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# SERIOUS BIRDSTRIKE-RELATED ACCIDENTS TO MILITARY AIRCRAFT OF EUROPE AND ISRAEL: LIST AND ANALYSIS OF CIRCUMSTANCES

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## ABSTRACT

This paper lists and summarizes the circumstances of 168 accidents in which military aircraft were destroyed or damaged beyond repair as a result of encounters with birds. At least 34 aircrew and 3 civilians on the ground were killed in these accidents. The analysis includes data from 21 countries: 14 in western and central Europe, 4 in eastern Europe, Israel, and Canadian and U.S. forces in Europe. Data were available for 15-46 years within the 1950-95 period, depending on the country. This paper excludes additional known accidents and fatalities in countries for which only fragmentary data were available. Of the 168 accidents considered, 45 were in the U.K. and Ireland, 18 in Scandinavia, 57 in western and central Europe, 11 in southern Europe (no data for Spanish forces), 21 in eastern Europe (data very incomplete), and 7 in Israel. At least nine European military aircraft were lost to birdstrikes outside Europe and Israel. Most aircraft lost were jet fighter and attack aircraft (88 before 1980; 55 from 1980 to date), single-engined trainers (12), or twin-engined bombers (7). Two 4-engine aircraft, a Victor tanker and Nimrod patrol aircraft, were lost in the U.K. The largest numbers of accidents (45 before 1980; 33 more recent) were during low-level (≤1000 feet AGL) cruise flight, mainly at high speeds. The second most common category involved aircraft at or near aerodromes (34 before 1980; 24 more recent), mainly at low altitude and low speed. Most losses involved engine ingestions and/or windscreen penetrations. Gulls, followed distantly by buzzards (hawks), ducks, pigeons and corvids, were the birds most commonly identified as being responsible for the accidents, with some notable regional differences. Additional accident data from other years and other countries are sought to provide a basis for a more comprehensive and representative list and analysis at a future date.

**Key Words:** Statistics, Military Aviation, Aircraft (type), Mishap Investigation

## 1. INTRODUCTION

Many military aircraft have crashed because of birdstrikes, and many aircrew have been killed. Buurma (1984) estimated that, in the early 1980s, West European military forces may have lost up to 10 jet fighters per year due to birdstrikes. Until recently there had been little attempt to report compiled multinational information about total numbers and circumstances of these accidents. At the 1994 BSCE meeting, I presented a preliminary list of 131 accidents in which military aircraft of 10 countries were destroyed and/or aircrew were killed (Richardson 1994). That list included at least partial data from seven European countries. It listed 69 serious bird-related accidents in Europe, plus 32 in the U.S.A., 9 in Canada, 5 elsewhere, and 16 at unknown locations.

Many more data on European birdstrike accidents have been compiled since 1994. Most of this information was provided by persons who attended the 1994 BSCE meeting, by various military flight safety offices, and (for the U.K.) by other compilers of military accident data. I thank all the individuals and agencies listed below under ACKNOWLEDGEMENTS and APPENDIX 1—Data Sources, without whose help this paper would have been impossible.

This paper includes 15-46 years' data from all major western and central European air forces except Spain. For some countries, data are also available from the navy and army air arms. In addition, some accident data are now available from four eastern European air forces: Hungary and the former East Germany, Czechoslovakia, and USSR (USSR data very incomplete). Also included are recently-released accident data from Israel plus Canadian and U.S. losses in Europe. Overall, these data include 152 military aircraft lost in Europe, 7 in Israel, 9 European aircraft lost outside the region, and at least 37 fatalities (see APPENDIX 2).

An analysis of the circumstances of serious accidents caused by birds is relevant in identifying the most hazardous situations. Analyses of serious accidents should use data from as many years and countries as possible to provide an adequate statistical basis. However, many factors vary among countries, and operations and equipment change across years. "Pooled" data must, therefore, be interpreted cautiously.

**It is hoped that this paper will stimulate release of information about other bird-related accidents in Europe and elsewhere, and about the circumstances of incompletely-documented cases listed in APPENDIX 2.**

## 2. DATA SOURCES AND PROCEDURES

This paper considers accidents from 1950 to date. It is based largely on accident data received from or corroborated by the flight safety offices of the countries concerned (APPENDIX 1). However, for most countries data are lacking or incomplete up to 1955-80, depending on the country (Table 1). In all cases, one must allow for the inevitable incompleteness of records, and for large differences in investigation and reporting standards among countries and years. For some countries with large air forces, the only known bird-related accidents are recent, suggesting that earlier records may be incomplete. For the former USSR, 10 known accidents are included, but these undoubtedly are only a small minority of the actual number.

"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 (164 accidents) or while attempting

to avoid birds (4 accidents), or ▸ there were human fatalities. In Europe and Israel, all known fatalities from birdstrikes also involved loss of the aircraft.

This paper includes known cases of aircraft "damaged beyond repair" (dbr) but not totally destroyed. For most countries, most or all listed accidents involved unequivocal destruction of the aircraft. However, for the U.K., especially before 1980, there are many known "dbr" cases (see APPENDIX 2). These aircraft were retired from military flying after being damaged by birdstrikes. Nowadays, aircraft with similar damage would often be repaired, given the higher costs and longer lifetimes of modern military aircraft. The "aircraft losses to birdstrike" data in Tables 1-10 do not distinguish "dbr" aircraft from aircraft totally destroyed. There probably were additional "dbr" birdstrikes in countries for which records of such occurrences are less readily traceable than in the U.K.

APPENDIX 1 documents, by country of aircraft ownership, the sources used to compile the accident data that are listed in APPENDIX 2 and analyzed below.

## 3. FREQUENCY OF SERIOUS ACCIDENTS

### 3.1 Aircraft Losses

At least partial data were available from 6 countries in the 1950s and 16 in the 1960s. Well over 19 military aircraft were lost to birdstrikes in Europe in the 1950s, and well over 33 in the 1960s (Table 1). For the 1970s and thereafter, data were available from 20-21 countries. Military aircraft losses for Europe and Israel were 49+ in the 1970s, 48+ in the 1980s, and 18+ in the 1990s to date (Table 1). It is emphasized that data are incomplete for some countries, especially for the earlier years. Also, official data on losses of aircraft from Spain are lacking, and data are lacking or incomplete for most eastern European countries.

Loss rates (aircraft/year) seem to have declined in recent years for some countries: Germany, Sweden, U.K. and Canadian Forces in Europe. Factors responsible are outside the scope of this review, but include changes in fleet sizes, flying hours, and aircraft types (e.g. retirement of F-104 in Germany and Canada). These apparent patterns must be treated cautiously because of differences among years and countries in investigation and reporting practices.

### 3.2 Fatalities

Subject to the same data limitations, there were at least 37 fatalities: at least 2 in the 1950s, 6+ in the 1960s, 12+ in the 1970s, 12+ in the 1980s (including three civilians on the ground), 4+ in the 1990s to date, and 1 in an unknown decade (Table 2). The worst known bird-related accidents for Europe and Israel since 1950 involved a Belgian F-104 lost in Germany in 1980, probably due to a birdstrike, with 3 civilian fatalities; and an East German Mi-8 helicopter lost to a bird ingestion in 1975 (3F). This excludes the Royal Navy Sea King helicopter lost on 19 May 1982 near the Falklands (21 or 22F), for which the cause is officially listed as "not positively determined" (Cdr R.P. Seymour, RN FSAIC, pers. comm., Jan 1996). There were at least 6 European and Israeli accidents with two aircrew fatalities and 19+ with one fatality. Overall, there were at least 27 accidents with 1-3 fatalities and 126 accidents with no fatalities. In the other 15 cases (14 pre-1980) I do not know whether there were fatalities.

TABLE 1. Minimum numbers of military aircraft of Europe and Israel lost to birds, 1950 to date[a]. Includes 9 European aircraft lost outside Europe and Israel (see [c], [g], [m]), plus 8 Canadian and 7 U.S. aircraft lost in Europe. Includes aircraft destroyed and damaged beyond economical repair.

| Country of Origin | Serv-ice(s) | Years with Data | Number of Aircraft Lost by Decade | | | | | Minimum Totals |
|---|---|---|---|---|---|---|---|---|
| | | | 1950s | 1960s | 1970s | 1980s | 1990s | |
| **Western European Forces** | | | | | | | | |
| Austria | AF | 57[b]-95 | 0 | 0 | 0 | 0 | 0 | 0 |
| Belgium | AF | 60-95 | ? | 0 | 1 | 3 | 0 | 4 |
| Denmark | all | 50-95 | 0 | 0 | 0 | 0 | 0 | 0 |
| Finland | AF | 81-95 | ? | ? | ? | 0 | 0 | 0 |
| France | AF | 75-Jan96 | ? | ? | 0+ | 0 | 5[c] | 5 |
| | Navy | 60-Jan96 | ? | 0 | 0 | 0 | 2 | 2 |
| Germany (W) | AF | 62-95 | ? | 4+ | 6 | 4 | 0 | 14 |
| | Navy | 62-95 | ? | 1+ | 6 | 2 | 0 | 9 |
| Greece | AF | 65-94 | ? | 0+ | 1 | 0 | 1 | 2 |
| Italy | AF | 61-94 | ? | 0+ | 0 | 2 | 1 | 3 |
| Netherlands | all | 56-95 | 2+ | 3 | 2 | 2 | 1 | 10 |
| Norway | AF | 56-95 | 0+ | 0 | 1 | 1[d] | 1 | 3 |
| Portugal | AF | 75-95 | ? | ? | 0+ | 1 | 1 | 2 |
| Sweden | AF | 65-95 | ? | 2+[e] | 7 | 0 | 0 | 9 |
| Switzerland | AF | ≤74-95 | ? | ? | 1+ | 0 | 1 | 2 |
| United Kingdom | RAF[f] | 50-94 | 14[c] | 10[c] | 11 | 13[g] | 2 | 50[f] |
| | RNavy | 58-95 | 2+[g] | 1 | 0 | 3+[h] | 0 | 6 |
| | Army | 64-95 | ? | ?[i] | 0 | 1 | 1 | 2 |
| **Subtotal** | | | **18** | **21** | **36** | **32** | **16** | **123** |
| **Eastern European Forces** | | | | | | | | |
| Czech.+Slov. Rep. | AF | Incomplete[j] | ? | 1+ | 0+ | 1+ | 0+ | 2+ |
| East Germany | AF | 67-88 | ? | 2+[k] | 5 | 3 | -[l] | 10 |
| Hungary | AF | 60-95 | ? | 0 | 0 | 1 | 0 | 1 |
| former USSR | AF | Incomplete[j] | 1 | 3 | 1 | 3 | 1 | 10+[m] |
| **Subtotal[j]** | | | **1** | **6** | **6** | **8** | **1** | **23+[m]** |
| **Other Forces** | | | | | | | | |
| Israel | AF | 72-95 | ? | ? | 4+ | 2 | 1 | 7 |
| Canada (in Eur.) | all | 64-95 | ? | 6+ | 1 | 1 | 0 | 8 |
| U.S.A. (in Eur.) | all | 73[n]-95 | ? | ? | 2+ | 5[o] | 0 | 7 |
| **Totals** | | | **19** | **33** | **49** | **48** | **18** | **168[m]** |

[a] Includes 2 RAF and 2 British Army aircraft lost while avoiding birds or (one case) simulated birds.
[b] There was no Austrian military flying in 1950-56.
[c] Two of these accidents were outside Europe and Israel.
[d] Excludes RNorAF F-16 loss on 5 Jul 1988 (fatal; possible birdstrike).
[e] Some further SwedAF crashes before 1967 were probably due to birds (T. Alerstam pers. comm.).
[f] Of the early RAF losses, many were "damaged beyond repair", not totally destroyed (see APPENDIX 2).
[g] One of these accidents was outside Europe and Israel.
[h] Excludes RN Sea King helicopter loss on 19 May 1982 (fatal; circumstances not positively determined) and RN Hunter birdstrike on 19 Aug 1982 (possibly damaged beyond repair).
[i] Excludes British Army Sioux helicopter lost on 6 Dec 1966 (fatal; reports of cause differ).
[j] Data from former Czechoslovakia and especially USSR are incomplete.
[k] One East German loss listed for 1960s may have been in early 1970s.
[l] East Germany combined with Germany (W) after 1980s.
[m] Row totals include one USSR accident (outside Europe, in Soviet Asia) during an unknown decade.
[n] Not known whether any of fifteen 1966-72 USAF accidents listed in Richardson (1994) were in Europe.
[o] One U.S. Army writeoff in Europe in 1984 is included; no other U.S. Army records available.

TABLE 2. Minimum numbers of human fatalities attributable to birdstrikes and bird avoidance during military aircraft operations of Europe and Israel, 1950 to date[a,b]. Includes 1 Soviet fatality in Asia and 3 U.S. fatalities in Europe. No known bird-related fatalities for aircraft of Austria, Denmark, Finland, France, Germany (W), Greece, Italy, Switzerland, or Canadian forces in Europe.

| Country of Origin | Service(s) | Years with Data | Number of Fatalities by Decade | | | | | Minimum Totals |
|---|---|---|---|---|---|---|---|---|
| | | | 1950s | 1960s | 1970s | 1980s | 1990s | |
| **Western European Forces** | | | | | | | | |
| Belgium | AF | 60-95 | ? | 0 | 0 | 3[a] | 0 | 3[a] |
| Netherlands | all | 56-95 | 0+ | 0 | 1 | 1 | 0 | 2 |
| Norway | AF | 56-95 | 0+ | 0 | 1 | 0[c] | 0 | 1 |
| Portugal | AF | 75-95 | ? | ? | 0+ | 0 | 1 | 1 |
| Sweden | AF | 65-95 | ? | 0+ | 5 | 0 | 0 | 5 |
| United Kingdom[c] | RAF | 50-94 | 2+ | 2+ | 0 | 3 | 0 | 7+ |
| | Army | 64-95 | ? | ?[c] | 0 | 0 | 1[b] | 1 |
| **Subtotal** | | | **2+** | **2+** | **7+** | **7+** | **2+** | **20+** |
| **Eastern European Forces** | | | | | | | | |
| Czech.+Slov. Rep. | AF | Incomplete[d] | ? | 1+ | ? | 0+ | ? | 1+ |
| Germany (E) | AF | 67-88 | ? | 1+[e] | 4 | 1 | - | 6 |
| Hungary | AF | 60-95 | ? | 0 | 0 | 1 | 0 | 1 |
| former USSR | AF | Incomplete[d] | ? | 2+ | ? | ? | ? | 3+[f] |
| **Subtotal[d]** | | | **?** | **4** | **4** | **2** | **0** | **11+[f]** |
| **Other Forces** | | | | | | | | |
| Israel | AF | 72-95 | ? | ? | 1+ | 0 | 2 | 3 |
| U.S.A. (in Eur.) | all | 73[g]-95 | ? | ? | 0+ | 3 | 0 | 3 |
| **Totals** | | | **2** | **6** | **12** | **12** | **4** | **37[f]** |

[a] Includes 3 civilian ground fatalities during a BelgAF crash probably caused by birds.
[b] Includes 1 British Army fatality attributable to a bird avoidance manoeuvre.
[c] Excludes RNorAF (1F), U.K. Navy (21-22F), U.K. Army (2F) accidents mentioned footnotes to Table 1.
[d] Data from former Czechoslovakia and especially USSR are incomplete.
[e] One East German fatality listed for 1960s may have been in early 1970s.
[f] Row totals include one USSR fatality (outside Europe, in Soviet Asia) during an unknown decade.
[g] Not known whether any of the 1962-1972 USAF accidents listed in Richardson (1994) were in Europe.

The crew ejected in a high proportion of the serious accidents, and most ejections were successful (APPENDIX 2). Unsuccessful ejections were often at low altitude. An 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. Also, a significant proportion of the fatalities involved aircraft without ejection seats, e.g. the Mi-8 helicopter in 1975 (3F), RAF Nimrod patrol aircraft in 1980 (2F), and British Army Lynx helicopter that hit terrain while avoiding birds in 1991 (1F). The worst confirmed losses to birds for non-European military aircraft have also involved aircraft with no ejection seats (USAF E-3 in 1995, 24F, Gresch 1996) or an insufficient number of ejection seats (B-1B in 1987, 3F, Greeley 1988).

This paper does not tabulate injuries, as explained in Richardson (1994). Some birdstrikes to European military aircraft have caused serious injuries, with or without loss of aircraft. In one case three ground personnel were injured by detonating ordnance (SwedAF, 1 Sep 1977).

# 4. CIRCUMSTANCES OF SERIOUS ACCIDENTS

## 4.1 Geographic Distribution

Some birdstrike-related accidents have occurred outside the borders of the operating country. Losses outside the home country included 2 Belgian, 2 French, 7 West German, 4 Netherlands, and 18 British aircraft (Table 3, APPENDIX 2). Eight of 17 known Canadian losses to birdstrikes since 1964 were in Europe, and at least seven U.S. aircraft have been lost to birdstrikes in Europe since 1973. Four of 10 known losses of former USSR aircraft were outside the European part of the USSR, in France (1), East Germany (2), and Asia (1). Nine of the 168 known losses tabulated were outside Europe and Israel, including two French aircraft in Chad; British losses in Aden (2), Hong Kong (2), Nigeria (1) and the Falklands (1+); and the Soviet aircraft in Asia.

European countries where the most known birdstrike accidents have occurred are Germany and the U.K.: 34 losses in West Germany since 1962 plus 11-12 in East Germany since 1967; 43 losses in the U.K. since 1950. Military aircraft from at least six countries have been lost to birdstrikes in West Germany (Table 3). Other countries with numerous losses include France (12+ aircraft from five countries), Sweden (9+ aircraft), Netherlands (7) and Israel (7). Although the Danish armed forces do not know of any losses of their aircraft to birdstrikes, at least six foreign military aircraft have crashed after birdstrikes in or near Denmark (Table 3).

Changes in the distribution of accidents are presumably occurring because of recent changes in the deployment of military forces. Also, the apparent distribution of bird-related accidents obviously depends on the completeness of records. Losses are no doubt more seriously underestimated in some countries than in others. Losses in Spain are underestimated because official Spanish data have not been obtained. Data on losses in eastern Europe (including the USSR) are very incomplete. Unofficial reports of birdstrike accidents in Albania, Poland and Romania are excluded from this paper pending corroboration.

## 4.2 Monthly Distribution

Serious bird-related accidents have occurred at all times of year, but numbers of accidents have been notably lower in winter—December, January and February—than in other months (Table 4). Both for Europe as a whole and for most regions within Europe, there has been no strong tendency for more accidents in spring and/or fall than in summer. However, in the U.K., birdstrike accidents have been especially common in November.

## 4.3 Types of Aircraft

Most military aircraft involved in serious bird-related accidents have been single-engine fighter or attack aircraft (121 of 167 known types, or 72.5%), most being flown by one pilot (Table 5). In addition, 12 of the losses (7%) were single-engine trainers. Twin-engine fighter and attack aircraft accounted for 21 accidents (13%). Other twin-engine fixed-wing aircraft, mainly Canberra and Il-28 light bombers, accounted for 8 losses (5%). Other losses consisted of three helicopters, two 4-engine aircraft, and one Soviet fighter of unstated type.

The circumstances of the helicopter and 4-engine losses are of special interest, in part because of their infrequency. ▸ An East German Mi-8 helicopter was lost in 1975 after ingesting a bird into a turboshaft engine. ▸ Two British Army helicopters were reportedly lost upon striking wires or

TABLE 3. Geographic distribution of serious accidents (writeoffs and/or fatalities) attributed to birds, considering military aircraft of Europe and Israel plus 8 Canadian and 7 U.S. aircraft lost in Europe, 1950 to date. Tables 1 and 2 show the specific years when data for each country were available. No known losses of aircraft from Austria, Denmark or Finland. "x+y" shows numbers of accidents before 1980 (x) and from 1980 to date (y).

| | | Number of Aircraft Lost in Various Countries | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country of Origin | Service(s) | Belgium | Denmark | France | West Germ. | Greece | Ireland | Italy | Netherlands | Norway | Portugal | Spain[a] | Sweden | Switzerland | UK | **Total West. Eur.** | All East. Eur. | Israel | Elsewhere | **Minimum Totals** |
| **Western European Forces** | | | | | | | | | | | | | | | | | | | | |
| Belgium | AF | 0+2 | - | - | 1+1 | - | - | - | - | - | - | - | - | - | - | **1+3** | - | - | - | **1+3** |
| France | AF,N | - | - | 0+5 | - | - | - | - | - | - | - | - | - | - | - | **0+5** | - | - | 0+2 | **0+7** |
| Germany (W) | AF,N | - | 2+2 | 1+1 | 14+2 | - | - | 0+1 | - | - | - | - | - | - | - | **17+6** | - | - | - | **17+6** |
| Greece | AF | - | - | - | - | 1+1 | - | - | - | - | - | - | - | - | - | **1+1** | - | - | - | **1+1** |
| Italy | AF | - | - | - | - | - | - | 0+3 | - | - | - | - | - | - | - | **0+3** | - | - | - | **0+3** |
| Netherlands | all | - | - | - | 3+1 | - | - | - | 4+2 | - | - | - | - | - | - | **7+3** | - | - | - | **7+3** |
| Norway | AF | - | - | - | - | - | - | - | - | 1+2 | - | - | - | - | - | **1+2** | - | - | - | **1+2** |
| Portugal | AF | - | - | - | - | - | - | - | - | - | 0+2 | - | - | - | - | **0+2** | - | - | - | **0+2** |
| Sweden | AF | - | - | - | - | - | - | - | | - | - | - | 9+0 | - | - | **9+0** | - | - | - | **9+0** |
| Switzerland | AF | - | - | - | - | - | - | - | - | - | - | - | - | 1+1 | - | **1+1** | - | - | - | **1+1** |
| United Kingdom | AF,N,Ar | - | 1+0 | 1+0 | 7+0 | - | 0+2 | - | 1+0 | - | - | - | - | - | 23+17 | **33+19** | - | - | 5+1 | **38+20** |
| **Subtotal** | | **0+2** | **3+2** | **2+6** | **25+4** | **1+1** | **0+2** | **0+4** | **5+2** | **1+2** | **0+2** | **-**[a] | **9+0** | **1+1** | **23+17** | **70+45** | **-** | **-** | **5+3** | **75+48** |
| **Other Forces** | | | | | | | | | | | | | | | | | | | | |
| Czech+Slov., E. Germ., Hung., USSR | AF | - | - | 0+1 | - | - | - | - | - | - | - | - | - | - | - | **0+1** | 13+8[b] | - | 1+0 | **14+9** |
| Israel | AF | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **-** | - | 4+3 | - | **4+3** |
| Canada | all | - | 1+0 | 3+0 | 3+1 | - | - | - | - | - | - | - | - | - | - | **7+1** | - | - | -[c] | **7+1**[c] |
| U.S.A.[a] | all | - | - | - | 0+1 | - | - | - | | - | - | 0+3 | - | - | 2+1 | **2+5** | - | - | -[c] | **2+5**[c] |
| **Totals**[a] | | **0+2** | **4+2** | **5+7** | **28+6** | **1+1** | **0+2** | **0+4** | **5+2** | **1+2** | **0+2** | **0-3**[a] | **9+0** | **1+1** | **25+18** | **79+52** | **13+8** | **4+3** | **6+3** | **102+66** |

[a] Biased by lack of Spanish Air Force data and unknown locations of many pre-1973 USAF accidents.
[b] These E. European accidents were in E. Germany (7+4), Hungary (0+1), former USSR (4+2), and unknown (2+1); data are incomplete.
[c] Canadian and U.S. military losses outside Europe and Israel are excluded; see Richardson (1994) for those data.

TABLE 4. Monthly distribution of serious accidents (writeoffs and/or fatalities) attributed to birds, by geographic region, considering military aircraft of Europe and Israel plus 8 Canadian and 7 U.S. aircraft lost in Europe, 1950 to date.

| | Number of Aircraft Lost by Geographic Region of Accident | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Months | UK + Ireland | Scan-dinavia | West+Cen. Europe[a] | Southern Europe[b] | Eastern Europe[c] | Israel | Other[d] | Minimum Totals |
| January | 2 | - | 2 | - | - | 1 | - | 5 |
| February | 2 | 1 | 3 | - | - | 1 | 1 | 8 |
| March | 2 | 2 | 7 | 1 | 2 | - | 1 | 15 |
| April | 4 | 2 | 4 | 2 | 5 | - | - | 17 |
| May | 2 | 3 | 5 | 1 | 2 | 1 | - | 14 |
| June | 4 | 2 | 3 | 3 | 1 | - | 1 | 14 |
| July | 3 | 1 | 8 | - | 1 | - | 1 | 14 |
| August | 2 | 3 | 8 | - | 3 | 1 | 1 | 18 |
| September | 7 | 2 | 6 | - | - | - | - | 15 |
| October | 5 | 2 | 6 | 2 | 3 | 2 | 1 | 21 |
| November | 11 | - | 3 | 2 | 1 | - | 2 | 19 |
| December | 1 | - | 2 | - | - | 1 | - | 4 |
| Unknown | - | - | - | - | 3 | - | 1 | 4 |
| Totals | 45 | 18 | 57 | 11 | 21 | 7 | 9 | 168 |

[a] West & Central Europe: accidents in France, Belgium, Netherlands, W. Germany, and Switzerland.
[b] Southern Europe: accidents in Portugal, Spain, Italy, and Greece.
[c] Eastern Europe: accidents in Czech & Slovak Rep., Hungary, E. Germany, former USSR west of Urals.
[d] Other: Russian Asia (1), Aden (2), Chad (2), Nigeria (1), Falklands (1), Hong Kong (2).

TABLE 5. Types of aircraft involved in serious accidents (writeoffs and/or fatalities) attributed to birds, considering military aircraft of Europe and Israel plus 8 Canadian and 7 U.S. aircraft lost in Europe, 1950 to date. Includes 9 European aircraft lost outside Europe (see footnotes). "x+y" shows numbers of accidents before 1980 (x) and from 1980 to date (y).

| Type of | | Number of Aircraft Lost | | | | Minimum |
|---|---|---|---|---|---|---|
| Aircraft | | 1-engine | 2-engine | 4-engine | Unknown | Totals |
| Turbine-powered Fixed-wing | | | | | | |
| Fighter & Attack[d] | Crew 1 | 68[a]+32[b] | 3+5[c] | - | 1+0 | 72+37 |
| | Crew 2 | 7+9 | 4[c]+8 | - | - | 11+17 |
| | Crew ? | 4+1 | 1+0 | - | - | 5+1 |
| | Subtotal | 79+42 | 8+13 | - | 1+0 | 88+55 |
| Trainer[e] | | 5+6 | - | - | - | 5+6 |
| Bomber, Patrol, Tanker | | - | 7[c]+0 | 1+1 | - | 8+1 |
| Other (RV-1D) | | - | 0+1 | - | - | 0+1 |
| Piston-engined Fixed-wing | | 0+1[f] | - | - | - | 0+1 |
| Helicopter | | 0[g]+1 | 1+1[g] | - | - | 1+2 |
| Totals | | 84+50 | 16+15 | 1+1 | 1+0 | 102+66 |

[a,b,c] Four ([a]), two ([b]) or one ([c]) of these accidents were outside Europe and Israel.
[d] Includes 2-seat training variants of high-performance aircraft.
[e] A few of these were 2-seat trainer aircraft flown by a crew of one.
[f] RAF Bulldog went out of control and crashed when avoiding "simulated" birds, 29 Sep 1986.
[g] Excludes British helicopter lost in uncertain circumstances (see footnotes [h,i] to Table 1).

the ground while avoiding birds. ▸ An RAF Victor 4-engine tanker was lost in 1976 after multiple gull strikes when takeoff was aborted above decision speed; in retrospect, it was concluded that the birdstrike caused little damage and the aircraft could have taken off. ▸ A Nimrod 4-engine patrol aircraft was lost in 1980 because of multiple gull strikes immediately after takeoff, with effective failure of three engines (Oliver 1990:68-70). (Another 4-engine aircraft was lost in the U.K. before 1950: in 1944, an RCAF Halifax bomber was destroyed in a crash landing after the only fully-qualified pilot was disabled by a bird penetrating the windscreen.) The rarity of serious bird-related accidents to helicopters and 4-engine aircraft is noteworthy. However, when major damage occurs, the risk is high: ejection seats are often absent, and the number of personnel aboard is often large.

All except five of the 167 losses of known aircraft types involved turbojet- or turbofan-powered fixed-wing aircraft (APPENDIX 2). The exceptions were the three turboshaft-powered helicopters, a small turboprop, and a piston-engine trainer. ▸ The one turboprop, a U.S. Army RV-1D Mohawk, was lost in Germany when a multiple birdstrike just after takeoff caused both engines to lose power. No turboprop military aircraft are known to have been lost to birdstrikes in Australia, Canada or the U.S.A. (Richardson 1994), but several civil turboprops, mainly 2- and 4-engine, have crashed (Thorpe, this volume). ▸ The one piston-engine aircraft loss in APPENDIX 2 was a special case: an RAF Bulldog trainer crashed when the student pilot lost control at low altitude after being told to manoeuvre around simulated birds (MoD 1988).

### 4.4 Phases of Flight

Of the 148 accidents for which phase of flight is known, 90 or 61% happened during cruise or weapons range flight, i.e. not closely associated with an airport. Most of these serious en-route birdstrikes (78 of 90) were at low-level (≤1000 ft AGL; Table 6). En-route birdstrikes accounted for similar proportions of the losses of single and twin-engine aircraft (63 vs. 57%).

Conversely, 58 (39%) of the 148 bird-related accidents during known phases of flight were on or near airfields during takeoff, climb, approach, touch and go landings, overshoots, or flight demonstrations. Of these serious accidents near aerodromes, the majority were during takeoff and climbout (Table 6). The two known accidents to European 4-engine aircraft since 1950 were during or immediately after takeoff. 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 and Speeds

Consistent with the above, 103 (72%) of 143 bird-related accidents at known altitudes involved encounters at ≤500 ft AGL (150 m), and 27 more (19%) were at 501-1000 ft (Table 7A). Of these low-altitude strikes, 50 were near aerodromes and 72 were during low-altitude cruise or weapons-range flights. The highest confirmed-altitude strikes resulting in aircraft loss were eight strikes at 2500-3500 ft (760-1065 m).

Reported speeds during bird encounters that caused aircraft loss ranged from 0 knots for a hovering Mi-8 to 595 knots (1100 km/h); seven of these strikes were at 500-595 kt (APPENDIX 2). Cases at high speeds (>400 knots) were almost all during cruise or weapons-range flights, mainly at low altitude (Table 7B). Cases at medium speeds (201-400 kt) occurred in many circumstances. Most accidents involving strikes at speeds ≤200 knots happened during the takeoff roll or early stages of climb, and most involved either aborted takeoffs with runway overruns or

TABLE 6. Phase of flight for serious accidents attributed to birds, as in Table 5. "x+y" shows numbers of accidents before 1980 (x) and from 1980 to date (y).

| Phase of Flight | Number of Aircraft Lost | | | | Minimum Totals |
|---|---|---|---|---|---|
| | 1-engine | 2-engine | 4-engine | Unknown | |
| **Aerodrome** | | | | | |
| Takeoff | 7+2 | 3[a]+0 | 1+0 | - | 11+2 |
| Climb | 11+7 | 1+3[a] | 0+1 | - | 12+11 |
| Approach | 4+6 | 0+1 | - | 1+0 | 5+7 |
| Other[c]/Unknown | 4[a]+2 | 2+2 | - | - | 6+4 |
| Subtotal | 26+17 | 6+6 | 1+1 | 1+0 | 34+24 |
| **Cruise** | | | | | |
| Cruise—Low[d] | 38[a]+26[b] | 7[a]+7 | - | - | 45+33 |
| Cruise—High[d] | 5+5 | 0+2 | - | - | 5+7 |
| Subtotal | 43+31 | 7+9 | - | - | 50+40 |
| **Unknown** | 15[b]+2 | 3+0 | - | - | 18+2 |
| **Totals** | 84+50 | 16+15 | 1+1 | 1+0 | 102+66 |

[a,b] One ([a]) or two ([b]) of these accidents were outside Europe and Israel.
[c] "Other" includes touch and go, overshoot, and flight demonstration. No losses during landing rollout.
[d] "Low" is ≤1000 ft AGL or described as "low-level". "High" is >1000 ft AGL or described as "high". "Cruise" includes flights on weapons ranges.

TABLE 7. Aircraft altitude and speed for serious accidents attributed to birds, by phase of flight, as in Table 5. "x+y" shows numbers of accidents before 1980 (x) and from 1980 to date (y).

| | Number of Aircraft Lost by Phase of Flight[c] | | | | |
|---|---|---|---|---|---|
| | At or Near Aerodrome | Low-alt. Cruise | High-alt. Cruise | Unknown | Minimum Totals |
| **A. Altitude (feet AGL)** | | | | | |
| 0-500 | 24[a]+20[a] | 29[b]+24[b] | - | 4[a]+2 | 57+46 |
| 501-1000 | 4+2 | 16+3 | - | 2+0 | 22+5 |
| 1001-2000 | 1+1 | - | 2+3 | - | 3+4 |
| 2001-4000 | 1+0 | - | 1+3 | 1+0 | 3+3 |
| Unknown—Low | - | 0+4 | - | 4+0 | 4+4 |
| Unknown—High | - | - | 2+1 | - | 2+1 |
| Unknown | 4[a]+1 | 0+2 | - | 7[a]+0 | 11+3 |
| Totals | 34+24 | 45+33 | 5+7 | 18+2 | 102+66 |
| **B. Speed (knots)** | | | | | |
| up to 200 | 23[a]+17[a] | 3+1 | 1+0 | 0+2 | 27+20 |
| 201 - 400 | 6+5 | 13[a]+6 | 0+2 | 2+0 | 21+13 |
| 401 - 600 | 0+1 | 26[a]+21[b] | 0+3 | - | 26+25 |
| Unknown | 5[a]+1 | 3+5 | 4+2 | 16[b]+0 | 28+8 |
| Totals | 34+24 | 45+33 | 5+7 | 18+2 | 102+66 |

[a,b] One ([a]) or two ([b]) of these accidents were outside Europe and Israel.
[c] Phases of flight categorized as in Table 6.

ejections soon after takeoff. A few cases at ≤200 kt involved helicopters or other low-speed

aircraft in cruise flight.

Birdstrikes during high-speed low-level cruise caused similar proportions of the bird-related accidents before 1980 (36%) and subsequently (37.5%, unknown altitude and unknown speed cases excluded; Table 7B). Strikes during medium- and high-speed low-level cruise caused 54% of the accidents before 1980 and 48% subsequently.

### 4.6 Parts of Aircraft Hit

The engine(s) were the most commonly-reported part(s) struck. Of 144 serious accidents in which the part struck was reported, 102 or 71% involved the engine(s), 24 (17%) the windscreen or canopy, and a further 11 (8%) both the engine(s) and windscreen (Table 8). There were only seven serious accidents in which the parts struck were reported not to include either the engines or windscreen. These cases involved strikes on the wing plus air intake (3 cases), intake only (2), wing only (1), and wing+nose+fuselage (1). Four of these seven accidents not involving the engine(s) and windscreen were cases where the aircraft was "damaged beyond repair", not totally destroyed. Some reports of engine ingestions or windscreen strikes mentioned that one or more additional parts were also struck (APPENDIX 2). The actual frequency of multiple-strike cases is undoubtedly higher than reported.

Centrifugal flow turbojets, as used in many early jet aircraft, have been considered more resistant to birdstrikes than axial flow engines. At least 15 aircraft powered by centrifugal flow turbojets were lost to birdstrikes (British Meteor, Vampires, Venom, Sea Hawk; Soviet Il-28, MiG-17; Czechoslovak MiG-15). Parts struck are known for 7 cases. The engine(s) were known to be involved (along with other parts) in only 2 of 7 cases, and one of those aircraft, an RN Sea Hawk, landed safely before being declared "damaged beyond repair".

Windscreen/canopy strikes (and especially penetrations) were much more common during cruise flight than during operations at or near aerodromes. During cruise, windscreen strikes were reported in 28 of 83 cases for which the part struck was reported (Table 8). At least 18 of these involved windscreen penetration, and in at least 4 more cases windscreen shattering or obscuring was a major contributing factor. In contrast, for accidents at and near aerodromes, a windscreen strike was reported in only 3 of 50 cases, and it was a major factor in no more than 1 of 50 cases. Engine ingestions were reported for 61 of 83 losses during cruise (73.5%) but for almost all losses near aerodromes (47 of 50 or 94%).

### 4.7 Types of Birds

Considering all 168 accidents, the birds responsible for the most accidents were gulls (35 cases), buzzards and hawks (11), ducks (8), pigeons (8), and corvids (6). These totals can be considered relative to the 98 accidents caused by collisions with known types of birds or 168 accidents caused by collisions with (or attempts to avoid) known and unknown types of birds (Table 9). Other groups that each accounted for at least 3-4 accidents were seabirds (Gannet and 2 others), pelicans, herons/egrets/storks, cranes, geese, waders (Lapwings or "plovers" in each case), and vultures. All values are minima because of the many accidents for which bird type is unknown.

***4.7.1 Types Struck by Phase of Flight:*** Gulls were the worst problem both near aerodromes and during low-level cruise, but caused only one known accident during cruise above 1000 ft AGL

TABLE 8. Parts of aircraft struck during serious accidents attributed to birds, by phase of flight,

as in Table 5. "x+y" shows numbers of accidents before 1980 (x) and from 1980 to date (y).

| Part of Aircraft | Number of Aircraft Lost by Phase of Flight[c]: At or Near Aerodrome | Low-alt. Cruise | High-alt. Cruise | Unknown | Minimum Totals |
|---|---|---|---|---|---|
| Windscreen[d] | 1+0 | 10+4[a] | 1+4 | 4+0 | 16+8 |
| Engine(s)[d] | 25[a]+20[a] | 26[a]+19[a] | 4+3 | 4+1 | 59+43 |
| Both of Above[d] | 1+1 | 3+6 | - | - | 4+7 |
| Other Parts Only | 1+1 | 0+3 | - | 2+0 | 3+4 |
| Unknown, Multiple | - | 1+0 | - | - | 1+0 |
| Unknown | 6[a]+0 | 5[a]+0 | - | 8[b]+0 | 19+0 |
| None (avoided) | 0+2 | 0+1 | - | 0+1 | 0+4 |
| Totals | 34+24 | 45+33 | 5+7 | 18+2 | 102+66 |

[a,b] One ([a]) or two ([b]) of these accidents were outside Europe and Israel. [c] Phases of flight as in Table 6.
[d] Some cases involved multiple strikes including parts additional to windscreen and/or engines.

TABLE 9. Types of birds struck during serious accidents attributed to birds, by phase of flight, as in Table 5. "x+y" shows numbers of accidents before 1980 (x) and from 1980 to date (y).

| Type of Bird | Number of Aircraft Lost by Phase of Flight[b]: At or Near Aerodrome | Low-alt. Cruise | High-alt. Cruise | Unknown | Minimum Totals |
|---|---|---|---|---|---|
| Seabird | - | 0+3[a] | - | - | 0+3 |
| Pelican | 1+0 | 2+0 | - | - | 3+0 |
| Heron+Stork | 0+2[a] | 0+1 | - | 1+0 | 1+3 |
| Crane | - | - | 0+1 | 2+0 | 2+1 |
| Bustard | - | - | - | 1+0 | 1+0 |
| Swan | - | - | - | 1[a]+0 | 1+0 |
| Goose | 0+2 | 1+0 | - | - | 1+2 |
| Duck | 0+1 | 5+1 | 0+1 | - | 5+3 |
| Wader/Shorebird | 1[c]+2 | - | - | - | 1[c]+2 |
| Gull | 7+6 | 11[a]+8 | 1+0 | 2+0 | 21+14 |
| Kite | 1[a]+0 | - | - | - | 1+0 |
| Hawk/Buzzard | - | 4+5 | 1+1 | - | 5+6 |
| Falcon | 1+0 | - | - | - | 1+0 |
| Eagle | - | 0+1 | - | - | 0+1 |
| Vulture | - | 1[a]+1 | 0+1 | - | 1+2 |
| Pigeon/Dove | 1+4 | 3+0 | - | - | 4+4 |
| Corvid | - | 3+0 | 1+1 | 0+1 | 4+2 |
| Starling | 1+0 | - | - | - | 1+0 |
| Other landbird (small) | 0+1 | - | 0+1 | - | 0+2 |
| Unknown | 21[a]+4 | 15+12[a] | 2+1 | 11[a]+0 | 49+17 |
| None (avoided) | 0+2 | 0+1 | - | 0+1 | 0+4 |
| Totals | 34+24 | 45+33 | 5+7 | 18+2 | 102+66 |

[a] One of these accidents was outside Europe and Israel. [b] Phases of flight categorized as in Table 6.
[c] One case involving gulls plus plovers is counted only under gulls.

(Table 9). Similarly pigeons caused accidents both near aerodromes and during low-level cruise.

In contrast, there were no known losses to buzzards or corvids near aerodromes; they were struck during both low- and high-altitude cruise. Losses to ducks were mainly during low-level cruise, as were all losses to seabirds and 2 of 3 losses to pelicans.

***4.7.2 Types Struck by Region**:* Gulls were the dominant problem in Scandinavia (50% of all birds struck and 82% of identified birds) and in the U.K.+Ireland (34-70%; Table 10). Gulls were less dominant in the loss statistics from west and central parts of continental Europe (16-26%). Elsewhere, samples were small but gulls were not dominant: southern Europe, 9-14%; eastern Europe, 5-8%; Israel, none; European aircraft lost outside Europe, 11-17%. Likewise, gulls are not dominant for military aircraft losses in North America (5-7%, Richardson 1994).

Other types of birds commonly responsible for aircraft losses were plovers and pigeons in the U.K., and buzzards, pigeons, ducks and corvids in west and central Europe. Elsewhere samples were very small. However, notable groups included pelicans and buzzards in Israel, and vultures

TABLE 10. Types of birds struck during serious accidents attributed to birds, by geographic region, as in Table 5. "x+y" shows numbers of accidents before 1980 (x) and from 1980 to date (y).

| | Number of Aircraft Lost by Geographic Region of Accident[a] | | | | | | | Min- |
|---|---|---|---|---|---|---|---|---|
| Months | UK + Ireland | Scan- dinavia | West+Cen. Europe | Southern Europe | Eastern Europe | Israel | Other | imum Totals |
| Seabird | - | - | 0+1 | 0+1 | - | - | 0+1 | 0+3 |
| Pelican | - | - | - | 1+0 | - | 2+0 | - | 3+0 |
| Heron+Stork | - | - | 0+1 | - | 1+0 | 0+1 | 0+1 | 1+3 |
| Crane | - | 0+1 | - | - | 2+0 | - | - | 2+1 |
| Bustard | - | - | - | - | 1+0 | - | - | 1+0 |
| Swan | - | - | - | - | - | - | 1+0 | 1+0 |
| Goose | - | - | 1+0 | - | 0+2 | - | - | 1+2 |
| Duck | 1+0 | - | 4+1 | - | 0+2 | - | - | 5+3 |
| Wader/Shoreb. | 0[b]+2 | - | - | - | 1+0 | - | - | 1[b]+2 |
| Gull | 8+6 | 6+3 | 6+3 | 0+1 | 0+1 | - | 1+0 | 21+14 |
| Kite | - | - | - | - | - | - | 1+0 | 1+0 |
| Hawk/Buzzard | 0+1 | - | 4+3 | 0+1 | - | 1+1 | - | 5+6 |
| Falcon | - | - | 1+0 | - | - | - | - | 1+0 |
| Eagle | - | - | - | - | - | 0+1 | - | 0+1 |
| Vulture | - | - | - | 0+2 | - | - | 1+0 | 1+2 |
| Pigeon/Dove | 1+1 | - | 3+3 | - | - | - | - | 4+4 |
| Corvid | - | - | 4+0 | - | 0+2 | - | - | 4+2 |
| Starling | - | 1+0 | - | - | - | - | - | 1+0 |
| Other landbird (small) | - | - | - | 0+1 | 0+1 | - | - | 0+2 |
| Unknown | 15+6 | 7+0 | 16+6 | 0+4 | 8+0 | 1+0 | 2+1 | 49+17 |
| None (avoided) | 0+4 | - | - | - | - | - | - | 0+4 |
| Totals | 25+20 | 14+4 | 39+18 | 1+10 | 13+8 | 4+3 | 6+3 | 102+66 |

[a] Geographic regions defined as in Table 4.

[b] One case involving gulls plus plovers is counted only under gulls.

in southern Europe (2 USAF losses in Spain). The vulture problem in southern Europe would

probably have been more prominent if official Spanish data were available. Vultures are more widely distributed in the U.S.A. than in Europe, and are the dominant cause of military aircraft losses in the U.S.A. (28-36%, Richardson 1994).

### 4.8 Special Cases

***4.8.1 Crashes While Manoeuvring to Avoid Birds**:* Of the 168 accidents listed, four British accidents involved aircraft that crashed during low-altitude manoeuvres to avoid colliding with birds (n=3) or simulated birds (n=1). These accidents may not be officially listed as being directly caused by birds. Two British Army accidents involved helicopters that hit wires (29 Apr 1986) or the ground (14 Nov 1991) while manoeuvring to avoid birds. Two RAF accidents (and two similar USAF accidents) were described in Richardson (1994).

***4.8.2 Fatality or Ejection but Aircraft Not Destroyed**:* I am not aware of any European military accidents in which an aircraft was landed successfully after one crewman was killed by a birdstrike. There have been at least three such cases in the U.S.A. (Richardson 1994).

At least two dual-seat military aircraft have landed successfully in the U.K. after a birdstrike and successful ejection of the rear-seat crewman. These ejections, both during high-speed low-level cruise flight, have not been included as serious accidents elsewhere in this paper. One involved a British Buccaneer that collided with geese on 9 Nov 1970 (Bourne 1991 and pers. comm.; T. West pers. comm.). The other involved a USAF F-15E whose canopy was penetrated by a duck on 16 Sep 1994 (*Air Forces Monthly* Nov. 1994:58; USAF BASH database).

## 5. CONCLUSIONS

Military services in many countries have been very helpful in releasing, for this analysis, detailed data on serious bird-related accidents to their aircraft. For military aviation, the birdstrike problem has been serious at least since 1950. Actual numbers of serious accidents and fatalities are even higher than shown in this paper, given the incomplete data, especially prior to 1980. If data from more years and countries can be compiled, including Spain and additional parts of eastern Eur-- ope and the Mideast, a more comprehensive analysis subject to fewer biases will be possible. **Agencies and individuals who can fill gaps or make corrections in APPENDIX 2, or expand it to other countries and years, are encouraged to contact the author or to publish the data.**

## 6. ACKNOWLEDGEMENTS

This compilation and analysis would have been impossible without help from many flight safety offices, birdstrike specialists, and aviation historians. These cooperators are mentioned in APPENDIX 1—Data Sources. I also thank those acknowledged in my 1994 paper; many of those data are used again here. All contributions were important, but the following individuals were especially helpful in responding positively to a series of requests for follow-up data: C.K. Aas, Dr. T. Alerstam, Dr. J. Becker, W.B. Brown, Dr. L.S. Buurma, S/L J.G. Chapman, W/C D.R. Collier Webb, Cdt. R. Degrieck, R.J. Dunn, Dr. Y. Leshem, Cdr R.P. Seymour, R.C. Sturtivant, and M.M. Thompson. I thank Tim West for making available the results of his exhaustive search for RAF birdstrike accidents. For help in making contact with various flight safety offices and/or encouraging them to release data, I thank Dr. L. Buurma (RNethAF), Maj. W. Stone (Canadian Armed Forces/DFS), and J. Thorpe (U.K. CAA/BSCE).

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## APPENDIX 1: Data Sources

### Countries Not Listed in Richardson (1994)

***Austria**:* There have been no known serious birdstrike accidents to Austrian military aircraft since military flying resumed in 1957 (Col. H. Marchard, Austrian AF, pers. comm., Jan 1996).

***Belgium**:* Air Force records extending back to 1960 show four aircraft losses to birdstrikes (Table 1 and APPENDIX 2); details were provided by the Belgian AF (Cdt. R. Degrieck and Maj. G. Transon, pers. comm., Dec 1994, Mar 1996).

***Czech and Slovak Republics**:* Murár (1994a,b) reports no recent serious birdstrike accidents. There was a fatal windscreen penetration in the early 1960s, and one aircraft was lost in 1985 (details from LCol. R. Peca, Flying Safety, Slovak AF, pers. comm., Feb 1995).

***East Germany**:* Dr. J. Becker, German Military Geophysics Office, provided details concerning 10 aircraft of the former National Peoples Army (NVA) lost to birdstrikes, 1967-88, plus information on two Soviet Air Force losses in East Germany (pers. comm., Jan-Feb 1996).

***Finland**:* There were no serious bird-related accidents to Air Force aircraft in 1981-89 (Finnish AF 1990) or in 1990-95 (Col. M. Ahola, LCol. J. Hipeli and M. Tavinen, Flight Safety, Finnish AF, pers. comm., Dec 1994, May 1996).

***France**:* Air Force records for 1975 to early 1996 show five aircraft lost to birdstrikes, all in the 1990s; details were provided by the French AF (Col. Louvion and LCol. Bouvet, pers. comm., Nov 1994, Apr 1996). Navy records for 1960 to early 1996 show the loss of two Aéronavale aircraft to birdstrikes; details were provided by CV de Lesquen, Flight Safety, French Navy (pers. comm., Feb 1996).

***Greece**:* Air Force records for 1965-94 show two serious bird-related accidents; details were provided by LCol. K. Kalamatas, Flight Safety, Hellenic AF (pers. comm., Dec 1994).

***Hungary**:* Records for 1960 to early 1996 show one known serious accident caused by a bird-strike; details were provided by LCol. A. Papp, Flight Safety, Hungarian Home Defence Forces (pers. comm., Mar 1996).

***Israel**:* Dr. Y. Leshem, Tel Aviv Univ. (pers. comm., Oct 1989, Sep 1994, Jan 1996) sent details for 7 known Israeli AF losses to birdstrikes in 1972-95, supplementing limited published data on some of the accidents (Petreanu and Abbady 1988; Leshem 1994).

***Italy**:* Air Force records for 1961-94 show two confirmed and one probable birdstrike losses; details were provided by Col. F. Draghi and LCol. Pani, Flight Safety, Italian AF, pers. comm., Dec 1994, June 1995).

***Portugal**:* Air Force records for 1975-95 show two aircraft lost to birdstrikes; details were provided by Col. L.F. Palma de Figueiredo, Flight Safety, PortAF, pers. comm., Feb 1996).

***Former USSR**:* Dr. V.E. Jacobi (pers. comm., Dec. 1994) provided details for seven definite losses of USSR military aircraft to birdstrikes during 1953-82. Dr. J. Becker sent data on two additional USSR losses in East Germany. The loss of a MiG-29 to a birdstrike at Paris in 1989 was widely reported (e.g. *Flight Intern.*, 22 July 1989:11).

### Updated Data from Other Countries

Richardson (1994) listed sources of data for 7 European countries considered in the earlier compilation, and for Canadian and U.S. forces operating in Europe. The following additional or updated data have been obtained subsequently.

For four countries, no additional accidents have been attributed to birds beyond those listed in Richardson (1994): ***Canada,*** updated data from Maj. T.L. Manderson, Flight Safety, CAF (pers. comm., Jan 1996). ***Denmark,*** Maj. E.G. Nielsen, Flight Safety, Tactical Air Comm. Denmark (pers. comm., Jan 1996). ***Netherlands,*** Dr. L.S. Buurma, NethAF (pers. comm., Jan and Mar 1996). ***Sweden,*** Dr. T. Alerstam, Lund Univ. (pers. comm., Jan 1996).

***Germany:*** Dr. J. Becker (pers. comm., Feb 1995, Jan 1996) provided ▸ more details on the 22 West German Air Force and Navy losses listed in Richardson (1994), ▸ details on a previously unlisted accident on 30 Oct 1970, and ▸ confirmation that there had been no recent bird-related losses of military aircraft in Germany.

***Norway:*** Air Force records back to 1956 confirm three losses to birdstrikes (LCol. K. Tungesik, Flight Safety, NorwAF, pers. comm., Feb 1996). More details about two accidents listed in Richardson (1994) and another in 1995 were provided by LCol. Tungesvik and C.K. Aas, Zoological Museum Aviation Bird Office (pers. comm., Aug 1994, Feb 1996). A fatal F-16 loss on 5 July 1988, not confirmed as due to a birdstrike, is excluded.

***Switzerland:*** Swiss AF records show no total loss of an aircraft other than a previously-listed 1974 accident, but a Hunter was damaged beyond repair in 1991. Details were provided by Col. W. Schafroth, Flight Safety, Swiss AF (pers. comm., Jan and Mar 1996). See also *Air Forces Monthly*, Mar 1996:58.

***United Kingdom:*** Much additional information about U.K. losses to birdstrikes has become available to me since 1994, when I listed 15 losses of RAF aircraft since 1980 to birdstrikes or bird avoidance. Official data on these and other RAF losses since 1970 were supplied by the RAF Inspectorate of Flight Safety, IFS (S/L S.P. Bridger, pers. comm., Oct 1994; S/L J.G. Chapman, pers. comm., Feb-Mar 1996). Data on other RAF losses back to 1950 were compiled from many sources. Unofficial published accounts, including Mason (1986:219*ff*), Jackson (1989: 144*ff*), Oliver (1990) and most notably Dunn (1996), provided a provisional list. Most of that information was checked ▸ against accident information cards held by the Air Historical Branch (*fide* Tim West, Lakenheath, U.K.) and/or ▸ by correspondence with IFS. W/C D.R. Collier Webb, Directorate of Flying, Boscombe Down, supplied details for aircraft lost during test flying on 23 Oct 1953 and 24 July 1981 (pers. comm., Mar 1996).

The Royal Navy Flight Safety & Accident Investigation Centre (FSAIC) sent details for most RN losses to birdstrikes back to 1958 (Cdr R.P. Seymour, pers. comm., Jan-Feb 1996). The fatal RN Sea King accident off the Falklands on 19 May 1982 is excluded; the cause was "not positively determined". Other data came from Langley (1970), Oliver (1990), Dunn (1996), naval aviation historian R.C. Sturtivant (pers. comm., Mar 1996) for most RN losses, and W/C Collier Webb for the accident on 28 Oct 1958.

For the British Army, data on bird-related damage to several aircraft for years back to 1964 (Maj. N.D. Gibson, HQ Director Army Aviation, pers. comm., Mar 1996) were supplemented by R.J. Dunn (pers. comm.) and E. Myall (pers. comm). Two helicopters lost to "bird avoidance" are included here, but there may have been other bird-related losses.

***United States:*** The USAF BASH database and Naval Safety Center database show no recent USAF, USN or USMC losses to birdstrikes in Europe (W.B. Brown, NSC, pers. comm., Jan 1996; Lt. C. Atkins, BASH Team, pers. comm., Mar 1996). Other USAF and USMC losses in 1995 are outside the scope of this paper. The locations of two F-111E birdstrike accidents in 1975, listed in Richardson (1994) as "Europe?", are confirmed as England (T. West, pers. comm.). Locations of 15 USAF losses in 1966-72 remain unknown to me; some may have been in Europe. The one U.S. Army aircraft lost to a birdstrike during 1983-87 (GAO 1989:8) was presumably an RV-1D Mohawk lost in Germany (*Flight Intern.,* 6 Oct 1984:848). No other U.S. Army data have been obtained.

APPENDIX 2: Serious military aircraft accidents attributable to birds in Europe and Israel, and for European aircraft elsewhere.

See Table 1 for services and years covered. Blanks denote "unknown". For explanatory notes, see last page of Appendix 2.

| Date | | | | Aircraft | | | | Acc. | # Persons | | | Flight | | | Altitude | | Parts Hit | | | Aircraft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y M D | Location | Where Struck | Service | Type | Sub-type | Category | | Category | Ab. | Ej. | Killed | Phase/ | Time | Type of Bird(s) Struck | AGL (feet) | Speed (knots) | Ws | En | Other | Registration |
| Belgian AF | | | | | | | | | | | | | | | | | | | | |
| 770926 | W. Germ. | Rheinbach | AF | Mirage 5 | BA | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Pigeons, Wood | 600 | 420 | P | | | BA-34 |
| 800512 | W. Germ. | Neunkirchen | AF | TF-104 | G | FA | 1 | wo | 2 | 2 | 3grnd | CrL | D | prob. birdstrike | 500 | 450 | | F | | |
| 881117 | Belgium | Kleine Brogel | AF | F-16 | A | FA | 1 | wo | 1 | 1 | 0 | Cl | D | Pigeons, Wood | 400 | 200 | | F | | FA-62? |
| 890718 | Belgium | Liege/Bierset | AF | Mirage 5 | BA | FA | 1 | wo | 1 | 0 | 0 | Ap | D | Pigeons, Wood | 300 | 195 | | F | | BA-45 |
| Canadian Forces (Europe only) | | | | | | | | | | | | | | | | | | | | |
| 641027 | France | Troyes | AF | CF-104 | | FA | 1 | wo | 1 | 1 | 0 | CrH | D | corvid? | 2000 | 200 | - | F | | 12849 |
| 650916 | W. Germ. | Zweibrucken | AF | CF-104 | | FA | 1 | wo | 1 | 1 | 0 | Ap | D | unkn. | 3000 | 300 | - | F | | 12853 |
| 650916 | France | near Boen | AF | CF-104 | D.2 | FA | 1 | wo | 2 | 2 | 0 | CrL | D | unkn. | 7-1000 | 410 | - | F | | 12659 |
| 660321 | W. Germ. | Eschau | AF | CF-104 | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | unkn. | 1000 | 410 | - | F | | 12820 |
| 670718 | Denmark | Kattegat | AF | CF-104 | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | gull? | 300 | 420 | - | F | N | 12734 |
| 690425 | France | Niefern | AF | CF-104 | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | large | 800 | 420 | P | - | | 12854 |
| 780818 | W. Germ. | Oberthal | AF | CF-104 | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | unkn. | 800 | 420 | - | F | | 829 |
| 810316 | W. Germ. | near Leipheim | AF | CF-104 | D.2 | FA | 1 | wo | 2 | 2 | 0 | CrL | D | buzzard | 500 | 510 | - | F | | 665 |
| Czech & Slovak AF | | | | | | | | | | | | | | | | | | | | |
| 6_ | Czechoslovakia? | | AF | MiG-15 | | FA | 1 | wo? | 1? | | 1 | | | unkn. | | | P | - | | |
| 850510 | Czechoslovakia | | AF | MiG-21 | MF | FA | 1 | wo | 1 | 0 | 0 | TO | D | gulls | 5 | 135 | - | I | | 4306 |
| French AF & Navy | | | | | | | | | | | | | | | | | | | | |
| 900517 | France | Fonties d'Aude | AF | Mir. 2000 | N | FA | 1 | wo | 2 | 2 | 0 | CrL | D | gull | 500 | 400 | S | F | | 321 |
| 900726 | Chad | Doum-Doum | AF | Mir. F1 | CR | FA | 1 | wo | 1 | 1 | 0 | CrL | D | unkn. | 300 | 475 | - | F | A | 633 |
| 910314 | France | Alincourt | AF | Jaguar | E | FA | 2 | wo | 1 | 1 | 0 | CrL | D | >1 | 500 | 400 | S | I | | E17 |
| 920613 | Chad | N'Djamena | AF | Jaguar | A | FA | 2 | wo | 1 | 1 | 0 | Cl | D | Egrets, White | 50 | 185 | | F | | |
| 960119 | France | Istres AFB | AF | Mir. 2000 | N | FA | 1 | dbr? | 2 | 2 | 0 | Ap | D | Gull, Yel.-leg. | 110 | 135 | | I | | |
| 920204 | France | off Penmarch | Na | S.Etendard | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Gannet, North. | 100 | 480 | S | F | | |
| 960126 | France | off Cassis | Na | S.Etendard | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Gull, Yel.-leg. | 500 | 450 | P | - | | |
| Germany (East) AF | | | | | | | | | | | | | | | | | | | | |
| 670807 | E. Germ. | Neuhardenberg | AF | MiG-21 | SPS | FA | 1 | wo | 1 | 1 | 0 | CrH | D | unkn. | >3300 | >324 | - | F | | |
| 67-74 | E. Germ.? | | AF | MiG-21 | | FA | 1 | wo | 1 | | 1 | | | unkn. | | | | | | |
| 720320 | E. Germ. | Neubrandenburg | AF | MiG-21 | PFM | FA | 1 | wo | 1 | 0 | 0 | Dem | D | >1 | 1000 | 324 | | F | F | |

APPENDIX 2: Serious military aircraft accidents attributable to birds in Europe and Israel, and for European aircraft elsewhere (cont'd).

See Table 1 for services and years covered. Blanks denote "unknown". For explanatory notes, see last page of Appendix 2.

| Date | | | | Aircraft | | | | Acc. | # Persons | | | Flight | | | Altitude | | Parts Hit | | | Aircraft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y M D | Location | Where Struck | Service | Type | Subtype | Category | | Category | Ab. | Ej. | Killed | Phase/ | Time | Type of Bird(s) Struck | AGL (feet) | Speed (knots) | Ws | En | Other | Registration |
| 740417 | E. Germ. | Drewitz,Cottbus | AF | MiG-21 | US | FA | 1 | wo | 2 | 2 | 0 | Cl | D | unkn. | <3300 | <324 | - | F | | |
| 750428 | E. Germ. | Neuhardenberg | AF | Mi-8 | | H | 2 | wo | 3 | na | 3 | Hov | T | unkn. | 660 | 0 | - | F | | |
| 761002 | E. Germ. | Neubrandenburg | AF | MiG-21 | PFM | FA | 1 | wo | 1 | 0 | 1 | Cl | D | unkn. | 165 | 216 | - | F | | |
| 770817 | E. Germ. | Neuhardenberg | AF | MiG-21 | MF | FA | 1 | wo | 1 | 1 | 0 | Ap | D | unkn. | 330 | 190 | - | F | | |
| 820622 | E. Germ. | Drewitz,Cottbus | AF | MiG-23 | BN | FA | 1 | dbr | 1 | 0 | 0 | CrH | D | ducks | 2000 | 485 | | I | F | |
| 880506 | E. Germ. | Neubrandenburg | AF | MiG-21 | PFM | FA | 1 | wo | 1 | 1 | 1 | Cl | T | ducks | 65 | 216 | | F | | |
| 880805 | E. Germ. | Gorlitz | AF | MiG-21 | US | FA | 1 | wo | 2 | 2 | 0 | CrH | D | crows | 1640 | 270 | | F | | |
| Germany (West) AF & Navy | | | | | | | | | | | | | | | | | | | | |
| 620411 | W. Germ. | Augsburg | AF | F-84 | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | buzzard | 500 | <450 | P | - | | |
| 640805 | W. Germ. | Furstenfeldbruck | AF | G-91 | R/3 | FA | 1 | wo | 1 | 1 | 0 | Cl | D | pigeons | 100 | 160 | | F | | |
| 670516 | W. Germ. | Elbe estuary | AF | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | gulls | 500 | 450 | P | | | |
| 691130 | W. Germ. | Schwabish Hall | AF | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | duck? | 800 | 450 | - | F | | |
| 701030 | W. Germ. | Holzkirchen | AF | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | crow | 800 | 450 | - | F | | |
| 710907 | W. Germ. | Eiderstedt Pen. | AF | G-91 | R/3 | FA | 1 | wo | 1 | 1 | 0 | CrH | D | gulls | 1200 | <450 | P | | | |
| 720801 | W. Germ. | Bremen-N | AF | G-91 | R/3 | FA | 1 | wo | 1 | 1 | 0 | CrL | D | buzzard | 500 | 360 | - | F | | |
| 760809 | W. Germ. | Brake/Weser | AF | G-91 | R/3 | FA | 1 | wo | 1 | 1 | 0 | CrL | D | buzzard | 500 | 360 | - | F | | |
| 771007 | W. Germ. | Bad Schwalbach | AF | TF-104 | G | FA | 1 | wo | 2 | 2 | 0 | CrL | D | pigeons | 800 | 450 | | F | | |
| 781010 | France | Nancy-W | AF | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | crows | 800 | 420 | | F | | |
| 810706 | W. Germ. | Niederstetten | AF | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | buzzard | 600 | 450 | - | F | | |
| 810817 | France | Ollieres | AF | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | buzzard? | 500 | 450 | - | F | | |
| 820421 | Italy | Frasca Ran. | AF | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | unkn. | | 450 | - | F | | |
| 820804 | W. Germ. | Hohenfels Ran. | AF | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | unkn. | | 400 | - | F | | |
| 670428 | W. Germ. | Bad Neinberg | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | duck? | 1000 | 200 | - | F | | |
| 760315 | W. Germ. | Eiderstedt Pen. | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Goose, Barnac | 800 | 420 | - | F | | |
| 770419 | Denmark | Moen | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | gulls | 300 | 450 | P | F | | |
| 780818 | W. Germ. | Heligoland | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | gulls | 500 | 400 | | F | | |
| 780919 | Denmark | Anholt | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | gull | 200 | 450 | - | F | | |
| 781207 | W. Germ. | Schleswig | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | ducks | 800 | 480 | | F | | |
| 790417 | W. Germ. | Eiderstedt Pen. | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Shelduck | 800 | 440 | - | F | | |

APPENDIX 2: Serious military aircraft accidents attributable to birds in Europe and Israel, and for European aircraft elsewhere (cont'd).

See Table 1 for services and years covered. Blanks denote "unknown". For explanatory notes, see last page of Appendix 2.

| Date | | | | Aircraft | | | | Acc. | # Persons | | | Flight | | | Altitude | | Parts Hit | | | Aircraft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y M D | Location | Where Struck | Service | Type | Subtype | Category | | Category | Ab. | Ej. | Killed | Phase/ | Time | Type of Bird(s) Struck | AGL (feet) | Speed (knots) | Ws | En | Other | Registration |
| 810826 | Denmark | Oksbol Ran. | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | gulls | 150 | 500 | | F | | |
| 850208 | Denmark | Bornholm | Na | F-104 | G | FA | 1 | wo | 1 | 1 | 0 | CrL | D | gull | 350 | 450 | - | F | | |
| **Hellenic (Greek) AF** | | | | | | | | | | | | | | | | | | | | |
| 750627 | Greece | central | AF | F-84 | F | FA | 1 | wo | 1 | 1 | 0 | CrL | D | pelican | 1000 | 320 | P | I | | 52-6443 |
| 921007 | Greece | Tanagra | AF | Mir. 2000 | | FA | 1 | wo | 1 | 1 | 0 | Cl | D | gull | 100 | 240 | | F | I | |
| **Hungarian Defence Forces** | | | | | | | | | | | | | | | | | | | | |
| 841016 | Hungary | Taszar | AF | MiG-21 | U | FA | 1 | wo | 2 | 2 | 1 | Ap | D | Goose, Bean | 850 | 205 | - | F | | |
| **Israel AF** | | | | | | | | | | | | | | | | | | | | |
| 730219 | Israel | Judean Des. | AF | Nesher | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | buzzard | 300 | 360 | - | F | | |
| 741028 | Israel | Hulah Valley | AF | A-4 | | FA | 1 | wo | 1 | 0 | 1 | CrL | D | Pelican, G.Wh. | 400 | 420 | P | - | | |
| 790115 | Israel | N. Sinai | AF | A-4 | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | medium | 500 | 500 | - | F | | |
| 791007 | Israel | Izrael Val. | AF | Kfir | | FA | 1 | wo | 1 | 1 | 0 | Ap | D | Pelican, G.Wh. | 900 | 220 | - | F | | |
| 830504 | Israel | Judean Des. | AF | A-4 | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Buzzard, Hone | 300 | 420 | P | - | | |
| 881218 | Israel | Judean Des. | AF | F-16 | | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Eagle, Golden | 300 | 420 | - | F | | 016 |
| 950810 | Israel | Negev | AF | F-15 | B/D | FA | 2 | wo | 2 | 0 | 2 | CrL | D | storks | 300 | 550 | - | F | F | |
| **Italian AF** | | | | | | | | | | | | | | | | | | | | |
| 890620 | Italy | near Ghedi | AF | Tornado | IDS | FA | 2 | wo | 2 | 2 | 0 | CrL | D | poss. birdstrike | 800 | 225 | | F | | 7077 |
| 891107 | Italy | near Lecce | AF | G-91 | Y | FA | 2 | wo | 1 | 1 | 0 | CrL | D | unkn. | 900 | 400 | - | F | | 6464 |
| 940601 | Italy | Poggiorsini | AF | MB339 | A | T | 1 | wo | 2 | 2 | 0 | CrH | D | swifts? | 2500 | 250 | - | F | I | 54464 |
| **Netherlands AF** | | | | | | | | | | | | | | | | | | | | |
| 590220 | Nether. | Soesterberg | AF | Hunter | Mk.6 | FA | 1 | wo | 1 | 1 | 0 | Cl? | | unkn. | <8000 | | - | F | | |
| 590915 | W. Germ. | Gronau | AF | Hunter | Mk.6 | FA | 1 | wo | 1 | 1 | 0 | CrH | N | unkn. | 2500 | | - | F | | |
| 600707 | Nether. | Leeuwarden | AF | Hunter | Mk.4 | FA | 1 | wo | 1 | 0 | 0 | TO | N | gulls | 0 | [low] | | F | | |
| 610620 | Nether. | Eindhoven | AF | F-84 | F | FA | 1 | wo | 1 | 0 | 0 | TO | | unkn. | 0 | [low] | | | | |
| 640729 | Nether. | Soesterberg | AF | Hunter | Mk.6 | FA | 1 | wo | 1 | 0 | 0 | Cl | | unkn. | low | | - | I | | |
| 750711 | W. Germ. | Wiesbaden | AF | NF-5 | | FA | 2 | wo | 1 | 1 | 1 | TO | | Kestrel, Eur. | 0 | [low] | - | F | | |
| 790301 | W. Germ. | Steinfeld | AF | F-104 | | FA | 1 | wo | 1 | 1 | 0 | CrH | | buzzard? | >2500 | | - | F | | D-8280 |
| 811201 | W. Germ. | Jever | AF | F-104 | G | FA | 1 | wo | 1 | 0 | 0 | CrL | | Duck, Eider | 4-500 | | - | - | W I | D-8133? |

APPENDIX 2: Serious military aircraft accidents attributable to birds in Europe and Israel, and for European aircraft elsewhere (cont'd).

See Table 1 for services and years covered. Blanks denote "unknown". For explanatory notes, see last page of Appendix 2.

| Date | | | | Aircraft | | | | Acc. | # Persons | | | Flight | | | Altitude | | Parts Hit | | | Aircraft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y M D | Location | Where Struck | Service | Type | Sub-type | Category | | Category | Ab. | Ej. | Killed | Phase/ Time | | Type of Bird(s) Struck | AGL (feet) | Speed (knots) | Ws | En | Other | Registration |
| 831004 | Nether. | Leeuwarden | AF | F-16 | A | FA | 1 | wo | 1 | 0 | 1 | TO | | Heron, Grey | 0 | | - | F | | J-252 |
| 900504 | Nether. | Eindhoven | AF | NF-5 | A | FA | 2 | dbr | 1 | 1 | 0 | T&G | | Pigeon, Hom. | low | | - | I | | K-3044 |
| Norwegian AF | | | | | | | | | | | | | | | | | | | | |
| 710809 | Norway | Lista | AF | F-5 | A | FA | 2 | wo | 1 | 0 | 1 | CrL | D | Gull, Les.Bl.-bk | 500 | 3-400 | P | - | | 67-14894 |
| 810602 | Norway | Tunhavdfjorden | AF | F-16 | A | FA | 1 | wo | 1 | 1 | 0 | CrH | D | Crane, Eur. | 2500 | 450 | P | - | | 78-0280 |
| 950504 | Norway | Moss, Ostfold | AF | F-16 | B | FA | 1 | wo | 2 | 2 | 0 | Cl | D | Gull, Gr. Bl.-bk. | 1100 | 320 | - | F | | 78-0307 |
| Portuguese AF | | | | | | | | | | | | | | | | | | | | |
| 880309 | Portug. | Peniche | AF | A-7 | P | FA | 1 | wo | 1 | 1 | 0 | CrL | D | seabird | 350 | 360 | - | F | | 5516 |
| 920429 | Portug. | Alcochete Ran. | AF | A-7 | P | FA | 1 | wo | 1 | 0 | 1 | CrH | D | unkn. | 2-4.5k | 3-450 | S | - | | 5523 |
| Swedish AF | | | | | | | | | | | | | | | | | | | | |
| 670627 | Sweden | Ronneby | AF | Lansen | A | FA | 1 | wo | 2 | 0 | 0 | Cl | | gull | 20 | TO | - | F | | |
| 690313 | Sweden | Skagerrak | AF | Lansen | A | FA | 1 | wo | 2 | 2 | 0 | CrL | | large | 100 | 430 | - | F | | |
| 700531 | Sweden | Soderhamn | AF | Lansen | A | FA | 1 | wo | 2 | 2 | 2 | Cl | | Starlings, Eur. | 35 | 175 | | F | | |
| 730416 | Sweden | G. Bothnia | AF | Draken | S | FA | 1 | wo | 1 | | 1 | CrL | | unkn. | 165 | 595 | | | | 35933 ? |
| 731017 | Sweden | Norrkoping | AF | Draken | J | FA | 1 | wo | 1 | 0 | 0 | TO | | gulls | 0 | 165 | S | | | 35379 ? |
| 741005 | Sweden | S Baltic Sea | AF | Lansen | A | FA | 1 | wo | 1 | 1 | 1 | CrL | | unkn. | 165 | 430 | - | F | | |
| 760830 | Sweden | Nykoping | AF | Lansen | S | FA | 1 | wo | 2 | 2 | 0 | Cl | | unkn. | TO | 160 | - | F | | |
| 770321 | Sweden | Skagerrak | AF | Viggen | AJ | FA | 1 | wo | 1 | 0 | 1 | CrL | | prob. birdstrike | ~85 | 595 | S | - | | 37032 ? |
| 770901 | Sweden | Karlsborg | AF | Lansen | A | FA | 1 | wo | 1 | 0 | 0 | TO | | small, >1 | 0 | 110 | | | | |
| Swiss AF | | | | | | | | | | | | | | | | | | | | |
| 741023 | Switzerl. | Payerne | AF | Mirage III | S | FA | 1 | wo | 1 | 1 | 0 | Cl | D | Gulls, Bl.-head. | 50 | 190 | S | F | | |
| 910812 | Switzerl. | Bellechasse | AF | Hunter | F.58 | FA | 1 | dbr | 1 | 0 | 0 | Dem | D | unkn. | <1650 | 405 | - | - | W I | J4028 |
| United Kingdom (AF, Navy, Army) | | | | | | | | | | | | | | | | | | | | |
| 530730 | France | | AF | Vampire | | FA | 1 | wo? | | 0? | 0? | CrL? | | >1 | low | | | I | W F | |
| 531023 | UK/En. | Souden | AF | Canberra | B.2 | B | 2 | wo | 2 | 0? | 2 | Cl | | >1 | v.low | [low] | | F | U | WF892 |
| 550226 | UK/En. | Wendling | AF | Meteor | | FA | 2 | wo | | | | CrL? | | unkn. | low | | | | | |
| 560127 | UK/Sc. | Morayshire? | AF | Vampire | FB.5 | FA | 1 | dbr | 1 | 0 | 0 | CrL? | | unkn. | low | | | | | VZ286 |
| 560202 | HongKo. | Sek Kong | AF | Vampire | FB.9 | FA | 1 | dbr | 1 | 0 | 0 | cir. | | unkn. | | | | | | WG850 |
| 561003 | UK/Sc. | Leuchars | AF | Hunter | F.4 | FA | 1 | wo | 1 | | | 'TO' | | unkn. | 'TO' | [low] | - | I | | XE705 |

APPENDIX 2: Serious military aircraft accidents attributable to birds in Europe and Israel, and for European aircraft elsewhere (cont'd).

See Table 1 for services and years covered. Blanks denote "unknown". For explanatory notes, see last page of Appendix 2.

| Date | | | | Aircraft | | | | Acc. | # Persons | | | Flight | | | Altitude | | Parts Hit | | | Aircraft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ser- | | Sub- | Cate- | | Cate- | A | E | Kil- | Phase/ | Type of | | AGL | Speed | W | E | | Regis- |
| Y M D | Location | Where Struck | vice | Type | type | gory | | gory | b. | j. | led | Time | Bird(s) Struck | | (feet) | (knots) | s | n | Other | tration |
| 561101 | UK/En. | Norfolk? | AF | Hunter | F.1 | FA | 1 | dbr | 1 | 0 | 0 | CrL? | unkn. | | low | | | | | WW600 |
| 570410 | UK/Wa. | Anglesey? | AF | Vampire | T.11 | FA | 1 | dbr | 2? | 0? | 0? | CrL? | gulls | | 500 | | - | - | W I | XH319 |
| 570522 | UK/En. | Devon? | AF | Hunter | F.1 | FA | 1 | dbr | 1 | 0 | 0 | | unkn. | | | | | | | WT681 |
| 570628 | UK/Sc. | Leuchars | AF | Hunter | F.4 | FA | 1 | wo | 1 | 0 | 0 | cir. | unkn. | | | | | | | XF997 |
| 571114 | UK/Sc. | Kinloss | AF | Hunter | F.4 | FA | 1 | dbr | 1 | 0 | 0 | Cl | unkn. | | 1800 | 300 | - | I | I | WT719 |
| 580212 | UK/En. | Linton on Ouse | AF | Vampire | FB.5 | FA | 1 | dbr | 1 | 0 | 0 | 'TO' | unkn. | | 'TO' | [low] | | | | WA257 |
| 591110 | UK/En. | Lincs.? | AF | Hunter | F.4 | FA | 1 | dbr | 1 | 0 | 0 | CrL? | gulls | | 300 | | | I | I | XF953 |
| 591118 | Aden | Khormaksar | AF | Venom | FB.5 | FA | 1 | wo | 1 | | | | unkn. | | | | | | | WR531 |
| 600329 | Aden | | AF | Hunter | FGA. | FA | 1 | dbr | 1 | 0 | 0 | CrL | gull | | 250 | 400 | | | | XF424 |
| 600507 | UK/En. | Somerset | AF | Vampire | FB.5 | FA | 1 | wo | 1 | | | CrL? | unkn. | | 100 | | | | | WA445 |
| 601109 | W. Germ. | near Jever? | AF | Hunter | F.6 | FA | 1 | dbr | 1 | 0 | 0 | CrL | unkn. | | 250 | 390 | | | | XE590 |
| 610316 | W. Germ. | near Jever? | AF | Swift | FR.5 | FA | 1 | dbr | 1 | 0 | 0 | | unkn. | | | | - | - | I | WK295 |
| 620904 | UK/En. | Swinderby | AF | Vampire | T.11 | FA | 1 | wo | 2? | 0? | 0? | TO | gulls+plovers | | 0 | 100 | | | | XD448 |
| 640817 | HongKo. | Kai Tak | AF | Canberra | B.15 | B | 2 | wo | | | | TO | D | Kites, Black-ear. | TO | [low] | - | I | | WH958 |
| 640930 | UK/En. | Jedburgh | AF | Jet Prov. | T.4 | T | 1 | wo | 2? | 2? | 0 | CrL | D | large | 300 | 190 | | | | XR664 |
| 650714 | Nether. | Roermond | AF | Canberra | B(I)6 | B | 2 | wo | | | 2? | OvSh | | unkn. | 300 | 130 | - | F | | WT324 |
| 660727 | UK/En. | N. Frodingham | AF | Jet Prov. | T.4 | T | 1 | wo | 2? | 2? | 0? | CrL | D | unkn. | 250 | 180 | | | | XP625 |
| 681120 | UK/En. | Watton | AF | Canberra | T.17 | B | 2 | dbr | | | | TO | D | gull | TO | 105 | - | I | | WJ988 |
| 710225 | W. Germ. | | AF | Canberra | PR.7 | B | 2 | dbr | | 0? | 0? | CrL | | unkn. | 100 | 300 | S | - | N | WT523 |
| 710629 | UK/En. | Dishforth | AF | Jet Prov. | T.3 | T | 1 | wo | 2 | 2 | 0 | Ap | D | large | 300 | 110 | - | F | F | XN558 |
| 720426 | UK/En. | The Wash | AF | Harrier | GR.1 | FA | 1 | wo | 1 | 1 | 0 | CrL | D | gulls | 500 | | | F | | XV749 |
| 720504 | Denmark? | | AF | Harrier | GR.1 | FA | 1 | wo | 1 | 1 | 0 | CrL | D | large | 400 | 360 | - | I | | XV794 |
| 720627 | W. Germ. | Wesel | AF | Harrier | GR.1 | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Gull, Bl.-head.? | 700 | 420 | - | F | N | XV780 |
| 730709 | W. Germ. | Wildenrath | AF | Harrier | GR.3 | FA | 1 | wo | 1 | 1 | 0 | Cl | D | >1 | 20 | 135 | | F | | XV791 |
| 731012 | UK/En. | Leeming | AF | Gnat | T.1 | T | 1 | 'dbr' | 2 | 0 | 0 | CrL | D | small, several | 250 | 360 | | I | N I | XR537 |
| 740107 | UK/En. | near Mansfield | AF | Jet Prov. | T.4 | T | 1 | dbr | 1+ | 0? | 0 | CrL | D | Pigeon, Wood | 300 | 230 | S | - | N | XP548 |
| 740516 | W. Germ. | Wildenrath | AF | Harrier | GR.3 | FA | 1 | wo | 1 | 1 | 0 | Cl | | small | 20 | 20 | - | F | | XV800 |
| 760928 | UK/En. | Marham | AF | Victor | K.2 | K | 4 | wo | | 0 | 0 | TO | D | gulls | 0 | 145 | - | - | NWF | XL513 |
| 790326 | W. Germ. | near Sudlohn | AF | Jaguar | T.2 | FA | 2 | wo | 2 | 2 | 0 | CrL | D | Rook | 250 | 240 | P | F | | XX147 |
| 800312 | UK/Wa. | Lampeter | AF | Harrier | GR.3 | FA | 1 | wo | 1 | 1 | 0 | CrL | D | buzzard | 200 | 420 | S | F | | XW765 |
| 800731 | UK/En. | Elvington | AF | Jet Prov. | T.3A | T | 1 | wo | 1 | 1 | 0 | Cl | D | Pigeons, Hom. | 400 | 140 | | F | M | XN590 |

APPENDIX 2: Serious military aircraft accidents attributable to birds in Europe and Israel, and for European aircraft elsewhere (cont'd).

See Table 1 for services and years covered. Blanks denote "unknown". For explanatory notes, see last page of Appendix 2.

| Date | | | | Aircraft | | | | Acc. | # Persons | | | Flight | | | Altitude | | Parts Hit | | | Aircraft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y M D | Location | Where Struck | Service | Type | Sub-type | Category | | Category | A b. | E j. | Killed | Phase/ | Time | Type of Bird(s) Struck | AGL (feet) | Speed (knots) | W s | E n | Other | Registration |
| 801117 | UK/Sc. | Kinloss | AF | Nimrod | MR.2 | P | 4 | wo | 20 | na | 2 | Cl | T | Gulls, Bl-h+Com. | 20 | 138 | S | F | NWTF | XV256 |
| 810601 | UK/Sc. | Forfar | AF | Jaguar | T.2 | FA | 2 | wo | 2 | 2 | 0 | CrL | D | Gull, Bl.-head. | 300 | 450 | P | F | | XX828 |
| 810724 | UK/En. | Bristol Channel | 'AF' | Jaguar | T.2 | FA | 2 | wo | 2 | 2 | 1 | CrL | D | gull | 500 | 450 | P | F | | XX916 |
| 821020 | UK/En. | Chivenor | AF | Hawk | T.1 | T | 1 | wo | 1 | 1 | 0 | Ap | N | unkn. | 350 | 130 | - | F | | XX300 |
| 830919 | UK/Sc. | Lossiemouth | AF | Jaguar | GR.1 | FA | 2 | wo | 1 | 1 | 0 | Ap | D | Lapwings | 100 | [low] | | F | U | XX114 |
| 831121 | UK/En. | Settle | AF | Jet Prov. | T.3A | T | 1 | wo | 2 | 2 | 0 | CrL | D | >1 | low | | | F | U | XM453 |
| 840815 | UK/En. | Cranwell | AF | Jet Prov. | T.3A | T | 1 | dbr | 2 | 0 | 0 | Cl | | Avoiding Birds | 25 | low | - | - | - | XN473 |
| 841107 | UK/Wa. | Mona | AF | Hawk | T.1 | T | 1 | wo | 2 | 2 | 0 | T&G | D | Lapwings | 100 | 140 | - | F | F | XX180 |
| 841129 | S. Atlan. | Stanley, Falkl | AF | Harrier | GR.3 | FA | 1 | wo | 1 | 1 | 0 | CrL | D | seabird, large | 250 | 480 | S | - | N | XZ992 |
| 860929 | UK/En. | near Thirsk | AF | Bulldog | T.1 | pT | 1 | wo | 2 | na | 0 | Cl | | Avoid Sim. Birds | ~250 | [low] | - | - | - | XX514 |
| 890914 | UK/En. | Abingdon | AF | Tornado | GR.1 | FA | 2 | wo | 2 | 2 | 0 | Cl | T | gulls | 150 | 170 | | F | | ZD710 |
| 910925 | UK/En. | Great Driffield | AF | Harrier | T.4A | FA | 1 | wo | 2 | 2 | 0 | CrL | D | Gulls, Bl.-head. | 250 | | P | - | U | XZ147 |
| 930628 | UK/En. | W of Coningsby | AF | Harrier | GR.7 | FA | 1 | wo | 1 | 1 | 0 | CrL | D | prob. birdstrike | low | | - | - | W | ZD430 |
| 580428 | UK/Sc. | Morayshire? | Na | SeaHawk | FB.3 | FA | 1 | dbr | 1 | 0 | 0 | | | unkn. | | | - | I | I | WM981 |
| 581028 | Nigeria | ENE of Kano | Na | SeaVixen | FAW | FA | 2 | wo | 2 | 2 | 0 | CrL | D | vulture | 100 | 450 | - | I | | XJ479 |
| 621115 | UK/Sc. | Firth of Tay | Na | Scimitar | F.1 | FA | 2 | wo | 1 | 1 | 0 | CrL | | gull? | 400 | 420 | - | I | | XD265 |
| 841201 | UK/Sc. | Ft. William | Na | SeaHarri. | FRS. | FA | 1 | wo | 1 | 1 | 0 | CrL | D | unkn. | 500 | 420 | - | F | | XZ458 |
| 851129* | UK/En. | English Channel | Na | Hunter | GA.1 | FA | 1 | dbr | 1 | 0 | 0 | CrL | | unkn. | 250 | 450 | - | - | I | WV267 |
| 871015 | N.Ireland | off NW Ireland | Na | SeaHarri. | FRS. | FA | 1 | wo | 1 | 1 | 0 | CrL | D | large | 250 | 480 | - | F | | ZA190 |
| 860429 | UK/En. | Catterick | Ar | Gazelle | AH.1 | H | 1 | dbr | 4 | na | 0 | | D | Avoiding Birds | 125 | [low] | - | - | - | XZ336 |
| 911114 | N.Ireland | Gortin Gap | Ar | Lynx | AH.7 | H | 2 | wo | 11 | na | 1 | CrL | D | Avoiding Birds | low | [low] | - | - | - | XZ186 |
| United States (Europe only) | | | | | | | | | | | | | | | | | | | | |
| 750305 | UK/En. | Shapfell | AF | F-111 | E | FA | 2 | wo | 2 | | 0? | CrL | | gulls | 1000 | | ? | ? | M | 68-0081 |
| 751105 | UK/En. | Boston | AF | F-111 | E | FA | 2 | wo | 2 | 2 | 0 | CrL | D | duck | 400 | 480 | S | - | | 68-0060 |
| 801113 | Spain | Bardenas Ran. | AF | F-4 | E | FA | 2 | wo | 2 | 1+ | 1 | CrH | D | hawk | 3500 | 450 | P | - | | 68-0475? |
| 840809 | UK/Sc. | Tain Ran. | AF | F-111 | E | FA | 2 | wo | 2 | 2 | 0 | CrL | D | Gull, Herring | 200 | 530 | - | I | N | 68-0019 |
| 861008 | Spain | Bardenas Ran. | AF | F-16 | A | FA | 1 | wo | 1 | 1 | 0 | CrL | D | Vulture, Griffon | low | hi | - | F | I | 82-0998? |
| 870520 | Spain | Bardenas-Reales | AF | F-4 | E | FA | 2 | wo | 2 | 0 | 2 | CrH | D | Vulture, Griffon | 2000 | | P | - | | 72-0160? |
| 840908* | W. Germ. | Wiesbaden | Ar | RV-1 | D | O | 2 | wo | 2 | 2 | 0 | Cl | | >1 | [low] | [low] | | F | U | 64-14238? |

APPENDIX 2: Serious military aircraft accidents attributable to birds in Europe and Israel, and for European aircraft elsewhere (cont'd).

See Table 1 for services and years covered. Blanks denote "unknown". For explanatory notes, see last page of Appendix 2.

| Date | | | | Aircraft | | | | Acc. | # Persons | | | Flight | | | Altitude | | Parts Hit | | | Aircraft |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y M D | Location | Where Struck | Ser-vice | Type | Sub-type | Cate-gory | | Cate-gory | A b. | E j. | Kil-led | Phase/ Time | | Type of Bird(s) Struck | AGL (feet) | Speed (knots) | W s | E n | Other | Regis-tration |
| Former USSR (very incomplete) | | | | | | | | | | | | | | | | | | | | |
| ? | Asia | Lake Chany | AF | MiG-17 | | FA | 1 | wo | 1 | 0? | 1 | CrL? | | swan | v.low | | | | | |
| 5304__ | Ukraine | Chernovtsy | AF | Il-28 | | B | 2 | wo | | | | | | cranes | 650 | | P | | N | |
| 60summer | Ukraine | Odessa (Arciz) | AF | Il-28 | | B | 2 | wo | | | 1+ | | | bustard | | | P | - | | |
| 6604__ | Estonia | Tallinn | AF | MiG-17 | | FA | 1 | wo | 1 | 0? | 1 | | D | Crane, Eur. | 2600 | 380 | P | - | | |
| 6804__ | USSR? | Baltic region | AF | MiG-21 | | FA | 1 | wo | 1 | 1 | 0? | | D | stork | 985 | 380 | - | F | | |
| 701007 | E. Germ. | Allstedt | AF | ? | | FA | | wo | 1 | 1 | 0 | Ap | T | Lapwings | 1000 | 215 | | F | | |
| 8003__ | Ukraine | Kcharkov Oblast | AF | MiG-21 | | FA | 1 | wo | | | | | D | Rooks | 330 | 162 | | F | | |
| 820710 | Russia | Borisoglebsk | AF | MiG-21 | | FA | 1 | wo | 1 | 1 | 0 | Ap | N | Swift | 395 | 200 | - | F | | |
| 890608 | France | Paris LeBourget | 'AF' | MiG-29 | A | FA | 2 | wo | 1 | 1 | 0 | Dem | D | unkn. | 525 | 97 | - | F | | |
| 911119 | E. Germ. | Juterbog | AF | MiG-23 | UM | FA | 1 | wo | 2 | 2 | 0 | Ap | D | goose | 500 | 215 | - | F | | |

* Unofficial report of uncertain accuracy.

Aircraft Categories: B=Bomber; FA=Fighter/Attack; H=Helicopter; K=Tanker; O=Other; P=Patrol; pT=piston-engined Trainer; T=Trainer. Following digit shows number of engines.

Accident Categories: wo = aircraft written off (destroyed); dbr = damaged beyond (economical) repair.

# Persons: Ab. = Number of aircrew aboard; Ej. = # who ejected; Killed = # aircrew killed or (in one Belgian AF case) # killed on ground.

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; La = Land; T&G = Touch and Go landing; OvSh = Overshoot; Dem = Demonstration flight; cir. = in circuit; Hov = Hover.

Time: D = Day; N = Night; T = Twilight.

Parts Hit. Ws = Windscreen: - = not struck; S = struck, not reported as penetrated; P = penetrated.
En = Engine(s): - = no ingestion; I = ingestion, damage limited or uncertain; F = engine failure after ingestion.
Other parts reported struck: A = Probe; F = Fuselage; I = Intake; L = Landing gear; M = Multiple parts; N = Nose or radome; T = Tail; U = Unknown other parts; W = Wing(s).