November 1976

BIRD STRIKES AND THE AIR FORCE

Portia R. McCracken
Air Force Civil Engineering Center, Tyndall AFB, Florida

BIRD STRIKES AND THE AIR FORCE

Portia R. McCracken
Air Force Civil Engineering Center
Tyndall AFB, Florida

The first recorded bird strike accident was in 1912, when a gull got caught in an aircraft control cable. The pilot was killed in the crash. Since that first squaring-off, man and bird have been engaged in an accelerating contest in which there can be no winner.

At first, birdstrikes were not really much of a problem. Aircraft were slow, and birds were able to learn to move out of their paths in time to avoid a collision. But, with the coming of the jet age, the problem began to take on more sinister proportions. At this point, birds ceased to be a minor annoyance and became instead a serious hazard to the safe operation of aircraft.

DISCUSSION

The United States Air Force (USAF) has been collecting bird strike data as part of its aircraft-mishap reporting system for more than 20 years. However, only during the last 10 years have the data been arranged and stored so that they are easily accessible. The more recent the data, the more complete they are.

It must be pointed out that bird strikes are reported only when they meet the criteria for reporting USAF aircraft mishaps. To generate a report and become a statistic, a bird strike must result in an aircraft accident or incident as defined by Air Force directive. To qualify as an accident, the bird strike damage must require significant manhours to repair or must result in injury or death to the crew. To qualify as an incident, the bird strike must have damaged the aircraft sufficiently to require some repair prior to the next flight, or the bird strike must be deemed to constitute a "significant hazard to the crew or aircraft." This is admittedly a subjective criterion and varies with the reporting official. No one knows how many unreported bird strkes are cleaned up during the post flight inspection; consequently, our data reflect only part of the problem.

It should also be pointed out that military operations differ from civilian operations mainly in the requirement for high-speed, low-level flying. This enroute flight activity has accounted for our greatest losses, both in aircraft and aircrew lives. In reviewing USAF data, it is important to understand that other than the low-level requirement, there is no significant bird strike difference between civilian and military aircraft and that the USAF data could probably represent the magnitude of the civilian problem as well.

The number of bird strkes reported during each of the last 10 years has consistently remained between 300 and 400 (Figure 1). Bird strikes in 1974 exceeded the average with 467, but 1975 was close to normal with 402 strikes. As explained earlier, only bird strikes causing damage, injury, or hazard are reported. To determine the relationship of reported bird strikes to total bird strikes, a test was conducted in 1971 requiring flying units to report *all* birds strikes for the year, regardless of damage. Of the more than 1,000 total bird strikes reported, only 390 met the USAF incident/accident criteria. If this one year sample can be construed as representative, then for every bird strike reported in the USAF, at least two other strikes actually occur.

The solid line in Figure 1 represents accidents in all categories. Since 1965 there has never been fewer than two bird strike accidents per year, and since 1969 the average has been three per year. Over the past 10 years, these accidents have resulted in the loss of 14 aircraft and 7 pilots. Bird strikes were also strongly suspected in several other accidents involving aircrew fatalities and destroyed aircraft.

For the period from 1965 to 1975, 3,600 reported bird strikes occurred causing over $81 million lost to damaged or destroyed aircraft (Figure 2). Since 1970 alone, approximately $70 million has been lost, of which over $61 million involved the cost of destroyed aircraft. These figures do not include any dollar amount for manhours required to repair the damaged aircraft. Actual costs are necessarily much higher. It is estimated that one billion dollars is lost annually world-wide in repairing damage from bird strikes. So far this year the USAF has lost $2.8 million in reported strikes; and in January alone of this year, C-5s at one of our West coast bases received more than $1.5 million in engine damage from ingesting pintail ducks within a 30 day period.

Looking at absolute numbers of bird strikes each year does not realistically define the problem. Reductions in flying time and changes in training requirements tend to confuse the issue. In order to see trends, we should look at bird strike rates per 100,000 sorties, hours, and landings. Rates are increasing (Figure 3) no matter which yardstick is used. All three rates have approximately doubled since 1970. The rapid increase in strikes per

sortie may reflect the fact that we are spending more time in the bird-hazardous environment. For example, training missions shoot more landings per sortie now than 10 years ago. We know that most birds fly at altitudes up to 3,000 feet, and statistics show that we hit a lot of those birds (Figure 4). Over 50 percent of our bird strikes occur below 3,000 feet. The high percentage of unknowns results from the number of bird strikes which were not noticed until after the flight or for which the crew failed to report the altitude.

When we look at bird strikes by aircraft type (Figure 5), we see that 57% involve fighters and trainers, which spend a great deal of time in the airdrome environment shooting takeoffs and landings. Half of our bird strikes occur during the takeoff or landing phase (Figure 6). Approximately 20% occur during low-level flight and represent a significant hazard to flight safety because of the high speeds and low altitudes involved. All of our major accidents attributed to bird strikes have occurred in the takeoff and landing phase and in the low-level phase. As expected, most of the bird strikes occur close to the air base (Figure 7). The large unknown category includes the unknowns shown in Figure 6 plus the low-level and initial climbout bird strikes in which the nearest base is unknown.

A bird's-eye view of a typical fighter illustrates why more than 50% of the bird strikes impact the wings and engine (Figure 8). Even though canopies and windshields show less than 7% of recorded damage, bird strikes here may be critical. Out of 14 major accidents caused by bird strikes between 1967 and 1975, four were from engine ingestions; and eight were caused by windscreen/canopy failure. Impact speeds ranged from 480 knots to as low as 160 knots. Bird sizes involved in these accidents ranged from a 2-ounce White-throated Swift to a Golden Eagle weighing between 10 and 14 pounds. In the majority of mishaps, the species and size of the bird is undetermined.

Twice a year, during spring and fall migration, our bird strike rates significantly increase (Figure 9). The spring migration is reflected by the increased monthly averages in April and May. By August the fall migration has begun, and heavy strikes are taken again in September, October and November. Waterfowl and shorebirds probably account for the major damaging strikes during migratory periods. Multiple strikes from passerines also contribute to our migratory problem; these strikes usually result in damage to the airframe from dents on leading edges of wings, tail assemblies, and the nose of the aircraft.

Because of the magnitude of the USAF bird strike problem, the Bird/Aircraft Strike Hazard (BASH) Team was formed in May 1975, based at the Air Force Civil Engineering Center at Tyndall Air Force Base in Florida. The BASH Team is composed of three officers who are biologists, one of whom is also an Air Force pilot, and three enlisted technicians. Team members are experienced in botany, ornithology, animal behavior, mammalogy, entomology, wildlife management, and flight operations. The function of the BASH team is to survey air bases with bird strike problems, examining the local vegetation, wildlife, bird flight patterns, and how the birds interact with their environment. Specific habitats attractive to birds are identified, bird control techniques are evaluated, and flight operations are examined for the potential effect of bird habits on those operations.

A good example of a base with a BASH problem was Cannon AFB in New Mexico. The principal aircraft is the F-111, an aircraft which flies a great number of low-level routes. This high-speed, low-level flying makes the F-111 particularly vulnerable to bird strikes. The BASH Team was asked to evaluate Cannon AFB and its major low level routes for their BASH potential.

We looked at vegetation and habitats, both natural and manmade. We examined wildlife and found that Cannon AFB had a unique problem. Off the approach end of one runway was a black-tailed prairie dog town. Now, obviously the prairie dogs themselves were not a flight hazard. However, the dogs were frequently hunted by hawks, which certainly were a hazard. Also, abandoned burrows provided homes for other small mammals and Burrowing Owls. The mammals attracted raptors, and the owls were a hazard themselves. Other environmental considerations were grass heights on the airfield, landfill operations, a large sewage holding pond, a depression used for aggregate fill, and a bomb range where controlled burning had been conducted.

Then we looked at operational factors, such as low level entry descent speeds, flight scheduling, and final approach vectors. After analyzing the environmental and operational factors which contributed to the problem, we made a number of recommendations to modify the environment and change operational procedures to reduce the BASH threat.

Sometimes we are asked to solve a pest bird problem such as birds in hangars. These birds, usually pigeons, Starlings, and sparrows, cause health, maintenance and housekeeping problems. Considerable hours are spent cleaning hangar floors of bird droppings, and no one knows how much money and time are spent each year protecting and repairing aircraft from the corrosive effect of such droppings.

The Air Force is achieving a one-third reduction in bird strikes when the BASH Team recommendations are followed. This is pitifully less than the Canadians and Europeans can boast, but they have a 10-year lead on us. We're finally taking the problem seriously and allocating resources and money toward solving it. The only problem is that nobody has told the birds yet. Perhaps this artist's conception of a new long-range bomber is the best answer after all. If you can't beat 'em, join 'em.

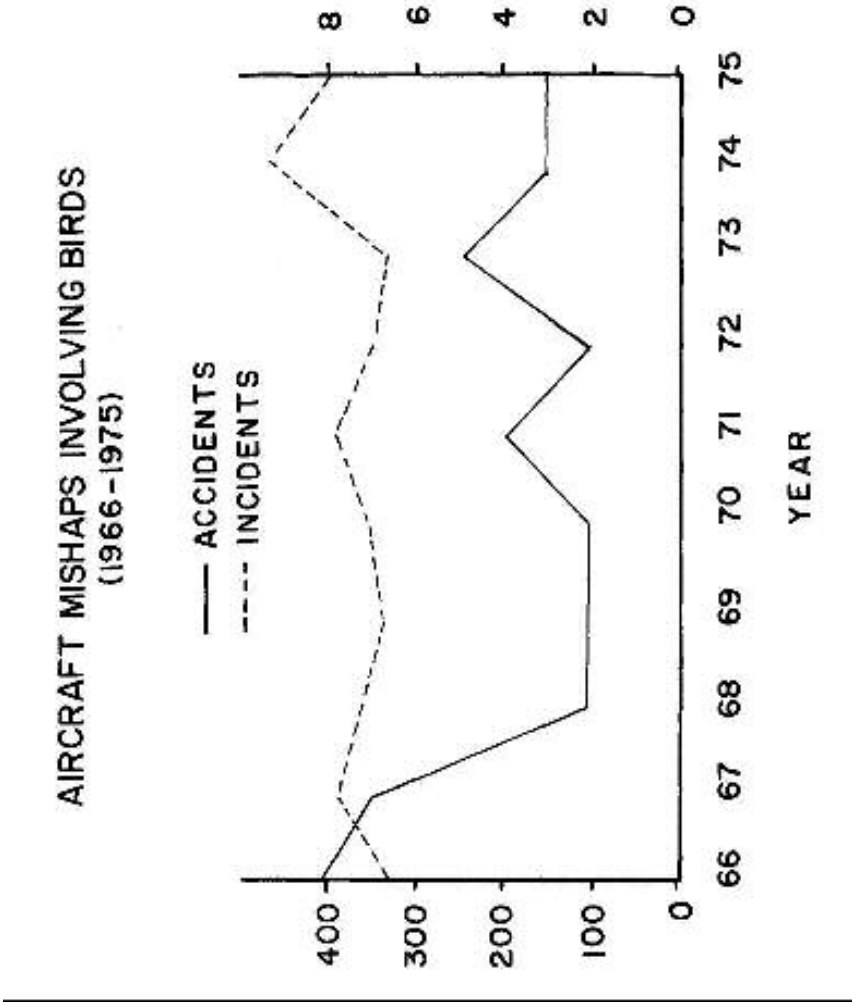
AIRCRAFT MISHAPS INVOLVING BIRDS
(1966-1975)
ACCIDENTS
INCIDENTS
400
300
200
100
0
8
6
4
2
0
66
67
68
69
70
71
72
73
74
75
YEAR

FIGURE 1

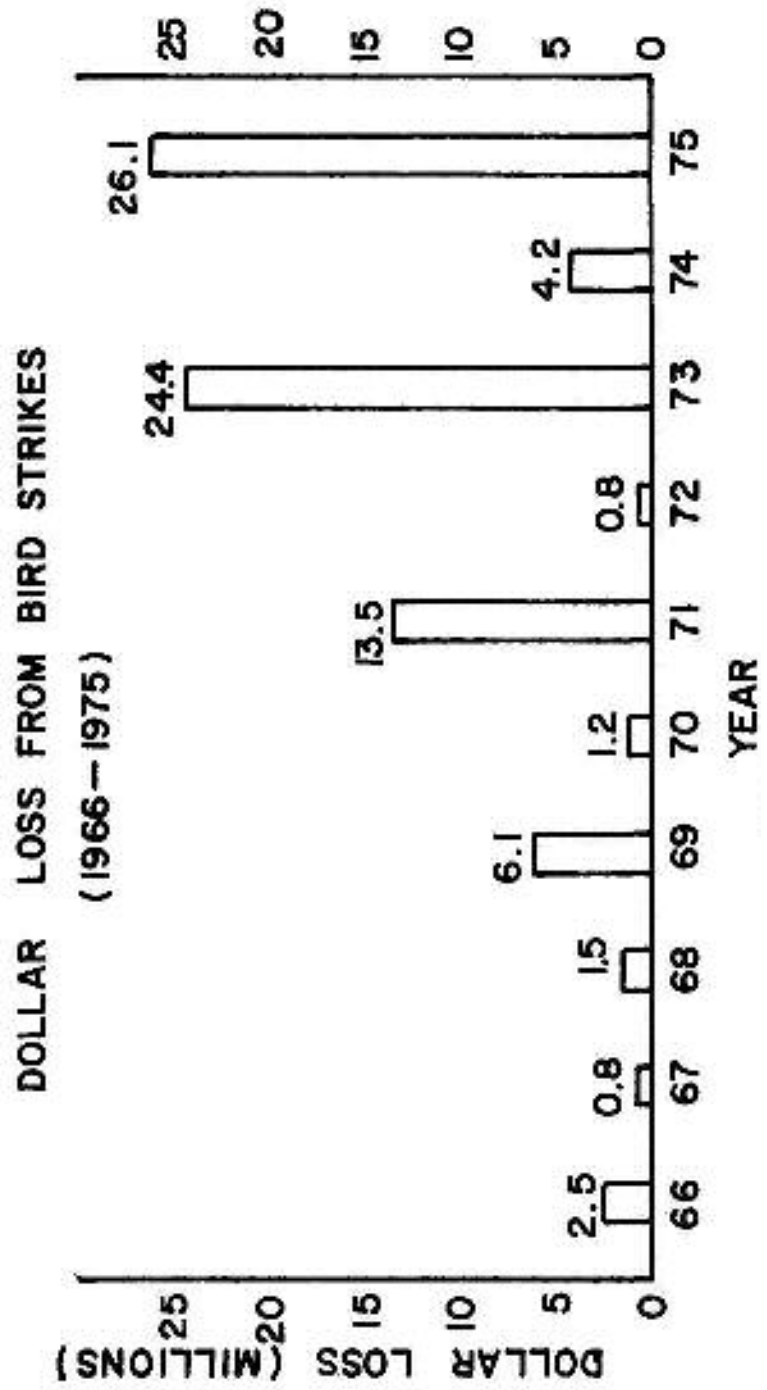
DOLLAR LOSS FROM BIRD STRIKES
(1966–1975)
DOLLAR LOSS (MILLIONS)
0
5
10
15
20
25
2.5
0.8
1.5
6.1
1.2
13.5
0.8
24.4
4.2
26.1
66
67
68
69
70
71
72
73
74
75
YEAR

FIGURE 2

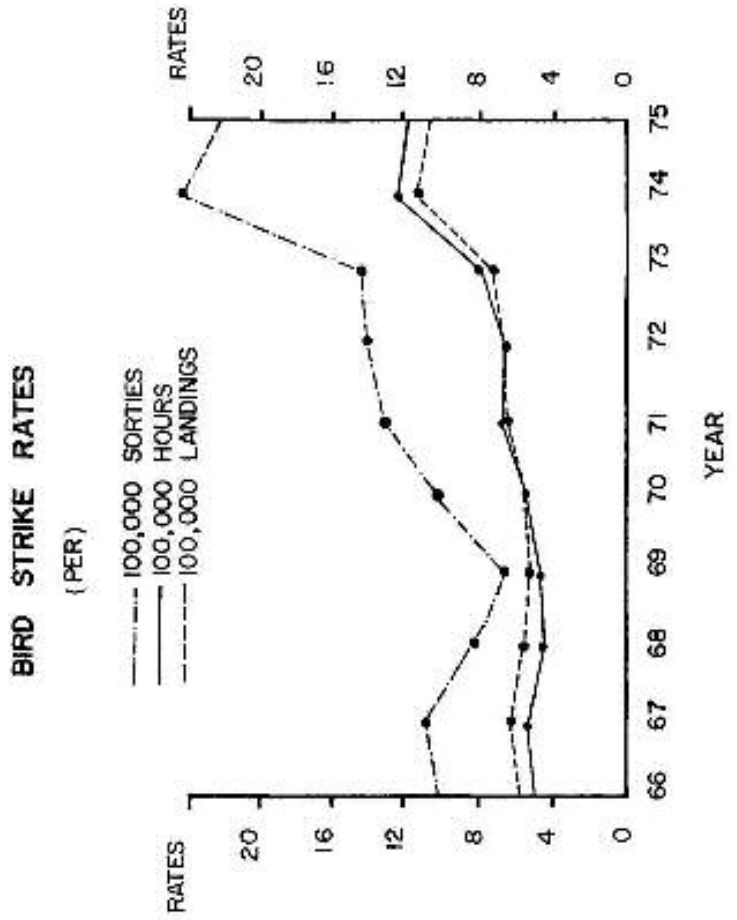
BIRD STRIKE RATES
(PER)
100,000 SORTIES
100,000 HOURS
100,000 LANDINGS
RATES
20
16
12
8
4
0
66
67
68
69
70
71
72
73
74
75
YEAR

FIGURE 3

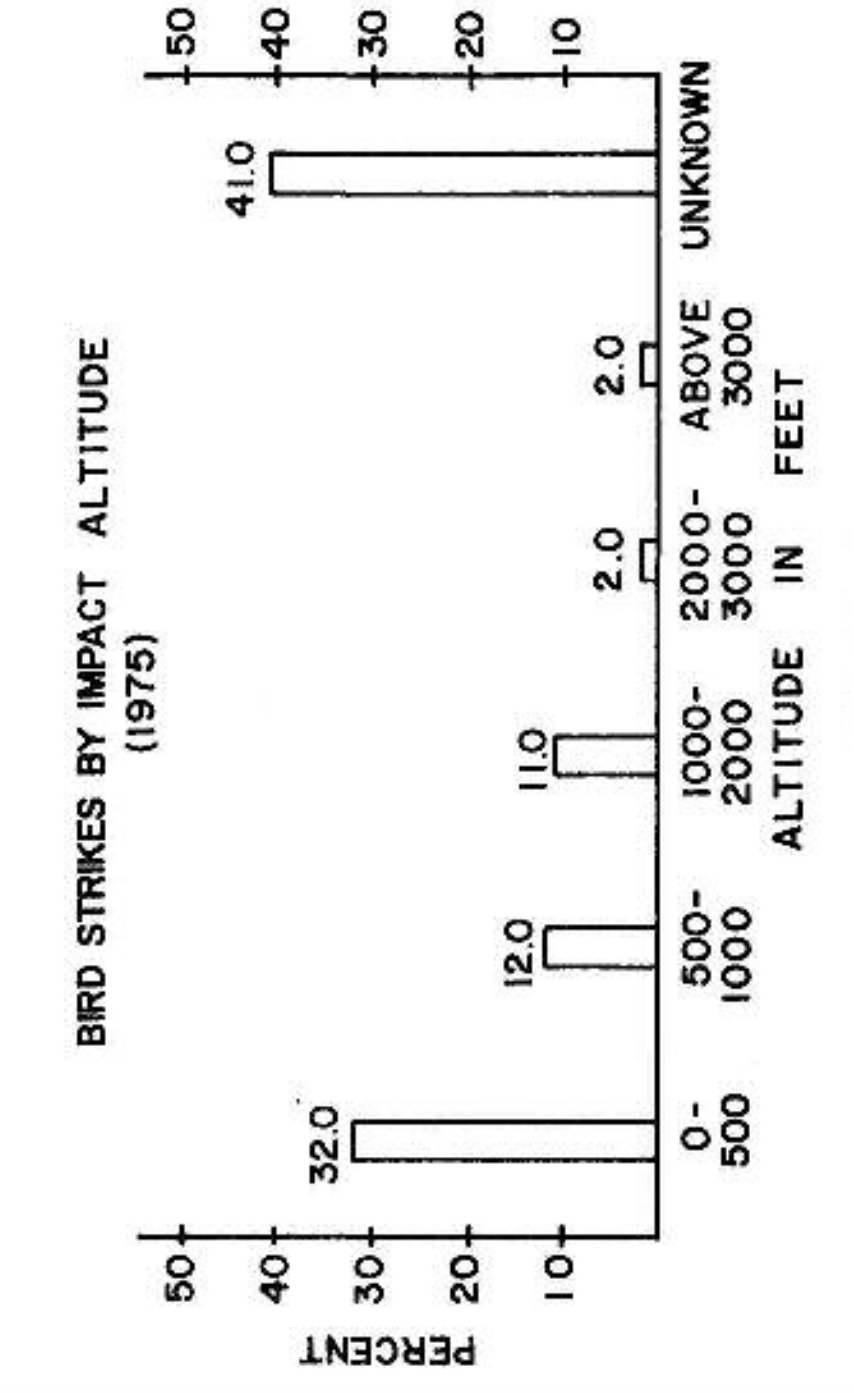
BIRD STRIKES BY IMPACT ALTITUDE
(1975)
PERCENT
50
40
30
20
10
32.0
12.0
11.0
2.0
2.0
41.0
0-
500
500-
1000
1000-
2000
2000-
3000
ABOVE
3000
UNKNOWN
ALTITUDE IN FEET

FIGURE 4

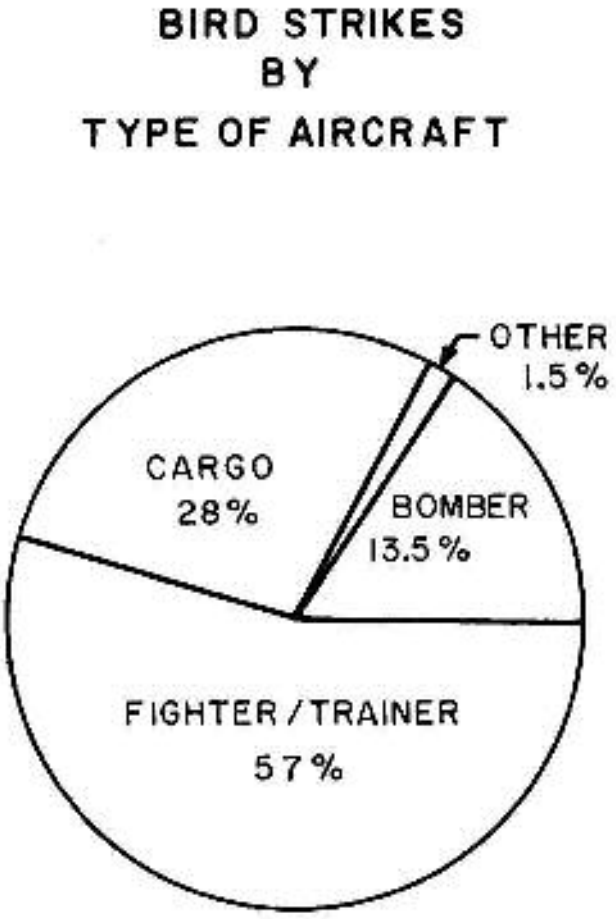
BIRD STRIKES
BY
TYPE OF AIRCRAFT
OTHER
1.5%
CARGO
28%
BOMBER
13.5%
FIGHTER / TRAINER
57%

FIGURE 5

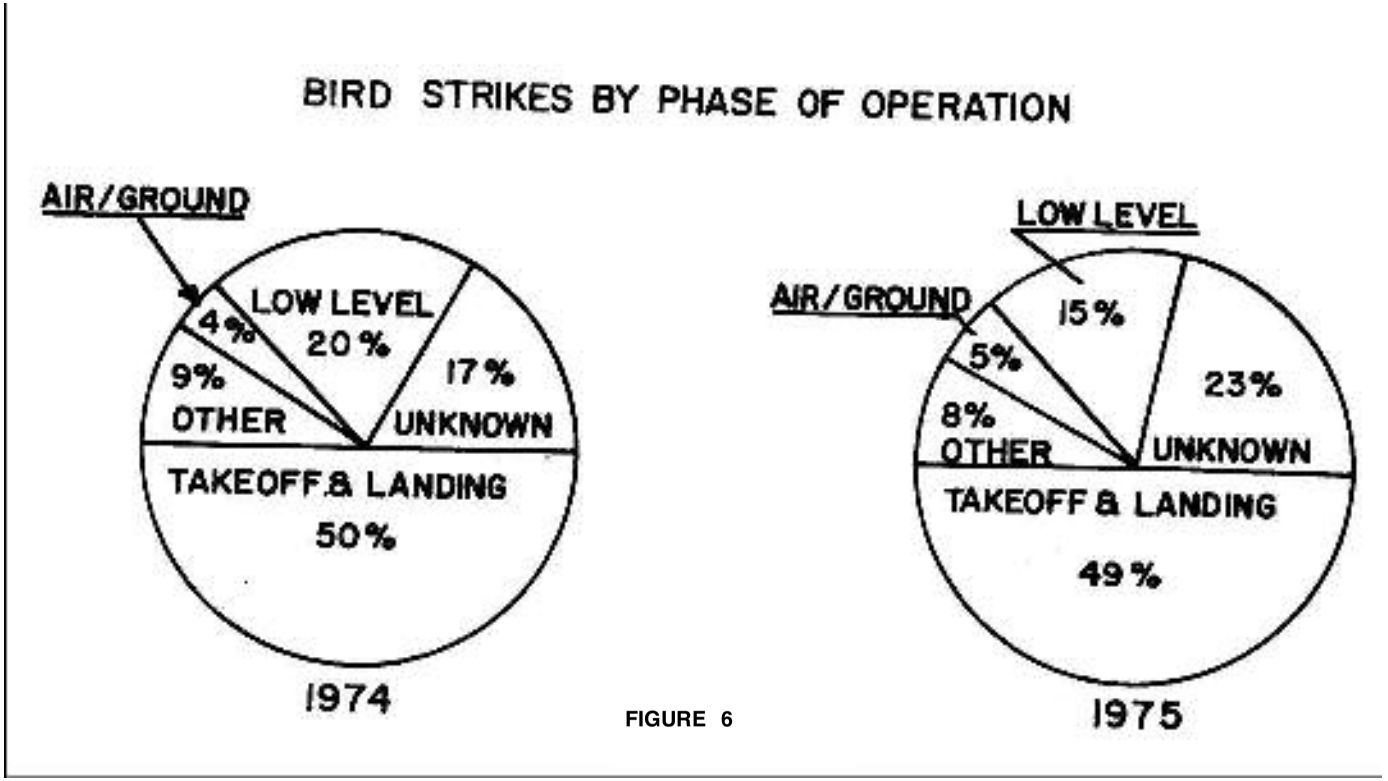
BIRD STRIKES BY PHASE OF OPERATION
AIR/GROUND
4%
LOW LEVEL
20%
17%
9%
OTHER
UNKNOWN
TAKEOFF & LANDING
50%
1974
LOW LEVEL
AIR/GROUND
15%
5%
23%
8%
OTHER
UNKNOWN
TAKEOFF & LANDING
49%
1975

FIGURE 6

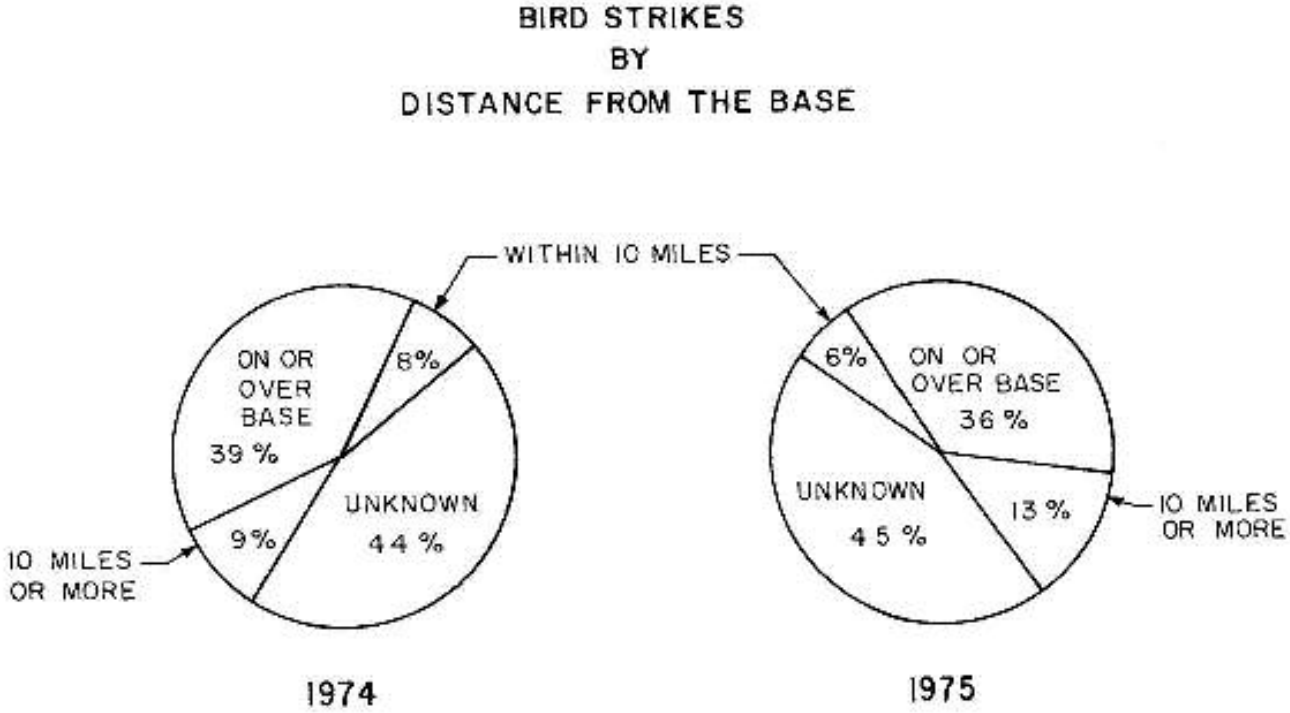
BIRD STRIKES
BY
DISTANCE FROM THE BASE
WITHIN 10 MILES
ON OR
OVER
BASE
39 %
8%
UNKNOWN
44 %
9%
10 MILES
OR MORE
1974
6%
ON OR
OVER BASE
36 %
UNKNOWN
45 %
13 %
10 MILES
OR MORE
1975

FIGURE 7

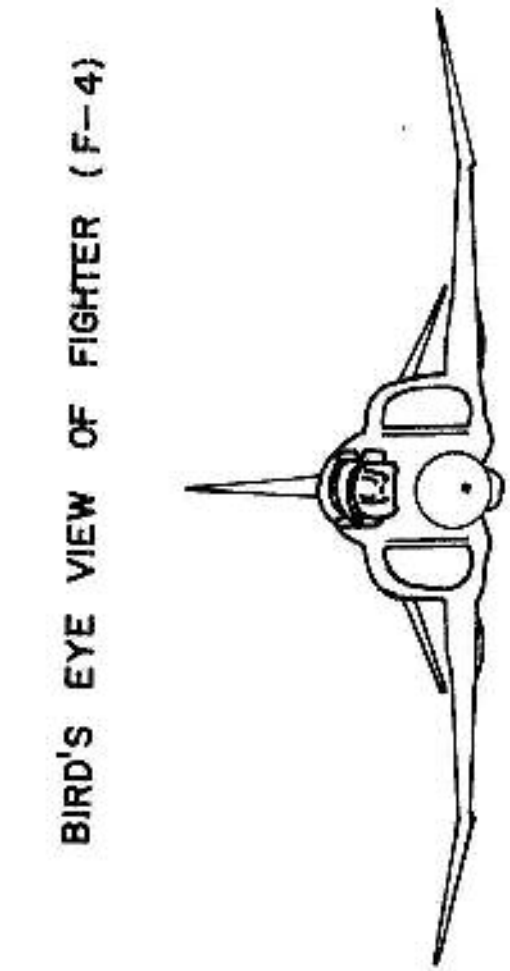

FIGURE 8

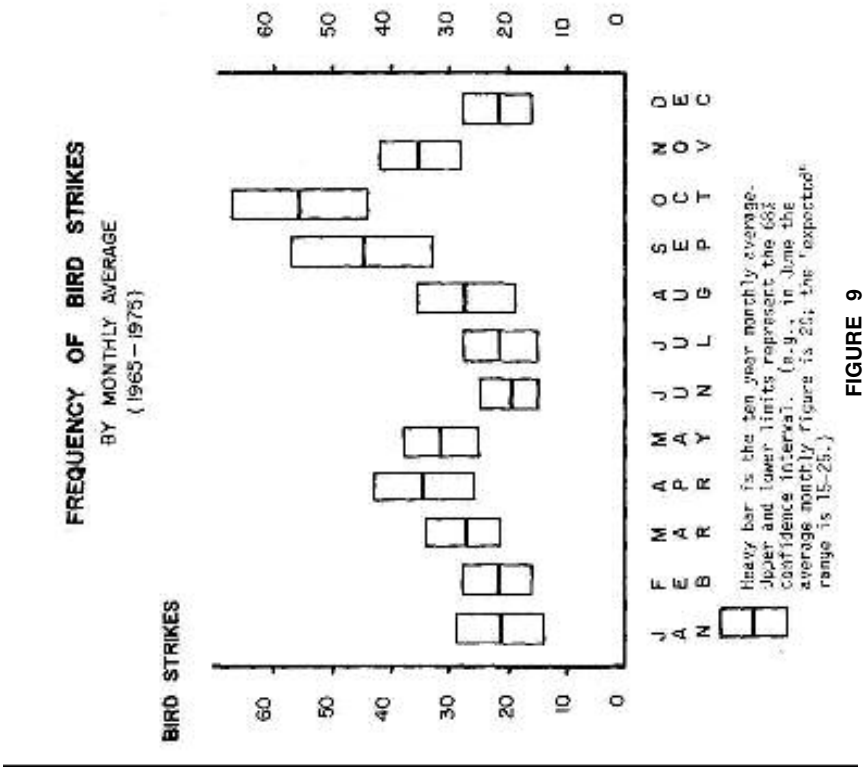
FREQUENCY OF BIRD STRIKES
BY MONTHLY AVERAGE
(1965-1975)
BIRD STRIKES
60
50
40
30
20
10
0
J F M A M J J A S O N D
A E A P A U U U E C O E
N B R R Y N L G P T V C
Heavy bar is the ten year monthly average. Upper and lower limits represent the 66% confidence interval. (e.g., in June the average monthly figure is 26; the "expected" range is 15-25.)

FIGURE 9