Bird Strikes to U.S. Air Force Aircraft 1988-1989

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Each year the U.S. Air Force suffers significant aircraft damage due to bird strikes. From 1988 to 1989, 6,444 strikes have been reported to the Bird Aircraft Strike Hazard (BASH) Team. During this period, two aircraft were destroyed resulting in no fatalities and an average annual cost of over 20 million dollars. The following are summaries of the two Class A mishaps in the past two years.

-- In January 1989, an F-16C struck a Turkey Vulture during a high speed, low-level mission. The bird penetrated the canopy forcing the pilot to eject. The aircraft was destroyed with cost estimates exceeding $10,000,000.

-- In January 1989, an F-16C ingested several starlings during takeoff. The pilot initiated an unsuccessful high speed abort resulting the loss of the aircraft. The pilot escaped uninjured. The estimated cost exceeds $10,000,000.

These examples are but a few of the devastating effects birds had on our aircraft in recent years. The severity of many of these strikes is due to encounters on high-speed, low-level missions. The Air Force's increased emphasis on realistic low-level mission profiles places our aircrews in prime avian habitat. High airspeed and high bird densities often result in significant damage or destruction of aircraft. Mission planning and airspace development to avoid birds requires more emphasis as our low-level activity increases. Several major commands have initiated aggressive bird strike reduction programs to combat these problems. Despite the large losses reported during 1987, the strike rate was 69.9 per 100,000 hours, a 10% reduction from the previous year. This reduction may have been the result of improvements in base-level BASH programs and a heightened awareness of BASH reduction strategies. The strike rate for the 1988 to 1989 period climbed to 115 per 100,000 hours. This may reflect an actual increase in strikes, or it may be the result of a vigorous campaign to improve reporting. The BASH Team now provides instruction on the BASH Reduction Program at the Flight Safety Officer School, University of Southern California, Norton AFB, California. This new effort has generated new emphasis and enthusiasm in the BASH program.

The following summary of bird strike data reported throughout the Air Force in the past two years is offered to illustrate the impact birds had on our aircraft. While thorough statistical analysis is not yet available on these data, general trends can be used to concentrate BASH reduction efforts for each mission profile.

Aircraft Involved in Bird Strikes

Virtually every aircraft in the USAF inventory reported bird strikes during from 1987 to 1989. Figure 1 shows the percentage of strikes by aircraft type. Cargo and fighter/attack aircraft reported the most strikes. Bird strikes to cargo aircraft are increasing each year as their low-level missions increase. Bird strike rates per 100,000 flying hours ranked by rate are reported by aircraft type in Table 1.

TABLE 1
Bird Strike Rate By Aircraft
(RANKED BY STRIKE RATE)
1987-1989

ACFT	STRIKES	RATE
E-4	28	516.2
B-1	200	331.6
KC-10	372	281.0
B-52	592	196.9
KC-135	886	143.9
C-130	1205	142.1
A-10	898	140.6
F-111	347	136.7
OA-37	60	102.9
C-5	182	98.3
T-38	856	84.5
C-9	72	83.1
T-37	659	74.3
F-16	733	70.5
C-141	462	56.0
F-15	256	41.3

Impact Location

Distribution of bird strikes to various aircraft components is basically random and related to the frontal surface area. Table 2 shows the percentage of total bird strikes by impact location.

TABLE 2
Bird Strikes By Impact Location

Impact Location	Percent of Total
Engine/Cowling	20.5
Windshield/Canopy	19.2
Wings	18.4
Radome/Nose	17.4
Fuselage	10.4
Multiple Locations	8.7
External Tanks/Pods/Gear	1.5
Other	4.0

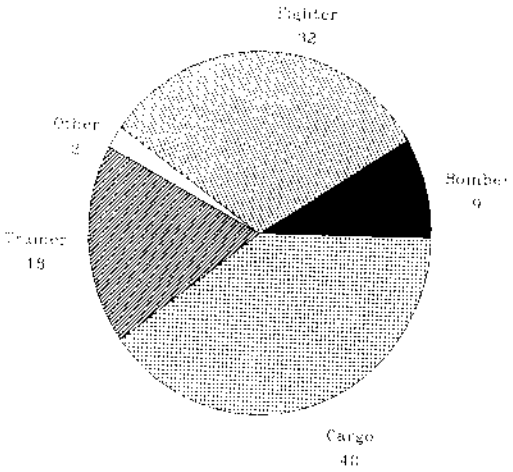

Figure 1. Strikes by Aircraft Type

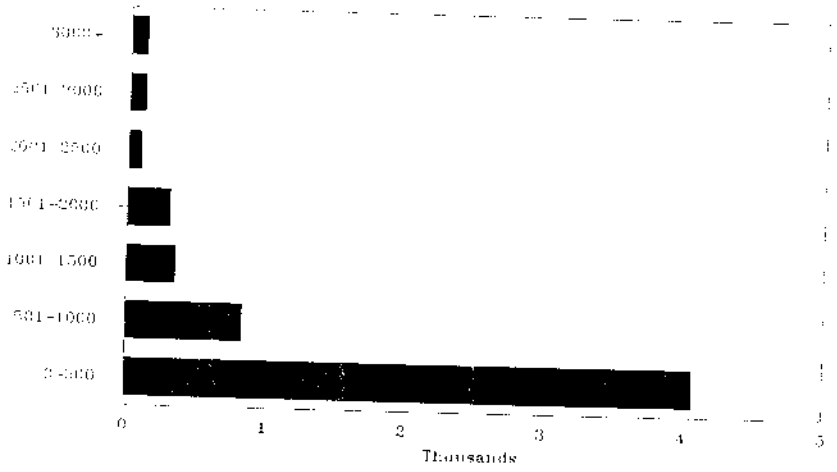

Figure 2. Strikes by Altitude

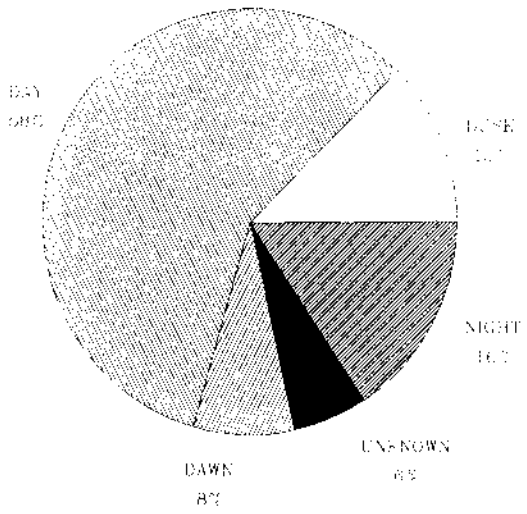

Figure 3. Strikes by Time of Day

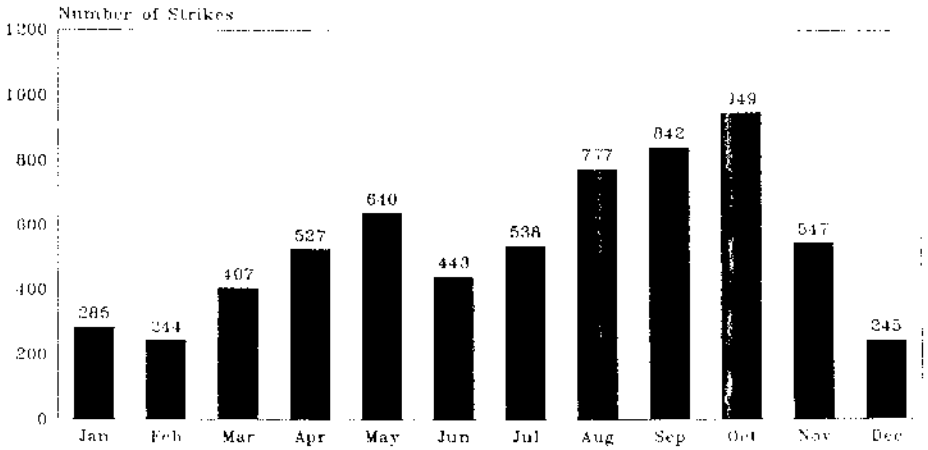

Figure 4. Strikes by Month

Engines and canopies again topped the list. We also anticipate further problems with canopy strikes and penetrations as the Air Force's low-level role increases. For example, the current F-15 canopy is only capable of withstanding a 4 pound bird at 350 knots. The F-15E, Strike Eagle, is encountering birds more frequently than it did in its air to air mission.

BIRD STRIKES BY ALTITUDE

Birds can be encountered at nearly all flight levels. The highest strike ever recorded was to a vulture at 37,000 feet. However, most birds fly much closer to ground level and over 95 percent of all strikes are reported below 3,000 feet AGL. Figure 2 shows bird strikes by altitude. Strike rates rise significantly as altitude decreases. This is partly due to where we fly, but mostly because birds are commonly active close to the ground. Any gain in altitude represents a substantially reduced threat of a bird strike. Pilots should consider higher altitudes whenever crossing known bird concentration areas, particularly during migratory periods.

TIMES WHEN BIRD STRIKES OCCUR

Bird strikes occur around the clock and throughout the year, but are most likely during certain periods. Figure 3 shows distribution of bird strikes by time of day. Most strikes are reported during daylight hours when we do most of our flying. Despite the low numbers, dawn and dusk are particularly hazardous times since many birds are most active at these times. Several bases have limited operations during these periods and have reduced their strike rate as a result. Most nighttime strikes are reported during migratory movements of birds during the spring and fall.

Figure 4 indicates bird strikes by month. Strike rates peak during the spring and fall migratory periods. These rates are perennially highest during September and October as birds move south. Bird populations are highest at this time following the summer breeding cycle.

Bird Strike By Phase Of Flight

Birds can be, and have been, struck in all phases of flight. Approximately half of the reported strikes occurred in the airfield environment (figure 5). Fortunately, most of these strikes were not as severe as in previous years. A substantial improvement in airfield grounds maintenance procedures and bird dispersal techniques in the past several years have resulted in improved flight safety in the airfield vicinity.

While only one quarter of reported strikes occurred in the low-level and range environments, the vast majority of damage and all five fatalities resulted here. Reduction of bird strikes in this environment can only be accomplished by careful airspace planning, development, and scheduling to avoid potential bird hazards. The Air Force is focusing efforts on reducing the low-level bird hazard in the future. The USAF

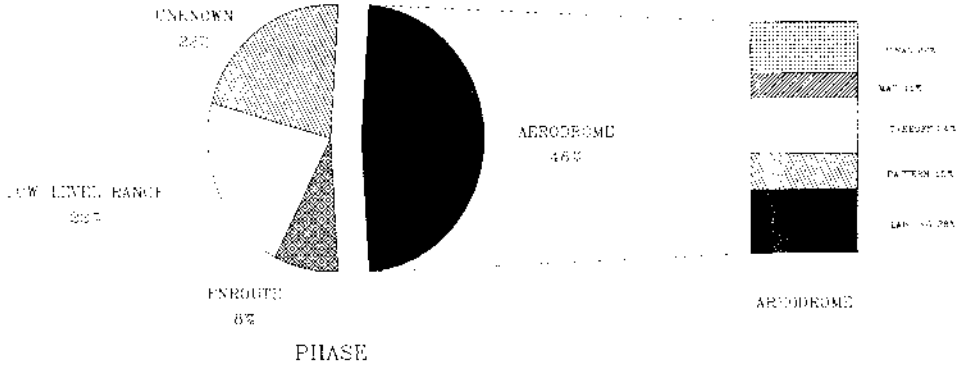

Figure 5. Strikes by Phase of Flight

Team is currently working on several major projects to address those hazards. Expansion of the Bird Avoidance Model (BAM) to include all high-risk bird species and all theaters of operation is being researched. The current model includes populations and movement data for waterfowl and some species of raptors (birds of prey) for the continental United States. Units using the current model reported up to 70 percent reductions in strikes to these birds.

Another area currently under research is the use of radars, particularly the Next Generation Weather Radar (NEXRAD), to help observe birds. NEXRAD is a tri-agency program of the Department of Commerce, Transportation, and Defense, with the Department of Commerce as lead agency. Under NEXRAD, a network of state-of-the-art doppler weather radars will provide improved detection of severe weather events in the CONUS and parts of Europe and the Pacific. Preliminary results indicate that this doppler weather radar can detect bird movements and provide altitude data. This information may provide aircrews with bird hazard warnings for mission planning and possibly enroute avoidance. The BASH Team is sponsoring the development of a bird recognition algorithm for possible inclusion in this system. We are continuing to explore new radar technology that may provide real-time bird detection in the airfield environment.

With these systems operating, we anticipate a future reduction of the severe bird strike hazard in the low altitude flight environment.

BIRDS IDENTIFIED IN STRIKES.

A variety of bird species have been identified following impact with our aircraft. Post strike bird remains are sent to the BASH Team for identification. Most of these remains are then forwarded to Ms. Roxie Laybourne for microscopic analysis. Recent analysis of bird species and weights suggests that we are encountering more larger birds than previously estimated. Table 3 lists the birds most commonly identified.

TABLE 3
SPECIES IDENTIFIED IN BIRD STRIKES

SPECIES	%
Gulls	29.5
Hawks	21.2
Vultures	11.4
Doves	10.9
Ducks	7.2
Egrets	5.5
Starlings	4.8
Larks	3.7
Geese	3.3
Herons	1.3

SUMMARY

The Air Force suffers tremendous losses to bird strikes each year. 1987 was the most costly year in terms of aircraft damage and lost lives. Recent incidents have created an increase in interest in BASH reduction efforts. Much needs to be done to reduce the hazards in all operating environments, but especially away from the airfield. The BASH Team considers development of complete bird population and movement data, and issuance of bird hazard advisories in our low-level and operating areas among its top priorities for future reductions of bird strike hazards. Armed with this information, we anticipate safer flying conditions and a substantial savings of resources throughout the Air Force.