BEFORE THE COMMISSION
APPOINTED BY THE OTAGO REGIONAL COUNCIL

UNDER	the Resource Management Act 1991 (RMA)
IN THE MATTER	Of an application by Dunedin City Council for resource consent being processed with reference RM20.280
BY	**DUNEDIN INTERNATIONAL AIRPORT** **Submitter**

STATEMENT OF EVIDENCE OF SEAN TARUNGARAU KERE ROGERS ON BEHALF OF THE CIVIL AVIATION AUTHORITY

DATED 6 MAY 2022

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STATEMENT OF EVIDENCE OF SEAN ROGERS ON BEHALF OF THE CIVIL AVIATION AUTHORITY

1. My name is SEAN TARUNGARAU KERE ROGERS. I am currently employed as the Manager of the Aeronautical Services Unit (ASU) of the Civil Aviation Authority of New Zealand (CAA).

2. I have 25 of years of aviation experience and hold the following qualification Bachelor of Science in Physics. I have 7 years experience in aviation safety regulation, including Air Traffic Management, Aeronautical Information, Aeronautical Facilities, Airspace and Aerodrome oversight. My regulatory expertise extends to Aviation Safety Management Systems. Prior to my role as Manager ASU, I was a Senior Officer in the Royal New Zealand Airforce with experience in operational and tactical management of aircraft operations across a variety of operating environments around the world.

Role and Evidence Scope

3. I have been asked by Dunedin International Airport Limited (”DIAL”) to provide expert evidence explaining the role of DIAL as the operator of a Part 139 Certified Airport in managing wildlife hazard risk from land use activities beyond DIAL’s aerodrome footprint.

4. I will also explain the nature of CAA’s regulatory role and powers. I will set out CAA’s advice to airports in relation to appropriate setbacks for landfills from Part 139 airports.

5. I will also share CAA’s experience in relation to bird strike hazard risk at airports around New Zealand and describe the existing bird strike hazard at Dunedin Airport. This should shed light on DIAL’s high sensitivity towards any increase in the existing bird strike hazard situation.

6. Lastly, I will describe the potential consequences for DIAL if the hazard were to become unacceptable, noting that the CAA can only regulate DIAL.

Expert witness code of conduct

7. I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note dated 1 December 2014 and agree to comply with it. I have complied with the Code of Conduct in preparing this evidence and I agree to comply with it while giving oral evidence before the hearing committee. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

The CAA's regulatory role and powers

8. The Director of Civil Aviation (the Director) has responsibility for certification and regulatory oversight of aerodromes within New Zealand, and these are managed in practice by delegation to personnel in the ASU. In exercising this safety oversight function, the Director enforces the minimum safety standards articulated within Civil Aviation Rules (CARs) applicable to aerodromes within the New Zealand.

9. The ASU (acting on behalf of the Director) has responsibility for certification and safety monitoring of aerodromes and heliports, and of air traffic control, telecommunications, navigation, meteorological and aeronautical information services. It also has other responsibilities regarding airspace and objects affecting navigable airspace. Each of these responsibilities is governed by the Civil Aviation Act 1990 and dedicated Rule Parts in the CARs.

10. The rule parts relevant to aerodromes are CAR Part 157 - Notification of Construction, Alteration, Activation and Deactivation of Aerodromes; and CARPart 139 Aerodromes - Certification, Operation and Use.

11. The CAA is also a workplace health and safety regulator under the Health and Safety at Work Act 2015 (HSWA) for the civil aviation system. In general terms, the CAA administers the provisions of the HSWA for the aviation sector, with its jurisdiction covering:

(a) Work to prepare an aircraft for imminent flight;

(b) Work on board an aircraft for the purpose of imminent flight or while in operation; and

(c) Aircraft as workplaces while in operation.

12. WorkSafe administers HSWA in respect of the aviation sector in all other circumstances.

Role of a Part 139 Certified Airport in managing wildlife hazard risk

13. Under Civil Aviation 139.71 (Wildlife hazard management) an applicant for the grant of an aerodrome operator certificate must, if any wildlife presents a hazard to aircraft operations at the aerodrome, establish an environmental management programme for minimising or eliminating the wildlife hazard.

14. Under Civil Aviation Rule 139.75 (Safety management) an applicant for the grant of an aerodrome operator certificate must establish, implement, and maintain a system for safety management in accordance with rule 100.3.

15. The above requirements must be complied with on an ongoing basis. In other words, an operator must actively manage wildlife hazards on an ongoing basis under its environmental management programme and safety management system.

16. Also under HSWA, the CAA would expect a Part 139 certificated airport operator such as DIAL to take all reasonable and practicable steps to mitigate current and potential threats to aviation safety including from wildlife hazards.

CAA's advice to airports in relation to appropriate setbacks for landfills from Part 139 airports

17. The CAA advice is derived from the guidance promulgated by the International Civil Aviation Organisation (ICAO). I provide a brief summary of the framework in the next paragraph.

18. The 1944 Convention on International Civil Aviation (the Chicago Convention) provides the basis for the unification and standardisation of safety-related civil aviation law. New Zealand is a signatory to the convention. Among other things, the Chicago Convention established the ICAO, which has as one of its functions the adoption of international standards and recommended practices (SARPs). These SARPs relate to a variety of matters including aerodromes, air navigation, registration of aircraft and the certification of personnel, such as flight crew.

19. The relevant guidance for wildlife management is contained in ICAO Document 9137 Airport Services Manual Part 3 Wildlife Hazard Management 5th Edition. Doc 9137, Part 3 is attached as appendix 1. While it is not legally binding on New Zealand, the guidance in Doc 9137 is a recommended international practice.

20. At paragraph 2.4.3.1 of Doc 9137 it states:

"State authorities and other public bodies responsible for territorial planning should collaborate with one another. For example, laying down restrictive legal requirements (establishing safeguarding areas) or, at least, raising awareness about what land uses or human activities should not be developed within the 13-km circle[1] in the vicinity of the aerodromes because they may be attractive for wildlife, may be a helpful starting point"

21. The ICAO document elaborates further on the selection of the 13 km radius in the associated footnote:

"The 13-km circle was based on a statistic that 95% of bird strikes occur below 2 000 ft, and that an aircraft on a normal approach would descend into this zone at approximately 13 km from the runway. An assumption was made that birds would remain overhead the attraction (at up to 2 000 ft) and that overflying aircraft would be at risk"

22. This note provides important context to the ICAO guidance by inferring the risk of bird strike is not uniform within 13Km but will increase with proximity and altitude to the aerodrome. This is an important consideration when conducting any wildlife hazard assessment.

23. As has already been established, ICAO produces SARP's to standardise global aviation practices, given the global nature of the aviation industry. Ultimately, it is up to the state to determine how those SARPs are incorporated into national legislation. Examples of how

New Zealand and other states have interpreted this have been provided in the Wildlife Management Plan. In this context it is important to stress that whilst New Zealand legislation does not include prohibitive criteria for off-aerodrome land use, the risk itself is not evenly distributed across the aviation system. Correspondingly, the CAA Regulatory Strategy Priorities focus our safety oversight functions on where the risk likelihood and consequence are the highest. As an aerodrome facilitating scheduled international passenger air transport operations, Dunedin Airport represents a convergence of CAA and ICAO regulatory focus. In this context, the advisory circular and ICAO guidance should be given necessary weight at locations where complex and dense aviation operations occur.

24. Paragraph 2.4.4 of Doc 9137 is relevant to environmental authorities and paragraph 2.4.5 to local and regional authorities. Importantly, it suggests that regional authorities should collaborate with other stakeholders on territorial planning issues. In this respect it would be the CAA expectation the DIAL be consulted at the planning and site selection stages of this proposal.

25. In the NZ context, the CAA has published Guidance Material for Land Use at or Near Aerodromes in 2008 (attached as appendix 2). This document highlights the importance of aerodromes monitoring changes to land use in areas outside their immediate control to ensure that these land use changes do not increase wildlife hazards to the aerodrome. It is an ICAO requirement that such activities are closely managed by the controlling authority. It is a CAA expectation that aerodromes are proactively engaging with regional authorities on issues relating to adjacent land use. It is also acknowledged that aerodromes are likely only influencing off-aerodrome land use decisions as opposed to making them.

26. NZ specific guidance is provided in the associated Civil Aviation Rule Advisory Circular 139-16 (AC 139-16), (attached as appendix 3). This states that although you can control the land use practices on your land to reduce the aerodromes attractiveness to birds, bird attractive land use activities outside the aerodrome’s boundary, beyond your

sphere of influence, can counter these activities. In addition, AC 139-16 provides further guidance under the following headings:

1. Hazardous Land Use Practices
2. Bird strike Incident Analysis
3. Passive and Active Wildlife Management
4. Community Partnerships with Local Authorities

27. Under the 4th bullet point, AC 139-16 states that local authorities should be told about the hazards and encouraged to develop land use restrictions and management techniques to minimise the presence of birds near aerodromes.

CAA's experience in relation to bird strike hazard risk at airports around New Zealand, and the existing bird strike hazard at Dunedin Airport

28. The CAA monitors wildlife incidents across the NZ aviation system through the mandatory safety incident reporting requirements contained in Civil Aviation Rule Part 12. It is a requirement for all holders of Civil Aviation Certificates and Licenses to report all safety incidents including Bird Strike incidents to the CAA. The CAA monitors bird strike incidents across the aviation system to identify trends, precursor events and heightened risk. As a risk-based intelligence lead regulator, the CAA may choose to intervene/interact with aerodromes based on identified wildlife management risks, as part of its safety and compliance monitoring functions. In situations of this nature the CAA role will be to ensure the safety management functions of the aerodrome certificate holder remain fit for purpose and compliant.

29. As part of its role as safety regulator any intervention strategy determined by the CAA would focus on the effectiveness of the Aerodrome Operators Wildlife Management Program as required by CARs. To support the effective implementation of Aerodrome Wildlife Management Programs the CAA publishes the previously mention guidance and rules, as well as sponsoring the NZ Aviation Wildlife Hazard Group (NZAWHG). The NZAWHG meets three times a year and is an opportunity for the aerodrome community to

communicate/cooperate and collaborate on matters relating to wildlife management in aviation.

30. Specifically in regard to DIAL, the current trend analysis indicates a low incident rate (less than 5 bird strikes per 10,000 aircraft movements) but is trending upwards. By rate comparison, the Dunedin Airport bird strike rate is relatively high compared to other NZ international airports. This analysis is taken from the previous 3 years of incident reporting. It should be noted that the quarterly reporting analysis conducted by CAA is for use by the CAA in exercising its safety oversight functions. The quarterly analysis is reactive and is used in risk-based targeting of regulatory interventions and does not supersede any of our other routine aviation surveillance and monitoring activities. In all situations an aerodrome is required to minimise wildlife risk as low as reasonably practicable (ALARP). This is in line with the intent of the Health and Safety at Work legislation and as such CAA does not stipulate a specific targeted level of safety beyond this. For example, should our quarterly bird strike incident reporting indicate a high level of reporting, the CAA would necessarily look at options to intervene in the associated aerodromes aviation operation in the interests of safety.

Potential consequences for DIAL if the hazard were to become unacceptable

31. Taking into account the obligations of holders of an Aerodrome Operator Certificate under Civil Aviation Rule Part 139 and the HSWA, DIAL is required to implement a Wildlife Management Program sufficient to minimise the risk of bird strike to as low as reasonably practicable.

32. The establishment of a landfill site at 4.5Km from the aerodrome runway will impact the bird strike risk at Dunedin Airport. Given the Wildlife Hazards Assessment drafted by Avisure is a preliminary report, no accurate assessment of the magnitude of this increased in risk can be made with a pre-liminary Hazard Assessment. The reasons for this are quite clearly articulated in the report itself in the Limitations section. Moreover, the potential use of bird mitigating nets in the future indicates uncertainty as to the actual impact of this proposal on bird

numbers. In light of the status of the Hazard Assessment as a pre-liminary document, it would be reasonable to conclude the risk to the travelling public will likely increase as a result of this proposal. Based on present information the establishment of the Smooth Hill Landfill will require DIAL to amend its wildlife management processes, to accommodate the impact on the risk of aircraft damage or loss due to bird strike.

33. It is a requirement for the Aerodrome to provide CAA with ongoing assurance that the associated risk is as low as reasonably practicable. In the eventuality that Bird strike incidences increase as a result of the proposed activity, the CAA has limited intervention options, should the bird strike risk become unacceptable. Primarily, CAA would anticipate DIAL applying additional wildlife management measures, to ensure no undue safety risk to the travelling public arises. if this is not sufficient to reduce the bird strike risk to an acceptable level, the aerodrome operator may be required to limit or reduce its aviation activities to ensure the associated safety risk remains acceptable. Such limitations may include:
    1. Limiting all aircraft movements.
    2. Limiting international aircraft movements.
    3. Limiting scheduled passenger transport services.

34. Such limitations could be part of the aerodromes risk management strategy or could be imposed by the CAA under sections 7, 9, 17 or 18 of the Civil Aviation Act 1990. These, amongst other things, enable the Director to impose conditions on an aviation document holder, such as DIAL, in order to address civil aviation risks. Ultimately, the powers of the Director extend to include revocation of the aerodrome operating certificate.

35. Such limitations may be required by the Director as part of its regulatory oversight of DIAL’s Aerodrome Certificate. It also does not exclude the potential for any of the airport users to similarly limit or reduce their level of activity at Dunedin Airport in order to minimise their risk exposure.

Sean Rogers

6 May 2022

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by

CORRIGENDA		
No.	Date	Entered by

FOREWORD

Previous editions of this manual focused on the control of birds on, and in the vicinity of, aerodromes. With the recognition that other forms of wildlife may also present a hazard to the operation of aircraft, the provisions on bird hazard reduction in the fifth edition of Annex 14 — *Aerodromes*, Volume I — *Aerodrome Design and Operations* were expanded to include a broader focus on wildlife strike hazard reduction. The eighth edition of Annex 14, Volume I requires that action be taken to decrease the risk to aircraft operations by adopting measures to minimize the likelihood of collisions between wildlife and aircraft. Thus, the guidance provided in the fourth edition of this manual was expanded to include both bird and other wildlife control for the purpose of reducing the hazard of bird/wildlife strikes to aircraft.

Amendment 3 to the *Procedures for Air Navigation Services — Aerodromes* (PANS-Aerodromes, Doc 9981) will include provisions and procedures to mitigate the risk posed by wildlife to aviation safety, through the proactive management and control of wildlife at aerodromes and their vicinities. PANS-Aerodromes, Part II, Chapter 6 contains provisions on the establishment of a Wildlife Hazard Management Programme (WHMP) at aerodromes, including guidance on habitat and land use management, reporting and recording wildlife incidents, expelling and deterring wildlife, and personnel training. This fifth edition of the *Airport Services Manual*, Part 3 — *Wildlife Hazard Management* (Doc 9137) (formerly titled Wildlife Control and Reduction) contains revised guidance, consistent with the aforementioned Part II, Chapter 6 and highlights the importance of developing a WHMP specific to each aerodrome.

This document was written on the assumption that birds and other wildlife are a serious hazard to aircraft, and outlines what can and should be done to address this hazard. It is not the purpose of this document to discuss the relative importance of various hazards but to stress the importance of good organization and planning in the creation of a successful WHMP.

The primary purpose of this manual is to provide aerodrome personnel with the information necessary to develop and implement an effective wildlife control group for their aerodrome. The management structure may differ at each aerodrome, however all structure types should be in accordance with the threat. The seriousness of a wildlife hazard problem is affected by geographic location, attractiveness of the aerodrome habitat to wildlife and air traffic density.

This manual suggests organizational structures that may effectively manage wildlife hazard control. A brief history in Chapter 1 describes the evolution of the wildlife hazard and provides examples of significant wildlife strikes. This manual explains why wildlife hazards occur at an aerodrome, the roles and responsibilities of all the stakeholders involved in wildlife hazard control, and the modifications to be carried out at an aerodrome to remove the features which attract wildlife. The content of this fifth edition was reviewed by the wildlife hazard management subject matter experts from the ICAO Wildlife Hazard Management Expert Group (WHMEG), supported by Airports Council International (ACI).

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GLOSSARY

ABBREVIATIONS AND ACRONYMS

AIP	Aeronautical information publication
ANSP	Air navigation services provider
ATC	Air traffic control
ATIS	Automatic terminal information service
CAA	Civil Aviation Authority
FOD	Foreign object debris
GIS	Geographical Information System
IBIS	ICAO Bird Strike Information System
LRAD	Long range acoustic device
MRO	Maintenance, repair and overhaul
NGO	Non-governmental organization
NOTAM	Notice to airmen
RADAR	Radio detection and ranging
RPAS	Remotely Piloted Aircraft System
SMS	Safety management system
WHMP	Wildlife Hazard Management Programme

Chapter 1

INTRODUCTION

1.1 WHAT IS A WILDLIFE HAZARD?

1.1.1 A wildlife hazard is the presence of wildlife (i.e. birds and other animals, both wild and domestic) that could result in damage to aircraft.

1.1.2 The risk of a wildlife hazard depends on the size, behaviour and number of wildlife and their proximity to aircraft during different phases of flight. Wildlife hazards on the aerodrome or while passing through critical airspace are likely to increase the probability of negative effects.

1.1.3 Wildlife risks fluctuate with the daily and seasonal cycles of wildlife activity. The species and number of wildlife at and around aerodromes may vary over the years due to land use and environmental changes (e.g. agricultural practices, urbanization, conservation and climate change). Aerodromes have site-specific characteristics regarding their habitat, climate and surroundings that should be reflected in their respective Wildlife Hazard Management Programmes (WHMP). Increased air traffic and the development of quieter aircraft engines may increase the likelihood of a wildlife strike. Wildlife hazard management methods and techniques should therefore be reviewed annually and updated regularly to ensure that effective control methods are implemented.

1.2 HISTORICAL BACKGROUND

1.2.1 Many wildlife incidents and accidents have occurred since the dawn of aviation. While piloting his airplane on 7 September 1905, Orville Wright had what is believed to be the first collision between an aircraft and a bird, an event now known as a bird strike. Less than seven years later, on 3 April 1912, in Long Beach, California, Calbraith Perry Rodgers, the first man to make a transcontinental flight across the United States, became the first person to die as the result of a bird strike. His Wright Flyer flew into a flock of gulls that jammed the aircraft's controls, causing it to plunge out of control into the ocean.

1.2.2 The frail structures of early aircraft made them susceptible to wildlife strike damage. However, their slow speed gave pilots and wildlife more time to take evasive action. The development of aircraft over the past 100 years has progressed to produce aircraft that are more resistant to wildlife strikes. Nevertheless, significant strikes continue to occur regularly worldwide.

1.2.3 The deadliest bird strike to date occurred on 4 October 1960 at the Boston Logan International Airport, when a Lockheed Electra L188 struck a flock of European starlings (Sturnus vulgaris) just as it became airborne. The birds were ingested into three of the aircraft's four engines, causing the aircraft to lose power, stall and crash into the harbour. Sixty-two people died out of the seventy-two passengers and crew members on board.

1.2.4 Wildlife strikes have also impacted changes to aircraft design. On 23 November 1962, a Vickers Viscount struck a flock of whistling swans (Cygnus columbianus) over the State of Maryland in the United States while flying at 6 000 ft. One of the horizontal stabilizers was penetrated by a swan, weakening the structure and causing it to separate from the aircraft which subsequently crashed and killed all crew members and passengers on board. This crash resulted in the design criteria for horizontal stabilizers being raised to withstand eight pounds (3.6 kg).

1.2.5 Perhaps the most famous bird strike in recent years took place on 15 January 2009, when an Airbus A320 hit a flock of Canada geese (Branta canadensis) just after taking off from LaGuardia Airport, New York City. The ingestion of multiple geese into both engines resulted in a forced emergency landing on the Hudson River. All 150 passengers and five crew members survived.

1.2.6 A more recent wildlife strike resulting in fatality was on 28 September 2012, when a Dornier Do-228 with sixteen passengers and three crew members was on initial climb out of Kathmandu Airport. The crew reported a bird strike, resulting in a fatal crash that killed all on board. The bird was identified as a black kite (Milvus migrans).

1.2.7 Although the majority of wildlife strikes involve birds, those involving other animals may also have a severe outcome. For example, on 4 December 2015, a Spicejet landing at Jabalpur Airport collided with a herd of wild boars that were crossing the runway. The aircraft went off the runway and the left main and nose gear of the aircraft collapsed. No passenger or crew member was injured.

1.3 FUNDAMENTALS OF WILDLIFE HAZARD MANAGEMENT

1.3.1 The objective of wildlife hazard management at aerodromes is to reduce the risk of a wildlife strike by implementing appropriate mitigation measures.

1.3.2 A strike is a collision between wildlife and an aircraft; a “near miss” is the potential of a wildlife strike.

1.3.3 To manage wildlife hazards, one must first assess the level of risk for each species present. Recording wildlife presence (at a species level) on, and in the vicinity of, the aerodrome, wildlife strikes and near misses is therefore necessary.

1.3.4 The following events should be recorded and used for assessing and mitigating the risk of wildlife hazards:

a) any reported collision between wildlife and an aircraft for which evidence in the form of a carcass, feathers, any other remains, or damage to the aircraft is found;

b) any reported collision between wildlife and an aircraft for which no physical evidence is found, but an indication of a collision exists (e.g. visual observation of the collision or acoustic perception of the impact);

c) any wildlife found dead on an aerodrome without any other obvious cause of death; and

d) incidents or observations where the presence of wildlife on or in the vicinity of the aerodrome could have an effect on a flight (e.g. missed approach, aborted take-off, etc.).

1.3.5 Measures to manage wildlife hazards at aerodromes may include, but are not limited to: manipulating habitats (see Chapter 4, Habitat management), harassment and repellent techniques and removal of wildlife (see Chapter 5, Management of hazardous wildlife). Emerging technology such as bird detection RADAR or remotely piloted aircraft systems (RPAS), may also enhance the detection, monitoring and control of hazardous wildlife (see Chapter 6, Advancements in technology).

1.3.6 In addition to managing the land use on aerodrome property, off-site land use in its vicinity must also be assessed and mitigated, as it can affect wildlife presence or activity. Land use suggestions can be offered to owners around aerodrome property to aid in wildlife management (see Chapter 4, 4.4).

1.3.7 The strategy for assessing wildlife at aerodromes and the control measures for reducing wildlife risk should be outlined in the aerodrome’s WHMP.

1.3.8 This manual applies to both existing and new aerodromes, including expansion projects. More information can be found in the *Airport Planning Manual*, Part 1 — *Master Planning* and Part 2 — *Land Use and Environmental Management* (Doc 9184)

1.3.9 State authorities should analyse and approve the location of new aerodromes, to ensure that issues with high potential for wildlife attraction are considered and mitigated where necessary.

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Chapter 2

STAKEHOLDERS

2.1 INTRODUCTION

2.1.1 A variety of stakeholders should contribute to wildlife hazard management at the aerodrome. These include, but are not limited to, the aerodrome operator, airside personnel, air navigation services providers (ANSPs), pilots, airlines, environmental authorities, local and regional authorities, civil aviation authorities (CAAs), security forces, police, local community groups, the air force and wildlife experts and scientific and academic communities.

2.1.2 The aerodrome operator is the primary stakeholder and the common link among all other stakeholders at the aerodrome. The safety management system (SMS) of the aerodrome should be coordinated with those of other stakeholders, where applicable, to be successful in wildlife risk management. Aerodrome operators should also have an open line of communication between various stakeholders, for example with the formation of a local aerodrome wildlife committee (see 2.6).

2.2 AERODROME OPERATORS

2.2.1 General

2.2.1.1 The primary responsibility of the aerodrome operator is to maintain aerodrome safety and ensure that action is taken to reduce the risk of wildlife strikes.

2.2.1.2 To achieve this goal, each aerodrome operator should develop, implement and demonstrate an effective WHMP (see Chapter 9, Wildlife Hazard Management Programme). The programme should represent the size and level of complexity of the aerodrome, taking into consideration hazardous species, the level of risk associated with them and the volume of flight operations (see Chapter 3, Aerodrome wildlife safety risk assessment). The aerodrome operator should ensure that all wildlife hazard control personnel and managers demonstrate competency, are adequately trained and are provided with the appropriate resources and equipment to carry out their tasks (See Chapter 7, Training).

2.2.1.3 The aerodrome operator should provide pilots and aircraft operators with recurrent wildlife behaviour and habits that may impact aircraft safety (see Chapter 8, Operational notifications).

2.2.1.4 The aerodrome operator should ensure that, where applicable, agreements with tenants of leased land contain specific wildlife hazard management control information. The aerodrome operator may choose to include enforcement language within their leases or concession agreements.

2.2.2 Aerodrome wildlife coordinator or manager

The aerodrome operator should appoint a wildlife coordinator or manager who is responsible and accountable for wildlife hazard management and personnel engaged in wildlife hazard control.

2.2.3 Aerodrome wildlife control personnel

A wildlife controller performs the front line role and may be any suitably trained and qualified member of aerodrome staff. This role will involve key duties such as, but not limited to:

a) maintaining surveillance of wildlife activity on, and in the vicinity of, an aerodrome;

b) implementing active wildlife control measures and interventions in accordance with the WHMP to counter any detected wildlife hazards;

c) providing, where applicable, the details of potential wildlife hazards to ATS units;

d) recording all wildlife observed (on- and off-site);

e) recording wildlife control activity and the effect of the control actions;

f) recording actual, potential or suspected wildlife strikes;

g) advising senior personnel on improvements to the wildlife control tasks or WHMP; and

h) assisting with surveys.

2.2.4 Collecting, reporting and recording data on wildlife incidents and observed wildlife

2.2.4.1 The aerodrome operator should have policies and procedures in place on how to obtain data related to hazardous wildlife species and their use of the aerodrome and its vicinity, to further assess such related hazards to aviation. For best results, data collection should begin at the planning and design phase of an aerodrome and continue throughout its lifecycle.

2.2.4.2 This data will mainly contain records of:

a) wildlife observed at the aerodrome and its vicinity;

b) wildlife control activities;

c) incidents with wildlife;

d) wildlife strikes and near misses;

e) areas of high wildlife activity on the aerodrome and in its surroundings; and

f) wildlife observations or surveys from the aerodrome's vicinity taken periodically, at least seasonally and noting migratory activities.

Note.— Procedures for the establishment of a wildlife log are described in the PANS-Aerodromes (Doc 9981).

Wildlife observations and control activities records

2.2.4.3 A record of all observed wildlife activity on an aerodrome and in its vicinity should be maintained. Aerodrome personnel involved in wildlife control should record these observations and include, at a minimum (See Chapter 5.2, Patrols and observations):

a) the type of wildlife activity and movements (for example: direction and altitude);

b) control action taken and effect;

c) the preferred areas frequented by wildlife; and

d) the frequency of presence of hazardous species detected.

2.2.4.4 These records should be written using the standardized templates prepared by the aerodrome and made available to wildlife control personnel. It is recommended that the records be accompanied by maps of the aerodrome, indicating the location of observations or control activities.

2.2.4.5 These observations should be followed up by periodic surveys and/or studies.

Periodic wildlife surveys

2.2.4.6 Appropriate data on the presence and behaviour of wildlife on, and in the vicinity of, the aerodrome may also be obtained by means of periodic surveys. Wildlife surveys should cover the entire year to account for seasonal changes and should also consider different phases of the day. The survey should also consider aircraft movements, runways in use and wildlife behaviour. The greater the presence of hazardous wildlife, the greater the need to conduct surveys to gather information.

2.2.4.7 The sampling method should be consistent, systematic and replicable, for the data to be comparable over time. This sampling method should also be aligned with the data collected in observation records.

2.2.4.8 The possibility of using different data sources and methodologies to carry out the surveys will depend on the material and human resources of the aerodrome.

2.2.4.9 The periodic surveys should be carried out by personnel with the knowledge and experience of studying wildlife.

2.2.4.10 There are many methods to conduct wildlife surveys. For example, wildlife observation points can be used to record the species seen and their behaviour during a clearly defined period of time. There are also sampling methods using paths of a specific length in which the wildlife observed along a route is recorded (referred to as transects), carried out on foot or by vehicle.

Wildlife incidents records and reporting

2.2.4.11 All stakeholders must report wildlife-related incidents defined in Chapter 1, 1.3.4, to the aerodrome operator.

2.2.4.12 The aerodrome operator should have well-defined reporting procedures in place for wildlife-related incidents with different stakeholders and should ensure the appropriate and meaningful review of data, while considering all circumstances. All stakeholders should be made aware of the procedures described in the aerodrome manual or any associated aerodrome documentation.

2.2.4.13 A wildlife incident reporting form should be included in the procedure and made available to all stakeholders. The forms used by the aerodrome operator or other stakeholders at the aerodrome should contain, at minimum, the information in the PANS-Aerodromes, Part II, Chapter 6, Appendix 2. More detailed information results in a more accurate risk assessment of wildlife data.

2.2.4.14 The aerodrome operator should report wildlife incidents to the CAA in accordance with national regulations on incident reporting.

2.2.4.15 All incidents, regardless of damage or evidence, should be reported, collected and entered into a database as mentioned in the PANS-Aerodromes, Part II, Chapter 6.

2.2.4.16 Wildlife species identification should be as accurate as possible. It is therefore essential for wildlife personnel to be adequately trained.

2.2.4.17 The aerodrome operator should have a procedure in place for the collection, management, conservation and identification of animal remains to identify a species after a strike as well as any remaining organic material using DNA analysis.

Inventory of attractive areas for wildlife

2.2.4.18 The aerodrome should keep a record of areas with wildlife attraction or concentration in the aerodrome and its vicinity. This inventory should lead to an analysis of the existing habitat and include reasons why wildlife species may be attracted. Certain habitats attract species for food, water or shelter. Examples include: fruits on aerodrome property that attract small flocking birds; large bodies of water that attract shorebirds and waterfowl; and forests that attract large birds of prey and mammals (See Chapter 4, 4.2, Attractants).

2.3 STAKEHOLDERS WITHIN THE AERODROME

2.3.1 Airside personnel

2.3.1.1 The aerodrome operator's reporting system should ensure that there is a requirement for all relevant third parties and all aerodrome personnel to report wildlife incidents, wildlife remains and any other relevant identified hazards, to the aerodrome operator.

2.3.1.2 Aerodrome personnel not directly involved in wildlife control measures should be made aware of hazardous wildlife attractants and understand the importance of both not creating foreign object debris (FOD) but also picking up or reporting FOD that could attract wildlife. The aerodrome operator should ensure this detail is included in information briefings and during airside induction and familiarization programmes.

2.3.2 Air traffic control (ATC)

2.3.2.1 ATC is the link between the airside personnel on the ground and pilots; they provide pilots with updated information concerning observations of wildlife activity on or near the aerodrome.

2.3.2.2 ATC should report all aerodrome wildlife incidents through the established procedures (for more examples, see Chapter 8, Operational notifications). In addition, ATC should maintain a continuous liaison with the aerodrome wildlife hazard control personnel.

2.3.2.3 Depending on the circumstances, ATC may take action or advise in response to potential wildlife strike hazards not limited to: take-off delay, use of alternative runways for landing and take-off, or different routes and altitudes according to established procedures.

2.3.2.4 ATC should attend and participate in both local aerodrome and national wildlife committees.

2.3.3 Pilots

2.3.3.1 All pilots should report wildlife strikes through the established procedures (see Chapter 8). They should also report wildlife activity or remains near or on the movement areas to ATC to advise other pilots and so the wildlife control unit can assess the situation and take action if necessarily.

2.3.3.2 If hazardous wildlife is observed prior to take-off or landing, pilots may choose to delay the departure or to initiate a missed approach.

2.3.3.3 The attendance of pilots in local aerodrome wildlife committees is highly recommended since due to their unique vantage point, they can provide pertinent information regarding wildlife movements and activity during approach, landing and take-off operations.

2.3.4 Aircraft operators

2.3.4.1 The aircraft operator should report all wildlife strikes to the aerodrome operator. Wildlife hazards observed (both in the air and on the ground) by the aircraft operator should also be reported. The aircraft operator may investigate a high strike frequency at a certain aerodrome; this may be done in conjunction with the aerodrome operator.

2.3.4.2 As part of the risk assessment or airfield audit of an aerodrome, the aircraft operator may request the WHMP for assessment, and provide input to the aerodrome operator.

2.3.4.3 The aircraft operator should provide training on wildlife hazards in relation to flight operations (see specific examples in Chapter 7, 7.2.1) and reporting requirements to pilots and ground personnel.

2.3.5 Others

Other stakeholders may include: aircraft manufacturers aiming to improve materials, airframe and engine resistance to bird impact; or aeronautical authorities with tasks such as developing protective legislation, exchanging information and knowledge, disseminating best practices, keeping a wildlife strike database, etc.

2.4 IDENTIFYING EXTERNAL STAKEHOLDERS IN THE COMMUNITY

2.4.1 The importance of identifying external stakeholders

2.4.1.1 Different habitats, land uses and human activities developed near an aerodrome can shelter and attract wildlife that is hazardous to aircraft. Since these areas are owned or managed by external stakeholders to the aerodrome, they should be made aware of the potential hazard and briefed on how, due to their activities or land uses, they can contribute to minimizing the attraction of wildlife.

2.4.1.2 A good working relationship with neighbouring stakeholders is an essential first step in protecting the interests of an aerodrome and its clients, since many community land use planners are unfamiliar with the potential impact of off-aerodrome land use activities on aircraft safety. Awareness programmes for key community stakeholders are particularly effective as they highlight the potential flight-safety issues associated with different land uses.

2.4.2 Land owners

2.4.2.1 The aerodrome does not have the authority to directly manage habitats outside of the aerodrome. Therefore, it is necessary to develop good relationships with the landowners in the vicinity. Landowners should be aware of the possible attractants of the land use activities on their grounds and the construction of their buildings. Aerodromes have the best understanding of the impact of wildlife on aviation safety and should initiate conversations and working groups with land owners who may not otherwise be aware of the risks (see 2.6, Methods of communication). Land uses that should be considered by aerodrome operators are outlined in Chapter 4, Habitat management.

2.4.3 State authorities

2.4.3.1 State authorities and other public bodies responsible for territorial planning should collaborate with one another. For example, laying down restrictive legal requirements (establishing safeguarding areas) or, at least, raising awareness about what land uses or human activities should not be developed within the 13-km circle[1] in the vicinity of the aerodromes because they may be attractive for wildlife, may be a helpful starting point.

2.4.3.2 The collaboration among different State authorities (e.g. aviation-environmental) may lead to the development of environmental legislation or regulation that promotes the control of, or even the elimination of, wildlife attraction areas located near aircraft flight routes.

2.4.3.3 State authorities should publish information that ensures landowners in the vicinity of the aerodrome are aware of the laws and regulations that apply to their lands. These laws and regulations may impact building design and land use (e.g. crop choices and harvesting methods).

2.4.4 Environmental authorities

2.4.4.1 Since environmental authorities may be responsible for protected and non-protected areas, they can collaborate with other stakeholders by facilitating procedures, authorization or permission necessary for the management or capture of hazardous wildlife species, especially those protected by environmental legislation.

2.4.4.2 Environmental authorities may develop legislation that requires an environmental impact assessment of certain projects (e.g. new aerodromes or facilities and infrastructures to be built near aerodromes). Wildlife hazards should be adequately evaluated and monitored. Consequently, environmental impact statements issued by these authorities should avoid promoting environmental restoration projects that may attract wildlife near aerodromes.

2.4.4.3 Coordination and collaboration between environmental authorities, the aerodrome operator and CAAs include the sharing of information related to wildlife species, population trends, habitats and wildlife concentration areas, biological characteristics, human-wildlife conflict management procedures, etc.

1. The 13-km circle was based on a statistic that 95% of bird strikes occur below 2 000 ft, and that an aircraft on a normal approach would descend into this zone at approximately 13 km from the runway. An assumption was made that birds would remain overhead the attraction (at up to 2 000 ft) and that overflying aircraft would be at risk.

2.4.4.4 Environmental authorities can also collaborate by implementing plans for newly protected areas, or by appropriately managing the existing ones, to ensure their compatibility with the aeronautical operations on the nearby aerodromes.

2.4.5 Local and regional authorities

2.4.5.1 Depending on the scope of their competences, local and regional authorities should collaborate with other stakeholders on territorial planning issues. If the authorities have decision-making capacity, they can assess the types of land uses or activities to be developed in the vicinity of an aerodrome and decide whether to authorize them or not. For this purpose, local and regional authorities can use easement regulations, safeguarding areas, wildlife hazard risk assessments, etc.

2.4.5.2 Although it depends on the State, the authorities are usually responsible for some facilities or activities known to be wildlife attractants, such as landfills. In this case, they can collaborate by properly managing the sites, minimizing as much as possible the wildlife presence and attraction.

2.4.5.3 In the case that an aerodrome lies close to an international border, aerodrome operators may need to reach out to local authorities in neighbouring countries to ensure that wildlife risks are considered.

2.4.6 Security forces and police

Security forces or police competences may vary depending on the State. Normally, they can contribute to the detection and even the prohibition of certain human activities that may involve wildlife hazards in the vicinity of the aerodrome, especially if those activities are illegal (e.g. inappropriate use of laser beam, unauthorized (or furtive) pigeon racing or training, etc.).

2.4.7 Local community groups and aerodrome neighbour organizations

2.4.7.1 When referring to local community groups or aerodrome neighbour organizations, farmers, land owners, hunter associations, pigeon racing associations, etc. should be included.

2.4.7.2 The activities of these groups may have negative effects on aerodrome safety. Proper coordination between the aerodrome operator and members of these groups is therefore essential. If these groups or organizations are adequately informed and made aware of the hazards caused by the presence of wildlife in the vicinity of the aerodrome, collaborative efforts may proceed more effectively and easily.

2.4.7.3 Good collaboration amongst local community groups may have the following effects:

a) Farmers may try to choose crops less attractive for wildlife (especially birds) and may adapt or modify the growing cycle, harvesting techniques, harvesting period, etc. to attract less wildlife.

b) Hunters can coordinate with the aerodrome operator concerning how and when they may conduct hunting, so as not to accidentally move animals towards the aerodrome. They can also be asked to assist in decreasing the population of hazardous wildlife.

c) Pigeon racing organizations may control the locations of pigeon lofts and pigeon release areas; they may also coordinate pigeon release schedules together with the aerodrome operator.

d) Agreements with farmers or shepherds may be reached, in terms of collaboration in vegetation management, animal care and property maintenance.

e) Fishing groups and organizations may change the time they handle fish so as not to attract birds.

2.4.8 The Air Forces (military)

2.4.8.1 Although military operations are quite different from those of civil operations, there are still opportunities for the exchange of information and knowledge between them.

2.4.8.2 Some States have joint-use civil-military aerodromes, at which both military and civilian aircraft have shared use of the airfield. In these cases, there must be coordination between civil and military aviation authorities, and the aerodrome operator. It is recommended to have a coordination procedure for wildlife hazard management.

2.4.9 Industry

2.4.9.1 The aviation industry dedicates time and effort to the research of new technologies and materials for airframes and engines to better withstand wildlife strikes.

2.4.9.2 The wildlife control industry is constantly investigating and adapting new technologies for innovative wildlife, rodent, invertebrate and vegetation control measures and equipment.

2.4.10 Wildlife subject matter experts and the scientific and academic community

2.4.10.1 Wildlife experts, through bird strike committees, associations, wildlife management companies, government agencies, etc., often exchange knowledge on how to manage wildlife. They can also collaborate by disseminating the issue of wildlife risk for aviation, raising awareness among other stakeholders, etc.

2.4.10.2 Scientists and universities may conduct research regarding wildlife hazard management, wildlife attractants, and the new technologies that can improve wildlife knowledge. This can be useful for other stakeholders to ultimately improve aviation safety.

2.4.11 Environmental non-governmental organizations (NGOs), ecological associations, and conservations agencies

Environmental NGOs and ecological associations should work with aerodromes and wildlife specialists to reduce the attractiveness of habitats to hazardous species on or near the aerodrome. Aerodromes should engage with these groups to raise awareness and understanding of the impacts of wildlife on aviation safety. Environmental associations may also have useful information about the biology and ecology of wildlife populations that may be used.

2.5 CIVIL AVIATION AUTHORITIES (CAAs)

2.5.1 Annex 14 — *Aerodromes*, Volume I — *Aerodrome Design and Operations*, requires States to certify all aerodromes used for international operations. As part of the certification process, the State CAA shall ensure that aerodrome operators have developed and documented procedures relating to wildlife hazard management.

2.5.2 CAAs are responsible for the regulation, oversight and enforcement of the WHMP and are also an important stakeholder in supporting and facilitating engagement across all aerodrome stakeholders, external agencies and other government agencies, as applicable.

2.5.3 The role of the CAA is to provide regulations, recommendations and best management practices as well as procedures for the enforcement and evaluation of compliance. CAAs may also collect data, provide outreach and information, partnerships and research opportunities.

2.5.4 The CAA should ensure that:

a) wildlife strike hazards are assessed through;

1) reports of wildlife strikes to aircraft;

2) information collected from aircraft operators, aerodrome personnel and other sources documenting the presence of wildlife which pose a potential hazard to aircraft operations; and

3) evaluation of wildlife hazards by competent personnel;

b) aerodrome operators have developed and implemented mitigating measures to manage wildlife hazard risks and minimize the likelihood of wildlife strikes with aircraft;

c) wildlife strike reports are collected and forwarded to ICAO for inclusion in the ICAO Bird Strike Information System (IBIS) database;

d) the personnel involved in wildlife hazard oversight activities are properly trained;

e) they manage their own national reporting systems for wildlife events; and

f) that they properly plan and manage airspace to reduce interactions of wildlife with aeronautical operations.

2.5.5 As necessary, the CAA may wish to engage wildlife specialists to assist in reviewing the appropriateness and effectiveness of an aerodrome operator's WHMP or other wildlife hazard management issues of concern.

2.5.6 The CAA should carry out awareness-raising activities, encouraging concern and collaboration among different stakeholders with regard to wildlife hazard management.

2.5.7 The CAA may also work with CAAs from other countries to exchange information and to promote a global reporting culture.

2.5.9 State authorities may collaborate by trying to establish or modify air traffic routes over geographical areas where the risk of wildlife strike is lower (e.g. avoid flying at certain altitudes over certain geographical areas, protected areas, wildlife refuges, etc.).

2.6 METHODS OF COMMUNICATION

2.6.1 General

2.6.1.1 Proper communication and the dissemination of information between the aerodrome operator and stakeholders are essential to raise awareness about everyone's role and responsibility and ensure that stakeholders

address wildlife challenges. Such methods of communication between external stakeholders and the aerodrome could include awareness campaigns, or the dissemination of information (information leaflets or maps to be distributed to municipalities listing safety areas, land uses, etc.). This may be useful to educate external stakeholders about wildlife hazards.

2.6.1.2 Internal stakeholders can also benefit from awareness campaigns and internal information leaflets about the importance of occurrence reporting, bird identification, etc. In addition, a briefing at the beginning of each shift with the wildlife coordinator or manager is an occasion to communicate about possible hazardous wildlife activity.

2.6.2 The local aerodrome wildlife committee

2.6.2.1 The establishment of an Aerodrome Wildlife Committee is required to facilitate the communication, cooperation and coordination of hazardous wildlife management at and around the aerodrome. This committee might be included within the safety management committee. In place of a dedicated local wildlife committee, the topic may be discussed in an airside or runway safety committee.

2.6.2.2 Members of the committee may include, but are not limited to:

a) accountable manager;

b) senior safety or compliance manager;

c) wildlife coordinator or manager;

d) wildlife controller representative;

e) aircraft operator representative;

f) airport planning manager;

g) aerodrome maintenance and operation manager;

h) ATC representative;

i) active aircrew representative familiar with the aerodrome;

j) local runway safety team representative; and

k) local authorities.

2.6.2.3 Depending on the organizational structure of the airport, other representatives can also be included, such as the rescue and firefighting department or the airside operations.

2.6.2.4 The success in the communication and coordination from a local perspective (on and in the vicinity of the aerodrome), is reliant to a large extent on the effective communication of the wildlife threat and recognized control measures adopted and agreed to by the local aerodrome wildlife committee.

2.6.2.5 Communication between internal stakeholders and users of the aerodrome should go both ways, i.e. the users should have a forum for expressing concerns, raising issues or submitting proposals. This forum may also increase the awareness of stakeholders in reporting wildlife-related incidents and convey the need to include wildlife hazard management in their SMS.

2.6.2.6 For external stakeholders, the local aerodrome wildlife committee will be mostly advisory, with the opportunity to share input, feedback, and, in some cases, take action aimed to reduce the presence of wildlife in the surroundings of the aerodrome.

2.6.2.7 The committee should inform and review the strike data collected and its observations of wildlife, assess wildlife risks and summarize any trend in order to mitigate any emerging issues. This may be as an appropriate aspect for follow-up for the implementation and maintenance of the WHMP.

2.7 ESTABLISHMENT OF A NATIONAL COMMITTEE OR FORUM

2.7.1 Annex 14, Volume I, requires the wildlife strike hazards on, or in the vicinity of, an aerodrome to be assessed through, among others, the establishment of national procedures and an ongoing evaluation of wildlife hazards by competent personnel.

2.7.2 The establishment of a national wildlife committee or forum has proven to be effective to gain and exchange information on research and development in aerodrome wildlife control. This committee or forum is an ideal way to connect different stakeholders with wildlife concerns within the aviation community and national aerodromes.

2.7.3 Although the composition of a national wildlife committee or forum may vary from State to State, it should include all stakeholders associated with or interested in the problem. A national committee or forum should include, but not be limited to, representatives from:

a) the State authority;

b) national departments (defence, agriculture, environment, planning);

c) aerodrome operators;

d) ANSPs;

e) aircraft operators' association;

f) pilots' association;

g) environmental authorities;

h) wildlife subject matter experts and the scientific community;

i) NGOs, ecological associations, conservation agencies;

j) regional authorities;

k) general aviation associations;

l) accident investigation board;

m) maintenance, repair and overhaul (MRO) organization; and

n) airframe and engine manufacturers.

2.7.4 The establishment of a national wildlife committee or forum will promote wildlife hazard management awareness and allow for the exchange of:

a) actual wildlife hazard management experiences,

b) new techniques and equipment,

c) new research and investigation studies,

d) national, environmental, and aeronautical legislation related to wildlife hazard management,

e) information about hazardous wildlife biology, behaviour, population trends, wildlife attraction points, etc.,

f) information on training standards for and/or emerging technologies; and

g) national wildlife strikes information and trends.

Chapter 3

AERODROME WILDLIFE SAFETY RISK ASSESSMENT

3.1 INTRODUCTION TO SAFETY RISK MANAGEMENT

3.1.1 Safety risk assessments can take many forms including enabling the aerodrome operator to understand the very real risk of catastrophic outcomes from wildlife strikes. More frequently, however, such processes are used to allow potentially scarce wildlife control resources to be targeted at the most important areas.

3.1.2 The first step in a safety risk assessment of wildlife hazards is to define the area that will be assessed. This should include the entire aerodrome and its vicinity, in particular aircraft approach and take-off.

3.1.3 Knowledge of the wildlife living in the aerodrome and its vicinity, their movements and to which areas they are attracted, is essential. This can be achieved with an adequate wildlife monitoring programme and by keeping historical records. Further information regarding the use of databases is provided in Chapter 6, Advancements in technology.

3.1.4 An important element of the safety risk assessment is understanding the definitions used for aerodrome wildlife management:

a) *a hazard* is a condition or object with the potential to cause or contribute to an aircraft incident or accident. In this context, a hazard is the presence of certain wildlife on or near an aerodrome; and

b) *a safety risk* is the predicted probability and severity of the consequences or outcomes of a hazard. In this context, safety risk is the probability of a wildlife strike by a particular species multiplied by the severity of damage to the aircraft that might reasonably occur.

safety risk = (probability of a strike) × (severity of damage caused)

3.1.5 Any assessment of risk needs to estimate the probability that a strike will occur and the likely level of harm that may result. Estimation of harm is relatively straightforward because the analysis of various wildlife strike databases around the world show that there is a consistent relationship between wildlife mass and the percentage of damage to aircraft. Strikes involving flocks of a given species of bird are more likely to result in damage to the aircraft than strikes with single birds of the same species. The larger the bird and the greater its tendency to be struck in groups, the greater the risk.

3.1.6 It is more difficult to estimate the likely strike frequency of a particular population of birds 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, skill level, experience and input data needed to apply them.

3.1.7 The most common form of safety risk assessment involves the categorization of both strike probability and severity into a number of levels, usually very low, low, moderate, high and very high. These levels would apply in a double entry matrix in which wildlife species would be classified according to a determined level of risk.

3.1.8 The results of a risk assessment matrix should be used to prioritize wildlife management techniques and methods. These actions should be documented in the WHMP (see Chapter 9). Further examples of wildlife management techniques and methods can be found in Chapters 4 and 5.

3.2 ESTIMATING THE PROBABILITY OF A STRIKE

3.2.1 The probability of a wildlife strike should be calculated using wildlife incident data (as defined in Chapter 1, 1.3.4) and current data on the presence, location and behaviour of wildlife in the aerodrome and its vicinity. Strike records also allow the determination of daily and seasonal trends to determine the likelihood of future strike events.

3.2.2 Using wildlife strikes to calculate probability depends on the number of strikes and the reporting culture. Aerodromes with fewer operations may generate fewer collisions; therefore, the limited data may not allow accurate or useful predictability on strike probability.

3.2.3 Where good quality strike data is not available, it is important to consider the potential risk of collision determined by the existence of wildlife and their movements on and in the vicinity of the aerodrome.

3.2.4 Based on the above, the probability of a wildlife strike is defined for diverse variables which are not exclusive. The more knowledge about the presence and behaviour of wildlife on, and in the vicinity of, the aerodrome, the stronger the estimation of wildlife strike probability and the final safety risk assessment for each relevant species.

3.2.5 The aerodrome should have records of wildlife incidents, as well as information about observed wildlife, its habits, preferred areas, etc. This information can provide an input for wildlife probability calculation.

3.2.6 Due to the differences in resources available depending on the aerodrome, the data to be used in the safety risk assessment can be quantitative and qualitative. Best practice is to use quantitative data.

3.2.7 Both quantitative and qualitative measurements of abundances of wildlife and number of strikes are used to rank probabilities of a species being involved in a strike at a particular aerodrome since aerodromes differ in the quality and quantity of information that they hold. This is useful to take into account different levels of knowledge and available statistics for different aerodromes.

3.2.8 An example is shown in Table 3-1 regarding the values of some descriptive variables of a specific species, in order to be categorized (quantitatively and qualitatively) for probability of impact:

Table 3-1. Example of impact probability categorization

	Probability category				
	Very high	*High*	*Moderate*	*Low*	*Very low*
QUANTITATIVE APPROACH Presence of wildlife *(number of days per year a species is observed on the aerodrome and its surroundings)*	> 200	100-200	50-100	50	10
QUALITATIVE APPROACH Presence of wildlife *(subjective evaluation)*	Permanent	Most	Some	Few	Occasional
QUANTITATIVE APPROACH Average number of strikes per year (5 years)	>10	3-10	1 - 2.9	0.3 - 0.9	0 - 0.2
QUALITATIVE APPROACH Strikes per year *(subjective evaluation)*	Very often	Often	Some	Occasional	Rare/None

3.2.9 Different biological and behavioural characteristics of wildlife species can help classify them in specific risk levels. For instance:

a) species that shy away from aircraft noise or that learn to avoid aircraft could be rated as low probability;

b) birds that flock in large numbers to certain habitats in the flight path could be rated a high or very high probability;

c) solitary animals might be rated as moderate probability;

d) species with low or erratic flights could be rated as high or very high probability; and

e) species with nocturnal activity on aerodromes with nocturnal flights should have a higher probability of impact.

3.2.10 Other behavioural factors should also be considered. The probability might also vary with the season, age or gender of the creatures, or other conditions such as grass length or rain and other weather conditions.

3.2.11 Other variables to assess the risk more accurately include: flight activity on the aerodrome (the higher number of air operations, the higher the probability of wildlife strike), the type of aircraft using the aerodrome (larger, faster aircraft are likely to increase the risk of wildlife strike). Relating the number of impacts with the number of flight operations may help better understand if an increasing frequency of impacts can be related to a greater number of operations, to a greater wildlife presence, or both.

3.3 ESTIMATING THE SEVERITY OF A STRIKE

3.3.1 The next step is to rank the expected severity of the impact or damage resulting from a strike event. A scale similar to the strike probability scale can be used.

3.3.2 Wildlife strikes have a directly associated severity, defined by the damage that the animal has caused to the aircraft after the impact. For observed wildlife, the severity scale will depend essentially on the size of the animal and its tendency to flock or congregate. Generally, heavier wildlife and greater flock size increases the probability of damaging an aircraft and impacting its flight performance. Flocking behaviour could include multiple impacts or increase the probability of a strike.

3.3.3 Severity can be rated, among other approaches, in terms of aircraft damage and human casualty, wildlife strikes with a consequence of damage to the aircraft, and number of events with an adverse effect on flights (for example missed approach or aborted take-off).

3.3.4 Table 3-2 describes how to categorize, in two different approaches, the severity related to a determined species according to the damage this species has caused in the strikes recorded by an airport. In this example, the severity of the common kestrel to aviation in a theoretical airport is analysed:

Table 3-2. Example of severity categorization (common kestrel)

	Severity category				
	Very High	*High*	*Moderate*	*Low*	*Very Low*
Percentage of strikes with common kestrel causing damage (compared with the total amount of wildlife strikes at the airport)	>20%	10-20%	6-10%	2-6%	0-2%
Type of aircraft damage and/or human casualty (in strikes with common kestrel)	Catastrophic	Hazardous	Major	Minor	Negligible

Note.— Descriptions of damage category terms used above are shown below in Table 3-3.

Table 3-3. Example of safety risk severity

Catastrophic	— Equipment destroyed; and — multiple deaths.
Hazardous	— A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely; — serious injury; and — major equipment damage.
Major	— A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency; — serious incident; and — injury to persons.
Minor	— Nuisance; — operating limitations; — use of emergency procedures; and — minor incident.
Negligible	— No safety consequences; — no aircraft damage; and — near miss.

3.3.5 In case of species for which no data about the severity of the damage they can cause is available, the severity could be calculated by the mass multiplied by the type of flock (see 3.3.7, flock size).

3.3.6 To perform this calculation, previous categories of weights or sizes of wildlife, and flock sizes should be established by the aerodrome operator to fit each species within a category.

3.3.7 Below is an example of how to establish these categories:

Table 3-4. Example of wildlife categorization based on body mass

Body Mass	*Examples*	*Body Mass Value*
< 50 g	Sparrows	2
51-200 g	Starlings	4
201-1 000 g	Pigeons	8
1-5 kg	Large gulls	16
>5 kg	Big birds of prey	32

Note.— Generic data.

Table 3-5. Example of wildlife categorization based on flock size

Flock size	*Examples*	*Flock value*
Usually solitary or widely spaced	Big birds of prey, Sparrows	1
Often in loose flocks	Pigeons, Large gulls	2
Often in tight flocks	Starlings	4

3.3.8 Flock size may depend on specific aerodrome location and species involved.

3.3.9 With the example values given in 3.3.7, it is possible to locate the analysed species in one of the severity ranges that could cause a collision with an aircraft.

Table 3-6. Example of severity categorization based on severity value

	Severity category				
	Very high	*High*	*Moderate*	*Low*	*Very low*
Severity value (mass category value x flock category value)	32-128	16	8	4	2

3.3.10 Regarding the severity categories to be established, each aerodrome should determine its own scale. Since the severity of collision also depends on the type of aircraft, the range of aircraft sizes or types of aircrafts operating at an aerodrome would also need to be taken into consideration; clearly the views of the aircraft operators should be considered.

3.4 ESTIMATING THE SAFETY RISK OF WILDLIFE SPECIES

3.4.1 A safety risk assessment matrix is completed by combining the probability and severity of each species to determine whether further action is required. A safety risk assessment should be reviewed at least annually or following a significant wildlife strike event and existing wildlife control measures adjusted to see if further action is required.

3.4.2 An example of a risk assessment matrix is shown in Table 3-7:

Table 3-7. Example of risk assessment matrix

		PROBABILITY				
		Very High	*High*	*Moderate*	*Low*	*Very Low*
SEVERITY	Very High					
	High					
	Moderate					
	Low					
	Very Low					

3.4.3 The three risk levels are defined as follows and should be the main focus when interpreting the risk matrix:

Level 1 (Green) — *Acceptable*. The risk is acceptable as it is. No further action is required.

Level 2 (Yellow) — *Tolerable.* The risk can be tolerated based on the safety risk mitigation. Review current action undertaken, identify possible further action.

Level 3 (Red) — *Intolerable*. Take immediate action. Further action is required to reduce the risk.

3.4.4 Example of a case study.

In an aerodrome, the following data of three wildlife species were collected throughout the year:

— *A common resident species at the aerodrome, the common kestrel, produced nine impacts, causing minor damage to aircraft in two of them.*

— *The migratory barn swallow produced many impacts in spring and summer, although it was not possible to calculate the exact number of impacts. Due to the bird's size, it has never caused any damage.*

— *This year, griffon vultures appeared for the first time in the area for several days throughout the year. There are no historical records about the presence of vultures in the aerodrome, but due to the bird's size and possible formation of flocks, their possible hazard for operations must be taken into account.*

According to the tables previously shown as examples of ways to categorize the probability and severity of impacts:

— *For the common kestrel, its impact probability is HIGH. Its severity, taking into account the percentage of impacts that have caused damage, is VERY HIGH. However, knowing that the common kestrel is typically solitary, and weighs less than 300 g, its severity could be reduced to some degree, to MODERATE. This reduction would also depend on the type of damage or caused effect on flight, the type of aircraft affected, etc. As it is known from aerodrome records that the aircraft damage has always been minor, the reduction to the degree of severity is confirmed.*

— *For the barn swallow, which has produced several impacts, the probability is HIGH. However, it should be taken into account that its occurrence is seasonal, which concentrates its probability of impact to a few months per year. This could allow for reduction to some degree of the probability of impact. Its severity, according to the absence of damage, and with its small size (20 g), is VERY LOW.*

— *For griffon vultures, although there have been no impacts yet, their new and persistent presence at the aerodrome should be taken into account. Its probability would be HIGH. Its severity, considering its size (more than 7 kg) and flight form, would be VERY HIGH.*

Therefore, the final risk assessment matrix in this example, after categorizing the analysed species, would be the following:

Table 3-8. Example of risk assessment matrix categorizing analysed species

		PROBABILITY				
		Very high	*High*	*Moderate*	*Low*	*Very low*
SEVERITY	Very High		Griffon vulture			
	High					
	Moderate		Common kestrel			
	Low					
	Very Low		Barn swallow			

Note.— Generic data.
This could be interpreted as:

— *It is necessary to apply more mitigation measures, or improve existing ones, to control the presence of the common kestrel at the aerodrome, thus decreasing the probability of impact.*

— *The presence of barn swallows is acceptable, although mitigation measures that are already being applied should continue to be applied in order to minimize their presence at the aerodrome as much as possible.*

— *Mitigation measures must be applied on the griffon vulture to minimize or eliminate its presence at the aerodrome, before impacts occur.*

Chapter 4

HABITAT MANAGEMENT

4.1 GENERAL

4.1.1 Modifying the on-site habitat and environment to eliminate or exclude food, water and shelter can limit the attractiveness of an aerodrome to wildlife. Additionally, habitat management of attractive sites on, or in the vicinity of, the aerodrome is the foundation for an aerodrome's WHMP because it addresses the root cause of wildlife hazards.

4.1.2 Land use practices that attract hazardous wildlife populations on, or in the vicinity of, the aerodrome can significantly increase the potential for wildlife strikes.

4.1.3 Wildlife is attracted to habitat because of their specific requirements for food, water, breeding activities and safety. A habitat that provides these requirements increases the likelihood of their presence and the risk of a strike.

4.1.4 Before undertaking activities to manage habitats, a safety risk assessment that identifies the hazardous wildlife and the root cause of their association with specific habitats (See Chapter 3, Aerodrome wildlife safety risk assessment) must first be carried out. Understanding habitat attractants requires the study of how wildlife uses these habitats.

4.1.5 Following a safety risk assessment, any habitat used by hazardous wildlife should be identified and a habitat management strategy should be developed. This strategy should prepare for the impacts of habitat management activities on the hazardous wildlife species at the aerodrome. In some cases, management activities that decrease the risk of strikes with some species may increase the risk of strikes with others. In these cases, the risk assessment should be used to determine which species present the greatest risk and are therefore the target of habitat management efforts.

4.1.6 When considering proposed land uses, aerodrome operators, local planners and developers must consider whether the proposed land uses, including new development projects, will increase wildlife hazards.

4.2 ATTRACTANTS

4.2.1 Food

Vegetation

4.2.1.1 Vegetation is frequently the dominant land cover at many aerodromes and can consist of open grassland, shrubs and trees. Certain vegetation may produce seeds, berries and attract invertebrates or other animals that are a food source for various hazardous wildlife. Managing an aerodrome's vegetation to minimize its attractiveness to wildlife is a critical activity.

4.2.1.2 Management actions targeted at vegetation can increase the risk of exposing prey items in the short-term. For example, mowing grass too short may expose invertebrates or other small animals, making them available to predatory birds. On the other hand, when the vegetation becomes too tall, it could fall down, providing shelter and a

fertile layer for mice or other wildlife. When planning any habitat modification, one must consider how the change may increase the availability of prey, and therefore, the risk of a wildlife strike. Bare soil gives weeds a chance to grow and may expose food such as seeds or invertebrates. Soil cultivation can also expose these food sources and may even bring buried prey items closer to the surface to attract hazardous wildlife. The timing and frequency of management actions on an aerodrome should be oriented to minimize hazardous wildlife.

Agriculture

4.2.1.3 Agricultural systems can increase the presence of wildlife on and around aerodrome lands depending on the cropping system. Agricultural systems that produce highly nutritious foods that can be exploited by wildlife (for example cereal grain) can increase the risk of strikes, as will those that involve frequent field tillage or mowing that exposes seeds, invertebrates or small animals. Certain cropping systems may benefit the aerodrome by removing vegetation that would otherwise provide habitat for prey species (e.g., hay operations that remove cut grass that would otherwise provide refuge for invertebrates or small mammals). Agricultural systems far from the aerodrome may aid in decreasing strike risks by luring hazardous wildlife away from the area of flight operations.

Waste Management

4.2.1.4 Food and garbage waste bins, slaughterhouses and open-air markets may be highly attractive to scavenging wildlife.

4.2.1.5 Landfills and garbage dumps are a significant source of food for wildlife. Certain species will travel several tens of kilometres 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 hazardous birds, for example gulls, kites and vultures, soaring over dump sites in the thermals created by composting garbage. The greater presence of birds may give rise to problems for approaching aircraft.

4.2.2 Water

Water bodies

4.2.2.1 Water is a primary requirement for wildlife: it offers them drinking water; a resting site; an escape from predators and a feeding site. Eliminating water habitats or excluding wildlife from using these habitats will decrease the number of wildlife using an aerodrome.

4.2.2.2 Ponded water that forms in depressions can be an attractive habitat for a variety of wildlife, particularly water birds, and should be removed. Water bodies can be made inaccessible in a variety of ways: for example, covering them with wires or netting to inhibit birds from landing. Water bodies that cannot be eliminated or covered should be designed to discourage their use by wildlife as much as possible and have a perimeter road so that wildlife-control personnel can quickly access all parts of the water body to disperse birds.

4.2.2.3 Emergent vegetation in drainage ditches may decrease the drainage capability and provide refuge and food sources for wildlife. Alternatively, emergent vegetation may exclude hazardous wildlife from using them. Steep banks may limit access to some types of wildlife, whereas others will not be affected.

4.2.2.4 Wetlands are often used by significant numbers of water wildlife, which tend to be a higher hazard species due to their size and flocking behaviour. If possible, any change to these water bodies should reduce their attractiveness to wildlife if the wildlife is known to present a flight safety risk.

4.2.2.5 The existence of several bodies of water around the aerodrome may result in wildlife movements from one to another, thereby increasing the risk of wildlife strikes, especially if the aerodrome lies between those water bodies.

Wastewater management

4.2.2.6 Wastewater management facilities and their settling ponds often attract large numbers of wildlife. The closer the building is to the aerodrome, the greater the potential risk. The aerodrome operator should develop an agreement with those responsible for the wastewater management facility to ensure that wildlife hazards resulting from sewage ponds are suitably managed. New facilities should not be constructed near an aerodrome or where wildlife movements to and from the ponds may affect aircraft movements.

Quarries

4.2.2.7 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. With any new excavation, the site should be restored to a state that suits flight safety. The enhancement of old extraction pits should be discouraged, as this can increase the risk of wildlife hazards.

4.2.3 Shelter (resting, security and nesting)

Open areas

4.2.3.1 Grasses can shelter prey that are fed upon directly by hazardous wildlife. Wildlife may hide in grasses or rely on open expanses of grassland to detect predators at a distance. Grasses can also provide a breeding habitat. Managing the species of grass on the aerodrome, as well as the height and density of grasses, may reduce the attractiveness of the habitat.

4.2.3.2 Soil will influence the vegetation that grows on a site and will also act as habitat for soil-dwelling organisms, some of which may be prey for hazardous wildlife. Some hazardous wildlife may use burrows or tunnels in the soil as a place to shelter from the environment, escape predators, or breed.

4.2.3.3 Other offsite land uses, such as parks, golf courses, and other amenity grasslands may attract hazardous wildlife. Managing these sites requires the dedicated engagement of stakeholders outside the aerodrome in order to influence land use changes that can reduce the attraction to hazardous wildlife.

4.2.3.4 Aerodrome pavement may provide a resting and loafing site for wildlife that are attempting to stay warm. Pavement can retain heat longer than its vicinity, resulting in wildlife using it to warm up on colder days. After rainfall, invertebrates (e.g. earthworms) may avoid the wet soil by coming onto the pavement areas, increasing their availability to hazardous wildlife. After heavy rainfall, pavement areas may become more attractive to gulls, increasing their presence at the aerodrome.

Forest

4.2.3.5 Trees and shrubs provide nesting or roosting opportunities for wildlife. Depending on the wildlife safety risk assessment, these may have to be eliminated on aerodrome property. The aerodrome operator should be aware of such areas in the vicinity of the aerodrome and the potential transiting routes for wildlife.

Nature reserves

4.2.3.6 The establishment of nature reserves in the vicinity of aerodromes can provide a strong attractant to hazardous wildlife. In general, nature reserves are formed where unique, diverse or remnant habitats exist and they may host hazardous species. The aerodrome operator should develop a solid relationship with reserve management, so that if habitat enhancement is conducted on the reserves, wildlife hazards to aircraft are considered.

Buildings

4.2.3.7 Wildlife often seek shelter and breeding sites on aerodrome property in the structural beams of hangars and bridges, in the nooks of jet ways and other structures. Airports should adopt a zero tolerance for hazardous wildlife using any airport structure.

4.2.3.8 The attraction of hazardous wildlife should be considered in the design phase of buildings, hangars, bridges and other structures at aerodromes to minimize exposed areas that birds can use for perching and nesting.

4.3 ON-AERODROME MANAGEMENT

4.3.1 General

4.3.1.1 On-aerodrome habitat management involves the removal and alteration of habitat features that attract hazardous species. Typical actions include adjusting the design of aerodrome buildings and structures, preventing wildlife from accessing aerodrome property using fencing, adjusting grass height, the pruning or removal of trees and shrubs, management of waste on the aerodrome and the removal of standing water (ponds, puddles).

4.3.1.2 The key to effective habitat modification is to remove existing attractions without introducing new enticements that may appeal to other species. Every species on the aerodrome represents a direct or indirect hazard; however, aerodromes should consult their risk assessment matrix (see Chapter 3) to identify the species with the greatest risk. On-aerodrome habitat modification should be aimed primarily against those species that pose the greatest risk to aircraft safety.

4.3.1.3 The aerodrome operator should be aware of not only managing habitat attractants on airside locations, but also ensure that habitat attractants are identified and managed landside.

4.3.2 Design (airport buildings and structures)

4.3.2.1 Screening holes and openings of hangars can prevent access to these buildings. In the case of hangars, where doors may be left open for an extensive period of time, netting can be installed across the base of the rafters to exclude birds from nesting in the rafter system. Adding a slope greater than 45 degrees to edges of buildings can also deter birds from nesting on these sites.

4.3.2.2 Where perching sites are present on existing structures, their access can often be eliminated with the installation of netting. Anti-perching devices, such as spikes, can be installed on ledges, roof peaks, rafters, signs, posts and other roosting and perching areas. If wildlife is already present on existing structures, the aerodrome operator should refer to Chapter 5 for more management techniques.

4.3.2.3 Unused structures such as sheds, abandoned buildings and structures, old windbreaks and rotten fence posts should be removed from airport lands to prevent nesting and roosting.

4.3.2.4 Where birds have already nested in buildings, nest removal may be possible, but should be done in consultation with local and national environmental requirements. The trapping, removal or relocation of young birds may be conducted if nest removal is not completed outside the breeding season.

4.3.2.5 Perching sites are important for birds; they offer vantage points that overlook the immediate surroundings. Perches are places from which birds sing, call and display. They also act as observation points, hunting lookouts and as places to rest, digest, preen, roost and gather socially. As potential perches for birds, lone trees, hedgerows, fences,

gates, posts, shrubs, stumps, junk, weed patches and boulders should be removed from airport lands. If this is not possible, spoked wires can be attached to perching sites to discourage their use. Power lines are popular perches and should be relocated underground. Certain specific wire can also be fitted to runway, approach, taxiway and apron lights to discourage their use as perches.

4.3.2.6 Aircraft parked on aprons or fields are also popular nesting locations. Birds usually enter aircraft through small access holes just large enough to accommodate them. Parked aircraft should be regularly checked for nesting birds, and if they are expected to be parked long-term, the aerodrome operator should consider installing netting to prevent such access.

4.3.3 Fencing

4.3.3.1 A complete perimeter fence is the prime method of preventing hazardous wildlife, other than birds, from gaining access to the aerodrome. There is a variety of fencing available, including electric fences. The most suitable fence for an airport depends on many factors, including the observed wildlife hazards, the potential impacts of certain types of fencing, seasonality of hazards, costs (both for construction and maintenance) and adjacent habitat types. Adding the use of cattle gates at entry and exit points for vehicle access points within a perimeter fence can prevent many hoofed mammals from crossing into aerodrome property.

4.3.3.2 Fencing should be buried below the ground when possible to discourage animals from digging under the fence to gain access to aerodrome property.

4.3.3.3. Fences and gates should remain closed and be regularly inspected.

4.3.4 Grass

4.3.4.1 Grass height should be decided based on the target high risk species. Grass height may be limited next to the manoeuvring area, but grass may be kept at a taller height depending on the management of local high risk species.

4.3.4.2 There is no single recommended grass height that is effective at all aerodromes. It is recommended that aerodromes conduct a site-specific study to find an optimal grass height. The decision to maintain short or tall grass depends on which species pose the highest hazard at the specific aerodrome.

4.3.4.3 Vehicle access to grass areas should be restricted to minimize damage and alteration to grass heights. Damaged grass areas might lead to standing water and the emergence of weeds attractive to hazardous wildlife.

4.3.4.4 Vegetation that is undesirable or mildly toxic to wildlife may deter wildlife feeding. For example, there are varieties of tall fescue and perennial ryegrass that contain fungal endophytes that may be unattractive to some birds, mammals and insects. The aerodrome operator should be aware of their State regulations concerning these varieties.

4.3.4.5 There are alternatives to grass covering bare soil around an aerodrome. An example of this is the application of a wood mulch added to water, seed, fertilizer and soil amendments which can provide coverage to areas that may be more attractive to hazardous species and help aid in the growth of new grass. The use of artificial turf may reduce food, shelter and burrowing attractants for hazardous wildlife.

4.3.5 Forest, vegetation and agriculture

4.3.5.1 Large areas of brush, shrubs or forests, natural or decorative, can provide habitat with safe areas where wildlife loaf, perch, roost and nest. These areas are commonly found on undeveloped airport grounds and can attract birds and other wildlife.

4.3.5.2 Brush and bushy vegetation should be eliminated from airports when possible and at the very least be eliminated from the proximity of manoeuvring areas.

4.3.5.3 Tree species that produce soft fruits, berries, or high numbers of seeds are especially attractive to wildlife and should be removed. Trees also provide cover for medium-sized and large mammals. Large trees located at the edges of open areas provide excellent vantage points from which raptors can survey for food. In addition, trees can create an edge effect, which is an intermediate area often rich in bird life because it borders two different habitats such as grassland and wooded areas. Trees should be located as far as possible from runways.

4.3.5.4 Where tree removal is not possible, undergrowth should be removed. Trees can also be thinned at their tops to make them less attractive as roosting sites. Trees should be frequently inspected for colonies of nesting or roosting birds.

4.3.5.5 Some varieties of decorative trees and shrubs may be acceptable but should be selected with the appropriate assistance of experts to ensure low risk species are chosen.

4.3.5.6 Agricultural activities at aerodromes may attract hazardous wildlife and it is recommended that airport lands not be used for agriculture.

4.3.5.7 Aerodromes that have on-site agricultural practices should ensure that crop selection is done in line with their wildlife hazard management programme. Modified ploughing and harvesting practices may also be necessary to decrease the risks to aviation.

4.3.6 Waste management

4.3.6.1 Aerodromes should require a wildlife-proof storage of food waste, prohibit wildlife feeding and promote good sanitation and litter control programmes. In many instances, simply closing the lid of waste bins can limit the access to these food resources by hazardous wildlife.

4.3.6.2 Waste disposal sites on aerodrome property should be removed to an off aerodrome location, outside of the 13-km circle. If this is impossible, organic waste should not be accessible to hazardous wildlife (e.g. buried or incinerated). Where waste management must occur on aerodrome property, disposal activities should also be conducted at night to attract fewer birds. Additional mitigation could also include fencing, netting or overhead wires to prevent access.

4.3.6.3 Improperly disposed refuse can attract wildlife and the aerodrome should ensure that waste management procedures include closing the lids of garbage bins and that waste is disposed of into bins and not littered on the property. Signage to discourage the feeding of wildlife should also be erected in public areas.

4.3.7 Water

4.3.7.1 The best method to reduce the attractiveness of water bodies on aerodrome property is to remove them: for example, by draining or filling. Where aerodromes have drainage ditches, these can be replaced with buried culverts. Where drainage ditches remain, aerodromes may have to clear these ditches of emergent vegetation. Areas where temporary water pools form after rain or spring melts should be filled or fitted with improved drainage systems.

4.3.7.2 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.

4.3.7.3 Where water bodies cannot be removed, there are methods which can help reduce the attractiveness to wildlife. Water bodies should be cleared of emergent and submerged aquatic vegetation and the banks should be cleared of vegetation and brush. This can be done by cutting, dredging, or herbicide use.

4.3.7.4 The slopes of water bodies should be graded to a steep slope, which will discourage burrowing mammals, bird species and offer a clearly defined edge which can be easily mowed.

4.3.7.5 Physical barriers should be erected to prevent wildlife access to water bodies. Methods include fencing around the perimeter, exclusion wiring and netting across all the surfaces or riprap installed on water embankments. Visual enhancements can be attached to the wires and netting to prevent birds from flying into the barriers. In certain instances, barriers such as large black balls that float on water bodies have been used successfully to prevent access to water bodies.

4.3.7.6 If water bodies cannot be covered or drained, dredging will increase the water depth and, as a result, decrease the surface area.

4.3.7.7 Where storm water management ponds are present on aerodrome property, the aerodrome should ensure a maximum retention period for the storm water to reduce attractiveness (e.g. in North America, this time period has been identified as 48 hours).

4.4 OFF-AERODROME MANAGEMENT

4.4.1 The concept of compatible land use planning is the environmental relationship between airports and their community neighbours. Its implementation requires careful study and coordinated planning. Land use around airports can influence restrictions on aircraft flights and affect aircraft safety.

4.4.2 A 13-km circle centred on the aerodrome reference point is recognised where land use should be assessed with regard to wildlife hazard management. However, the circle may be extended or reduced based on a wildlife evaluation of the aerodrome vicinity. States should consider all aviation safety concerns related to land development in the vicinity of the aerodrome to minimize the attraction of wildlife. Aerodrome operators are encouraged to communicate their safety concerns with the local authority in order to raise awareness (see Chapter 2, 2.6, Methods of communication). Prior planning is necessary to ensure that incompatible land use is not allowed to become established. Such developments should be subjected to a risk assessment process as described in Chapter 3 and changes sought, or the proposal opposed, if a significant increase in the wildlife strike risk is likely to result.

4.4.3 In order to successfully deal with land use issues, a comprehensive WHMP including coordination among the aviation regulatory authority, aerodrome operator, aircraft operators and the surrounding communities should be implemented.

Note.— A list of types of land use that should be prevented, eliminated or mitigated is available in the Procedures for Air Navigation Services - Aerodromes *(PANS-Aerodromes, Doc 9981), Part II, Attachment to Chapter 6.*

4.4.4 A monitoring process of sites where hazardous wildlife is to be found should be instigated, at least seasonally. The survey of the land use around aerodromes should be reviewed at a period determined by the safety risk assessment. In general, it is desirable to carry out a new comprehensive land use survey assessment every five years.

4.4.5 Modern technology like satellite detection facilitates the registration and monitoring of different land use types (see Chapter 6, Advancements in technology).

4.4.6 The aerodrome operator should engage with local farmers in the vicinity of the aerodrome to encourage them to choose agriculture practices that are the least attractive to hazardous species. These practices may include types of crop, livestock and grain and feed storage.

4.4.7 The appropriate authority should encourage prohibiting or restricting the establishment of new or existing organic waste sites near aerodromes. If a waste management site in the vicinity of an aerodrome cannot be closed, it may be necessary to provide control measures at the site to reduce its attractiveness to hazardous wildlife.

Chapter 5

MANAGEMENT OF HAZARDOUS WILDLIFE

5.1 THE IMPORTANCE OF UNDERSTANDING ANIMAL BEHAVIOUR

5.1.1 Wildlife can react in different ways to different methods of dispersal, and protect themselves from predators by hiding or fleeing. The role of the wildlife control personnel on duty at an aerodrome is to understand the ways in which hazardous wildlife species are likely to react vis-à-vis the different methods of dispersal in order to reduce their presence on or around an aerodrome most effectively and reduce their risk to aircraft.

5.1.2 Hazardous species may respond differently to expelling and deterring techniques. Some species fly away from the stimulus while other species crouch down and hide or even approach the stimulus. Knowing these responses will enable the controller to select the correct method to reduce the immediate risk.

5.1.3 When confronted with deterring or expelling techniques, all wildlife will initially become ‘alert’ to a potential threat before they exhibit their ‘response’. For example, many birds that have become accustomed to the presence of routine wildlife control on an aerodrome adopt a ‘watch and wait’ behaviour. A wildlife control vehicle or person will result in wildlife becoming ‘alert’ but not necessarily responding until the control method becomes clear. If wildlife remains undetected on the aerodrome, it will learn that such a response saves itself energy and will therefore be able to continue with its activities unhindered. The reaction of species can therefore be controlled by moving past the wildlife, stopping and waiting or instigating an action. Since different species will react in different ways at different aerodromes in different seasons, time of the day and weather conditions, it is essential that these responses are understood on a site-by-site basis. Control can be achieved by understanding whether the ‘response’ of wildlife will be to ignore, hide or flee.

5.1.4 At aerodromes where active wildlife control measures are routinely implemented, behaviours may differ from aerodromes where infrequent actions are undertaken. The most likely response will again differ in relation to the amount of time target species have been subjected to deterring or expelling techniques at any given aerodrome.

5.1.5 Wildlife controllers must therefore be able to identify the species present at their aerodrome and understand their behaviour. The aerodrome should provide a wildlife guidebook to officers to assist them in detecting species, in particular rarer species that may not frequent the aerodrome on a regular basis. A dynamic risk assessment based on the likely reaction of the species present, the location of aircraft movements at the time and the control methods available will then enable the most appropriate cause of action. Chasing hazardous wildlife with simple methods such as loud noises and manual techniques (arm waving, clapping, etc.) may be all that is required to disperse them directly away from the wildlife control personnel. More sophisticated methods may include using a distress call system to draw a flock of gulls away from a runway, or using pyrotechnics to deter a group of circling raptors.

5.1.6 Wildlife control personnel should be equipped with a range of appropriate systems for deterring, dispersing or removing species they are likely to encounter and the ability to deploy such systems wherever necessary on the aerodrome. The objective of deterring or expelling is not to scare wildlife randomly around an aerodrome but to control movements and disperse them away from high risk areas. The ultimate objective is to render the aerodrome a hostile location and ‘educate’ hazardous species that the risk of remaining within the aerodrome environment outweighs the potential rewards that the environment may offer.

5.1.7 All active control systems should only be deployed when required, in order to reduce habituation (the process by which wildlife learns to ignore a stimulus if it has no actual threat). Overuse of individual methods results in

habituation and the subsequent failure of those methods. Human operated (active) control will always, therefore, be more effective than automated (static) scaring systems. Similarly, the use of lethal threat will remain an important tool to reinforce the effect of non-lethal expelling and deterring techniques.

5.1.8 Once the responses of different wildlife species at an aerodrome are understood, they can be associated with control actions to reduce their risk. When recording such actions, the patrols and observations explained below should be considered.

5.2. PATROLS AND OBSERVATIONS

5.2.1 Patrols of airside areas to check for birds and other hazardous wildlife are a direct requirement for wildlife hazard management of aerodromes. Critical risks result from wildlife being present on or crossing runways and approach or departure paths, therefore patrols should aim to prevent their presence in these areas. These patrols should facilitate either immediate dispersal from those locations or preventative dispersals from areas likely to result in such movements. Additionally, ATC and other personnel should inform wildlife controllers when they observe wildlife; the wildlife controller can then determine the level of hazard (See Chapter 3, Aerodrome wildlife safety risk assessment).

5.2.2 Patrols should target the locations of hazardous wildlife activity, especially near runways and approach or departure paths. Local knowledge, data assessments and visual observations can provide vital information on where recent hazardous wildlife has been congregating or dispersed from.

5.2.3 During patrols, the recording of hazardous wildlife will enable the aerodrome operator to identify existing and future problem areas (for example, low areas that gather standing water after rains, blocked drainage ditches, un-managed grassland, fruit- or berry-bearing bushes, buildings or lighting and signage stands that provide perching areas etc.). Such areas should be logged to take proactive habitat management action.

5.2.4 Wildlife controllers should ensure that wildlife does not habituate to routine pathways or timings. If the same path is followed on every occasion, wildlife may learn when it is safe to remain in an area and will only briefly depart on the approach of a vehicle. Randomization of routes and wildlife controller behaviour is beneficial. By waiting, or by returning to the same location shortly afterwards, controllers will gain an understanding of the observed species and which areas are being used most frequently. Constantly varied patrols will also help wildlife controllers to learn the behaviour in different seasons, times of the day, weather conditions and habitat preferences of wildlife at an aerodrome. For example, some aerodromes conduct wildlife management patrols at least 15 minutes prior to any movement. When possible, wildlife management personnel should position themselves at the most critical areas. For the patrols, the wildlife controllers should have appropriate vehicles, binoculars and recording devices (e.g. pad of paper, tablet, audio recorder).

5.2.5 During patrols, any wildlife remains found should be collected, identified to the species level and documented in a wildlife log. Even if remains are not evidenced as being recorded in a collision with an aircraft, its presence on the aerodrome may assist with identifying risks with that species that could prevent future strikes.

5.2.6 When a control action is undertaken, the wildlife management personnel should ensure they record the following information;

a) name of the personnel on duty;

b) shift start and finish time;

c) time for each activity or record;

d) weather and lighting conditions;

e) location of activities;

f) details of the wildlife observed and/or dispersed;

g) numbers of each species seen, including zero sightings;

h) type of dispersal action taken;

i) reaction of wildlife to dispersal; and

j) direction of dispersal.

5.3 REPELLENTS

5.3.1 Overview

5.3.1.1 The following provides an outline of possible options for controlling wildlife on aerodromes to reduce strike risks. This list is not exhaustive but covers a group of the main techniques used around the world for active wildlife control on aerodromes. There are many more systems available than it is possible to cover here. There is no single solution or set of procedures that is best for all situations. Aerodrome operators should carry out a thorough review of any equipment before purchase to ensure that it is fit for purpose. Each wildlife species is unique and will often respond differently to various repellent techniques. Factors such as food resources, weather, time of year or day and predation can clearly interact to diminish or enhance repellent effectiveness. To lessen habituation: use each technique sparingly and appropriately when target wildlife is present; use various repellent techniques in an integrated fashion; and if necessary, reinforce repellents with occasional lethal action directed at problem species.

5.3.1.2 Equipment used by wildlife management personnel on the aerodrome to control hazardous wildlife should be appropriate to the aerodrome environment and species encountered.

5.3.1.3 Advances in electronics, remote sensing and computers have resulted in 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.

5.3.2 Audio repellents

Pyrotechnics

5.3.2.1 Use of pyrotechnic wildlife scaring techniques, either from a cartridge fired from a shotgun, a specialized pistol or from a stationary cannon, is a common means of dispersing wildlife at aerodromes. Wildlife will usually move away from the detonation so it is possible to control their direction to some degree: detonations behind wildlife can hasten their departure, and to either side can keep them on track and to hold a flock together. Pyrotechnics fired high in the path of an approaching flock will cause it to pause and orbit. However, birds will often avoid a significant headwind and they will eventually turn back.

5.3.2.2 There are various projectiles, fired from breech-loaded shotguns or from specialized launchers, which provide an auditory blast or scream as well as smoke and flashing lights to frighten birds. 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 aerodrome. Using pyrotechnics distributed by wildlife management personnel and targeting a specific species, helps teach wildlife to associate the pyrotechnic with a threat (person).

5.3.2.3 The effect of a cartridge can be improved by using a trace, especially when trying to control direction. The trace should be visible in sunlight throughout its flight.

5.3.2.4 Several types of pistols are used at aerodromes. The pistol should be fit for purpose and be pressure-tested for the type of cartridge used. Using pyrotechnics may present a FOD hazard to aircraft which should be managed accordingly.

5.3.2.5 In many circumstances, wildlife management personnel may not be allowed to fire a cartridge beyond the aerodrome perimeter, but by firing at a greater angle its effect can be extended outwards over a considerable distance, including locations with the approach path. A large flock of birds, rather than several smaller ones, is more likely to leave the aerodrome using this method. However, firing directly into a flock will probably fragment the cartridge and the wildlife may not regroup. Care is needed to control and not scare birds away. A detonation in close proximity to a flock may be useful to disperse wildlife that regroups quickly, such as flocks of starlings.

5.3.2.6 Each aerodrome should coordinate with ATC concerning the use of pyrotechnics.

5.3.2.7 In very dry conditions, proactive fire prevention is needed after a shot is taken. In these conditions, any trace should be followed until it has landed to check it has not ignited the vegetation.

5.3.2.8 Propane cannons (exploders) produce a shotgun sound blast. In general, birds quickly habituate to propane cannons that detonate at random or pre-set intervals throughout the day and they can scare birds into flight paths, creating extra hazard. To ensure they remain effective, cannons should be used only sparingly and only 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. Some systems are designed so that cannons placed around an aerodrome may be detonated remotely, on demand by radio signal. Such systems are preferable to those on random timers.

5.3.2.9 Propane cannons are the most commonly used audio repellent for deer. However, deer, like most wildlife, will rapidly habituate to their use. Such systems are therefore best implemented infrequently for short-term emergencies (a few days) and should not be relied upon to repel wildlife effectively. Propane cannons are likely to be more useful as a secondary tool provided they are manually operated via remote control. Automated cannons should not be used as this may result in scaring wildlife into a higher risk location as opposed to controlling their departure.

Distress calls

5.3.2.10 Distress calls are a unique call only given by certain bird species when they have been caught by a predator. Distress calls should not be confused with other calls such as alarm calls and contact calls. Flocking species such as gulls, corvids, lapwings and starlings are the species that tend to have, and therefore respond most positively to, distress calls. Distress calls should be species-specific, although for mixed flocks the call of the most prevalent species should be chosen. Distress call equipment should always be manually operated as static automatic units increase the risk of habituation and have the potential to scare birds into the critical airspace rather than control their movements. The most effective units are vehicle mounted, administered through roof-mounted, forward facing speakers. Hand-held units can also be used. Distress call equipment should always be used from a stationary position, although starlings may be herded using a slowly moving vehicle.

5.3.2.11 With the distress call equipment, the controller is attempting to recreate a scenario where a bird has been caught by a predator. Other members of the species will then investigate the threat as a group and fly to the origin of the call, circling above and trying to ascertain where the potential danger is coming from. Throwing a lure up (white for gulls and black for corvids for example), which resembles a struggling victim, can stimulate a flock to lift if necessary. Aerodrome operators should be aware that predatory mammals may approach the sound of a distress call as they

investigate a possible food opportunity. Volume settings should be natural so they will not attract birds onto the aerodrome from a distance. It is good practice to start the broadcast at a low volume and increase it until the target birds start to respond.

5.3.2.12 When the call is stopped, the remaining birds' instincts are to move away from the danger as a group. They will fly further away from the source of the perceived threat in the direction from which they arrived. Birds will become habituated to distress calls relatively quickly hence they should be used sparingly within a suite of techniques underpinned with lethal control. At the time a distress call is being broadcast, other forms of dispersal should not be implemented as this may confuse the behavioural reaction of the birds in question.

Electronic noise-generating systems

5.3.2.13 Modern technology allows for the use of systems that can emit targeted sounds over very long distances. These long range acoustic devices (LRAD) offer the opportunity to target any sound type (acoustic wail, distress call, synthetic bang etc.) at wildlife some distance away. As the use of distress calls is primarily to draw birds towards the sound source their use at significant distances may not be appropriate for an aerodrome. Similarly, the use of 'noise' may startle wildlife but if it is unable to determine where the noise is coming from it may be difficult to control their reaction. Caution is required with the use of long range projection devices to ensure they do not draw birds in from a wider environment.

5.3.3 Visual repellents

Presence of humans and vehicles

5.3.3.1 While there are many visual stimuli that can be used to control wildlife, the most effective tool that elicits a response from hazardous wildlife is often the simple sight of a vehicle or person who implements wildlife hazard management. Wildlife that is consistently harassed within the aerodrome environment will quickly become aware of the approach of a controller and may react if the vehicle stops or a person alights from the vehicle before any control method is implemented. This demonstrates a learned behaviour in that wildlife is aware that control is forthcoming and it will leave before any further threat occurs.

Visual objects

5.3.3.2 Most visual repellents are a variation of the scarecrow. Visual repellents such as hawk effigies, silhouettes on kites, eye-spot balloons, flags, reflective tape and lures have short-term effectiveness that are not suitable as long-term solutions to an aerodrome's bird problems. If a system can educate hazardous species that control personnel is on-site, it may have some value as an indicator but it does not generally work as a long-term control method. Displaying dead birds in a "death pose" can scare other birds from entering a specific area by presenting what is interpreted by the birds as a deadly threat. However, species of scavenging wildlife are attracted to dead birds lying on the ground so their use on aerodromes should be carefully considered prior to any deployment.

Lasers

5.3.3.3 Certain species of birds perceive the approaching laser beam as a threat, causing the birds to fly away. Lasers are best used at night or at dawn and dusk. Since lasers may present a secondary hazard to pilots or drivers of other vehicles, caution should be exercised. 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).

Remotely piloted aircraft systems (RPAS) and drones

5.3.3.4 See Chapter 6.

Trained predators

5.3.3.5 Trained dogs and falcons introduce a predator presence, resulting in a flee response of hazardous wildlife. Proper training for animals and instruction for their handlers will ensure that the animals do not become a strike risk.

Non-lethal projectiles

5.3.3.6 Any projectiles can be shot or catapulted toward the targeted species to elicit a flee response. Aerodromes should be aware of any restrictions for using these devices and wildlife personnel should be properly trained to ensure their safe handling.

5.3.4 Trap and relocate

Hazardous wildlife can be caught and released away from the aerodrome. The aerodrome operator should be aware of local laws and regulations when trapping and releasing hazardous wildlife. If live bait is used, it should be monitored and fed regularly (daily at a minimum). When bait or decoys are used, measures should be taken to prevent additional wildlife from being attracted to the aerodrome.

5.3.5 Chemical repellents

Non-lethal chemical repellents work by affecting the animal's senses through smell or taste aversion. These repellents may be sprayed on roosting sites, food sources or other gathering areas where hazardous wildlife is present. Certain chemical repellents (e.g. predator urine) may actually attract other hazardous wildlife, and aerodromes should be aware of the impacts of using these repellents. It is important to note that only chemical repellents registered and approved by the proper national, regional and local authorities should be used.

5.3.6 Lethal control

5.3.6.1 All lethal control should be undertaken humanely and safely by management and according to local laws at all times. It is often a national law to ensure that lethal action is only implemented after non-lethal methods have shown to be unsuccessful. Aerodrome personnel should maintain a record of the managed species and those removed through lethal control each year. Where a State does not allow the use of lethal means, the issue should be addressed at the State and national wildlife committee level.

5.3.6.2 The implementation of lethal action to reduce or eliminate the presence of hazardous wildlife on or around an aerodrome requires understanding the behaviour of the species being targeted. Action to influence and educate wildlife may be needed in full view of all targeted species in order for them to associate lethal action with the presence of a wildlife controller. When habitat management and wildlife repellents fail to reduce risk, the implementation of lethal methods can therefore reinforce the effect of non-lethal techniques. It can also be used to reduce the numbers of hazardous individual animals, remove sick or injured wildlife, or to deal with an immediate risk. In certain circumstances lethal measures can be used to eradicate an airside population of a species that cannot be educated by non-lethal methods.

5.3.6.3 Adults and juveniles can be euthanized using humane methods such as firearms or carbon dioxide gas. Bird eggs may be oiled or addled to prevent hatching or nests can be removed after eggs are laid.

Chapter 6

ADVANCEMENTS IN TECHNOLOGY

6.1 GENERAL

There are continuing advancements in existing technologies that can predict and detect wildlife potentially hazardous to aircraft operations and provide information thereon to reduce the risk of these hazards. Such technologies and procedures are particularly important in dealing with the significant hazards posed by wildlife in the vicinity of aerodromes.

6.2 SATELLITES FOR LAND USE MONITORING

Satellite imagery can aid in monitoring off-aerodrome sites that may attract hazardous wildlife. Land use around the aerodrome may be monitored by viewing a series of satellite images taken over a specific period of time. These images can allow airport managers to track changes in land uses that may impact the distribution of wildlife around the airport. Expansions of wetlands or waterbodies, landfills, or amenity grasslands, are all examples of land use changes that may increase the strike risk of wildlife. The availability of satellite imagery can provide quantifiable data on land uses and becomes critical evidence for habitat management measures and communicating with stakeholders.

6.3 GEOGRAPHICAL INFORMATION SYSTEM (GIS)

6.3.1 Geographical Information Systems (GIS) can be used by aerodrome managers to manage and analyse spatial data. Much of the data collected as part of a WHMP is spatially referenced, as it pertains to a specific geographical location. Using GIS to analyse the data allows aerodrome managers to assess patterns of wildlife observations and control interventions as they relate to aircraft operations. Wildlife strikes can be related to specific points on the runway and mapped with GIS to show “hotspots” where strikes occur.

6.3.2 GIS may also be used to track and analyse land uses off the aerodrome. When combined with other data collection methods (such as satellite land use imagery), GIS can be a powerful tool for analysing and understanding how wildlife hazards are distributed and interact with the aerodrome operating environment. It is recommended to provide professional training for aerodrome personnel in charge of working with GIS, to optimize the quality and reliability of the results.

6.4 DETECTION SYSTEMS

6.4.1 Radio detection and ranging (RADAR)

6.4.1.1 RADAR (e.g. avian or FOD detection radar) can act as a tactical tool that detects and tracks wildlife hazards in real time.

6.4.1.2 RADAR data can be used by wildlife controllers to monitor wildlife activity, especially birds, over large areas of an aerodrome and its vicinity. The sensor data may also be used for the real time tracking of wildlife in response to control measures. This is especially important when controlling birds at night to ensure they have exited the aircraft operating area.

6.4.1.3 RADAR data may also be used to create avoidance algorithms for aircraft and bird flight paths. When flight paths are predictable, an avoidance algorithm may be used to trigger an alert to an air traffic controller that an increased strike risk is imminent.

6.4.1.4 RADAR may provide strategic data for the assessment of wildlife hazards. RADAR datasets that span anywhere from a single season to several years can reveal patterns of wildlife movements. These patterns can then be used to target habitat attractants and strategize mitigations that reduce the risk of wildlife hazards.

6.4.1.5 RADAR datasets can show spatial patterns and timing of bird and bat movements. Aerodrome and aircraft operators can then alter flight operations to minimize the likelihood of aircraft operating in areas of high bird concentrations.

6.4.1.6 These same datasets may be used to assess patterns of habitat use on and off the aerodrome. Priorities for habitat management can be created by identifying areas that provide a strong attractant for hazardous wildlife. These data may be critical to convince external stakeholders that a hazard exists when wildlife is using off-site properties and take appropriate measures.

6.4.1.6 RADAR data can be used to assess the efficacy of mitigation measures (treatment and control) of habitat use and active control techniques.

6.4.1.7 The ability of RADAR sensors and their associated processing software to detect and track wildlife activity at different altitudes, distances, and under varying atmospheric conditions must be understood to maximize the benefit of a RADAR system. RADAR signals may be blocked by obstacles, influenced by ground clutter, and are not always able to detect all wildlife.

6.4.2 Camera detection

Wildlife monitoring cameras may include thermal detection cameras (infrared), or high or low definition cameras. The process usually consists of the installation of a series of cameras that monitor the field continuously, detecting movement of objects. These cameras may be associated with software that analyses and processes the images. This information can be used in conjunction with avian radars (helping to determine that radar detections are accurate), as an alert system to the wildlife control unit and to carry out data collection about the movements of wildlife on and in the vicinity of an aerodrome.

6.5 REMOTELY PILOTED AIRCRAFT SYSTEMS (RPAS) AND DRONES

6.5.1 RPAS and drones have the ability to manage wildlife from the air and can manoeuvre over hazardous wildlife to harass or survey. RPAS that harass wildlife may be constructed to simulate a predator (e.g. bird of prey). Surveillance RPAS have cameras attached that give the operator a view of the land on and in the vicinity of the aerodrome that can assist with identifying hazardous wildlife. Surveillance benefits may include night time observations and monitoring areas that are difficult to access. An example of this is observing rooftops where nesting can be seen without having to climb the roof.

6.5.2 Any operational RPAS must comply with local and national regulations. An aerodrome must have established flight rules for the operation of an RPAS on and around the aerodrome. RPAS operators should be certified to the degree that the law requires.

6.6 PULSE LIGHTS ON AIRCRAFT AND AERODROME USE OF FLASHING LIGHT PATTERNS

6.6.1 Wildlife can detect flicker or pulse rates (frequency) as well as particular colours (wavelength). Lighting techniques can therefore be used to deter them away from aircraft. Frequency and wavelength may be adjusted, as different species may react to different lighting techniques.

6.6.2 Pulse lighting is a modification to the aircraft lighting that pulses lights at a specific frequency and pattern. Wildlife may be able to detect the aircraft sooner, resulting in increased avoidance time.

6.6.3 Flashing light patterns are produced by displaying one or more moving shapes on LED screens. There are different combinations of moving patterns that can be used according to the targeted species. The continuous movement of the pattern may induce a sense of discomfort in birds which move away from the light-emitting screens. This repellent device depends on the ability of wildlife to see the device and is affected by the size of the screen and the landscape of the aerodrome.

6.7 DATABASE

Databases should be implemented at aerodromes in order to keep record of wildlife incidents (see definition in Chapter 1, 1.3.4) and allow aerodrome operators to draw conclusions and trends based on these data. Database management can be as simple as using electronic spreadsheets or can be more complex with other intricate systems. Databases should be connected with reporting systems so that aerodrome personnel can input data directly into the database. Data can then be easily extracted and manipulated in order to produce reports and draw trends and conclusions about wildlife incidents. The aerodrome should ensure that these results are reflected in an updated risk assessment when necessary.

Chapter 7

TRAINING

7.1 TRAINING REQUIREMENTS

7.1.1 An aerodrome operator should adequately train their wildlife hazard control personnel and managers in wildlife hazard management. This training should be conducted by competent wildlife hazard control personnel or specialists with proven experience in this field in accordance with recognized competency-based training principles.

7.1.2 A State should prepare and distribute guidelines for the training of aerodrome wildlife management personnel.

7.1.3 An aerodrome operator should ensure that wildlife management personnel are competent. Competency is the combination of skills, knowledge and attitude required to perform a task to the prescribed standard. Potential wildlife management personnel should complete a training programme and be tested, and the results recorded and kept on file. This record-keeping period may be defined by local and national regulations. In the absence of such regulations, records should be kept long enough to provide proof of competency.

7.1.4 Recurrent training should be carried out to ensure that personnel are kept up-to-date with any changes in wildlife hazard management at the aerodrome. Recurrent training is recommended to be completed at least every two years.

7.2 CONTENT OF A TRAINING PLAN

7.2.1 When training personnel for wildlife hazard management, the topics mentioned in the *Procedures for Air Navigation Services - Aerodromes* (PANS-Aerodromes, Doc 9981), Part II, Appendix 1 to Chapter 6, should be covered and may also include, but are not limited to:

a) nature and extent of the wildlife management problem;

b) management of hazardous wildlife and their habitat;

c) national and local regulations, standards and guidance material related to aerodrome wildlife hazard management programmes;

d) overview of aerodrome WHMP;

e) wildlife ecology and biology;

f) wildlife identification and observation, including the use of field guides and wildlife survey methods;

g) protected species, including related regulations and policies;

h) documentation, identification, and reporting measures of wildlife strikes;

i) off-aerodrome land use issues;

j) wildlife removal techniques;

k) safe use of firearms, hazardous materials;

l) stakeholder involvement;

m) importance of awareness and outreach programmes; and

n) basic principles of the safety management system (SMS) and how they apply to aerodrome wildlife hazard management (See the manual on *Flight Safety and Volcanic Ash* (Doc 9974) and the *Safety Management Manual* (Doc 9859)).

7.2.2 Within the aerodrome, personnel may require different levels of training depending on their role within the WHMP.

7.2.3. Wildlife personnel should also have the necessary competencies to operate on the aerodrome. These competencies can be found in the *Procedures for Air Navigation Services - Aerodromes* (PANS-Aerodromes, Doc 9981).

7.2.4 Personnel appointed to provide training in wildlife management at the airport should ultimately be determined by the airport operator. They should be able to demonstrate proven competence in the field of work and produce evidence that they have completed a formal course of instruction combined with professional experience.

Chapter 8

OPERATIONAL NOTIFICATIONS

8.1 GENERAL

8.1.1 Operational notifications include active correspondence addressing wildlife issues on or near an aerodrome, notifications and alerts. Protocols allowing clear, concise communication should be established prior to the implementation of operational notifications and included within the training requirements for personnel involved with wildlife management. This becomes especially important during active control of wildlife hazards and emergencies. Personnel and offices responsible for wildlife hazard management should be identified for ease of contact during both day and night.

8.1.2 Personnel involved with data collection, surveys, patrols, wildlife control and emergency responses should work closely with air navigation services provider (ANSP) personnel. Wildlife controllers should coordinate with the ANSP when necessary to ensure that the movements of dispersing wildlife will not affect aircraft.

8.1.3 Clear and precise procedures should be developed for ATC and controllers should be trained such that they are able to give specific and timely information to pilots and wildlife control crews to avoid identified hazards. Operational standards for procedures and training protocols should be uniformly developed and implemented among States.

8.1.4 Pilots have the authority to alter flight operations when hazard advisories are issued. Training in procedures for such altered flight operations based on these data should be provided by airlines and developed and monitored by State regulatory agencies.

8.1.5 Data from predictive models and remote-sensing systems, where available, should be shared with all entities responsible for reducing wildlife strike hazards, including aerodrome operations personnel, ATC, airlines, pilots and regulators. Communications procedures and regulatory oversight are necessary to ensure the timely exchange of information and proper responses to hazard advisories. Data from models and remote-sensing systems can be supplied at varying levels of detail to different agencies. For example, aerodrome operations and wildlife control personnel will need detailed and specific information on the level of hazard and the specific time and location of the detected or predicted hazard to appropriately respond with control or dispersal equipment. The ANSP will need to be advised when there is a potential wildlife hazard and may provide this information to pilots (see the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444).

8.1.6 Data links are available through wireless computer systems or cellular phone technology to alert individuals and agencies that can respond to hazard advisories. Data links to specific aerodrome operations, including their vehicles, are currently available in numerous States and aerodromes. Links to ATC should be established with appropriate audio or visual triggers when threshold levels are met. Uplinks to aircraft are possible with existing communications networks, in either voice or digital formats, should action from pilots be necessary.

8.1.7 The continual dissemination of general warnings for extended periods of time should be avoided. General warnings such as “birds in the vicinity of the aerodrome” offer little information to aid pilots and eventually may be ignored if not updated with more specifics.

8.1.8 Drivers should follow the procedures for their particular aerodrome when reporting sightings of wildlife, with respect to the correct use of radiotelephony and standard phraseology. Their reports may include more specific information such as:

a) large flock of birds on grass north of taxiway Bravo; and

b) feral dog in vicinity of runway 17 and taxiway Charlie.

8.1.9 Essential aerodrome information is information regarding the manoeuvring area and its associated facilities which is necessary to ensure the safe operation of aircraft. Essential aerodrome information is passed to aircraft whenever possible prior to start-up or taxi and prior to the commencement of final approach. For example:

a) caution large flock of birds north of runway 27 near taxiway A; and

b) wildlife 1, permission to disperse flock of geese at approach end of runway 09.

8.2 AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS)

8.2.1 ATIS is a continuous broadcast of recorded aeronautical information for aerodromes and their immediate surroundings. ATIS broadcasts contain essential information, such as current weather information, active runways, available approaches, wildlife hazards and any other information required by the pilots. The broadcasts indicate significant (moderate or severe) wildlife activity, as reported by an approved agency that presents temporary hazards on the ATIS broadcast. Pilots take notice of available ATIS broadcasts before contacting the local control unit, which reduces the controllers' workload and relieves frequency congestion.

8.2.2 The recording is updated in fixed intervals or when there is a significant change in the information. ATIS broadcasts involving wildlife should be timely and specific as defined in the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444). Pilots do not need to know species-specific information but they do need to know general descriptive information detailing size and number of animals, locations and timing of occurrence. Examples include:

a) large birds on approach to Runway 32 between 500 - 2,000 feet AGL;

b) deer observed near threshold of Runway 05R; and

c) flocking birds on airfield.

8.3 NOTICE TO AIRMEN (NOTAM)

8.3.1 A NOTAM is a notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. They can communicate persistent bird and wildlife hazards and can be mandatory or advisory in nature. Examples of NOTAM subjects include changes in hours of operations, hazards such as pavement issues, wildlife, snow, surface conditions, and others. NOTAMs are effective at providing seasonal wildlife alerts when bird migration or nesting occurs and can also provide useful information concerning the presence of threatened or endangered species.

8.4 PILOT REPORT

A pilot report may be filed to indicate encounters with hazardous wildlife. The pilot reports are short-lived warnings providing immediate information on pilot observations that are transmitted in real time to ANSPs. Large animals near active surfaces, soaring vultures and raptors within approach and departure corridors and waterfowl such as geese feeding in grassy areas next to runways, are all examples of timely reports generated by pilots.

8.5 AERONAUTICAL INFORMATION PUBLICATION (AIP)

Additional information at aerodromes, such as an indication of bird concentrations at the aerodrome, together with an indication of significant daily movement between resting and feeding areas, to the extent practicable, and charts related to bird concentrations in the vicinity of the aerodrome, should all be included in the Aeronautical Information Publication (AIP).

Note.— More information on the contents of the Aeronautical Information Publication is available in the Procedures for Air Navigation Services — Aeronautical Information Management *(PANS-AIM, Doc 10066), Appendix 2.*

Chapter 9

WILDLIFE HAZARD MANAGEMENT PROGRAMME

9.1 AERODROME WILDLIFE HAZARD MANAGEMENT PROGRAMME (WHMP)

9.1.1 Introduction

9.1.1.1 A wildlife hazard management programme (WHMP) is a method for aerodrome operators to adopt reasonable wildlife risk control measures, address features that may attract wildlife, control the presence of wildlife on, and in the vicinity of, the aerodrome. A WHMP should be developed based on the wildlife hazard risk assessment, according to the size and complexity of the aerodrome.

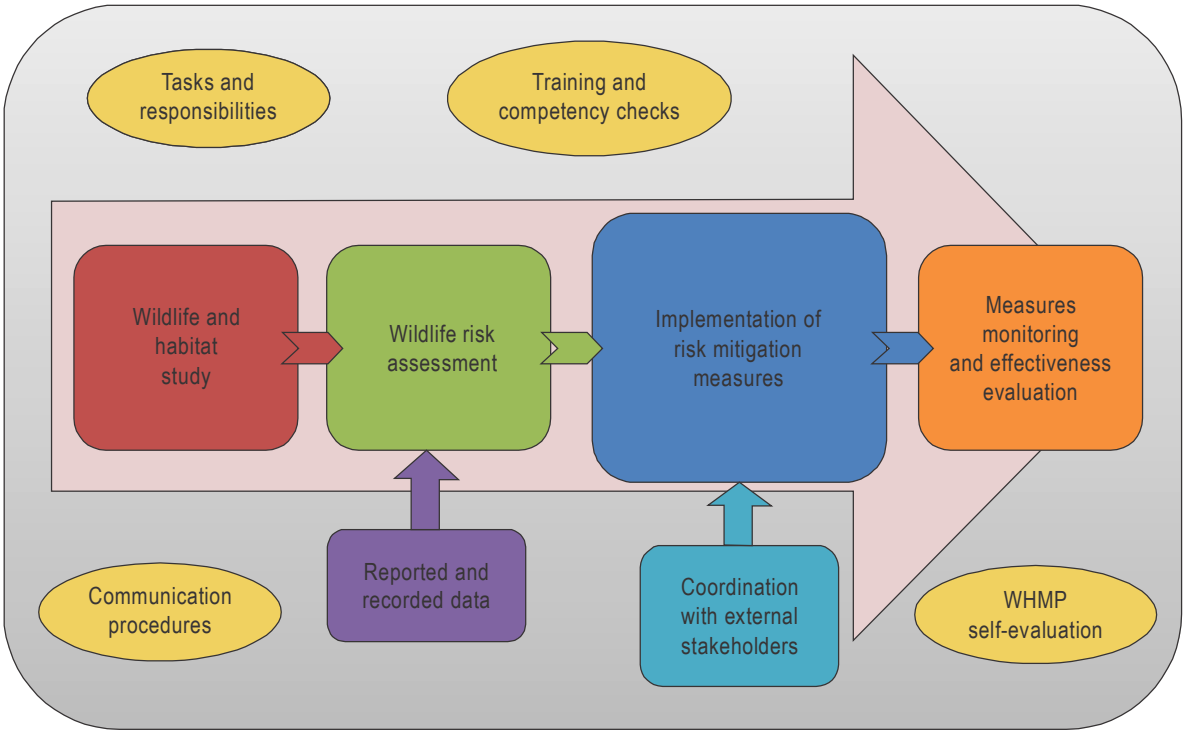

Figure 9-1. Wildlife hazard management programme process

9.1.1.2 An aerodrome should establish procedures for data collection, risk analysis and the implementation of wildlife control measures. Aerodrome personnel should be competently trained in wildlife hazard management with well-defined roles and responsibilities.

9.1.1.3 The WHMP should not only consider the establishment of internal actions specific to the aerodrome operator. For it to be effective, involving different stakeholders and external entities throughout its development will be needed, since they may be linked to the presence of wildlife, attracting habitats, land use, etc.

9.1.1.4 Wildlife hazards on, and in the vicinity of, the aerodrome are constantly changing due to modifications in land use, management policies, and environmental factors. In addition, wildlife can adapt or habituate to control strategies that were once effective, or they might develop new behavioural or feeding patterns on, or near, the aerodrome. These factors can affect the efficacy of the WHMP´s success.

9.1.1.5 The WHMP should be reviewed if changes to wildlife hazards are observed (e.g. planned land use changes, significant strike event, new wildlife species observed, operational changes, etc.) and at a minimum, this review should occur annually. The WHMP should be revised as necessary.

9.1.1.6 A WHMP should include, as a minimum:

a) a description of the organization of the WHMP;

b) the roles and tasks of aerodrome personnel involved with the WHMP;

c) a description of the aerodrome operations;

d) procedures including means and aerodrome personnel for collecting, reporting and recording data on observed wildlife and wildlife strike events;

e) a wildlife safety risk assessment method and procedure (including annual reviews);

f) procedures, means and personnel for habitat and land management;

g) procedures, means and personnel for the expelling, deterring and removing of wildlife, including lethal means where appropriate;

h) procedures for coordinating with internal and external stakeholders;

i) procedures, means and provisions for the training of aerodrome personnel; and

j) procedures and performance indicators to monitor the mitigation measures applied and assess their effectiveness, as well as the effectiveness of the WHMP itself (in terms of increase or decrease on the wildlife strike risk level).

9.1.2 Roles and tasks in the WHMP

9.1.2.1 The WHMP should detail the roles and tasks of all aerodrome personnel who:

a) develop and implement the WHMP;

b) oversee the daily activities (detailed in the sections below);

c) record wildlife (presence and movements);

d) record and analyse the collected data (observations, wildlife strikes, etc.);

e) carry out periodic surveys, wildlife studies and safety risk assessments to develop and implement the WHMP;

f) manage the habitat to reduce the attractiveness of identified areas, if relevant;

g) expel, deter and remove hazardous wildlife;

h) report wildlife strikes to the CAA and ICAO;

i) coordinate with stakeholders and external entities;

j) evaluate and update the WHMP as needed; and

k) for any other reason, is involved in wildlife hazard management.

9.1.2.2 In addition to the previous responsibilities, the aerodrome operator should appoint a wildlife manager or coordinator who will coordinate all tasks related to wildlife hazard management associated to the WHMP.

9.1.2.3 With regard to the wildlife control personnel at the aerodrome, if they do not cover the operating hours of the aerodrome, it should be indicated which groups would be in charge of wildlife control in their absence.

9.1.2.4 Further information about roles and tasks regarding stakeholders are in Chapter 2, Stakeholders.

9.1.3 Collecting, reporting and recording data on wildlife strikes and observed wildlife

9.1.3.1 Collected data should be as accurate and reliable as possible since it will help identify hazards at the aerodrome and within its vicinity.

9.1.3.2 The WHMP should refer to the protocols or communication procedure between the different stakeholders present at the aerodrome involved in detection, recording, collecting and reporting of wildlife observations and strikes.

9.1.3.3 The aerodrome operator should ensure that there is a process for rapid communication among those involved in wildlife control as well as with ATC and airlines. This is necessary when a specific wildlife hazard is present to allow the issuance of appropriate warnings to aircraft operating on, and within the vicinity of, the aerodrome, by the ANSP.

9.1.3.4 It should also be indicated what means and procedures the aerodrome operator uses to collect and identify species by feathers, animal remains, DNA analysis, etc.; as well as the personnel involved in the previous activities.

9.1.3.5 More information about how wildlife surveys should be conducted and how wildlife incidents should be recorded and reported is available (See Chapter 2, 2.2.4 Collecting, reporting and recording data on wildlife incidents and observed wildlife).

9.1.4 Wildlife safety risk assessment

9.1.4.1 The data collected and recorded throughout the year should be used to carry out a wildlife risk assessment (see Chapter 3).

9.1.4.2 The results and conclusions of the wildlife risk assessment should be documented in the WHMP and provide information about the hazardous wildlife species and their presence. This will help identify which are the most sensitive areas of the aerodrome and its vicinity, since areas with high presence of wildlife may coincide with aircraft flight paths.

9.1.4.3 The aerodrome operator should prioritize its wildlife management depending on the level of risk. Mitigation measures should be applied to species with the highest risk.

9.1.5 Wildlife hazard management measures

9.1.5.1 The aerodrome operator should apply measures for habitat and land use management, to prevent the entry of wildlife at the aerodrome and to expel or eliminate the wildlife currently present within the aerodrome.

9.1.5.2 The WHMP should include the resources used to perform wildlife management tasks (e.g. vehicles, pyrotechnics, traps, etc.). Personnel in charge of habitat and wildlife management, and personnel responsible for carrying out the preventive and corrective measures should be indicated. Further information about these measures can be found in Chapter 4, Habitat management and Chapter 5, Management of hazardous wildlife.

9.1.5.3 All different mitigation measures should be included in the WHMP, enabling appropriate assessments throughout the year.

9.1.5.4 It is advisable that each measure in the WHMP include the following information, at a minimum,:

a) species and risk activity targeted;

b) type and description of mitigation;

c) technical details;

d) implementation period and time frame;

e) personnel responsible for its application; and

f) results and effectiveness.

9.1.5.5 Each measure should have an appropriate performance indicator, i.e. a specific measurable characteristic that can assess its effectiveness.

9.1.5.6 Some examples of performance indicators are provided below:

Example 1

Issue: The buzzard population at Aerodrome X increased despite habitat management, resulting in an increased risk. The main food source for the buzzards was identified as small rodents. Rodenticide was introduced on the aerodrome to reduce the number of rodents as food source for buzzards.

Indicators: the number of buzzards on the aerodrome; the number of rodents on the aerodrome; the mass of rodenticide used; the number of buzzard strikes.

Example 2

Issue: Cracks and cavities are found in the terminal building. Increased number of swifts and pigeons are nesting and sheltering. The aerodrome operator introduces netting in these cavities to prevent access.

Indicators: number of cracks or cavities detected; number of cracks or cavities covered; number of nests in the cavities; number of birds in the cavities; amount of faeces found in the cavities.

9.1.6 Coordination with stakeholders

9.1.6.1 The WHMP should include a description of the communication, cooperation and coordination mechanisms with all relevant stakeholders; especially with those involved in activities that may encourage the presence of wildlife (crop harvesting, water features, pigeon racing, landfills, hunting, etc.).

9.1.6.2 Wildlife hazard management mitigation measures undertaken by external stakeholders in the vicinity of the aerodrome should be recorded, monitored and evaluated in the aerodrome WHMP.

9.1.6.3 Further information about stakeholders can be found in Chapter 2.

9.1.7 Personnel training

9.1.7.1 The WHMP should include training information for:

a) wildlife control personnel; and

b) those responsible for WHMP development and implementation.

9.1.7.2 The WHMP should include procedures for the initial and recurrent training of personnel involved in wildlife control and in wildlife hazard management.

9.1.7.3 Further information about training contents and requirements can be found in Chapter 7, Training.

9.1.8 Self-evaluation

The aerodrome operator should have a procedure to evaluate at least the following aspects periodically:

a) proper implementation of tasks and responsibilities regarding wildlife control;

b) adequate functioning of communication protocols;

c) correct identification of the most hazardous species and attracting areas; information is updated periodically and appropriately;

d) effective collection and recording of data (including the protocol for collecting animal remains and identification of wildlife strikes);

e) accuracy and effectiveness of the reporting system;

f) state of implementation and effectiveness of each mitigation measure;

g) periodic coordination with stakeholders (wildlife local committees, working groups, etc.) according to schedule; and

h) occurrence of appropriate wildlife training according to schedule.

9.2 WILDLIFE HAZARD MANAGEMENT PROGRAMME EVALUATION

9.2.1 The aerodrome operator should evaluate the effectiveness of the WHMP annually, at minimum. Changing conditions on the aerodrome, both operational and ecological, personnel performance and outdated procedures may be identified during this evaluation, prompting a review of the WHMP.

9.2.2 WHMP evaluation may have several levels of complexity and detail, and may consist of simple responses to basic checklists, or establishing a quantifiable measurement system, which includes leading and lagging indicators and qualifications, from which it will be considered if the WHMP is working well or if it needs to be improved.

9.2.3 The most basic level of WHMP evaluation should be to respond affirmatively or negatively to questions contained therein. If the answers to those questions are negative or unclear, measures should be established to address shortcomings. Basic questions may include:

— Are wildlife management roles, tasks and responsibilities adequately established at the aerodrome? Is the “wildlife manager or coordinator” considered in the WHMP?

— Is there a proper communication procedure between the different stakeholders to alert about the presence of strikes with wildlife?

— Are the wildlife management personnel aware of the species that pose a risk to air traffic and about attractive areas for wildlife at the airport and its vicinity?

— Are wildlife observations and strikes recorded and reported properly? What is the average of identification of species on wildlife strikes?

— Does the WHMP include an appropriate wildlife risk assessment conducted by competent personnel?

— Are habitat management measures and measures of dispersion and extraction of wildlife taken at the aerodrome? Is the effectiveness of these measures measured?

— Is there coordination with external stakeholders? Are regular meetings held with them? Is the local wildlife committee effective?

— Is training on wildlife management given to personnel involved in wildlife management (at all different levels)?

— Is the self-evaluation of the WHMP being performed?

9.2.4 Once this base is established, complexity can be increased by asking more specific questions to determine the degree of compliance.

— Has a land use plan been established with regard to effective land use on and off the aerodrome, as it pertains to the WHMP?

— What ecological measures are implemented to reduce wildlife attractiveness at the aerodrome and in the vicinity?

— Are garbage dumps forbidden around the aerodrome? If yes, within what distance are they forbidden?

— Is the aerodrome fence suitable to prevent hazardous wildlife incursions?

— Which repellent methods are implemented at the aerodrome?

— Are aerodrome personnel employed and trained specifically to control and disperse wildlife at the aerodrome?

— What is the wildlife strike rate at the aerodrome over the last five years (with or without damage to the aircraft)?

— Is there a procedure to regularly collect information about wildlife on, and in the vicinity of, the aerodrome, both dead and living?

— Has a procedure for the positive identification of wildlife remains been established?

— How many reports from pilots are related to intrusions of wildlife, other than birds, over the last five years?

— Has a list of wildlife attractants at, and in the vicinity of, the aerodrome been completed?

9.2.5 The foundation for these evaluations is the maintenance of consistent records of wildlife presence, wildlife control activities and wildlife incidents. Using a standardized format for all record keeping allows for an easy compilation of events and activities into monthly and annual statistical and narrative summaries. Once these summaries are available, objective examinations and comparisons of trends in strikes, wildlife activities, control methods deployed, and other factors can be made. Examples of systematic documentation procedures include: daily logs of wildlife activities, surveys, patrols, wildlife strikes with aircraft and wildlife control activities.

9.2.6 The most rigorous and systematic method to know how well wildlife is being managed at the aerodrome would be to use a performance measurement mechanism. Performance indicators (parameters used for monitoring and assessing performance) are select metrics that are most closely aligned with the ultimate goal of reducing wildlife risks, and will help to assess if the wildlife hazard is adequately managed by the aerodrome operator.

9.2.7 Performance indicators should be metrics obtained and measured in a simple way, and which are clear about what they measure. They can be primary (lagging) or secondary (leading) indicators.

9.2.8 Primary (lagging) indicators measure events that have already occurred. They are also referred to as outcome-based indicators and normally represent, but not always, the negative outcomes the organization is aiming to avoid. Secondary (leading) indicators measure processes and inputs being implemented to improve or maintain performance. These are also known as activity or process indicators as they monitor and measure conditions that have the potential to lead to or contribute to a specific outcome.

9.2.9 Lagging indicators are typically output oriented, easy to measure but hard to improve or influence (e.g. number of wildlife strikes), while leading indicators are typically input oriented, hard to measure and easy to influence (e.g. number of repellent activities).

9.2.10 Although there has generally been a tendency to use lagging indicators (number of wildlife strikes related to aircraft movements, percentage of strikes resulting in damage or effect on flight, etc.) as measures of the effectiveness of a WHMP, leading indicators are good indicators as well. They show how personnel are performing their tasks and how the system is prepared to prevent the worst events (incidents and accidents) from happening, through good safety practices, correct use of procedures, etc.

9.2.11 Some leading indicators for evaluating a WHMP would be:

a) presence of wildlife at the aerodrome;

b) completeness of wildlife strike reports;

c) completeness of wildlife management logs;

d) percentage of wildlife species identification in strike events;

e) percentage of personnel receiving wildlife management training;

f) percentage of wildlife management actions completed; and

g) frequency of meetings of wildlife committees.

9.2.12 An ideal performance measurement will take into account both primary and secondary indicators. In order to use these metrics, it is essential to have an accurate historical record of all activities and events that belong to wildlife hazard management.

9.3 CAA EVALUATION OF WILDLIFE HAZARD MANAGEMENT PROGRAMME EFFECTIVENESS

9.3.1 The CAA should evaluate the WHMP to ensure the effective and efficient mitigation of wildlife hazards. CAAs may be able to identify gaps in the WHMP and should ensure that the WHMP complies with any regulations.

9.3.2 CAAs can evaluate the programme's effectiveness and determine its compliance with regulations by conducting periodic inspections and audits. The CAA may use evaluation questionnaires similar to those indicated in 9.2, Wildlife hazard management programme evaluation.

9.4 CAA EVALUATION OF THEIR SAFETY OVERSIGHT SYSTEM FOR WILDLIFE HAZARD

9.4.1 The CAA should have a national plan for wildlife hazard management as part of the State Safety Programme. This plan may include regulations, the publication of guidance material, outreach, research, data collection and partnerships with the goal of reducing wildlife risk.

9.4.2 The CAA should measure the effectiveness of the oversight of aerodromes and aviation safety in general as described in the *Safety Management Manual* (Doc 9859). With respect to wildlife hazards to aviation, this may include reviews of its methods to address wildlife hazards.

9.4.3 The CAA should ensure that the personnel involved in wildlife hazard oversight activities are properly trained (See Chapter 2, 2.5, Civil Aviation Authorities). If the CAA is not able to conduct a review itself, it may look for external assistance (other countries, other national wildlife committees) to determine if the guidance is sufficient.

9.4.4 The CAA should have procedures in place to determine compliance with wildlife strike reporting requirements. The CAA should evaluate the quality and quantity of the wildlife strike reporting data. The CAA can identify deficiency trends and ultimately improve wildlife strike reporting.

9.4.5 The CAA should analyse and summarize their strike records to determine not only the quantity of those records but their quality as well. There are a number of methods used to determine how best to evaluate the effectiveness of wildlife strike reporting and the ultimate reduction in damaging strikes; some use a simple ratio between damaging vs. non-damaging strikes, or a number of damaging strikes per aircraft operations, or total mass of wildlife struck rather than the number of strikes incurred.

9.4.6 The effectiveness of the CAA can be measured by assessing the number of aerodromes that have implemented a successful WHMP.

— END —

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CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

Guidance material for land use at or near aerodromes

June 2008

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Overview

The environment at and surrounding an airport has unique characteristics that impact on land use. Specific requirements for the operation of aircraft, airport design and airspace management are covered in the Civil Aviation Act 1990 and Civil Aviation Rules. The regulatory oversight of these requirements is undertaken by the Director of Civil Aviation and the Civil Aviation Authority of New Zealand.

New Zealand is a signatory to the Convention on International Civil Aviation (the Chicago Convention) which is a set of international requirements for civil aviation coordinated through the International Civil Aviation Organisation (ICAO). New Zealand has adopted the ICAO standards and recommended practices as the basis for New Zealand Civil Aviation Rules (CARs).

Aerodrome operators in New Zealand should monitor and review land use activities around their aerodrome to ensure the safe operation of aircraft and protection of airspace. Those persons making changes to land use must ensure that they comply with any applicable CARs, local authority planning requirements and work with aerodrome operators in land use changes.

The following provides guidance for those persons proposing land use changes around aerodromes and identifies specific points to be taken into account.

Glossary

Aerodrome—

(1) means any defined area of land or water intended or designed to be used either wholly or partly for the landing, departure, and surface movement of aircraft; and

(2) includes any buildings, installations, and equipment on or adjacent to any such area used in connection with the aerodrome or its administration.

(An aerodrome includes a heliport)

Civil Aviation Rules means rules made under the Civil Aviation Act.

Types of Aerodromes

Many aerodromes in New Zealand hold a Civil Aviation Rule Part 139 aerodrome operating certificate. These include international and large domestic aerodromes. The Part 139 certificate is required for aerodromes where aircraft with more than 30 passenger seats operate regular air transport operations. Aerodromes that do not meet the more than 30 passenger seat criteria may also hold a Part 139 certificate. The Part 139 certificate requires the aerodrome operator to comply with a range of rules and requirements including ongoing CAA oversight.

Under Part 139, there are two specific requirements to be met for land use; Obstacle Limitation Surfaces and Wildlife Hazard Management.

The remainder of New Zealand's aerodromes are non-certificated. The only CAR requirements on a non-certificated aerodrome are those that form part of the operating requirements for any airline or aircraft operator that uses the aerodrome.

Obstacle Limitation Surfaces

Under CAR 139.51 an aerodrome operator must have in place obstacle limitation surfaces for the aerodrome that are defined surfaces in the airspace above and adjacent to the aerodrome. These obstacle limitation surfaces are necessary to enable aircraft to maintain a satisfactory level of safety while manoeuvring at low altitude in the vicinity of the aerodrome. These surfaces should be free of obstacles and subject to control such as the establishment of zones, where the erection of buildings, masts and so on, are prohibited.

More information on obstacle limitation surfaces (OLS) can be viewed online at www.caa.govt.nz under Advisory Circulars.

For Part 139 certificated aerodromes the OLS requirements can be found in Chapter 4 of CAA Advisory Circular AC139-6.

For non-certificated aerodromes the OLS requirements can be found in Chapter 3 of CAA Advisory Circular AC139-7.

For heliports the OLS requirements can be found in Chapter 4 of CAA Advisory Circular AC139-8.

The OLS surfaces are normally published in the local District Plan and can also be sourced directly from the aerodrome operator.

It is important that any proposed building or structure does not infringe required OLS areas. Consultation with the aerodrome operator and the relevant local authority at an early stage is essential.

Wildlife Hazard Management

Under CAR 139.71 an aerodrome operator must establish an environmental management programme to minimise or eliminate any wildlife hazard that presents a hazard to aircraft operations at their aerodrome in areas within their authority.

The management of wildlife, especially birds, is critical for aircraft operational safety. Bird strikes put the lives of aircraft crew members and their passengers at risk. In the United States over 7,500 bird and other wildlife strikes were reported for civil aircraft in 2007. Bird and other wildlife strikes to aircraft annually are estimated to cause well over $600 million in damage to civil and military aviation in the United States alone.

It is important that land use changes are monitored and reviewed by the aerodrome operator in areas outside their immediate control to ensure that these land use changes do not increase wildlife hazards for the aerodrome.

Garbage disposal dumps and other sources that may attract wildlife activity on, or in the vicinity of, an aerodrome, need to be assessed as a potential source of wildlife hazard. It is

an International Civil Aviation Organisation requirement that such activities are closely managed by the controlling authority. If necessary an aeronautical study may need to be undertaken to assess the potential wildlife activity hazard.

Examples of wildlife attractants include:

- Refuse Dumps and landfills
- Sewage Treatment and Disposal
- Agricultural - cultivation of land, types of activity e.g. pig farming.
- Fish processing plants
- Cattle feed lots
- Wildlife refuges
- Artificial and natural lakes
- Animal farms
- Abattoirs and freezing works

Proper planning of these activities and their impacts on wildlife should be undertaken. It should be noted that aircraft approach and departure areas may extend for a distance from the aerodrome runway, therefore wildlife impacts on aircraft activities may not be immediately apparent. Consult the aerodrome operator as early in the planning as possible.

The International Civil Aviation Organisation provide specific environmental management and site planning information on the following:

Refuse dump or landfills

If a refuse dump is proposed in the vicinity of the aerodrome there may be a requirement to provide bird control at the site to reduce the attractiveness to birds. The potential threat to aircraft depends on location relative to airport and flight paths, type of refuse, and the types of birds expected in the vicinity.

The ICAO Bird Control and Reduction Manual recommends that refuse dump sites be located no closer than 13 kilometres from the airport property. The proper siting of refuse dumps can reduce hazard and any location should be analysed by a group of specialists on bird problems.

Water

Surface water is a large bird attractant and developments that have drainage ditches, artificial waterways and large areas of water close to an aerodrome may attract birds and other wildlife.

In the ICAO Bird Control and Reduction Manual it is noted that in the vicinity of an aerodrome artificial and natural lakes increase the bird strike hazard depending on the size and the shape of the lake, its ecological state and the surroundings. It is recommended that

an ornithologist/biologist evaluate the ecological conditions of the whole vicinity as well as migration in the area. The bird strike hazard can be reduced if the lake is made smaller and the shores steeper, and if fishing, hunting and water sports are forbidden. Filling a lake with soil or covering the surface with wires and nets are two of the better solutions to the problem.

Notice of Intention to Construct, Alter, Activate or Deactivate an Aerodrome

Civil Aviation Rule Part 157 requires that prior notice be given to the Director of Civil Aviation whenever a person intends to construct, alter, activate or deactivate an aerodrome. This notice will enable the Director to identify whether the use of the airspace associated with the aerodrome proposal will be a hazard to other established airspace users. It will also allow identification of problems to do with the safety of persons and property on the ground.

It is also necessary to consider efficient use of airspace at an early stage. The Director, after receiving such notice, will give advice on the effects the proposal would have on the use of navigable airspace by aircraft and on the safety of persons and property on the ground. An aeronautical study will be undertaken and a determination on the proposal made.

The Part 157 rule requirements and Part 157 Advisory Circular are available on the CAA web site www.caa.govt.nz

There is also a Part 157 information leaflet available from CAA or at: http://www.caa.govt.nz/aerodromes/Aero_Studies_Pt157_info.pdf

Objects and Activities Affecting Navigable Airspace

Civil Aviation Rule Part 77 prescribes rules for a person proposing to construct or alter a structure that could constitute a hazard in navigable airspace; or use of a structure, lights, lasers, weapons, or pyrotechnics, that could constitute a hazard in navigable airspace.

There are several areas that require a Part 77 application for a determination on such objects and activities including:

- A structure that extends more than 60 m in height above the ground level at its site.
- A structure that exceeds the general tree height in the area by 18 m and is located in an area of low level aerial activity or other low flying activity, or in a low flying zone or low level route as prescribed under Part 71.
- A structure that is located below the approach or take-off surfaces of an aerodrome as defined in Part 77.
- A structure that penetrates the obstacle limitation surface of an aerodrome.

- A person proposing to use a structure that may discharge efflux at a velocity in excess of 4.3 m per second through an obstacle limitation surface of an aerodrome or higher than 60 metres above ground level.
- A person proposing to operate a light or a laser if the light or laser is liable to endanger aircraft.
- A person or organisation that proposes to use a weapon that fires or launches a projectile that has a trajectory higher than 45 m if within 4 km of an aerodrome boundary, or 120 m if more than 4 km from an aerodrome boundary.
- A person who proposes to stage a pyrotechnics display that involves the firing or launching of a projectile that has a trajectory higher than 45 m if within 4 km of an aerodrome boundary or 120 m if more than 4 km from an aerodrome boundary.

A person proposing to construct or alter a structure must notify the Director of Civil Aviation 90 days before the proposed date of commencement of construction or alteration. The specific requirements are detailed in Civil Aviation Rule 77.13.

An aeronautical study will be undertaken and a determination on the proposal made.

Full details and information on Part 77 requirements are available in the Part 77 Rule which can be accessed at the CAA web site www.caa.govt.nz.

Noise Issues

Noise issues to do with aerodromes are the responsibility of the local controlling authority and the CAA does not have any statutory function in relation to aircraft or aerodrome noise. The Minister does produce rules relating to noise abatement measures under Civil Aviation Rule Part 93 which are published on behalf of the aerodrome operator from local authority requirements.

Local Authority Zoning

The CAA encourage local authorities to protect aerodromes in their areas to ensure the long term sustainability of the aerodrome, the safety of the aircraft operations, and the safety of persons and property. In addition to the required obstacle limitation surfaces other areas can be specifically zoned to assure that future uses of the land are compatible with airport operations and to protect persons and property. Zoning solely to obstacle limitation surface is insufficient to prevent the construction of incompatible uses such as housing or uses that attract congregations of people in the approach areas.

In the United States a runway protection zone (RPZ) is used by many local authorities for the protection of people and property on the ground. Compatible land use within the RPZ is generally restricted to such land uses as agricultural, golf course, and similar uses which do not involve congregations of people or construction of buildings or other improvements that may be obstructions. Land uses prohibited from the RPZ are residences and places of public assembly including churches, schools, hospitals, office buildings and shopping centres.

Summary

Aerodromes have an important role in aviation safety in particular the safety of aircraft and passengers. In New Zealand the Civil Aviation Authority oversees aviation safety based upon international aviation requirements. It is important that persons wanting to alter land use near an aerodrome do so in consultation with the aerodrome operator, the relevant local authority and, where necessary, the Civil Aviation Authority.

It is important that land use changes near aerodromes are also compliant with any Civil Aviation Rule requirements.

Contacting the CAA

The Aeronautical Services Unit of the CAA has responsibilities for the oversight of the services supporting the New Zealand aviation system. The unit is responsible for certification and surveillance of aerodromes and heliports, and air traffic, telecommunications, navigation, meteorological and aeronautical information services.

The unit also has responsibilities regarding airspace and Part 77 determinations for objects affecting navigable airspace, such as structures, fireworks, unmanned balloons, kites and model aircraft. They can offer advice on matters relating to Part 139 certificated aerodromes and Part 157 aerodrome determinations.

They can be contacted by phoning the CAA on 04 560 9400 or through specific contact details on the CAA web site www.caa.govt.nz

CIVIL AVIATION AUTHORITY OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Advisory Circular AC139-16

Revision 0

Wildlife Hazard Management At Aerodromes

07 October 2011

General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rule.

Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate AC.

Purpose

This AC describes an acceptable means of compliance with Civil Aviation Rule Part 139.71, Wildlife Hazard Management, in relation to the control of bird hazards at aerodromes.

The AC also contains information related to the control of birds in the vicinity of aerodromes for the guidance of aerodrome operators and local territorial authorities.

The AC is not exhaustive in addressing how to control bird hazards. It presents a compilation of methods to assist aerodrome operators and local territorial authorities to establish or enhance a bird hazard management programme, and may raise issues for their further consideration.

Related Rules

This AC relates specifically to Civil Aviation Rule Part 139.

Change Notice

This is the initial issue of AC139-16.

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Introduction

Birds and aircraft co-exist with extreme risk. A bird strike can cause significant damage to aircraft and lead to other dire consequences.

To mitigate the risk of bird incidents (i.e., strikes and near misses), certificated aerodrome operators are required by Civil Aviation Rule Part 139 to have a wildlife hazard management programme. A significant component of any such programme is a bird hazard management programme to address the control of bird hazards at and near an aerodrome.

An effective programme usually takes a holistic and integrated approach, incorporating a variety of measures (i.e., active and passive management techniques) to gain maximum benefit.

This advisory circular discusses the key parts of a bird hazard management programme. It has been written to help any aerodrome operator, whether certificated or not, to establish or enhance a bird hazard management programme.

The management techniques described in the first part of this advisory circular are a compilation of generic methodologies that do not necessarily target a specific problem species.

This advisory circular also raises other issues aerodrome operators need to consider as part of their strategic planning process.

An effective bird hazard management programme can significantly reduce the costs, risks and damages associated with bird strike.

Overview of a bird hazard management programme

Justification

A bird strike can result in direct, indirect and ancillary costs.

Direct costs

The direct costs of a bird strike are directly proportional to the amount of damage incurred by the aircraft as a result of the strike.

Jet engines with their large air intakes are more vulnerable to damage than propeller-driven aircraft engines, which have a smaller air intake and are shielded by the propeller unit, which incurs most of the damage. However, engines are not the only expensive components of the aircraft structure that are likely to be damaged. The leading edge of the wings, the flaps, the lights, landing gear, windscreens, pitot tubes and the navigation aerials are also prone to damage.

Indirect costs

The indirect costs associated with a bird strike include the costs of:

- fuel used and dumped during precautionary and emergency landing procedures
- transporting replacement parts and mechanics to the site

- accommodating, compensating and providing meals for stranded passengers and flight crews
- relocating replacement aircraft with flight crew
- replacing damaged aircraft on subsequent scheduled flights until repairs have been made to the damaged aircraft
- the damaged aircraft's downtime
- delays, especially on highly integrated airline schedules and particularly for airlines employing major hub-and-spoke operations
- lost passenger confidence and goodwill.

Passengers also incur indirect costs, such as the costs associated with:

- missed connections
- re-booking alternate flights
- lost business opportunities as a result of delays.

Ancillary costs

Ancillary costs are incurred by the aerodrome owner or operator, regulatory authorities, other aerodrome users and the emergency-response agencies that deal with the results of bird strikes.

The ancillary costs associated with a bird strike include the costs of:

- runway closures
- the airport emergency response
- the off-airport emergency response by ambulance, fire and police services and hospital emergency-room staff
- runway clean-up and repairs
- flight arrival and departure delays
- the additional fuel used by aircraft during delays
- developing, implementing and maintaining aerodrome wildlife management programmes
- investigations and safety reviews
- administration by the regulatory agencies involved with bird hazard management.

Holistic and integrated approach

An effective bird hazard management programme is usually developed with input from a variety of sources, including all aviation interests (i.e., from the aerodrome operator, air traffic control and aircraft operators to people and organisations that influence land use such as local authorities and other government agencies), as well as the Department of Conservation, biologists and ornithologists.

An effective programme takes a holistic approach, starting with an assessment of all the bird species in the area to ensure that a reduction in one species or the creation of a habitat to deter one species will not be beneficial to another species.

Each aerodrome's different ecological structures and environmental conditions mean similar control techniques may have different consequences for the same target bird species. Therefore, a programme should be independently devised for each aerodrome and its results monitored carefully.

Passive and active management techniques work together to ensure effective bird management. Active management techniques can be counterproductive if, for instance, passive measures have not reduced the availability of food, water and shelter at other parts of the aerodrome or its environs. Longer term passive management techniques (i.e., modifying a bird's habitat by removing ponds or planting different ground cover) reduce the need for active management measures.

Birds develop habits quickly, so become accustomed to control techniques that are excessive or repetitive or visual deterrents that are stationary for extended periods. Therefore, it is important to conduct a range of activities to maintain the programme's overall effectiveness.

Planning

Active management techniques should reduce an immediate bird hazard. However, it is vital to use a range of methods to ensure their continued effectiveness and immediate benefit.

A strategic, longer term approach also needs to be adopted. Passive management techniques generally take longer to implement and are more expensive in the short term, but have a more sustainable effect than active management techniques.

Passive techniques aim to modify habitats and reduce the attractants that cause birds to congregate in the aerodrome's environs. Some active management techniques can also be used to take effect over a longer period. For example, targeting a reduction in the number of juveniles by manipulating the egg-hatching of a particular problem species is one such approach. Over a few years the number of birds reaching adulthood and breeding status will be reduced.

Budgets

Budgetary planning is another important aspect of an effective bird hazard management programme. Aerodrome operators should take account of active and passive management methodologies when preparing their annual budgets. These can be viewed as compliance costs (i.e., protection against liability action that could occur as a result of a bird strike) or, quite simply, as protection of aeronautical revenues.

Expenditure may be seasonal or constant over the year, depending on the bird hazard management programme.

Staff, the materials used to implement active management techniques and the use of contractors or sponsorship for habitat modification should all be taken into account.

Aerodrome operators should also consider their capital expenditure budgets when installing permanent features on physical infrastructure or purchasing equipment as a result of the bird hazard management programme.

Staff

Few aerodrome operators can justify employing dedicated bird patrol staff, so consider using staff who are also used for other specialist duties.

Staff should be trained to identify bird species and carry out detailed surveillance, harassment and environmental management procedures. A bird hazard management checklist that can be applied to infrastructure design and construction and maintenance activities is also useful for staff.

Make sure employees, tenants, concessionaires and contractors at the aerodrome are aware (through a campaign or as part of their terms and conditions for working at the aerodrome) of the hazards created by birds and how they can minimise or eliminate bird attractants in their business or work environment.

Bird incident statistics

Collecting data

Part 12, Accidents, Incidents and Statistics, requires the pilot in command of an aircraft to report bird incidents to the Civil Aviation Authority. Usually, they do this by passing the details of a bird incident to the nearest Air Traffic Service unit for onward transmission to the Civil Aviation Authority, or to the Civil Aviation Authority via company reporting systems.

The Civil Aviation Authority has adopted the following system for classifying whether a bird occurrence occurred on or off the airport:

"On airport" bird strikes are strikes that occurred at or below 200ft above ground level (AGL) during the landing or approach or 500ft AGL during the take-off or climb. "Off airport" bird strikes are strikes that occurred above 200ft AGL during the approach and above 500ft AGL during climb.

Using this system, the critical information to classify whether an incident is on or off airport is the aircraft's phase of flight and also its altitude.

The Civil Aviation Authority provides aerodrome operators with a statistical report and comments about incidents and trends. Some aerodrome operators have also reached agreement with the Airways Corporation of New Zealand to provide data about bird incidents as they are reported. This provides aerodrome operators with up-to-date information and a greater range of useful information such as aircraft type, time of incident, height and speed at which the incident occurred, phase of aircraft flight, bird species if known and the number of birds involved.

This information can be used for in-house analysis of incidents.

Analysing data

Data analysis can help you to determine whether a bird hazard management programme needs to be instigated and to make strategic decisions about the actions required to mitigate a particular problem.

Spreadsheet or database software can make analysis more effective and easier than a paper-based system, which can be onerous and more error prone.

In-house analysis can be completed easily if you obtain the data from the Airways Corporation of New Zealand and the Civil Aviation Authority. Outline the parameters of the information you are seeking from the Civil Aviation Authority.

When analysing bird incidents consider whether they, for example:

- Occurred on or off the aerodrome
- involved a predominate bird species
- involved a particular aircraft type
- were concentrated during particular times of the day (which could be due to peak movements of aircraft, rather than birds)
- were seasonal (which could be related to food sources or migratory patterns)
- involved a particular area of the aerodrome (e.g., one end of a runway, which could indicate a specific habitat problem area or the migratory habits of the birds)
- happened at a similar height (which might indicate migratory patterns)
- What options are available if bird incidents occur off the airport

This analysis is also useful for measuring the effectiveness of measures being implemented.

Example

Analysing bird incident data, then making appropriate adjustments can lead to fewer bird incidents.

For example, in one case an aerodrome operator and aircraft operator noted that B737 jets were incurring more strikes involving migratory birds, than the larger wide-bodied jets. Investigation revealed that the B737's take-off point was earlier than the other jet's take-off point, so the B737 was flying through the birds' path while the larger wide body jet was passing underneath. It was decided to alter the B737's take-off point so that it too passed under the birds' flight, resulting in fewer strikes.

Evaluating the programme

Analysing bird incident data is part of evaluating the bird hazard management programme's effectiveness. However, to determine whether the results are indicative of a trend or are merely an aberration, you need to undertake regular monitoring and analysis for some years.

Managing information

It is important that bird incidents are reported so the extent of the bird hazard problem can be determined and stakeholders (such as the aerodrome operator, aircraft operator and Civil Aviation Authority) can make informed decisions to manage the risks. Bird incident data is important at local, national and global levels.

In New Zealand a 'bird incident' includes:

- a collision between an aircraft and one or more birds (i.e., a bird strike)
- one or more birds passing sufficiently closely to an aircraft in flight to cause alarm to the pilot (i.e., a near miss).

New Zealand aerodrome operators are also encouraged to report to the Civil Aviation Authority (using a Rule Part 12 incident report) when bird remains are found at an aerodrome and it is known or suspected that a bird incident report has not been filed.

New Zealand experience

Statistics

In the decade from 1994, there was over 10,000 bird incidents reported in New Zealand: approximately 4000 bird strikes and 6,000 near misses.

Bird species

Analysis of the reported bird incidents indicates the prevalence of a few problem species:

- Australian harrier (hawk)
- finch (chaffinch, greenfinch and goldfinch)
- magpie
- mallard
- paradise shelduck
- pigeon
- South Island pied oystercatcher
- southern black-backed gull
- sparrow
- spur-winged plover
- starling.

Additionally, many incidents have been reported against 'gulls' in general. As there are only three gull species in New Zealand, this suggests that, in addition to the large black-backed gull, the smaller species of black-billed gull and red-billed gull could also be problems.

The last section of this document describes these species and the methods that have been used to successfully control the hazard they pose.

Generally, control methods for small birds are similar no matter what the species. However, if the problem species is not listed above, you may need to consult an ornithologist to help you to establish a dedicated programme.

Environmental survey (bird hazard assessment)

One of the first steps when devising a bird hazard management programme is to undertake an environmental survey or bird hazard assessment. This survey focuses on the conditions attracting birds to the aerodrome and needs to be completed before any major habitat changes are implemented.

The survey should determine:

- the number of birds hazardous to aviation in the area
- the species of bird in the area
- how the birds are distributed, both spatially and temporally

- why the birds are in the area
- how the birds move in relation to the aerodrome and aircraft flight paths.

It should also assess the area's geography, hydrology, soil, climate and vegetation, building designs and human activities such as agricultural and waste-disposal operations.

This research provides the factual information needed to understand why hazardous species are at the aerodrome and, as a result, suggests the habitat modifications you should consider. In some instances a more comprehensive study of a particular bird species by an expert may be required; at other times a cursory survey will be all that is needed to locate the primary bird hazards.

Keep in mind that a bird hazard management programme is about managing risk, not eliminating all the birds from the aerodrome (even if some operators consider this a utopian situation).

It is important to establish birds' habitual behaviour and relationship to the aircraft flight path, because they may not pose a risk in some combinations of circumstances.

Finally, to help assess the effectiveness of the bird hazard management programme, consider undertaking a regular (e.g., annual) bird census to see whether and to what extent the number of birds is changing. Local members of the Ornithological Society or research students can often be used to undertake this survey on your behalf.

Implications of land use activities near aerodromes

Planning land use near aerodromes

Although you can control the land use practices on your land to reduce the aerodrome's attractiveness to birds; bird-attractive land use activities outside the aerodrome's boundary and beyond your sphere of influence can counter your activities.

Particularly severe problems arise when birds make regular flights across an aerodrome (e.g., when they fly between roosts and feeding areas). The greatest problem at many aerodromes is the presence of one or more waste disposal sites near the aerodrome. These facilities provide food for many birds, mainly gulls, which may then use adjacent aerodromes as loafing and resting sites.

Therefore, it is crucial aerodrome operators make submissions during urban planning or district scheme reviews and work with local authorities to ensure bylaws are established, so municipal authorities know that such activities influence bird populations, which can be hazardous to air transportation if near an aerodrome and approach or take-off flight paths for aircraft.

When hazardous land uses are already established and prohibitions or restrictions are not options, remedial action may be taken, for example:

- inform owners and managers about the hazards created by their operations
- help develop programmes to minimize the operation's attractiveness to birds.

Hazardous land use practices

Landfills

Landfills should not be located close to aerodromes, because they are immensely attractive to scavenging birds due to the abundant food source. However, landfills can be made less attractive to birds with:

- overhead wires installed to interfere with the birds' flight path
- the working area of the tip face made as small as possible and, preferably, contained in a pit where access by birds is restricted
- refuse being covered with soil daily to reduce available food sources when the landfill is not operating.

The dumping of food waste should be strictly controlled, with waste covered immediately.

Most active management techniques used at aerodromes can also be used effectively at landfills. Reducing a food source should reduce the bird population.

Wastewater treatment plants

Wastewater treatment plants should also not be located close to aerodromes. These sites normally contain settling or aeration ponds or other expanses of water that attract water fowl and sea birds.

Control methods aim to minimise the attractiveness to birds of the ponds and their environs as resting areas. They include:

- wires erected across ponds
- the gradient of the side slopes of ponds increased to deter birds from resting and to interfere with the birds' flight path to and from the water banks around ponds to obscure the birds' view of predators when they are on the water
- vegetation planted around ponds to reduce the areas available for resting and interfere with the birds' view and flight paths.

When tanks are used, the upper surface should be covered completely or with a wire grid or netting.

Agriculture

Crops

Aerodromes in rural locations are often bounded by areas suitable for agriculture. Even aerodrome operators use parts of their lands for crop production to increase revenues (e.g., brassica, corn or root crops or grass to be harvested as supplemental feed).

If cropping is to be conducted at the aerodrome, get advice from plant scientists or ornithologists to gauge the effect it may have on birds in the area. Grains and cereals are major bird attractants, so avoid them whenever possible.

Approach surrounding farmers to discuss the issues related to bird attractant agriculture. Develop good working relationships with the farmers, so you can try to influence the choice of crop planted or at least be kept informed of changes to plantings.

Ploughing and cultivating of the soil attracts gulls and, in the South Island, the black-fronted tern.

To mitigate the bird hazard try to influence the time of day that agricultural work takes place near the aerodrome (e.g., try to have it conducted at night, when aircraft traffic is likely to be minimal).

Animals

The rearing of animals can also attract birds, particularly during calving and lambing seasons, which provide an abundant food source for birds.

You can do little to detract birds in these instances, but ask farmers to keep animals away from paddocks neighbouring the aerodrome during this period.

Cattle sale yards also attract birds with their abundant food sources (e.g., flies and other insects attracted by the animals). Work with local authorities to ensure such activities are not planned or located close to aerodromes.

Recreational activities

Grounds

New Zealanders enjoy a lifestyle that encourages outdoor pursuits, which lead to open expanses of finely mown fields (e.g., golf courses, sports fields including school grounds, parks and picnic areas). These are potentially hazardous land uses, because of the high risk of food waste being left at the sites. Viewing areas at aerodromes, where people farewell others or watch the activity at the aerodrome, are also potentially hazardous land uses for the same reason.

These potential feeding grounds cause birds to fly across the aerodrome or flight path from their roosting site, using the aerodrome as a resting place.

Work with local authorities and sports clubs to minimise the food sources for birds in these areas, by encouraging the careful management of food waste and grounds.

Water

Many aerodromes are situated in coastal regions. Fishing and boating are popular pastimes for many New Zealanders. Assess and control bodies of water if water fowl may be attracted.

Discourage local fishers and boaties from cleaning fish or disposing of waste where birds, once attracted, might create a hazard to aircraft.

Contact the local harbour master and fishing, yachting and boat clubs to seek their help in eliminating these forms of food source that might create a hazard.

Consider displaying a sign at the local pier to deter people from these activities.

Passive management techniques – habitat modification

Passive management techniques modify the birds' habitat to make it less attractive or unattractive.

The main attractants to aerodromes and their environs for migratory or resident birds are food, water and shelter to feed, rest and nest safely.

Minimising or eliminating bird attractants

Food sources available to birds at aerodromes include food waste, seed-producing and aquatic vegetation, rodents, and invertebrates and earthworms. In all cases monitor the food source carefully and regularly.

Food

Waste

Managing edible waste in garbage is important.

Monitor restaurants and other food outlets at aerodromes to ensure their food wastes are properly contained during disposal.

Monitor carparks, viewing areas and other outside places where people congregate to ensure food waste left in the area does not become attractive to birds. Consider placing signs to discourage bird feeding in these areas.

Vegetation

Measures to control vegetation are discussed later in this document in the section 'Managing ground cover'.

Worms

Worms are a strong attractant to birds of all sizes. When it rains, worms are often seen on paved areas.

A longer term solution is a vermicide spraying programme to eradicate the worms. Spray all grass areas or just the area surrounding the manoeuvring area.

Insects

Insects, in larvae or adult form such as grass grub, porina moth and crane fly attract large numbers of birds. You may need expert assistance to identify an insect species being eaten by birds. Often insects are a seasonal problem, mostly around spring and summer.

Consider spraying grass areas annually, targeting these insects when they are evident.

Water

Ducks, gulls and shorebirds are particularly attracted to surface and standing water.

Modify or eliminate all physical features that hold standing water, for example:

- drain and backfill pits or depressions that regularly collect water after rain
- clear clogged waterways, especially drainage ditches, because not only are birds attracted by the water for drinking and bathing, they benefit from the insect and aquatic life that flourishes there
- cover bodies of water such as ponds with wire to stop birds from landing
- grade the banks surrounding ponds to discourage birds from resting in the water; they are less likely to frequent areas when they cannot see predators above the bank
- grade ditches so water runs off as rapidly as possible
- cut grass and other vegetation on sloping banks

- replace ditches with underground drainpipes or culverts.

Seek expert assistance from the Department of Conservation if wetland areas are within the aerodrome environs.

Shelter

Aerodromes provide a good place for birds to shelter where they can loaf, perch, roost and nest. Birds often seek the shelter of buildings on roof ledges, towers and aerials. They nest on roofs and ledges, in crevices and holes, in vents and ducts as well as in long grass, shrubbery and vegetation. However, once identified, these habitats can usually be modified to deter birds from sheltering there.

Birds also find safety in open spaces such as on paved areas and open short grass fields that afford clear views of the surroundings, so birds can see approaching predators.

Paved areas retain heat, so provide warmth during the evenings at certain times of the year.

Paved areas are also a hard surface onto which birds can drop shells and the like to break them and get at the food source inside.

Exclusion techniques

Netting

Netting can be used in a variety of indoor and outdoor areas to stop birds from entering an area to feed, roost or nest.

Netting is often used:

- in the open ceilings of buildings or across spouting
- across small ponds and drainage ditches
- over small areas of earthworks to prevent birds foraging for worms, insects or new seed
- over small to medium trees to discourage birds from roosting (although other visual bird deterrents are often more aesthetically pleasing).

However, netting can become a hazard if it becomes free and lodges in aircraft engines. Therefore, it is not recommended for use near aircraft movement areas.

Wire

Wire can be used in a variety of ways to exclude birds from specific areas.

Place wire about 0.75 m to 1 m from the surface to interfere with the birds' landing approach. Place the wires in a grid of about a square metre or more depending on the targeted species. This is effective on flat roofs and across aeration ponds for medium to larger birds. However, it is not practical against small bird species.

Wires placed much higher above the surface have been used in some locations such a refuse sites. This interferes with the bird's flight pattern and discourages it from the area.

Use wire or metal spikes set in clusters or an extended strip to deter birds, particularly smaller species, from landing on building ledges or on top of aerial towers or power poles. The spikes make it impossible for the bird to land.

Chemical

Chemicals used for exclusion purposes are usually sticky substances (i.e., tactile repellents) that deter birds from roosting on ledges and other flat surfaces. Although effective in the short term they require reapplication (often annually) to maintain their effectiveness.

Consider whether such areas will be accessed frequently by people (e.g., during preventative or regular maintenance routines).

Managing ground cover

Grass management

All aerodromes have grassed areas, which are major attractants to birds, primarily for feeding, but also for loafing and sometimes nesting.

The most effective grass management technique depends on the problem bird species.

You need to also consider the environment, including the soil type and climate, in which the grass will be grown. The grass type that best matches the management technique also needs to match the environment in which it is to be planted.

Weeds provide another food source and cause less dense patches of vegetation, where birds can rest, so a thick sward of grass is ideal.

While you can modify the soil (e.g., by applying fertiliser), you cannot influence the climate. Get assistance from local farmers, seed suppliers, local authority parks and reserves staff, green keepers or scientists specialising in grass management when choosing the grass.

Grass requires constant attention with mowing, weed spraying, and fertiliser and pesticide application. However, this effort can result in an effective long-term solution to control birds.

The best grass height depends on the bird species being targeted. Short and long grass management techniques have advantages and disadvantages.

Long grass technique

Use long grass to discourage birds that like wide open spaces where they can see any threat or predator approaching. Although this is the case for most birds, it is particularly so for the spur-winged plover and black-backed gull.

It is important the grass grows thickly to be most effective as a deterrent. Cut the grass low and apply fertiliser before spring to maximise the benefit obtained during spring growth and encourage the grass to grow densely.

The grass should be about 30–40 cm in height, but not left to go rank, which creates a thatching effect across the ground, negating its purpose.

Do not allow seed heads to develop, attracting birds.

Take care to ensure the grass does not obstruct visual navigation aids or signs.

Long grass will deter larger birds such as spur-winged plovers from feeding and loafing in these areas. Smaller birds such as starlings, sparrows and finches will not be attracted to the longer grass unless it begins to seed. However, birds such as the Canada goose and paradise shelduck feed on grass, particularly when grain, pea and cereal crops are not available. They are particularly attracted to new grass growth.

Birds such as ducks and black-backed gulls have also been known to build nests in longer grass.

Long grass can also attract rodents. Careful monitoring is required to ensure rodents do not become a food source attractive to another species such the harrier (hawk) or become a wildlife hazard themselves.

Short grass technique

Use short grass to discourage rodents and other wildlife that might find refuge or protection in longer grass.

The optimum grass length to deter smaller bird species and discourage rodents is about 15–20 cm.

The disadvantage of this technique is that it creates suitable areas for larger bird species to loaf and feed.

Combination long and short grass techniques

Some aerodromes have adopted a combination of long and short grass. Grass is grown long around the runway and taxiway areas, but kept short in outer areas.

Another technique that has been trialled was to grow long grass in strips of about 1–2 m wide at right angles to the runway with about 20 m of short grass between strips. The objective of this method was to make sure birds could not see approaching threats or predators when they were in the short grass, so were discouraged from being in those areas. However, the grass used could not be grown to a sufficient height or density to provide a suitable visual barrier. With the right grass, however, this technique should work.

Planting out

Another way to modify a bird's habitat is to plant out the area being used by the birds.

In one case, the site modified was not at the aerodrome, but was the nesting site for a colony of black-backed gulls that crossed the flight path of aircraft every day, flying to and from their feeding sites. As part of a longer term plan, the site was planted in native trees to discourage the birds, which prefer nesting in pasture land. This has reduced the available nesting sites and shifted the bird population away from the area.

Active management techniques

Active management techniques do not modify the birds' habitat; they aim to disperse the birds (i.e., visual or auditory deterrents) or remove them (i.e., elimination and relocation).

If large flocks of birds are evident on the aerodrome and cannot be effectively dispersed from the area, the aerodrome operator should issue a NOTAM to advise flight crews of the potential hazard.

Dispersal techniques

Birds quickly become accustomed to deterrents that are used excessively or exclusively. Therefore, it is important to use a range of deterrents and to change the location of deterrents regularly and randomly to maintain their effectiveness. Combining dispersal techniques with removal will also keep the birds wary of the deterrent.

Migratory birds can pose additional dispersal challenges, because of their transient nature. Close examination of their flight paths and habits is required. This information should be published in the *New Zealand Aeronautical Information Publication* or notified directly to aircraft operators.

Visual deterrents

Visual deterrents are placed in the aerodrome environs to make a particular bird species so uncomfortable they leave the area.

Kites

Kites have been used to good effect to scare birds, especially kites in the form of predatory birds. This is a more effective control against smaller birds.

It is important such items are well tethered and do not pose a threat to aircraft

Statues

Statues of predatory birds have been used to limited effect against smaller bird species.

Items that dazzle

Items that dazzle birds are effective at dispersing birds to other areas (e.g., tinsel strips, streamers on strands of wire from multiple electric fence standards, or rotating shapes with shiny surfaces).

Use such devices cautiously to ensure pilots are not dazzled.

Hanging items in trees

Metal cat faces with prominent eyes hung in trees or shrubs have also been used to good effect to discourage smaller birds from roosting or nesting.

Patrols

Use vehicle and people patrols in areas where birds congregate.

However, if birds become accustomed to vehicles they will stay just out of its range without dispersing.

Dogs

Dogs trained especially for bird scaring are used effectively in the United States. The dogs are screened for their suitability and trained on military and civilian aerodromes, so they become accustomed to operating around various aircraft.

However, exercise extreme caution to ensure dogs do not become a hazard. Dogs are best used during periods of no aircraft activity.

Pyrotechnics

Pyrotechnics are effective visual and auditory deterrents – a flash of light and an explosive noise. As with other deterrents excessive use can reduce their effectiveness.

Pyrotechnic cartridges such as Bird Frite cartridges are fired from shotguns. Operators must be properly trained in their use.

Exercise caution when using pyrotechnics near the manoeuvring area. Coordinate with Air Traffic Control units to ensure aircraft safety is not further compromised.

Auditory deterrents

Auditory deterrents target the birds hearing to cause distress in the bird.

Ultrasonic devices

Ultrasonic devices transmit noises above the range of human hearing and cause birds distress.

They have been used effectively, predominately in hangers.

Bird distress and predatory bird calls

Playing bird distress calls over loud speakers, targeting a specific bird species, has been used effectively. Playing predatory bird calls has some effect against smaller birds.

However, play bird distress calls cautiously, as some bird species (e.g., magpies) are attracted to the calls of their own species. Seek expert assistance to ensure birds will disperse and not attract more birds to the area.

Pyrotechnics

As discussed above, pyrotechnics are effective visual and auditory deterrents.

Removal techniques

Removal techniques include elimination and relocation. However, authorisation is often required to kill or disturb bird species.

Protected species

Wildlife Act 1953

The Wildlife Act 1953 regulates the control and protection of wildlife. It sets out, among other things, levels of protection for birds. Birds in New Zealand are protected unless listed in the Act's Schedules. The Schedules of relevance to the control of birds at aerodromes are:

- Schedule 1 – Wildlife declared to be game
- Schedule 2 – Partially protected wildlife
- Schedule 3 – Wildlife that may be hunted or killed subject to Minister's notification
- Schedule 5 – Wildlife not protected.

View the Act at www.legislation.govt.nz

Many problem species at aerodromes are protected under the Act. Species such as the red-billed gull, black-billed gull, spur-winged plover and oystercatcher are not listed, so are protected. Other species such as the mallard, paradise shelduck and Canada goose are listed as game birds, but are protected outside of hunting seasons, the dates of which local Fish and Game Councils establish.

Therefore, it is important to obtain authorisation before eliminating any protected bird species at the aerodrome, regardless of the birds' stage of development (i.e., embryo, juvenile or adult).

Authorisation

Obtain authorisation to kill or disturb a protected species from the local Conservancy Office of the Department of Conservation, stating which birds you are seeking to control.

Such authorisation is likely to be subject to conditions. It is usually preferred that all attempts using alternative methods are tried before protected birds are killed, and only then is killing authorised if the birds are constituting a hazard to the safe operation of aircraft. The number of birds killed is to be kept to a minimum.

Record killed birds with leg bands and send their details to the Department of Conservation.

Any unusual species killed might also need to be frozen, pending further notice by the Department of Conservation.

Maintain accurate records when this authorisation is invoked. You will need to send details at least annually to the Department of Conservation.

Relocation

For protected bird species that are rare or have some other particular significance, seriously consider capturing the birds and relocating them away from the aerodrome.

Trapping or netting can be attempted with help from the Department of Conservation, local animal welfare agencies or expert ornithologists. The objective is to capture the bird with the minimum of stress and harm for the bird.

One disadvantage is that most birds have strong homing instincts and can return to areas from where they were trapped in a short time. Seek expert guidance.

Although not protected or rare, magpies have been successfully relocated to other territories. However, be cautious when caging or netting magpies, as their distress calls will attract other magpies.

Targeting eggs and juveniles

Eggs

Reduce the local population of a bird species by searching for nests and destroying eggs. This has the long-term effect of reducing the number of breeding birds and the number of juvenile birds in the air.

A continual failure in breeding at a particular site will lead to some bird species leaving the area. Birds such as the black-backed gull can have a life span of up to 28 years, so reducing the size of the breeding colony can be particularly important.

Care needs to be taken, however. Different bird species react differently to the destruction of their eggs. The black-backed gull will continue to lay if one clutch of eggs is destroyed or removed. Therefore, breaking eggs in the nest can inadvertently extend these birds' breeding season. On the other hand, the spur-winged plover is likely to leave the nest.

To overcome the problem of extending the breeding season, inject gulls' eggs with formaldehyde to kill the embryo. Mark such eggs and leave them in the nest. Monitor the nest to ensure no new eggs are laid. The gull will continue to lay on the nest until it is clear the eggs are unviable. By this stage, however, the gull is unlikely to reproduce again that season.

Obtain expert assistance to undertake this method of control. It is also wise to use a dye in the solution injected, so if anyone takes the eggs, it will be evident when the egg is broken that the content is inedible.

Some aerodromes have used mechanical means to destroy the eggs of ground nesting birds. A vehicle towing harrows, a roller or a leveller or objects such as a piece of railway iron, a wire

gate or several tyres tired together can be effective. Take care not to damage any other aerodrome infrastructure such as lighting or signs.

Juveniles

Nestling chicks can be killed in the nest and removed from the site.

Juvenile birds, particularly gulls, ducks and plovers, may pose an increased hazard to aircraft compared with adult birds as they have not developed a cautious awareness of aircraft and are less agile or predictable in flight. Targeting younger birds when shooting could reduce this risk.

Elimination

The most permanent solution to any bird hazard is to kill the problem birds by shooting them or poisoning them directly or indirectly (i.e., through their food).

Shooting

Shooting birds is not always easy to implement. Birds can become cautious, recognising specific vehicles transporting shooters, and can remain outside the danger zone making it difficult to approach them. Some aerodromes have increased their chances of success in implementing this approach by a number of methods. Using game bird hunters has been successful; as has using helicopters to shoot the birds while they are on the ground either congregating generally or during the moult.

Extreme care needs to be taken when using live ammunition, particularly when shooting on or near an aerodrome.

Poisoning

Another method to eliminate problem birds is poisoning. The use of Alphachloralose by registered users is the most effective method for killing large numbers or specific pockets of birds.

Monitor the birds' habits to determine the best location and method for applying the poison.

Familiarise the birds with the food source and to test their acceptance of the bait in a series of baiting sessions. It may be necessary to encourage the birds to feed at a different time of day to reduce the geographical spread of dead birds. This might be achieved by encouraging the birds to feed before roosting or nesting for the evening.

Careful planning is required to minimise the number of non-target species killed.

This method has been known to work successfully with black-backed gull, feral pigeons, starlings and ducks.

Partnerships

Bird hazard management programmes are most effective when all stakeholders are involved in their development and implementation.

Expert assistance

Ornithologists can provide consulting services to help develop bird hazard management programmes. (Some also specialise in wildlife hazard management.) Local ornithologists can advise you and carry out the ecological survey and annual bird counts.

For ornithologists in your district, contact the Ornithological Society of New Zealand, PO Box 12397, Wellington or OSNZ@xtra.co.nz.

Scientists from Landcare Research or universities can help with managing soil, grass and food sources at aerodromes.

Pest destruction agencies usually also cater for smaller species of birds, generally in and around buildings.

Local authorities

Local authorities are responsible for planning land use activities, and setting bylaws and for wastewater treatment, landfills and parks and reserves including sports fields.

Local authorities should be told about the hazards and encouraged to develop land use restrictions and management techniques to minimise the presence of birds near aerodromes.

Department of Conservation

The local Conservancy Office of the Department of Conservation is charged with managing the wildlife in its region. Staff authorise the disturbing or killing of problem protected species and provide information about specific species (e.g., their habitat, food sources, populations and colony sites and control methods). Staff can also help with ecological studies.

The Department of Conservation worked with aerodrome operators to reduce a problem species, the black-backed gull, which in turn helped to re-establish native birds in the general area.

Interested parties

Other interested parties are often willing to help you if it will be mutually beneficial. For example, the Ornithological Society of New Zealand and Royal Forest and Bird Society may help with ecological surveys, species identification and population counts and universities may help with researching birds, animal behaviour and soil, crop or pasture management.

Graduate students may be undertaking independent field research that is relevant to the bird hazard management programme and may be willing to share information or trial new techniques with aerodrome operators.

Communication and the media

Communication plays a big part in any bird hazard management programme. This is particularly important if you are about to implement a control programme that extends beyond the aerodrome's boundaries and is aimed at reducing the population of a particular species.

The public does not usually view an active reduction in bird numbers favourably. Therefore, you need to manage the media carefully. To help minimise negative publicity, emphasise the programme's safety aspects and the alternative measures that have been taken. Consider whether it would be better to do this before or after you have implemented the programme. Consider using communication professionals to minimise the negative impact on the industry in general.

Sometimes local authorities will require you to place advertisements in local newspapers, distribute fliers, or place signs at strategic locations to advise the public about the control

programme. If this is the case, provide a contact name and number on the advertisement, flier or sign, so pubic enquiries can be dealt with consistently by an informed person.

Other information sources

Information is paramount when developing a bird hazard management programme. All aerodromes operators share similar problems, albeit to differing degrees. Network with other operators to keep abreast of new techniques and share experiences with problem species.

Additionally, the International Civil Aviation Organisation has published a generic document on bird control and reduction, *Airport Services Manual* (Doc 9137-AN/878), which you can get from the Civil Aviation Authority.

Detailed information is also available on the internet. A particularly good source is Transport Canada (responsible for civil aviation in Canada), which has published comprehensive documents on bird hazard management particularly for aerodrome operators. Download Transport Canada's *Sharing the Skies: An Aviation Industry Guide to the Management of Wildlife Hazards* or *Wildlife Control Procedures Manual* or other documents from http://www.tc.gc.ca/en/menu.htm. Other similar agencies also publish on relevant topics.

Get books on New Zealand birds from local book shops or libraries to help you recognise and better understand a particular bird's preferred habitat and food source.

Include UK CAP 680, US Department of Agriculture – Wildlife Hazard Management at Airports (Richard Dolbeer and Ed Cleary)

Appendix 1

Specific species – descriptions and control methods

The synopses that follow outline the status (protected, unprotected or game bird) of the 14 problem bird species and describe the adults and juveniles, breeding and nesting habits, other characteristics and the most effective methods for controlling them. The species are the:

- Australasian harrier (or hawk)
- Black-billed gull
- Canada goose
- Finch (chaffinch, greenfinch and goldfinch)
- Magpie
- Mallard
- Paradise shelduck
- Pigeon
- Red-billed gull
- South Island pied oystercatcher
- Southern black-backed gull
- Sparrow
- Spur-winged plover
- Starling

Australasian harrier (or hawk)

Status

Schedule 3 – Wildlife that may be hunted or killed subject to Ministers notification.

Description – adult

- Upper surface – mainly dark brown.
- Under parts – light yellowy-buff with streaking.
- Eye ring – yellow.
- Iris – light brown.
- Bill – blue-black.
- Legs and feet – yellow.
- Claws – blue black.
- Full grown height – 60 cm.

Older male

- Wings – often silvery-grey.

Description – juvenile

Nestling

- Down – buff white.
- Feet – pink changing to yellow.

Immature bird

- Similar to adult, but undersides more chocolate brown.

Breeding period

- Nests on ground, mainly in swamps and scrub areas.
- Lays October to December; usually four chalky-white eggs.

Other

- Bird of prey.
- Feeds mainly on small mammals, insects, lizards and occasionally small birds; often seen eating animals killed on the road or shot in the field, e.g., rabbits.

Methods for controlling species

Use short grass management technique.

- Use pyrotechnics (e.g., Bird Frite).

Black-billed gull

Status

Fully protected.

Description – adult

- Head, neck, under parts and tail – white.
- Back – pearly grey.
- Wings – black tipped with white.
- Eye ring – red June to January, otherwise black.
- Iris – white.
- Bill – slender and black.
- Feet – black with dull red patches.
- Full grown height – 37 cm (half the size of the black-backed gull)

Description – juvenile

- Head –brown and back.
- Wings – brown patches.
- Tail – white with traces of black.
- Eye ring – dark brown.
- Iris – dark brown.
- Bill – flesh pink with grey black tip.
- Legs – flesh pink with black tinge.

Breeding and nesting habits

- Breeds in colonies.
- Builds nests early October; nests on larger shingle riverbeds and around lakes; usually returns to same nesting site as previous year.
- Lays October to December; two to three eggs, pale grey, pale olive-green or pale blue, usually with dark and light brown patches.

Other characteristics

- Feeds on aquatic and land insects.
- Often seen in ploughed fields and scavenging at refuse tips during winter; prevalent in the South Island, but some colonies in the North Island.

Methods for controlling species

- Use long grass management technique.
- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite).
- Gain local council support for managing refuse sites and playing fields to minimise food sources.

Canada goose

Status

Schedule 5 – Wildlife not protected.

Description – adult

- Head – black.
- Neck, chin and throat – white.
- Under parts – pale grey-brown to cream.
- Wings – pale grey-brown to cream.
- Eyelid – black.
- Iris – dark brown.
- Bill – black.
- Feet – dark grey.
- Full grown height – 1 m.

Description – juvenile

At hatching

- Crown – olive.
- Head and neck – bright yellow.
- Upper parts – olive-brown.
- Under parts – yellow.

At second covering

- Down – dirty grey.

Breeding and nesting habits

- Builds nests early September; nests on ground, but not necessarily near water, generally in high country.
- Lays late September/October; young birds may lay November; four to seven creamy-white eggs.

Other characteristics

- Feeds on grasses and green fodder crops.
- Congregates in flocks for moult during late summer.
- Lives for up to 25 years.

Methods for controlling species

- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and live shells.
- Shoot flocks en masse during moult to reduce population.

Note: It is important to disturb the birds as soon as they appear, so they do not establish a tradition of feeding, nesting etc.

Finch (chaffinch, greenfinch and goldfinch)

Status

Schedule 5 – Wildlife not protected.

Description – adult

Chaffinch

- Wing – two conspicuous white bars.
- Full grown height – 12 cm (about same size as sparrow).
- Male – breast rich pinkish brown.
- Female – drab.

Greenfinch

- Tail – forked.
- Bill – pale and heavy.
- Full grown height – 12 cm (larger than sparrow)
- Male – olive green with yellow markings on wings and tail.
- Female – duller and browner than male.

Goldfinch

- Head – red, white and black (distinctive).
- Wings – black with conspicuous broad yellow band.
- Full grown height – 10 cm (smaller than sparrow).

Breeding and nesting habits

- Lays four to six eggs.

Chaffinch

- Breeds October to February.

Greenfinch

- Breeds September to January.

Goldfinch

- Breeds September to December.

Other characteristics

Chaffinch

- Feeds on insects and seeds.
- Often flocks with other finches in winter.

Greenfinch

- Feeds on seeds, fleshy fruits and insect larvae.
- Flocks in autumn.

Goldfinch

- Feeds on seed heads, especially composites (e.g., dandelion and thistle), insects and their larvae.
- Often flocks with other finches in winter.

Methods for controlling species

- Use short grass management technique.
- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and live shells.
- Shoot flocks en masse to reduce population.

Magpie

Status

Schedule 5 – Wildlife not protected.

Description – adult

- Head – black.
- Plumage – black and white (distinctive).
- Full grown height – 40 cm.
- White-backed species (predominate) and black-backed species.

White backed male

- Back – white.

White backed female

- Back – grey.
- Bill – blue-white with black tip.
- Legs –black.

Breeding and nesting habits

- Breeds August to November.
- Nests in high trees offering shelter.
- Lays two to five eggs, bluish-green with greyish brown blotches.

Other characteristics

- Lives in groups.
- Territorial.
- Feeds usually in open pastures; mainly feeds on insects and other invertebrates such as spiders, slaters, centipedes, small snails and earthworms; also feeds on lizards, mice, small birds and seeds, especially clover and clover leaves.
- Captive birds live up to 15 years.
- Keeps away smaller birds.

Methods for controlling species

- Use long grass management technique.
- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and live shells.
- Trap birds (by cage) for relocation to other areas.

Mallard

Status

Schedule 1 – Wildlife declared to be game.

Description – adult

- Wide individual variation in density of markings.
- Fully grown height – 55 cm.

Male breeding plumage

- Head – glossy green with white collar ring.
- Upper breast – chestnut.
- Under parts – finely streaked silvery grey.
- Wings – grey with bright blue patch with white margins.
- Iris – dark brown.
- Bill – yellowish green.
- Legs – orange.

Male eclipse plumage (late summer and autumn)

- Similar to female, but olive green bill.

Female

- Chin, throat and front of neck – light buff.
- Upper body – brown, streaked and spotted with lighter markings.
- Eyes – irregular dark line through them.
- Wings – similar to male.
- Bill –orange-brown.
- Legs – orange.

Description – juvenile

Duckling (two to three weeks old)

- Blackish brown.
- Face – yellow.
- Eyes – dark line through them.

Juvenile

- Similar to adult female, but duller.

Breeding and nesting habits

- Breeds September to December.
- Nests commonly in rank pasture grasses or under bushes close to water; may nest under logs and buildings.
- Lays an average 12 eggs, cream with light green tinge; may lay again if first clutch of eggs lost.

Other characteristics

- Feeds on plants or small insects mainly aquatic invertebrates; ripening grain and pea crops also favoured.
- Tolerant of people although as a game bird is extremely wary.

Methods for controlling species

- Use short grass management technique during breeding season.
- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and live shells.

Paradise shelduck

Status

Schedule 1 – Wildlife declared to be game.

Description – adult

- Full grown height – 63 cm.

Male

- Predominantly black with metallic sheen on head.
- Upper and lower wings – white.
- Eye rings – black.
- Bill – black.
- Legs – black.

Female

- Head – white.
- Back – dark.
- Under parts – chestnut.
- Eye rings – black.
- Bill – black.
- Legs – black.
- Tail – black.

Description – juvenile

Duckling

- When hatched – white.
- Top of head – brown.
- Back of head to tail – brown stripe.
- Wings – brown mark.

Fledgling

- Resembles adult male.

Breeding and nesting habits

- Breeding season August to December.
- Nesting starts in August; nests hidden in depression on ground or in hollows or trees, not necessarily adjacent to water.
- Lays 5–10 cream eggs; lays few eggs after October.

Other characteristics

- Principle habitat is grazed pasture.
- Feeds on young grass and clover shoots particularly; also grains and seed heads; will feed on insects and earthworms when available.
- Non-breeding birds generally remain in large flocks.
- Flocks during moult in late summer, usually around lakes and ponds.
- Flightless during the moult.

Methods for controlling species

- Use long grass management technique and careful selection of grass type.
- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and live shells.
- Destroy flocks during the moult to maximise population reduction.

Pigeon

Status

Schedule 5 – Wildlife not protected.

Description – adult

- Plumage – varies.
- Head and chin – light grey.
- Throat, upper breast, side of neck – metallic green or purple.
- Breast and rump – light grey.
- Iris – orange-red with yellow inner ring.
- Bill – slate.
- Legs and feet – dull red.
- Full grown height – 33 cm.

Description – juvenile

- Like adult, but darker and browner without metallic sheen.

Breeding and nesting habits

- Nest on ledges of buildings.
- Breeds throughout the year, peaking in spring and summer; reaches breeding maturity at six months.
- Lays two white eggs.

Other characteristics

- Travels in flocks.
- Often travels long distances between roost and feeding grounds in rural areas.
- Feeds on grains, cereals, peas, worms, slugs, snails, and bread (from people).

Methods for controlling species

- Use short grass management technique and careful selection of grass type.
- Use vermicide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and live shells.
- Poison flocks (with Alphachloralose) by baiting feed.
- Place wire spikes on ledges and netting over holes in buildings.

Note: Pigeons are sometimes kept for racing. If they are based near the aerodrome they could cause problems. Liaise with pigeon owners to encourage them to exercise the birds when the aerodrome is least busy. Seek local council assistance if necessary.

Red-billed gull

Status

Fully protected.

Description – adult

- Head and neck – white.
- Under parts – white.
- Back – pearly grey.
- Wings – black tipped with white.
- Eye rings – scarlet; iris – white.
- Bill – short and red.
- Feet – scarlet.
- Tail – white.
- Full grown height – 37 cm (half the size of the black-backed gull)

Description – juvenile

Similar to adult, but:

- Wings – brown-black patches.
- Eye ring and iris – dark brown.
- Bill – dark brown.
- Legs – dark brown.

Breeding and nesting habits

- Breeds in colonies.
- Builds nests in September; nests on islands, rocky headlands, cliffs and beaches.
- Lays October to December; two to three eggs, grey to brown with light and dark brown blotches all over.

Other characteristics

- Feeds on small fish, crustacean and worms; sometimes feeds on berries and scavenges dead animal matter.
- Tends to be coastal, but can become a problem when it is stormy at sea, so moves inland to feed.

Methods for controlling species

- Use long grass management technique.
- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite).
- Gain local council support for managing refuse sites and playing fields to minimise food sources.

South Island pied oystercatcher

Status

Fully protected.

Description – adult

- Upper parts – conspicuously black with white below.
- Breast plumage – extends from above to in front of closed wing.
- Eye rings – orange; iris – scarlet.
- Bill – bright orange with yellow tip.
- Legs – coral pink.
- Full grown height – 46 cm.

Description – juvenile

Nestling

- Body – light grey to buff brown.
- Eye rings – brown changing to yellow near fledgling.
- Iris – brown.

First year

- Upper parts – brown feathers with buff edges.
- Legs – grey-pink.

Second year

- Upper parts – black.
- Iris – red.
- Legs – pale pink.

Breeding and nesting habits

- Breeds August to January; birds pair up and occupy same territories yearly.
- Nests in shingle inland riverbeds.
- Lays two to three eggs, pale brown with black and brown blotches.

Other characteristics

- Flocks January to August; mainly on estuaries, mudflats and wet paddocks and migrate throughout New Zealand.
- Feeds on aquatic insects, worms, snails and shellfish.
- Variable oyster catcher is slightly larger and completely black; it has similar characteristics, but is found only on shorelines.

Methods for controlling species

- Use long grass management technique.
- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite).

Southern black-backed gull

Status

Schedule 5 – Wildlife not protected.

Description – adult

- Male marginally larger than female.
- Plumage – white, except for back and tops of wings – black.
- Rest of plumage – white.
- Eye rings – bright orange.
- Iris – grey.
- Bill – yellow to orange-yellow; deep orange or red spot on lower mandible.
- Legs and feet – yellow to pale orange.
- Full grown height – 60 cm.

Description – juvenile

Nestling

- Upper parts – dark lead grey with darker spotting on head.
- Chest and lower wing down – grey with white tips.
- Iris – dark brown.
- Bill – black.
- Legs and feet – dark brown.

First year

- Plumage – mottled greyish-brown.
- Eye rings – grey.
- Bill – black.
- Legs and feet – brown.

Second year

- Head, neck and upper chest – spotted with brown.
- Back – black mixed with brown–black.
- Under parts – mainly white.
- Tail – dark brown with white bars.
- Eye rings – yellow.
- Iris – grey-brown.
- Bill – pale yellow, often with black band at tip of lower mandible.
- Legs and feet – blue-brown.

Third year

Like adult, but often:

- Head, neck and upper breast – brown mottling.
- Eyelids and beak –paler.
- Legs and feet –paler.

Breeding and nesting habits

- Largest New Zealand gull species.
- Can start breeding in third year.
- Builds nests August/September; nest sites vary from open pasture to beaches, rock ledges, rushes and small scrubs.
- Lays October to January; three green or grey eggs.

Other characteristics

- Varies diet to suit environment.
- Flocks between breeding seasons.
- Can live to 28 years.

Methods for controlling species

- Use long grass management technique.
- Use vermicide and pesticide on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and occasional live shells.
- Use wires on flat roof surfaces.
- Gain local council support for managing refuse sites and playing fields to minimise food sources.
- Destroy eggs by injecting them with formaldehyde.
- Poison (with Alphachloralose) colonies and juveniles known to cross flight paths.

Sparrow

Status

Schedule 5 – Wildlife not protected.

Description – adult

- Full grown height – 14 cm.

Male

- Back – rich reddish brown with black streaks.
- Throat – black bib.
- Under parts – greyish brown.
- Bill – brown, but black during breeding.
- Feet – pale reddish brown.

Female

- Similar to male, but no black bib down throat.

Breeding and nesting habits

- Breeding season is September to February.
- Nests in holes in buildings, tress and cliffs, and high trees.
- Raises several broods.

Other characteristics

- Gregarious.
- Feeds in flocks of varying size.
- Roosts communally in dense trees or hedges.
- Feeds predominately on seeds, but also insects; nips shoots from sprouting crops and buds and blossoms from fruit trees.
- Enters buildings for human-produced food.

Methods for controlling species

- Use short grass management technique; select grass type carefully.
- Use vermicide and pesticides on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and live shells.
- Place netting over holes in buildings.
- Use moving visual deterrents (e.g., kites, tinsel or metal cat faces hung in trees).
- Poison flocks' feed.

Spur-winged plover

Status

Schedule 5 – Wildlife not protected.

Description – adult

- Crown and shoulders – black.
- Back – olive-brown.
- Under parts – white.
- Facial wattles – yellow (distinctive).
- Wing spurs – yellow.
- Iris – brown.
- Bill – yellow.
- Feet and legs – red with grey-black scale pattern.
- Full grown height – 38 cm.

Description – juvenile

Nestling

- Crown – black, lightly flecked brown and buff; narrow black band above white collar.
- Upper surface and shoulders – flecked black, brown and buff.
- Under parts – white.
- Wattle – small and putty-yellow.
- Bill – slate blue.
- Legs and feet – slate blue.

Immature bird

- Crown – speckled, later black and brown bars.
- Shoulder – patch smaller and less prominent than adult.
- Wattles – small putty coloured with lemon tinge.
- Bill and small wing spurs – horn coloured with brown tips.
- Legs and feet – red-grey.

Breeding and nesting habits

- Nests built in hollows in ground with clear view.
- Breeds July to December.
- Lays three to four eggs, muddy-green with variable blotching or purplish brown all over.

Other characteristics

- Feeds on worms and insects; forages in short pasture, cultivated paddocks, hay stubble, low crops or areas left fallow.
- Flocks in autumn and winter.
- Once settled, lives within a range of 3–4 km.
- Can live for up to 12 years.

Methods for controlling species

- Use long grass management technique.
- Use vermicide and pesticides on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and occasional live shells.
- Destroy eggs and nests during breeding season.
- Shoot flocks from helicopters.

Starling

Status

Schedule 5 – Wildlife not protected.

Description – adult

- Full grown height – 20 cm.

Male – autumn

- Plumage – blackish with green and purple sheen.
- Upper body – buff-tipped feathers.
- Upper breast – iridescent.
- Under parts – white tips.
- Iris – dark brown.
- Bill – brownish black.
- Legs – reddish brown.

Male – summer

- Whole bird –darker and glossy.
- Bill – becomes yellow and mandible blue at base.

Female

Similar to male, but:

- Iridescent colours less brilliant.
- Iris – brown with yellow or orange outer ring.
- When bill is yellow, lower mandible is pale yellow or pinkish white.

Description – juvenile

- Upper parts – uniform greyish brown flecked with brown.
- Under parts – brown.
- Bill – brownish black.

First autumn

- Feather tips – white and buff, giving spotted appearance.

First spring

- Spots wear off; like adult, but iridescent colours less bright.

Breeding and nesting habits

- Breeds September to January, often in two broods.
- Nests in holes in trees, cliffs, banks, buildings and other structures.
- Lays four to six pale blue to white eggs.

Other characteristics

- Feeds on worms, insects, fruit and seeds.
- Prefers open pasture, but avoids tall grass.
- Travels 20–30 km between roost and feeding ground common.
- Feeds in flocks.
- Roosts communally after breeding season.

Methods for controlling species

- Use long grass management technique (i.e., grow grass 20 cm or longer).
- Use vermicide and pesticides on manoeuvring area grassed surfaces.
- Use pyrotechnics (e.g., Bird Frite) and occasional live shells.
- Place netting over holes in buildings.
- Use moving visual deterrents (e.g., kites, tinsel or metal cat faces hung in trees).
- Poison flocks' feed.