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Agenda Item 2: Safety Oversight –
2.5 Safety - Related Topics

RESEARCH ACTIVITIES FOR MANAGING WILDLIFE HAZARDS TO AIRCRAFT

(Presented by the United States of America)

SUMMARY

Birds, deer, and other wildlife present significant hazards to aircraft. Worldwide, in addition to numerous fatalities annually, the total estimated cost of such collisions is US$2 billion. The most efficient step in reducing the probability of a wildlife collision is to remove attractants from the airfield and its immediate vicinity. This includes maintaining a ground cover on airport property that could be desirable food or is attractive in any way and keeping attractants such as water and refuse removed from the vicinity of the airfield. Since wildlife that encroach on or near the airfield must be repelled or dispersed, the Ohio Field Station of the National Wildlife Research Center has developed or tested several new and novel repellent and dispersal devices. These include anti-perching devices, avian effigies, lasers, and electric fencing. In addition, various vegetation types are being tested to determine their attractiveness to wildlife. Recent studies have shown that special electrical fences used to prevent deer from entering specific areas have been very effective.

1. Introduction

1.1 Collisions with birds and other wildlife cost the airline industry, and ultimately the flying public, approximately US$2 billion annually (Cleary et al. 2005). In addition to the economic losses, some collisions have resulted in loss of human life. Many species of hazardous wildlife have shown large population increases during the past few decades, especially large flocking birds such as Canada geese (*Branta canadensis*), cormorants (*Phalacrocorax* spp.), and gulls (*Larus* spp.), thus increasing the risk of collision (Dolbeer and Eschenfelder 2003). While many of the collisions have involved smaller aircraft, large commercial aircraft have also been damaged, thus the potential for a catastrophic crash of a large commercial airliner remains of vital concern.

1.2 ICAO recognizes the hazard wildlife presents to aircraft in Annex 14, Volume I, Section 9.5.3 which requires airport authorities to "...take action to decrease the number of bird constituting a potential hazard..." Amendment No. 7 to this Annex, which becomes effective on November 24, 2005, requires the reporting of bird strikes to the ICAO Bird Strike Information System, in addition to requiring that wildlife be excluded from airfields through the use of fences or other barriers.

1.3 Because they can fly and overcome barriers, birds present a special hazard to aviation. The first step in reducing the risk of a wildlife collision is to maintain an environment that does not attract them. Attractants include food, water, nesting sites, and loafing areas. Although an airfield might be made unattractive, some birds utilize it because it might be a convenient location to perch when not feeding. In this case perching must be deterred or the birds must be dispersed away from the airfield.

1.4 The U.S. Department of Agriculture's (USDA) National Wildlife Research Center (NWRC) conducts research on techniques to reduce aviation wildlife hazards in the United States. An Interagency Agreement with the Federal Aviation Agency (FAA) partly funds research in the following three areas: wildlife habitat management and land-use studies, wildlife damage control methods, and avian sensory perception.

2. Discussion

2.1 Airfield vegetation that does not attract wildlife should be selected. There are few, if any, plant species that are repellent or toxic to birds that would not also be hazardous to humans. The first and potentially most important criterion for selecting airfield vegetation is that it not be suitable for food by hazardous wildlife. If an animal does not use vegetation for foraging, it will be less likely to use it for resting since it will spend little time in the area. Many varieties of tall fescue contain a fungal entophyte that produces noxious chemicals. Many animals, including Canada geese (*Branta canadensis*) avoid feeding on such plants (Washburn and Seamans 2004) because it produces gastric distress and inhibits the uptake of nutrients by the digestive system (Oliver 1997).

2.1.1 The Ohio Field Station (OFS) of the NWRC is actively investigating species and varieties of forageable wildlife vegetation, especially for Canada geese, that are suitable for planting on airfields. Previous research has shown that a specific vegetation that is unattractive to wildlife will not necessarily grow in all environments. Consequently, vegetation must be suitable for the local climatic and soil conditions of airfields in different geographic locations in order to be successful.

2.1.2 Presently, two varieties of grass are being compared with Kentucky bluegrass and an entophyte containing a variety of tall fescue to determine whether Canada geese avoid them for foraging. Additional varieties will be tested in 2006-2007.

2.2 Facilities on and near airfields can also attract hazardous wildlife. Refuse management facilities provide sources of food while water impoundments provide sources of water. Movements to and from such facilities can result in birds regularly flying over an airfield and possibly establishing a roost or breeding site. Since it is frequently impossible to move roosts or breeding locations, it is especially important to design water and trash management facilities in such a way that they do not attract birds.

2.2.1 Airport environments are poorly suited for residential and most commercial enterprises because of the noise from aircraft movements. Historically, this has resulted in landfills and other solid waste facilities being located near airfields. Most solid waste facilities, especially landfills, attract many types of birds and other wildlife, presenting hazards to aircraft during takeoff and landing. The increased numbers of birds moving within close proximity to the airfield increases the risk of a collision. Due to the continued interest in placing solid waste facilities near airports, the question remains, which, if any, solid waste facilities do not increase the risk of a collision. *A priori* the only structures that might be considered are limited to fully enclosed trash-transfer facilities. There is an ongoing research study designed to determine which features of trash-transfer facilities do not result in an attraction of birds to

the site. In addition to fully enclosed facilities, various 3-sided designs also are being evaluated as to whether or not they attract feeding or loafing birds.

2.2.2 In order to satisfy legal and environmental requirements, airports must have catch basins to hold water runoff without allowing seepage into the local water system. Some such catchments are particularly attractive to water birds and especially waterfowl. An ongoing study will help in determining which facility designs and features are more attractive to birds. This knowledge can be used in the future to develop designs used to minimize the attraction of birds and wildlife to water retention facilities on and near airfields.

2.3 Deer are the most commonly reported mammal struck by aircraft (Cleary et al. 2005). Because of their large size, deer present a severe hazard to aircraft and must be excluded from airfields. Recent OFS research involved testing two types of devices designed to restrict deer from entering the airfield. Although the most reliable barrier is a 3 m. chain-link fence topped with barbed-wire, such a configuration is not always feasible or, in the case of smaller, non-certified airports is too expensive to install.

2.3.1 Properly installed electrical fencing, consisting of copper wires woven through polyester rope, dramatically reduced white-tailed deer (*Odocoileus virginianus*) intrusions into an enclosure containing whole corn during the winter (Seamans and VerCauteren 2005). The fencing was equally effective whether the enclosure was 5 X 5 m. or 45 X 45 m. Although later research showed that the deer were capable of jumping over the 1.3 m. tall fence, the few intrusions that did occur were caused when a deer passed between the strands of the fence.

2.3.2 Although fencing can restrict deer from entering an airfield, the deer can still enter through openings in the fences. Such openings are necessary to allow the movement of aircraft and vehicles into and out of areas of the airfield. An electrical mat, which carries a high voltage charge similar to an electrical fence, was tested and found to be effective at reducing intrusions through fence openings. The reduction in intrusions was similar to that found for the electric fence. Not only did deer not walk across the charged mats, they did not jump over the 1.2 m. wide mats. This type of system makes a suitable alternative to traditional cattle guards (metal pipes laid over a ditch). Not only are the electric mats less expensive but, if properly designed and installed, they can bear the weight of small aircraft and vehicles that might otherwise become trapped by the pipes of a cattle guard.

2.4 Birds and other wildlife that are present on an airfield must be dispersed and deterred in order to prevent them from colliding with an aircraft. Several dispersal and wildlife deterrent devices and techniques have been evaluated at the OFS, some of which target single species or a small group of species, while others are designed for a broad spectrum of species.

2.4.1 One innovative device that is more or less species specific is the dead bird effigy. The original study was with turkey vultures (*Cathartes aura*) in which the effigy was up to 100% effective in dispersing vulture roosts (Seamans 2004). The effigy, a taxidermy turkey vulture, was most effective when positioned such that it hung by one foot and leg and was allowed to move and twist when the wind blew. An effigy lying prone on the ground or a structure was much less effective. Effigies used on Canada geese were effective; however, for a shorter period of time, usually a few days (Seamans and Bernhardt 2004). Research with other species hazardous to aviation has been initiated and is ongoing.

2.4.2 Birds will frequently roost and nest inside and on the roofs of airport hangers, warehouses, and terminals. Several products have been promoted to discourage this behavior including noisemakers, lights, mirrors, and mechanical devices. The OFS has tested several devices designed to discourage birds from perching in selected locations. Some, such as BirdBlox™ effectively prevent birds

from perching on rafters and beams inside. This device is composed of pointed, finger-like projections of thin plastic that physically prevent birds from alighting on the horizontal surface. Other devices, such as razor wire or rotating lights and mirrors, were ineffective at preventing birds from landing or at dispersing birds that landed (Seamans et al. 2001, Washburn 2005).

2.4.3 Hand-held lasers developed at the OFS have been used successfully to disperse many species of birds (Blackwell et al. 2002). As a result of this research, a new laser specifically for bird dispersal has been designed and marketed. Additional research is needed to increase the effectiveness of lasers in a variety of situations (Gorenzel et al. 2002).

2.5 While 74% of bird strikes occur on airport property, more than one-quarter occurs away from the airport; therefore, mitigation efforts on the airport will have minimal effect on the risk of a collision elsewhere. To reduce the probability of a collision away from the airfield, a bird must detect the aircraft and identify it as a hazard so that the bird can avoid a collision. Techniques to increase avian awareness of aircraft will also decrease the risk of a collision on the runways.

2.5.1 Pilots of aircraft equipped with pulsing landing lights have reported that they experienced fewer bird strikes than when flying aircraft with steady landing lights. OFS scientists examined the reaction times of several species of birds hazardous to aviation in order to test whether birds notice pulsing lights more quickly than steady lights, (Blackwell and Bernhardt 2004). The results indicate that pulsing lights might decrease the reaction time of caged wild birds.

2.5.2 Since avian vision differs substantially from that of humans (i.e. spectral range, resolution, sensitivity, colors, and flash rates), those lights that are most noticeable to pilots might not be best suited for attracting the attention of birds. Consequently, research scientists at OFS have initiated research to examine the individual and combined effects of color (wavelength), pulsing rate, and movement on detection and escape response by brown-headed cowbirds (*Molothtrus ater*), Canada geese, mourning dove (*Zenaida macroura*), and feral pigeons (rock doves, *Columba livia*). Initial results with cowbirds indicate that they respond more rapidly to flashing lights than steady lights on a moving vehicle. These research results are expected to lead to the modification of aircraft pulsed landing light systems, and perhaps the development of new devices and aircraft coatings that will make aircraft more noticeable to birds.

2.5.3 OFS researchers are also examining the retinal photoreceptors of some hazardous bird species to determine the spectral sensitivity of different classes of receptors and how they interact to establish a species' range of sensitivity and ability to distinguish among similar colors. Such knowledge is crucial in order to develop new devices that can produce signals within a species' sensory capability. Meanwhile, producing colors that are beyond a species' detection capabilities or that cannot be distinguished is also unproductive. Behavioral experiments such as those described above can also be used to explore an individual species' behavioral responses and sensitivity to specific colors.

2.6 Research studies anticipated for 2006-2008 include investigating additional vegetation species for potential airfield use. Airfield vegetation types are typically limited to grasses, but other types of plants might also be suitable if they do not attract wildlife and require no more maintenance than grass. A variety of repellents and repellent techniques will be examined and those that appear to have the greatest potential of reducing the number of animals on the airfield will be tested. For example, species-specific effigies of dead birds have proven successful in some cases but other hazardous taxa need to be tested, including crows and gulls. Research into the visual sensory capabilities and behavioral responses to visual stimuli will continue. The results of these studies will the development of new deterrent devices for attachment to aircraft and new repellent devices for use on airfield structures and elsewhere. Other

research studies will be focused on reducing food sources, such as rodents and earthworms, which are used by predaceous species of birds.

2.7 **References**

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3. **Conclusion**

3.1 The Conference is invited to promote further research to reduce the presence of wildlife on airfields and support and encourage research to alert birds to the presence and hazard of aircraft on and away from airfields.

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