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The U.S. Air Force Bird Avoidance Model

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Each year, the United States Air Force (USAF) reports approximately 3,000 bird strikes to its aircraft. These incidents cost nearly $50 million on average. In the last decade, the Air Force has suffered the loss of 14 aircraft and 33 aircrew fatalities. The other services report higher rates of strikes per flying hour and suffer similar losses. Civilian aircraft are not immune to this problem, and U.S. airlines report nearly $100 million in annual losses. Most bird strikes occur around airfields where habitat management, bird dispersal techniques, and active population control can be employed. For military aircraft, however, the majority of catastrophic incidents occur on high-speed, low-level, and range missions where bird control is not possible. The only alternative in these environments is to avoid known bird concentrations. This is where the Bird Avoidance Model (BAM) comes into play.

The BAM is a Geographic Information System (GIS) based program that integrates historical information on bird distributions and abundances with various geographic and environmental factors. It creates graphic risk surfaces for determining the relative degree of hazard for any location in the Continental U.S. Data on bird populations and movement patterns come from numerous government and private sources and is the result of, literally, millions of hours of field work from biologists, refuge managers, amateur bird watchers, and volunteers. Thirty years of data from over 10,000 locations throughout the country are evaluated and used as the basis for the model. Interpolation algorithms fill in the gaps between the surveyed locations so that each square kilometer of the U.S. has a unique risk value assigned.

The initial version of the model includes over 50 species considered most hazardous to flight operations. Large birds, such as waterfowl and raptors, and flocking species, such as blackbirds and gulls, constitute the greatest threat. A risk surface is generated using the available data and normalized by body weight for each species. The individual risk surfaces are then cumulatively added and a total risk calculated. Data are available for each two-week interval of the year and for various daily time periods. A color-coded graphic display, in a GIS map format, is available for each data layer, and the scale of coverage can be selected by the user.

Specifically, the model relies on large historical data sets, such as the Christmas Bird Count (CBC) and the Breeding Bird Survey (BBS), as baseline estimates of bird abundance and distribution. These data are available in grid maps at one kilometer resolution. All other data sets are spatially registered and matched to this resolution. Much work was done to develop a conversion factor to equate the CBC and BBS on a relative scale so that the risk of bird strikes could be compared for these two times of the year. Information from migration counts and arrival and departure dates for species of interest at hundreds of wildlife refuges was used to interpolate the movement of populations during the intervening periods. Daily activity patterns were also modeled for each species so that the risk surfaces vary by time of day as well as seasonally. The user can, thus, select the geographic location, time of year, and time of day when planning a flight profile.

The user interface for the new BAM is a simple, menu-driven, PIC-based program that allows flight planners, route designers, and aircrew to select the geographic location, time of year, and time of day that they desire to fly a particular route. Relative risks for each operation can be assessed by comparing routes to each other or by comparing various temporal alternatives on individual routes. Safest times and locations can then be selected by the user. The model also has numerous geographic and environmental data sets that can be overlaid on the bird risk surface. For example, the user can zoom in on a portion of the country, display the bird risk, and overlay roads, airports, aircraft operating areas, terrain maps, land uses, or a variety of climatic information such as temperature or precipitation on the computer display.

The model will be distributed by the Air Force Bird Aircraft Strike Hazard (BASH) Team to various users throughout the country. While the program and data needed to generate the Bird Avoidance Model require enormous amounts of computer space, the products of the model will be available on CD for the ultimate users. It is anticipated that copies will be available to anyone with a PC and the commercial software needed to run the program.

The new BAM will provide a tremendous planning tool for the aviation community to reduce the incidence of bird strikes to aircraft. Organizations employing early versions of the model have reported reductions in the bird strike rates of as much as 70%. The new model will provide much more data and at a resolution orders of magnitude better than the existing models.

The work is not done, however. We need to field test the model, refine some of the data layers, expand to areas outside the U.S. and, ultimately, provide near-real time updates to the model using technologies such as doppler radars and satellite telemetry. A current collaboration is underway to extend this technique to countries in Europe and the Middle East. The Department of Biology at the Air Force Academy, in collaboration with other departments and agencies, will continue to participate in the future as long as sponsoring agencies continue their support of these efforts. Ultimately, we hope to make the skies a bit safer for those who share them with the birds.

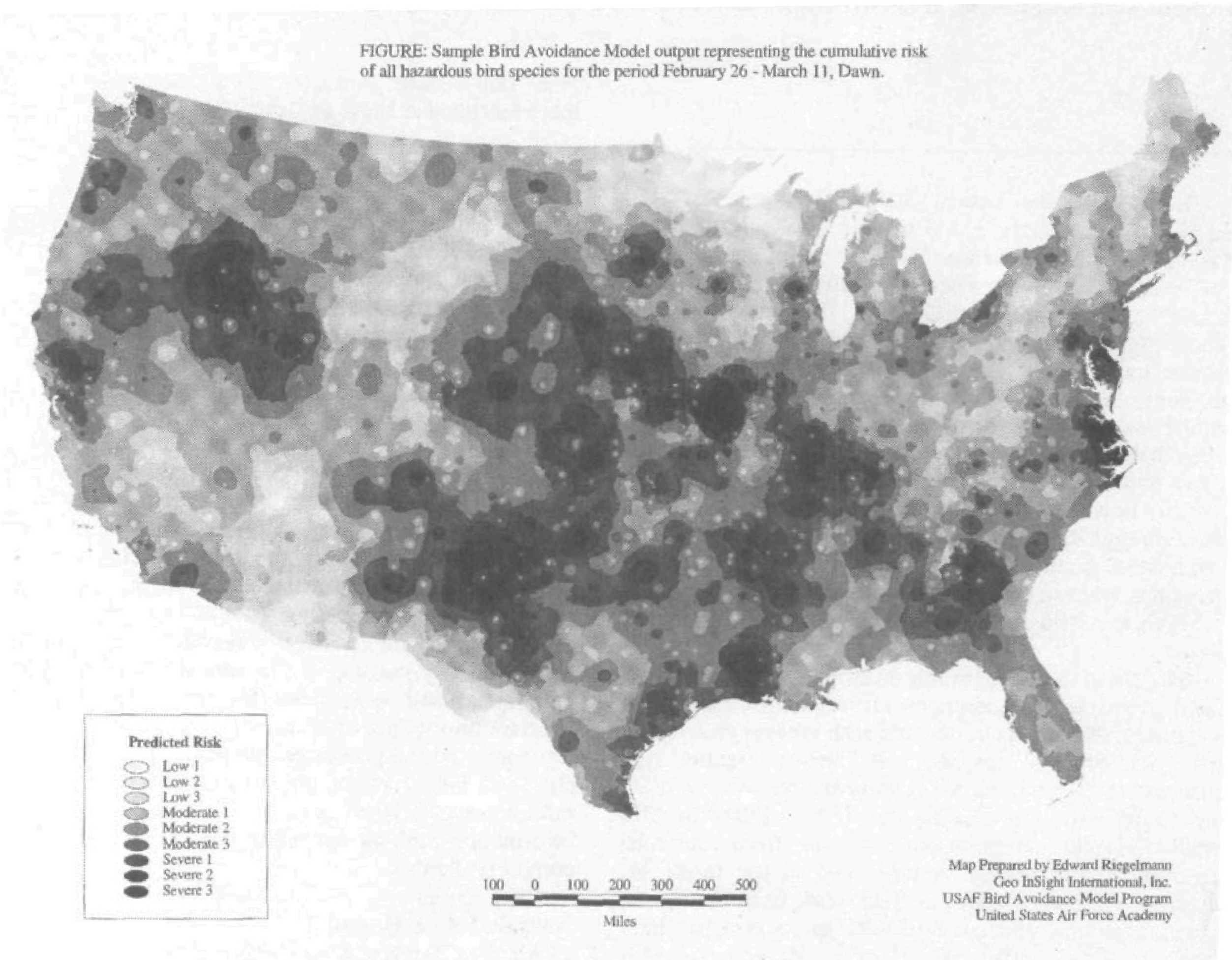
FIGURE: Sample Bird Avoidance Model output representing the cumulative risk
of all hazardous bird species for the period February 26 - March 11, Dawn.
Predicted Risk
Low 1
Low 2
Low 3
Moderate 1
Moderate 2
Moderate 3
Severe 1
Severe 2
Severe 3
100 0 100 200 300 400 500
Miles
Map Prepared by Edward Riegelmann
Geo InSight International, Inc.
USAF Bird Avoidance Model Program
United States Air Force Academy

Figure 1.