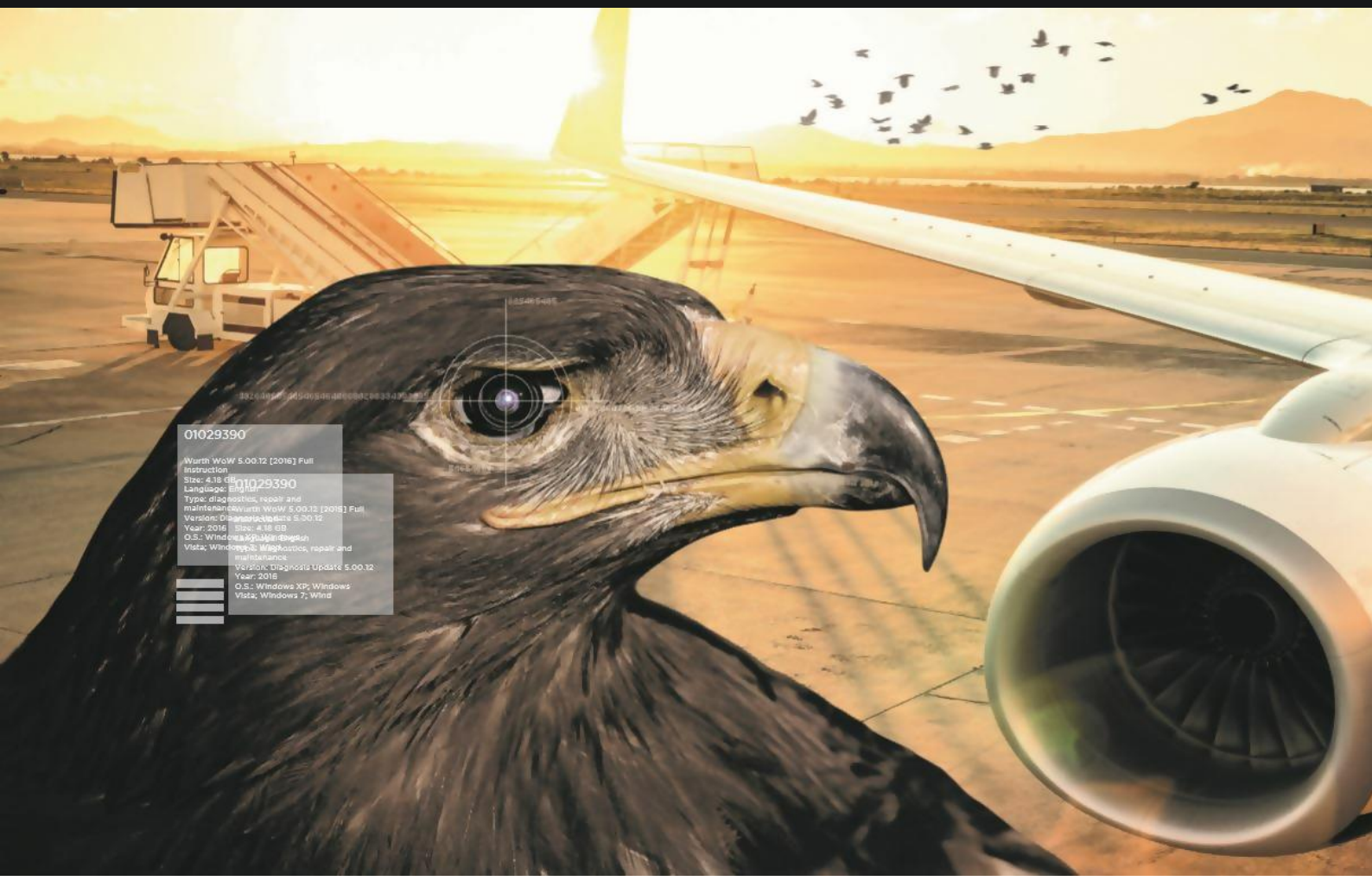
Whitepaper

The danger of birds and drones for military, civil and commercial flight

What to keep in mind when evaluating solutions



THE EDGE COMPANY

BCMS
Bird Concentration Monitory System

General Summary

Wildlife strikes, the impact between an aircraft and one or more wild animals - mainly birds (the so-called "bird-strike") - are constantly increasing worldwide, with consequent costs in terms of human lives and material damage to aircrafts. In the United States, the number of wildlife strikes has risen from 1,847 in 1990 to 13,795 in 2015 and in Italy from 348 in 2002 to 1,313 in 2016. This increase is due to several factors, including greater attention to the analysis performed, accuracy in reporting events, the significant increase in air traffic and undoubtedly the increase in some bird populations. It is easy to see, therefore, how the phenomenon of wildlife strikes has a strong impact on civil and military aviation all over the world. The International Bird Strike Committee (IBSC) (now the World Birdstrike Association) was established in 1966 to deal with the problems associated with wildlife strikes, and is composed of a group of professionals with the task of sharing experiences to improve air safety by understanding and reducing the risk of bird impact with aircrafts. In Italy, the Bird Strike Committee Italy (BSCI), founded in 1987, which depends on ENAC, has the task of: Preparing and monitoring the implementation of legislation on the subject; collecting, processing and sending statistics to ICAO; supporting internal ENAC bodies and airport operators; carrying out training courses, targeted visits and awareness-raising actions; involving local authorities and maintaining international relations. The common key to national and international regulations dealing with the wild life strike problem is the recommendation to airport operators to adopt measures to minimize the probability of collision between wildlife and aircraft through: reporting systems; groups of experts and operational units; prevention and control plans (developed on the basis of studies and research in and around the airports). Monitoring, therefore, is undoubtedly the best tool for the prevention of wildlife strikes, but how effective/efficient is the monitoring in airports now?

What is the danger with birds in airports?

Most impacts between aircraft and wildlife occur at airports and in their immediate vicinity. Approximately 80% of impacts occur below 300ft altitude during take-off and landing. The risk of impact, during a landing or take-off phase, is linked to several contingent factors: type of bird present in the airport, the intensity of the activity, the number of individuals, the direction, the position and in general to factors typical of the airport under consideration: geographical location, proximity to foraging areas for birds or sources of attraction such as landfills and cultivated fields, the presence of wetlands, the

fact of being positioned along particular migration routes for certain bird species, the management of airport sediments and much more. All these factors contribute to the determination of the degree of risk of impact at a given airport. Very often, airport areas represent a resting or foraging area for different species of birds, the meadows surrounding the runways provide plenty of food to species such as the Magpie, the Starling, the Crow and other species that moving from one area of the airport to another constitute a continuous danger to aircrafts during takeoff or landing. The same can be said of Pigeons and Swallows, which use buildings and hangars as nesting areas and consequently end up flying over the runways hundreds of times a day. The airport area is also often used as a resting place by migratory or wintering species such as Starlings and Lapwings which, for example, in some periods of the year frequent Fiumicino airport with several thousand individuals. We can conclude that the presence of landfills, wetlands and areas where there is high availability of water, food and suitable sites to shelter, reproduce, aggregate and rest, in and around an airport, are a formidable attraction for wildlife, especially birds. For all these reasons, an effective risk management and mitigation plan must include a reliable and constant monitoring system capable of providing detailed and timely information on the habits of the birds that frequent the airport area.

What type of bird is a danger to aircrafts?

Not all bird species are equally dangerous, both in terms of the probability of causing a bird strike and the extent of the damage they can cause to the aircraft. Obviously, bigger species such as the Mediterranean herring gull or the common seagull can cause considerable damage compared to smaller species such as sparrows or swallows, but the tendency of a species to fly in large flocks is also a factor of danger. If we think of flocks of thousands of starlings, we can consider them as bullets that can cause more damage than a single seagull. The average data collected at Italian airports tells us that the most dangerous species in terms of number of impacts with aircraft are: kestrels, swallows and swifts, pigeons and seagulls - rather common species that frequent the airport areas assiduously or, as in the case of swallows and swifts, in late spring - but whose high concentrations due to the ephemeral presence of food in this period, make them particularly dangerous for air traffic. Sunrise and sunset are the times of the day when birds are most active, and also the times when more bird strikes occur; while June and July are the months of the year when the risk of bird strikes is greatest, given the presence of large numbers of inexperienced birds who have just left the nests. Each airport, however, represents a different case, depending on the geographical position in which it is located and the birdlife that frequents it. The distribution of bird species in Italy, as well as in the rest of the world, is not homogeneous, but differs according to environmental conditions,

the morphology of the territory, and also locally based on the distribution of trophic resources and refuge areas, and obviously it is also influenced by migrations. All this makes each airport a unique system that requires a coordinated approach of monitoring and management systems and tools to mitigate the risk of bird strikes as much as possible.

Species	Swift/Swallow	Kestrel	Herring gull	Pidgeon	Unknown sp.
					?
weight	56/25gr	0.150-0.300kg	0.7-1.5kg	0.5kg	?
wingspan	48/35cm	60-75cm	120-140cm	75cm	?
No. of impacts in 2017	185	160	76	51	35
% on the total	23.93%	20.70%	9.83%	6.60%	4.53%

Number of impacts by species in 2017 (Enac 2017 Annual Report)

Risk reduction strategies

The main strategy on which the action of mitigation of the risk of bird-strikes in airports is based has its cornerstone in the daily monitoring of birds. The model presented in Circular APT-01B is the result of a survey carried out in order to obtain as much information as possible with minimum effort and maximum accuracy. The monitoring is supported by the various deterrent systems and the ecological-environmental management plan of the airport in order to minimize the sources of attraction for birds and make the airport a hostile place for bird presence. In order to obtain reliable information, the forms must be filled in every time a runway inspection is carried out (at least 4 times a day), using a new form for each inspection, in order to have a complete picture of the situation. The annual cycle of data collected in this way is enough to provide a more than optimal picture of the bird situation at the airport. However, the critical points of this strategy are many and varied:

- Accuracy in data collection (species recognition, counting, position)
- Non-continuous data collection during 24h
- Inability of BCUs to monitor the entire airport grounds at the same time

These are just some of the weaknesses of the monitoring system currently used in airports

around the world. If we could count on a system able to simultaneously monitor the entire airport area, from dawn to dusk, able to recognize, classify, count and identify the position of the bird species present and perhaps provide an estimate of the instantaneous risk for each movement based on the detected species, the number of individuals, the direction, this would allow us to:

- have the airport area under constant control
- take effective action in the event of an alarm based on the actual risk
- use deterrence systems more efficiently (distress-call) knowing the target species before the intervention
- optimize the work of the BCUs
- collect accurate and consistent data on birds for the annual report

In the various phases of the process of mitigating the risk of wildlife strikes, the monitoring phase is certainly the weakest - and consequently the one with the greatest possibility of being improved and thus of providing a step forward that could mean a drastic reduction in the impacts between aircrafts and wildlife.

The focal point: if I do not know exactly what is happening at the airport I cannot intervene immediately and efficiently, so I cannot do effective prevention. If instead of doing 4, 8, 20 monitoring sessions a day, we could have the entire area of the airport monitored from dawn to dusk, second by second - it is easy to see how this can affect the ability to control and prevent risk.

Economic impact on civil and military aviation

The civil aviation of the United States alone spends almost a billion dollars a year on wildlife strikes, while in Italy it is estimated a cost of 40 million euros/year, between repairs and delays in flights.

Since 1988, more than 255 people have been killed in the world because of wildlife strikes, and at least 380 military aircrafts and 88 civilian aircrafts have been destroyed.

Flight phase	No. of impacts	%
Landing roll	69	23.47%
Landing	63	21.43%
Take off run	59	20.07%
Approach	35	11.90%
Take off	31	10.54%

Climb	22	7.48%
Descent	12	12 4.08%
Taxi	3	1.02%

No. of impacts in the various flight phases - year 2017 (Enac 2017 annual report)

The focal point is simple: if you do not know exactly what happens at the airport, it is not possible to intervene immediately and efficiently, and therefore it is not possible to effectively prevent the risk of impact between the aircraft and the fauna.

What happens when a bird and a plane collide?

The consequences of the impact between an aircraft and one or more birds basically depend on parameters such as: the type and extent of the impact area; the physical and mechanical properties of the impact area and the strength of the impact.
The force exerted by the bird during the collision depends on the physical characteristics of the animal (therefore on its species), the number of animals involved, the impact trajectories and the speed.
An impact at low speeds with a small bird is likely to cause minor damage both from a mechanical and structural point of view and from the point of view of passenger safety, while a collision at high speed with birds of considerable size such as seagulls or crows can generate significant safety risks. As kinetic energy increases, damage to structures, be they wings or nacelles or windshields or engines, can become very serious. Obviously the most serious damages that may occur are those to the engines: birds that end up in the engines can rapidly compromise their operation damaging the turbines, and therefore the safety of the crew.

Equipment and countermeasures to avoid wildlife strikes?

As previously mentioned, the first and indispensable tool to prevent wildlife strikes is airport monitoring - only by knowing what happens I can know how and when to intervene. The tools available today to intervene in the prevention of wildlife strikes are many and with varying effectiveness:

Removal by noise tools

1. PROPANE GAS GUNS: devices that generate high intensity explosions and can be fixed-cycle, variable or randomized.
2. DISTRESS CALL AND ELECTRONIC SYSTEMS: equipment that emits warnings for certain bird species, capable, if carefully used, of effectively removing one or more species from the desired area. Usually placed on vehicles able to quickly reach

the area to be cleared.

3. FIRECRACKERS AND OTHER PYROTECHNIC DEVICES: different types of projectiles are available on the market, they can be fired from various types of weapons and are configured in such a way as to obtain strong and weak explosions, obtain fumes of various smells and colors, obtain flashing lights, etc.
4. ULTRASOUNDS AND INFRASOUNDS: they belong to the category of least effective means of removal, since most birds receive sound frequencies in the same way as human beings.

Falconry

The use of hawks to keep birds away from airports is a tried and tested practice. The innate fear in many bird species, which pushes them to flee at the sight of the silhouette of a falcon flying is the basis of this practice, used in some airports - including Italian airports. However, the excessive costs of this system and some logistical problems for its development in the airport have slowed down its diffusion over the years.

1. only some species of birds are sensitive to the presence of hawks - seagulls, for example, are difficult to remove
2. with some species, such as herons, it is almost ineffective; crows even drive out hawks by doing the so-called "mobbing".
3. all hawk species cannot work in adverse weather conditions (heavy rain, wind, fog) and with temperatures above 35°.
4. only small aerodromes are suited to the use of hawks
5. it is necessary to hire highly professional falconers
6. the operations must be carried out daily throughout the year, it is therefore essential to use more than one falcon, with additional costs
7. the first tangible results can be seen after a minimum period of 6 months

In consideration of all the above, we can say that the use of distress-calls (calls for alarm of a certain species) has proved over the years to be the most effective system for the removal of birds at airports. If used well they do not generate habituation, and in association with a continuous and constant monitoring of the airport are the best tool for the prevention of bird strikes. This system should be associated with an appropriate policy of ecological and environmental management of the airport, established on the basis of accurate and detailed naturalistic research.

Final conclusions

Civil and military airports, even all airfields, should inherently guarantee the take-off and landing phases with systems for preventing impacts with flying objects, which may be birds or, as is increasingly the case, drones.

The Ventur - BCMS® system is the "system of systems", as it is capable of effectively

recognizing and classifying bird species and calculating their trajectory, but also of immediately orchestrating the actions required to remove species from the area to be kept safe.

In fact, it is possible to integrate the system with the others already present and to interface in an immediate way.

The Ventur - BCMS® system allows you to:

- Have a low-cost alternative to traditional radar or micro-doppler systems
- Have an intuitive system with a quick learning curve. No expensive course to teach new employees how to use it
- No permit issues for electromagnetic wave emissions
- Provide immediate and visual support for the detection of fauna and birdlife that could cause problems to the normal flight activities of the area concerned
- Prevent costly downtime if the system is used to protect power generation fields with wind turbines

Unlike radar and micro-doppler systems, Ventur can recognize the species with an accuracy of more than 95%, in order to guarantee the activation of the most suitable deterrent system.

The Ventur-BCMS® system is ecological, does not emit electromagnetic pollution, and is friendly to wildlife and birds because it is able to reach the ultimate goal without having to resort to bloody deterrent means.

Installation at the 4th Air Force Wing of Grosseto of intelligent cameras for bird-detection