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A Simple Risk Model For Assessing Bird Strike Potential

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ABSTRACT

A simple risk algorithm was developed to assess the potential for serious bird strikes at US Air Force installations within continental US. The model computes a relative risk using five variables that describe each installation's mission, aircraft type , geographical region, regional bird hazards, and local bird hazards. The model ranked installations with known hazards at the top of the hazard list and placed installations known not to have serious hazards near the bottom. A significant statistical correlation was found between the computed risk value for each installation and the average number of strikes reported over the past six years.

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Introduction. Since 1985 over 14,500 bird strikes have been reported to US Air Force aircraft worldwide. Of these strikes approximately 60% have occurred in the vicinity of the aerodrome. With over 100 installations within the continental United States, prioritizing bird strike reduction efforts is a challenging task. In an effort to identify those installations with the greatest potential for a serious bird strike, the BASH Team developed a model to assess bird strike hazards. The Airfield Risk Assessment Program (ARAP) was designed to be independent of the number of reported strikes at each installation. We believe that any risk assessment effort that included reported strikes could lead to a decrease in reporting, rather than an improvement in bird control or avoidance. ARAP allows for relative comparison of risk at installations as well as for a relative assessment of the impact of changing weapon systems and changes in the local landuses. The BASH Team uses this program to prioritize on-site technical assistance and to assess other community planning issues.

Components of the Airfield Risk Assessment Program. ARAP has five basic components; aircraft type, installation mission, bird types, geographical region, and local hazards (Fig 1). The first, aircraft type, is a measure of aircraft vulnerability, and assigns a value to each aircraft according to the probability of being involved in a Class A mishap (loss of aircraft, aircrew fatality, or over 1 million US dollars in damage). This value was assigned based upon the number of Class A, B, and C mishaps, the total number of reported strikes, and the total cost of these strikes, reported over the past five years. Aircraft vulnerability is also dependent on aircraft design; for example the number, location, and type of engines. These factors were combined to determine a value on a 1 to 10 scale (Table 1).

The second component of the program is the primary flying mission at the installation. This value is based upon the amount of airfield traffic (aircraft exposure), and the experience level of the aircrew. For example, an Undergraduate Pilot Training (UPT) base is given a value of 10 due to extensive airfield traffic and the low experience level of student pilots. Replacement Training Units (RTU) for fighter aircraft also have intensive use of the airfield, but with slightly greater aircrew experience (Table 2).

The third component includes values for six general categories of birds (Table 3). These birds have been

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AC_TYPE

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F-15
F-16
F-117
F-111
T-41
T-37
T-38
T-39
T-43
B-1
B-2
B-52

AIRPORT RISK ASSESSMENT PROGRAM

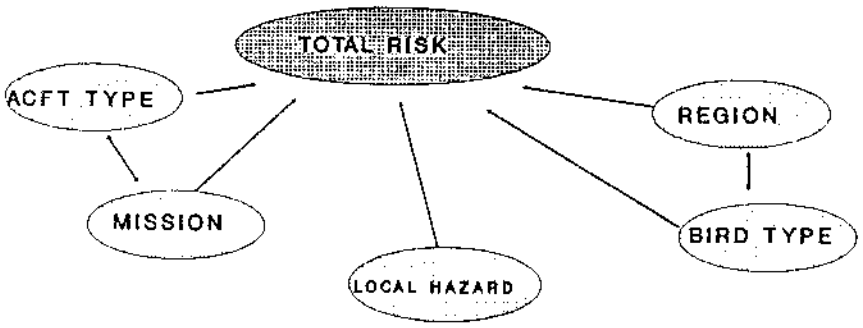

Fig 1. ARAP Program Components

AIRCRAFT TYPE

AC_TYPE	VALUE	AC_TYPE	VALUE
F-4	4	C-5	2
F-5	10	C-130	1
F-15	5	C-12	1
F-16	8	C-21	2
F-117	?	C-22	1
F-111	4	C-23	1
T-41	1	C-141	2
T-37	3	C-17	3
T-38	10	A-10	3
T-39	4	E-3	2
T-43	3	E-4	2
B-1	2	U-2/TR-1	5
B-2	?	C-9	1
B-52	1	KC-10	2
		KC-135	2

Table 1. Aircraft Vulnerability

MISSION	VALUE
UPT	10
RTU-FIGHTER	8
RTU-HEAVY	5
STRATEGIC/AIRLIFT	3
STRATEGIC/LOCAL	4
TACTICAL	8
TACTICAL AIRLIFT	4
HELICOPTER	1

Table 2. Installation Mission

BIRD TYPE	VALUE
RAPTOR	8
GULL	10
WATERBIRDS	3
BLACKBIRD	6
DUCKS/GEESE	7

Table 3. Hazardous Bird Types

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identified as hazardous due to their size, flocking behavior, and affinity for airfields. Additionally, these birds have been identified in bird strike reports, and are the most common in strikes resulting in serious damage.

The fourth component of ARAP is geographical region. This factor is based on the distribution, and abundance of hazardous bird species in different regions of the United States. We divided the country into six regions and the coastlines (Fig 2).

The final component of the program includes the impact of known local hazards or bird attractions in the vicinity of the airfield. The assigned value includes both the type of hazard and the distance between the hazard and the runway (Table 4).

The Risk Algorithm. Initially, we simply added each component of the model, normalized the values and ranked the values produced for each installation. A close look at the results lead us to include the interaction of aircraft type and installation mission and the summation of the interaction of geographical region with each bird type (Table 5). This interaction more reasonably described the risk we were aware of at the installations that we had recently visited. This manipulation, however, resulted in the local bird hazard values contributing very little to the overall risk assessment. To compensate for this error, we multiplied these values times 10 to allow this component to contribute to the risk assessment. Data were entered for each installation into a Statistical Analysis Software (SAS) data file, and the risk value was determined for each installation. All values were normalized as a percent of the highest risk value determined to create a 0 - 100 scale. The final equation for risk was: Risk = ((local hazard x 10) + (aircraft type x installation mission) +(bird type x region))/(232.5) x 100.

Results. A ranked list of installations was output product of the analysis program (Table 6). We were curious if the computed risk were reasonable assessments, and polled three independent experts who had extensive on-site experience at these installations. We asked each to provide us a list of the five most hazardous and five least hazardous Air Force installations. In all cases the computed risk assessments captured the top five installations provided by the experts within the top ten computed values, and the least hazardous installations fell with in the lower ten computed values. A statistical analysis was executed to determine if reported strikes, an independent variable from the risk value, was correlated to the risk value. A significant correlation ($r = 0.36$ $p = .003$) was found between the computed risk and the average number of strikes reported over the past six years. Risk values were also analyzed using a stepwise regression analysis to determine which factors in the model contributed

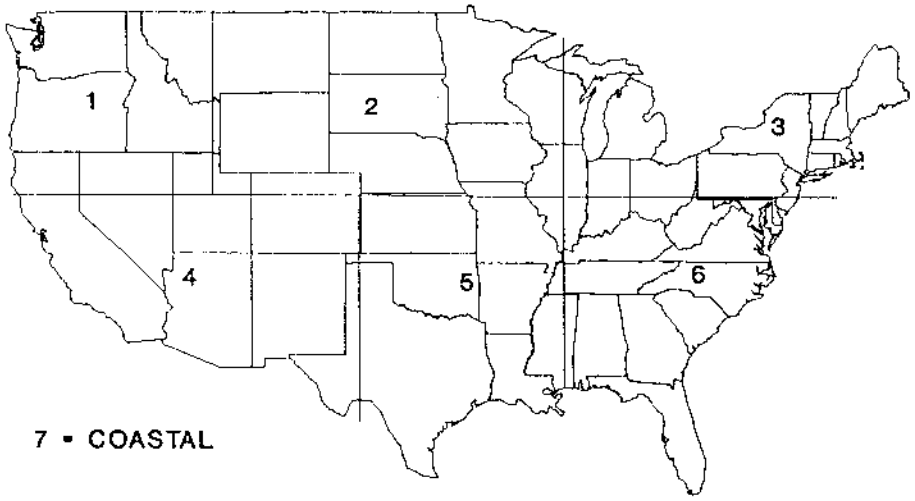

Fig 2. Bird Distribution Regions

REFUGE (W/IN 10 MILES)	6
LANDFILL (W/IN 2 MILES)	10
LANDFILL (W/IN 5 MILES)	7
LAKE/POND (W/IN 2 MILES)	4
LAKE/POND (W/IN 5 MILES)	2
WETLAND (W/IN 5 MILES)	3
BIRD ROOST (W/IN 2MILES)	2
AGRI OUTLEASE	1
DEER/MAMMAL HAZARDS	2

Table 4. Local Hazards

REGION	RAPTOR
1	1
2	1
3	1
4	2
5	3
6	3
7	3

Table 5. Su

Table 6.

REGION	RAPTOR	GULL	WATERBIRDS	BLACKBIRDS	DUCKS/GEESE	TOTAL
1	1	0	1	1	1	24
2	1	1	1.5	2	2.5	52
3	1	2	1	1	1	44
4	2	0	1	2	1	38
5	3	1	2.5	5	3	92.5
6	3	1	1.5	5	1	75.5
7	3	5	3	0	3	104

Table 5. Summation of Bird/Region Interaction

BASE	RISK	AVG STRIKES/YEAR
REESE	100.000	34.8333
LAUGHLIN	95.699	37.0000
BERGSTROM	93.118	3.0000
RANDOLPH	91.398	52.8333
DOVER	90.323	17.8333
COLUMBUS	82.796	49.8333
SHEPPARD	82.796	44.1667
VANCE	82.796	48.6667
MACDILL	82.581	18.3333
TINKER	69.032	15.0000
TYNDALL	66.237	6.6667
HOMESTEAD	65.376	11.1667
WESTOVER	65.376	2.3333
BARKSDALE	63.011	56.0000
WILLIAMS	59.355	42.1667

Table 6. Top 15 USAF Installations (CONUS)

the most to the variation in risk. The results of this analysis suggest that geographical region and bird type had the greatest influence, followed by aircraft type, local hazards, and installation mission.

Summary. The Airfield Risk Assessment Program is a simple tool that identifies installations with the highest probability of a serious bird strike. The program is independent of reporting or on-site control programs and serves only as a relative assessment of factors such as mission, aircraft, geographical location and local bird hazards. The program allows management to focus attention and efforts on the installations with the greatest potential risk, and to assess future changes in mission and landuse.

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