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SERIOUS BIRDSTRIKE-RELATED ACCIDENTS TO MILITARY AIRCRAFT OF TEN COUNTRIES: PRELIMINARY ANALYSIS OF CIRCUMSTANCES

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ABSTRACT

This paper lists and summarizes the circumstances of 131 accidents in which military aircraft crashed and/or aircrew were killed as a result of encounters with birds. Over 40 aircrew were killed in these accidents. The accidents involved military aircraft of 10 countries during periods of variable duration, depending on the country. This paper excludes additional known accidents and fatalities in years and countries for which only fragmentary data were available. Of the accidents considered, 69 were in Europe, 9 in Canada, 32 in the U.S.A., 5 elsewhere, and 16 at unknown locations. Most involved jet fighter, attack and training aircraft, but two accidents involved 4-engine bomber and patrol aircraft. The largest number of accidents was during high-speed low-level flight (≤1,000 ft AGL). Most involved engine ingestions and/or windscreen penetrations. Gulls and secondarily buzzards were the most commonly-involved groups in Europe; vultures were the most serious problem in the U.S.A. It is desirable to prepare a more comprehensive listing of serious military accidents based on fuller records for some of the accidents already considered, plus data from other years and more countries. This would provide the basis for a more complete and representative analysis of the problem.

Key Words: Australia, Canada, Denmark, Germany, Netherlands, Norway, Sweden, Switzerland, U.K., U.S.A., accidents, fatalities, years, locations, months, aircraft type, phase of flight, altitude, speed, windscreen penetration, engine ingestion, species, list

1. INTRODUCTION

A large but unknown number of military aircraft have crashed as a result of birdstrikes, and many aircrew have been killed (e.g. Blokpoel 1976:49). Buurma (1983) estimated that, in the early 1980s, West European military forces may have been losing up to 10 jet fighters per year due to birdstrikes. However, comprehensive data on the numbers and especially the circumstances of birdstrike-related accidents are difficult to find and collate. No detailed list or analysis has been published previously.

Better understanding of the frequency and circumstances of these accidents could help focus attention on situations in need of attention. Although there have been many analyses of the circumstances of birdstrikes in general, serious accidents comprise a small minority of these cases. The probabilities of serious accidents in various situations may not be directly proportional to frequencies of all birdstrikes.

Analyses of serious accidents should use data from as many years and countries as possible to provide an adequate statistical basis. Notwithstanding the need for a broad approach, many factors vary among countries, and operations and equipment change across years. "Pooled" data must, therefore, be interpreted cautiously.

This paper lists (see Appendix) and summarizes the circumstances of 131 serious accidents to military aircraft of 10 countries from which reasonably comprehensive data were obtainable for 15 or more years. I am grateful to many individuals for assistance in compiling these data (see Acknowledgements).

It is hoped that this paper will stimulate agencies and persons with access to military accident data to release information about additional birdstrike-related accidents, and to provide further details about incompletely-documented cases already listed in the Appendix. A more comprehensive list and analysis will then be possible.

2. DATA SOURCES AND PROCEDURES

This paper considers accidents from 1950 to date. However, data are lacking or incomplete up to 1955-80, depending on the country. In many tables, accidents before 1980 are tabulated separately from the more recent cases. In all cases, one must allow for the inevitable incompleteness of records, and for differences in investigation and reporting standards among countries and years.

"Serious accidents" are defined as those in which a military aircraft was destroyed or damaged beyond economical repair as a result of colliding with birds (124 accidents) or while attempting to avoid birds (4 accidents). Also included are 3 accidents in which a crewman was killed by a bird penetrating the cockpit but another crewman landed the aircraft successfully. Tables 1-4 also take account of a further 3 accidents for which available details are too sparse for inclusion in the Appendix. For completeness, the Appendix also lists two USAF

incidents in which one crewmen ejected successfully after a birdstrike but another crewman landed the aircraft. These two incidents are excluded from the "serious accident" tabulations.

Australia: The Directorate of Flying Safety provided detailed data on relevant accidents in their records (3 RAAF accidents; 0 Navy and Army). Supplementary data were obtained from published accounts of two of these accidents (Wilson 1989a,b).

Canada: The CAF Directorate of Flight Safety (DFS) provided detailed data from its ACAIRS accident database documenting 17 accidents from 1964 to date. Two further 1964 accidents that may or may not have been caused by birds are excluded. Supplementary data were obtained from several accident summaries in the DFS publication *Flight Comment*, and from Campbell (1967), CFHQ/DFS (n.d.), NDHQ/DFS (n.d.), and Bashow (1991).

Denmark: Records indicate that, since 1945, there have been no bird-related writeoffs or fatalities in Danish military aviation (Maj. P.E. Christiansen, pers. comm., July 1994).

Germany: Dr. J. Becker, German Military Geophysical Office, provided a list of the 22 GAF (air force and naval) aircraft known to have been destroyed by birdstrikes from 1962 to date. Buurma (1983) lists a few of these. An AlphaJet writeoff on 13 March 1990 is excluded as it is not recognized as being mainly attributable to a birdstrike (J. Becker, pers. comm.).

Netherlands: Dr. L.S. Buurma (Ornithology Sect., RNethAF) provided additional details on the 10 RNethAF birdstrike-related accidents, 1956 to date, that have been described in print (Blokpoel 1966; Buurma 1982-84; *Flight Comment* 1983(2):16-18; *Flight International* and *Air Forces Monthly*, various issues). An F-16A accident on 9 Aug. 1993, unofficially reported as involving birds, is excluded based on final analysis (L. Buurma, pers. comm.).

Norway: Two RNorAF accidents in 1971 and 1981 are listed, from Lid (1973) and Buurma (1982-84). I have no details for another case in the 1980s noted in BSCE 20:679.

Sweden: Dr. T. Alerstam (pers. comm.) kindly provided detailed accounts for the nine known birdstrike-related accidents to Swedish Air Force aircraft in the 1967-1988 period. A few SwedAF crashes before 1967 were probably caused by birds but details are unavailable.

Switzerland: Dr. B. Bruderer (pers. comm.) provided details for the one known Swiss AF case, briefly described in Bruderer (1976).

United Kingdom: The Appendix lists 15 losses of RAF aircraft since 1980 to birdstrikes or bird avoidance, based largely on accident summaries released by the U.K. Ministry of Defence and, in some cases, published in *Flight Int.* or *Air Forces Monthly*. Other major sources included Leeming (1984), Turner (1987) and Oliver (1990).

Many more RAF aircraft were lost from 1950 to 1979 (and earlier) due to birdstrikes. Many unofficial reports are listed in Langley (1970), Mason (1986:219*ff*), Jackson (1989:144*ff*), Oliver (1990), and *Flight Int.* Given the incompleteness and uncertain accuracy of these rec-

ords, they are not used here, pending further efforts to obtain specific data. Some Royal Navy aircraft have also been lost to birdstrikes, but pending the availability of more specific data all RN cases are also excluded.

U.S. Air Force: The Appendix lists 39 losses of USAF and Air National Guard aircraft to birdstrikes or bird avoidance in 1962-94, and three more cases when a crewman was killed by windscreen penetration. Most 1962-73 data are from annual reports by the USAF Directorate of Aerospace Safety, entitled *USAF aircraft collisions with birds* for 1962-70 and *USAF bird strike summary* for 1971-73. Unfortunately, locations of most 1962-73 accidents were not reported, and some confirmed cases may not have been listed. Other useful sources for this period were Ferrari [n.d., 1966], Compton et al. (1973), Tillman (1973), and Beason (1975).

For 1974-91, detailed records from the USAF BASH Team's database were available, courtesy of M. Thompson and Maj. R. Merritt. Supplementing these data were personal communications and publications from the BASH Team (e.g. Hodge 1987; DeFusco 1988; Merritt 1990; Merritt and Dogan 1992), and unofficial reports in *Aviation Week & Space Technology*, *Air Forces Monthly*, and *Flight International*.

U.S. Navy & Marine Corps: For 1969-79, five crashes were mentioned in Anon. (1972) and Mason (1986:224), but there may have been other unreported cases. In only 3 of 5 cases were sufficient details available for listing in the Appendix. For 1980-94, detailed data on 7 USN/USMC crashes were provided by the Naval Safety Center, courtesy of W.B. Brown, supplemented by Dolvin (1987) and Bivings and Medve (1990).

3. FREQUENCY OF SERIOUS ACCIDENTS

3.1 Writeoffs

Data on losses prior to 1980 are incomplete or lacking for most countries, and the numerous RAF losses prior to 1980 are specifically excluded. Even so, well over 32 military aircraft from the above countries and services were destroyed by birdstrikes in the 1960s, and well over 42 in the 1970s (Table 1). During the 1980s, at least 40 aircraft from the 10 countries were destroyed by birdstrikes (n=37) or while manoeuvring to avoid birds (n=3). So far during the 1990s, at least 15 aircraft[1] have been lost (Table 1).

Loss rates (aircraft/year) have declined in recent years for some countries, including Germany, Sweden, the RAF, Canada, and possibly Australia. Factors responsible are outside the scope of this review. However, they presumably include retirement of Canadian and German F-104s, which had high loss rates to birdstrikes (see Appendix), and reductions in total fleet sizes and flying hours in some countries. However, USAF loss rates have not declined; USAF F-16 and T-38 aircraft, in particular, continue to be lost to birdstrikes at a rate

[1] Excluding Norway and Sweden, for which recent data are not available.

TABLE 1. Minimum numbers of military aircraft of 10 countries lost to birds[a], 1950 to date. Includes aircraft destroyed and damaged beyond economical repair.

Country of Origin	Service(s)	1950s	1960s	1970s	1980s	1990s	Minimum Total
Europe							
Denmark	all	0	0	0	0	0	0
Germany	AF,N	?	5	11	6	0	22
Netherlands	AF	2	3	2	2	1	10
Norway	AF	?	?	1	2?[b]	?	3+
Sweden	AF	?	2+[c]	7	0	?	9+
Switzerland	AF	0	0	1	0	0	1
United Kingdom	RAF	+[d]	+[d]	+[d]	13[a]	2	15+[a,d]
North America							
Canada	all	0?	10	4	2	1	17
USAF	AF	?	11+	9+	12[a]	7[a]	39+[a]
USN & USMC	N,MC	?	?	~5[e]	3	4	12+
Australia	all	0?	1	2	0	0	3
Totals		**2**	**32+**	**42+**	**40**	**15**	131+

[a] Includes 2 RAF and 2 USAF aircraft lost while avoiding birds or (one case) assumed birds (see §4.9).
[b] Details unknown for one RNorAF accident in 1980s, mentioned in BSCE 20, p. 679.
[c] Some further SwedAF crashes before 1967 were probably due to birds (T. Alerstam pers. comm.).
[d] Numerous RAF aircraft lost to birdstrikes in 1950s - 1970s, but exact numbers not available.
[e] Some of these USN/USMC accidents may have been in 1969. Details are unknown for 2 of 4 USN/USMC aircraft lost in 1969-71; these two are not listed in the Appendix.

TABLE 2. Minimum numbers of human fatalities attributed to birdstrikes[a] on military aircraft of 10 countries, 1950 to date. No known fatalities for Denmark, Switzerland or Germany.

Country of Origin	Service(s)	1950s	1960s	1970s	1980s	1990s	Minimum Total
Europe							
Netherlands	AF	0	0	1	1	0	2
Norway	AF	0	0	1	0?	?	1
Sweden	AF	?	0+	5	0	?	5+
United Kingdom	RAF	+	?	?	3	0	3+
North America							
Canada	all	0?	0	2	0	0	2
USAF	AF	?	7+[b]	4+[b]	8	1[b]	20+
USN & USMC	N,MC	?	?	2[c]	1	1	4+
Australia	all	0?	1	2	0	0	3
Totals		+	8+	17+	13	2	40+

[a] No fatalities in the 2 RAF and 2 USAF accidents attributed to bird-avoidance manoeuvres (*cf.* §4.9).
[b] Three USAF fatalities were in aircraft that were not destroyed (§4.9; Appendix).
[c] Two USN/USMC fatalities in 1969-71 (Anon. 1972); details unknown so not in Appendix.

of 1-2 per year (Appendix). These apparent patterns must be treated cautiously because of possible differences among years and countries in investigation and reporting practices.

3.2 Fatalities

Subject to the same data limitations, there were at least 8 aircrew fatalities in the 1960s and 17 in the 1970s (excluding RAF), and at least 13 in the 1980s and 2 in the 1990s to date (Table 2). The worst single accident among the ones tabulated here was the USAF B-1B lost to a pelican strike in 1987 (3 fatalities). However, the Tables exclude Royal Navy losses, for which I have not seen official data. The RN reportedly lost a Sea King helicopter in a collision with a large seabird over the South Atlantic on 19 May 1982, with 21 or 22 fatalities (Ethell and Price 1983; Brown 1989).

In some respects, one of the most noteworthy features of the records is the small proportion of the birdstrike-related crashes that were fatal. The crew ejected in a high proportion of the serious accidents, and most ejections were successful (Appendix). An analysis of the circumstances of the fatal accidents is beyond the present scope, but unsuccessful ejections were often at low altitude. Two of the aircrew lost in the B-1B accident did not have ejection seats (Greeley 1988). A gradually increasing proportion of in-service military aircraft are capable of successful ejections down to low or zero altitude and airspeed, so the success of ejections might be expected to increase. However, some pilots continue to be killed by birds penetrating windscreens, either with or without the subsequent loss of the aircraft.

This paper does not attempt to tabulate injuries. Injuries were common not only during the serious accidents discussed here but also during other birdstrike incidents when the aircraft was not lost, e.g. during windscreen penetrations. In the data available to me, records of injuries were incomplete and difficult to interpret, partly because of the widely varying severity of injuries.

I have seen no reports of ground personnel killed by birdstrike-related accidents to the military aircraft of the 10 countries and services considered here. However, three ground personnel were injured by detonating ordnance in one case (SwedAF, 77/09/01). There have been unofficial reports, of unknown accuracy, of ground fatalities and injuries during birdstrike-related accidents in at least three other countries (*Flight Int.*, 3 Dec. 1988:94; *Aviat. Safety Monitor*, Aug. 1991:6; *Air Forces Monthly*, July 1992:62).

4. CIRCUMSTANCES OF SERIOUS ACCIDENTS

4.1 Geographic Distribution

Some birdstrike-related accidents have occurred outside the borders of the operating country (Table 3). For example, almost half of the known Canadian losses to birdstrikes were in Europe, and the USAF lost three aircraft to birdstrikes on the Bardenas Range in Spain during the 1980s. Also, significant numbers of the serious GAF and RNethAF accidents were in other European countries (Table 4), as were several of the unofficially-reported RAF

TABLE 3. Geographic distribution of serious accidents (writeoffs and/or fatalities) attributed to birds, considering military aircraft of 10 countries, 1950 to date.
"x+y" shows number of accidents before 1980 (x) and from 1980 to date (y).

Country of Origin	Service(s)	Geographic Region of Accident: Own Country	in Europe	not Europe or N.Am.	Unknown	Totals
Europe						
Denmark	all	-	-	-	-	0+0
Germany	AF,N	13+2	3+4	-	-	16+6
Netherlands	AF	4+2	3+1	-	-	7+3
Norway	AF	0+1	-	-	1+1?	1+2?
Sweden	AF	9+?	-	-	-	9+?
Switzerland	AF	1+0	-	-	-	1+0
United Kingdom[a]	RAF	?+14	?+0	?+1	-	?+15
North America						
Canada	all	7+2	7+1	-	-	14+3
USAF[a]	AF	7[b]+14[b]	0+4	0+1	15[b]+1	22[b]+20[b]
USN & USMC	N,MC	5[c]+7	-	-	-	5[c]+7
Australia	all	2+0	-	1+0	-	3+0
Totals[a]		48+42	13+10	1+2	16+2	78+56

[a] Pre-1980 results biased by exclusion of UK data and unknown locations of many USAF accidents.
[b] USAF accidents include 3 cases when one pilot killed but other flew aircraft back to base.
[c] USN/MC accidents include 2 cases from 1969-71 reported as in U.S.A. but otherwise unknown.

TABLE 4. European distribution of serious accidents (writeoffs and/or fatalities) attributed to birds, considering military aircraft of 10 countries, 1950 to date.
"x+y" shows number of accidents before 1980 (x) and from 1980 to date (y).

Country of Origin	Service(s)	Country of Accident: Denmark	France	W. Germ.	Italy	Neth. erl.	Norway	Spain	Sweden	Switzer.	UK	Total
Europe												
Germany	AF,N	2+2	1+1	13+2	0+1	-	-	-	-	-	-	16+6
Netherlands	AF	-	-	3+1	-	4+2	-	-	-	-	-	7+3
Norway	AF	-	-	-	-	-	?+1	-	-	-	-	?+1
Sweden	AF	-	-	-	-	-	-	-	9+?	-	-	9+?
Switzerland	AF	-	-	-	-	-	-	-	-	1+0	-	1+0
United Kingdom[a]	RAF	-	-	-	-	-	-	-	-	-	?+14	?+14
North America												
Canada	all	1+0	3+0	3+1	-	-	-	-	-	-	-	7+1
USAF[a]	AF	-	-	-	-	-	-	?+3	-	-	?+1	?+4
Totals[a]		3+2	4+1	19+4	0+1	4+2	?+1	?+3	9+?	1+0	?+15	40+29

[a] Pre-1980 results biased by exclusion of UK data and unknown locations of many USAF accidents.

accidents before 1980. Although the Danish armed forces do not know of any losses of their own aircraft or aircrew to birdstrikes, at least one Canadian and four German aircraft have crashed in or near Denmark because of birdstrikes (Table 4, Appendix).

The distribution of serious accidents obviously depends largely on the countries and services considered, on their respective operating areas, and on the completeness of records. Consideration of data from other European countries, requiring the addition of extra lines to Table 4, would show a broader distribution of accidents within Europe. Tables 3 and 4 are both biased by the exclusion of pre-1980 RAF data, and the unknown locations of many pre-1980 USAF accidents. Changes in the distribution of accidents can be expected because of recent changes in the deployment of military forces.

4.2 Monthly Distribution

Serious birdstrike-related accidents have occurred at all times of year in both Europe and North America (Table 5). However, in Europe, serious accidents seem most common in spring (March-April) and late summer/early autumn (July-October). The few data from Canada may reflect a similar pattern, but with the spring peak delayed to May. Interpretation of the cause(s) of this pattern is beyond the present scope. Factors that may be involved include occurrence of bird migration in spring and late summer/autumn; fledging of many young, inexperienced birds in summer; and seasonal variations in flying conditions and hours.

In the U.S.A., there is less evidence of a seasonal pattern in serious birdstrike accidents. Whether this reflects small sample size or a real difference from the European/Canadian situation is uncertain. High proportions of the U.S. military flying and accidents are in southern parts of the country, where seasonal patterns may differ from those in northern Europe and Canada. However, overall USAF statistics on seasonal occurrence of birdstrikes show peaks in spring and late summer/autumn (Thompson et al. 1986; Merritt and Dogan 1992). To clarify the seasonal pattern of serious accidents in the U.S.A., it would be useful to determine the locations and months of the many USAF accidents in the 1960s and 1970s for which these data are not now available, and to obtain more complete USN/USMC records for those years.

4.3 Types of Aircraft

Most military aircraft involved in the known serious birdstrike-related accidents have been 1-engined fighter or attack aircraft (82 of 131 tabulated cases, or 63%). The 1-engined fighter-attack category dominates the reported loss statistics for each geographic region (Table 6). (However, in the U.S.A. there may have been almost as many bird-related accidents involving 2-engined trainers, assuming that most of the six "unknown region" USAF trainer accidents were in the U.S.A.) Twin-engined fighter and attack aircraft accounted for 17% of the accidents, and 1- and 2-engined trainers accounted for 6% and 11%, respectively.

In Europe and Canada, where 1-engine trainers are widely used, the trainers lost to birdstrikes were all 1-engined. In the U.S.A., where 2-engine trainers are more common, all

TABLE 5. Monthly distribution of serious accidents (writeoffs and/or fatalities) attributed to birds, by geographic region, considering military aircraft of 10 countries, 1950 to date.

Months	Geographic Region of Accident					Total
	Europe[a]	Canada	USA	Other	Unknown	
January	-	-	4	-	-	4
February	2	1	-	-	-	3
March	7	1	2	-	1	11
April	7	-	3	2	-	12
May	4	3	4	-	-	11
June	5	1	1	-	-	7
July	7	-	3	-	-	10
August	11	1	-	-	1	13
September	10	-	4	2	1	17
October	9	1	6	-	-	16
November	5	1	-	1	1	8
December	2	-	1	-	1	4
Unknown	-	-	4	-	11	15
Totals	69	9	32	5	16	131

[a] Includes CAF and USAF accidents in Europe.

TABLE 6. Types of aircraft involved in serious accidents (writeoffs and/or fatalities) attributed to birds, by geographic region, considering military aircraft of 10 countries, 1950 to date. "x+y" shows number of accidents before 1980 (x) and from 1980 to date (y).

Type of Aircraft	Geographic Region of Accident					Total
	Europe[a,b]	Canada	USA[b]	Other	Unknown	
Fighter & Attack						
1-engine	39+14	5+1	4+12	2+1	4+0	54+28
2-engine	1+8	-	3+3	1+1	4+1	9+13
Trainer						
1-engine	0+5	2+1	-	-	-	2+6
2-engine	-	-	4+5	-	6+0	10+5
Bomber & Patrol	0+1	-	0+1	-	-	0+2
Helicopter	-	-	-	-	1+0	1+0
Piston Engined	0+1	-	-	-	-	0+1
Totals	40[b]+29	7+2	11[b]+21	3+2	15+1	76+55

[a] Includes CAF and USAF accidents in Europe.
[b] Pre-1980 results for Europe and USA are biased by the exclusion of UK data and the unknown locations of many USAF accidents.

trainer accidents involved 2-engine trainers. However, this breakdown is confounded by the need for some arbitrary decisions as to aircraft categories. Two-seat versions of high-performance fighter/attack aircraft like the F-104, Jaguar and Harrier were considered to be fighter/attack aircraft. The T-38 was considered a trainer and the related F-5 a fighter.

Larger aircraft were rarely lost to birdstrikes. Within the services and years considered, there were reported losses of only one bomber (the USAF B-1B) and one other large aircraft (an RAF Nimrod MR.2 patrol aircraft). No records of accidents involving cargo or tanker aircraft were found for the services and years considered.[2] The rarity of serious birdstrike-related accidents to these classes of large aircraft is noteworthy, given that these types of aircraft hit many birds annually (e.g. Bivings and Medve 1990; Merritt and Dogan 1992).

The only piston-engined aircraft included in the Tables is a special case: an RAF Bulldog trainer that crashed when the student pilot lost control at low altitude after being told to manoeuvre around a simulated flock of birds (MoD 1988). There have been a few unofficial post-1950 reports of birdstrike-related losses of piston-powered military aircraft in countries other than those considered here.

The only helicopter accident included in the Tables is a sketchy report of a USAF helicopter pilot reportedly killed by a birdstrike in the 1960s. As noted before, unofficial accounts of RN accidents, including the RN Sea King described in §3.2, are not tabulated here.

4.4 Phases of Flight

Of the 124 accidents for which phase of flight is known, 73 or 59% happened during cruise, low-level or weapons range flight, i.e. not closely associated with an airport. Most of these cases were at low-level (≤1000 ft AGL; Table 7). In Europe and Canada, accidents during low-level flight made up a substantial proportion of the serious bird-related accidents both before 1980 and subsequently. In the U.S.A., this class of accidents has become proportionally more frequent from 1980 on, although the analysis is confounded by the unknown locations of many pre-1980 USAF accidents.

Conversely, 51 (41%) of the bird-related accidents during known phases of flight were on or near airfields during takeoff, climb, approach, or touch and go landings. Of these serious accidents, many more were during takeoff/climbout than during approach/landing or touch and go (Table 7). In this paper, aircraft are considered to be on climbout from the moment they leave the ground, and on approach until they reach the runway.

4.5 Altitudes

As might be expected from the above, 71 (67%) of 106 bird-related accidents at known altitudes involved encounters below 500 ft AGL (150 m), and 20 more (19%) were at 501-

[2] An unofficial report states that an RAF Victor K.2 tanker was damaged beyond repair as a result of a birdstrike on takeoff on 76/09/28 (Oliver 1990), before the period for which RAF data are tabulated.

TABLE 7. Phase of flight for serious accidents (writeoffs and/or fatalities) attributed to birds, by geographic region, considering military aircraft of 10 countries, 1950 to date.
"x+y" shows number of accidents before 1980 (x) and from 1980 to date (y).

Phase of Flight	Geographic Region of Accident					Total
	Europe[a,b]	Canada	USA[b]	Other	Unknown	
Aerodrome						
Takeoff	5+2	-	2+3	1+0	3+0	11+5
Climb	7+4	2+1	2+2	1+0	4+0	16+7
Approach	1+2	-	1+1	0+1	1+0	3+4
Touch & Go	0+2	1+0	0+2	-	-	1+4
Subtotal	13+10	3+1	5+8	2+1	8+0	31+20
Cruise						
Cruise—Low[c]	23+13	3+1	2+10	0+1	5+1	33+26
Cruise—High[c]	4+2	1+0	2+1	1+0	-	8+3
Cruise—Alt. ?	0+1	-	0+2	-	-	0+3
Subtotal	27+16	4+1	4+13	1+1	5+1	41+32
Unknown	0+3	-	2+0	-	2+0	4+3
Totals	40[b]+29	7+2	11[b]+21	3+2	15+1	76+55

[a,b] Footnotes as in Table 6.
[c] "Low" = ≤1,000 ft AGL or described as "low-level". "High" = >1,000 ft AGL or described as "high".

TABLE 8. Aircraft altitude and speed for serious accidents (writeoffs and/or fatalities) attributed to birds, by geographic region, considering military aircraft of 10 countries, 1950 to date.
"x+y" shows number of accidents before 1980 (x) and from 1980 to date (y).

	Geographic Region of Accident					Total
	Europe[a,b]	Canada	USA[b]	Other	Unknown	
A. Altitude (feet AGL)						
0-500	23+15	5+2	5+12	1+1	6+1	40+31
501-1000	11+1	1+0	1+3	0+1	2+0	15+5
1001-2000	2+1	1+0	2+2	2+0	2+0	9+3
2001-4000	2+1	-	-	-	-	2+1
>4000	-	-	-	-	-	-
Unknown—Low	0+5	-	0+4	-	2+0	2+9
Unknown—High	1+0	-	1+0	-	-	2+0
Unknown	1+6	-	2+0	-	3+0	6+6
Totals	40[b]+29	7+2	11[b]+21	3+2	15+1	76+55
B. Speed (knots)						
up to 200	12+7	0+1	2+6	1+0	5+0	20+14
201 - 400	4+1	1+0	4+3	1+0	4+0	14+4
401 - 600	18+8	3+1	1+10	1+1	3+0	26+20
Unknown	6+13	3+0	4+2	0+1	3+1	16+17
Totals	40[b]+29	7+2	11[b]+21	3+2	15+1	76+55

[a,b] Footnotes as in Table 6.

1000 ft (Table 8A). The highest-altitude strikes resulting in crashes were three cases at 2,500-3,500 ft AGL, and a fourth at >2,500 ft AGL—all in Europe. However, in one U.S. incident, a Sandhill Crane penetrated the windscreen of a T-38 at 9,000 ft ASL, one pilot ejected successfully, and the other landed the still-flyable aircraft (Anon. 1973).

4.6 Speeds

Reported speeds during bird/aircraft collisions that resulted in serious accidents ranged from 100 to 595 knots (185-1,100 km/h). Most accidents precipitated by collisions at speeds ≤200 knots happened during the takeoff roll or early stages of climb, and most involved either aborted takeoffs with runway overruns or ejections soon after takeoff. Cases at medium speeds (201-400 kt) occurred in many circumstances. Cases at high speeds (>400 knots) were almost all during low-level cruise or weapons-range flights (Appendix).

In Europe and Canada, high-speed low-level collisions caused major proportions of the birdstrike-related accidents both before 1980 and subsequently (Table 8). However, in the U.S.A., this type of accident became more prevalent from 1980 onward.

4.7 Parts of Aircraft Hit

The engine(s) were the most commonly-reported part(s) struck. Of 115 serious accidents in which the part struck was reported, 71 or 62% involved the engine(s), 29 (25%) the windscreen, and a further 8 (7%) both the engine(s) and windscreen (Table 9). There were only seven serious accidents in which the parts struck were reported not to include either the windscreen or engines. These cases involved strikes on the wing (4 cases), nose (1), fuselage (1), and landing gear (1). Some reports of engine ingestions or windscreen strikes mentioned that certain other parts were also struck, and the actual frequency of these multiple-strike cases is undoubtedly higher than shown in the Appendix. Even so, the high proportion of serious accidents that involve strikes on engines and windscreen is noteworthy. This is especially evident in comparison with military birdstrike statistics in general, which show lower percentages of strikes on these parts of the aircraft (e.g. Thompson et al. 1986; Merritt and Dogan 1992). The difference may reflect the greater likelihood that engine or windscreen strikes will lead to a serious accident. There may also be differences in the predominant locations of strikes on the types of military aircraft involved in most serious accidents relative to locations of strikes on all types of military aircraft combined.

4.8 Types of Birds

Considering all 10 countries, the bird groups responsible for the largest numbers of accidents were gulls (22 cases), hawks (14), vultures (13), ducks (8) and geese (4). These totals can be considered in relation to the 83 accidents caused by collisions with known types of birds or the 127 accidents caused by all birds, including the many unknowns (Table 10).

4.8.1 Europe: *Gulls* were the most serious reported problem in Europe (Table 10). Gulls accounted for 16 of 43 European accidents involving known bird types, and 16 of 67

TABLE 9. Parts of aircraft struck during serious accidents (writeoffs and/or fatalities) attributed to birds, by geographic region, considering military aircraft of 10 countries, 1950 to date. "x+y" shows number of accidents before 1980 (x) and from 1980 to date (y).

Part of Aircraft	Geographic Region of Accident					Total
	Europe[a,b]	Canada	USA[b]	Other	Unknown	
Windscreen[c]	6+4	-	4+5	1+1	8+0	19+10
Engine(s)[c]	29+14	6+2	3+13	2+0	2+0	42+29
Both of Above[c]	2+2	1+0	1+0	-	2+0	6+2
Other Parts Only	0+3	-	1+2	-	1+0	2+5
Unknown, Multiple	-	-	-	-	1+0	1+0
Unknown	3+4	-	2+1	-	1+0	6+5
None (avoided)	0+2	-	-	0+1	0+1	0+4
Totals	40[b]+29	7+2	11[b]+21	3+2	15+1	76+55

[a,b] Footnotes as in Table 6.
[c] Some cases involved multiple strikes including parts additional to windscreen and/or engines.

TABLE 10. Types of birds struck during serious accidents (writeoffs and/or fatalities) attributed to birds, by geographic region, considering military aircraft of 10 countries, 1950 to date. "x+y" shows number of accidents before 1980 (x) and from 1980 to date (y).

Type of Bird	Geographic Region of Accident					Total
	Europe[a,b]	Canada	USA[b]	Other	Unknown	
Seabird	-	-	-	0+1	-	0+1
Pelican	-	-	0+2	1+0	-	1+2
Heron	0+1	-	-	-	-	0+1
Crane	0+1	-	1+0	-	-	1+1
Goose	1+0	1+0	1+1	-	-	3+1
Duck	4+1	2+0	-	-	1+0	7+1
Wader/Shorebird	0+1	-	0+1	-	-	0+2
Gull	10+6	-	1+1	-	4+0	15+7
Hawk/Buzzard	4+5	1+0	0+3	-	1+0	6+8
Falcon	1+0	-	-	-	-	1+0
Eagle	-	-	-	-	1+0	1+0
Vulture	0+2	-	2+7	-	2+0	4+9
Pigeon/Dove	2+1	-	-	-	-	2+1
Corvid	2+0	-	-	-	-	2+0
Starling	1+0	-	1+1	-	-	2+1
Other landbird (small)	-	-	1+2	-	-	1+2
Unknown	15+9	3+2	4+3	2+0	6+0	30+14
None (avoided)	0+2	-	-	0+1	0+1	0+4
Totals	40[b]+29	7+2	11[b]+21	3+2	15+1	76+55

[a,b] Footnotes as in Table 6.

accidents overall (37% and 24%). The next most common groups were *buzzards and other hawks* (9 accidents; 21% and 13%), *ducks* (5 accidents), and *pigeons* (3 accidents).

4.8.2 U.S.A.: The main problem group in the U.S.A. was *vultures*, which accounted for 9 of 25 within-U.S.A. accidents involving known types of birds, and 9 of 32 cases overall (36% and 28%). In addition, two USAF accidents in Europe and two more in unknown regions involved vultures. At least one of the latter was very likely in the U.S.A.[3] A further concern is that the frequency of serious accidents attributable to vultures has been higher in recent years than it was before 1980 (Table 10). Available data suggest that 10 of the 13 known vulture-caused accidents to U.S. military aircraft, and all nine of those since 1980, were during cruise or weapons range flights at altitudes ≤2,000 ft AGL. The increased frequency of accidents attributed to vultures is presumably partly related to the increased proportion of U.S. military flying that has been at low-level in recent years.

In the U.S.A., *gulls* accounted for only 2 of 25 military accidents involving known types of birds (Table 10). Even allowing for the near certainty that 1-2 of 3 USAF accidents classed as "Unknown region/Gull" were in the U.S.A., gulls were of no more than secondary importance. Other types of birds responsible for two or more serious accidents in the U.S.A. included Starlings and other small landbirds (5 accidents), hawks (3), pelicans (2) and geese (2).

4.9 Special Cases

4.9.1 Crashes While Manoeuvring to Avoid Birds: Of the 131 accidents listed in the Appendix, two RAF and two USAF accidents involved aircraft that crashed as a result of manoeuvres to avoid colliding with actual (n=3) or simulated (n=1) birds. These accidents resulted from concern about birdstrikes, so this paper treats them as serious bird-related accidents. However, they may not be listed in official records as being directly caused by birds. The following information supplements data given in the Appendix: ***(1)*** An RAF Jet Provost, upon encountering a flock of birds just after takeoff on 84/08/15, landed hard on the remaining runway and was damaged beyond economical repair (MoD in *Flight Int.*, 6 July 1985:14). ***(2)*** The unusual RAF Bulldog accident on 86/09/29 was described in §4.3 (see MoD 1988). ***(3)*** A low-flying USAF A-10A struck wires, reportedly while manoeuvring to avoid birds, flew on for many kilometres, but became uncontrollable due to wirestrike damage (DeFusco and Turner 1986; M. Thompson, pers. comm.). ***(4)*** In 1990, a USAF OA-37B on approach went out of control while avoiding birds, possibly vultures, and crashed.

4.9.2 Windscreen Penetrations With Fatality or Ejection; Aircraft Not Destroyed: Five 2-seat USAF aircraft are known to have returned to base successfully after a windscreen penetration resulted in either the death (n=3) or ejection (n=2) of one pilot (Appendix). The three fatal cases are included as serious accidents in the preceding tabulations and are not further discussed. The two ejections are not counted as serious accidents. Of these, one case involved a Black Vulture struck during low-level high-speed cruise, and the other invol-

[3] A Turkey Vulture (New World species) penetrated the cockpit of a USAF trainer, killing one crewman.

ved a Sandhill Crane struck at high altitude (9,000 ft ASL; see §4.5). At least one other case of this type, outside the scope of this paper, involved a Royal Navy Buccaneer, from which one crewman ejected after a collision with geese in 1970 (Bourne 1991 and pers. comm.).

5. CONCLUSIONS

Despite frequent restrictions on release of military accident data, rather comprehensive data on serious bird-related accidents can be compiled for many countries. This paper provides a preliminary list for 10 countries, and summarizes some aspects of the circumstances of these accidents. It is obvious that the birdstrike problem remains a serious one for military aviation. However, the analysis is limited by data gaps and uncertainties for many known accidents, and difficulties in accessing data for some years and countries. This preliminary summary has not exhausted the possibilities for compiling data from the 10 countries already considered. Also, useful data from some additional countries can also be compiled. When this is done, a more comprehensive analysis, potentially subject to fewer biases, will be possible. **Agencies and individuals who can fill gaps or make corrections in the Appendix, or who can provide access to publicly-releasable records of additional accidents in these or other countries and years, are encouraged to contact the author or to publish the data.**

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APPENDIX. Some serious military aircraft accidents attributable to birds.
For explanatory notes, see last page of Appendix. Blanks denote "unknown".

No.	Accid.	Flight	Type	Altitude	Parts

APPENDIX. Some serious military aircraft accidents attributable to birds.
For explanatory notes, see last page of Appendix. Blanks denote "unknown".

Date (Y M D)	Location Where Struck		Aircraft Type/Subtype		No. Engines	Accid. Category	# Aircrew T.	E.	K.	Flight Phase/ Time		Type of Bird	Altitude AGL (feet)	Speed (knots)	Parts Struck W/E/O
Australian Defence Force (all cases are RAAF; 1962 to July 1994)															
620911	Malaysia	Butterworth	F-86	Avon	1	wo	1	1	1	TO	D	unkn. bird	TO	200	F
720427	Aust/NT	Darwin	Mir.III	OA	1	wo	1	1	0	Cl	D	unkn. bird	1500	350	F
770930	Aust/NS	Evans Head Ra.	F-111	C	2	wo	2	2	2	CrH	D	Pelicans, Aus.?	2000	465	P M
Canadian Armed Forces (RCAF/CAF; 1964 to July 1994)															
641027	France	Troyes	CF-104		1	wo	1	1	0	CrH	D	corvid?	2000	200	F
650916	W.Germ.	Zweibrucken	CF-104		1	wo	1	1	0	Ap	D	unkn. bird	3000	300	F
650916	France	Boen~	CF-104	D	1	wo	2	2	0	CrL	D	unkn. bird	7-1000	410	F
660321	W.Germ.	Eschau	CF-104		1	wo	1	1	0	CrL	D	unkn. bird	1000	410	F
661012	Can/Alb.	Cold L	CF-104		1	wo	1	1	0	CrH	D	Goose, Snow	2000	420	F
670330	Can/Alb.	Cold L	CF-104		1	wo	1	1	0	Cl	D?	unkn. bird	<500	400	F
670718	Denmark	Kattegat	CF-104		1	wo	1	1	0	CrL	D	gull?	300	420	F
681115	Can/Sas.	Unity	CF-104		1	wo	1	1	0	CrL	D	ducks	250	420	S F
690425	France	Niefern	CF-104		1	wo	1	1	0	CrL	D	large	800	420	P
690819	Can/Alb?	Cold L	CF-104		1	wo	1	1	0	CrL	D	hawk?	150	580	F F
740527	Can/Alb.	Cold L	CF-104		1	wo	1	1	0	CrL	D	large?	100		F
760511	Can/Sas.	Moose Jaw	Tutor		1	wo	2	2	0	TG	D	unkn. bird	<500		F
760531	Can/Sas.	Regina	Tutor		1	wo	2	2	2	Cl	D	Duck, Mallard	6-800		F
780818	W.Germ.	Oberthal	CF-104		1	wo	1	1	0	CrL	D	unkn. bird	800	420	F
800624	Can/Alb.	Cold L~	CF-104	D	1	wo	2	2	0	CrL	D	unkn. bird	250	530	F
810316	W.Germ.	Leipheim~	CF-104	D	1	wo	2	2	0	CrL	D	buzzard	500	510	F
910226	Can/Sas.	Moose Jaw	Tutor		1	wo	2	2	0	Cl	D	unkn. bird	100	150	F
Germany/West (GAF, incl. Navy; 1962 to July 1994)															
620411	W.Germ.	Augsburg-NW	F-84		1	wo			0	CrL		buzzard	500	<450	P
640805	W.Germ.	Furstenfeldbruck	G-91		1	wo			0	Cl		pigeons	100	160	F

APPENDIX. Some serious military aircraft accidents attributable to birds (cont'd).
For explanatory notes, see last page of Appendix. Blanks denote "unknown".

Date (Y M D)	Location Where Struck		Aircraft Type/Subtype		No. Engines	Accid. Category	# Aircrew T.	E.	K.	Flight Phase/ Time		Type of Bird	Altitude AGL (feet)	Speed (knots)	Parts Struck W/E/O
670428	W.Germ.	Bad Neinberg	F-104		1	wo			0	CrL		duck	1000	200	F
670516	W.Germ.	Elbe estuary	F-104		1	wo			0	CrL		gulls	500	450	P
691130	W.Germ.	Schwabish Hall	F-104		1	wo			0	CrL		duck?	800	450	F
710907	W.Germ.	Elderstedt Pen.	G-91		1	wo			0	CrH		gulls	1200	<450	P
720801	W.Germ.	Bremen-N	G-91		1	wo			0	CrL		buzzard	500	360	F
760315	W.Germ.	Elderstedt Pen.	F-104		1	wo			0	CrL		Goose, Barnacle	800	420	F
760809	W.Germ.	Brake/Weser	G-91		1	wo			0	CrL		buzzard	500	360	F
770419	Denmark	Moen	F-104		1	wo			0	CrL		gulls	300	450	P F
771007	W.Germ.	Bad Schwalbach	TF-104		1	wo			0	CrL		pigeons	800	450	F
780818	W.Germ.	Heligoland	F-104		1	wo			0	CrL		gulls	500	400	F
780919	Denmark	Anholt	F-104		1	wo			0	CrL		gull	200	450	F
781010	France	Nancy-W	F-104		1	wo			0	CrL		crows	800	420	F
781207	W.Germ.	Schleswig	F-104		1	wo			0	CrL		ducks	800	480	F
790417	W.Germ.	Eiderstedt Pen.	F-104		1	wo			0	CrL		Shelduck	800	440	F
810706	W.Germ.	Niederstetten	F-104		1	wo			0	CrL		buzzard	600	450	F
810817	France	Ollieres	F-104		1	wo			0	CrL		buzzard?	500	450	F
810826	Denmark	Oksbol Range	F-104		1	wo			0	CrL		gulls	150	500	F
820421	Italy	Frasca Ra./Sard.	F-104		1	wo			0	CrL		unkn. bird	low	450	F
820804	W.Germ.	Hohenfels Range	F-104		1	wo			0	CrL		unkn. bird	low	400	F
850208	Denmark	Bornholm	F-104		1	wo			0	CrL		gull	350	450	F
Netherlands (RNethAF; 1956 to July 1994)															
590220	Nether.	Soesterberg	Hunter	Mk.6	1	wo	1	1	0	Cl?		unkn. bird	<8000		F
590915	W.Germ.	Gronau	Hunter	Mk.6	1	wo	1	1	0	CrH	N	unkn. bird	2500		F
600707	Nether.	Leeuwarden	Hunter	Mk.4	1	wo	1	0	0	TO	N	gulls	0		F
610620	Nether.	Eindhoven	F-84	F	1	wo	1	0	0	TO		unkn. bird	0		
640729	Nether.	Soest.>Leeuw.	Hunter	Mk.6	1	wo	1	0	0	Cl		unkn. bird	low		I
750711	W.Germ.	Wiesbaden	NF-5	A	2	wo	1	1	1	TO		Kestrel	0		I

APPENDIX. Some serious military aircraft accidents attributable to birds (cont'd).
For explanatory notes, see last page of Appendix. Blanks denote "unknown".

APPENDIX. Some serious military aircraft accidents attributable to birds (cont'd).
For explanatory notes, see last page of Appendix. Blanks denote "unknown".

Date (Y M D)	Location Where Struck		Aircraft Type/Subtype		No. Engines	Accid. Category	# Aircrew T.	E.	K.	Flight Phase/ Time		Type of Bird	Altitude AGL (feet)	Speed (knots)	Parts Struck W/E/O
790301	W.Germ.	Steinfeld	F-104		1	wo	1	1	0	CrH		buzzard?	>2500		F
811201	W.Germ.	Jever	F-104	G	1	wo	1	0	0	CrL		Duck, Elder	4-500		
831004	Nether.	Leeuwarden	F-16	A	1	wo	1	0	1	TO		Heron, Grey	0		F
900504	Nether.	Eindhoven	NF-5	A	2	dbr	1	1	0	TG		pigeon	low		I
Norway (RNorAF; may be incomplete)															
7108	Norway?		F-5		2	wo	1	0	1	CrL		Gull, Les.Bl-b.	low	3-400	P
810602	Norway	southern	F-16		1	wo	1	1	0			Crane	low		P
Swedish Air Force (1967 to 1988)															
670627	Sweden	Ronneby	Lansen	A	1	wo	2	0	0	Cl		gull	20	TO	F
690313	Sweden	Skagerrak	Lansen	A	1	wo	2	2	0	CrL		large	100	430	F
700531	Sweden	Soderhamn	Lansen	A	1	wo	2	2	2	Cl		Starlings	35	175	F
730416	Sweden	G. Bothnia	Draken	S	1	wo	1		1	CrL		unkn. bird	165	595	
731017	Sweden	Norrkoping	Draken	J	1	wo	1	0	0	TO		gulls	0	165	S
741005	Sweden	S Baltic Sea	Lansen	A	1	wo	1	1	1	CrL		unkn. bird	165	430	F
760830	Sweden	Nykoping	Lansen	S	1	wo	2	2	0	Cl		unkn. bird	TO	160	F
770321	Sweden	Skagerrak	Viggen	AJ	1	wo	1	0	1	CrL		bird (prob.)	~85	595	S
770901	Sweden	Karlsborg	Lansen	A	1	wo	1	0	0	TO		small	0	110	
Swiss Air Force (only reported case)															
741023	Switz.	Payerne AFB	Mir.III	S	1	wo	1	1	0	Cl	D	Gulls, Bl.-hd.	50	190	S F
United Kingdom (RAF only; 1980 to 1993)															
800312	UK	Lampeter, Wales	Harrier	GR.3	1	wo	1	1	0	CrL	D	buzzard	low		S F
800731*	UK	Elvington	Jet Pro	T.3A	1	wo	1	1	0	TO		unkn. bird	TO		
801117	UK	Kinloss, Scotl.	Nimrod	MR.2	4	wo	20	na	2	Cl	T	gulls (2 spp.)	20		F M

APPENDIX. Some serious military aircraft accidents attributable to birds (cont'd).

For explanatory notes, see last page of Appendix. Blanks denote "unknown".

Date (Y M D)	Location Where Struck		Aircraft Type/Subtype		No. Eng ines	Accid. Cat- egory	# Aircrew T.	E.	K.	Flight Phase/ Time		Type of Bird	Altitude AGL (feet)	Speed (knots)	Parts Struck W/E/O
81[0601*]	UK ?	Forfar, Scotl.?	Jaguar	T.2	2	wo	2	2	0			Gull, Bl.-hd.			P F M
81[0724*]	UK ?	off Devon? / ETPS	Jaguar	T.2	2	wo	2	2	1			unkn. bird			
821020*	UK	Chivenor	Hawk	T.1	1	wo	1	1	0	Ap	N	unkn. bird	low		
830919	UK	Lossiemouth	Jaguar	GR.1	2	wo	1	1	0	Ap		unkn. birds	100		F M
831121*	UK	Yorkshire	Jet Pro	T.3A	1	wo	2	2	0	Cr?		unkn. bird			
840815	UK	Cranwell	Jet Pro	T.3A	1	dbr	2	0	0	Cl		AVOIDING BIRD	25	low	- - -
841107	UK	Mona, Wales	Hawk	T.1	1	wo	2	2	0	TG		Lapwings	v.low		F
841129	S. Atlan.	Stanley, Falkl.	Harrier	GR.3	1	wo	1	1	0	CrL	D	seabird, large	250	480	S F
860929	UK	Thirsk~, Yorks.	Bulldog	T.1	1 p.	wo	2	na	0	Cl		AVOID "BIRDS"	~250		- - -
890914	UK	Abingdon	Tornado	GR.1	2	wo	2	2	0	Cl		unkn. birds	TO		F
910925	UK	Humberside	Harrier	T.4A	1	wo	2	2	0	CrL		Gull, Bl.-hd.	low		P
930628	UK	Heckingt., Lincs	Harrier	GR.7	1	wo	1	1	0	CrL		bird (prob.)			
U.S. Air Force (incl. Air Nat. Guard; 1962 to July 1994; probably incomplete before 1974)															
621010*	USA/MA	Westover AFB	F-102		1	wo?						Starlings			
641031	USA/TX	Houston	T-38	A	2	wo	1	1	1	Ap		Goose, Snow	1500	280	P F
66	USA ?		T-38 ?		2	wo	2?	0	0	TO		unkn. bird	0		F
66	USA ?		F-100		1	wo		0	0	TO		gull	0		L
66	USA ?		T-38		2	wo	2	2	0	Cl		Gulls, Ring-bil.	1500	350	P F
6610	USA/TX	Reese AFB	T-37		2	1K/RTB	2	0	1	CrH	T	Crane, Sandhill	1200	240	P
67	USA ?		T-38		2	wo	1	0	1	Ap		unkn. bird		280	P
6709*	USA ?		F-100		1	wo			1			hawk			
68	USA ?		F-100		1	wo	1	0?	1	CrL		unkn. bird	1000	450	P
68	USA ?		F-100		1	wo	2	2	0	CrL		Eagle, Golden	350	475	P
69	USA ?		T-37	B	2	wo	1	0	1	Cl		vulture	1200	195	P
6_?*	USA ?		helic			wo?		na	1			unkn. bird			P
70	USA ?		T-37	B	2	1K/RTB	2	0	1	Cl		Vulture, Turkey	2000	195	P
70	USA ?		T-38	A	2	wo	2	2	0	Cl	T	small	500	270	S F N

APPENDIX. Some serious military aircraft accidents attributable to birds.(cont'd).
For explanatory notes, see last page of Appendix. Blanks denote "unknown".

APPENDIX. Some serious military aircraft accidents attributable to birds.(cont'd).
For explanatory notes, see last page of Appendix. Blanks denote "unknown".

Date (Y M D)	Location Where Struck		Aircraft Type/Subtype		No. Engines	Accid. Category	# Aircrew T.	E.	K.	Flight Phase/ Time		Type of Bird	Altitude AGL (feet)	Speed (knots)	Parts Struck W/E/O
71	USA ?		RF-4	C	2	1E/RTB	2	1	0	CrL		Vulture, Black	500	480	P
71	USA ?		F-101	B	2	wo	2	0	2	TO		small	0	100	I
71	USA ?		F-111		2	wo	2	2	0	CrL	D	Vulture, Turkey	500	492	P
72	USA ?		T-38	A	2	1E/RTB	2	1	0	CrH		Crane, Sandhill	[9000]	300	P I
73(early)	USA/UT	Zion Nat. Pk.	F-111	A	2	wo	2	2	0	CrL		Swift, Wh. thr.	300	400	P
740114	USA/TX	Randolph AFB	T-38	A	2	wo			1+	Cl		unkn. bird	600	270	S
740506	USA/TX	Randolph AFB	T-38	A	2	wo			0?	TO		unkn. bird	0		I
750305	Europe?		F-111	E	2	wo	2?		0?	CrL		gulls	1000		? ? M
751105	Europe?		F-111	E	2	wo	2?		0?	CrL		duck	400	480	S
790727	USA/AZ	Davis-Monthan~	A-10	A	2	wo	1	1	0	CrH		unkn. bird	1100		
801113	Spain	Bardenas Range	F-4	E	2	wo	2	1+	1	CrH	D	hawk	3500	450	P
810908	USA/OH	Cleveland Lakef.	T-38	A	2	wo	2	2	1	Cl		Gulls, Ring-bil.	50		F
820511	USA/UT	Great Salt L.	F-16	A	1	wo	1	1	0	CrH	D	Pelican, White	2000	400	F N
840809	UK	Tain Ra./L. Eye	F-111	E	2	wo	2	2	0	CrL	D	Gull, Herring	200	530	N
850402	USA/TX	Sheppard AFB	T-38	A	2	wo	2	2	0	Cl		unkn. bird	500	240	I
8512 ~	USA ?		A-10	A	2	wo	1	1	0	CrL		AVOIDING BIRD	low		- - -
861008	Spain	Bardenas Range	F-16	A	1	wo	1	1	0	CrL	D	Vulture, Grif.	low		F
861020	USA/GA	VR-106 ll rt.	F-4	E	2	wo	2	2	1	CrL	D	Vulture, Black	low	490	F
870520	Spain	Bardenas-Reales	F-4	E	2	wo	2	0	2	CrH	D	Vulture, Grif.	2000		P
870928	USA/CO	La Junta	B-1	B	4	wo	6	3	3	CrL	D	Pelican, White	600	560	I
890104	USA/FL	Okeech./Avon Ra.	F-16	A	1	wo	1	1	0	CrL		Vulture, Turkey	640	510	P
890105	USA/SC	Shaw AFB	F-16	C	1	wo	1	0	0	TO	D	Starlings	0	145	F
9004	Panama	Howard AFB	OA-37	B	2	wo	1	1	0	Ap		AVOIDING BIRD	1000		- - -
910418	USA/AS	Ft. Smith	F-16	A	1	wo	1	1	0	CrL	D	Vulture, Turkey	300	550	F
920903	USA/TX	Abilene-N	T-38	A	2	1K/RTB	2	0	1	CrL	D	Vulture, Turkey	500	400	P
920918?	USA/MN	Duluth	F-16		1	wo	1	1	0	TO	D	Plovers, Golden	0	TO	F
921217	USA/TX	Dixie Ra.	F-16	A	1	wo	1	1	0	Cr_		Hawk, Red-t.?		500	F
930617	USA/TX	Dallas NAS	T-38	A	2	wo	2	2	0	TO		Swallows, Cliff	low		F

APPENDIX. Some serious military aircraft accidents attributable to birds,(cont'd).
For explanatory notes, see last page of Appendix. Blanks denote "unknown".

Date (Y M D)	Location Where Struck		Aircraft Type/Subtype		No. Eng ines	Accid. Cat- egory	# Aircrew T.	E.	K.	Flight Phase/ Time		Type of Bird	Altitude AGL (feet)	Speed (knots)	Parts Struck W/E/O
930706	USA/TX	Reese AFB	T-38	A	2	wo	2	2	0	TG		Lark, Horned	low		F
9407 *	USA/TX	Eagle Pass	F-16		1	wo	2	2	0	Cr_		Vulture, Turkey	low		
U.S. Navy & Marine Corps (1980 to July 1994; incomplete before 1980)															
70~	USA	southeast	A-7	B	1	wo	1	1	0	Cl	D	vulture?	300		F N
70~	USA	southeast	A-4	B	1	wo	1	1	0	TO		gulls	0	150	F
750327*	USA/SC	Beaufort	Harrier	AV-8A	1	wo	1	1	0			unkn. bird			
801031	USA/NC	Dare Range	A-4	M	1	wo	1	0?	1	CrL	D?	unkn. bird	500	450	
840505	USA/FL	Cecil NAS	A-4	E	1	wo	1	1	0	Ap		unkn. bird	1500		P
860117	USA/AZ	Yuma	Harrier	AV-8B	1	wo	1	1	0	CrL	D	Hawk, Red-tail.	200	480	P
900421	USA/SC	Beaufort	Harrier	TAV-8	1	wo	2	2	0	CrL	D	vulture	low	480	F
920528	USA/FL	Gainesville	F-18	A	2	wo	1	1	1	CrL	D	Vulture, Turkey	200	475	P
931015	USA/NC	Raleigh	Harrier	AV-8B	1	wo	1	1	0	CrL	D?	Hawk, Red-t.?	1000	420	F
940308	USA/NC	Bogue	EA-6B		2	wo	3	3	0	TG		Goose, Canada	low	low	F

* Unofficial report of uncertain accuracy.
Accident Categories: wo = aircraft written off (destroyed); dbr = damaged beyond (economical) repair;
1K/RTB = 1 of aircrew Killed but aircraft returned to base; 1E/RTB = 1 Ejected but aircraft returned to base.
Aircrew: Number of aircrew aboard, T = in Total; E = who Ejected; K = who were Killed.
Flight Phase: TO = takeoff; Cl = Climb; CrL = Cruise at low-level (up to 1000 ft AGL); CrH = Cruise at high altitude (above 1000 ft AGL); Ap = Approach; TG = Touch and Go landing.
Time: D = Day; N = Night; T = Twilight.
Parts Struck: W = Windscreen; E = Engine(s); O = Other.
W = Windscreen: - = not struck; S = struck, not reported as penetrated; P = penetrated.
E = Engine(s): - = no ingestion; I = ingestion, damage limited or uncertain; F = engine failure after ingestion.
O = Other parts reported struck: M = Multiple; F = Fuselage; L = Landing gear; N = Nose or radome; W = Wing(s).

TWENTY-TH
1972-1994

Yossi Leshem
Society for the
Har Gilo, Doar

ABSTRACT

As a re
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