CIVIL AVIATION AUTHORITY OF FIJI

GUIDANCE MATERIAL

Wildlife Hazard Management

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PREFACE

This Guidance Material (GM) is published by the Civil Aviation Authority of Fiji for purposes of promulgating supplementary material to that published in the Authority's Standards Documents.

This GM provides guidance to aerodrome operators and regulatory staff on Wildlife Hazard Management.

This GM explains certain regulatory requirements by providing interpretive and explanatory material.

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Chief Executive
Civil Aviation Authority of Fiji

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1 INTRODUCTION

1.1 Overview

1.1.1 This Guidance Material has been developed from the ICAO Doc 9137, Airport Services Manual, Part 3 — Wildlife Control and Reduction and material available through other CAA's and airport operators in an attempt to put together, in one document, best practice in this area and to assist the aerodrome operator in meeting the requirements of the SD – Aerodrome Appendix 9 section 5.0.

1.1.2 Annex 14, Volume I, and the SD – Aerodrome requires that all aerodromes be certified or registered in accordance with the requirements contained within the SD. As part of the certification process, aerodrome operators are required to develop an aerodrome manual which includes information on the aerodrome site, facilities, services, equipment, operating procedures and management, including a safety management system.

1.1.3

1.1.5 The growing traffic numbers comprised of a more quieter aircraft and the increase in wildlife populations, greater effort is required to control and monitor wildlife movements on and within the vicinity of airports. In addition, the cost of downtime for inspection and repair of aircraft following bird/wildlife damage or suspected bird/wildlife damage is significant. The additional costs and disruption as a result of aborted flights, rescheduling of aircraft passengers and air cargo, transfer of passengers to alternative means of transport, overnight accommodation at the expense of the aircraft operator and the deleterious effects on connecting flight schedules that can be significant and damaging to airline operating budgets and public goodwill (the passenger experience) are also major factors in the cost of a bird strike.

1.1.6 An analysis by ICAO of all birdstrike data collected from participating States reveal that approximately ninety per cent (90%) of bird/wildlife strikes occur on or in the immediate vicinity of airports. In some cases, this threat can be reduced by adapting the aircraft's schedule in favour of the wildlife, especially when the presence of wildlife is for a limited time. Reducing the presence of wildlife in aircraft flight paths can be achieved through ecological means such as habitat management or the dispersal or removal of hazardous wildlife. While the wildlife control programme will be airport-specific, the development of such nature and environmentally sensitive programmes should adhere to national environmental regulations.

1.1.7 Wildlife Hazard Management is thus a critical component of aerodrome operations and this is reflected in Fiji's State Safety Programme document which establishes the acceptable level of safety for bird strikes as **541 bird strikes per 1 million flights in Fiji** (based on a 5 year average, 2007 – 2011), with a safety performance target (SPT) to **reduce and maintain a rate of below 404 bird strikes per million flights by end of 2014** (this lowest rate was achieved in 2010).

1.1.8 Data collected on bird strikes, show that Fiji recorded 54 strikes per 152,282 movements for the year 2017 and 40 strikes per 164,189 movements for the year 2018. Meaning that the safety performance target set for this area was met for both years; i.e. Fiji recorded 7 strikes less than the SPT in 2017 and 26 strikes less than the SPT in 2018. The Authority is reviewing its SPTs and will be setting new targets for 2020 and beyond.

1.1.9 Wildlife hazards, just as any other hazards to aviation safety, should be identified, assessed and managed in order to reduce the risk, through a Safety Management System (SMS). The two step risk process is employed in much the same way, i.e. identify the hazard; the species present in and around the aerodrome including severity of damage each species could cause to an aircraft if struck (this is the hazard level). Once the hazard level is identified, past data is assessed to determine which species are more likely to be involved in a collision (this is the probability level). The product of these factors provides us with the risk for a particular species. An assessment of habitats in and around the aerodrome that have the potential to attract wildlife is also completed, so that the habitat can be managed to reduce the presence of species identified as constituting a risk to flight safety.

1.1.10 Following the conduct of the risk assessment, aerodrome operators, where practicable, should implement a programme tailored to local conditions, with assistance from the national committee or other outside agencies, as required. This programme sets out the actions required to reduce wildlife hazards in and around critical aircraft operating areas, and decrease the risk of a strike.

1.1.11 The analysis of bird/wildlife data in respect of bird strikes and observations and monitoring of bird/wildlife activities can reveal trends that will assist airport authorities to recognize areas of concern which should be addressed through a well-managed wildlife control programme. Bird/wildlife strike statistics can also be analysed to determine those times of year or day when bird/wildlife control is needed the most

1.1.12 A programme to reduce the risks associated with bird/wildlife strikes is referred to in Annex 14, Volume I, Section 9.4 and the SD – Aerodromes Appendix 9 section 5.0, "*Wildlife strike hazard reduction*". An airport should implement a bird/wildlife strike prevention programme in order to reduce the risks presented by birds and wildlife at the airport and in its vicinity. The scale and details of this programme will vary from airport to airport, but all programmes should contain basic information as described in Chapter 2. Given the unique nature of a wildlife hazard management, it is important that each aerodrome develop its own programme.

1.2 What is Wildlife Management?

1.2.1 Wildlife management involves manipulating an animal's behavior or its habitat in order to achieve a specific goal with regards to an animal's behavior, population, or geographic distribution. At aerodromes, the goal of wildlife management is to change the behavior of animals so that they do not occupy critical safety zones where aircraft operate. The key to managing wildlife at aerodromes is to understand the animals' basic requirements and how their behavior can lead to an aviation safety hazard. Essentially, it is imperative to know why animals behave the way they do.

1.3 Animal Needs and Habitats

1.3.1 All animals have basic requirements for survival and reproduction and these requirements dictate how they will behave. They need energy and nutrients, including water, to survive and thrive. They must maintain the core temperature of their bodies, they must avoid being eaten by other animals, and they must reproduce. All of the behavior can be traced to these basic requirements. Different species have different behaviors and some of these can lead to high risk situations at aerodromes. Once the aerodrome operator understands the needs of the animal that lead to its high risk behavior, they can begin to take steps to change that behavior.

1.3.2 An animal meets its basic requirements by utilizing habitats within the environment. A habitat is any kind of distinguishable feature within the environment, such as an open meadow, a stand of trees or a water body. Different animals use different habitats to meet their requirements, and some vary the types of habitats they use at different times of the year, depending on the specific requirement they are fulfilling.

1.4 Manipulating Habitats

1.4.1 With an understanding of how animals behave and use different habitats to meet their requirements, we can begin to manage them. Around the aerodrome, this usually means manipulating habitats, especially around the critical safety zones, so that animals are not able to fulfill their requirements there. This kind of manipulation varies depending on the animals involved and the requirements they need to fulfill. For example, a drainage ditch full of water will provide ducks with a safe place to bathe and feed. If the ditch is directly adjacent to a runway, there may be a risk of ducks being struck by aircraft as they move to and from the ditch habitat. When the drainage ditch is enclosed with a culvert, the habitat that the duck requires is gone. The duck is no longer able to fulfill its requirements in that location, and will have to find another suitable habitat. As a result, there will be fewer ducks in a critical safety zone for aircraft, and, therefore, a reduced risk to aviation safety.

1.5 Active Management

1.5.1 Sometimes nothing can be done to change a habitat on an aerodrome, so active management might be necessary to manipulate wildlife behavior directly. For example, concrete tarmacs commonly required for aircraft operations, can provide a habitat attractive to wildlife. In cold weather, the concrete can warm faster than its surroundings and become the warmest habitat available attracting congregations of birds. To change the behavior might need an intervention involving stimulating the animal in a way that it perceives a danger that outweighs the gains it will receive by not changing its behavior. In the case of birds warming themselves on concrete tarmac, a loud noise from a pyrotechnic explosive, rifle shot or air siren can provide enough stimulus to make the animals fear for their safety and leave.

1.6 Removal

1.6.1 In some cases, it may be not feasible to manipulate the habitat or change wildlife behavior permanently. Removal of an animal or a group of animals may be the only option. This can involve trapping and releasing them in a new location, or in extreme cases killing them. Aerodrome operators must ensure that they are compliant with all regulations regarding the wildlife species in question, and that they carry out removals in a manner as humane as possible.

1.7 Ethical Responsibility

1.7.1 Wildlife management at aerodromes is a critical part of safe aircraft operations. Furthermore, aerodrome operators have an ethical responsibility to contribute to the conservation of wildlife and biodiversity. Some of the species that present a high risk to aviation safety might be critically endangered or threatened. It is the responsibility of the aerodrome operator to deliver solutions that maintain aviation safety whilst conserving the species in question.

1.7.2 Wildlife management is a complicated practice that involves thorough understanding of animal biology and behavior, including the ways in which they fulfill their basic requirements. Aerodrome operators will generally achieve the greatest level of safety if they invest in a dedicated Wildlife Hazard Management Programme. Each aerodrome will have a different set of challenges associated with wildlife, but the fundamentals of wildlife management apply to all of them. Aerodrome operators must work with an animal's behavior, and not against it, if they are to successfully maintain aviation safety.

2 Wildlife Hazard Management Programme

2.1 Programme

2.1.1 A wildlife hazard management (WHM) programme provides the strategy for reducing the risk that wildlife poses to safe airport operations. The programme is based on the risk assessment of wildlife hazards and should define the following:

a) assignment of personnel (roles and responsibilities of personnel in the programme):

(1) a manager who is accountable for developing and implementing WHM programme;

(2) a coordinator who should oversee the daily activities and analyse the collected data and carry out risk assessments in order to develop and implement the WHM programme;

(3) trained and competent staff who should detect and record the presence of birds/wildlife and assess the bird/wildlife hazard and expel hazardous birds/wildlife. It is recommended that the training of staff engaged in bird control activities include an element of ornithological knowledge, to enable aerodrome bird control staff to make reliable and accurate identifications of birds both from observations and post bird strike during the collection and analysis of bird remains. Should there be a facility by which stakeholders can obtain a scientific analysis (feather or DNA) taken from snarge (bird remains) or an unidentifiable carcass following a strike should also be described in the management programme;

b) a process to report, collect and record data on struck and living birds/wildlife;

c) a process to analyse the data and assess the bird/wildlife hazard in order to develop mitigation, proactive and reactive measures. This should include a risk assessment methodology and identification of the wildlife species that are a priority for risk reduction;

d) a process of habitat and land management both on the airport and in its vicinity in order to reduce the attractiveness of the area to birds/wildlife. Where applicable and relevant, this should include effective grass management techniques and, where applicable, a long/tall grass policy for “on-airfield” areas;

e) a process to expel or remove hazardous birds/wildlife, including by lethal means where appropriate i.e. prescribe actions necessary to reduce the risk associated with individual species;

f) a process for liaison with non-airport agencies and local landowners, etc., to ensure the airport operator is aware of developments that may contribute to creating additional bird hazards in the infrastructure, vegetation, land use and activities in the airport vicinity (crop harvesting, seed planting, ploughing, establishment of land or water features, hunting, etc., that might attract birds/wildlife);

g) a process to have regular meetings with all stakeholders of the airport's bird/wildlife strike prevention committee and a communication strategy for ensuring that the information necessary for managing wildlife risk is shared effectively, and

h) a Training Programme for the personnel involved in Wildlife Hazard Management where considered applicable, particularly at international/larger aerodromes (Nadi and Nausori).

2.1.2 Each aerodrome's WHM programme will be unique to that aerodrome, tailored to and commensurate with the size and level of complexity of the airport, taking account of the identification of the bird hazard and the risk assessment of that hazard.

2.1.3 To ensure that the WHM programme remains effective, a monitoring and evaluation strategy for the entire programme should be implemented.

2.2 Roles and Responsibilities

2.2.1 The WHM programme should explicitly identify the personnel who will be involved in the programme, including the roles and responsibilities they will fulfill. Chapter 3 outlines the specific roles and responsibilities associated with wildlife management at an aerodrome.

2.3 Communication Strategy

2.3.1 Aerodrome operators should create communication procedures for managing and reacting to wildlife hazards and for acting when a strike does occur.

2.3.2 It is critical for the safety that key personnel are notified when there is an elevated risk of wildlife strike. The communication strategy should summarize which personnel are responsible for recognizing and alerting of an increased wildlife hazard, and which personnel should be notified. The communication strategy should be inclusive of wildlife management technicians, pilots, and air traffic controllers.

2.3.3 A communication strategy is also necessary for when a strike does occur. This allows the effective collection of data pertaining to the strike, including the airline and type of aircraft involved, the stage of flight, the damage to the aircraft and whether there was an effect on flight, and the species of wildlife involved. The wildlife strike data can then be used as an evaluation tool.

2.4 Taking Action to Reduce Risk

2.4.1 Once the risk presented by various wildlife species is prioritized, a series of actions for reducing that risk is outlined. The actions needed to reduce the risk can take several forms and include managing aerodrome habitats so that they are less attractive (fulfill fewer of the animals basic requirements); dispersing wildlife with behavioral stimulants; physically excluding wildlife from the aerodrome; physically removing wildlife from the aerodrome; and strategies for managing habitats that are within the vicinity of the aerodrome but outside its boundaries. The actions should also include a system for communicating the risk of bird strikes to critical personnel, including pilots, air traffic controllers, and wildlife management personnel.

2.5 Training Programme

2.5.1 A Training Programme should be established through the WHM programme. Effective training ensures that actions taken to reduce wildlife hazards are consistent across all personnel. A basic Training Programme is provided in Chapter 6.

2.6 Monitoring and Evaluation

2.6.1 Once action is taken to reduce risk, it is important to establish monitoring procedures to collect the information needed to evaluate the efficacy of the action. The WHM programme must define this strategy. Chapter 7 outlines the general requirements of monitoring and evaluation.

2.7 Research Priorities

2.7.1 Research projects should be designed to assess the efficacy of novel management practices and control actions on reducing wildlife hazards. Proper experimental design is critical to the successful evaluation of novel practices, and aerodrome operators should whenever possible consult with local biologists when considering their research priorities.

3 Roles and Responsibilities

This chapter looks at the various roles and responsibilities of the stakeholders involved in wildlife hazard management at aerodromes. The assignment of actual roles, titles and tasks will vary from airport to airport. At smaller airports the roles might be divided or merged to just 1 or 2 levels. Larger airports will require larger, possibly dedicated teams. Some tasks or roles may be contracted to an external company or organization.

3.1 The CAAF

3.1.1 It is incumbent upon the CAAF to ensure that any procedures in the aerodrome manual relating to bird/wildlife control are developed and implemented as part of the aerodrome safety management system (SMS).

3.1.2 Birds and other wildlife on, and in the vicinity of, the airport may represent a threat to aircraft safety. In some cases, this threat can be reduced by adapting the aircraft's schedule in favour of the wildlife, especially when the presence of wildlife is for a limited time. Reducing the presence of wildlife in aircraft flight paths can be achieved through ecological means such as habitat management or the dispersal or removal of hazardous wildlife. Whilst a WHM programme will be airport-specific, the development of such nature and environmentally sensitive programmes should adhere to national environmental regulations.

3.2 The Aerodrome operator

3.2.1 Because of the importance of bird/wildlife control, each aerodrome operator has the responsibility to develop, implement and demonstrate an effective bird/wildlife strike and wildlife control programme at the airport, and this should be tailored to and commensurate with the size and level of complexity of the airport, taking account of the identification of the bird hazard and the risk assessment of that hazard.

3.2.2 Aerodrome operators, where practicable, should implement a programme tailored to local conditions, with assistance from the CAAF, national committee (where one has been established) or other outside agencies, as required. Where practicable, the aerodrome operator should appoint an airport bird/wildlife control coordinator who is responsible and accountable for the airport's bird/wildlife hazard management programme and the personnel engaged in bird/wildlife hazard control. This may include the formation of a local airport bird/wildlife committee that will develop and implement the specific programme. It is imperative that personnel responsible for these tasks are able to demonstrate competence, are trained by qualified personnel and are provided with the appropriate resources and equipment to carry out their tasks.

3.2.3 The airport operator's responsibilities should be borne by the senior manager role and this should be specified in the aerodrome's Safety Management System (SMS).

3.3 The Airport Wildlife Hazard Management Committee

3.3.1 Wildlife hazard management on an airport often requires communication, cooperation, and coordination among various groups on the aerodrome. This is especially true when identifying hazardous wildlife situations, executing large-scale habitat management actions, or developing management strategies for hazardous wildlife that are endangered or threatened. Establishment of the Airport Wildlife Hazard Management Committee is required to facilitate this communication, cooperation and coordination. This committee could be included within the safety management committee.

3.3.2 The airport wildlife hazard management committee should include those involved in wildlife hazard management, airport planning, maintenance, operations and any other stakeholders. It should also include air traffic services, flight operators, rescue and firefighting services, security, duty managers, finance, etc.

3.3.3 The committee should review strike data collected and observations of birds/wildlife, assess bird/wildlife risks and summarize trends in order to evaluate and determine what effective control measures should be implemented in order to manage the issues arising.

3.3.4 The committee will ensure that all stakeholders are engaged in the programme.

3.3.5 Members of the Committee should include the following:

- Senior Manager
- Wildlife hazard Management Coordinator/Manager
- Wildlife Control Officer representative
- Aircraft Operator representative
- Airport Planning Manager
- Aerodrome maintenance and operation Manager
- ATC representative
- Local runway safety team representative
- Local authorities
- Depending on the organizational structure of the airport, other representatives can also be included, such as the Fire and Rescue Service.

3.4 The Airport Wildlife Hazard Management Coordinator/Manager

3.4.1 The Wildlife Hazard Management Coordinator/Manager is in charge of the day-to-day management and efficient implementation of the WHM programme.

3.4.2 The coordinator (or equivalent) should coordinate the activities of the WHM programme with air traffic control (ATC) and other stakeholders. The coordinator's responsibilities should allow for the time required to be involved with observations, control and reporting.

3.4.2 The coordinator should also review strike reports, monitor daily activity records and maintenance reports to determine the requirements for short- and long-term management programmes, and this information should be passed to managers accountable for safety on a regular basis (recommended at least monthly).

3.4.3 The person might be a technical specialist, such as a biologist, or such expertise might be out- sourced. In more detail, this role will involve key duties such as the following:

- Advising the Airport/Senior Manager on all matters relating to wildlife hazard prevention;
- Develop and implement the WHM Programme;
- Planning and organizing wildlife control operations in accordance with the WHM programme;
- Supervising and monitoring wildlife control operations to ensure that the WHM programme is implemented correctly;
- Supervising wildlife control record keeping (log, bird counts, wildlife strike recording and reporting, bird dispersal, culling and habitat management diaries, etc.);
- Providing technical supervision of Wildlife Control Operators, intelligence gathering, and planning;
- Facilitating active surveillance, wildlife dispersal, culling and other field tasks;
- Ensuring that all necessary passes and permits are current;
- Ensuring the supply, safe keeping and correct maintenance of wildlife control equipment and consumables
- Coordinating with operation and/or grounds maintenance to ensure that habitat is managed according to the WHM programme; and
- Providing a communications channel between the aerodrome policy makers/providers, wildlife control operators and other interested parties, such as airline operators and air traffic control.

3.5 Senior Manager

3.5.1 A Senior Manager should be identified who has overall responsibility for wildlife control. This may be a dedicated role or included in the responsibilities of the safety manager.

3.5.2 The role should involve tasks and responsibilities that include:

- Ensuring that the WHM programme is developed and implemented;
- Ensuring the WHM programme is referred to and becomes part of the aerodrome Safety Management System (SMS) and the operational safety culture of the aerodrome;
- Ensuring sufficient financial and human resources, including initial and on-going training are provided to enable implementation of the WHM programme;
- Participating on the airport Wildlife Committee;
- Working with external parties such as local, regional and national governments in order to avoid or mitigate regulation that might impinge on the safe operation of airports.

3.5.3 Specific responsibilities arising from items that should be included in the WHM programme would include the following:

- Ensuring that the protected species register is included in the WHM programme and that proper safeguards for these species are in place;
- Ensuring that the required reports are submitted (monthly or at other agreed intervals) to the CAAF;
- Ensuring that, where appropriate, habitats and land uses identified in the WHM programme, especially those that will require capital expenditure, are included in the Airport Masterplan.

3.6 Wildlife Control Officer

3.6.1 A Wildlife Control Officer performs the front line role and may be any suitably trained and qualified member of aerodrome staff.

3.6.2 This role will involve key duties such as:

- Maintaining surveillance of wildlife activity on the aerodrome and beyond;
- Implementing active wildlife control measures and interventions in accordance with the WHM programme to counter any detected wildlife hazards;
- Providing the air traffic service, where applicable, with details of a potential wildlife hazards;
- Recording wildlife control activity;
- Recording actual, potential or suspected wildlife strikes;
- Advising senior personnel on improvements to the wildlife control tasks or WHM programme; and
- Assisting with surveys, etc.

3.6 Stakeholders outside the Airport

3.6.1 Aerodrome operators should also identify which stake holders will be responsible for providing input and consultation. Stakeholders can include transportation officials (including government), other aerodrome staff, airline representatives (including pilots), conservation organizations (government and non-government), local municipalities/cities, and organizations that are responsible for land management in the area surrounding aerodrome.

4 Assessment of the Risk of Wildlife Hazards

4.1 Risk Assessment

4.1.1 An important step in managing wildlife hazard is to assess the level of risk that each species of animal presents to aircraft operations at the aerodrome. This risk assessment is more than simply surveying the species found in and around the aerodrome; it involves assessing the likelihood of each species striking an aircraft and the probability and extent of damage that may result. This allows the aerodrome operator to prioritize its actions to target the highest risks. The Risk assessment should whenever possible, identify the biological factors that cause different wildlife species to present a risk to aviation safety. Identification of these factors will greatly aid in the formulation of a Wildlife Hazard Management Programme.

4.1.2 There are several methods of conducting a Risk Assessment of Wildlife Hazards. The risk assessment methodology set out by the International Birdstrike Committee is recommended guidance and this is provided in the ensuing paragraphs.

4.1.3 The guidance will outline a simple, qualitative method that can be used as a starting point for a more detailed Risk Assessment. In its most basic form, a Risk Assessment determines the level of risk that each species of wildlife presents based on the combination of the probability that it will be struck by an aircraft and the severity of the outcome.

4.1.4 Prior to discussing the assessment of the risk of wildlife strikes, it is important to ensure that consistent terminology is used. The words “hazard” and “risk” are often used interchangeably in normal conversation but they have specific meanings in the science of risk analysis:

a) A hazard is defined as a situation that, in certain circumstances, can lead to an event that results in harm. In this context, a hazard is the presence of certain birds/wildlife on or near an aerodrome.

b) Risk is the probability that the harmful event will occur, multiplied by the severity of the harm that could result. In this context it is the probability of a bird/wildlife strike by a particular group of birds/wildlife multiplied by the severity of damage to the aircraft that results.

Risk = (probability of an event) × (severity of harm) and so for bird/wildlife strikes:

Risk = (probability of a strike) × (severity of damage caused)

4.1.5 It is therefore possible to have a large number of large birds/wildlife close to an airport (a significant hazard) which results in a very low risk if the birds/wildlife never move onto the airfield or fly across the operational airspace. It is also possible to have a large number of small wildlife (typically weighing less than 120 g or 4 oz) that are regularly struck by aircraft but which result in a low risk because of their size and weight, meaning that the level of harm resulting from the strikes is always very low (except when colliding with dense flocks).

4.1.6 Any assessment of risk therefore needs to estimate the probability that a strike will occur and the likely level of harm that will result. Estimation of harm is relatively straightforward because analysis of various bird/wildlife strike databases around the world shows that there is a consistent relationship between bird/wildlife mass and the level of damage to aircraft. Strikes involving flocks of birds (even small species) are also more likely to result in damage to the aircraft than strikes with single birds. Thus the larger the bird/wildlife and the greater its tendency to be struck in groups, the greater the risk.

4.1.7 It is more difficult, however, to estimate the likely strike frequency of a particular population of bird or other wildlife because their behaviour cannot be predicted with certainty. There are a number of possible approaches to estimating strike probability, which vary in sophistication and in the level of skills and experience needed to apply them.

4.1.8 The most common form of risk assessment involves the categorization of both strike probability and likely severity into a number of arbitrary levels, usually low, medium and high. Again, this is easily done for strike severity using the mass of the birds/wildlife involved, with a correction for their tendency to occur in groups. Assigning birds/wildlife to a category for strike probability is more difficult and requires some specialist knowledge of the behaviour of the species involved and how that behaviour is influenced by the environment around the airport concerned. Some airports may have staff that are sufficiently experienced in bird/wildlife behaviour to allow them to undertake this work. Otherwise, contracting the services of bird/wildlife strike prevention specialists or local ornithologists may be necessary.

4.1.9 A typical option for risk assessment may involve a numerical approach that uses the number of strikes encountered with different species over the recent past as a measure of the probability of likely future strikes. For this process to work reliably the airport's records must indicate that the majority of strikes that occurred at the airport have been reported, that reporting has been consistent from year to year and that the bird/wildlife species involved have been identified correctly. If these three requirements have not been met, it is better to use one of the more generic risk assessments described above. One such numerical approach involves taking the mean number of strikes recorded for each species in the past five years and using this to assign the species concerned to one of five frequency categories. The mass of the species is then used as a measure of likely severity and the species are assigned to one of five severity categories. The boundaries of these categories can be set by the airport or regulator concerned. The frequency and severity measures are then combined into a 5 x 5 risk matrix (see Figure 1) with the different cells of the matrix designated as one of three risk levels.

4.1.10 The first step in a risk assessment of wildlife hazards is to define the area that will be assessed. This generally includes the entire aerodrome. The area of the risk assessment should include the take-off routes and landing approaches when significant wildlife hazards are present in these zones.

4.1.11 The next step of a risk assessment is to rate the probability that species will be involved in a strike. The examples below uses a scale with 5 levels but fewer or more levels could be used. The probability can be assessed qualitatively on a scale, for example, from Very Low to Very High. Species that shy away from aircraft noise or that learn to avoid aircraft could be rated as Low or Very Low. Birds that flock in large numbers to certain habitats in the flight path could be rated a High or Very High. Solitary animals might be rated as Medium but other behavioral factors might have to be taken into account. This probability might also vary with the season or other conditions such as grass length or rain and weather conditions.

4.1.12 The next step is to rank the expected severity of the impact or damage resulting from a strike event. Sometimes called the Hazard Level Ranking, this can use a scale similar to strike probability scale. This ranking will depend on the size of the animal and its tendency to flock or congregate. Heavier animals have a greater capacity to damage an aircraft and impact its flight performance. As a guide, birds that tend to flock and weigh more than 1.8 kg can cause the most severe damage to aircraft. The birds (or bats) that are solitary and weigh less than 50 g might be expected to cause the least severe damage. Flocking behavior might mean that a strike event could include multiple impacts or it could increase the probability of a strike.

SEVERITY	PROBABILITY				
	Very high	High	Moderate	Low	Very low
Very high	3	3	3	2	2
Moderate	3	3	3	2	2
High	3	3	2	1	1
Low	2	2	1	1	1
Very low	1	1	1	1	1

Figure 1 A 5x5 risk assessment matrix

4.1.13 The three risk levels require different responses from airport managers as follows.

a) Risk level 3. Risk from this species is currently very high. Additional management actions should be implemented for this species as soon as possible.

b) Risk level 2. Risk from this species merits further review of available options and action if appropriate. Current risk management for this species should be reviewed and additional steps taken if appropriate.

c) Risk level 1. Risk from this species is currently low. No further action is required beyond the risk management measures currently in place.

4.1.14 It is also accepted that there may be local variations to this matrix, such as:

a) Green (Level 1). No further action is required.

b) Amber (Level 2). The current residual risk requires a review of available options and possible action. c) Red (Level 3). The current residual risk requires further action to reduce it.

4.1.15 The actions and assessment need to fit with the reality of what can realistically be achieved within the legislation available and the resources at the airport's disposal. It should be noted that where the risk assessment in a Level 3 indicates "unacceptable" there may be very little the airport can do about managing this risk to entirely remove it, for example, due to the coastal location of the airport, or where the airport is surrounded by conservation areas and the airport operator is unable to access and influence the wildlife hazards due to constraints placed upon the airport by local wildlife legislation.

4.1.16 The risk assessment matrix may also need to be adapted to cater for the risk posed by multiple strikes, whereby this risk would need to be raised to a high level.

4.1.17 A quantitative approach (see Figure 2) uses historical strike records at the aerodrome expressed as the number of strikes (by species) per 10,000 aircraft movements. As a guide, 4or more strikes per 10,000 movements would constitute a Very High probability of a strike, whereas less than 1 strike per 10,000 movements constitutes a Very Low probability. This type of approach is suited for larger aerodromes such as Nadi and Nausori airports.

			Severity of Strikes				
			Catastrophic	Critical	Moderate	Minor	Negligible
Probability of Strikes			A/C Crash & Severe	A/C Crash & Light Casualty	A/C Severe Damage & No Crash	A/C light Damage	near miss
Definition	Meaning	Value	A	B	C	D	E
Frequent	5/10,000 movements	5	5A(Unacceptable)	5B(Unacceptable)	5C(Unacceptable)	5D(High)	5E(Moderate)
likely	4/10,000 movements	4	4A(Unacceptable)	4B(Unacceptable)	4C(Unacceptable)	4D(Moderate)	4E(Moderate)
Occasional	3/10,000 movements	3	3A(Unacceptable)	3B(High)	3C(High)	3D(Moderate)	3E(low)
Seldom	2/10,000 movements	2	2A(Unacceptable)	2B(High)	2C(Moderate)	2D(Low)	2E(Very Low)
Improbable	1/10,000 movements	1	1A(Unacceptable)	1B(High)	1C(Low)	1D(Very Low)	1E(Very Low)

Figure 2 Example of a quantitative approach

Note:- The level of risk for each species of bird, bat and terrestrial animal is determined as a combination of the Probability of a Strike and the Severity of the Outcome. In the example the Risk is also rated on a scale of 5 – Very Low, Low, Medium, High and Unacceptable. Alternatives might use a scale of 3 and the traffic light colors (Green, Amber, and Red) to highlight the high priority species.

The risk assessment will rank the risk of each species and highlight those species that should be prioritized for risk mitigation in the WHM Programme.

4.1.17 Severity can be rated in terms of aircraft damage and human casualty. Negligible could mean near miss and aircraft damage. Minor could mean light aircraft damage. Moderate could mean severe aircraft damage. Critical might mean that the aircraft could crash with no human death, just wounded, and Catastrophic might mean an emergency situation with aircraft crash and severe wounds or death casualty. Each airport should determine its own scale. The range of aircraft sizes operating at an airport will also need to be taken into consideration, so clearly the views of the aircraft operators should be considered.

4.1.18 All of the above techniques are designed to assess the total risk of a bird/wildlife strike at an airport. This is effectively the airport operator's risk exposure. In order to assess the risk to an airline or an individual passenger flying to or from an airport, some account of movement rate needs to be incorporated into the risk assessment. The simplest approach to this is to express strike frequency per aircraft movement or, more conventionally, as strikes per 10 000 aircraft movements. As with the techniques described above, the sophistication with which this strike rate can be interpreted depends upon the level of detailed information available concerning the

bird/wildlife strikes that are encountered. If information is limited to the total number of strikes per year then the strike rate per 10 000 movements may simply be categorized as low, medium or high. If bird/wildlife strikes are reliably reported and identified and there is a sufficient data set, then it may be possible to treat the strike rate for an individual species as a measure of strike probability. However, it should be borne in mind that the severity depends on the mass of the species and the flocking behaviour.

4.1.19 Whatever risk assessment technique is chosen, it is essential that the findings are followed up by effective risk management. For those risks that are judged very high (Level 3), a list of available actions should be developed, in consultation with bird/wildlife management experts where necessary, and the costs and benefits of the various options assessed before a decision is reached on which options to select. It is equally important that the effectiveness of these options is evaluated at appropriate intervals after they are implemented. Repeating the risk assessment process annually to determine if the risk is falling to an acceptable level is recommended.

4.1.20 At the same time for those risks judged low (Level 1), the actions in place should not ease and should continue at the same intensity and frequency.

4.1.21 Finally, it is essential that the entire process be properly documented in order to show that the aerodrome operator concerned is acting with due diligence in managing the bird/wildlife risk on and around its property.

4.1.22 A more thorough discussion of the assessment of risk can be found in ICAO's Safety Management Manual (SMM) (Doc 9859).

4.2 Identifying Root Causes of Wildlife Hazard

4.2.1 The final stage of the risk assessment of wildlife hazards is to identify the root cause of each wildlife hazard. Here, it is critical to understand the behavior and basic requirements of each hazardous species of wildlife. Remember, each animal has a basic requirement for energy and nutrients, including water. They must maintain their bodies core temperature, they must breed and reproduce, and they must avoid being predated by another animal. When identifying root causes of wildlife hazards, consider each species and its basic requirements. Then, observe the aerodrome and surrounding areas to determine how the different habitats may aid the species in fulfilling its requirements.

4.2.2 This stage of the risk assessment should, wherever possible, involve a trained wildlife biologist who is familiar with ecology and animal behavior. Ideal habitats for hazardous wildlife may not be readily apparent, and the attractiveness of aerodrome habitats may vary seasonally. Consider all stages of an animal's requirements throughout the annual cycle. Breeding seasons, annual migrations, seasonal weather patterns, and food availability are all factors that can contribute to temporal changed in wildlife hazard.

4.3 Using Advanced Risk Assessment Methods

4.3.1 The risk assessment outlined in the sections above are one of the more basic ones that an aerodrome can utilize to quantify wildlife hazards. Aerodrome wildlife managers may wish to consider a greater set of variables, and therefore, assess risk more accurately. For example, the type of aircraft using the aerodrome will influence the level of risk; larger, faster aircraft will increase the risk of a damaging wildlife strike.

4.3.2 When considering the probability of a wildlife strike, components of each species behavior can also be considered. This is especially valuable when detailed records of historical wildlife strikes are not available. Such factors as variations in a species annual abundance around the aerodrome, the animal's propensity to engage in "hazardous" behavior, and its relative ability to avoid aircraft can be considered.

5 Operational Practices

5.1 Introduction

5.1.1 The WHM programme should provide details on the actions and procedures necessary to manage both habitat and wildlife given the specific local conditions and considerations. In broad terms, habitat management is a long term issue and may involve capital investment to deal with land, vegetation and water bodies both on and off the airport site. Shorter term activities include the upkeep of the vegetation such as grass cutting and tree trimming.

5.1.2 Actions to deal with wildlife on a daily basis starts with patrols and inspections, observation of wildlife and other conditions, making interventions and assessing the response to inventions. It is also crucial to record all actions and observations in order to be able to review the effectiveness of the WHM programme and development improvements.

5.1.3 Reporting to be established, monthly or a similar period and equipment should also be checked and reviewed on a similar basis. It is generally difficult to provide definitive guidelines, because best practice depends greatly on the local conditions at an airport, the different key wildlife species and their particular behaviors.

5.1.4 Airports should systematically review features on, and in the vicinity of, the airport that attract birds/wildlife. The WHM programme should include a plan to reduce the attractiveness of these features and to decrease the number of hazardous birds/wildlife present or to deny them physical access to these areas.

Figure 3Wildlife culling at Nadi International Airport

5.1.5 Airport development should be designed such that it will not be attractive to hazardous birds/wildlife and no attraction will be created during construction. This may include denying restin birds/wildlife.

5.1.6 A complete perimeter fence of adequate height is the prime method of preventing hazardous wildlife, other than birds, from gaining access to the airfield areas. Fences and gates should be left closed and regularly checked. No food sources should be available to animals on the airport.

5.1.7 Vegetation composition (grass) should be kept at a height that is considered unattractive to hazardous birds/wildlife, while accepting that this may not be applicable in arid locations. The attractiveness of vegetation is a balance between food presence, food accessibility and protection against predators:

a) earthworms, insects, rodents and other animals are present in and on the soil and in the vegetation.

b) The vegetation itself and its seed are food for plant and seed eaters;

c) food accessibility depends on vegetation height and density. Long, dense vegetation will inhibit most hazardous birds/wildlife from moving around, detecting and accessing the food;

d) birds/wildlife safeguard themselves from predators by hiding and/or fleeing. Long, dense vegetation is preferred as a hiding place by agoraphobian species. These species avoid the open space of the runway and short vegetation. On the other hand, claustrophobic species avoid long, dense vegetation and prefer to stay in the open space of the runway and short vegetation where they have a wide view to see predators well in advance to enable them to flee on time; and

e) birds/wildlife feeding on seeds will avoid the airport if its vegetation is mowed during the flowering season. When these flowers attract insects that are attracting aerial feeders (for example swallows, swifts and bee-eaters), the vegetation should be cut before the flowering season in order to maximize deterrence of local wildlife species, and the height and species composition of the vegetation should be managed to minimize food sources.

5.1.8 Agricultural crops, where possible, should be discouraged from the airfield environment since agricultural crops and related activities (ploughing, mowing) will provide food for hazardous birds/wildlife.

5.1.19 Water bodies in many parts of the world can be a particular hazard because they can be very attractive to birds. It may be possible for these to be modified by netting them to exclude birds, fencing them to deny access to birds that walk in, have the sides steepened or made less attractive in other ways. Refuse/garbage dumps can also be very attractive to birds and can cause bird flyways to cross the airport. Preventing food sources from being available either through management or netting/fencing of the facility can be effective to deter birds and other wildlife.

5.2 Habitat Management

5.2.1 Habitat management can be the most effective method to reduce wildlife hazard at an airport. This section outlines some general concepts and considerations. More details on this have been set out in Appendix A of this GM.

5.2.2 The management of habitats on the airport will be quite different from that on land adjacent and near to the airport. Some considerations are part of the long term development of the airport and should be included in the Airport Masterplan. Others issues are more related to regular maintenance and upkeep of airport lands.

Figure 4 Well-maintained fence, no gap at the bottom

5.2.3 The key to habitat management is avoiding conditions that attract wildlife such as food, water, shelter, and resting and breeding areas.

5.3 On Airport Habitats

5.3.1 Major earthwork considerations on airports are usually required to manage storm-water runoff, and drainage channels and settling ponds can become water bodies that attract wildlife. Such work is usually done at the time of runway and taxiway development and future developments would be included in an Airport Masterplan. Wildlife hazard issues must be taken into account at the airport infrastructure planning stages.

5.3.2 Landscaping then usually involves seeding open areas for grass or other appropriate plant coverage to avoid soil erosion. Grass and plant species must be selected taking into account maintenance and watering needs, seeds and fruit, and shelter and nesting for wildlife. Shotgun Airport

5.3.3 A perimeter fence around the airport airside areas is often required for safety and security reasons. The ability to exclude local wildlife will be a key consideration with designing and constructing a boundary fence.

5.3.4 The need to protect the habitat of certain native animal and plant species might be a part of the airport's land management and biodiversity plans or obligations. This might in fact conflict with the need to reduce wildlife hazard and airport senior management may need to work closely with government wildlife or conservation department to develop appropriate local regulation. Careful consideration of wildlife hazards will be required when planning such conservation habitats.

5.4 Off - Airport Habitats

5.4.1 The land use and habitat management on areas near an airport are also an important consideration, although an airport operator may have limited ability to control off-site land use and will need to work in partnership with local landowners and stakeholders.

5.4.2 In principle, the habitats off-site should be more attractive to wildlife than the airport site itself. However extreme cases such as a land fill or garbage dump might attract so much wildlife that it may pose an increased hazard on airport land.

5.4.3 Off-site land uses and activities that can affect wildlife and might need careful consideration might include the following:

- Nature conservation and recreational areas;
- Local agricultural practices;
- Land fill and solid waste management;
- Storm water and waste water treatment plans;
- Water bodies including reservoirs, lakes, rivers and the sea;
- Wetlands including marshes; and
- Gravel pits and quarries.

5.5 Routine Patrolling

5.5.1 Routine patrolling is the core of the WHM programme and should include site tours or inspections, observations, interventions and record keeping. Regular surveillance of the aerodrome is necessary to spot hazardous wildlife. The use of binoculars, spotting scopes and possibly night vision equipment by trained staff allows for optimum observation. During patrols, the wildlife control operators should determine high-risk areas and spend disproportionately more time in those areas.

5.5.2 The frequency of patrols will be highly dependent on local conditions and the behavior of wildlife. In some locations or during some seasons, daily patrols may suffice. Under certain situations patrols may be required every 30 minutes or even more frequently. Runway safety inspections may be incorporated or performed in parallel with wildlife hazard management patrols. Patrols should be carried out in a random pattern rather than a regular route so that wildlife do not 'learn' or become accustomed to the timing of patrols.

5.6 Patrols and Inspection

5.6.1 During a patrol, a wildlife control operator should be on the lookout for a range of activities and situations, including the following:

- Observe wildlife in an area, how many, what species, what activity, what it appears to be attracted to;
- Observe signs of occupancy by wildlife such as feeding, nesting, resting, droppings, or carcasses;
- Observe conditions of the habitat such as grass, surface water, trees, fences, FOD (Foreign Object Debris);
- Inspect specific features such as traps or visual deterrents;
- Observe and report any other safety issues associated with the operation of the airport, whether or not it related to wildlife hazard management.

5.7 Remote Detection Systems

5.7.1 Some airport might employ remote detection systems such as radar or video monitoring systems. Such technology will probably never replace the need for manned patrols and interventions, but could assist with reducing the frequency of patrols.

5.7.2 Coordination between the remote monitoring center and operators that might respond to wildlife sightings is required.

5.8 Intervention Techniques

5.8.1 Intervention techniques are actions taken by a wildlife control operator to remove wildlife from areas of high risk.

5.8.2 One of the intentions of intervention techniques is to train the wildlife not to occupy areas where they are not wanted. If an animal learns that the effort to occupy a place and get chased away is greater than the benefit provided by the food or opportunity to rest in that area, it may stop returning.

5.8.3 Most intervention techniques rely on scaring wildlife with an audible or visual threat. This can include the following:

- Movement of the patrol vehicle and the human pressure associated with the wildlife control operator. (Care must be taken that the patrol itself does not become a hazard to aircraft operations.)
- Noise to scare wildlife such as sound generators, pistol or gun shots, and pyrotechnics or firecrackers. (Care must be taken that wildlife are moved away from aircraft operations.)
- Noise to deter wildlife such as recorded distress or alarm calls. (Care must be taken that such calls do not attract curious or predatory species.)
- Visual repellents including lasers, kites, balloons, scarecrows and small models.
- Trained predators such as falcons and dogs used to chase wildlife.
- Trapping, tagging and relocation, especially for larger animals and protected species.
- Culling or killing. (This is generally a last resort, as a dead animal is not a trained animal. It is not an option for certain species such as endangered or protected species.)
- In some situation chemical repellents and pesticides might have a role to play, although the use of poisons and environmental pollutants should be discouraged.

5.8.4 Care must be exercised to avoid any intervention from accidentally flushing birds at ill-timed moments in to the path of aircraft. Care must also be taken the patrol vehicle or personnel do not become air safety hazards. Wildlife training discussed in Chapter 6 is a crucial requirement to reduce this risk.

5.8.5 Mobile patrols should be more persistent than the wildlife. Simply moving wildlife and then driving away is seldom effective wildlife control. It often is necessary to remain in the area following control to prevent the immediate return of wildlife or to repeatedly return to the area at frequent intervals to ensure that the controlled wildlife have not returned and to reinforce control if necessary. The aim is to achieve a bird free aerodrome and the control needs to be thorough to ensure the birds leave the airfield.

5.9 Recording and Reporting

5.9.1 Recording All Daily Activities

5.9.1.1 Keeping records of all activity related to wildlife hazard management is fundamental to the WHM programme. Data is required in order to be able to assess the effectiveness of the Programme as a whole, as well as specific trends such as habituation.

5.9.1.2 There is an increased tendency towards airlines and/or their insurers to pursue legal action to recover the costs of wildlife strike damage from airports at which they occur. It is important that airports record the wildlife control actions that they take in order to be able to demonstrate that they had an adequate WHM programme in place at the time of an incident and that the programme was functioning properly. Data gathered as part of the programme is also important in assessing the effectiveness of the actions taken.

5.9.1.3 A number of different methods for recording this data exist, from simple paper records to sophisticated devices including laptops, tablet PC or other electronic devices. The latter save time and effort, especially if the data is to be subsequently entered into a computer for further analysis. Whatever the means of recording used, the important issue is that a comprehensive record of the bird control activities is kept in order to demonstrate that the airport is following its own policies and procedures. Records need to include the time, location and nature of the following:

- Each patrol or inspection and the route taken;
- Observation of any unusual condition of the habitat or site such as the state of the vegetation, trees, water bodies or perimeter fence;
- Species of wildlife sightings including any particular activity such as feeding or resting, and the discovery of any carcasses, dropping or other signs of activity;
- Interventions that are made;
- The outcome of any intervention, the response of the wildlife and the effectiveness of the hazard elimination.
- Incidents such as wildlife strikes on aircraft and near misses. (Systems will also be in place for such reporting by pilots, airlines and ground staff.).

5.9.2 Monthly Reporting

5.9.2.1 Daily records can be summarized into monthly reports, which aid in the evaluation of trends in wildlife numbers, control actions, and wildlife strikes. Monthly reports should be reviewed by the Airport Wildlife Committee of stakeholders to assess performance of the WHM programme. The Committee should be involved in the creation of Performance Indicators for managing wildlife at the aerodrome. Performance indicators can encompass any metric associated with reducing risk to aircraft operations, including reducing the number of wildlife strikes, reducing the total mass of wildlife strikes, reducing the average mass of wildlife strikes, or reducing the number of hazardous wildlife around the aerodrome.

5.10 Equipment

5.10.1 The wildlife control officer should be equipped with devices appropriate to the wildlife species encountered, the numbers present, and to the area that they need to control. Staff should have access to appropriate devices for removal of wildlife, such as firearms or traps, or the means of calling on expert support to supply these interventions techniques when required.

5.10.2 **Portable Equipment;** Portable equipment, that requires a staff member on the airfield to operate it, is generally regarded as offering the best control, providing that the staff members involved are properly trained and motivated. Devices such as pyrotechnic, pistols, or vehicle mounted distress call generators produce an impression of a direct threat which can be continually varied in time and location by the operator in a manner not available to static systems. This is to prevent wildlife habituating to a static device as they learn that it is not a serious threat.

5.10.3 **Static equipment;** In general, static wildlife scaring devices, such as gas cannons or other sound generators, gradually lose their effectiveness over time. Although some of the more sophisticated devices, which generate a variety of sounds in random or pre-programmed order,

may delay this habituation. They are generally more suitable for providing short-term wildlife deterrence from limited areas (e.g. ground being reinstated after building works).

5.10.4 Various new methods for either habitat management at airports, detection systems or new dispersal techniques have been developed in the past years. There are many methods of wildlife dispersal available. Aerodrome operators should assess the need before purchasing equipment.

*Figure 6- **An underground stationary gas powered noise generator***

5.11 Habituation

5.11.1 The classic challenge for wildlife hazard management is that most animals will become accustomed to certain dispersal interventions or find new ways to settle themselves safely in the airport environment. Therefore, it is vital for airport operators to continuously adjust and vary the measures taken. An airport should proactively seek different or new ways to reduce the wildlife hazard.

*Figure 7 **Deterrent Spikes don't keep all birds off of signs.***

6 Training

6.1 Introduction

6.1.1 The significance of wildlife and habitat management plans/programmes must be recognized as a major safety priority of all aerodromes regardless of size, aircraft movements or the lack of a perceived threat.

6.1.2 Aerodromes should have specific comprehensive wildlife and habitat management training programs. Staff tasked for wildlife and habitat management should be trained and assessed as fully competent to perform their duties. It is important that the role is comprehensively explained to staff and that they fully understand their roles and responsibilities.

6.2 Objectives of the Training programme

6.2.1 It is important for aerodromes to outline the objectives of a tailored wildlife and habitat management plan/programmes. It is not sufficient for staff to undertake any role within the aerodrome wildlife team without appropriate wildlife and habitat training.

6.2.2 Training Plan Objectives

- Ensure training plan meets international, national and local standards as applicable
- To deliver appropriate wildlife/habitat management training to staff that are tasked with managing and implementing the plan
- Ensure local aerodrome conditions and effective control measure are included
- Ensure staff have a full understanding of procedures and practices required to deliver on objectives of the WHM programme
- Provide practical training that ensures competency on wildlife control

6.3 Outline of Training Programme

6.3.1 Aerodromes with well managed and researched programs that are delivered by fully qualified and trained staff are better prepared and positioned to deal with wildlife threats at aerodromes. The guide on the next page will help plan training content.

6.3.2 **Aerodrome Location;** aerodrome location will dictate much of the content of the training programme and the procedures that are best suited to each aerodrome. Aerodromes located at the coast or close to forests will require a different set of control measures than other aerodromes in urban locations. Aerodromes developing WHM programmes must take their local wildlife management into consideration.

6.3.3 **Standardization of Training;** training should be conducted professionally by appropriately qualified personnel using approved material drawn from appropriate standards and guidance material. Training content and programs should be approved by a wildlife manager with guidance from a subject matter expert to ensure that the programme content is sufficient and all mandatory safety and operational requirements are met.

Overview Theoretical Training	Familiarization Practical Training	Specification Specific Wildlife Training
• Aerodrome overview • Aerodrome certification • Aerodrome procedures • ICAO requirements • CAAF Standards • Environmental regulations • Aerodrome safety management system • Promulgation of information • Health & Safety overview • Accident & incident reporting/investigation	• All aerodrome operational procedures & standards • Landside overview • Airside safety • Airside security • Apron driving • Airfield training • Radio telephony • Runway incursion training • Protection of NAVAIDs • Low/reduced visibility programme • On the job training • Recurrent refresher training • Familiarization programme	• Detailed theoretical aspects of wildlife programs • Integrated approach to all elements of habitat & /wildlife programs • All practical elements required to support programs • Familiarization programme • Equipment training & procedural use of all equipment • Defined on the job training • Recurrent refresher training • Administration programme in respect of the specific Record keeping • On/off field programme

6.3.4 **Blended Learning Approach**; aerodromes should have a targeted WHM programme that supports the roles of each person responsible for managing or implementing the programme. Training should be delivered from a theoretical, practical, and procedural aspect and include a familiarization programme.

6.3.5 **Liaison Plan**; the wildlife team will require training on the importance and significance of coordination in respect of all wildlife stakeholders.

6.4 Understanding the Different Roles

6.4.1 Aerodromes must understand the importance of aircraft safety from a habitat and wildlife management perspective. This importance will be highlighted in an Aerodrome Safety Management System and will be supported by comprehensive Aerodrome procedures to manage the habitat and wildlife management plans. A named senior manager will have overall responsibility for the plan and will be supported by a wildlife subject matter expert. Additional support will be provided by the aerodrome wildlife committee and local runway safety team. The dedicated wildlife management team should be properly resourced and receive comprehensive training for the specialized role they perform.

6.4.1 Aerodrome Senior Manager

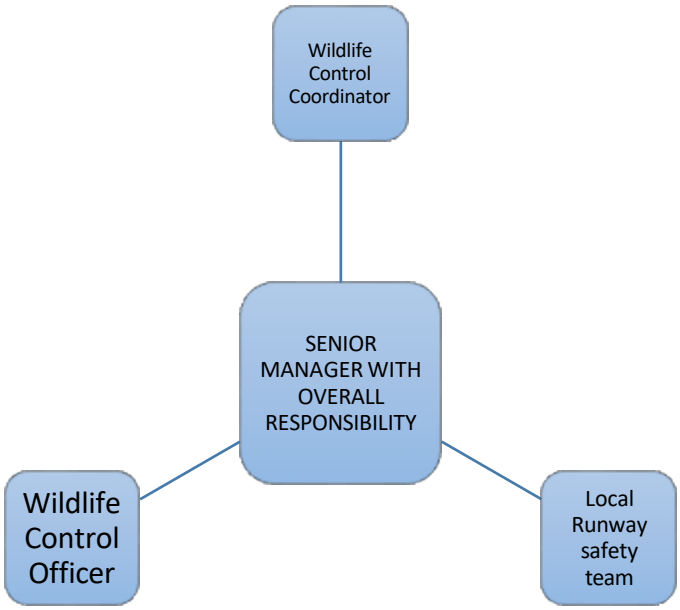

Figure 8 - Wildlife Management Plan Support/Responsibility Structure

Note 1.:- This role is central to managing and directing the aerodrome wildlife and habitat plan. The purpose of training is to ensure this person has all the necessary knowledge and understanding to ensure the proper oversight and management of the plan.

Note 2. - In order to be fully competent this person must receive appropriate training to support the role. A central part of this training will consist of briefings from subject matter experts so that they are fully informed of the potential danger that wildlife habitat & management pose to aircraft and aerodromes.

6.4.2 Wildlife Control Coordinator

Figure 9 - Wildlife Management Plan Support/Responsibility Structure

Note. 1 *This role within the wildlife and habitat management plan/programme is critical to safety outcomes for aerodromes. This subject matter expert will be responsible for briefing all stakeholders on the best procedures and practices to be followed to ensure a fully effective wildlife management plan/programme.*

Note. 2 - *In order to be fully competent this person must receive appropriate training to support their role. It is also important that this person fully understand the balance between the operational aviation context and the management of the wildlife and habitat at an aerodrome.*

6.4.3 **Wildlife Committee**; The wildlife committee plays a central role in monitoring of the wildlife control and habitat programme. Full training should be provided to ensure all members understand the objectives of the programme. Training should include regular briefings from subject matter experts so that they are fully informed of the potential danger that wildlife habitat pose to aviation at the aerodrome.

Figure 10 ***- Wildlife Management Plan Support/Responsibility Structure***

Note:- This committee draws from its own experience and seeks the advice and guidance of a wildlife control coordinator to make recommendations to both the wildlife manager in respect of immediate actions required and to the senior aerodrome manager responsible for wildlife management in respect of issues that require national or international intervention.

6.4.4 Wildlife Control Officer

*Figure 11****-Wildlife Management Plan Support/Responsibility Structure***

Note. 1 Detailed appropriate training is essential for this role as it is central to the full implementation of an effective wildlife and habitat management plan/programme. This includes a full understanding of all aspects of the wildlife team objectives and how they should best perform the task in a safe and efficient manner.

Note 2. This group is critical to the safe and efficient delivery of the wildlife a n d habitat management plan/programme at the aerodrome. A properly resourced and effectively trained personnel can make a decisive difference to wildlife habitat management at any aerodrome.

Note 3. Detailed appropriate wildlife management and habitat training is essential for this role as it is central to a safe and effective wildlife and habitat management plan/programme. A full understanding of all aspects of the wildlife team objectives and how they should best perform the task in a safe and efficient manner must be central to the training programme.

6.5 Additional Training

6.5.1 **Airside Training;** all employees operating airside at aerodromes will have received appropriate airside training to ensure that they can perform their airside duties in a safe and efficient manner. Airfield training will include radio telephony procedures and practical assessments.

6.5.2 **Environmental Training**; awareness of environmental factors are very important for aerodromes and are an ever increasing influence on aerodrome procedures. Wildlife teams must be fully aware of all environmental issues and how they can contribute to the sustainability policy at aerodromes. The following guidelines should apply at aerodromes:

- Understanding of environmental sustainability;
- Environmental evaluation and analysis of wildlife plan;
- Use of best practice environmental techniques.

6.5.3 **Practical/on the Job Training**; it is not sufficient to provide theoretical training for this role as much knowledge will be gained from carrying out the task under a proficient and competent person. The programme should be sufficiently enough to ensure effective delivery and should have a sign off process on the proficiency of the person across all the practical, procedural and skills required to manage and implement the plan/programme. It is critical that each aspect of the procedures required for wildlife habitat and management are well practiced and understood by the wildlife team.

6.5.4 **Wildlife Management Control Measures**; It is critical that the wildlife team receives comprehensive training on the different techniques that can be used in the wildlife management programme. This must include all procedures and practices that are at the disposal of the aerodrome. Each team member must receive full training on all aspects of the programe to include familiarization with all equipment that is available to the team.

6.5.5 **Assessment of Training Process**; aerodromes must be assured that the wildlife training programme is adequate to deliver trained personnel to deliver on the objectives of the programe; accordingly each training programme will require an assessment process that will clearly demonstrate the proficiency of the programme.

This process will consist of the following components:-

- **Theoretical assessments** that demonstrate team members have the knowledge necessary to deliver the objectives of the wildlife management programme
- **Familiarization** with procedures, practices & techniques of wildlife management
- **Practical** assessments that demonstrate team members have the practical knowledge necessary to operate all equipment and techniques
- **General suitability,** whereby team members can demonstrate a level of operational competencies to deliver on the objectives of the wildlife management programme

Note:- All training programs should be reviewed prior to delivery to ensure that the programme is up to date and reflective of current best practice of wildlife management techniques.

6.5.6 **Runway Incursion Prevention Training;** Due to the nature of the role and the requirement to operate close to runways (never inside the runway strip unless with ATC permission) staff must have completed runway incursion prevention training.

6.5.7 **Post Incident Training**; where a wildlife management person is involved and found to have failed to follow procedures, the option to re- train may exist. It is important that the area of weakness is identified and remedial action taken. All incidents on the airfield are investigated by aerodrome authorities, sometimes in cooperation with ATC.

6.5.8 **Research Plan; i**t is very important that aerodromes employ the best possible practices available to them when developing wildlife plans. Detailed accurate information based on proven research is an important element in ensuring that best practice principles apply.

Where possible, aerodromes should have a dedicated resource that will ensure that advances in the field of wildlife management and habitat management, (whether that be scientific, procedural or proven improved control techniques) are reflected in the aerodromes wildlife and habitat management plan/programme.

6.5.9 **Refresher Training**; each aerodrome should have an effective refresher training programme that the wildlife team will complete on a regular basis. The training must include a dedicated wildlife management and habitat module which will reflect on statistical information, procedural reviews, staff feedback and a central piece by a subject matter expert at the aerodrome (internal or external) and by a senior manager responsible for the aerodrome management and habitat plan.

6.5.10 **Training Programme for other Aerodrome Users**; aerodrome operator will ensure that all operators at the aerodrome are aware of their responsibilities in respect of Wildlife control. Reference should be made to procedures that apply to all operators at the aerodrome. This plan should be included at induction for all staff and also the main points included in refresher plans. Wildlife habitat management and control should feature in any airport wide safety campaign as a matter of course.

Training offered should cover the goals and objectives of the aerodrome wildlife management programme and the role each company and staff member can pay their part in this essential programme.

Training awareness programme should be made available to the following groups:

- Air Traffic Services
- Airlines (in particular home based pilots and companies)
- Ground handlers
- Food catering companies
- Waste removal companies
- Contractors construction projects
- Other entities as deemed necessity

7 Evaluation of the WHM programme

7.1 Introduction

7.1.1 Aerodromes should have a process to review and evaluate the wildlife habitat and wildlife management plan/programme to provide safety assurance that the plan/programme is fully effective and correctly implemented. The review should be completed on an annual basis but also must include an on-going review process to ensure that the plans/programmes are always current and fully functional at all times.

7.1.2 A review should consider the general workings of the plans/programmes with a view to efficiency and effectiveness. Reference to statistics from previous years (five) should form part of the review. Trend analysis of statistics is a key to ensuring there is an informed view as to the success and effectiveness of wildlife management plans/programmes.

7.2 Evaluation Process Overview

7.2.1 Evaluation of the Aerodrome Wildlife & Habitat Management Plan/programme:-

- Are roles clearly defined and understood by all?
- Do aerodrome personnel understand their roles and responsibilities?
- Do programs meet required standards in ALL respects?
- Is the programme effectively resourced &managed?
- Are procedures efficient and effective?
- Are programs current with all regulations and best practices?
- Is there an effective review process in place?

7.3 Evaluation Plan

7.3.1 **Evaluation Plan Report;** this comprehensive annual report should be prepared and compiled by an appropriately qualified person who has full knowledge of the plan/programme and the standards required for effective delivery. The completed report along with all recommendations must be forwarded to the aerodrome wildlife committee and the senior management responsible for the delivery of the plans/programmes.

7.3.2 **Evaluation Inputs;** The wildlife manager (or appropriate professional) tasked with performing the annual evaluation should undertake de-briefing from staff on general effectiveness and observations on all aspects of the plan/programme. The evaluation seeks non-performance or areas for improvement. Staff are often best positioned to provide valuable feedback on the plans/programmes. Feedback should be sought from:

7.3.3 **Aerodrome Survey;** a wildlife survey is a valuable tool for aerodromes to ensure their wildlife management and habitat plans/programmes are effective, meet all regulations and standards required. The survey will be completed formally on an annual basis by a qualified professional. Evaluation of all operational, practical, procedural and technical aspects of wildlife and habitat management will form part of this survey. A comparison with previous year's findings and recommendations to ensure the survey delivers on the purpose of the survey.

7.3.4 **Statistical Comparisons Year on Year; i**t's extremely important that accurate statistics are gathered and interpreted by a competent person to ensure that aerodromes can have effective control measures in a timely fashion. Reference should be made to previous statistical data over the last five years and recommendations and action points raised accordingly. Particular attention should be placed on the quality and accuracy of aerodrome wildlife statistics and how these statistics are interpreted so that trends are measured and mitigation measures immediately put into place.

7.3.5 **Review of Procedures;** a full comprehensive review of all control procedures and practices to ensure that effective control measures are in place and are correctly followed and documented. A review of seasonal migration patterns is essential.

7.3.6 **Equipment Serviceability;** a full equipment audit shall be undertaken annually to establish serviceability and effectiveness of all equipment used to support wildlife management.

7.3.7 **Rotational Procedure;** a systematic review of rotational control procedures and the perceived effectiveness of the process. Particular attention to identification of new species and control measures are required to deal with the species.

7.3.8 **Research Review;** Where possible, aerodromes should have a dedicated resource that will ensure that advances in the field of wildlife management and habitat management, whether that be scientific, procedural or proven improved control techniques are reflected in the aerodromes wildlife and habitat management plan/programme.

7.3.9 **Intelligence Gathering;** the importance of gathering intelligence locally at the aerodrome and surrounding areas can contribute greatly to ensuring that control measures are effective. A plan for sharing information with local aerodromes or aerodromes with similar wildlife and habitat issues is a useful process of mutual benefit where control measures are compared and evaluated.

7.3.10 **Wildlife Documentation Audit; a**n evaluation of all reports and records to ensure they meet appropriate standards as they must provide accurate information that can be understood and that will be of value in the evaluation process.

A full check of all wildlife team documentation, paying particular attention to following documentation:

- Locations of wildlife, identification, patterns of movement, control measures records;
- What measures were used, what precise method and how effective?
- Nuisance species reports;
- Protected species, endangered species register;
- Monthly alert reports;
- Rotational control measures records;
- Recording aerodrome wildlife hot spots (on/off aerodrome) and potential strike danger records;
- Analysis of wildlife strikes, removal techniques records;
- Reported strikes on near misses (over last 5 years) records;
- Investigated strike and near miss reports;
- Analysis of carcass (on site and external analysis) records.

Note: - Emphasis should be placed on quality of all records in particular daily logs to ensure the best quality intelligence is gathered so that this information can be fed back into the plan in a timely fashion

APPENDIX A HABITAT MANAGEMENT

A.1 Introduction

A.1.1 Birds and other wildlife occur on airport property for a variety of reasons, mainly food, water and shelter.

A.1.2 Once the attraction has been identified, a plan should be developed either to remove it entirely, reduce it in quantity, or to deny access to it. It is not possible to define precisely what types of habitat management will be effective at a particular site because airfields are different and the bird/wildlife species that frequent them will vary. Typical examples include manipulating the species and/ or height of vegetation cover on the airport, removal of trees and bushes fencing off the aerodrome, netting of water bodies, excluding birds from buildings by netting or other means, selection of non-attractive amenity planting around terminals. Regardless of the techniques used, all airports should be able to show that they have assessed the bird attractions on their property and developed and implemented a habitat management plan to reduce these attractions as far as is practicable.

A1.3 Modifications to the airport's habitat/environment to eliminate or exclude food, water and shelter can limit the attractiveness of an airport to birds and other wildlife. Habitat management provides the foundation for an airport's bird/wildlife hazard management programme because it offers ecologically based, long-term measures for reducing the number of hazardous birds/wildlife at the airport. If direct action against birds/wildlife is chronically necessary, it is usually because habitat management has not yet been fully implemented or further measures are not cost- effective.

A.1.4 Before undertaking activities to manage the environment, it is important to first carry out an ecological survey of the airport and surrounding area to identify sources of food, water and shelter attractive to wildlife on and in the vicinity of the airport. This way, the environmental management plan is able to deal with specific conditions or habitats that are attracting wildlife. A standardized reporting system that documents wildlife species, numbers and location on the airport, as well as strike events, can provide the foundation for an ecological survey. From this ecological survey, prioritization of activities or projects within the plan may then occur. There are many wildlife attractants that an environment management plan can control.

A.1.5 Habitat management is probably the most important method of preventing or reducing wildlife strikes on and around an airport. The airfield habitat should be less attractive to the animals than the surrounding areas. If there are off-airport sites that attract birds these may need dealing with also these can create flight line of flight paths of birds moving from one area to another (e.g. from an overnight roost to a feeding location) then the airport should, in conjunction with local regulators seek to reduce the attractiveness of these off airport sites also.

A.2 On Airport Habitat Management

A.2.1 Wildlife can be attracted to particular sites for feeding, breeding, roosting, resting or access to water. Efforts put into reducing the attractiveness of the airfield can be the most productive way to reduce the risk of wildlife strikes. The large expanse of grass, low vegetation or even the lack of vegetation present at airports is attractive to wildlife that prefer open country habitats partly because they rely on being able to observe predators at long distances. When combined with food resources, airports can be very attractive habitats for open-country wildlife. The presence of numerous buildings and hangars along with trees and bushes adjacent to the airfield can also provide suitable habitat for many species.

A.2.2 Therefore, it is necessary to identify and evaluate the attractants present on the airport so that they can be reduced, eliminated, or effectively managed, thereby achieving a long- term solution to the problem of wildlife strikes.

A.2.3 If the aerodrome environment is made less attractive to the wildlife species present, they will seek their needs elsewhere and the resident wildlife population will decline significantly, along with the number of wildlife strikes. By modifying the habitat, it is possible to modify both the quantity and the type of wildlife species active on the airfield.

A.2.4 There are a number of habitats on an airfield to which wildlife may be attracted. These are listed below with an explanation of what features can be attractive and what steps can be taken to counter this.

- Buildings provide sites for nesting, roosting and perching;
- Open water access to water, breeding and roosting sites;
- Trees, shrubs, berries perching, nesting and feeding;
- Grass see details below on how to manage airfield grass.

A.2.5 Controlling the attractiveness of an airport to birds and other wildlife is fundamental to good control. Indeed, it is probably more important than bird dispersal in terms of controlling the overall risk. If an airport provides easily accessible resources to birds/wildlife in terms of food, water, shelter or breeding sites, then they will continue to try and return despite any dispersal tactics that are used to dissuade them. Habitat management to deter birds/wildlife involves two processes, identifying the attractive features and implementing changes to either remove the attraction or to deny access.

A.2.6 An airport should undertake a review of the features on its property that attract hazardous birds/wildlife. The precise nature of the resource to which birds are attracted should be identified and a management plan developed to eliminate or reduce the quantity of that resource, or to deny birds access as far as is practicable. Documentary evidence of this process, its implementation and outcomes should be kept.

A.2.7 Food

It is difficult to remove all food sources for birds and other wildlife on airports. Because grass is the common vegetation on most airports, grassland management has an important influence on food available to birds.

Wildlife may enter airport lands in order to feed on seeds, vegetation, invertebrates or rodents and other small mammals in grasslands or agricultural crops; on fruits in trees and shrubs; or on exposed food waste from catering services or restaurants. These sources of food are especially attractive to a variety of birds. Agricultural measures like mowing, harvesting and ploughing will attract birds because of the disturbance and exposure of seeds, invertebrates and rodents. If the presence of birds is to be decreased substantially, it is necessary to take action mainly at the source by reducing their food supply. The use of pesticides and herbicides may be a solution in some cases. Although it is impossible to remove all food sources on airports, the following are suggested measures that can be taken to mitigate the problem:

a) **Agriculture.** Cultivation of airport lands will, no matter what the crop type, attract birds at some part of the life cycle of the crop. Therefore, it is recommended that airport lands not be used for agriculture.

b) **Food waste.** Airports should require wildlife-proof storage of food waste, prohibit bird/wildlife feeding and promote good sanitation and litter control programmes.

c) **Waste management facilities** (refuse collection, landfill sites and/or garbage dumps). Refuse dumps that accept putrescible (organic) wastes are highly attractive to various bird and mammal species that are hazardous to aviation. It is important to bring about national and local legislation in order to prohibit or restrict the establishment of new sites that accept putrescible wastes close to airports and, ideally, national legislation to provide for the closure of existing dumps that are attracting wildlife hazardous to aviation. However, in reality, this will be very difficult to achieve without new State legislation. Generally It is desirable that sites be no closer than a 13 km circle centred on the ARP and, in some cases, further — where studies of flightlines of birds attracted to these sites prove them problematic for the airport. If a refuse site in the vicinity of an airport cannot be closed, it likely will be necessary to try to influence the operators to provide control measures at the site to reduce its attractiveness to wildlife. However, this cannot be determined unless a formal assessment of the site is carried out to establish the type of waste and the wildlife species attracted to the locale. Such control could include fencing, netting or overhead wires to prevent access to the active surface and active dispersal of birds using pyrotechnics or other dispersal techniques. Fully enclosed waste-transfer facilities and sites which take only inorganic refuse such as construction and demolition waste generally will not attract hazardous wildlife.

A.2.8 Water

Insofar as possible, very wet land and stagnant water on aerodromes should be drained. The presence of water is a major factor in attracting wildlife, particularly birds, aquatic mammals and amphibians and creates habitat for aquatic invertebrates that often hatch synchronously in large numbers thereby attracting large numbers of insect predators (e.g. birds, bats).

It is often difficult and costly to eliminate all wet areas from an aerodrome. Where construction measures, such as drainage, cannot be undertaken, airport operators should identify water bodies that are used by significant numbers of hazardous wildlife and undertake action to limit the access of wildlife to these bodies. Placing floating balls, netting or overhead wires, can be excellent solutions, depending on the species present.

Surface water is often highly attractive to birds. Exposed water should be eliminated or minimized to the greatest extent possible on airport property as follows:

1. Depressions and water bodies. Pits or depressions that fill with water after rains should be levelled and drained. Larger water bodies, such as storm-water retention lagoons, can be covered with wires or netting to inhibit birds from landing. Larger water bodies that cannot be eliminated should have a perimeter road so that bird/wildlife-control personnel can quickly access all parts of the water body to disperse birds. Water bodies and ditches should have steep slopes to discourage wading birds from feeding in shallow water.

2. Drainage ditches. When drainage ditches clog up with vegetation or eroded soil and the flow of water is impeded, insect and other aquatic life flourish, thereby attracting birds if remaining unnetted. In order to address such issues, culverting the ditches is recommended. Clearing the ditches at regular intervals is important. They should be graded so that the water will run off as rapidly as possible. Grass and other vegetation should be cut on the sloping banks. Where practicable, the water attractant can be eliminated by replacing ditches with buried drain pipes.

A.2.9 Shelter

Birds and other wildlife often seek shelter and breeding sites on airport property in such places as the structural beams of hangars and bridges, in nooks of jetways and other structures, and in trees and shrubs. Some birds, such as gulls and waterfowl, seek the open spaces on airport property for safety while resting. These areas give the birds a clear view of their surroundings in all directions. Dogs and other mammals will seek shelter in dense stands of trees, shrubs and drains.

Analysis of buildings can identify places that can be used by wildlife. The elimination of these potential shelters will decrease the numbers of animals present. All dilapidated or ruined buildings, on or in the direct vicinity of the aerodrome, should either be repaired or demolished. Those structures are often colonized by wildlife that uses them as shelters and for breeding purposes.

Signs and lights along runways and taxiways are ideal perches for birds, and particularly raptors, which use them as observation posts when hunting. Limiting their use as perches can be an excellent solution to reduce the presence of birds. The installation of metal spikes, preferably the 'Rotating 3-spike version', prevents birds from landing on them.

Other measures can be taken to deter birds and other wildlife from seeking shelter and breeding sites on airport property:

a) **Structures.** Architects should consult biologists during the design phase of buildings, hangars, bridges and other structures at airports to minimize exposed areas that birds can use for perching and nesting. When perching sites are present in older structures (such as rafter and girded areas in hangars, warehouses and under bridges) access to these sites can often be eliminated with netting. Anti- perching devices, such as spikes, can be installed on ledges, roof peaks, rafters, signs, posts and other roosting and perching areas to keep certain birds from using them. Changing the angle of building ledges to 45 degrees or more will deter birds. However, it is emphasized that incorporating bird exclusion or deterrence into the design of structures is the most effective, long-term solution.

b) **Abandoned structures.** All unnecessary or abandoned posts, fences and other structures that can be used as perches by raptors and other birds should be removed from airport property. Piles of construction debris and discarded equipment, unmowed fence rows and other unmanaged areas are not only aesthetically unpleasing but typically provide excellent cover for rodents and other wildlife. These areas should be eliminated at airports.

c) **Trees and shrubs.** Much care must be taken when selecting and spacing plants for airport landscaping. Avoid plants that produce fruits and seeds desired by wildlife. Also avoid the creation of areas of dense cover for roosting by flocking species of birds. Thinning the

canopy of trees or selectively removing trees to increase their spacing can help eliminate bird roosts that form in trees on airports.

d) **Ground vegetation.** Because vegetative ground cover (typically grass) is usually the dominant habitat on an airport, the management of an airport's airside ground cover to minimize its attractiveness to wildlife is a critical activity. However, management of ground vegetation requires expert knowledge about the local ecological conditions because of variations in soil types, rainfall patterns, temperature profiles and wildlife, resulting in site- specific vegetation. The following are suggested methods of reducing wildlife attraction to airport ground cover:

a. Some studies have shown that maintaining a monoculture of tall or long (150 mm to 200 m high) dense grass can discourage gulls, lapwings and similar birds from landing and feeding on soil invertebrates. However, other studies and observations indicate that tall grass does not discourage certain large birds such as geese, herons and egrets. Tall, dense grass interferes with visibility and locomotion of the smaller birds. Although rodent populations may increase in tall grass, the density and height of the grass may be managed by effective cutting and clearing methods (also known as "bottoming out") in order to discourage raptors and rodents from feeding. Maintenance of tall, dense stands of grass may require special mowing equipment and other activities to prevent thatch build-up and to keep the grass uniformly tall and free of weeds.

b. When seeds are the most important food source, the vegetation should be mowed during the flowering season. In case these flowers attract insects that, when airborne, attract swallows and other aerial feeders, the vegetation should be mowed before the flowering season.

c. Short grass (less than 150 mm) may result in fewer rodents compared to tall grass because of reduced cover and increased disturbance caused by frequency of mowing. Mowing activities may attract birds to feed by exposing invertebrates and rodents. The height of the vegetation and the timing and frequency of mowing on an airport should be oriented to minimizing hazardous wildlife and not to any other horticultural benefits which may arise from the ground cover.

d. A promising approach to reducing wildlife attraction to airport ground cover, regardless of the height, is the use of vegetation that is undesirable or mildly toxic to wildlife.

It is advisable that aerodrome operators consult with professional biologists and horticulturists to develop a vegetation type and mowing regime appropriate for the growing conditions and wildlife at the location. The main principles to follow are to use a vegetation cover and mowing regime that do not result in a build-up of rodent numbers or the production of seeds, forage or invertebrates desired by wildlife.

Grass management has to be adapted for each aerodrome. General guidelines are difficult to establish. Therefore, according to the type of vegetation, growing conditions and wildlife at the location, an appropriate mowing regime must be determined.

Aerodromes which do not have vegetation covering the soil do not offer much food to birds, but may attract certain species to nest or roost directly on the soil. At airports where sparse or no vegetation attracts hazardous species, studies could be conducted to determine possibilities for plant coverage that prevents nesting and roosting without increasing food sources. It is not automatically the best choice to provide a grass covered airfield. If the surrounding areas are arid desert then the green grass may well attract birds.

Depending on the type of grass used and the local climate, grass coverage needs to be maintained. Depending on the type of grass, the machinery used to mow will have to be adapted to pick up maximum amounts of grass after mowing, and must not create ruts, which may offer wildlife a favorable environment. For example, if they become filled with water. The continual collection of grass may also lead to reduced soil fertility and may require periodic added fertilization, preferably in the form of low-nutrient organic fertilizer.

The period during which grass is cut is a determining factor in wildlife hazard management. It is essential to be able to carry out this work under dry weather conditions and be sure that it can be completed as rapidly as possible. Consideration should also be given to conducting grass cutting at night time. Night cutting eliminates the risk of attracting birds to the mowers to feed. The period after mowing should allow for grass to grow to its optimal height before the next mowing is carried out.

The grass that is cut must be sufficiently mulched, or preferably collected and removed from the aerodrome. The presence on the ground of decomposing grass creates a thatch layer that favors an increase in invertebrate numbers which will in turn attract birds. Clumps of grass also provide ideal nesting habitat for field rodents and can contribute to high rodent populations which can attract raptors.

This may mean an airfield should have grass cut to a particular length such that local bird species cannot find food and cannot rest because their sight in interrupted by the grass. At other locations it may be more important to not provide perching opportunities on structures or, in dry areas not to provide access to surface water. A study of the airport environment should lead to the implementation of a Habitat Management Plan that describes the management needed for the different areas and habitats of the airport perimeter.

Where grass does grow naturally in the environment it can be managed as described elsewhere. In terms of operational procedures this will mean a plan to achieve the following:

- Soil sampling to ensure there are no insects and larvae that will attract birds to feed;
- Weed-killer to reduce weeds upon which birds may feed;
- Insecticide to remove insects upon which birds may feed;
- Fertilizer application to ensure the grass can grow to the required length;
- Bottoming out - cutting the grass very short in spring; -to ensure fresh vigorous growth and to remove grass cuttings or thatch that can build up and harbor insects and attract birds;
- Regular topping cuts to maintain upright grass of the required height. In warm wet periods the grass may grow more quickly and in hot dry periods it may cease to grow these variations in the weather will need to be taken into account so as not to strictly follow a time based plan for cutting.

A.3 Off Airport Habitat Management

A.3.1 Birds that are not present on the airport but overfly the airport or its approaches and climb-out areas may also come into conflict with aircraft. Off-airfield monitoring of bird species and behaviour should occur and should include species, flightlines, seasonal patterns, time of day, etc.

A.3.1 Any significant bird/wildlife attractants within a defined radius centred on the aerodrome reference point (ARP) should be assessed and a management plan developed to reduce their attractiveness to birds/wildlife. While it is understood by leading bird/wildlife experts that an ARP might not always be centred exactly on the geographic centre of an aerodrome, typically a 13 km (or 7 NM) circle is considered a large enough area for an effective wildlife management plan. However, as necessary, action should also be taken when the bird/wildlife attractants are outside the 13 km circle if the airport operator has any influence on planning and development issues.

A.3.2 In accordance with the recommendations of Annex 14, Volume I, Chapter 9, 9.4.5 and SD- Aerodromes, for any new off-airfield developments being proposed that may attract birds or flightlines across the airport, it is important that the airport operator be consulted and involved in the planning process to ensure that its interests are represented. Generally, the airport does not have the opportunity to directly manage habitats outside of the airport. Therefore, it is necessary for the airport to develop good relationships with the adjacent landowners and the local government to be able to influence land uses that affect hazardous wildlife distribution, movements and abundance.

A.3.3 Gathering specific data on wildlife outside the physical boundaries of the aerodrome is important. While it is critical to know the seasonal abundance of each hazardous species on and near the airport, it is also important to know how those species interact with the airport. For example, knowledge of movement routes makes it possible to provide pilots with reliable information on potential hazards within approach and departure paths. Knowing where species nest/den etc. can be very important in determining control strategies for young animals that are frequently most at risk of causing a strike.

A.3.4 The areas surrounding the aerodrome have a direct impact on the presence of wildlife on the aerodrome. Their physical location may also result in animals crossing the aerodrome regularly. It may be necessary to gain an understanding of wildlife behavior outside the aerodrome.

A.3.5 The types of environments in the vicinity of an aerodrome, have a direct impact on the presence of wildlife are described below (The list is not exhaustive).

a) Local Agricultural Practices

In general, experts advise against growing agricultural crops on the aerodrome. Outside the aerodrome site, it is difficult to influence the choice of crops, unless national legislation has been adopted on this subject. Whatever the situation, it may be necessary to engage with local farmers in the vicinity of the aerodrome to influence their activities.

Many countries already regulate the use of agricultural land in the vicinity of aerodromes to minimize the attraction of wildlife. The planning of crops around the aerodrome may take the form of crop plans, recommendations for farming methods, or even the adoption of legislation. In all cases, it is extremely essential for the aerodrome operator to establish coordination with

the local authorities and to ensure that they are aware of the risks to aviation which may arise from wildlife.

b) Landfill/Garbage Disposal Sites

Landfills and garbage dumps are a significant source of food for birds. Certain species will travel several kilometers to reach a dump. Birds flying to and from these sites may cross over an aerodrome or aircraft flight paths. It is not uncommon to observe birds, in particular gulls, soaring over dump sites in the thermals created by composting garbage. The greater presence of birds may give rise to problems for approaching aircraft. The presence of garbage dumps on aerodromes must be totally prohibited. In accordance with various national recommendations for the prevention of bird hazards, best practice call for the elimination of garbage dumps within a radius of up to 13 kilometers of the aerodrome. Even this regulation may be inadequate to prevent hazards if the airport is located between the landfill and the roosting site of the birds using the landfill.

c) Sewage Treatment and Wastewater Plants

These plants and their settling ponds often attract large numbers of birds. The closer the plant to the aerodrome, the greater the potential hazard is likely to be. It is necessary for aerodrome operators to develop agreements with those responsible for the plants to ensure that bird's hazards that result from sewage ponds are suitably mitigated. New plants should not be constructed near an airport or where movements to and from the plant bird may affect aircraft movements.

d) Reservoirs, lakes, Ponds, Rivers and Salt Marshes

Wetlands are often used by significant numbers of water birds, which tend to be among the higher hazard species due to their size and flocking behavior. If possible changes to these waterbodies should be undertaken to reduce their attractiveness to birds if the birds are known to present a flight safety risk.

The existence of several bodies of water may result in bird movements from one to another, thereby increasing the risk of bird strikes especially if the airport lies between those waterbodies. Particular attention has to be paid to the risk of bird strikes at aerodromes situated in coastal areas or near estuaries.

e) Gravel Pits and Quarries

Areas from which raw materials and stone are extracted are often filled with water. It is common for these areas to be left without being restored, thereby attracting birds. In the case of any new excavations, it is important to ensure that, following its exploitation, the site is restored to its initial state. In some cases old extraction pits are being enhanced to increase the biodiversity of an area which, if near an airport, may increase the bird hazard.

f) Nature Reserves

The establishment of nature reserves in the vicinity of aerodromes can attract wildlife. In general, nature reserves are formed where unique, diverse or remnant habitats exist. They may or may not harbor hazardous species. Airports should develop a solid relationship with reserve management, so that if habitat enhancement is conducted on the reserves' wildlife hazards to aircraft are a primary consideration.

g) Possible Future Hazards in the Vicinity of the Aerodrome Safeguarding

Airport operators should take steps to prevent new or increased hazards caused by developments in the vicinity of the aerodrome and should also encourage developments that

reduce wildlife hazards. ICAO quotes a distance of 13km from the airport. However, developments beyond 13km can still create a hazard if animals move past the airport or runway ends, to and from the newly developed land use. Information needs to be collected by the appropriate State authority and/or the airport operator about the local wildlife species, their abundance and their movements to and from feeding and roosting areas at different times of the year.

Where such developments are likely to increase the hazard, the airport operator should communicate those concerns to the developer, municipal planners and the national aviation authority.

h) Landscaping of Aerodromes

In many projects for the revitalization, extension or construction of new aerodromes, external landscaping is given importance in the project in order to welcome aerodrome users in an agreeable manner. The planting of trees, bushes and other plants has the undesired effect of attracting wildlife, and particularly birds. The management of the wildlife hazard should be considered part of the project planning from the very beginning. Care should be taken with the selection of sites for planting and the varieties used which can have a significant impact on the presence of wildlife. In all cases, plants which produce food such as berries and fruit should be avoided. Also, continuous stands of vegetation should be avoided. Preferably, trees should be spaced so that they do not form a continuous canopy and shrubs should not be planted under the canopy of trees and should also be spaced so as to not touch each other. Open form trees and shrubs should be selected, avoiding coniferous trees and shrubs which provide year- round shelter.

Airports should conduct an inventory of bird attracting sites within the ICAO defined 13km bird circle, paying particular attention to sites close to the airfield and the approach and departure corridors. A basic risk assessment should be carried out to determine whether the movement patterns of birds/wildlife attracted to these sites means that they cause, or may cause, a risk to air traffic. If this is the case, options for bird management at the site(s) concerned should be developed and a more detailed risk assessment performed to determine if it is possible and/ or cost effective to implement management processes at the site(s) concerned. This process should be repeated annually to identify new sites or changes in the risk levels produced by existing sites.

Once sites that support birds/wildlife that are, or might, cause a flight safety problem are identified, management options can be developed. These can range from minor habitat modification, changing cropping or other agricultural practices, major drainage operations or large scale removal of bird/wildlife populations. Again the choice of technique will depend on the particular situation encountered and expert advice should be sought if necessary. Larger scale off-airport bird/wildlife management may also involve liaising with local conservation interests, especially if the sites that need to be managed are nature reserves. In some cases it may be impossible to resolve the conflicting interests of flight safety and conservation, but in trying to do so the airport will be in a better position to show due diligence in the event of an accident or legal claim in the

ANNEX B Wildlife Repellent/Intervention Techniques

B.1.1 Repellent and harassment techniques should be used to keep hazardous wildlife away from specific areas on or near an airport. The long-term cost-effectiveness of repelling hazardous wildlife does not compare favourably with habitat modification or exclusion techniques. Wildlife will return as long as the attractant is accessible. However, habitat modification and exclusion techniques will never rid an airport of all hazardous wildlife. Repellent techniques are a key ingredient of any wildlife hazard management plan.

B.1.2 Repellents work by affecting the animal's senses through chemical, auditory or visual means. Habituation or acclimation of birds and mammals to most mechanical repellent techniques is a major problem. When used repeatedly, without added reinforcement, wildlife soon learn that the repellents or techniques are harmless and the repellents or techniques are ignored.

B.1.3 When using repellents, four critical factors should be remembered:

a) there is no single solution to all problems;

b) there is no standard protocol or set of procedures that is best for all situations. Repelling wildlife is an art and a science. Motivated, trained and suitably equipped personnel who understand the wildlife on the airport are critical for the successful use of repellents;

c) each wildlife species is unique and will often respond differently to various repellent techniques. Even within a group of closely related species, such as gulls, the various species will often respond differently to various repellent techniques; and

d) to lessen habituation to repellent techniques:

(1) use each technique sparingly and appropriately when the target wildlife is present;

(2) use various repellent techniques in an integrated fashion; and

(3) reinforce repellents with occasional lethal control (only when necessary depredation permits are in place) directed at abundant problem species.

B.1.4 Advances in electronics, remote sensing and computers have resulted in "intelligent'' systems that can automatically dispense repellents (for example, noisemakers, chemical sprays) when targeted wildlife enter selected areas. These devices are used to reduce habituation and increase the effectiveness of other repellent techniques. It should be remembered that automated repellents are not a substitute for trained people on the ground, who can respond appropriately to incursions by various wildlife species, and should be considered only when more traditional methods of control and dispersal have proved ineffective.

B.1.5 **Wildlife patrols and runway sweeps in vehicles**; Effective control requires the use of a mobile patrol, operated by trained and equipped staff who are able to disperse wildlife immediately as they are detected. This patrol should operate 24hrs or at least during aircraft operational hours. Patrols of airside areas to disperse birds and other hazardous wildlife are a critical part of an integrated programme of wildlife hazard management on airports. Driving a vehicle toward the wildlife may be enough to cause the wildlife to disperse. This is especially true if the driver has been using repellent and removal techniques. Regular and continuous patrols and sweeps help wildlife control personnel to learn the behaviour, daily movement patterns and habitat preferences of wildlife on the airport. This information helps identify hazardous wildlife attractants on the airport (for example, low areas that gather standing water after rains) and hence future problems. All wildlife carcasses found during runway sweeps should be collected, identified as to species and documented in a wildlife strike log of carcass remains.

B.1.6 Wildlife dispersal techniques have been in use at many aerodromes for a long time and it is important to use a variety of these techniques to remain effective. However, in-depth knowledge of the airport and vicinity habitats and the distribution, movement patterns and behavior of the wildlife present remains the determining factor in the choice of methods. The management of the hazard should involve the regular monitoring of wildlife and analyzing their behavior, rather than being limited to simply harassing wildlife.

B.1.7 The levels of sophistication of devices available are highly variable and can include:

- Chemical repellents
- The simple scarecrow, (a static visual device);
- Complex radio controlled sound generators (static acoustic);
- Pyrotechnic pistols and vehicle mounted distress call apparatus (mobile acoustic), handheld lasers (mobile visual),
- Traps (static lethal); and
- Shotgun (mobile lethal).

B.1.8 **Visual repellents**; most visual repellents are simply a variation on an ancient theme, the scarecrow. Predator models can exist in the form of kites, balloons, scarecrows, hawk effigies or silhouettes, flags and Mylar reflecting tapes. Experience throughout the world shows very rapid habituation by birds, and thus have only short-term effectiveness and are not suitable as long-term solutions to an airport's bird problems. Most short-term success achieved with these devices is likely attributable to "new object reaction" rather than to any frightening effect produced by them. The more mobile the model, the longer it will be effective. These methods should only be used for brief periods of time, generally no more than 3-4 hours and if they can be used with other more effective methods their effectiveness can potentially be increased. Scarecrows are also only effective for very short periods of time and then only when there is action or other methods in use. The "Scary Man" scarecrow has been used in some locations, but the effectiveness is very limited both spatially and temporally.

B.1.9 **Chemical repellents for birds;** It is important to note that only chemical repellents registered and approved by the national and local authorities should be used. It should be noted at the outset that there are no chemical "solutions" for airport wildlife hazards, and at best some applications may work on some species in some circumstances. Additional measures will always be necessary, and some chemical repellents may not be available or appropriate to local conditions. The following chemical repellents, listed by active ingredient, may be available for use on airports:

a) Perches (polybutenes). Several commercial products are available in liquid or paste form. These sticky formulas make birds uncomfortable when they alight on them, encouraging the birds to look elsewhere to perch or roost. To be effective, all perching surfaces in a problem area should be treated, or the birds will move a short distance to an untreated surface. Under normal conditions, the effective life of these materials is six months to one year, but dusty environments can substantially lessen their life expectancy. Once the material loses effectiveness, it is necessary to remove it and apply a fresh coat. Applying the material over duct tape, rather than directly to the rafter surface upon which it will be used, will simplify clean-up.

b) Turf feeding (anthraquinone, methyl anthranilate). These two chemicals are commonly used as bird repellents for turf (grass):

(1) Anthraquinone acts as a conditioned-aversion repellent with birds. Birds eating food treated with anthraquinone become slightly ill and develop a post-ingestion aversion to the treated food source. Birds can see ultraviolet (UV) light and this enables birds to detect anthraquinone visually using UV light. They become conditioned to avoid the treated food source. Because of its conditioned-aversion properties, anthraquinone should not be applied to the entire airfield. It should be applied only in areas where birds graze or in higher risk areas, such as runway approaches.

(2) Methyl anthranilate is an artificial grape flavouring commonly used as a food additive, which is registered in some States as a feeding repellent for birds on turf. Birds have a taste aversion to methyl anthranilate, seemingly reacting to it in much the same way that mammals react to concentrated ammonia (smelling salts).

Both anthraquinone and methyl anthranilate are available in liquid formulations intended for foliar application. The effectiveness of these sprays in repelling grazing birds depend on growing conditions, rainfall, mowing and availability of alternate feeding areas. Repellency based on conditioned aversion is longer lasting than repellency based on taste.

c) Water (methyl anthranilate). Another formulation of methyl anthranilate may be applied to pools of standing water on airports and at other locations to repel birds from drinking and bathing. This application works well on temporary pools of standing water.

d) General area (fogging with methyl anthranilate). Methyl anthranilate is also available for use in fogging machines (thermal or mechanical) to disperse birds from hangars, lawns and other areas.

e) Frightening agent (Avitrol [4-Aminopyridine]). Avitrol is used to repel pigeons, house parrows, blackbirds, grackles, cowbirds, starlings, crows and gulls from feeding, nesting, loafing and roosting sites. Birds eating Avitrol-treated bait react with distress symptoms and calls, behaviour that frightens away other birds in the flock. Although registered as a “frightening agent” Avitrol is toxic to the birds that eat treated bait. Avitrol-treated bait should be applied in small amounts with untreated bait so most birds in the flock do not eat the treated bait. The primary use of Avitrol at airports has been for pigeon control around buildings. The safe use of Avitrol requires:

(1) knowledge of the bird’s feeding patterns;

(2) proper pre-baiting procedures to ensure bait acceptance and avoidance of non- target species;

(3) removal of dead birds after treatment.

B.1.10 **Cartridge, Cracker Shell and Pyrotechnics;** Cartridges and shell crackers are the most common means used throughout the world to scare birds. The visual and auditory effect of cartridges and crackers vary but is a direct and variable method that can be taken to wherever birds are situated. Certain types produce an explosion when they are fired or when they have traversed a certain distance while others only detonate at the end of their trajectory. Some leave smoke trails or flares and others produce a whistling sound. Pyrotechnics are fired using revolvers, pistols or shotguns.

The scaring effect of cartridges or crackers fired from firearms is well known. Cartridges and shell crackers should be used carefully. They should not be fired from within a vehicle. They should always be fired between the risk area and the birds so they will be scared away from the area where they pose a risk to the airport operation.

Pyrotechnics should not be launched into flocks of birds. This typically causes uncontrolled dispersal in all directions. Typically pyrotechnics should be directed to one side of the flock opposite to the desired direction the controller wishes the birds to flush.

To be really effective, the goal should always be to aim projectiles to detonate below the sight line of birds. For birds on the ground, the detonation should take place at ground level. Once the birds have taken flight, another shot fired between the ground and the birds should scare them away. For birds in flight, cartridges should be fired behind them. If the intent is to change the trajectory of a flock in flight, several cartridges could be fired in their flight line.

The direction and speed of the wind should be taken into account to avoid errant shots. Care should be taken not to accidentally fire cartridges and crackers into aircraft movement areas, such as the apron. Where there is dry grass, care should be taken due to the fire hazard

B.1.11 **Non-lethal projectiles to repel birds;** paint balls and rubber or plastic projectiles, fired from paint-ball guns and twelve-gauge shotguns respectively, have been used to reinforce other dispersal techniques. A high-quality paint-ball gun should be used to ensure accuracy and velocity. Paint-ball guns are typically fired at 6 to 30 metres from the target wildlife. There are several types of rubber or plastic projectiles (slugs, buckshot, pellets, beads) for use in a shotgun. The proper distance from the bird for firing varies by projectile and species of bird. Personnel should be trained in the safe use of firearms and the particular projectiles to be used. The objective is to shoot from a great enough distance for the projectile to cause temporary pain, but not injury, to the bird struck. However, the use and effectiveness of projectiles are largely unproven and would not be permitted by some States or airport operators due to health and safety regulations.

B.1.12 The following are some examples of audio repellents that can be used on birds:

a) **Propane cannons.** Propane cannons (exploders) produce a shotgun-sounding blast. In general, birds quickly habituate to propane cannons that detonate at random or preset intervals throughout the day, and they can scare birds into flight paths creating extra hazard.
Thus, to ensure they remain effective, cannons should be used only sparingly and when birds are in specific areas. Reinforcement by occasional shooting of a common bird species with a shotgun may improve the effectiveness of the cannons. Protected birds should be avoided unless the necessary depredation permits are in place. Some systems are designed so that cannons placed around an airport may be detonated remotely, on demand by radio signal, when birds are in the area.

If properly equipped with remote control, the advantage of this method is that staff in the control tower can operate them when necessary. If the wildlife hazard prevention patrol is on the other side of the airfield, this method can allow them to extend their range by activating a device remotely. However, the effectiveness of each device is limited to a set range and when positioned at a fixed location, only birds within this range are exposed. Even then, without a significant negative experience associated with the noise birds very rapidly habituate and the effectiveness rapidly declines.

b) **Distress-call and electronic noise-generating systems**. Recorded distress calls are available for birds commonly found on airports in many parts of the world, such as gulls, crows and starlings. Such calls, broadcast from speakers mounted on a vehicle, will often initially draw the birds toward the sound source to investigate the threat. These birds should be dispersed using pyrotechnics or by shooting an occasional bird with a shotgun. Distress calls routinely broadcast from stationary speakers, with no associated reinforcement to provide added fear or stress, have little utility. Birds habituate rapidly to electronic sound generators that produce various synthetic sounds from stationary speakers.

Distress/Alarm Calls; Birds emit distress calls when captured by a predator. The use of distress calls is therefore effective as long as the birds are correctly identified to species and the right distress calls are then used. This involves recording and emitting distress calls through high-quality loud speakers which emit the full range of call frequencies and are then mounted on the bird hazard prevention vehicle.

Depending on the geographical situation of the aerodrome and the species present, the use of distress calls can be an excellent solution. Their effectiveness is well proven in the case of gulls, for example.

Birds normally react to distress calls in the following manner:
- They are alerted and take flight;
- They approach the source of the sound and circle overhead
- Certain birds dive to assess the source of the threat

When the calls cease, the birds very often leave the area. It can be effective to combine audio methods with visual methods such as the use of cracker shells or models or

effigies. When calls are associated with a dead or distressed bird, the reaction of most birds is to leave the area. According to expert opinion, when distress calls alone are used, birds cannot precisely identify the threat or the predator and the safest action for them is to disperse. In view of this, the dispersal of birds through the use of distress calls may take time.

It is important to mount loudspeakers on the wildlife hazard prevention vehicle. They should be mounted facing the front of the vehicle. In this way, the driver always has the birds being dispersed in sight and can monitor their response and take any necessary follow-up measures.

Some guidelines for the use of bird distress calls are as follows:

- The vehicle should be stationary;
- The vehicle should be upwind of the flock of birds;
- The vehicle (and loudspeakers) should face the flock of birds;
- The ideal distance between the vehicle and the birds is less than 100 meters;
- The broadcasting of distress calls should last for around 90 seconds

The use of distress and alarm calls are one of the most challenging control methods to use. Not only is their effect somewhat subtle, the proper application of the method is challenging. As a result, few controllers use the method appropriately and effectively and as a result tend to abandon using the method all together. Repeated training by individuals who have successfully mastered the use of alarm and distress calls and the effective use of models should be used to provide controllers with expertise in the use of this method.

c) Shell crackers and other pyrotechnics. There are various projectiles, fired from breech- loaded shotguns or from specialized launchers that provide an auditory blast or scream as well as smoke and flashing lights to frighten birds. Some of the newer cartridges have ranges of up to 275 metres. Pyrotechnics, when used skilfully in combination with other harassment techniques and limited lethal reinforcement (shooting with a shotgun), are useful in driving birds off an airport. Pyrotechnic devices require that a person fire the projectile. This targeting of specific birds helps teach them to associate the pyrotechnic with a threat (person).

d) Ultrasonic devices. Ultrasonic (sound above the range detected by humans) devices are not proven to be an effective bird repellent. Bird species hazardous to aircraft are unable to hear ultrasonic frequencies, and therefore it is considered that these devices are largely ineffective as bird deterrents. Their use against mammals in airport environments is also largely unproven.

B.1.13 **Trained Falcons and Dogs;** Trained falcons and dogs, which are both potential predators for many species of hazardous birds found at airports, are undoubtedly effective in dispersing birds. To work properly, however, considerable investment in the training of both the animals and their handlers needs to be made. This training is essential to both in order to ensure that the animals do not become a strike risk and also to ensure that the deterrent value of deploying the falcon or dog is

maximized. Airports should not underestimate the staff time and cost involved in incorporating falcons or dogs in their bird control programs.

It is also important to remember that falcons and dogs are not effective at dispersing all hazardous birds in all conditions. They should be regarded as one tool amongst many that the bird controller can use. The use of trained predators alone is not an adequate substitute for the other bird management techniques described above. These can be particularly effective with large flocks of birds on the ground around an airport however the deployment of such methods needs close coordination with ATC so as to not create a hazard by lifting the birds when aircraft are landing or taking off.

For additional guidance on falconry use on airports can be found in the ICAO Airport Services Manual Doc 9137 Part 3 section 8.6.

B.1.14 **Lasers;** Lasers can be used to scare birds away. Trials have been conducted with fixed devices that use laser beams to scare off birds. Fixed lasers units and hand held lasers can be useful in dusk/dawn or night time, however it is recommended that trials are undertaken before purchasing expensive equipment. Some bird's species react only to some colors of laser, so local testing needs to verify what works. Procedures need to be put in place to ensure lasers are used safely and do not create any hazard to users of the airfield or people off-airport.

Hand-held laser projectors projecting a one-inch diameter red beam have been used successfully during trials in Europe to disperse birds from night-time roosting areas in reservoirs and trees. Hand-held laser projectors are effective at long ranges (over 0.4 km) and have also shown some effectiveness in dispersing birds from hangars. Based on trials in France it was decided that automated, continuous-scanning, green-laser projectors could be used, without any safety problem, on civil and military airfields. However, the use of laser equipment is not universally accepted, and to some extent its effectiveness remains unproven. During trials, daylight conditions reduced or eliminated the effectiveness of lasers. The use of lasers in an airport environment requires caution. Annex 14, Volume I, Chapter 5, 5.3.1, recommends setting up a laser-beam free flight zone, a critical flight zone and a sensitive flight zone around aerodromes. Guidance on how to protect flight operations from the hazardous effects of laser emitters is contained in the Manual on Laser Emitters and Flight Safety (Doc 9815).

B.1.15 **Trapping/Killing/Culling;** Constructive measures should be taken to limit the presence of mammals. If removal is desired or required, experienced hunters or trappers should be called upon to assist in the trapping or removal of wildlife. If they persist despite these measures, it is likely that more permanent measures should be taken such as habitat modification or exclusion methods. The destruction of animals through the killing of individuals and removal of nests or eggs should be carried out in accordance with local legislation. In no case should the destruction

of animals be used as the primary and /or sole method of wildlife management on an aerodrome. The use of limited, targeted, lethal control by trained staff may be necessary either to reinforce non-lethal control measures or to remove individual problem wildlife that cannot be controlled through any other method. Where wildlife is shot or captured, operatives should be trained in wildlife identification to insure that the correct species it targeted, and trained in proper removal methods and handling of live and dead animals. Trapping and handling of live animals takes considerable training to be successful and guarantee the safety of both the animals and the trapper and likely requires additional permitting by the government.

B.1.16 **Radio-controlled model aircraft to repel birds**; radio-controlled (RC) model aircraft, a relatively new technological innovation that provides both visual and auditory stimuli, have been used occasionally to harass birds on airports. If used precisely by competent and trained operators, limited trials have shown that RC aircraft can be used to herd birds away from airport runways, but their effectiveness remains largely unproven. Some RC aircraft, for example, have been designed to mimic the appearance of a falcon and to even fire pyrotechnics remotely.

Using RC aircraft in a busy airport environment requires highly trained operators and a thorough risk assessment, with written procedures, in coordination with other stakeholders such as ATC. Before using RC aircraft, it is important that operators ensure that the radio frequencies used are compatible with other radio uses in the airfield environment, particularly flight crew, airfield operations and air traffic control.

ANNEX C Reference & Sources

- ICAO, Annex 14, Volume I, Aerodrome Design and Operations
- ICAO, Doc 9137, Airport Service Manual, Part 3, Bird Control and Reduction
- ICAO, Doc 9332, Manual on Bird Strike Information System (IBIS)
- ICAO, Doc 9184, Aerodrome Planning Manual part 1, Master Planning
- ICAO, Doc 9184, Aerodrome Planning Manual part 2, Land Use and Environmental Control
- Airports Council International (ACI), Aerodrome Bird Hazard Prevention and Wildlife Management Handbook
- Airports Council International website
- International Civil Aviation Organization: www.icao.int
- CAAF Bird Strike Database