓ In the case of no activity observed, the report should be filled out as "no birds."
- ✓

Airport Fences and Drain Grate Controls

Gaps in the fences that separate the airport from the outside world and in the drain grates at the rainwater drainage system openings can allow entry for mammals such as cats, dogs, and foxes. Immediate intervention is required at these points to prevent any disruptions to flight safety. Additionally, because these points can provide food and water for birds, continuous inspections should be carried out.

5. Conclusion

In conclusion, a species that has long dominated the skies and served as an example for human flight now appears to be one of the greatest threats to flight safety. In this regard, the most important measure for the safety of both sides is preventive activities. Istanbul Airport has examined airports from all over the world for these activities and implemented all effective methods that could be applicable. During the discussions, it was clearly stated that all practices worldwide are being followed, with one notable method being the use of whips to scare away birds. Authorities, upon hearing that using whips to make noise has a frightening effect on birds and is used by other airports, have obtained them for use at Istanbul Airport. This demonstrates that Istanbul Airport spares no expense. Based on the literature review and observations, it is evident that eliminating places that attract birds or taking precautions in these areas is crucial. With the advancement of technology, methods are constantly changing and improving. However, despite all these technological advancements, it has been observed that one of the most effective methods in bird control is still the primitive method of chasing them away.

References

- Allan, J. R. ve Orosz, A. P. (2001). The Costs of Birdstrikes To Commercial Aviation. In 2001 Bird Strike Committee-USA/Canada, Third Joint Annual Meeting, Calgary, 218-226.
- Balicki, W., Glowacki, P. ve Loroch L. (2021). Birds Strike – İmpact on the Safety of Civil Aircraft Operations in Poland in 2008-2018. *Acta Mechanica Et Automatica*, *15*(2), 100-106.
- Creswell, J.W. (2021). Nitel araştırma yöntemleri: Beş yaklaşıma göre nitel araştırma ve araştırma deseni [Qualitative inquiry & research design: Choosing among five approaches]. S. B. Demir ve M. Bütün, Trans. (Eds.). Ankara: Siyasal Kitabevi
- Çoban, R. (2017). Sivil Havacılık Sektöründe Kuş Çarpması Olayları Üzerine Bir Araştırma: Amerika Örneği. 4. Ulusal Havacılık Teknolojisi ve Uygulamaları Kongresi Bildiri Kitabı, 45-58.
- Dolbeer, R. A., (2013), The History of Wildlife Strikes and Management at Airports. USDA National Wildlife Research Center - Staff Publications.
- EASA (2008). Bird Strike Damage & Windshield Bird Strike Final Report, ATKINS. https://www.easa.europa.eu/sites/default/files/dfu/Final%20report%20Bird%20Strike%20Study.pdf
- FAA, (2023). FAA Wildlife Strike Database. https://wildlife.faa.gov/home Erişim Tarihi 27.01.2023.
- Havalimanı Nihai ÇED Raporu, 2013. İstanbul Bölgesi 3. Havalimanı, İstanbul İli, Arnavutköy ve Eyüp ilçeleri Nihai ÇED Raporu, T.C. Ulaştırma Denizcilik ve Haberleşme Bakanlığı Altyapı Yatırımları Genel Müdürlüğü. https://cdn.teyit.org/wp-content/uploads/2019/08/nihai_ced_istanbul.pdf (25.02.2023)
- Hedayati, R., Sadighi, M. ve Aghdam, M. M. (2014). On The Difference of Pressure Readings From the Numerical, Experimental and Theoretical Results in Different Bird Strike Studies, Aerospace Science and Technology, 32, 260-266.
- Howtoistanbul (2023). Erişim Adresi: http://howtoistanbul.com/tr/birds-of-istanbul/8560 (31.01.2023).
- https://www.wikiwand.com/tr/T%C3%BCrkiye%27deki_ku%C5%9Flar_listesi (30.01.2023).
- ICAO, (2023). Facts and Figures. Erişim Adresi: https://www.icao.int/sustainability/pages/facts-figures_worldeconomydata.aspx (27.01.2023).
- ICAO, 2008 - 2015 Wildlife Strike Analyses (IBIS), Electronic Bulletin, 2017. https://www.icao.int/safety/IBIS/2008%20-%202015%20Wildlife%20Strike%20Analyses%20%28IBIS%29%20-%20EN.pdf (06.03.2023).
- ICAO, Airport Services Manual, Doc 9137AN/898 Part 3, Wildlife Control and Reduction, Fourth Edition, 2012.
- İstanbul Havalimanı Emniyet Bülteni, 2019. https://www.istairport.com/EmniyetBulten/Emniyet%20B%C3%BClteni%202019-8.pdf (26.02.2023).
- Keskin , Ö. H., Toprak, E. ve Türkkan, S. (2021). İstanbul'un Çöpleri (III): Atık Yükü Artıyor, Planlama Yetersiz. Erişim Adresi: https://teyit.org/dosya-istanbulun-copleri-iii-atik-yuku-artiyor-planlama-yetersiz (04.03.2023)
- Köken, İ. (2018). İstanbul Havalimanı A'dan Z'ye Cumhuriyet Tarihinin En Büyük Altyapı Yatırımı. Erişim Adresi: https://www.bbc.com/turkce/resources/idt-sh/Istanbul_airport_turkish (02.03.2023).
- Marra, P. P., Dove, C. J., Dolbeer, R., Dahlan, N. F., Heacker, M., Whatton, J. F., Diggs, N. E., France, C. ve Henkes, G. A. (2009). Migratory Canada Geese Cause Crash of US Airways Flight 1549. Frontiers in Ecology and the Environment, 7(6), 297-301.
- Metz, I. C., Ellerbroek, J., Mühlhausen, T., Kügler, D. ve Hoekstra, J. M. (2020). The Bird Strike Challenge. Aerospace, 7(3).
- Punch, K. F. (2005). Sosyal araştırmalara giriş, (Çev.) Bayrak D., Arslan H. B. ve Z. Akyüz, Ankara: Siyasal Kitabevi.

- Sarı, A., Arpacık, A. Başkaya, A. ve Çelik, A.(2022). Aviation Safety Ranking Values And Bird Species at Trabzon International Airport, Türkiye. Acta Zoologica Academiae Scientiarum Hungaricae 68(4), 375–391.
- Tolunay, D. (2015). İstanbul'daki Üçüncü Havalimanı ÇED Raporunun Değerlendirilmesi. 6. Ulusal Hava Kirliliği ve Kontrolü Sempozyumu, 225-238.
- Vos, J. B., Rizzi, A., Darracq, D. ve Hirschel, E. H. (2002). Navier–Stokes solvers in European aircraft design. Progress in Aerospace Sciences, 38, 601–697.
- Wikiwand, (2023).