ALASKA BIRD AVOIDANCE MODEL (AK BAM) DEVELOPMENT AND IMPLEMENTATION

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Abstract

An Alaskan Bird Avoidance Model (AK BAM) based on historical data has been developed using much of the same methodology as was employed in the development of the United States Bird Avoidance Model (US BAM). The US and AK BAMs are now integrated in one system and may be accessed by all at www.usahas.com. The geographic information system graphic user interface depicts relative risk of bird strikes in time and space for each square kilometer of the entire state. Operational airspace, topography, land cover, land uses, infrastructure, and other data layers may be overlaid on the bird risk surfaces at the user's discretion. Alaska's extreme climactic and geophysical environment made modeling bird distributions and abundance a significant challenge in developing operational bird strike risk surfaces. From a baseline derived from Breeding Bird Survey (BBS) and Christmas Bird Count (CBC) data, new methodologies were investigated and developed. Improvements over the US BAM include statistical correlation of bird populations with habitat data, flexible daily activity patterns, seasonal population fluctuations, and regional migration analyses. These improvements have made the AK BAM much finer in its resolution and results in more realistic relative risk predictions. These methodologies are now being applied to the entire BAM structure along with improvements to the Internet mapping application user interface.

Keywords: Bird Avoidance Model, BAM, Alaska, Geographic Information System, Internet Mapping Application.

1. Introduction

The state of Alaska has its first Bird Avoidance Model (BAM). A coordinated effort from several agencies has produced an operational Alaska Bird Avoidance Model (AK BAM). It builds upon the contiguous US BAM, familiar to many users, that has been online for the past several years. The models may be found at www.usahas.com. The US Air Force Safety Center's Bird/Wildlife Aircraft Strike Hazard (BASH) Team contributed funding for the project with the Natural Resources division of the Air National Guard providing major funding as well. Germany provided Mr. Wilhelm Ruhe for one year as an invaluable visiting scientist from their Geophysical Institute and as a member of the International Bird Strike Committee. Data were provided by myriads of sources from federal, state, local, and private agencies. A coordinated team effort from government personnel and contractors was necessary to tackle the complex nature of producing the initial version of the AK BAM.

The AK BAM research team was hosted 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. The institute conducts research for the Department of Defense, the Air Force, and the USAF Academy. IITA supports acquisition, educational and operational IT needs, develops an information-rich environment to prepare graduates for the high tech Air Force, and applies multidisciplinary expertise to IT research. They help develop research topics, select researchers, administer sponsored research, publicize results, and host conferences and workshops that facilitate the dissemination of information to a wide range of private and government organizations. With their multidisciplinary approach, the IITA was the ideal sponsor of the research leading to development of the new AK BAM.

2. Alaska BAM Description

The Alaska BAM operates just as the US BAM by allowing users to analyze potentially hazardous concentrations of birds in their operational airspace. The crux of the model is the color-coded "relative risk surface" that depicts distribution and abundance of birds in time and space over the entire state of Alaska (see Figure 1). Risk is defined as the likelihood of encountering a hazard and the severity of that hazard. Individual layers in the BAM define the hazard level of birds in units of airspace. Thus, relative risk can be assessed by comparing one physical location with another, by comparing one time of day with another, or by comparing a period of the year with another. Relative risk layers of the model are defined by the cumulative biomass, in ounces, of all hazardous bird species within a 1 x 1 kilometer of airspace from the surface to 3,000 feet above ground level. Bird risk surfaces are depicted for every two-week period of the year and four daily time periods. These surfaces may be overlaid with a variety of environmental, infrastructure, and airspace depictions in a dynamic, web-based mapping application (see Figure 2). The surfaces were derived from over thirty years of ornithological data on seventy species of birds deemed most likely to cause catastrophic loss of aircraft, damage to components, or injury and/or loss of life. Both models relied heavily on Breeding Bird Survey and Christmas Bird Count data from across the nation. Species were determined by examining data from historic bird strike records provided to the USAF BASH Team by safety officers around the globe and from bird population levels as determined from numerous sources. Behavioral characteristics and activity patterns were also key in determining potential hazards posed by these species. These same data were important in developing the US BAM, but there are several improvements made to the AK BAM. Methodological changes in the modeling techniques were made based on two decades of experience in developing the US BAM, improvement in computer processing technology and programs, and the nature of the data available in Alaska. These new techniques are now being reexamined to make future improvements and updates in the US BAM as well.

3. Improvements in the Alaska BAM

From the start of the Alaska Bird Avoidance Model project, it was obvious that the paucity of ornithological data, especially in space, would require a more sophisticated approach. When observation sites are in reasonable proximity to each other, a standard interpolation technique is valid, as was used in the US BAM. However, ornithological data collection sites are unevenly and widely spaced over the state of Alaska as a consequence of inaccessible areas and low human population densities; attractive properties to many, but difficult to deal with in this instance. As a result, there are several major changes in the methodology that led to creation of the new bird risk surfaces. These changes involved additional data processing and judgment from experts in the field. The resultant calculations for the risk surface creation increased by about an order of magnitude over comparable US BAM elements. The major improvements involve three main areas as briefly explained below.

- **Habitat Correlation**

The approach used for Alaska is based on additional information from land cover and land use characteristics. Such data were derived from satellite imagery provided by the US Geological Survey. These data are of 1 x 1 kilometer resolution and are almost globally available. Using a more accurate spatial dataset on aquatic areas enhanced their accuracy. The land cover data were transformed and processed for bird habitat classifications, resulting in 10 different habitat classes. Typical habitat preferences were defined for each of the relevant species in Alaska. Spatial interpolation of sampled bird population densities and cumulative biomass of species groups were related to their specific habitat preferences (see Figure 3).

- **Flexible Bird Activity and Population Size**

In both the US BAM and AK BAM, there are 4 daily activity periods within each bi-weekly period (dawn, daytime, dusk, night). In the US BAM, a conservative approach was taken whereby if birds were known to be in the area and active at a specific time of day, all these birds were assumed to be in the air. This has changed to a completely flexible approach in the Alaska BAM. For each species group and time period, a value was calculated based on an estimate of the percentage of birds in the air. During breeding periods, for example, only 50 percent of some bird species may be in the air, while the other 50 percent may be tending a nest. Baseline populations are now incrementally adjusted to reflect increases in the number of birds after fledging and decreases due to winter mortality and other causes.

- **Regional Migratory Periods**

Both versions of the BAM treat migration as periods in which the winter population size and distribution is transitioned into the summer population size and distribution, and vice versa. This is calculated by a mathematically linear increase or decrease within the migration period. In the case of the US BAM, the whole of the contiguous United States is treated as one area that experiences this transition, leading to long migration periods that are conservative but may not be most accurate. For Alaska, a huge and quite diverse area, geographical regions with specific environmental characteristics have been defined. Each region is treated separately during migration periods, including adjustments to daily bird activity patterns. The approach leads to a more realistic and incremental depiction of bird migration in the model (see Figure 3).

4. Conclusion

These improvements have made the initial version of the AK BAM the most sophisticated and resolute bird avoidance model in use today (see Figure 4). Aircrews and planners can be confident that they are working with the best available current information. The work is not nearly complete, however. While the major fire may have been extinguished, there remain many smoldering embers left to stamp out. Additional ornithological data are always being evaluated, particularly as population levels or distribution patterns change and new information is collected in the field. Refinements are being made to background environmental data and new airspace designations. Hopefully, with continued funding support, continuous improvements can be made to the AK BAM and other such systems. Work may now also begin to bring the dynamic version of BAM, in place in the contiguous United States as the Avian Hazard Advisory System (AHAS), to Alaska. The Bird Avoidance Model forms the underpinning of AHAS, and it is envisioned that a similar integrated system can be developed for Alaska in the future. The Federal Aviation Administration and Canadian civil and military aviation communities are now beginning to cooperate on an integrated North American bird avoidance system for military and civil aviation across the continent. IITA is leading an international team writing a strategic plan for future bird avoidance research. The goal of the future research is to provide a North American Bird Strike Advisory System that can provide real-time bird strike advisories to air traffic controllers and

aircrews throughout Canada and the United States. For now, operational planning to minimize risks posed by concentrations of hazardous birds may be accomplished using Alaska's new BAM.

5. Acknowledgments

We would like to thank the Air Force Safety Center for funding the Alaska BAM project.

FIGURES:

FIGURE 1. Sample Alaska Bird Avoidance Model output.

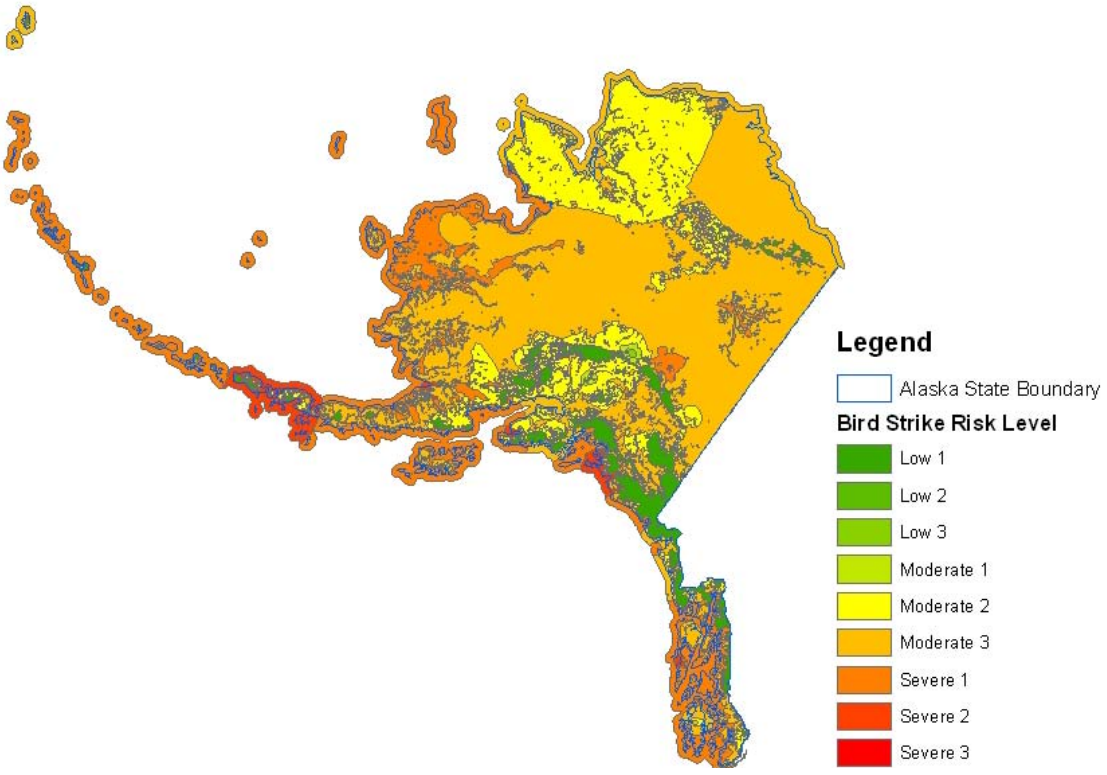

FIGURE 2. Customized overlays on AK BAM bird risk surface.

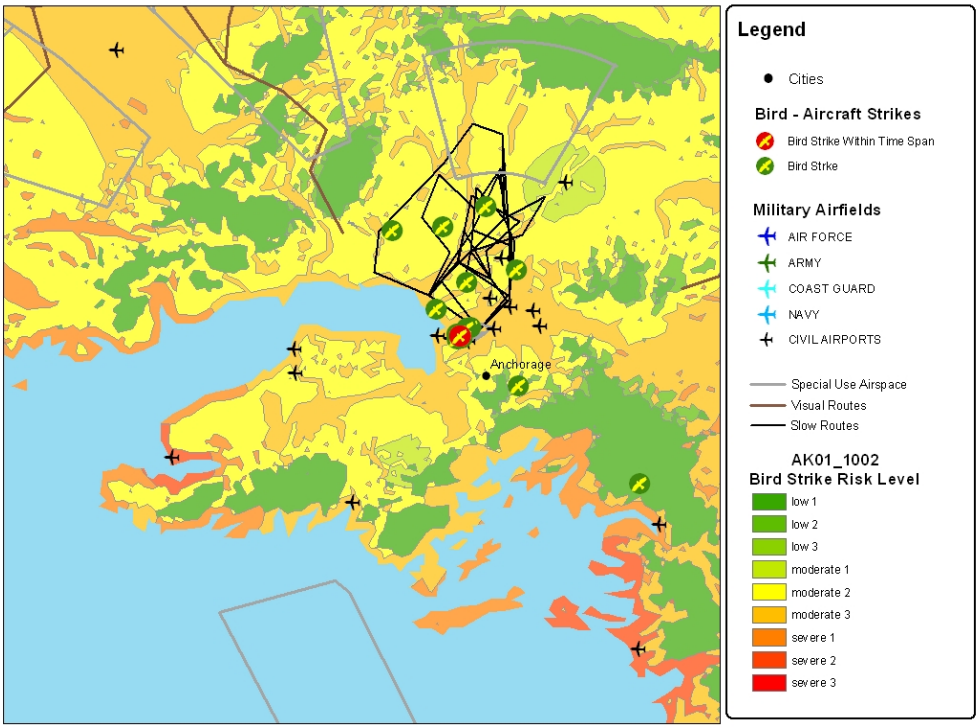

FIGURE 3. Examples of environmental data sets used in AK BAM development.

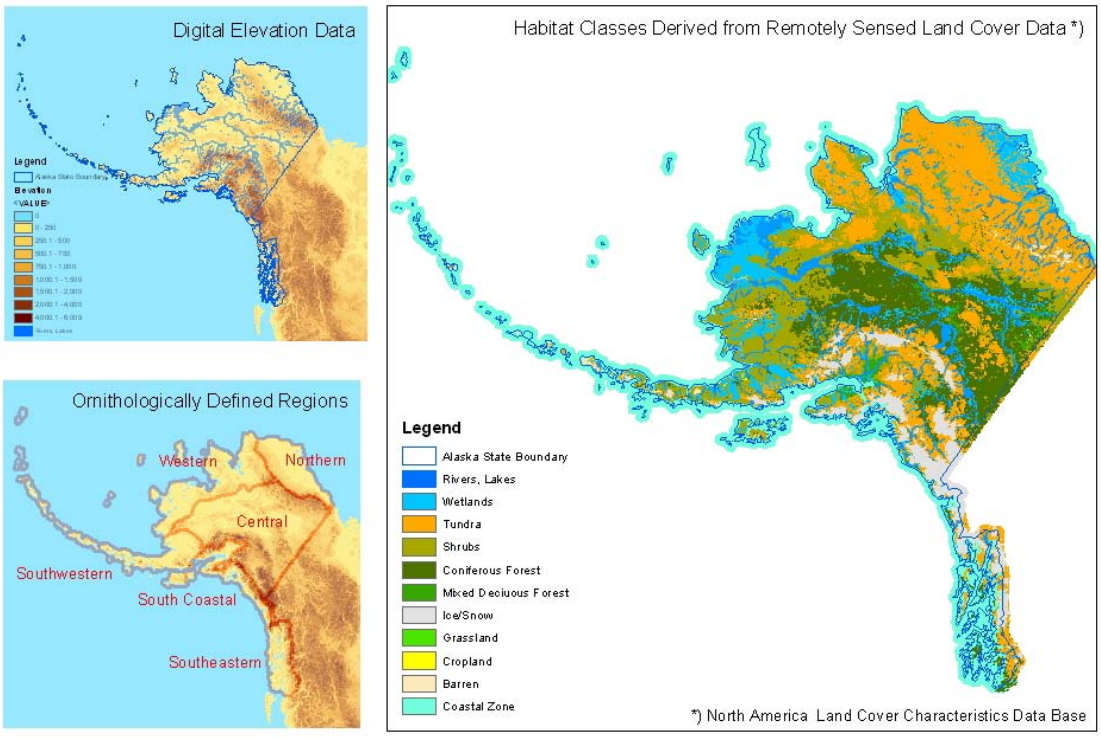

FIGURE 4. Examples of some of the steps made in refining AK BAM resolution.