

# Preventive wildlife strike strategy implemented at the airports operated by Fraport Greece during the COVID-19 pandemic

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Dimitrios Monogios has more than 35 years of working experience in the airline, ground handling and airport industry, out of which 22 years has been in organisation and employee development (OED). He has expert ability to lead project teams and translate employee-required knowledge, skills and behaviours into high-impact learning designs, curricula and workshops to create an internal knowledge transfer. He has extensive teaching experience with more than 6,000 training hours in Management — Aviation Safety and Human Factors training. Dimitrios Monogios obtained his BSc in Statistic and Actuarial Sciences from the University of Piraeus, a Diploma in Quality System Management from the European Organization for Quality and a Master's in International Business Administration (IMBA) from Glasgow University.

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### Abstract

*Any collision between wildlife (including birds) with an aircraft is known as a wildlife strike. Most of the time such a strike has no operational impact but occasionally it could result in delays because of a technical check or even cause damage to aircraft. The COVID-19 pandemic severely affected Europe's transport sector. Air connectivity collapsed worldwide and the demand on the airports operated by Fraport Greece (FG) decreased significantly during the pandemic years (2020–21). With less air traffic and more stay-home orders, a variety of bird species were attracted to the green, quieter areas of the airports. The European Aviation Safety Agency (EASA) issued warnings concerning the increased presence of wildlife hazards in European airports. This case study aims to communicate to the aviation industry the wildlife strike prevention strategy implemented at the airports operated by FG during the pandemic years. The fundamentals of wildlife management, airport ecology, flight safety and sustainability are presented in a structured way to provide the reader with many relevant messages. The management implications, together with the best practices of this preventive wildlife strike strategy, are discussed for their possible wider use in the aviation industry.*

### Keywords

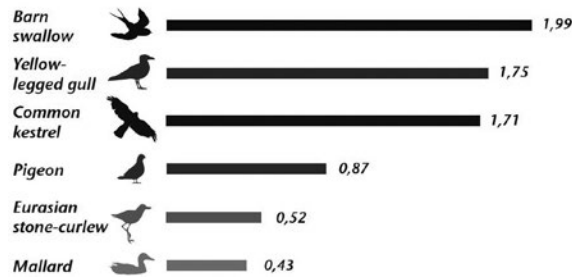
*COVID-19, aviation, airport, wildlife strike, flight safety, sustainability*

### INTRODUCTION

For a variety of wildlife species, airports can be attractive due to the habitat they provide.<sup>1</sup> Each airport is unique in terms of landscape and wildlife. The Wildlife Hazard Management Programme (WHMP) describes an airport and its surroundings, includes a dataset, the risk assessment, procedures and measures applied to manage conflicts caused by the presence of animals. The effectiveness of the wildlife control measures is assessed through regular and continuous

monitoring. Therefore, wildlife management needs to be flexible and adaptable to changes in both the aviation and the natural ecosystems.<sup>2</sup>

The 14 regional airports that Fraport Greece (FG) operates serve global destinations such as Mikonos and Santorini. Each airport operated by FG has its own specific WHMP, tailor made according to the local airport and environmental conditions. Aktion Airport and Chania Airport 'Ioannis Daskalogiannis' are excluded from this Wildlife Hazard

**Most common species' strikes/10,000 movements for 4 years (2018-2021)**

**Figure 1** Most hazardous species at the airports operated by FG  
Source: Annual Wildlife Hazard Management Review 2021, Fraport Greece.<sup>10</sup>

Management System (WHMS), as per the provisions of the Concession Agreement under which FG operates. The overall objective of an airport's WHMP is to reduce the risk of animal presence in areas where aircraft operate. The structure of each FG WHMP follows the principles of a safety management system (SMS) and sustainability, according to the findings of empirical research.<sup>3</sup>

The structure of each FG WHMP includes the following:

- WHMP and safety policy;
- a description of the movement area and airport surroundings;
- wildlife strike risk management;
- WHMP assurance;
- WHMP promotion.

Collection and analysis of data from confirmed aircraft wildlife strikes is an essential step towards understanding and mitigating wildlife collision risks. Systematic study and analysis of the confirmed wildlife strikes leads to the design and implementation of effective corrective actions to mitigate these risks and minimise their impact on the aviation industry.<sup>4,5</sup>

An effective WHMP requires the establishment of a risk management system to identify hazardous bird species, understand their behaviour and distribution,

modify their preferred habitat, assess the risk of bird collisions with aircraft and mitigate the associated risks by implementing a variety of dispersal methods. Understanding of how each species use an airport's habitat is key for the development of an effective WHMP.

Restrictions of air traffic resulting from the COVID-19 pandemic made airports more attractive, with conditions characterised by less disturbance, and reduced human and vehicle presence.<sup>6</sup> The increased presence of wildlife on and around aerodromes has, therefore, been identified by the EASA as a serious flight safety hazard.<sup>7,8</sup> Emphasis was given to the necessity to control wildlife before the recommencement of air traffic in each pandemic year (Figure 1).<sup>9</sup>

The objective of this case study is to present the preventive wildlife strike strategy implemented at the airports operated by FG. This strategy was designed in 2017, developed and implemented during the following years while the challenges this strategy faced during the pandemic years 2020–21 are presented in detail. First, the FG business model is presented. The preventive strategy follows with the top management commitment, continues with the official training and communications' adaptations for the airports' operations personnel, the trust

culture built with the airlines, as well as the rest of the airport stakeholders. The key performance indicators (KPIs) are then discussed, as part of the programme's assurance, together with the system's continuous improvement mechanisms. The assurance and promotion of this preventive strategy follow, and the case study concludes with the take home messages.

### THE COMPANY FRAPORT GREECE

FG is responsible for maintaining, operating, managing, upgrading and developing 14 regional airports in Greece over a period of 40 years. The operational transfer of the 14 airports to FG took place on 11th April, 2017 (Figure 2).

For the period of January to November 2022, the YTD statistics demonstrate an increase in traffic of 3.7 per cent versus 2019, with the total traffic reaching 30.2m passengers.

### THE WILDLIFE HAZARD MANAGEMENT TEAM

The Operations Division of FG has a responsibility to provide a safe operating environment to aircraft operators. The Head of Strategy, responsible to the Chief Operations Officer, manages the Strategy Department (STR), under which the Wildlife Hazard Management Section (STR-WH) operates.

The Wildlife Hazard Manager is in charge of the design and development of FG's WHMS. They collaborate with internal and external stakeholders, regional and national government bodies on wildlife strike risk mitigation, provide the official Wildlife Hazard Management (WHM) training and ensure that FG complies with the regulatory requirements of the EASA and the Hellenic Civil Aviation Authority (HCAA).

The Wildlife Hazard Management Officer organises the wildlife control



**Figure 2** Airports operated by FG, Cluster A on the left and Cluster B on the right  
Source: [www.fraport-greece.com](http://www.fraport-greece.com).

operations, supervises the wildlife control record-keeping (wildlife control logbook), provides technical support, conducts the risk assessments, statistical analysis, wildlife surveys and provides the official WHM training. The Wildlife Hazard Management Officer and the Wildlife Hazard Manager are based at FG's headquarters in Athens.

The Wildlife Control Team is responsible for the daily habitat and wildlife monitoring, the implementation of various dispersal measures and liaison with local stakeholders. This highly specialised team comprising the Wildlife Control Supervisor and three Wildlife Controllers provides wildlife control services from dawn to dusk seven days a week at Thessaloniki Airport 'Makedonia'. In addition, the Wildlife Control Team supports the Airside Supervisors (follow me vehicle drivers), who are officially trained to provide wildlife control services at all airports operated by FG.

The Airside Supervisors, among other duties, identify wildlife hazards, keep detailed records in the wildlife control logbook, collect wildlife strike data and implement a variety of measures to

disperse birds and other hazardous wildlife (Figure 3).

### ACI WORLD HEALTH ACCREDITATION

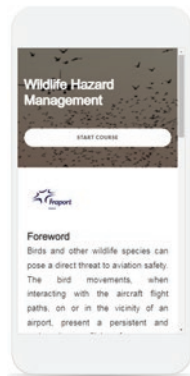
Since the outbreak of the COVID-19 pandemic, FG has strictly followed every protocol and guideline issued by the authorities and implemented all the measures that protect the airport community from the virus and its further spread. The Airport Council International (ACI) World Airport Health Accreditation is a further testament that this commitment towards the safety of both passengers and local communities has turned into effective action.

### SETTING THE BASES FOR THE DIGITAL TRANSFORMATION OF FG EMPLOYEES' TRAINING: 'LEARNING WITHOUT BARRIERS'

The new working reality that took shape so violently in 2020 due to the COVID-19 pandemic worked for FG's Human Resources and Training Department as an accelerator of change. This change, which



**Figure 3** Wildlife control vehicle in front of the new terminal at Thessaloniki Airport 'Makedonia'  
Source: Annual Wildlife Hazard Management Review 2020, Fraport Greece.<sup>11</sup>



**Figure 4** Wildlife Hazard Management was one of the first e-learning courses developed and tested in all delivery forms, including mobile publishing  
Source: Authors.

started early in 2020, was reflected in the preparation and gradual implementation of a corporate plan. One of its key priorities was the digital transformation of Human Resources and Training processes and training methods, in full alignment with the corporate strategy for ‘Learning without Barriers’ (Figure 4).

### THE JOURNEY TO DIGITAL TRANSFORMATION:

The steps followed for the design, development and initiation of a resilient and future-proof learning scheme are described briefly below:

- Redefine learning strategy in alignment with the corporate strategy in a business environment characterised by turbulent changes and unforeseen/unpredictable events.
- Leverage the existing corporate learning management system and the experience in adult training by focusing on the immediate implementation of the corporate learning strategy ‘Learning without Barriers’.
- Align and prioritise employees’ functional/statutory training with business needs and legislative requirements by also protecting human life from exposure to the COVID-19 virus.
- Learners’ needs (learners’ style, skills, technology limitations).
- The authoring tool to support our instructional strategies (elements to include in the e-learning course and the results intended to be achieved through them: quizzes, assessments, puzzles, animations etc) and the delivery outputs to be compatible with the corporate learning management system (LMS).
- Development time (how long will it take to develop the course).
- User-friendly interface.

- Focus on the established training procedures and mainly on steps followed for the instructional learning design (ADDIE model, see Figure 5) in close collaboration and cooperation with key internal stakeholders (instructors and subject matter experts). Prior to the conversion of the existing training scheme from instructor-led training (ILT) to online learning, the following aspects were taken into consideration:
  - Determine which training modules could be transformed from ILT into online learning, based on identified training priorities (asynchronous; synchronous learning or blended approach).
  - Review current training content and selection of an e-learning authoring tool: Map existing classroom activities to interactivities by selecting an authoring tool for the design and development of interactive and engaging e-learning content based on corporate needs and instructional strategy. The criteria set for the selection of the authoring tool were the following:



- Necessary skills and knowledge required to become familiar with and use the authoring tool.
- Delivery methods: The authoring tool to support responsive design and be accessible on all devices (including mobile publishing) and browsers.
- Budget and maintenance costs.

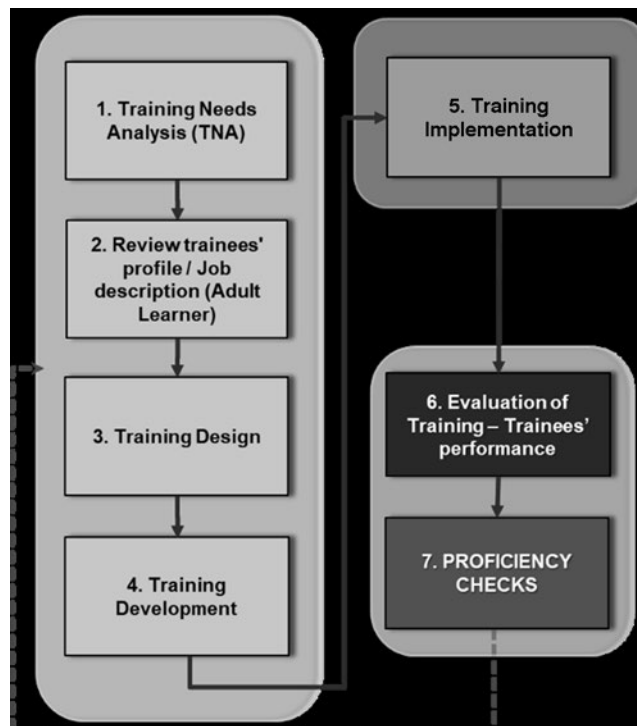
Re-evaluate assessment approach, aiming to:

- determine trainees' assessment methods, by taking into consideration training objectives per training programme and the advantages and limitations of each assessment method;
- use more effectively the triple function of assessment (assessing what learners know before, during and

after the training) with a proper combination of ILT and online assessment methods.

The outcome of the above process was:

- Choosing the right authoring tool enabled the design, development and conversion of 51 in-house training courses from ILT to online training by leveraging new and emerging learning trends with a learner-centric approach that was accessible on all devices (including mobile phones as part of the strategy of 'Learning without Barriers'). Wildlife Hazard Management was one of the first e-learning courses developed and tested in all delivery forms, including mobile publishing.



**Figure 5** Training design process  
Source: Authors.

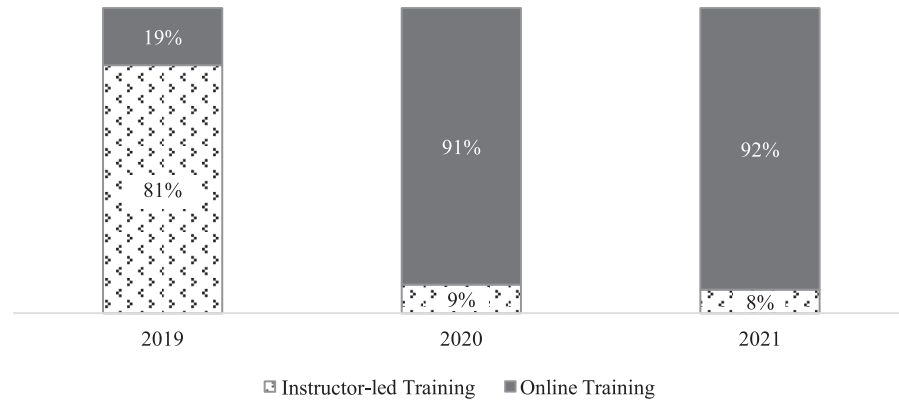
- The unhindered implementation and completion of the Annual Corporate Training Plan and Proficiency Checks of aerodrome employees, despite the existing limitations due to the COVID-19 pandemic. In 2020, the percentage of online training seminars was 45 per cent, compared to 2 per cent during 2019 (Figures 6 and 7).
- The increase of FG's participants in training activities during 2020 versus 2019 (+56 per cent) in a period with low operational activity, as the employees had more online learning opportunities that enabled them to participate and attend at their own pace; any time and anywhere via laptops, tablets and smartphones ('Learning without Barriers').
- Stimuli from the analysis of trainee satisfaction results and corrective action for improvements in the instructional learning design.
- The foundations were laid for a learning culture.
- Significant cost savings, without compromising the quality of the training outcome.

Lessons learned through the digital transformation of ILT to online training to date are:

- Online versus ILT: ILT is not abandoned. On the contrary, using a combination of ILT and online training is evaluated to date as extremely effective. The transformation process has provided the opportunity to:
  - (a) relook at and rethink the traditional format of training;
  - (b) repurpose existing content and learning materials;
  - (c) utilise authoring tools that provided the opportunity to create engaging e-learning content by reducing both the development time and cost;
  - (d) develop the knowledge and skills of a small team of corporate experts in adult training as well as instructors in e-learning design and development through the use of modern training tools and methods;
  - (e) provide new training and learning opportunities to the employees even during the COVID-19 pandemic.
- Online training:
  - Provides additional training and learning opportunities to employees who can be trained anywhere, at any time, and at their own pace.
  - Enables trainees' continuous access to course content and other sources, without restricting the learning to a particular training handbook or standard operating procedures. Additionally, course content was easy to revise whenever necessary and available to employees through the LMS without delay.
- The digital transformation could not be started without building and maintaining an effective and resilient collaboration among internal parties (Adult Training experts, instructors, subject matter experts and employees), which was based on the following core principles:
  - clearly defined roles;
  - accountability;
  - commitment;
  - communication;
  - trust;
  - less ego, more consistent and enthusiastic effort;
  - creativity.

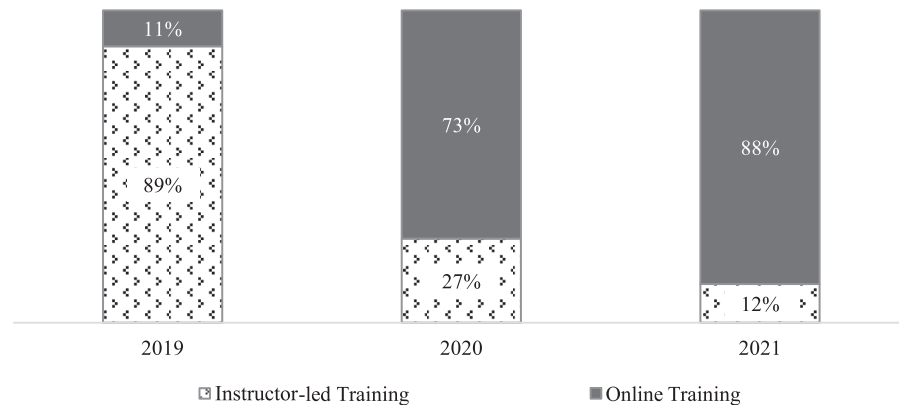


2019 - 2022 % of Participants in ILT & Online Training



**Figure 6** 2019–22 percentage of participants in ILT and online training  
Source: Authors.

2019 - 2022 % of Training Manhours in ILT & Online Training



**Figure 7** 2019–22 percentage of training man-hours in ILT and online training  
Source: Authors.

### TOP MANAGEMENT STRATEGY FOR WILDLIFE STRIKE PREVENTION

The necessity to keep monitoring and controlling hazardous wildlife was communicated by the Wildlife Hazard Manager to the Head of Strategy and the Chief Operations Officer since the

outbreak of the pandemic. It was emphasised that wildlife strike prevention is based on regular monitoring of hazardous bird species and their habitat. During the pandemic years, there were no reductions in wildlife hazard management at the airports operated by FG.

On the contrary, the WHM Team has grown with additional expert personnel. The recruitment of additional Wildlife Controllers was planned in 2019, but postponed for one year due to the outbreak of the pandemic. The necessity to invest in expert dedicated personnel to prevent wildlife strikes was emphasised by the Wildlife Hazard Manager to the top management, and three additional employees were hired during the second pandemic year.

Wildlife control requires a set of skills in ecology and airport operations. The continuous development of these skills is based on initial and recurrent training cycles. Hiring personnel at FG for the wildlife control positions during the pandemic required great effort to identify the profile of successful candidates who fit into the corporate culture and could demonstrate a variety of skills in ecology field surveys, communication and report writing, while comprehending the discipline needed to comply with the regulatory framework of the aviation industry. During the pandemic years and despite the uncertainties, FG procured tractors and lawnmower riders for all 14 airports it operates. Efficiencies, therefore, were built and developed both in active wildlife control and habitat management, in order to make the airports' environments less attractive to wildlife and proactively prevent wildlife strikes.

Safety is the top priority at FG. Traffic shows high seasonality at all 14 regional airports. Wildlife control is seen as a continuous process at FG and is applied during the high traffic season, as well as during the winter (off-peak) season. Change management is a crucial part of this strategy to continuously assess wildlife hazards on and off-airport up to a radius of 13km from an airport's reference point. The implementation of each

FG WHMP continued unaffected during the lockdown periods. Finally, yet importantly, wildlife control actions intensified before the restart of operations in the beginning of summer 2020 and summer 2021.

### COMMUNICATION STRATEGY WITH THE AIRSIDE OPERATIONS PERSONNEL

At a time when travelling to the regional airports was not possible, ensuring flow of communication between the headquarters and the regional airports was deemed crucial. The regional airports were divided in zones according to their geographical location and their wildlife strike risk profile. With a series of webinars, the WHM Team provided support and guidance to the FG airport operations personnel on the following topics:

- *The importance of dispersing birds even with no traffic at all.* Wildlife control needs time and constant effort. Bio-monitoring at an airport environment requires a set of skills that need to be improved through lifelong learning.
- *Bird biology* of hazardous species such as gulls, ducks and birds of prey. Detailed information was provided on the species' behaviour, breeding biology, food preferences, habitat and migratory patterns.
- *An integrated wildlife control approach* should include a variety of measures. Possible habituation, meaning the reduction of efficiency of control methods, would be avoided by proper application of these methods. Even in times of reduced human presence and less disturbance, such an approach ensures that high populations of



**Figure 8** White stork (*Ciconia ciconia*) at Kavala Airport 'Megas Alexandros'  
Source: Authors.

hazardous species are excluded by an airport.

- *Recap webinars*, before the recommence of operations in June 2020, in April 2021 and April 2022. This series of webinars alerted the FG operations personnel to intensify bird monitoring and control actions before the initiation of the aircraft flights, following the cessation of each flight ban.
- *Feedback provision*: a strong communication was developed via emails, webinars and online classrooms to ensure that FG operations personnel were alert and able to build a proactive way of thinking to make the airport a non-friendly environment, particularly for birds of large mass or flocking behaviour. For instance, analysis of the wildlife activity at Rodos Airport 'Diagoras' revealed that migratory raptors such as the Red-footed Falcon (*Falco vespertinus*) and Eleonora's Falcon (*Falco eleonora*) fly over Rodos in April–May every year, thus, the personnel must be aware of the necessity to record such observations and apply the essential dispersal methods (Figure 8).

## WILDLIFE STRIKE PREVENTION STRATEGY

The safety issue analysis of the EASA identified the increased presence of wildlife at aerodromes as being one of the most important hazards for National Aviation Authorities, airport operators and airlines to consider.<sup>12</sup>

The FG WHM Team communicated this to the airports' operations personnel, together with clear guidance on how to deal with the new 'current normal'. FG runways and taxiways were frequently inspected for bird activity, even during days with no traffic at all. There were no reductions due to COVID-19 regarding the airside operations personnel, records were kept in detail from each wildlife patrol and all wildlife control data was recorded in new sophisticated software. Additional wildlife control equipment has been procured. All documentation was kept up to date and the risk assessments, together with the statistical analysis, were performed at regular intervals. Bird migration was in progress during the lockdown periods in 2020 and in 2021. Monitoring of bird migration,

even on days with no traffic, retained continuity in data for the surveys of resident and migratory bird species.

### **HABITAT MANAGEMENT AND WILDLIFE CONTROL MEASURES**

Habitat management is the cornerstone of successful wildlife hazard management. By reducing the resources that habitats offer to wildlife, the abundance of birds and other animals and the hazards they pose will also be reduced. Although such measures require greater effort in the beginning (in terms of expenditure and staff), in the long term they are much more cost effective than other measures, since the need for other control or dispersion actions is reduced.<sup>13</sup> To actively control wildlife, bioacoustics are used for wildlife species that communicate distress through sounds. For non-vocal species, digital sounds are emitted to disperse them away from airport areas. In the case of the presence of large flocking birds, the use of pyrotechnics disperses hazardous wildlife with exceptionally good results. In 2021, an anti-bird laser was piloted at Thessaloniki Airport 'Makedonia' for the dispersal of ducks, gulls, herons and pigeons. In the framework of continuous improvement, the Wildlife Control Team keeps applying new methods for habitat management and active dispersal.

### **EXAMPLE OF A SPECIES BASED MANAGEMENT PLAN**

The Common Kestrel (*Falco tinnunculus*) has been identified as one of the species with a higher number of bird strikes during the past years at Thessaloniki Airport 'Makedonia'. In order to lower their abundance at the airside and as a

consequence of the number of Common Kestrel strikes, a specific programme was designed to trap, ring and relocate Common Kestrels, following permission from the Ministry of Energy and Environment. Trapping would be undertaken by the WHM Team using specially designed traps. Ringing is performed by an external expert holding a current permit. Following ringing, the trapped Common Kestrels will be relocated to a suitable habitat away from the airport, to minimise the chances that the relocated birds return to the airport. During the first implementation of the project, it will be interesting to see the trapping, release and return rate to the airport. Supplementary habitat management with superficial soil tilling reduces the amount of vegetation and, consequently, the available prey to Common Kestrels.<sup>14</sup> This results in making the airport less attractive to the Common Kestrels.

### **WILDLIFE SURVEYS UP TO 13KM**

The term 'in the vicinity' includes land or water areas up to a 13km radius from an airport's reference point. The wildlife surveys include wildlife species, their populations and habitats for roosting and breeding. These surveys include migration and winter population counts and the identification of main sites attracting wildlife within the 13km radius of an airport. Before the pandemic outbreak, the WHM Team conducted the wildlife surveys up to 13km from an airport's reference point. Owing to travelling restrictions, a series of webinars was addressed to specifically appointed FG Airside Supervisors. Clear instructions were given by the WHM Team on how to conduct these surveys in the airports' surrounding areas. Their bird identification and habitat monitoring skills were



**Figure 9** Attractants within the 13km safeguarding zone: Flamingos (*Phoenicopterus ruber*) at Aggelochori lagoon, Thessaloniki  
Source: Authors.

further advanced in this way. The necessary equipment was procured, including high optical zoom cameras, binoculars, camera traps and bird identification books (Figure 9).

### COMMUNICATION STRATEGY WITH THE AIRLINES

FG has developed a culture of trust with the customer airlines. From the commencement of the Concession Date (11th April, 2017), such communication involved official invitations to airline executives to visit the FG headquarters in Athens and get first-hand information on safety and sustainability issues at the airports operated by FG. During the pandemic years, meetings with the airlines' safety and operations personnel were held through the use of teleconference means, which enabled frequent communication and further investigation of wildlife strike incidents. The wildlife strike databases between FG and the airlines were cross-checked, to ensure

correctness and alignment. Most of all, such a culture of trust and communication with the airlines develops a common understanding on what a wildlife strike is and on how complex the operational system remains. Such common understanding and joint efforts, create further synergies to improve the efficiency of the wildlife strike prevention action plan.

### COMMUNICATION WITH THE GROUND HANDLING COMPANIES

Ground handling companies and aircraft maintenance personnel play a crucial role in wildlife strike prevention when it comes to the delivery of wildlife strike remains for further investigation and identification. FG communicates actively to all ground handling companies the need to collect and deliver — before washing or cleaning — all evidence of a strike found on an aircraft. In cases of a damaging strike, but also in cases where ambiguity exists on the flight phase in which the strike occurred, remains are

sent for DNA analysis to a Greek university to obtain information on a wildlife species level. In addition, during the pandemic years, the ground handling companies were proactively contacted to block any parts of long parked aircraft that could permit birds to enter and nest. Further requested actions referred to proper waste management, in order to eliminate any organic waste that could attract wildlife and stray animals.

### COMMUNICATION WITH OTHER AIRPORT STAKEHOLDERS

Through participating in the virtual Airport Safety Committee meetings, the preventive wildlife strike prevention strategy was communicated to all airport stakeholders from the outbreak of the pandemic. Apart from the ground handling companies mentioned above, other key stakeholders included the airline representatives, the Air Traffic Control (ATC) and the Hellenic Air Force (HAF). The need to inspect the runways frequently, even with no traffic at all and especially before the recommencement of operations, was pointed out to the ATC. The strategy reasoning was made clear during the committee meetings and the action plan was recorded in the minutes of meetings. For the airports that are operated in collaboration between Fraport Greece and the HAF, synergies were built in enhancing the efficiency of proactive wildlife monitoring and the immediate subsequent actions needed to be taken for wildlife control.

### DEVELOPMENTS ON THE KPIS

Assessing the level of risk of each bird species is key to developing efficient management practices. An initial approach to

evaluate performance is the calculation of the total number of strikes per 10,000 aircraft movements for each calendar year (lagging indicator). This approach, however, does not consider the mass of each bird species. Consequently, FG has created a new KPI that indicates strikes of birds with a mass of over 100g per 10,000 aircraft movements. The creation of this KPI aims to exclude incidents with birds that are highly likely to suffer a strike but are of low severity category (eg swallows). Therefore, this new KPI presents a more objective index to evaluate performance over time and sheds light directly on which bird species pose a hazard to flight safety.

According to FG standard operating procedures, the manoeuvring area must be regularly and proactively inspected for wildlife monitoring and control with routine and non-routine runway inspections (proactively for wildlife control). In addition, these inspections aim to collect the remains of animals that suffered a strike though there was no report to the ATC by any of the preceding flights.

The number of confirmed strikes of birds with a mass of over 100g per 10,000 aircraft movements is:

$$\frac{\text{Confirmed strikes, birds over 100 g}}{\text{Aircraft movements}} \times 10,000$$

A new KPI, named as the percentage of airport reporting (leading indicator) has been created to present the percentage of confirmed wildlife strikes that FG operations personnel report without any prior notice from airport users. Even though, for such incidents, the aircraft operator that suffered the strike does not report a strike and cannot

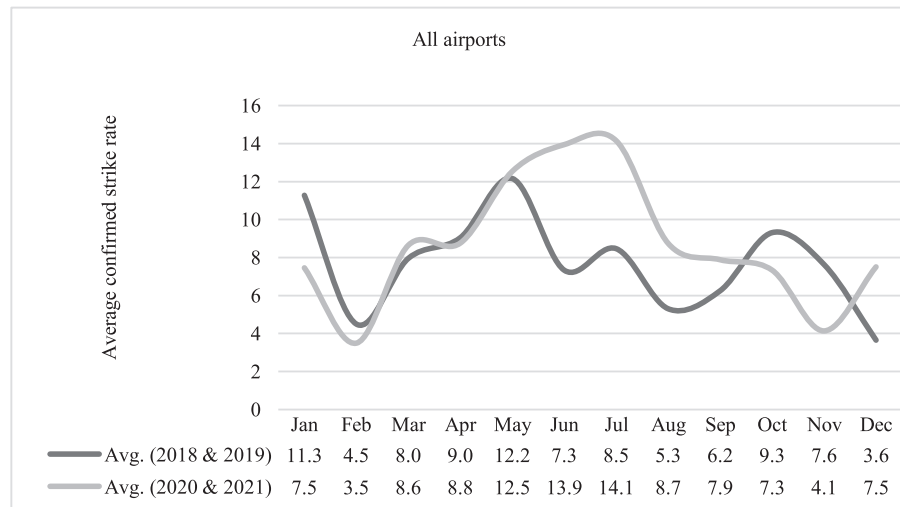


be identified, the valuable information about the bird species that suffered the strike remains, leading to accurate risk assessment and effective risk management actions. In addition, this KPI reflects the built reporting culture and shows the commitment of operations

personnel to improving aviation safety standards (Figures 10 and 11).

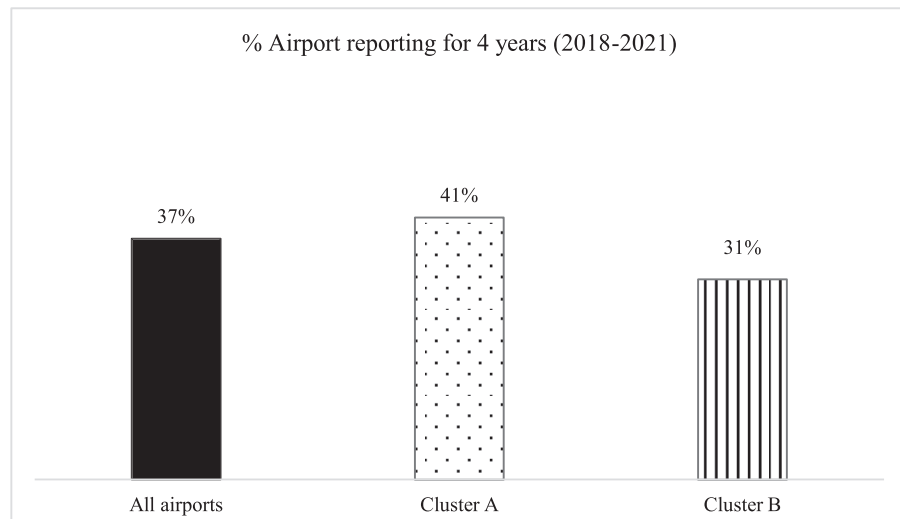
Percentage of airport reporting is:

$$\% \frac{\text{Confirmed strikes reported by FG Airside Personnel}}{\text{Confirmed strikes}}$$



**Figure 10** Monthly confirmed wildlife strikes (bird species with a mass of over 100g) per 10,000 aircraft movements between pre-pandemic years (2018 and 2019) and COVID-19 pandemic years (2020 and 2021). Possible impact of low traffic on the slightly increased rates in 2020 and 2021 is under evaluation

Source: Annual Wildlife Hazard Management Review 2021, Fraport Greece.<sup>15</sup>



**Figure 11** Confirmed wildlife strikes reported exclusively by Fraport Greece airside operations personnel

Source: Annual Wildlife Hazard Management Review 2021, Fraport Greece.<sup>16</sup>

## BIODIVERSITY CONSERVATION

Part of the innovation strategy to demonstrate leadership in airport environmental sustainability is the FG's 'Biodiversity Conservation Programme'. This programme was introduced in 2020, approved by the top management in 2021 and provides a framework within which FG opts to manage biodiversity at the airport areas as part of its Environmental and Social (E&S) Management System (ESMS). The variety of the Biodiversity Conservation Programme objectives include grassland preservation, water surface monitoring, conservation of non-hazardous wildlife (insects, amphibians, reptiles) as well as marine conservation initiatives<sup>17</sup> (Figures 12 and 13).

The programme was developed with in-house expertise during the pandemic but is not related to pandemic conditions and was not developed in response to it. Over a period of years, starting in 2021 and until the end of 2025, wildlife monitoring is not limited to bird species, but extends to amphibians, reptiles, insects and invertebrates. Wildlife monitoring is conducted with various field survey

techniques using high-tech equipment. Consequently, a comprehensive database will be created for a variety of wildlife species and their populations that are found at the airports operated by FG and close to their vicinities (Figure 14).

Airport operators struggle nowadays with achieving biodiversity conservation initiatives while maintaining flight safety. The periodic assessments of the wildlife strike risk at an airport are an effective decision-making tool as long as it is based on good quality data through a long monitoring period.<sup>18</sup> This data shall include not only the wildlife strikes reported by aircraft crew, but also cadavers found on a runway with evidence of an aircraft strike. The most widely adopted methodology is a species based one, categorising each struck bird species according to its mass on acceptable, tolerable and intolerable risk regions. Wildlife species that are permanent or occasionally present at an airport and fall into the green acceptable risk regions, shall be monitored to ensure their risk level remains low and considered for biodiversity conservation purposes (eg small farmland birds declining due to agricultural intensification).



**Figure 12** Golden Jackal (*Canis aureus*) at Kavala Airport 'Megas Alexandros'  
Source: Authors.



**Figure 13** Red-footed Falcon at Rodos Airport 'Diagoras'  
Source: Authors.



**Figure 14** *Coenonympha pamphillus* at Thessaloniki Airport 'Makedonia'  
Source: Authors.

However, birds will be managed and controlled within an airport, and a greater likelihood for biodiversity conservation initiatives derives from researching bat species, insects, amphibians, reptiles and small mammals. The airport operator should invest in researching the food chains of birds and collect reliable data on wildlife species interdependence. Biodiversity conservation should be data based and risk based, as is the case with wildlife control.

At Thessaloniki Airport 'Makedonia' the FG Wildlife Control Team monitors bat presence and activity remotely by using static detectors, deployed at fixed locations in close proximity to water surfaces.<sup>19</sup> In addition, hand-held bat detectors are used to observe and record bats in flight, away from their roosts. This bat monitoring scheme takes place between the middle of February and late October, from dusk to dawn, and the data obtained by the recorders is analysed by specialised software.

Another innovative effort has been demonstrated by the management of the population of Golden Jackals residing within the area of Samos Airport 'Aristarchos of Samos'. Samos Island holds a genetically differentiated population compared to other Golden Jackal populations in the Balkans. Such a genetically diverse Golden Jackal population here has consequently greater conservation value. New generation infrared cameras with motion detectors for night recordings and passive acoustic monitoring systems provide valuable data on the presence of Golden Jackals on the airport site. The strike risk is regularly assessed, together with the pros and cons of their presence. Golden Jackals are nocturnal predators feeding on birds and other wildlife species. In addition, it seems they adapt their behaviour to avoid aircraft operations and human presence. All these parameters are taken into account to develop a tolerability concept and a balance between control and conservation actions. With intensive grass cutting at the manoeuvring areas, Golden Jackals are restricted to the airport perimeter in a sustainable way, by eliminating their preferred habitat. The project of gradual and mild relocation of the Golden Jackal population from Samos Airport was initially conducted with the 'Archipelagos' Institute of Marine Conservation and provided the opportunity for numerous biology students to obtain voluntarily a first-hand experience in airport wildlife hazard management.<sup>20</sup>

Other research conducted at the airports operated by FG focuses on field surveys with detailed vegetation sampling to describe main habitat types and identify potential positive and negative botanical indicators. Additionally, biodiversity monitoring includes taxonomic diversity of butterfly species, reptiles, amphibians and small mammals of conservation concern, in order to develop appropriate

habitat management plans. Wildlife populations are assessed, together with the threats and pressures they face. In relation to the interdependences with wildlife strike risks, airport operators should direct their conservation efforts towards creating small airport habitat patches or biodiversity spots for orchids, butterflies, bats, and create insect hotels or small biodiversity ponds for amphibians, dragonflies, etc.

At selected airports operated by FG, biomonitoring extends to the marine environment, since these airports are located adjacent to the Mediterranean Sea. In cooperation with external marine research institutions, FG monitors the biodiversity of benthic communities (Seagrass, *Posidonia oceanica*). The methodology includes seabed type and seagrass mapping by using acoustic techniques, such as side scan sonar. Fish community diversity and structure is studied with high resolution underwater stereo video recordings performed via scuba diving. The assessment of the threats and pressures on the Seagrass meadows will be based on a suite of generic and stressor-specific monitoring indicators.

The results from the Biodiversity Conservation Action Plan 2021–25, for both the terrestrial and marine biomonitoring research projects at FG are anticipated with great interest to be analysed and form the basis of the next five years' action plan for biodiversity conservation, 2026–30.

## WHMP ASSURANCE AND PROMOTION

The assurance of each FG WHMP includes performance evaluation with the selection of appropriate KPIs, change management and continuous improvement. The development of KPIs was presented above. An example of change management during the pandemic refers to the delivery of a new runway at Thessaloniki Airport in September 2020. Prior to the initiation of

aircraft operations, the wildlife strike risk was assessed for the new runway, proactive wildlife control measures were applied to the runway construction sites that were attracting gull species. Regarding the up-to-date documentation needed, the airport's WHMP was revised accordingly. Examples of continuous improvement include the piloting of new methods to deter birds and their combination in various ways to assess their effectiveness in synergies. Decoys are tested with bird scare kites, bioacoustics, balloons, gel repellents, pyrotechnics and other bird control means to increase the efficiency of bird control by avoiding habituation.

Since 2018, FG has published its Annual Wildlife Hazard Management Review online. The aim of this review is to reach a wider audience and indicate the importance of investing in specialised wildlife hazard management programmes and dedicated personnel to achieve the highest level of safety. Each review includes information about the methods and best practices utilised to prevent wildlife strikes, provides the reader with wildlife strike data analysis and presents the highlights of the biodiversity records. Since the

outbreak of the COVID-19 pandemic, this annual review emphasises the necessity to monitor wildlife behaviour even in periods with less air traffic, identify any new risks caused and adapt the control procedures accordingly.

### USE OF ADVANCED TECHNOLOGIES

During the pandemic years, the WHM Team, in close collaboration with the Safety Management Department, designed and developed the Concept of Operations for Drone flights at Thessaloniki Airport 'Makedonia'. This proposal has been submitted to the HCAA for the necessary approvals and permissions. The use of drones for WHM is expected to bring a new era in wildlife and habitat monitoring and enhance the WHM services at Thessaloniki Airport 'Makedonia'. Additional expected benefits cover a wide area of safeguarding and runway inspections, as well as security management. The project has been piloted in 2022 following the successful completion of a drone flying training course and will proceed according to the relevant permission and approvals by the HCAA (Figure 15).<sup>21</sup>



**Figure 15** Use of drone at Thessaloniki Airport 'Makedonia'  
Source: Annual Wildlife Hazard Management Review 2020, Fraport Greece.<sup>22</sup>



## CONCLUSION

Wildlife management should be highly prioritised by airport operators in terms of both improving flight safety standards and promoting environmental sustainability with biodiversity conservation initiatives. The COVID-19 pandemic has caused an unprecedented challenge to the aviation industry but also provided an opportunity for positive change management and aviation transformation. Resilience and agility are decisive aspects for an effective collaboration among internal parties within an organisation during this transformation process. A system should be in place for continuous wildlife hazard identification, hazard assessment and risk management on and off-airport aiming to reduce the presence of wildlife species constituting a risk to flight safety. Wildlife control should be seen as an ongoing and continuous process requiring effort, time and an advanced set of skills at all organisational levels in airport operations. A strategy to prevent wildlife strikes needs to address its scope to the airport stakeholders, especially the ATC service providers, the airlines and the ground handling companies. In addition, synergies should be built with the external stakeholders and the local communities around an airport's vicinity to promote flight safety and the objectives of a WHMP. Communication is, therefore, crucial in continuously improving such a system, accompanied by official training and the respective competence checks. The KPIs to evaluate the system's performance should be carefully selected with leading and lagging indicators. The promotion of a WHMP should be highly valued to facilitate sharing of knowledge, new improved best practices and collaboration on a European level to transform the industry and bring the airport operations forward in a safe and sustainable manner.

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