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ADVISORY

WILDLIFE HAZARD MANAGEMENT

1. AUTORITY

This advisory circular is issued by the Executive Chairman of Instituto of Civil Aviation of Mozambique (IACM) in pursuance of power vested in him under Article 31 of Law 21/2009 of 21 September and Article 12 of Resolution 19/2011 of 30 of November.

2. OBJECTIVE

An important consideration related to aerodrome operational safety is the prevalence and habits of wildlife in the area and the associated risk of aircraft wildlife strikes. Wildlife hazards at proposed new aerodromes can be minimized by careful selection of the aerodrome site; for example, avoiding established bird migration routes and areas naturally attractive to birds. Wildlife hazards may also be minimized by using the land surrounding the aerodrome for purposes which will not attract concentration of the wildlife to the area. At existing aerodromes, the wildlife problem may be controlled by making the aerodrome and its environment unattractive to wildlife. The purpose of this Adviser Information Circular is to provide guidance to the aerodrome operators in the Republic of Moçambique on the procedures and methods for managing and mitigating against wildlife hazards.

3. REFERENCE

1) MOZ CARS 139
2) MOZ CATS 139, Volume I
3) MOZ CATS 139, Volume II
4) ICAO Annex 14 – Aerodromes
a. Volume I – Aerodromes Design & Operations
b. Volume II - Heliports
5) ICAO Doc 9137 Part 3 – Bird Control and Reduction

6) ICAO Doc 9184 Part 2 – Land Use and Environmental Control
7) ICAO Doc 9332 – Manual on the ICAO Bird Strike Information System (IBIS)

4. INTRODUCTION

The onset of the jet age revolutionised air travel, but magnified the wildlife strike problem. Early piston –powered aircraft were noisy and relatively slow. Wildlife could therefore avoid the aircraft and the strikes which did occur typically resulted in little or not so significant damage. Modern jet aircraft are fast and relatively quiet and their engine fan blades are more vulnerable than propellers to wildlife strike damage. When turbine-powered aircraft collide with birds or other wildlife, serious structural damage and engine failure can occur. Multiple-engine damage from ingestion of flocks of birds has been known to occur.

Air travel has increasingly become common place. Coincidentally, in many States including the Republic of Mozambique, wildlife management is also becoming increasingly successful. Aggressive natural resource and environment protection programs are contributing to the impressive increases in the population of many large-bodied species of birds. In the Republic of Mozambique, some species are protected by law. At the same time suburban and urban developments continue to be implemented in the vicinity of aerodromes, thus increasing the numbers of supposedly domestic animals and pets but also wildlife that cohabit with the population in and around aerodromes. These factors combined with the increased speed of aircraft and quietness, and vulnerability of modern aircraft, interacts to form the basis for the serious wildlife hazard that Aerodrome Operators face.

The nature and magnitude of the problem an individual aerodrome faces will depend on many factors including air traffic type and volume, local and migratory wildlife populations and local wildlife habitat conditions. Wildlife is attracted to the aerodrome environment because desirable food, water and/or habitat is present.

Successful aerodrome wildlife-management programs do not function in isolation; the aerodrome environment is only a small part of a local ecosystem, and any changes that take place at or near an aerodrome will have far reaching consequences. Failure to conduct appropriate ecological studies can lead to elimination of one hazard and creation of a far more serious one. **O**ff-aerodrome land management and use can contribute as much or more to the creation of wildlife hazards as those at an aerodrome itself. With urban-growth pressures showing no signs of easing, land in the vicinity of aerodromes have become more attractive for activities such as industry, waste-disposal, luxury water sports resorts and agriculture. If not planned and managed properly, these developments do increase the hazard to aircraft operations.

Aerodrome Operators have a responsibility to assess the risk and magnitude of the wildlife strike problem. This assessment must include accurate and complete reporting of all strike incidents, assessment of wildlife using the aerodrome environment and assessment of the wildlife habitat available to wildlife at the aerodrome. Based on the aerodrome conditions and this assessed strike risk, the Aerodrome Operator should develop a Wildlife Hazard Management Plan (WHMP) for reducing strike risk and occurrence.

5. WILDLIFE HAZARD MANAGEMENT PLAN (WHMP)

5.1. Management of the WHMP

The Aerodrome Operator should designate a senior staff at the aerodrome, preferably the Aerodrome Operations Manager, to coordinate and be responsible for the implementation of the WHMP and to monitor its performance. The objective of the WHMP is to minimize the risk to aviation safety, aerodrome structures or equipment, or human health posed by the presence of populations of hazardous wildlife at or around the aerodrome. The WHMP should primarilybe structured so as to achieve the following:-

a) Identify the personnel responsible for the implementation of each phase of the plan;
b) Identify and provide information on the hazardous wildlife attractants on and in the vicinity of the aerodrome;
c) Identify appropriate wildlife management measures and techniques to minimize the hazard;
d) Identify and prioritize the appropriate wildlife management measures;
e) Identify and recommend to management the resources required;
f) Identify the training requirements for aerodrome personnel;
g) Identify public awareness campaign for the neighbourhood populations; and
h) Identify when and how the plan should be reviewed and updated.

5.2. Wildlife Hazard Committee

The implementation of the WHMP can only be effectively accomplished by the collective effort of many individuals and several agencies. The Aerodrome Operator, therefore, should appoint a Wildlife Hazard Committee to be chaired by the Aerodrome Operations Manager assisted by representatives from at least the Aerodrome Wildlife Management Unit, Aerodrome Maintenance Office, Aviation Security Office, Aerodrome Finance Office, Air Traffic Service, Law Enforcement Authority and a representative(s) of the Local Authority within which the aerodrome is located.

5.3. Wildlife management measures

MOZ-CATS 139 Volume I, para 139.9.4; requires Aerodrome Operators to regularly assess the wildlife strike hazard on, or in the vicinity of, an aerodrome. There are a number of methods by which this assessment can be made. The Aerodrome Operator is expected to use judgment to identify which is the most appropriate method based on an understanding of the type of hazard and surrounding environment. In particular this assessment is intended to specifically identify what attracts the wildlife at the airport in the first place and to take decision on how to minimize those attractants. Examples of wildlife attractants include but are not limited to:

a) Refuse dumps and landfills;
b) Sewage treatment and disposal facilities;
c) Agricultural - cultivation of land, types of activity e.g. pig farming;
d) Fish processing plants;
e) Cattle feed lots;
f) Wildlife refuges
g) Artificial and natural lakes;
h) Animal farms;
i) Abattoirs and freezing works.

4.3.1. Refuse dumps and landfills

Aircraft approach and take-off paths extend for a distance well beyond the runway threshold. For this reason, wildlife impact may not be immediately apparent. Local Authority solid waste landfills have been known to attract large numbers of hazardous wildlife, particularly birds. Because of this, these operations, when located within certain limits are considered incompatible with safe airport operations and should be monitored carefully to determine their effect to the wildlife hazard at the aerodrome.

Experience elsewhere has shown that refuse dump sites and landfill should be located no closer than 13 km from the aerodrome facility. The Aerodrome Operator should endeavor to lobby the land use planning office to achieve this limitation. Nevertheless, even if this limitation is achieved and a new refuse dump is proposed or exists beyond the 13km, there must be a requirement to provide bird control measures at the site to reduce its attractiveness to birds. The potential threat to aircraft depends on location of the site relative to the aerodrome and flight paths, type of refuse, and the bird species expected in the vicinity. No refuse dump has been known to effectively control the presence of birds as the measures necessary to achieve this are too expensive and regular monitoring and assessment is essential.

4.3.2 Waste disposal within the aerodrome

The Aerodrome Operator, in as much as they attempt to get the Local Authorities to properly manage the refuse dumps and landfills, should provide facilities within the aerodrome that ensure wildlife hazards are minimized. Some of the measures are:

a) Provide adequate numbers of waste disposal bins and ensure they are covered at all times;
b) If necessary provide waste-handling facilities that receive garbage behind closed doors and process it by compaction, incineration or similar manner;
c) Remove all residues by enclosed vehicles;
d) Waste disposal vehicles should not be located on the aerodrome property; and
e) Do not handle or store waste outside or in a partially enclosed structure accessible to hazardous wildlife.

Where trash transfer service is provided by the Local Authority or a third party, the Aerodrome Operator should ensure that they do not use facilities that leave the main doors open during normal operations, are open on one or more sides, temporarily store uncovered quantities of solid waste outside, use semi-trailers that leak or have trash clinging to the outside and do not control odours by ventilation and filtration systems.

4.3.3. Sewage treatment and disposal facilities

Wastewater treatment or similar facilities do attract wildlife and should not be located on or near the aerodrome. In any case the Aerodrome Operator should monitor the facility and encourage the wastewater treatment facility operator(s) to incorporate measures and mitigation techniques, developed in consultation with a wildlife management biologist, to minimize hazardous wildlife attractants into their standard operating practices. Wastewater treatment facilities sometimes employ artificial marshes and use emergent aquatic vegetation as natural filters. These artificial marshes may be used by various species of birds, such as blackbirds and waterfowl, for nesting, feeding or roosting. Disposal of wastewater or sludge on airport property even if to improve soil moisture and quality on unpaved areas leads to improved turf growth that can be an attractive food source for many species of animals. Also, the turf requires more frequent mowing, which in turn might mutilate or flush insects or small animals and produce thatch, both of which can attract hazardous wildlife. In addition, the improved turf might attract grazing wildlife. Problems might also occur when discharges saturate unpaved airport areas as the resultant soft, muddy conditions can severely restrict or prevent emergency vehicles from reaching accident sites in a timely manner.

4.3.4. Agricultural cultivation of land.

All agricultural crops do attract hazardous wildlife during some phase of production. Avoid production of cereal grains and sunflowers. The Aerodrome Operator should weigh the cost of wildlife control and potential accidents against the income produced by the crops when deciding whether to allow crops on an aerodrome. In any case, IACM should be consulted.

Any livestock operations, confined or not, (i.e., feedlots, dairy operations, hog or chicken production facilities, or egg-laying operations) often attract flocking birds, such as starlings, that pose a hazard to aviation. The Aerodrome Operator should promote a program to reduce the attractiveness of any livestock operation within the aerodrome vicinity. They should not allow grazing of free-ranging livestock on any aerodrome property because the animals might wander onto the operational areas. In addition livestock feed, water, and droppings might attract hazardous birds.

4.3.5. Fish landing sites and processing facilities and plants

If the aerodrome is located near a lake, ocean etc; it is invariable that the surrounding populations involve themselves in fishing activity as a source of livelihood. Landing sites will attract many fish eating birds and other wildlife. Fish processing plants too will attract birds and other wildlife. Experience elsewhere has shown that the Aerodrome Operator can use awareness creation measures, public education and other persuasive means to minimise the hazards. The population should be convinced that it is in their advantage if

they appreciate the need to safely co-exist with the aerodrome and if facilitated (say by providing appropriate refuse bins at the landing sites, appropriate landscaping the surroundings etc) can cooperate. It is essential to note that legal enforcement measures may not as effective.

5.4. Wildlife management within the aerodrome

Within the aerodrome, habitat management provides the most effective long-term remedial measure for reducing wildlife hazards. Habitat management includes the physical removal, exclusion, or manipulation of areas that are attractive to wildlife. The ultimate goal is to make the environment fairly uniform and unattractive to the species that are considered the greatest hazard to aviation. Habitat modifications will be monitored carefully to ensure that they reduce wildlife hazards and do not create new attractions for different wildlife. A series of both habitat and non-habitat based action may include:-

a) Exclude all current and potential bird perching areas around terminals, walkways, parking garage;
b) Remove roosting opportunities by hazing, tree removal and thinning tree canopies;
c) Clear and maintain ditches throughout the airfield to enhance drainage;
d) Evaluate potential wildlife hazards associated with all new construction;
e) Remove fruit and nut bearing trees;
f) Grade and fill tire ruts on infield caused by construction equipment; and
g) Develop a record keeping system for wildlife strikes and hazing efforts;

Structures provide cover and hunting perches for wildlife. If wildlife use is considered when a building is being designed, costly control measures can frequently be avoided. Structures found to routinely attract birds in a hazardous manner may be fitted with wire coils or porcupine wire. Buildings should not provide nesting, perching, or roosting sites for birds and should inhibit access by mammals such as rodents and cats.

Structures not pertinent to air operations and no longer in use should be removed, including abandoned houses, sheds, machinery, and light poles. Such structures are attractive to rodents, small birds and rabbits and, in turn, attract hawks, owls and other predators that can become a significant air hazard. Structures used for crash-fire training are considered to be pertinent to air operations and are generally compatible with safe air operations

Water drainage facilities and small drainage ditches found on aerodromes can attract a moderate number of birds and mammals. Such should be monitored closely to ensure hazardous species do not acclimate to these sites. Temporary open water areas outside the aerodrome should be monitored and the Aerodrome Operator should work with local agencies and landowners to help deter hazardous wildlife.

Small depressions (tire ruts) created by vehicles operating within the infield areas fill up with water for short periods of time and can attract birds. This situation may become particularly problematic during periods of heavy construction activity. Where ruts are found, Aerodrome Maintenance should fill and/or grade the damaged area. In areas where there

are larger pools, the land should be filled or graded such that water consistently drains into ditches which should be appropriately sloped so that water does not pool.

Other than paved areas, grass will be the primary cover inside the perimeter security fence. Aerodrome Operators should ensure that grass species and other varieties of plants attractive to hazardous wildlife are not used on the aerodrome. In addition, grasses that produce large seeds and are known to be attractive to wildlife should be avoided. The type of grass used within the perimeter fence and between the runways should produce small or no seeds, but still be able to generate new growth or re-seed itself to provide a thick stand and prevent erosion. The selected ground cover should withstand drought, flooding, and other normal climatic conditions, and be somewhat unpalatable to grazers. The grasses should also harbour relatively few insects and rodents that may attract wildlife.

The Aerodrome Operator should consult the local biologists and other experts to determine the optimum grass height and best mowing periods and times.

6. Bird Strike Hazard Control Measures

No airport or aircraft type is immune from the hazards of wildlife strikes. Many species of birds and mammals have been involved in damaging strikes. A flock of starlings suddenly rising from the ground, a lone kestrel hovering in search of prey, a pair of geese taking flight after grazing in the airfield, or a stray dog bounding across a runway—all can result in significant aircraft damage or in extreme cases, a crash and loss of human lives. Aircraft strikes with wild animals, especially at aerodromes located near national parks, have been recorded. At some remote unfenced aerodromes, even humans crossing the airstrip, on foot, on a bicycle or on an animal drawn cart can be a source of worry.

This AIC presents the overall approach to be taken to manage wildlife hazards on aerodromes. The strengths and weaknesses of various wildlife control methods, as well as certain methods that should not be used, are also outlined. It must be noted that wildlife damage control is a dynamic field, and new products, technologies, and innovations are continuously being introduced. In addition, changes in the legal status of control techniques, chemical registrations, and wildlife species may from time to time be applicable in Mozambique.

It is well understood that the environment management and site modification measures described do contribute effectively towards the control of bird strike hazards. For the control of bird strike hazards however, there are additional options. Experience at many aerodromes has shown that for bird strike hazard control, not one single measure is effective all the time. It is a combination of various measures that give the desired results over a period of time. Some bird strike control measures may work only for short periods of time, some are effective only for specific bird species and yet some may control bird strikes but encourage other wildlife. The Aerodrome Wildlife Committee must therefore be vigilant all the time to effectively monitor the performance of the aerodrome WHMP and make timely adjustments and modifications.

In order to determine which measures will be appropriate, it is necessary for the Aerodrome Wildlife Committee to find answer to several pertinent questions which are more applicable to bird control but are may also apply for control of other wildlife control;-:

1) What is the wildlife doing that make the control of their numbers or damage necessary? The type of activity that needs to be controlled will determine both the severity of the problem and the type of control methods used;
2) Which species of wildlife are causing the problem? Accurate identification of the exact species is critical because different species often require different management techniques;
3) Why is the wildlife on the airport? Are they attracted to the airport for food, water, or shelter; or are they just flying over the airport from night-time roosting sites to daytime feeding sites? The answer to this question will determine, to a large extent, the most appropriate control methods to use;
4) What are the daily and seasonal movement patterns of the wildlife among feeding, loafing, and roosting/nesting areas? Try to identify the times of day and seasons of year, as well as locations on airport, where the wildlife pose the most critical threat to aviation safety and where they are most vulnerable to management actions;
5) What is the legal status at the problem species? All wildlife species are not afforded equal legal protection by all levels of government;
6) What effective and legal management methods are available? In wildlife hazard management, effective and legal are not necessarily synonymous;
7) How selective are these control methods? The objective is to control only the target wildlife, not all the species in the area;
8) How much will it cost to apply the selected control methods? The cost of control might dictate which methods are practical, given the seriousness of the threat caused by the species; and
9) What are public attitudes toward the problem wildlife species and the hazards that these species pose? Public opinion also may influence the type of management actions taken.

Once the Aerodrome Wildlife Hazard Committee (AWHC) has established answers to these questions, there are four basic control strategies are available to solve wildlife problems on an aerodrome. The AWHC should attempt to integrate all four control strategies into the WHMP as appropriate:-

1) Aircraft flight schedule modification;
2) Habitat modification and exclusion;
3) Repellent and harassment techniques; and
4) Wildlife removal.

6.1. Aircraft flight schedule modification

Although not generally practical for regularly scheduled commercial traffic on larger aerodromes, there may be various situations when flight schedules of some aircraft can be adjusted to minimize the chance of a strike with a wildlife species that has a predictable pattern of movement. For example, pilots could be advised not to depart during a 20-minute period at sunrise or sunset when large flocks of certain species of birds cross an

aerodrome going to and from an off airport roosting site. At other aerodromes during parts of the year, scheduling night time arrivals and departures, when birds are not flying, might be the only means of avoiding strikes. Finally, air traffic controllers on occasion might need to temporarily close a runway with unusually high bird activity or a large mammal (e.g., elephants, giraffes, monkeys etc) incursion until wildlife control personnel can disperse the animals.

6.2. Habitat modification and exclusion

Habitat modification means changing the environment to make it less attractive or inaccessible to the problem wildlife. All wildlife require food, shelter, and water to survive. Any action that reduces, eliminates, or excludes one or more of these elements will result in a proportional reduction in the wildlife population at the aerodrome. Habitat modifications to make the airport and surrounding area as unattractive as possible to hazardous wildlife must be the foundation of the WHMP.

Initially, management actions to reduce food, shelter, and water on an aerodrome might be expensive. However, when costs are amortized over several years, these actions might be the least expensive approach. If done correctly, it is generally not necessary to go back and do it again. Also, these control methods are generally well accepted by the public and minimize the need to harass or kill wildlife.

6.2.1. Food

In the urban setting, the more common food sources for birds include droppings around taxi stands and car parks, improperly stored food waste around grocery stores, restaurants and catering services. In the rural setting, food sources attractive to birds include sanitary landfills, feedlots, certain agricultural crops (especially cereal grains and sunflower), and spilled grain along road and rail rights-of-way. Aerodromes should avoid using trees and other landscaping plants that produce fruits or seeds attractive to birds. On airside areas, the large expanses of grass can sometimes provide ideal habitat for rodent and insect populations that attract raptors, gulls, other bird species, and mammalian predators such as coyotes. In addition, grasses allowed to produce seed heads can provide a desirable food source for doves, blackbirds, and other flocking species. The management of airside vegetation to minimize rodents, insects, and seeds might be complex, requiring insecticide, herbicide, and other chemical applications; changes in vegetation cover; and adjustments in mowing schedules (e.g., mowing at night to minimize bird feeding on insects exposed by the mowing). Such management plans will need to be developed in conjunction with professional wildlife biologists and horticulturists knowledgeable with the local wildlife populations, vegetation, and growing conditions.

6.2.2. Shelter

All birds require cover for resting, roosting, escape, and reproduction. Non-migratory birds in urban areas, left undisturbed, will establish territories on corporate lawns, golf courses, and even building roofs associated with nearby ponds. Pigeons, house sparrows, and starlings use building ledges, abandoned buildings, open girders and bridge work, and dense vegetation for cover. Blackbirds use marsh vegetation, such as cattails, for nesting

and roosting. Many bird problems can be solved by eliminating availability of such areas either through removal or by exclusion.

The aerodrome should take care when selecting and spacing plants for airport landscaping, avoiding plants that produce fruits and seeds desired by birds. Trees that create areas of dense cover for roosting, especially by starlings and blackbirds should be avoided. Thinning the canopy of trees, or selectively removing trees to increase their spacing, can help eliminate bird roosts that form in trees on airports.

The management of an aerodrome airside ground cover to minimize bird activity requires research. Tall grass, by interfering with visibility and ground movements, discourage many species of birds from loafing and feeding. However, tall-grass can result in increased rodent populations, a food source for reptiles. A promising approach to reducing wildlife attraction to airport ground cover, irrespective of the height, is the use of vegetation that is undesirable or mildly toxic to wildlife.
Adequate research on grass height or vegetation type for airside ground cover is therefore essential.

The Aerodrome Wildlife Hazard Committee should consult with professional wildlife hazard management biologists and horticulturists to develop a vegetation type and mowing schedule appropriate for the growing conditions and wildlife at the location. The main principles to follow are to use a vegetation cover and mowing regime that do not result in a build-up of rodent numbers or the production of seeds, forage, or insects desired by birds.

The aerodrome should remove all unnecessary posts, fences, and other structures that can be used as perches by reptiles and other birds. Piles of construction debris, discarded equipment and other unmanaged areas are not only aesthetically unpleasing but typically provide excellent cover for rodents (rats and house mice) and den sites for wild dogs.

6.2.3. **Water**

Water acts as a magnet for birds; therefore, all standing water should be eliminated to the greatest extent possible. Depressions in paved and vegetated areas, and disturbed areas at construction sites that accumulate standing water after rain should be filled or modified to allow rapid drainage. This is particularly important at coastal airports where fresh water is highly attractive to birds for drinking and bathing. Retention ponds, open drainage ditches, outdoor fountains and other wetland sites on or adjacent to aerodromes should be avoided. If necessary, storm water retention ponds should allow a maximum 48-hour detention period for the design storm. Such ponds should be designed to remain totally dry between rainfalls. Where constant flow of water is anticipated through the basin, or where any portion of the basin bottom might remain wet, it should be designed with a concrete or paved pad in the bottom to prevent vegetation that might provide nesting habitat. When it is not possible to drain a large detention pond completely, physical barriers, such as bird balls, wires grids, pillows, or netting, to deter birds and other hazardous wildlife should be considered. However such physical barriers should not adversely affect water rescue.

If the aerodrome has an off-airport storm water treatment facility, the facility operator should be encouraged to incorporate appropriate wildlife hazard mitigation techniques into their operating practices.

6.2.4. Exclusion techniques

If food, water, or cover cannot be eliminated by habitat modification, then actions can sometimes be taken to exclude the wildlife from the desired resource. Exclusion involves the use of physical barriers to deny wildlife access to a particular area. As with habitat modification, exclusion techniques, such as installing a covered drainage ditch instead of an open ditch, can initially be costly. However, exclusion provides a permanent solution that is not only environmentally friendly, but when amortized over many years, might actually be the least expensive solution.

Architects should consult biologists during the design phase of buildings, hangers, bridges, and other structures at aerodromes to minimize exposed areas that birds can use for perching and nesting. For example, tubular steel beams are much less attractive as perching sites for starlings and pigeons than are I-beams. If desirable perching sites are present in older structures, access to these sites (such as rafter and girded areas in hangers, warehouses, and under bridges) often can be eliminated with netting. Curtains made of heavy-duty plastic sheeting, cut into 12-inch strips, and hung in warehouse or hanger doorways, can discourage birds from entering these openings. Anti-perching devices, such as spikes, can be installed on ledges, roof peaks, rafters, signs, posts, and other roosting and perching areas to keep certain birds from using them. Changing the angle of building ledges to 45 degrees or more will deter birds.

6.2.5. Repellent and harassment techniques

Repellent and harassment techniques are designed to make the area or resource desired by wildlife unattractive or to make the wildlife uncomfortable or fearful. Long term, the cost-effectiveness of repelling wildlife usually does not compare favourably with habitat modification or exclusion techniques. No matter how many times wildlife are driven from an area that attracts them, they or other individuals of their species will return as long as the attractant is accessible. However, habitat modifications and exclusion techniques will never completely rid an airport of problem wildlife; therefore, repellent techniques are a key component of any wildlife hazard management plan.

Repellents work by affecting the animal's senses through chemical, auditory, or visual means. Habituation or acclimation of birds and mammals to most repellent devices or techniques is however a major problem. When used repeatedly without added reinforcement, wildlife soon learn that the repellent devices or techniques are harmless. The devices become a part of their "background noise", and they ignore them. Critical factors to be recognized in deploying repellents are:-

1) There are no "silver bullets" that will solve all problems;
2) Likewise, there is no standard protocol or set of procedures that is best for all situations. Repelling wildlife is an art as much as a science. The most important factor is having motivated, trained, and appropriately equipped personnel who understand the wildlife situation on their airport;
3) Each wildlife species is unique and will often respond differently to various repellent techniques. Even within a group of closely related species, such as gulls, the various species will often respond differently to various repellent techniques; and
4) Habituation to repellent techniques can be minimized by—

a. Using each technique sparingly and appropriately when the target wildlife is present,
b. Using a variety of repellent techniques in an integrated fashion, and
c. Reinforcing repellents with occasional lethal control (with necessary permits in place) directed at abundant problem species such as gulls or geese.

Advances in electronics, remote sensing capabilities, and computers are resulting in the development of "intelligent" systems that can automatically deploy repellent devices (e.g., noisemakers, chemical sprays) when targeted wildlife enter a designated area. These devices might help reduce habituation and increase effectiveness of repellents in some situations. However, these devices will never replace the need for trained people on the ground to respond appropriately to incursions by a variety of highly adaptable wildlife species.

6.2.6. Ground patrols and runway sweeps in vehicles (Bird dispersal methods)

Regular patrols of airside areas to disperse birds and other hazardous wildlife are a critical component of an integrated program of wildlife hazard management on airports. Often, driving a vehicle toward the wildlife will be enough to cause the wildlife to disperse, especially if the driver has been deploying repellent and removal techniques and strategies as outlined below. Regular patrols and sweeps also permit wildlife control personnel to learn the daily movement patterns, habitat preferences, and behaviour of wildlife on the airport. This information can be useful in determining wildlife attractants on the airport that need to be removed (e.g., low areas that gather standing water after rains) and in anticipating problem situations. All wildlife carcasses found during runway sweeps should be removed, identified to species, and documented on a wildlife strike log.

6.2.7. Audio Repellents for Birds

Propane cannons – These are shotgun-generated sound blasts and therefore the Aerodrome Operator should use them only after approval of the appropriate authority. In general, birds quickly habituate to cannons that detonate at systematic or random intervals throughout the day. Thus, to ensure they remain effective, use cannons sparingly and only when birds are in the area. Reinforcement by occasional killing a few birds under an appropriate permit might enhance effectiveness.

Distress-calls and electronic noise-generating systems - Recorded distress calls are available for common birds. Such calls, broadcast from speakers mounted on a vehicle, will however often initially draw the birds toward the sound source to investigate the threat. The birds then can be dispersed by pyrotechnics or by using a shotgun to shoot an occasional bird. As with propane cannons, distress calls routinely broadcast from stationary speakers, with no associated follow-up stimuli that provide additional fear or stress, have little utility. Birds also habituate rapidly to other electronic sound systems that generate a variety of synthetic sounds from stationary speakers.

Shell crackers and other pyrotechnics –These are a variety of projectiles that can be fired from breech-loaded shotguns or from specialized launchers to provide an auditory blast or scream, as well as smoke and flashing light, to frighten birds. Some of the newer cartridges have ranges of up to 100m. These pyrotechnics, when used skilfully in combination with other harassment techniques and limited lethal control (shooting via

shotgun), can be very useful in driving birds off of an aerodrome. An advantage of these pyrotechnic devices is that they require a person to fire the projectile, thus ensuring that they are deployed directly at the target birds and that the birds associate the pyrotechnic with a threat (person).

Ultrasonic devices - Ultrasonic (i.e., above the sound range detected by humans) devices have not proven to be effective bird repellents. In fact, most birds do not detect frequencies as high as humans can detect much less frequencies above the level of human detection.

6.2.8. Visual Repellent Methods

There are a variety of visual repellent methods, mostly simply a variation on an ancient theme—the scarecrow, such as hawk effigies or silhouettes, eye-spot balloons, flags, and Mylar reflecting tapes. These methods have shown only short-term effectiveness and are inappropriate for use as a long-term solution to bird problems on airports. Most short-term success achieved with these devices is likely attributable to "new object reaction" rather than to any actual frightening effect produced by them. For example, after a flag with a large eye-spot is exposed to pigeons, they may leave. However, within 24 hours, the pigeons return and from then on, the pigeons behave in a completely normal fashion and show no interest in, or reaction to, the flag. Another visual deterrent that has been successfully used is the display of dead birds in a “death pose.” Many local tribes use this method to scare off birds from rice or millet farms. A dead turkey vulture hung by its feet in a vulture roosting or perching area, will cause vultures to abandon the site. Dead gulls and ravens suspended from poles can disperse these species from feeding and resting sites. The dead bird must be hung in a “death pose” to be effective.

6.2.9. Trained Falcons & Dogs to repel birds

Trained falcons and other birds of prey can be used to disperse birds. The advantage of falconry is that the birds on the airport are exposed to a natural predator for which they have an innate fear. The disadvantage is that a falconry program is often expensive, requiring a number of birds that must be maintained and cared for by a crew of trained, highly motivated personnel. To be effective they have to be used regularly and persistently by skilled and conscientious personnel.

The use of trained dogs, especially border collies, to chase geese and other birds from aerodromes and other sites is a recent development. As with falcons, the advantage is exposure to a natural predator. Likewise, the disadvantage is that the dog must be under the control of a trained person at all times, and the dog must be cared for and exercised 365 days a year. A dog will have little influence on birds that are flying over the airport.

6.2.10. Birds Capture and Relocation Techniques

Bird capture and relocation can be an effective technique to use at the aerodrome. However, these actions will not solve every problem. It can only be considered for use in combination with other methods. In addition, with few exceptions special permit. In certain cases some species are state-protected. Any capturing or killing must be done humanely and only by people who are trained in wildlife species identification and the techniques to be deployed. To avoid killing, live trapping can be used. This have the advantage of selectivity: any non-target birds can be released unharmed. The major disadvantage is that

live trapping is often labour intensive. Traps must be tended frequently to remove captured birds and, in the case of cage traps with decoy birds, to provide food and water.

6.2.11. Destroying Eggs and Nests

Provided the correct permits are obtained from the appropriate authority, destroying eggs and removal of nest material, egg addling (oiling, shaking, or puncturing) can be used. However egg addling encourages the nesting birds to stay on the aerodrome. At the time of nest destruction, adult birds should be harassed. Check the nesting area weekly for re-nesting until the end of the nesting season. While destroying the nests, where practical, install physical barriers to prevent re-nesting.

6.2.12. Shooting Birds

Provided the correct permits are obtained from the appropriate authority, shooting birds in an aerodrome may be used. The shooting is done quietly and discretely, with the objective being to disturb the birds as little as possible so that the maximum number can be removed. The Aerodrome Operator may resort to this method because the birds are not responding to various repellent methods. Shooting a shotgun has several effects on a flock of birds. First, it reinforces other audio or visual repelling techniques. Second, the loud noise, coupled with the death of one or more of the flock members, can frighten the rest of the flock away. Third, the target birds are permanently removed. Four cardinal rules apply when using shooting as a control method at airports:-

1) Use only personnel who are trained in the use of firearms and who have an excellent knowledge of wildlife identification;
2) Use the proper gun and ammunition for the situation;
3) Have the appropriate wildlife kill permit and keep accurate records of birds killed by species and date; and
4) Notify airport security, air traffic control, and, if appropriate, the local law enforcement authority before instituting a shooting program.

7. REPORTING

The Aerodrome WHMP should have an element of data collection, review and sharing with other aerodrome operators but also reporting to IACM. The reporting to IACM provides essential input to the parameters used in determining safety performance targets as a fundamental statistic in the implementation of the State Safety Programme and the Aerodrome Safety management System.

7.1. How To Report A Wildlife Aircraft Strike:

A wildlife strike is considered to have occurred when:-

a) A pilot reports striking 1 or more birds or other wildlife;

b) Aircraft maintenance personnel identify aircraft damage as having been caused by a wildlife strike;
c) Personnel on the ground report seeing an aircraft strike 1 or more birds or other wildlife;
d) Bird or other wildlife remains, whether in whole or in part, are found within 60m of a runway centreline, unless another reason for the animal's death is identified; and
e) An animal's presence on the airport had a significant negative effect on a flight (i.e., aborted takeoff, aborted landing, high-speed emergency stop, aircraft left pavement area to avoid collision with animal)

Attached as Appendix -1 is a sample Bird Strike Report Form and Appendix – 2 is Supplementary Bird strike Reporting Form Operator Costs and Engine Damage Information. The Aerodrome Operator is obliged to submit a report for each strike to IACM who in turn submits this information to ICAO for incorporation in the ICAO's Bird Strike Information System Database.

Collection and analyses of data is invaluable in determining the nature and severity of the wildlife strike problem. The Database provides a scientific basis for identifying risk factors; justifying, implementing and defending corrective actions at airports; and for judging the effectiveness of those corrective actions. On a global scale, the ICAO Database is invaluable to engine manufacturers and aeronautical engineers as they develop new technologies for the aviation industry. Each wildlife strike report contributes to the accuracy of and effectiveness of the Database. Moreover, each report contributes to the common goal of increasing aviation safety.

7.2. Bird Identification:

Accurate species identification is critical for any bird-aircraft strike reduction programs. Wildlife biologist must know what species of animal they are dealing with in order to contribute effectively to the development and monitoring of the aerodrome WHMP and assist it to make proper decision on most appropriate method(s) to be applied at the aerodrome. Bird strike remains that cannot be identified by airport personnel or by a local wildlife biologist can be sent to universities. In such cases, the local wildlife biologist should observe the following guidelines for collecting and submitting feather or other bird/wildlife remains for species identification:-

1) Collect and submit remains as soon as possible after the strike;
2) Provide complete information regarding the incident by filling out the Bird/Other Wildlife Strike Report form;
3) Provide contact information for response on the species identification;
4) Collect as much material as possible in a clean plastic/ziplock bag; (do not send whole birds);
5) Pluck/pick a variety of feathers from the wings, tail and body;
6) **Do not** cut off feathers as this may complicate the identification;
7) Include any feathers with distinct colours or patterns;
8) Include any downy "fluff";
9) Include beaks, feet, and talons if possible;

10) Where only a small amount of material is available, such as scrapings from an engine or smears on wings or windshields, send all of it; and
11) **Do not** use any sticky substance such as tape or post-it notes to attach feathers.

Appendix – 1: SAMPLE BIRD STRIKE REPORT FORM

Send to:

Operator 01/02

Aircraft Make/Model 03/04

Engine Make/Model 05/06

Aircraft Registration 07

Date day ..... month ..... year 08

Local time 09
dawn ☐ A *day* ☐ B *dusk* ☐ C *night* ☐ D 10

Aerodrome Name 11/12

Runway Used 13

Location if En Route 14

Height AGL ..... *ft* 15

Speed (IAS) ..... *kt* 16

Phase of Flight 17

parked	☐ A	*en route*	☐ E
taxi	☐ B	*descent*	☐ F
take-off run	☐ C	*approach*	☐ G
climb	☐ D	*landing roll*	☐ H

Part(s) of Aircraft

	Struck		*Damaged*
radome	☐	18	☐
windshield	☐	19	☐
nose (excluding above)	☐	20	☐
engine no. 1	☐	21	☐
2	☐	22	☐
3	☐	23	☐
4	☐	24	☐
propeller	☐	25	☐
wing/rotor	☐	26	☐
fuselage	☐	27	☐
landing gear		28	
tail		29	
lights		30	
other (specify)	☐	31	

Effect on Flight

none	☐ 32
aborted take-off	☐ 33
precautionary landing	☐ 34
engines shut down	☐ 35
other (specify)	☐ 36

Sky Condition 37

no cloud	☐ A
some cloud	☐ B
overcast	☐ C

Precipitation

fog	☐ 38
rain	☐ 39
snow	☐ 40

Bird Species* 41

Number of Birds

	Seen 42	*Struck* 43
1	☐ A	☐ A
2-10	☐ B	☐ B
11-100	☐ C	☐ C
more	☐ D	☐ D

Size of Bird 44

small	☐ S
medium	☐ M
large	☐ L

Pilot Warned of Birds 45
yes ☐ Y no ☐ X

Remarks *(describe damage, injuries and other pertinent information)* 46/47

.....

.....

.....

.....

Reported by .....
(Optional)

* *Send all bird remains including feather fragments to:*

Appendix – 2: Supplementary Bird strike Reporting Form Operator Costs and Engine Damage Information

SUPPLEMENTARY BIRD STRIKE REPORTING FORM
OPERATOR COSTS AND ENGINE DAMAGE INFORMATION

A. BASIC DATA

Operator 01/02

Aircraft Make/Model 03/04

Engine Make/Model..... 05/06

Aircraft Registration..... 07

Date of strike *day* ..... *month* ..... *year*..... 08

Aerodrome/Location if known..... 11/12/14

B. COST INFORMATION

Aircraft time out of service.....*hours* 52

Estimated cost of repairs or replacement *U.S.$ (in thousands)* 53

Estimated other costs
(e.g. loss of revenue, fuel, hotels) *U.S.$ (in thousands)* 54

C. SPECIAL INFORMATION ON ENGINE DAMAGE STRIKES

Engine position number	1	2	3	4
Reason for failure/shutdown	55	56	57	58
uncontained failure	☐ A	☐ A	☐ A	☐ A
fire	☐ B	☐ B	☐ B	☐ B
shutdown — vibration	☐ C	☐ C	☐ C	☐ C
shutdown — temperature	☐ D	☐ D	☐ D	☐ D
shutdown — fire warning	☐ E	☐ E	☐ E	☐ E
shutdown — other (specify)	☐ Y	☐ Y	☐ Y	☐ Y
shutdown — unknown	☐ Z	☐ Z	☐ Z	☐ Z
Estimated percentage of thrust loss*	____59	____60	____61	____62
Estimated number of birds ingested	____63	____64	____65	____66

Bird species..... 41

* These may be difficult to determine but even estimates are useful.

Send all bird remains including feather fragments to:

Reported by .....

Maputo, 21 April 2015

INSTITUTE OF CIVIL AVIATION OF MOZAMBIQUE

THE CHAIRMAN OF THE BOARD AND CEO

Capt. João Martins de Abreu