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# BIRD FLIGHT FORECAST AND INFORMATION SYSTEM

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***Summary***

The development of a comprehensive bird flight forecast and information system is discussed. Once completed, the system will provide information on past, current and predicted bird abundance, distribution and flight patterns. Preliminary results from our study in Fallon, NV demonstrate the potential to accurately forecast bird flight times and altitudes.

Keywords: bird flight forecast model, satellite telemetry, bird flight times and altitudes

**Introduction**

Several methods have been developed to diagnose the extent of the bird strike hazard to aircraft. Examples of these methods include the implementation of wildlife monitoring programs, bird avoidance models and radar surveillance techniques. Although these methods are effective in illustrating the current or historical avian threat to aircraft, all of these methods are incapable of predicting changes in this threat beyond the limited skill of a track-persistence forecast This paper describes the development of a forecast model that predicts changes in the times and altitudes of avian flight based upon the physical and dynamical processes that govern this flight. The goal of this research is to develop a comprehensive bird flight forecast and information system that combines the aforementioned diagnostic and forecast techniques to reduce the bird strike hazard to aircraft.

**Model Theory and Development**

Numerous studies have examined the relationships between bird abundance, distribution and flight patterns and such variables as habitat, geography, weather and climate. For example, DeFusco (1994) correlated geographical, meteorological, and physiographical variables with the distribution and abundance of Turkey Vultures in the United States. Kerlinger (1989) has shown that the flight strategies of migrating hawks are often influenced by geographical and meteorological factors. Finally, several studies have examined the dependence of avian soaring flight on diurnal fluctuations in thermal intensity (Haugh 1972, 1974; Larkin, 1982; Pennycuick, 1989). These relationships form the backbone upon which bird abundance, distribution and flight forecast models could be developed because the variables that govern changes in these patterns are often predictable.

The bird flight forecast model (BFFM) currently under development is designed to explicitly model those processes that govern avian abundance, distribution and flight patterns. The accuracy of any forecast model is ultimately dependent upon the strength of the relationships upon which the model is developed. Establishing solid relationships requires the proper identification of those processes that govern avian abundance, distribution and flight patterns, and the gathering of data necessary to develop these relationships. We are currently exploring these relationships for several species of birds. These species include American White Pelicans, Turkey Vultures, Black Vultures, Swainson's Hawks, and Red-Tailed Hawks. Preliminary results from our study of American White Pelicans follow.

Preliminary Results

*a. Data and Methodology*

During June and July 1997, we monitored the movements in the Fallon, NV area of 10 American White Pelicans instrumented with satellite telemetry transmitters. Two two person teams followed these pelicans during their daily flights, obtaining high-resolution altitude data (at approximately 70-second intervals) from the transmitters attached to these birds. Each team also made observations of bird behaviors and weather conditions when possible. These data are currently being analyzed in relation to the habitat, geography and weather observed in the area. This paper describes the relationship between pelican flight altitudes and changes in the weather as discovered during this field study. Preliminary results from this analysis suggest that by predicting changes in environmental factors we can predict changes in the times and altitudes of pelican flight.

*b. Results*

Figure 1 illustrates the temporal evolution of the flight envelope for one instrumented pelican on 7 July 1997. The morning data were gathered as the pelican completed an approximately 100-km flight from its foraging grounds to its breeding colony. After a brief stop at the breeding colony, the bird returned to its foraging grounds via the same route. This figure shows that relatively low-level flight in the morning evolves into higher-level flight during the afternoon. This increase in flight altitudes is related to an increase in thermal depth and intensity throughout the day. Figure 2 illustrates the temporal evolution of the flight envelope for the same pelican on 1 July 1997. In contrast to figure 1, the flight envelope does not continue to increase throughout this day because the sinking air associated with a high-pressure system limited thermal depth during the late morning and early afternoon. Given that the primary mode of flight for American White Pelicans is soaring flight, these results suggest that forecasts of thermal depth and intensity can be used to forecast the times and altitudes of the pelican flight envelope.

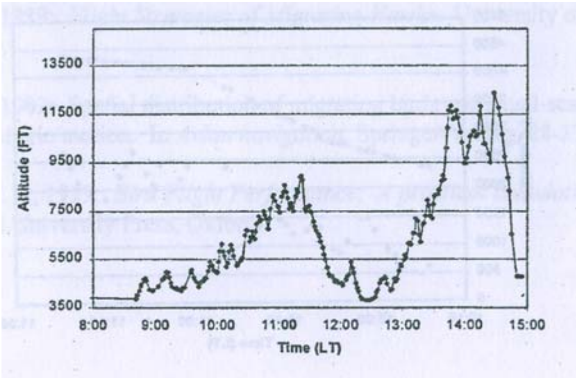


*Figure 1: Flight altitudes for pelican 5720 on 7 July 1997.*

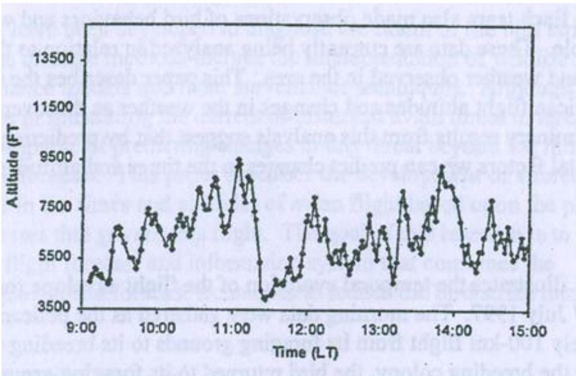


*Figure 2: Flight altitudes for pelican 5720 on 1 July 1997.*

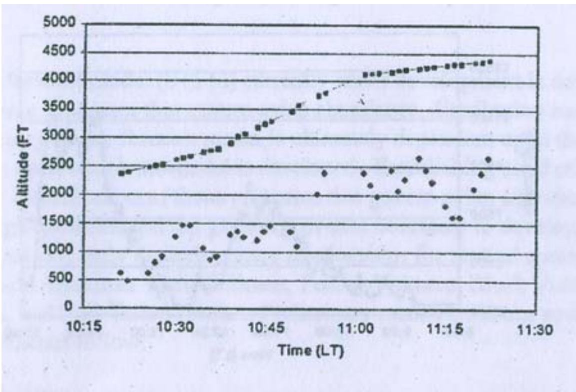


*Figure 3 illustrates the forecast thermal depth and observed flight altitudes for one instrumented pelican on 16 June 1997. As thermal depth increased throughout the morning the altitude of the pelican flight envelope also increased. Furthermore, the flight envelope remained in the middle of the thermal layer. A comprehensive statistical analysis of all telemetry and meteorological data is currently underway to verify the strength of these relationships.*

**Discussion**

The value of wildlife monitoring programs, radars, and bird avoidance models in reducing the bird strike hazard to aircraft is significant. These tools combined are capable of providing information on historical and real-time changes in bird abundance and distribution patterns. Unfortunately, these tools are either diagnostic or climatological in nature, and therefore provide little detailed information on expected changes in bird abundance and distribution patterns. Anticipating changes in these patterns prior to their occurrence is critical to reducing the bird strike hazard to aircraft. By combining wildlife monitoring programs, radars, and bird avoidance models with bird flight forecast models it is possible to develop an efficient and accurate bird flight forecast and information system. This system would provide information on past, present, and predicted bird abundance and distribution patterns, and could provide this information in a similar manner as weather information is made available to the aircraft community today.

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