ABSTRACTS

1) OVERVIEW AND HISTORY OF THE WILDLIFE HAZARD MANAGEMENT PLAN (WHMP) AT SALT LAKE CITY INTERNATIONAL AIRPORT

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After the wildlife hazard assessment is complete and the FAA requirements are met, there is a sense of relief that the wildlife mission is accomplished. The airport has a wildlife hazard management plan (WHMP), the bird cannons are in place and wildlife issues are under control. What happens next? Are the birds that are still coming to the airport just an inherent unavoidable risk? The airport has implemented all the recommendations and spent considerable time and money on an assessment, what more can be done? Salt Lake City International Airport implemented its first WHMP in 1992 and this presentation will cover the history of wildlife issues and how the plan and procedures have evolved to meet changing conditions and wildlife problems. The presentation will cover why wildlife is being attracted to the airport and describe what prey base and habitat is attracting wildlife and what options are available to best utilize resources and reduce the potential for wildlife strikes at Salt Lake City International Airport.

(2) CONSERVATION SUCCESS AND CHANGES IN FEDERAL LEGISLATION: IMPLICATIONS FOR EAGLES AND AIRPORTS

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Recovery of the bald eagle represents a true conservation success story. Bald eagles are now repopulating areas throughout much of this species' historic range in the lower 48 states of the U.S. that were unoccupied only a few years ago. Given this exponential population growth, the risk of bald eagle-aircraft collisions is an increasing problem at airports and military airfields. Since 1990, 111 bald eagle strikes (48 with damage) to civil aircraft were reported to the FAA. Concurrently, there is widespread public interest in eagles with a strong concern that eagle populations be protected. Effective, publically accepted methods to reduce the hazards posed by eagles using airport environments are needed. Following the "delisting" of bald eagles (i.e., removal from the federal list of threatened and endangered species) in 2007, important changes to key federal regulations regarding eagles, specifically the Bald and Golden Eagle Protection Act (Eagle Act), occurred that have implications for aviation safety issues and eagle management at airports and military airbases. The U.S. Fish and Wildlife Service (USFWS) amended existing Eagle Depredation Permit regulations (50 CFR 22.23) to extend the length of permits for hazing of eagles, developed new Eagle Nest Take regulations (50 CFR 22.27) and permits (i.e., for "take" of inactive nests only), and developed a new permit program (50 CFR 22.26) to authorize "programmatic take" of bald and golden eagles where the "take" is associated with, and not the purpose of, otherwise lawful activities. In relation to airports, meeting Airport Wildlife Hazard Management Plan obligations and adopting advanced conservation measures to reduce the probability of eagle "take" are critical components of the new Eagle Act permits. Once deciphered and implemented, these changes and processes should allow airport managers and wildlife biologists to more effectively address safety concerns involving eagles in a prompt and timely manner.

(3) WHEN REGULATIONS COLLIDE: USING THE AVIATION STORMWATER DESIGN MANUAL TO MINIMIZE BIRD STRIKES

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Airports across the nation are increasingly being regulated with respect to stormwater runoff. Many are being required to install stormwater treatment and flow control facilities within their airport operational area to meet these new standards. However, typical stormwater facilities often attract wildlife hazardous to aircraft, posing a significant safety risk to people in the air and on the ground. The significance of this issue was highlighted late in the 2003 Memorandum of Agreement between the FAA and other federal agencies, and through proposed legislation in Washington state to require stormwater and wetland mitigation be developed in a manner that is compatible with safe airport operations. WSDOT Aviation was directed to explore solutions to address hazardous wildlife attractants near airports and thus, produced the Aviation Stormwater Design Manual. The Aviation Stormwater Design Manual, can be used by airports and surrounding communities across the country, provides guidance for best management practices and modified stormwater facilities that minimize hazardous wildlife attractants. The manual is comprised of six chapters with emphasis on state and national regulatory requirements, wildlife planning issues, identifying the wildlife species of concern, facility siting considerations, and stormwater facility design modifications. The manual, available on the web since 2009, is intended to be used on the airport and adjacent to the airport within the airport's operating environment. It includes design details for a full

range of facility types including the potential retrofit of existing stormwater facilities. The manual emphasizes an adaptive management approach for airports, and an adaptive approach is also anticipated for the manual itself as more is learned about stormwater and wildlife at airports.

(4) UPDATE ON FAA WILDLIFE HAZARD MANAGEMENT ISSUES IN THE EASTERN REGION AND STATUS OF WILDLIFE HAZARDS AT GENERAL AVIATION AIRPORTS IN NEW YORK

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The FAA's Eastern Region is taking a closer look at wildlife hazard management programs that are required under 14 CFR Part 139. An update will be provided on guidance recently issued within the region on wildlife hazard management plans, coordination with air traffic control towers on managing wildlife hazards, and coordinating with land owners and managers in the vicinity of airports on hazardous wildlife attractants. In addition the results of the study summarized below, and an update on FAA support for management of wildlife hazards at general aviation (GA) airports in the Eastern Region, will be provided. Changes in the use of GA airports in New York along with increases in some wildlife populations has led to potential safety vulnerabilities that may require new management approaches. The purpose of this study was to describe the greatest and most common wildlife hazards to aviation safety at GA airports in New York. A number of common hazards and attractants were identified at GA airports statewide. Populations of the most hazardous wildlife species are increasing, and damaging wildlife strikes are most frequent and most severe at GA airports. The combination of these factors with the changes in use of GA airports due to new GA aircraft and new GA services, such as air taxi service, makes these airports increasingly vulnerable to wildlife strikes including costly damaging strikes and the risk of loss of human life. A different approach is needed to effectively assess and manage wildlife hazards at smaller GA airports. Further study is needed to characterize risks at these airports and to develop effective management strategies.

(5) APPLYING GIS AND RELATIVE HAZARD SCORES TO PRODUCE A MEANINGFUL WILDLIFE HAZARD ASSESSMENT

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The primary goal of a wildlife hazard assessment (WHA) is to identify problematic areas that may attract hazardous wildlife to the airport and/or surrounding property. Upon completing a WHA, an airport should be able to immediately focus on managing the most critical areas to reduce potential hazards. No specific assessment protocol is currently provided by the Federal Aviation Administration (FAA) to quantify wildlife hazards. GIS technology was used at Southwest Florida International Airport to record observations and graphically present data. A 400–foot grid was applied to the airport property. Each wildlife observation was recorded in the quadrant where the observation was made and entered into an Access database. A formula was developed to give each quadrant a numerical value representing hazard and relative risk. Individual wildlife species were assigned a Relative Hazard Score as per FAA Advisory Circulars, multiplied by the number of times observed, then normalized by a frequency calculation. The result is a tool that shows the areas of hazardous wildlife concentration throughout the airport, classified by relative risk. This tool also allows the user to query the data and create maps depicting specific attributes. This method can be utilized by airports to define quantifiable benchmarks and provide objective metrics to assess program success.

(6) BREAKING AND ENTERING: GAINING ACCESS TO WILDLIFE HAZARD ASSESSMENT CONTRACTS

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This paper examines the author's attempts to break into the professionally satisfying, financially lucrative, and mission-critical safety realm of airport wildlife hazard assessment (WHA) and control. WHAs and related wildlife control operations are technically simple and straightforward. They involve basic biological science and survey techniques and an understanding of integrated wildlife control techniques, coupled with fundamental knowledge of aviation science and aeronautical operations. Nonetheless, entering this closed, contentious, and highly competitive community has proved to be easier said than done. A scientific, ethical, and legal rationale for modifying FAA guidelines for qualified airport wildlife biologists under 150/5200-36 is presented.

(7) THE EFFECT OF WEATHER CONDITIONS ON BIRD-AIRCRAFT STRIKES AT U.S. AIRPORTS

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ABSTRACTS

In recent decades, bird-aircraft strikes or bird strikes have increased substantially and fast become a serious threat to aviation safety. A set of risk attributes and factors, including weather condition, habitat type, hazardous bird population and air traffic, has significantly influenced the rapid growing risk of bird strikes. Study of bird strike prevention currently focuses on real-time bird activity control near airports where a vast majority of bird strikes occur. Weather condition, which can directly affect bird activity in a very short time period, is becoming one of the major concerns. In order to effectively predict the risk of bird strikes, it is necessary to understand and evaluate the role of weather conditions in causing bird strikes. This study investigated the effect of weather conditions at and around the time of bird strikes using data from 6 airports in the U.S. Variables, like wind speed, wind direction, rainfall, temperature and cloud cover were included. The results indicated that: (1) rainfall showed positive association with bird strikes; (2) temperature tends to be higher on previous days of bird strikes; (3) wind direction showed possible association with runway bearings; and (4) the other variables did not show obvious association with bird strikes. The analyzed results support the modeling study in risk prediction of bird strikes and provides useful information to airport bird hazard management and control.

(8) INTEGRATING AVIAN RADAR INTO DAILY OPERATIONS AT NAS KINGSVILLE, TEXAS

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The utilization of avian radar as early warning and prediction tools for airports continues to be a topic of discussion for aviators, airport managers and airport biologists. While safety is the primary concern, ensuring mission viability is paramount. The question becomes, "can the real time data that avian radar systems provide, be integrated into airport operations to improve flight safety without significantly impeding mission accomplishment?" The mission of NASK is to train Naval and Marine Corp tactical jet pilots. Periodic interruption of flight operations as a result of increased bird activity could have a significant impact on mission requirements. However, NASK has lost two $25M T-45 training jet aircraft to bird strikes since 2005. Both of these bird strikes occurred in October, during the peak of fall migration. NASK lies in the main flight path of the Central Flyway with estimated migrations of up to eight millions birds. NASK needed to find a tool that would allow for the early warning of large concentrations of birds, in real time, that were likely to encroach within a 5 mile radius of the airfield. This information would than need to be disseminated to the cockpit, allowing pilots to avoid areas of high bird activity. This would allow for safer operations with minimal flight interruption. During the past two fall migration periods, NASK has incorporated two avian radar systems, Merlin and Accipiter, into every day operations. Both systems allowed for real-time information dissemination without significant disruption to flight training. Additionally, both systems enabled earlier resumption of regular flight ops following higher levels of bird activity by showing the dissipation of bird activity within critical airspace. This paper will detail use of real time information and give specific examples of how both radars were used to provide this information directly to pilots.

(9) GULLS GONE WILD: WHY DNA IS NOT ADEQUATE FOR 'WHITE-HEADED' GULL IDENTIFICATIONS

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Because of the high rate of gulls involved in bird strikes, and the difficulty in identifying these species using traditional methods and DNA 'barcoding', the Federal Aviation Administration (FAA) sponsored a two-year Smithsonian fellowship to genetically characterize 16 species of 'white-headed' gulls. This study focused on a variety of markers that vary in their mode of inheritance and rate of mutation; autosomal microsatellites, nuclear introns, and mitochondrial DNA control region, to 1) investigate the molecular identification of gulls that are involved in bird strikes, and 2) better understand genetic relationships within the 'white-headed' gull complex. We examined 700 samples encompassing the geographic distributions of all 16 species and found low to high levels of population genetic structure within and among species across marker types. Despite the observation of some population genetic structure, there is considerable allele and haplotype sharing among species which complicates the identification of these species. Genetic sharing among these species is attributable to the propensity of gull species to hybridize in areas of secondary contact, and relatively recent evolutionary age of the 'white-headed' gull complex. For the purposes of the FAA study, we assembled a genetic matrix with sequence and fragment data from known 'white-headed' gull species that can be used to assign a probability of acceptance for molecular identifications. Once the molecular designation is assigned, corroboration with circumstantial data surrounding the bird strike event such as date of strike, geographic location, time of day, morphological feather evidence and amount of damage can be used to further eliminate species that are genetically similar. The results of our study, using the most current genetic techniques, show that 'white-headed' gulls are genetically too similar to rely solely on this method for species identifications and underscores the importance of submitting all available evidence when gulls are involved in bird strikes.

(10) USING FTA® CARDS TO COLLECT DNA FOR BIRDSTRIKE IDENTIFICATIONS

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The Whatman® FTA (Fast Technological Analysis) card is a novel way to instantly "fix" DNA and inhibit degradation of DNA samples post-collection. Although this card was originally designed for sampling human fluids, it has since been used for a variety of zoological studies. Recently, the Smithsonian Feather Identification Lab has encouraged the use of these cards as a possible option for collecting DNA samples from birdstrike events. We analyzed over 200 FTA® cards that were received from various airfields during 2008–2009 to determine if these cards yield viable DNA for identifications; to compare those results to standard tissue extractions of the same material; and to evaluate the denseness of successful samples. Preliminary results suggest that FTA® cards are a valid option for collecting DNA samples and yield successful identifications in more than 60% of the cases. FTA® cards have similar extraction success to tissue samples, and the denseness of the sample on the card is not related to DNA identification success. FTA® cards are lightweight, readily available, and are approved by USDA as a disease 'treatment' for foreign avian shipments. This card, or similar products, remain an option for the collection of birdstrike samples.

(11) "NO SOUP FOR YOU!": USING DIETARY ANALYSIS TO REDUCE BIRD-AIRCRAFT COLLISIONS

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Bird-aircraft collisions (bird strikes) cause serious safety hazards to aircraft. Habitat management within airport environments is the most important long-term component of an integrated wildlife damage management approach to reduce the use of airfields by birds. Understanding the feeding habits and temporal patterns in food selection of hazardous species provides insight into their activity patterns and the forage resources that might attract these birds to airports. More importantly, if hazardous birds are consistently feeding on certain prey items (e.g., insects or plants), wildlife damage management actions could be designed and implemented to remove those identified forage resources and thus reduce the risk of bird strikes. Avian food habits information can be obtained from a variety of sources, including the scientific literature, direct observation of feeding individuals, and from diet analysis of birds struck by aircraft or collected during control activities at airports. An important consideration is dietary plasticity (i.e., variation in foods consumed), as the feeding habits of birds can vary within a species (e.g., European starlings), across the range for a given species (e.g., laughing gulls), and temporally (e.g., seasonally) within and among various species. Interpretation of information gained from dietary analyses of birds must be representative of the situation in question, in regard to both time and space. Using the findings from food habit assessments, airport managers and wildlife biologists can enhance the effectiveness of an integrated wildlife damage management program to reduce wildlife hazards. Airport landscaping and airfield vegetation can be modified to reduce foraging opportunities to hazardous birds. The selection and timing of pesticide applications (e.g., insecticides, rodenticides, herbicides) can be made to maximize the impact on appropriate targets to reduce forage availability. Periods of increased bird presence on airports, for example during times of high insect abundance, can be anticipated and mitigated through planned wildlife control activities.

(12) BIRDS UNDER GRIDS AND OVER WATER: DETERRING WATERFOWL FROM SEWAGE TREATMENT PONDS AND STREAMS

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Deterring birds from water on or near airports is an important part of a bird strike reduction program. Overhead wires of various materials and in a variety of patterns can reduce bird use of specific areas. It has been suggested that widely spaced grid wires can be as effective as narrowly spaced wires and therefore more economical due to decreased material and initial labor costs. However, when a 50–foot grid was placed over waste-water ponds in South Carolina the total number of waterfowl using the ponds increased. Canada goose numbers did decline while mallard, ring-necked duck and ruddy duck numbers increased. Similarly, a 15–foot grid over narrow streams in Illinois also showed no significant difference in total bird use before and after grid installation. Mallards, great

blue herons and great egrets all used the gridded areas. It is possible that waterfowl using the gridded areas perceived the overhead grids as protection from avian predators. An integrated bird hazing approach is therefore necessary at these grid locations and we anticipate would be required at other grid locations as well. As data become available, installation and maintenance costs will be summarized to provide a more complete economic cost of an anti-bird grid.

(13) SUMMARY OF WILDLIFE SERVICES' RED-TAILED HAWK TRANSLOCATION EFFORTS AMONG 19 U.S. AIRPORTS, 2008–2010

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The Federal Aviation Administration reported that 36% of bird strikes occurred on the airfield while an additional 57% occurred during takeoff run and approach, suggesting that most strikes (93%) occurred on or near airports, 1990–2008. While tools to locate and quantify hazardous birds are critical, actively managing birds on airports is paramount to reducing bird strike risk. Red-tailed hawks (RTHA) rank 7th in number, 3rd in damage costs, and 4th in costs per strike. Proper habitat management and prey removal are widely considered the best long-term methods to deter RTHA from airfields. However, environmental, public relations, or economic factors sometimes prevent these methods from being implemented. Harassment, lethal removal, and translocation are heavily relied upon by wildlife biologists to reduce RTHA abundance at airfields. In 2007, USDA Wildlife Services (WS) coordinated with The Bird Banding Laboratory to develop a nation-wide WS airport raptor color-band. Between March 2008 and February 2010, WS color-banded and translocated 281 after-hatch-year (AHY) and 302 hatch-year (HY) RTHA from 19 airports in 9 states. Birds were translocated 7–253 miles and in all months. At least 7% of all birds returned (10% of AHY and 3% of HY). Two AHY returns were subsequent bird strikes (released 28 August and recovered 14 January [MO], released 9 February and recovered 1 September [WI]). Return rates for HY birds were below 7% for all distances (20–mile scale) and all months. However, return rates for AHY birds were variable. AHY returns were greatest when released in May, June, September and October (50%, 38%, 33%, and 44%, respectively). AHY returns were greatest between 41 and 60 miles (43%) with significant declines in 20-mile increments below and above that (1–20 mi = 9%, 21–40 mi = 13%, 61–80 mi = 10%, 81–100 mi = 8%, 101–120 mi = 5%, and >121 mi = 3%). These results suggest that: 1) RTHA translocation can be effective in removing all age classes of RTHA from airfields, 2) distances other than 41–60 miles should be selected, and 3) adult RTHA are a hazard to aircraft.

(14) PRACTICAL APPLICATION OF VEHICLE MOUNTED INFRARED SYSTEMS IN WILDLIFE CONTROL AT HURLBURT FIELD

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Hurlburt Field is situated along the Gulf Coast and is one of two wings under the Air Force Special Operations Command. The nature of the wildlife control issues on the airfield are diverse including a variety of habitat types as well as a wide range of avian, mammalian, and reptilian populations. All present potential to interrupt airfield operations and training and require an array of tools to manage effectively. Approximately 70% of Hurlburt Field's airfield operations occur at night and therefore require a unique approach to managing the wildlife risks and reducing the hazards. This presentation will provide an overview of forward-looking infrared (FLIR) usage as a tool in effective airport wildlife control. The ability to work in a night operations environment safely and effectively is enhanced by the tools and equipment available to the wildlife control team. FLIR systems for use in any wildlife control program are key to successfully managing risk that wildlife present. One of the major benefits of a thermal imager over night-vision technology is that thermal imaging detects infrared wavelengths, as opposed to night-vision systems, which enhance visible light. Thermal imaging is not affected by ambient light. This allows for use of the system in an environment where bright lights are in use at night without losing the images as well as use of the system during the day. FLIR systems also allow for searches of adjacent woods and open spaces throughout an airfield to clear out mammals, such as deer and coyotes. Thermal imagers can spot deer encroaching on airfields at night and can find deer during the day in trees and brush. Ultimately, this enables the wildlife control team to find and drive deer and other mammals farther away from the flightline. Overall, these systems make wildlife control efforts highly effective and efficient.

(15) OFF-AIRFIELD BIRD HAZARD MANAGEMENT AT UK AERODROMES

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Following the recent series of incidents involving off-airfield bird strikes, options for better understanding the role different habitats play in determining, and therefore managing, the risk such sites pose to aircraft needs to be sought. In the UK, airports are required to provide a 'bird map' detailing the presence of hazardous birds in the vicinity of an aerodrome. This paper details how better organization and gathering

of data by airport operators can be used to influence both planning decisions and owners of existing sites to help reduce the overall risk of bird strikes in the vicinity of aerodromes.

(16) REMOVAL OF OFF-AIRPORT WILDLIFE HAZARDS: A CASE STUDY OF NEW YORK CITY CANADA GEESE

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In New York City (NYC), two airports are sensitive to the abundance of Canada geese using off-airport habitats due to historical goose strikes and the USAir Flight 1549 incident in January 2009. Working off-airport requires communication with property owners and public land managers to gain cooperation. A coalition of federal, state, and local government agencies formed a wildlife hazard management steering committee to identify wildlife hazards to aviation, develop management plans to minimize the hazard, and implement the plan. Federal and state wildlife agencies assembled appropriate scientific literature and developed a management plan with other federal, state, and city agencies. Personnel with USDA Wildlife Services (WS) and NYC Departments of Parks and Recreation and Environmental Protection worked with operations staff at John F. Kennedy International and LaGuardia Airports to identify properties used by geese. WS biologists evaluated and assessed 52 properties near the two airports. During plan implementation in 2009, a total of 1,235 Canada geese were removed from 17 locations harboring molting geese. Managing wildlife in urban or suburban areas requires positive interaction and open communication with the public. Public lands within NYC attract many residents who use these parks to maintain quality of life. We used a multi-faceted public education campaign to share information about the goose management program. NYC residents were supportive of managing geese to protect aviation safety and to have the parks for other intended recreational uses. Three of 170 residents engaged by WS strongly opposed the removal of geese. Conflicts are often overstated by advocacy groups; thus, management agencies need to assess potential conflicts and manage risks. National animal rights organizations opposed the management action on behalf of their reported 129,000 members in the NYC area (total population of 14 million). One-half of 130 form letters opposing the action where from NYC. A collateral benefit, airports in upstate New York conducted similar goose management actions to protect aviation safety.

(17) ANADROMOUS SALMON STREAM INTERACTION AND CONFLICT WITH KETCHIKAN INTERNATIONAL AIRPORT

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Damon Hampel, *Ketchikan Indian Community Deer Mountain Hatchery and Eagle Center, Ketchikan, AK 99901 USA*
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The Ketchikan International Airport recently underwent runway expansion and airport grounds modification. As part of this expansion, an existing catalogued salmon stream was re-routed closer to storm-water drainage adjacent to the runway. To prevent salmon from accessing the storm-water drainage area, a salmon barrier was put in place. Despite the barrier, salmon were discovered spawning in the drainage area during a routine wildlife survey. This situation resulted in a >50% increase in the normal count* of gulls (primarily California, mew, glaucous-wing and herring gulls) as well as an increase in bald eagles present around the runway. The barrier was improved using additional materials, and the spawning salmon were collected using dip-nets and then placed in the proper stream. The wildlife response team and airport staff used traditional and non-traditional methods of deterrence to control the wildlife that had accumulated in the area. To assist in resolving this issue, the Ketchikan International Airport developed a unique inter-disciplinary working group. Among the members of this ad-hoc wildlife working group included oil spill response professionals (that may perform wildlife hazing during an oil spill), local hatchery professionals, borough airport officials, and wildlife regulators.

**Normal field counts prior to the formation of the ad-hoc working group were performed solely by borough maintenance personnel.*

(18) INTEGRATION OF REAL-TIME BIRD RADAR INFORMATION INTO CIVIL AIR TRAFFIC CONTROL OPERATIONS: A ROADMAP

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Over the past decade bird detection radar systems from various manufacturers have been increasingly used by military users to reduce bird-aircraft strike risk on airfields and bombing ranges, and various systems are now being used or evaluated for use at commercial airports. Following an initial assessment

of bird strike risk at the new international airport site near Durban, South Africa in 2007, the Airport Company South Africa (ACSA) committed to install a permanent bird radar system at the airport. Over a two year period, a concepts-of-operation (CONOPS) was developed and approved by the stakeholders for integration of bird radar data into airport air traffic control procedures that includes real-time bird strike risk advisories and alerts in the air traffic control tower. Early inclusion of all stakeholder groups with participation by the air carriers, airports and the South African Air Transportation and Navigation Service (ATNS) in the process facilitated the development of the tower bird radar display and standardized procedures and phraseology that are used to provide real-time bird strike risk warnings and advisories to pilots. This presentation outlines the process through which this first of a kind effort was accomplished, discusses "lessons learned", and establishes a "roadmap" for other airport and air traffic system implementations to follow that includes the safety case that provided assessment of bird remote sensing technology methodologies compared to the use of traditional visual observations for defining the bird strike risk level and for issuing pilot advisories.

(19) TOWARDS MAXIMIZING SITUATIONAL AWARENESS USING AIRPORT AVIAN RADARS

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Since the miraculous ditching in the Hudson of US Airways Flight 1549 following multiple bird strikes, stakeholders including pilots have issued renewed calls for improved situational awareness of bird activity around airports. Early this year, an independent DoD validation program issued its final report on avian radar performance assessed at Navy, Air Force, and Marine Corps facilities based on 3 years of scientific study. Additional reports for the FAA under its avian radar assessment program, based on deployments at Seattle-Tacoma, Chicago O'Hare, and JFK are in preparation or under review. These results substantiate the ability of the avian radars tested to continuously track bird movements in the vicinity of airports 24/7/365 resulting in a wealth of bird track data that can be used in mitigation efforts to reduce bird strikes. Recognizing that the sheer volume of bird track data generated by avian radars may overwhelm some users, efforts are underway to transform these data into visualization tools that will improve situational awareness for wildlife and airfield personnel without adding additional work loads. In this paper we report on a selection of these tools, categorize them into tactical and strategic uses for specific users, and illustrate their value with real data from a variety of avian radar deployments. The tactical tools include real-time bird traffic monitoring, early warning text messaging, and spatially-localized BASH condition alerts. Strategic tools include accumulated avian traffic patterns, bird abundance and distribution patterns, and an airport-based dynamic avian statistical hazard (DASH) advisory. As many other useful information tools can be developed, we propose a straight-forward, correlation-based methodology that uses local wildlife knowledge and ground-truth to maintain quality assurance. The collection of tools presented here will hopefully provide users from biologists to pilots with spatial and temporal situational awareness baselines upon which they can use their domain expertise to build and extend through dialogs with developers and regulators.

(20) USING AVIAN RADAR TO PREDICT BIRD MOVEMENT AT SEATTLE-TACOMA INTERNATIONAL AIRPORT

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A common claim supporting the use of avian radars at civil airports is that airport information improves situational awareness, particularly the dynamics of the movement of birds on and around the airport. Avian radars have been in place at Seattle-Tacoma International Airport (SEA) since August 2008, operating continuously as part of a Federal Aviation Administration performance assessment program. A test of radar utility was conducted when airport wildlife personnel identified a starling roost in the terminal area and suggested use of archived radar data to better characterize the problem. A characteristic "bloom" of activity was identified based on confirmed starling movement and an analysis of radar data was initiated to define movement patterns and the timing of movements. The archived radar data was evaluated and the timing and pattern of movement characterized. This data was related to sunrise and sunset times and a predictive model developed. The results indicated that the birds left the roost on average 2 minutes before sunrise, although inclement weather did have an effect on the time of movement. Wildlife personnel at SEA have used this model to schedule observations and management, confirming model accuracy. In this example, avian radars improved situational awareness and confirmed movement patterns that focused wildlife management efforts.

(21) CYBERTRACKER AND WINDOWS MOBILE: AN INEXPENSIVE SOLUTION FOR ELECTRONIC WILDLIFE CONTROL DATA COLLECTION

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Several packaged solutions for electronic data capture in airport wildlife control program exist on the market today, most of which are costly and require the distributor's/manufacturer's involvement in order to initiate any changes or upgrades in the database. Cybertracker is a free database solution, that when coupled with an inexpensive Windows Mobile PC, smartphone, PDA, or other handheld computer and GPS combination, can allow airport wildlife control personnel to collect electronic data in the field with ease, including GIS information and an unlimited number of other variables. The Cybertracker database was originally developed for usage by non-literate African trackers in order to collect scientific data in the wild, so the implementation and employment of the system is, as a result, quite straightforward and painless. The software requires no programming skills, allowing wildlife managers to freely customize the data collection for their own needs and allowing on-the-fly upgrades and modifications with endless levels of detail. Data collected through Cybertracker can also be readily exported to Excel and other spreadsheets for further analysis and review. We will look at the implementation of an electronic data collection system through the purchase of an inexpensive mobile device and development of a Cybertracker database. We will examine the strengths and weaknesses of the setup, usage, and modifications to the electronic database for wildlife control programs at airfields, as well as the possibilities of airfield personnel in setting up their own systems.

(22) A QUANTIFIED SPECIES-SPECIFIC BIRD HAZARD INDEX ENABLING A BIRD CONTROL DECISION SUPPORT SYSTEM

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To assess the bird situation at airfields a risk assessment matrix, which indicates the risk that bird species pose to an airport, is often used. For a given period, bird species are positioned in this matrix according to the frequency with which they were involved in bird strikes and the percentage of strikes resulting in damage. The matrix is a tool to evaluate the bird hazard management program, enabling the management to take appropriate measures. For day to day purposes it does not provide the possibility of calculating a hazard level at any given moment, based on birds present in the runway environment. Therewith it does not provide a decision tool for bird control units to prioritize bird control measures. This requires a quantified species-specific Bird Hazard Index which enables the estimation of the hazard level at any specific time. We have developed such a quantified species-specific Bird Hazard Index by combining the species specific bird strike sensitivity and damage sensitivity. Strike sensitivity is calculated using the discrepancy between the local RNLAF bird strikes per species and their presence on an airbase (using 30 years of systematic bird counts on RNLAF airbases). The damage percentages from EURBASE represent the species specific damage sensitivity. Combining those two a species specific Bird Hazard Index is generated. In this research the Bird Hazard Index is calculated for 20 prominent bird species, covering more than 80% of the total number of birds present at RNLAF airbases. With this quantified species-specific index it is possible to objectively assess the hazard of the local bird situation at any moment during any bird count at any airbase. This enables the development of a bird control decision support system. In addition this method can be used as an audit tool based on bird counts only, without the use of bird strike statistics.

(23) IT'S A BIRD, IT'S A PLANE, IT'S VISUAL ANALYTICS!

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With increased awareness and reporting in the aviation community, the FAA National Wildlife Strike Database is expanding faster than ever. In the first half of 2009 there were an average of 20 strikes/day on commercial aircraft alone contributing to a total of over 100,000 records between 1990 and 2009. For stakeholders concerned about wildlife hazards this is both a gift and a curse. More data are beneficial from the analysis perspective because the database continues to get closer to mirroring the real world. However, analyzing more records is time consuming, especially when investigating specific issues and reading individual reports. This paper presents the use of Visual Analytics tools and methodologies to analyze bird strike data more efficiently. Visual Analytics is the science of analytical reasoning facilitated by interactive visual interfaces. Using visualizations as a form of analysis rather than just for presenting results can be extremely useful. For an airframe manufacturer, visual analytics was extraordinarily beneficial for risk management. Visualizing high-energy bird strikes using kinetic energy, height and speed on the same scatterplot was highly effective at identifying damaging strikes, assessing airplane and system requirements, and determining flight crew response. We also plotted the distribution of strikes by species on a map and looked at strikes by time of day and flight phase, allowing for rapid analysis of bird strike characteristics. Several other analyses will be discussed in the paper as they were attempted using visual analytic techniques. The aviation community can benefit from these types of approaches when analyzing bird strike data.

ABSTRACTS

(24) INCREASING TREND OF DAMAGING STRIKES TO AIR CARRIER AIRCRAFT OUTSIDE THE AIRPORT BOUNDARY: IMPLICATIONS FOR MITIGATION MEASURES

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A basic tenet of programs to mitigate the risks of bird strikes has been to focus management efforts at airports since various historical analyses of bird strike data for civil aviation have indicated the majority of strikes occur in this environment (during take-off and landing at <500 feet above ground level [AGL]). However, a trend analysis of bird strike data involving commercial air carriers from the U.S. National Wildlife Strike Database for Civil Aviation, 1990–2008, indicates that this tenet may need to be revised. The percent of all strikes that occurred above 500 feet increased significantly from about 25% in 1990 to 30% in 2008. Of more importance, the percent of all damaging strikes that occurred above 500 feet increased from about 37% in 1990 to 45% in 2008. I also examined trends in strike rates (strikes/1 million commercial aircraft movements) for strikes occurring at < and >500 feet. From 1990–2008, the damaging strike rate above 500 feet increased significantly from about 2.5 to 4.0 whereas the damaging strike rate for strikes at <500 feet has declined since 2000. The substantial damage strike rate decreased significantly for strikes at <500 feet from 1990–2008 but has not declined for strikes at >500 feet from 1990–2008. An analysis of strike data for Canada geese (Branta canadensis), the most frequently struck bird species with a body mass >4 lbs, showed a pattern similar to that for all species. I conclude that mitigation efforts incrementally implemented at airports in the USA over the past 20 years have resulted in a reduction of damaging strikes in the airport environment. This reduction in strikes has incurred in spite of increases in populations of Canada geese and many other species hazardous to aircraft. However, these successful mitigation efforts, which must be sustained, have done little to reduce strikes outside the airport environment. Off-airport mitigation efforts that need to be enhanced include elimination of bird attractants within 5 miles of airports, use of bird-detecting radar, enhancement of aircraft visibility to birds, and bird migration forecasting.

(25) DIFFERENTIAL SUSCEPTIBILITY OF AIRCRAFT TO BIRD STRIKES

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While it seems intuitively obvious that small, relatively slow moving propeller powered aircraft are less likely to encounter bird strikes than large, fast moving turbofan powered aircraft, quantification of this difference and examination of differences between aircraft within the same categories has not been examined in depth. Commercial aircraft movements for 2009 at Vancouver International Airport were compared with the mass of birds struck by each aircraft type. As hypothesized, propeller-powered aircraft strike proportionately less bird mass than turbofan aircraft. However, there were large differences in susceptibility to strikes within turbofan aircraft. Aircraft design characteristics are explored to determine if they might explain some of the differences in aircraft susceptibility to bird strikes.

(26) OBJECT DETECTION AND AVOIDANCE BY BIRDS: IT'S NOT A MATTER OF "OUTRUNNING" A JET

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Birds see and react to objects while flying at airspeeds from approximately 10 to 30 meters/second and in vertical dives that exceed 100 meters/second, and they can respond to aerial predators within 0.25 second. Visual systems that allow birds such versatility in flight or avoidance of aerial attack can also be exploited to enhance their response to aircraft. Specifically, birds need not "outrun" an object approaching at 100 meters/second, but detect and avoid it. Recent experimental findings and data from field trials with aircraft support the idea that it is possible to enhance avian detection and avoidance of aircraft. Our objectives are to briefly review the 1) ecological foundation for avian response to object approach; 2) avian visual acuity data that support object detection at distance; and 3) recent experimental and field evidence supporting the novel use of aircraft lighting to enhance avian detection and avoidance of aircraft. Efforts to enhance avian detection and avoidance of aircraft compliment ground-based bird-strike reduction programs, particularly at the critical phases of takeoff and landing. Further, this research is the only effort that incorporates external components of the aircraft to proactively deter bird strikes.

(27) SOFT SKILLS: A TOOL BOX UNEXPLOITED

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Competency in technical skills required to implement an airport wildlife hazard management program is a necessity but not an absolute. Soft or non-technical skills are essential to establishing basic business relationships and ensuring the success of operational programs. Failure to recognize and develop these skills can result in a less than effective airport wildlife management program.

(28) NATIVE AND NATURALIZED TURF SPECIES UTILIZED AT AIRPORTS MANAGED FOR WILDLIFE HAZARDS IN THE NORTHEASTERN US

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Habitat management is an important component of an integrated approach for reducing wildlife hazards on airfields. This research has examined alternative turf species that are either native or naturalized in the Northeastern US. Many native turf species tend to not be attractive to wildlife due to their low palatability and seed production. Five native or naturalized turf-forming species were hydroseeded in 30–m2 experimental plots at three airports in central NY: little bluestem (Schizachyrium scoparium), indiangrass (Sorghastrum nutans), poverty oats grass (Danthonia spicata), crinkled hair grass (Deschampsia flexuosa), and lemon thyme (Thymus pulegiodes). A widely used Contractor's Mix was used as a control. Species were evaluated first for their ability to establish an acceptable cover and low maintenance stand and secondly for wildlife attraction by insects, birds and mammals. All natives were able to be germinated using hydroseeding methods. Percent cover was monitored throughout the growing season. Although native species required longer to establish than the Contractors Mix, both little bluestem and indiangrass established an acceptable cover at one airport after the first growing season. Avian, insect, and large and small mammal surveys were conducted throughout the field season. Insects were found twice as often in the Contractor's Mix relative to the next most commonly visited grass which was indiangrass. Both avian and mammal visitation tended to be higher in the Contractor's Mix plots. The overall goal of the project is to provide recommendations for turf management at general aviation airports that can be used as part of a plan for wildlife hazard management; however, results of the work may be utilized by other larger or smaller airfields with similar concerns.

(29) OBSERVATIONS OF THE EFFECTS OF SPECIFIC SOUNDS EMITTED FROM A PLANAR MAGNETIC TRANSDUCER ON WILD AVIAN AND MAMMAL POPULATIONS

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This paper will discuss the efficacy of utilizing a loudspeaker equipped with planar magnetic transducers to safely exclude birds and other mammals from areas in which they pose a hazard to humans (aircraft operations, vehicle operations, etc.) and to themselves. The topics covered will include a basic description of the design and operation of planar magnetic transducers and why they are the best available method for directing loud (>100 dB) sounds at a long distance (400–800 meters) to a specific area without causing noise pollution to surrounding areas, the effect of different natural sounds (gunshots, wounded birds, predators, etc.) and specific frequencies on birds and other mammals, and the effects of those sounds on each group of animals studied. Recent history has seen using repeated loud sounds (propane cannon, gun shot, etc.) to dissuade avian populations from airfields. Though these methods are initially effective, the repeated sound with no consequence to the birds drastically reduces the effectiveness of the method with birds only leaving the area for a few seconds after the sound. This research will focus on the type sounds that have the most effect on specific groups of animals and the regularity with which those sounds may be used while maintaining effectiveness of the method. It is hoped the results of this research will produce a reliable method to safely and effectively dissuade avian and other mammal populations from entering areas hazardous to themselves and the human public.

POSTERS

Glen E. Bernhardt, Bradley F. Blackwell, Travis L. DeVault, *and* **Lisa A. Kutschbach-Brohl,** *USDA/APHIS/ Wildlife Services, National Wildlife Research Center, 6100 Columbus Avenue, Sandusky, OH 44870 USA*

Fatal injuries to birds resulting from collisions with aircraft provide an opportunity to better understand species-specific avoidance behaviours in response to aircraft approach. We examined injuries to 92 birds (32 species) that died as the result of collisions with aircraft at John F. Kennedy International Airport (JFKIA). Our objectives were to determine whether 1) fatal injuries associated with a collision were discernible from those incurred due to impact with the ground, and 2) whether injuries to birds within phylogenetic groups/foraging guilds were distinctive, thus indicating cohort-specific response behaviours. We assumed that injuries associated with ground impact or post-collision trauma would be randomly distributed. We located injuries along three axes (dorsal-ventral, anterior-posterior, and right-left), then calculated the Cartesian distance between the injury coordinates and a random location on a carcass. Across all birds, injury locations were generally ventral, posterior, and on the left side. Because of the ventral distribution of injuries, we conclude that the birds had taken evasive action in response to the aircraft. We further suggest that lateralized brain function may explain the unequal right-left distribution of injuries.

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SRC is developing an advanced L-Band avian radar called BSTARTM for deployment to US civilian airports and military airfields and is currently participating in an FAA avian radar assessment. The FAA and the University of Illinois Center of Excellence in Airport Technology (CEAT) has been involved in R&D efforts aimed at using radar as a tool to detect and track birds for many years. This poster presentation describes the features of BSTARTM and discusses the advantages of choosing L-Band for airport avian radar design. As a participant in the FAA avian radar assessment, SRC deployed BSTARTM to Naval Air Station (NAS) Whidbey Island for a developmental assessment. This poster presentation describes the results of the deployment, the display and visualization tools and the database tools for bird radar data that SRC has developed to perform analysis of bird activity at airports or other locations of interest.

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The Federal Aviation Administration (FAA) started to record and report aircraft bird strike incidents in the U.S. in 1990. Prior to 1990, only serious bird strike incidents appear to have been recorded. An estimate of the number of pre-1990 bird strikes would be useful in order to understand long-term trends. According to the FAA, there were 87,715 bird and bat strikes in the U.S. between 1990 and 2008, increasing from 1,742 in 1990 to 7,332 in 2008 – more than quadrupling during the 19-year period. The increase is not fully explained by changes in aircraft activity: there were 9% and 11% increases in general aviation and air carrier movements, respectively, in the U.S. between 1992 and 2008. Quieter aircraft and an increasing bird population are also considered to be major factors in the bird strikes trend. One way of estimating the number of pre-1990 incidents, therefore, would be to examine changes in bird populations. This approach is challenging, since nearly 50 different wildlife groups have been recorded in bird strike incidents since 1990; each group demands separate attention. Between 1990 and 2008, there were 209 human injuries resulting from 167 strikes, and 16 human fatalities resulting from 9 strikes. In comparison, 42 injuries from 8 incidents, and 108 fatalities from 14 incidents, were reported for the 1912 to 1988 period. Another approach, therefore, would be to estimate the total number of incidents as a function of the number of severe incidents. For example, there was an average of 1.4 bird strike-related fatalities per year between 1912 and 1988; the average dropped to 0.8 per year between 1990 and 2008. The average number of fatal bird strike-related incidents, however, increased from about one every 5.5 years to about one every two years between the two periods. The latter statistic suggests that the average annual number of incidents may have increased by a factor of about 2.5 between the two periods. Thus, there may have been about 136,000 bird strikes in the U.S. between 1912 and 1988. The methodologies, results and data limitations are discussed in this poster presentation.

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A bird strike involves the collision between an aircraft and a bird, which can be the result of at least two scenarios: (a) the bird did not detect the aircraft, (b) the bird detected the aircraft but did not have enough time to avoid it. Both scenarios suggest a constraint in the ability of birds to visually detect an aircraft. Bird vision is quite different from human vision in that it involves different configuration of the visual fields and color vision. A bird's ability to detect an airplane depends on the visual contrast between the airplane and the background, which is expected to be different from humans because of the peak sensitivity of the avian visual pigments. Our goal was to establish whether the variation in the color designs of different aircraft types would affect the frequency of bird strikes in seven species. We predicted that the frequency of bird strikes would increase with aircraft that had color designs that would reduce visual contrast for birds. We used the FAA Wildlife Strike Database as a source of the number of bird strikes per species and aircraft type, and data from TranStats (Bureau of Transportation Statistics) to standardize the bird strike data for the number of flights per aircraft type per airline. Preliminary results suggest that the number of bird strikes per aircraft type differs between airlines with different color designs. We derive implications for the use of colors that would make aircraft more visible to birds.

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Red-tailed Hawks (Buteo jamaicensis) are common North American raptors. Because of their relative abundance, wide distribution and affinity for open areas they are one of the raptor species most frequently encountered at airports. At Portland International Airport (PDX), red-tailed hawks occur as year-round residents, spring and fall migrants and wintering and transient birds. Trapping and translocation is one on-going method used to reduce the number of red-tails and incidence of red-tailed hawk strikes, particularly during spring and fall migration when non-resident red-tails are most numerous. Between October 1999 and December 2009, 849 red-tails were trapped at PDX and released elsewhere. Fifty-eight release sites ranging from 5 to 288 miles from PDX were used. Return rates from individual release sites ranged from 0% – 100%. Nearly 26% of released red-tails returned to PDX at some point. The number of days to return ranged from zero to 1,077. Approximately 50% of those that returned did so within 30 days. Red-tails captured as adults (older than one year) were nearly twice as likely to return as immature red-tails (less than one year old). The distance and direction of release sites from PDX, status of bird at capture (resident vs. non-resident) and other factors influenced the relative success of each site and each release.

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As all conferees know, the risks to aircraft from collisions with birds and other wildlife are increasing each year. Many initiatives are proposed, and many implemented, to decrease such risks, but have been ineffective to materially decrease these risks as the number of bird strikes increase every year. No such initiatives under consideration appear to prevent such accidents as encountered by US Airways Flight 1549 at about 2,900 feet altitude and five miles from takeoff. This paper explores concepts for development of on-board active avoidance systems to clear the flight path of aircraft during takeoff, flight plan, and landing. The proposed systems include laser and/or narrow-beam microwave emitters installed in instrument pods or radomes mounted on aircrafts' fuselages or wings. Avionics systems control such laser and/or microwave beams for such characteristics as power (or range), beam divergences, and frequency/wavelength, which can be tailored to default values or empirical database values based upon aircraft speed profile, anticipated wildlife species, light and wind conditions, seasons, etc. Beam parameters are controlled by beam divergences and/or by "painting" pseudo planes at desired ranges by pointing throughout its bounds using spiral or raster pointing methods. The laser and/or microwave beams have been demonstrated by experiments to be effective means of dispersing some species while presenting no threat to the wildlife or the environment. Birds' eyes are coated with a film, or oils depending on species, to protect them from the UV rays of the sun and appear to have a natural vision defense to injury against the beam generated by moderate-power lasers. Experiments by Air Force Research Laboratory show that narrow-beam microwave irradiation rapidly heats bird or wildlife surfaces to the pain threshold, but it takes hundreds of seconds to burn the skin giving ample margin between inducing pain and causing a burn.

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The use of radar systems specifically designed to record bird activity at airfields has become increasingly common to try and reduce the risk of collision between birds and aircraft (bird strike). We examine bird radar data from three Air Force Bases (AFB) distributed across the United States; Beale AFB, in Northern California, Offutt AFB in southeast Nebraska, and Dover AFB on the Delaware coast. We will examine bird radar data in relation to bird strike data recorded at each of these bases from January 1, 2009 through December 31, 2009. We are conducting data analyses using an information-theoretic modeling approach. The purpose of these analyses is to: (1) identify environmental factors associated with bird activity (2) quantify bird strike data from multiple sites and (3) begin to formulate a predictive model in order to lower risk for bird strike occurrence based on our suite of environmental variables. We will employ a generalized additive mixed effects model (GAMM) with random effects which will allow us to account for site related variation. In addition we will examine several a priori hypotheses regarding bird activity patterns in relation to environmental data using the horizontal based radar encounter data from the three avian radar systems in place at these three AFB's. Predictor variables include ordinal date, moon phase, sunrise/sunset times, and weather variables including wind/ rain/fog.

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Much has been accomplished in the documentation, analysis and wildlife control of bird activity around airports. The FAA wildlife strike database has recently shown a dramatic increase in the number of aircraft bird strikes. Even with the latest airport wildlife control methods, and excellent wildlife management programs, the number of bird strikes continues to increase. With increasing bird populations and number of aircraft using the same volume of airspace, it is critical to consider the use of technology now to help minimize the risk of a bird strike. To date, no bird target data is allowed in a control tower or cockpit. While locating an avian radar in a control tower holds some promise for operational use as demonstrated at some military bases and foreign countries, there are still no solutions for pilots to directly control their destiny in event of a potential bird strike. This poster presents an architecture, implementation and various concepts of operations (CONOPS) to use a ground based avian radar to locate birds in the vicinity of an airport and use existing data links to send bird targets to the cockpit.

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Since the inception of FAA's National Wildlife Strike Database in 1990, 89,727 reported wildlife strikes to airplanes have resulted in at least $628 million annually in losses to civil aviation in the United States and >200 human lives lost. Approximately 92% of bird strikes occurred at or below 3,000 feet above ground level which suggests that most aircraft risk occurs within the immediate vicinity of the airport. Risk reduction strategies involve a combination of land use planning, vegetation management, deterrents, harassment, and removal. Land use planning typically involves establishment of turf grasses, which are maintained in short cover by frequent mowing. Frequent mowing is costly, carbon intensive, and may have the unintended consequence of producing vegetation structure that attracts bird species that pose aviation risk (e.g., Canada geese, killdeer, and European starling). Establishment and maintenance of alternative plant communities might reduce costs, generate revenue through production of biofuel, livestock forage, seed material, and reduce aviation risk. We describe a study to measure wildlife use of native warm season grasses for biomass and forage production to reduce aviation risk. We will evaluate four treatments: a switchgrass monoculture with a single biofuel harvest, native warm season grass mix with a single biofuel harvest, switchgrass monoculture with multiple forage harvests, and native warm season mix with multiple forage harvests. These treatments will be contrasted with traditional turf-grass management of airport lands and the prevalent land cover around our study area. Our approach will characterize species composition, abundance, and animal space use at ground level and in typical aircraft flight space around the treatments. Our goals are to consider the feasibility of each treatment to minimize aircraft risk, provide economic return to the airport, and provide habitat to species that pose minimal threats to aviation.

Gary R. Ness and Kim Kenville, Flockbuster Company, 159 8th Avenue NW, West Fargo, ND 58078 USA

Wildlife and bird strikes are a national issue and a growing concern for the aviation community. The spotlight has been on waterfowl since the "Miracle on the Hudson". A product developed by FlockBuster has been used with success as a repellant for birds, moving birds from farm fields, thus reducing crop damage and increasing profit to the grower. With the above mentioned success of moving blackbirds away from sunflower fields, it was determined that the product would be tested on the airport/aviation community. FlockBuster conducted a summer-long field test in Devils Lake, ND (a commercial service airport - KDVL). The airport is surrounded by one of North Dakota's largest lakes and city-owned waste water treatment plant. The airport has two very significant bird problems: seagulls and geese. Initially the project, focused on seagulls, but due to natural nesting protective instincts and the timing of the project, the Seagull area was found to be very difficult to make any significant progress, and that part of project was abandoned. The next problem identified was the goose population which was within the airport's Runway Protection Zone (RPZ). This area was analyzed and an application strategy was developed. The strategy was to move the geese by applying Flockbuster to the area, thus making the birds move on their own to another area not within the RPZ. There were several documented applications with minimal results. In time, the treated area became too difficult for geese to occupy and they began to move to the east of the project area, and by mid-summer the birds had successfully moved away the (RPZs). FlockBuster believes this product can be a part of an environmentally-friendly mitigation strategy which airports can humanely repel the birds away from their safety areas.

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The U.S. Air Force and USDA/APHIS/Wildlife Services (WS) a have long standing collaborative programs to mitigate risks posed by wildlife to aviation safety. The U.S. is currently engaged in a two front war in southwest Asia and military assets in both Iraq and Afghanistan are dealing with human health and safety issues; working at these sites poses specific challenges. WS is currently assessing and mitigating wildlife hazards, in Iraq and Afghanistan to reduce the realized and potential risk posed by local wildlife populations. Both bases are unique in the diversity and abundance of wildlife species, environmental factors as well as the habitats that surround the regions. Wildlife hazard assessments (WHA) technical assistance and operational activities were initiated in November 2009. Joint Base Balad (JBB), Iraq is located along the Tigris River approximately 40 miles north of Baghdad in central Iraq. JBB is surrounded by agricultural crops such as corn, millet, and vineyards. Large flocks of rock doves, wood pigeons, rooks and rabbits are routinely observed which contribute to direct and indirect strike hazards. Approximately 29,000 birds were observed while conducting surveys from November 2009 to March 2010. Operational activities including harassment, trapping, and lethal control have resulted in a reduction in strikes by 77%. Bagram Airbase (BAF) is located in the Parvan Province of Afghanistan approximately 7 miles southeast of the city of Charikar and 27 miles north of Kabul. It is served by a 10,000–foot runway built in 1976 capable of landing large cargo and fighter aircraft. Seasonal bird migrations pose a great threat to aircraft and consequently air combat missions. Similar to JBB, wildlife mitigation for human health and safety is on-going. Point transects and runway surveys have been established in conjunction with direct control efforts directed towards resident avian and mammalian species. Operational activities have contributed to a 40% reduction bird strikes at BAF.

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Real-time data on the migration of raptors through southwest Idaho during autumn is needed by land management agencies and flight safety officials. During September and October, between 4,000 and 8,000 raptors have been counted while passing along the mountains east of Boise, Idaho. Raptors use thermals and uplifting wind currents along ridgelines and mountain ranges to migrate. However, specific information is lacking on the movements, behavior, and flight corridors used by raptors crossing the Snake River Plain. Between 2004 and 2008, 28 raptors were marked with VHF radio-transmitters and, in 2009, three raptors were marked with satellite transmitters (PTT units) to facilitate remote monitoring. Migration routes were identified through Military Operations Areas and general aviation airspace which has the potential for BASH. Raptors were observed using three behaviors when confronted with the plain: they crossed the 90+ miles distance quickly, typically

about 3.5 hours; short-stopped their movements to rest and feed in the canyons south of the Snake River for several days; or crossed southern Idaho going east and southeast toward the borders with Nevada and Utah.

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The Federal Aviation Administration (FAA) in combination with the USDA/APHIS/Wildlife Services National Wildlife Research Center (NWRC), the National Center for Atmospheric Research, Indiana State University and Purdue University are expanding on-going efforts to evaluate the effectiveness of avian radar systems at airports. This 3-year assessment effort is part of the FAA's overall investigation of the effectiveness of commercially available avian radar detection systems at U.S. civil airports. Though it is well established that avian radar systems can detect wild birds, there is little published information concerning the accuracy and detection capabilities including the probability of false detection related to range, altitude, target size, and effects of weather. Researchers from the NWRC are leading the effort to conduct 1) a technical evaluation of a commercially available avian radar system, including sensor components and associated data delivery systems, 2) field evaluations of the system's accuracy using remote controlled aircraft and radio-marked wild birds, 3) an assessment of the integration of radar technology with other, more traditional aspects of wildlife hazard management at airports, and 4) a behavioral study on the potential effects of radar energy on bird behavior. Information gathered from these studies might contribute to the development of future wildlife hazard mitigation guidelines as part of an integrated wildlife hazards management approach at civilian and military airports across the country.

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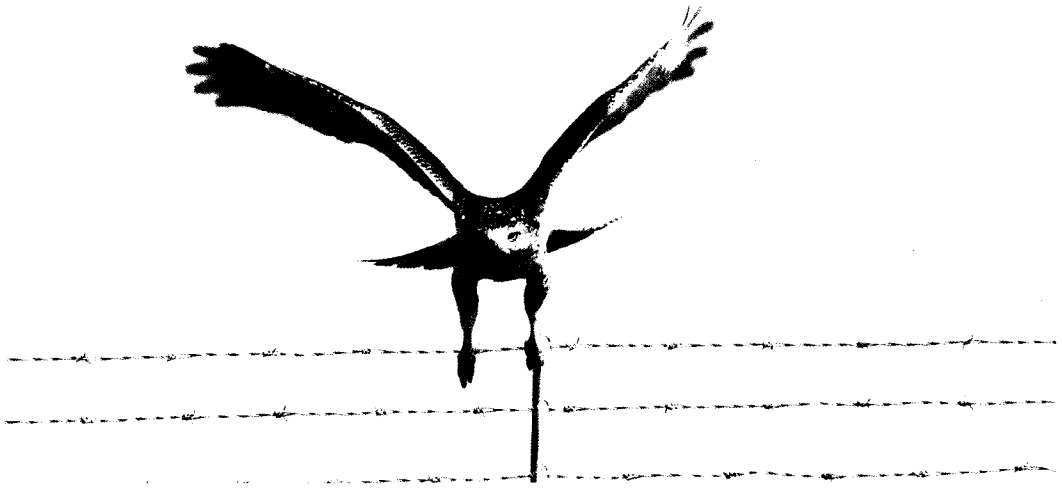
In October 2008, an interagency agreement between the United States Navy Southeast Region and Smithsonian Institution Feather Identification Lab was initiated allowing all U.S. Navy and U.S. Marine Corps personnel to submit bird strike remains for identification. Since the agreement began, we have experienced a steady growth in participation. For FY 09, the first of Navy participation, 400 cases were submitted for identification. This poster presents the results of bird strikes in the second year of this program (FY2010 to present) and details the increase in participation, the types of species identified, basic statistical results, and reviews the methods used to identify bird strikes. Based on the information presented in this poster, the U.S. Navy and U.S. Marine Corps bird strike identification program is growing steadily as participation and awareness of the free-of-charge bird identification service expands.



Waterfowl (31%), gulls (25%), raptors (18%), and pigeons/doves (7%) represented 81% of the reported bird strikes causing damage to USA civil aircraft, 1990-2008.