Low-Level Airspace Bird Strike Hazard Evaluation and Using a GIS to Integrate Bird Population Dynamics Into an Aircraft Bird Avoidance Model

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ABSTRACT:

Twenty-eight percent of all USAF bird strikes occurred during low-level flight operations between 1987 and 1991. These strikes resulted in more than $250 million in damage, the destruction of four aircraft, and five aircrew fatalities. Low-level airspace evaluation once focused only on the Bird Avoidance Model (BAM), which is a useful tool for estimating waterfowl hazards. However, additional bird species not modelled by the BAM, such as raptors, gulls, cranes, and pelicans also pose significant hazards to aircraft operations. Hazards associated with these species are being examined separately using known bird population and migration dynamics. To reduce hazardous and costly bird strikes to aircraft, the USAF BASH Team is updating the BAM. The new BAM will calculate the relative risk of a bird strike by integrating biological and geographical data into a Geographic Information System (GIS). The GIS is allowing detailed analyses of robust databases, including the North American Breeding Bird Survey (BBS), Bird Banding Recovery, Christmas Bird Count (CBC), Hawk Migration Association of North America (HMANA), and Refuge databases which have helped verify bird distribution and abundance in the BAM. The USAF BASH Team will continue to enhance the BAM through the future addition of weather components and the integration of bird recognition data provided by the Next Generation Weather Radar (NEXRAD). NEXRAD will provide a near real-time bird avoidance capability for low-level aircraft operations.

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BACKGROUND: The United States Air Force (USAF) is reports more than 3,000 bird aircraft collisions each year. Approximately 28% of USAF bird strikes from 1987 to 1991 occurred during the low-level and range phases of flight. These strikes caused a disproportionate amount of damage, due to higher aircraft operating speeds, and resulted in the destruction of four aircraft, five aircrew fatalities, and greater than $250 million in damage. In the early 1980's, the Bird Aircraft Strike Hazard (BASH) Team developed a predictive risk model to identify areas and times associated with high bird strike risk. The Bird Avoidance Model (BAM) estimates the probability of a bird strike along a low-level training route by distributing a density of birds into a volume of space and sweeping the frontal surface area of an aircraft through that space. The BAM has been a useful tool for estimating waterfowl (ducks, geese, and swans) hazards, but other birds considered hazardous to military aircraft operations were not incorporated into the model. Birds such as raptors (birds of prey), gulls, cranes, and pelicans are evaluated separately using known population and migration dynamics, however these data for many species remain incomplete.

CURRENT RESEARCH: The BASH Team has recognized the necessity of incorporating these potentially hazardous bird species as well as terrain features associated with increased bird activity into a new Bird Avoidance Model. The current BAM program lacks the flexibility to add species, update databases of dynamic biological systems, and incorporate geophysical data. The use of Geographic Information System (GIS) technology offers the ideal solution for integrating these spatial data. Data to be incorporated into the model will include bird species' weights, flock densities, a relative aircraft damage factor, and species' behavioral differences. The temporal aspects of the hazards, including time of year (seasonal variation) and time of day (diurnal variation) and associated altitude components will be included in the risk assessment. The BAM output, provided to military flight and mission planners, will include a graphical depiction of bird hazards and a text file with recommendations for aircraft operations in the vicinity of the hazard. Modelling efforts for the continental United States are currently underway using Geographic Resource Analysis Support System (GRASS). GRASS is a public domain GIS developed by the U.S. Army Corps of Engineers Construction Engineering Research Lab (USACERL). This raster-based GIS, run on a UNIX-based operating system, is ideally suited to analyze biological distribution data and provides the flexibility to add species and calculate risk based on selected criteria.

Geographically referenced population and migration dynamics for waterbirds, raptors, cranes, pelicans, gulls, and blackbirds are being collected from state and federal agencies and are entered into a Dbase III+ file. The GRASS GIS has allowed easy analysis of robust databases such as The Hawk Migration Association of North America (HMANA), North American Breeding Bird Survey (BBS), Christmas Bird Count (CBC) and Bird

Banding Recovery to aid in the verification of bird distributions and abundance in the BAM. The expanded BAM is scheduled for completion in September 1993.

FUTURE RESEARCH: The BAM can be supported by bird movement and altitudinal data and ultimately weather components supplied by the Next Generation Weather Radar (NEXRAD) system, once it becomes operational. Recognition algorithms for waterfowl, gull, and blackbirds for NEXRAD have been developed. The NEXRAD system will provide coverage for most of the United States and a large section of Europe, and will furnish a near real-time bird avoidance capability for low-level military aircraft operations.

The US Air Force experiences a significantly higher bird strike rate during low-level operations outside the United States. In Europe, low-level bird advisories are issued as a result of personal observations and observations of air defense radars located in Belgium, The Netherlands, and Germany. The integration of these advisories along with geophysical and biological databases, with a predictive model based on GRASS will significantly improve flight safety. The BASH Team hopes to begin collecting data for this effort in Fall of 1992. Deployments into regions such as the middle east, with extremely hazardous bird migrations, emphasized the need for a global-scale modelling effort. The BASH Team is searching for global migration path information and establishing contacts with European and global GRASS users.