

INTEGRATED NORTH AMERICAN BIRD AVOIDANCE SYSTEM: RESEARCH AND DEVELOPMENT STRATEGIC PLAN

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Abstract

Bird strikes to both civil and military aircraft in North America reportedly cost over \$US 1 billion annually. Bird control efforts and population management are conducted in the airfield environment, but many strikes and a disproportionate amount of damage are recorded in the off-airfield environment. Avoiding birds in flight remains a viable option that requires further research and development. Bird avoidance in time and space is scale dependent in both time and space. Long range planning can be addressed by such historical systems as the USAF's Bird Avoidance Model. Near real time, regional advisories are provided by the Avian Hazard Advisory System. Real time and localized advisories are addressed with mobile avian radars, airport surveillance radars, and other systems under research and development by various agencies. Effort is now underway to integrate all these disparate systems under one overarching umbrella for the United States and Canada. The USAF Academy Institute for Information Technology Applications is currently hosting the program to consolidate such efforts. Maintenance and updates to the US BAM and the new Alaska BAM, integration of BAM and AHAS internet map server applications, development of small to large scale bird detection radars, and communication networks for control programs and ultimately to be projected into cockpits fall under the new purview. A strategic plan for the proposed integrated North American Bird Avoidance System has been developed to outline research, development, and implementation of these efforts. Department of Defense, Federal Aviation Administration, Transport Canada, Canadian Defense Forces, and various contractors are current participants. The goals are to end competition and incompatibility between components and to create a unified system for all users. Ultimately, efforts to integrate systems in a worldwide network will be pursued with cooperating nations across the globe.

Keywords: Strategic Plan, North America, Bird Avoidance, Radars, BAM, Communication, Advisories.

NORTH AMERICAN BIRD STRIKE ADVISORY SYSTEM STRATEGIC PLAN

1. Introduction

Collisions between birds and aircraft have occurred since the earliest days of aviation. The bird strike problem has become more severe over time with crowded airspace, faster aircraft, and significant increases in hazardous bird populations. Globally, since 1990, there have been a minimum of 147 fatalities and over 120 aircraft lost due to bird strikes. It is virtually impossible to accurately calculate the costs of these incidents due to lack of mandatory reporting, differing reporting standards, indirect costs, and commercial interests; but by any measure the costs are staggering.

The United States Federal Aviation Administration (FAA) records an average of over 6,000 bird strikes per year to the civil aviation industry, including direct and associated costs at a minimum of \$97.9 million per year. Corrected for the estimated 80% of unreported strikes, costs may well exceed \$489.8 million per year. Figure 1 shows a 2002 bird strike on the nose of a civilian aircraft that occurred on departure from Dulles International Airport. Transport Canada (TC) estimates direct costs to its industry between \$64 and \$127 million US dollars annually from over 900 reported strikes per year and an estimated 30% unreported strikes.

The US Air Force (USAF) reporting rates are considered much higher than in the civilian sector due to mandatory reporting requirements. The USAF annually records approximately 4,000 bird strikes and direct costs of over \$25 million. The USAF recorded 22 lost aircraft and 33 fatalities since 1985. Figure 2 shows a bird strike on a USAF C-141.

Figures 1 and 2 show bird strikes that did not result in the loss of human lives. Figure 3 shows a September 1995 bird strike that resulted in an E3-B AWACS crash that claimed the lives of 22 Americans and 2 Canadians.



Figure 1. 2002 Turkey strike on commercial aircraft at Dulles International Airport.



Figure 2. Canada Goose strike on radome of US Air Force C-141.

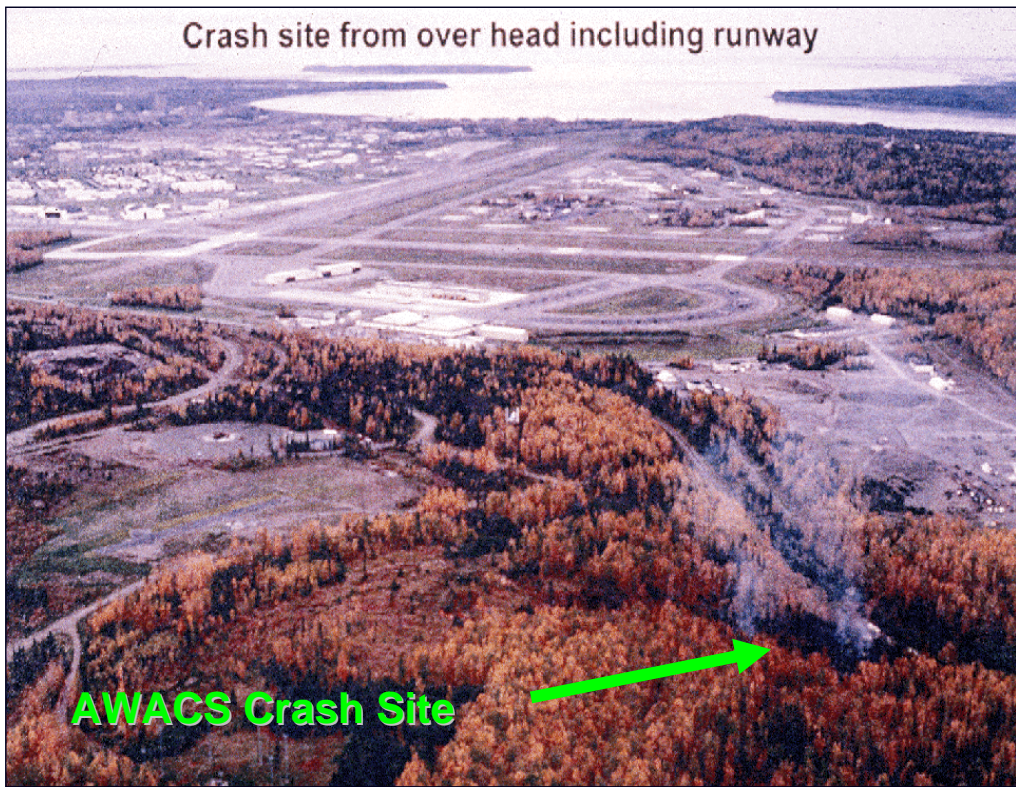


Figure 3. September 1995 AWACS crash from Canada Geese struck at Elmendorf Air Force Base, Alaska.

The US Navy and Marine Corps together report approximately 450 bird strikes annually costing an average of \$21.7 million per year in direct costs, including six lost aircraft and two fatalities since 1994. Indirect costs to the US Department of Defense (DOD) are not calculated, but exceed the above values by substantial margins. Aviation industry analysts calculate the total direct and indirect costs to the civil aviation industry at over \$1.2 billion US dollars annually. Insurance industry analysts place this figure much higher and conclude costs may approach \$4.5 billion US dollars annually for US and Canadian civil aviation alone.

While we may never know the exact costs attributed to bird strikes on civil and military aviation, the economic losses are extreme. The demonstrated potential for injury and loss of life may be of greater concern.

The majority of reported bird strikes to both civil and military aircraft occur in the immediate airfield environment where control measures may be implemented to reduce hazardous bird conditions. Land use planning, habitat management, active and passive bird dispersal techniques, and population control measures are all effective means of lessening the risk. Such techniques are well defined and implemented at civil and military airfields around the world. However, analysis of civil and military strike records clearly indicates that once aircraft depart airport property, a disproportionate amount of damage and costs are incurred. Birds are difficult or impossible to effectively manage or control outside the boundaries of airports. Planning to avoid birds in time and space, and warning systems to enable evasion of birds in flight become the only viable options to manage off-airfield risks.

Historically based models such as the USAF's Bird Avoidance Model (BAM) aid in long-range planning for avoiding known concentrations of potentially hazardous birds throughout the continental United States and Alaska. The Avian Hazard Advisory System (AHAS) provides a dynamic version of the BAM by updating the risk assessments every 10 minutes based on detection of birds and monitoring weather conditions conducive to bird movements. AHAS gathers data from the nationwide NEXRAD and other weather radar systems. Small-scale mobile radars are available to monitor local bird movements in real-time at select locations. For several years, work has been conducted to develop and field a three-dimensional airport bird detection radar (3-D ABDR) to detect, track, and monitor birds at commercial airports in Canada. European nations use weather and national defense radar networks to detect birds and provide warnings to pilots and decision makers. Other components are also currently being developed or proposed to address the issues of bird detection, forecasting, modeling, warning, and communications. These diverse and various systems can be effectively used for planning, scheduling, and avoiding birds in time and space, and may also be used to trigger other actions such as active bird dispersal efforts. However, research and development efforts have not been effectively coordinated to create a fully integrated system for bird strike advisories throughout North America. Competition for scarce funding resources and fragmented efforts to develop systems has resulted in non-standard and often incompatible application of bird avoidance procedures. Cooperation and integration of techniques, specifications, requirements, and procedures are needed to effectively manage the problem.

2. Problem Statement

At the current time, there are a number of problems that have encumbered the development of an **integrated** bird strike risk warning system throughout North America. These can be categorized as follows:

- **Organizational Structures.** There is no centralized agency to conduct research and development of technology, to network communication systems, nor to implement procedures for North American civil and military bird avoidance programs. There has been progress made in technological and research aspects of current bird avoidance research and development. However, implementation efforts are often uncoordinated, fragmented, and redundant, resulting in inefficient use of limited resources. The result is a patchwork of numerous bird strike risk reduction schemes of various quality and effectiveness.
- **Technical Challenges.** The ability to detect or predict the presence of birds in such a way that they can be avoided in time or space is not fully developed. The detection of birds can rely on radar or other remote sensing technologies. The development of real-time predictive bird presence models is in its infancy.

- **Communications.** The ability to communicate warnings following detection of bird hazards so that aerodrome staff can focus directed bird dispersal efforts is not developed. Beyond airport property, the ability to communicate meaningful and useful real-time warnings is virtually non-existent.
- **Policy.** Policy coordination for bird avoidance procedures is incomplete. Policy organizations, decision makers, and users are poorly informed or unaware of potential solutions. The range of procedures and bird avoidance techniques are incompletely defined.
- **Funding.** Sustained program funding for long-term research, development, and integration of a bird strike advisory systems does not exist. Current efforts are individually funded by potentially cooperating governments and agencies in an ad hoc manner.

3. Vision Statement

The vision of the cooperating agencies is to produce a real-time and widely available North American Bird Strike Advisory System that protects aircrew, passengers, and aircraft. The agencies will cooperatively research, develop, and implement advisory systems that will provide technological and procedural solutions to minimize the risk of bird strikes to civil and military aircraft.

4. Research, Development, and Implementation Goals and Objectives

There are a number of key goals and objectives identified by the cooperating agencies that will be required to fully integrate a North American scale bird strike advisory system.

These components will be developed at various locations and by several agencies and include:

- Continuing work on the existing USAF BAM and AHAS research, development, and maintenance efforts. Expanding BAM and AHAS into a consolidated North American system.
- Using GIS maps to show bird hazards and resulting risks at and near airports. Providing an airport-level risk management system at high resolution to complement the current 1 kilometer US BAM resolution.
- Exploiting current technologies, develop and test short, intermediate, and long-range radar-based as well as other remote sensing bird hazard detection capabilities. These capabilities must be explored over the full range of real-time and near real-time scales.
- Using state of the art technology to determine how the presence of birds creates various levels of risk to aircraft and develop operational risk assessments.
- Creating the combined US/Canada Bird Strike Advisory Center (BSAC) to manage integration of all system components. The BSAC will collect, analyze, and consolidate historical, near real-time, and real-time bird hazard data at the local, regional, and North American scale.
- Developing airport- to North American-level bird strike risk management systems in compliance with GeoBase and/or commercial GIS systems. Developing communications networks to disseminate real-time, near real-time, and historical bird strike advisories from local to North American scale. The BSAC will distribute bird strike advisories.

5. Data Sources

Data will consist of historical and real-time information. Historical data includes the current United States BAM and is data that has been collected over many years in terms of bird species, population density, migratory patterns, relative bird strike risk, and operational airspace infrastructure. The AHAS

provides dynamic updates to the BAM in near-real time at the regional level. Real-time data will be collected by radar at all levels. At the regional and national level, longer range radar may be able to detect bird migration patterns. At the airport or airfield level, dedicated radars must be able to detect birds in the critical airspace, defined as three-dimensional coverage out to five nautical miles and up to 3,000 feet above ground level. These components must be integrated into a networked and accessible system that is user-friendly and widely available. Research is necessary to determine the best methods to gather ornithological and operational data at various spatial and temporal scales.

6. Administration

A Bird Strike Advisory Center (BSAC) will be the central collection and distribution organization for the North American system. The BSAC's composition, location, and functions shall be defined by Memorandums of Agreement (MOAs) between the contributing governments and agencies. The BSAC functions as the operating arm of the Executive Board comprised of representatives from the contributing governments and agencies.

An Executive Board will oversee an integrated Bird Strike Advisory System for the United States and Canada. The Board will consist of DOD, FAA, Transport Canada, and Department of National Defence representatives. The Board will convene ad hoc advisory committees when deemed necessary to address specific components of the integrated system. The Board will secure funding for the Bird Strike Advisory Center and associated programs.

A Program Manager will coordinate and implement the policies established by the Executive Board, and is responsible for making contractual agreements, coordinating contracts or the oversight of contracts. The Program Manager serves as the intermediary between the users and the Executive Board and is the focal point for system queries. Additionally, the Program Manager oversees the processing of various data collected to produce a finished product to disseminate to the end users.

The Program Office, consisting of the Program Manager and Project Staff, will administer the Bird Strike Advisory Center with oversight from the Board. The Center will oversee coordinated efforts in the following areas:

- Research and develop bird detection systems for North American, national, regional, and localized applications.
- Coordinate data acquisition for hazardous bird concentration areas.
- Develop data management systems to depict and model hazardous bird concentration areas.
- Develop communication networks to provide bird advisory information in the long term, intermediate term, and real time.
- Identify and develop capabilities to provide real time warnings to decision makers, airport operators, ground-based wildlife dispersal teams, and airborne users.
- Ensure standardization and integration of technological systems.
- Provide policy and guidance for implementation of the bird strike advisory system in coordination with the end users.

7. North American Bird Strike Advisory System Implementation and Operations

The North American Bird Strike Advisory System will be similar in appearance to United States and Canadian national weather information systems. Real-time information and predictions will be available on user-friendly, web-based maps at North American, national, regional, and local levels. Throughout this system development process, consultations with international stakeholders will be maintained to ensure global compatibility and standardization. The system will be accessible on-line and users will be able to extract real-time information at airport and regional levels. Figure 4 shows large scale bird hazard forecasting based on historical data and regional radar inputs. The inset depicts the airport-level representation of the local area around the Dallas-Fort Worth Airport using airport maps and radars.

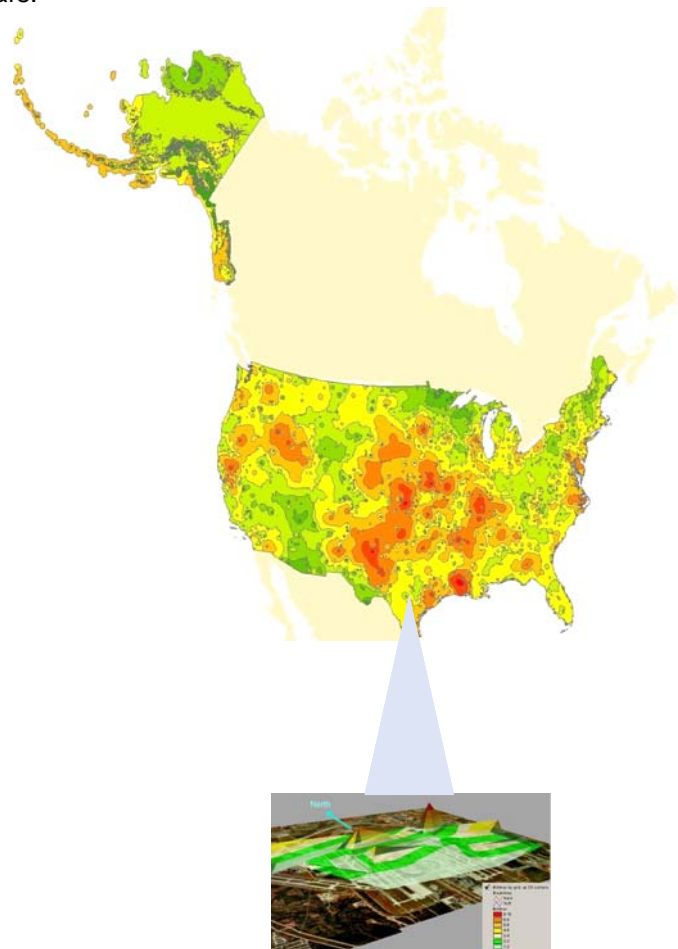


Figure 4. Conceptual depiction of a portion of the North American Bird Strike Advisory System

There will be diverse users of the integrated system. At the airport level, airport personnel, air traffic controllers, and pilots will be able to access historical and real-time information. For flight planning purposes, pilots and airlines will be able to use information at the North American and national levels. In an approach mode, a pilot will also be able to get current updated information from either direct connect to the system, or via the airline operations center and military equivalents. Figure 5 is a notional representation of the North American Bird Strike Advisory System.

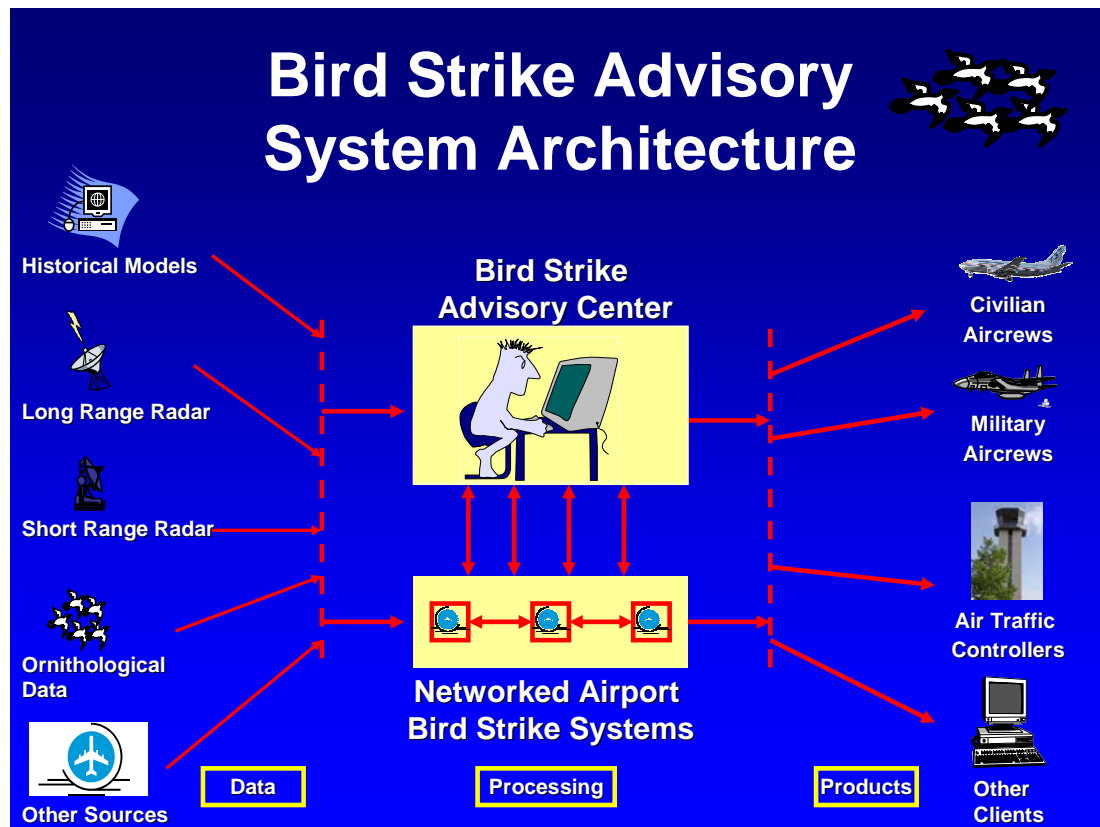


Figure 5. Notional North American Bird Strike Advisory System

The implementation of the bird strike advisory system will be progressive, but offered at the local, regional, and North American level at the same time. In order for the North American Bird Strike Advisory System to be successful, research and development will perform the following:

- Establish the combined United States/Canada Bird Strike Advisory Center.
- Expand the United States BAM and AHAS into Canada.
- Establish a single web-based advisory system based on BAM and AHAS.
- Implement radar and other remote sensing technologies to provide near real time and real time bird hazard advisories at local and regional scales.
- Implement a bird strike risk warning system at the airport level. This can be done at a limited number of airports at the same time.
- Implement local-, regional-, national-, and North American-level bird strike advisory systems.
- Implement communications systems to provide bird strike advisories to ground-based and airborne users.
- Integrate the various airport bird strike risk warning systems into the consolidated North American Bird Strike Advisory System.
- Provide the system online.

8. Conclusion

The North American Bird Strike Advisory System presented here has been coordinated with technical experts and representatives from the various United States and Canadian agencies who will ultimately be responsible for supporting the integrated system. Specific Memorandums of Agreement need to be initiated to fully implement the system. The system envisioned in this summary is just underway and will be phased in over a period of several years. Ultimately, we desire a fully operational system with integrated components to address the severe and costly problem of bird strikes throughout the North American continent. This system can also be further integrated on the global scale with participating international agencies from all interested nations. Exchanging cooperation, technology, and procedures with our international partners can only serve to create a safer environment for all who share the skies with the birds.

9. Acknowledgements

The North American Bird Strike Advisory System Strategic Plan development effort was led by the Institute for Information Technology Applications (IITA). Located at the USAF Academy in Colorado Springs, Colorado, the IITA is an independent research center supported by the Air Force Office of Scientific Research. There have been numerous other agencies who have contributed to this document. The staff of the USAF Institute for Information Technology Applications, along with the Federal Aviation Administration and Transport Canada, sponsored the development of this work providing material support and administration for the effort. Other organizations that provided invaluable inputs and assistance include the USAF Bird/Wildlife Strike Hazard Team at the USAF Safety Center, the Air National Guard Bureau, the US Navy BASH program, and the US Department of Agriculture/Wildlife Services. We would also like to acknowledge the following international organizations for their efforts: German Bundeswehr Geoinformation Office, the International Bird Strike Committee, and the United Kingdom's Central Science Laboratory. The outstanding international, multi-agency cooperation was essential to the development of this Strategic Plan and ultimately to the success of the North American Bird Strike Advisory System.