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BIRD STRIKE COMMITTEE EUROPE

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BIRD STRIKES DURING 1978 TO EUROPEAN REGISTERED CIVIL AIRCRAFT
(Aircraft over 5700 kg Maximum Weight)

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Summary

The strikes reported throughout the World in 1978 by operators from eleven European countries have been analysed. The analysis includes rates for countries, aircraft types and aerodromes based on aircraft movements. It also covers bird species, part of aircraft struck, effect of strike, cost and airlines affected.

The strike rate in 1978 was the same as in the previous year. Gulls (Larus spp.) were involved in nearly half the incidents. The major effects were the destruction of a Boeing 737, and damage to 60 engines. During the year bird strikes were estimated to have cost European airlines at least 3.2 million US dollars in engineering repairs, to which must be added the value of the Boeing 737 (about £4.5 million).

CONTENTS

This study is based on information supplied and the accuracy and detail is only as good as that reported.

1 INTRODUCTION

1.1 In order that a common basis for the analysis of bird strike data could be agreed, a Working Group of the Bird Strike Committee Europe was formed in 1972, led by the representative from the United Kingdom Civil Aviation Authority Airworthiness Division at Redhill. After consultation with other member countries, sets of Analysis Tables with explanatory Notes were circulated to all members of the BSCE, together with a request that each country produced an analysis on their bird strikes. These analyses were consolidated to form an annual report on Bird Strikes to European Registered Civil Aircraft, and reports covering the individual years 1972 to 1977 inclusive have been presented to annual BSCE meetings. This paper presents the 1978 analysis.

1.2 Appendix 1 contains the Tables of data relating to this paper.

1.3 Appendix 2 provides brief details of serious world-wide bird strike incidents.

2 SCOPE

For the following reasons, the analysis includes all civil aircraft of over 5700 kg (12 500 lb) maximum weight, and executive jets which weigh just less than 5700 kg, eg Lear and Citation.

(a) the airworthiness requirements relating to bird strikes are different for the smaller class of aeroplanes,

(b) much more is known about the reporting methods of operators of transport types, and their movement data is more readily available than that for air taxi or private owner aircraft,

(c) aircraft of less than 5700 kg are in general, much slower with a different mode of operation, requiring less airspace, and a noticeably different strike rate would be expected.

3 DISCUSSION

3.1 ANNUAL RATE/COUNTRY (see Table 1)

(a) Information has been obtained from a total of 11 European countries. A few of these were not able to provide full information, and their data, therefore, appears in some tables and not in others.

(b) The overall strike rate for the 1488 incidents contained in this analysis is 5.5 per 10,000 movements (two movements per flight). This is the same as the rate of 5.5 recorded during 1977 (5.2 in 1976).

(c) The strike rate reported by each country is dependent upon two major factors -

- reporting standard

- the bird strike problem at airports within that country, and that country's airlines route structure.

(d) The country with the highest reported strike rate is Switzerland with 12.3 per 10,000 movements, followed by Germany with 9.8.

3.2 AIRCRAFT TYPES (see Table 2)

(a) Jet Aeroplanes

(i) For several years there appears to have been no consistent correlation between aircraft of similar design, eg DC8 and B707, BAC 1-11 and DC9. It may be that aircraft which appear similar to humans are not similar to birds, and there are other factors such as noise patterns, which can affect the strike rate.

(ii) Again in the 1978 data there is a distinct correlation between strike rate and aircraft frontal area, the rate for the four wide-bodied aircraft being 7.1, well above the mean for all jets of 5.9, although there are considerable variations between some aircraft of similar size. The most glaring discrepancy, for which no explanation has been found, is between the rates for the DC10 and L1011 Tristar. For reasons which are not clear, the reported DC10 rate is much greater than that for the L1011 Tristar.

(b) Turboprop Aeroplanes

The average strike rate for all turboprops is significantly less than that for jets.

(c) Piston Aeroplanes

Very few strikes were recorded to piston engined aeroplanes.

(d) Helicopters

The number of strikes reported to helicopters is very low, only eleven. Because helicopters fly mainly at low altitude where birds are most frequently found, they are continuously exposed to the risk of a strike. Therefore flying hours have been used to determine a strike rate. For reasons which are not at present known, the rate is low at 1.3 per 10,000 hours.

3.3 AERODROMES (see Table 3)

(a) The aerodrome data is of particular importance as it may indicate where bird control measures need to be taken. Some countries were able to provide aerodrome movement data for their nationally registered aircraft, so that a national rate could be quoted.

The total number of strikes at each aerodrome, reported by all European sources has also been included.

(b) Strikes reported on aerodromes are influenced by one or more of the following:

(i) reporting standards

(ii) the prevailing bird situation which may vary according to place and time

(iii) the number of aircraft movements

(iv) the effectiveness of bird control measures

(v) local factors, perhaps beyond control of the aerodrome, eg a rubbish dump or bird roost site in the vicinity.

(c) Because of factors outlined in (b), direct comparison of the reported strike rates for different aerodromes is likely to be misleading.

(d) The aerodromes with high numbers of strikes (over 40) are Dusseldorf, Frankfurt, Hamburg, Amsterdam, London-Heathrow and Zurich. However, most of these airports are known to have a high number of aircraft movements and a difficult bird problem but, through effective use of bird control measures, have managed to maintain a commendably low strike rate. This demonstrates what can be achieved.

(e) Significant numbers of strikes have been reported at some aerodromes outside Europe. Thirteen strikes were reported at Delhi, and the numbers at Bangkok, Nairobi, New York JFK, and Dakar appear to be rather high, since the number of movements by European aircraft at most of these aerodromes is comparatively low.

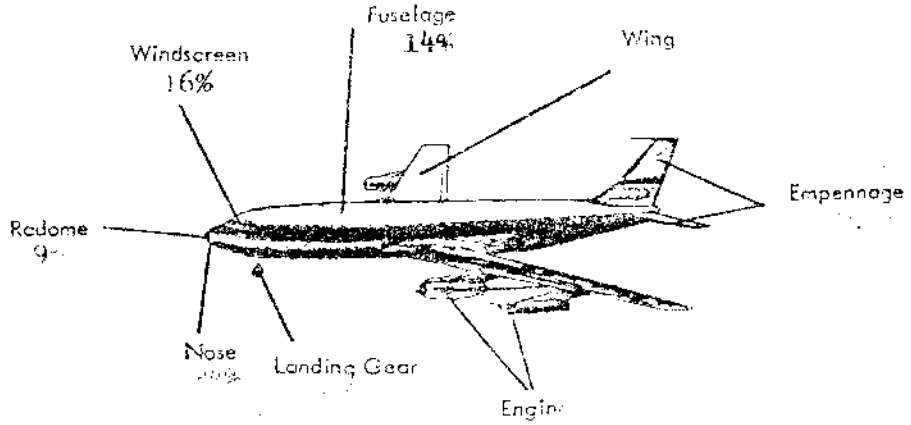
(f) There were 60 incidents where the aircraft was considered to be en-route.

3.4 BIRD SPECIES (see Table 4)

Some knowledge of the bird species involved was available in 688 incidents (46%). The identification standard ranged from examination of bird remains by a trained ornithologist, to the fleeting glance of a pilot. Overall 41.4% of strikes involved gulls (Larus spp), of which the black-headed gull (Larus ridibundus) and Common gull (Larus canus) were the most frequently identified. Next on the list were the combination of swifts, swallows and martins with 13.5%, followed by Lapwings (Vanellus vanellus) with 11.2%, birds of prey at 7.6% and pigeons (Columba spp) with 7.3%. The percentage of gull and lapwing strikes was similar to the previous year. Less than 1% of incidents (4 cases) were known to involve birds of greater than 1.81 kg (4 lb).

3.5 PART OF AIRCRAFT STRUCK (see Table 5)

(a) From the figure it can be seen that the parts most frequently reported as being struck were nose with 24%, windscreen with 16%, engines 15%, followed by fuselage with 14%. It should be noted that there were 17 incidents where more than one engine was struck, of which three involved all engines.



3.6 EFFECTS OF STRIKES (see Table 6)

(a) A Belgian registered Boeing 737 was destroyed [illegible] accident at Gosselies in Belgium (See Appendix 2).

(b) During the period covered by this paper 60 engines were damaged such as to require repair or replacement. Of these 37 were on twin-engined aircraft. It appears that 25 of engine strikes involve engine damage.

(c) Only 4 windscreens were changed, a small number when compared with 250 windscreen strikes (2%). It is thought that none of these incidents involved penetration of the windscreen.

(d) There were 12 cases of [illegible] damage, out of 142 radome strikes, (9%). In most cases the radome was only delaminated, but in a few cases it was shattered. The radome strength is limited by the need for dielectric properties enabling satisfactory operation of the weather radar.

3.7 COST (see Table 7)

Only four countries (Denmark, Norway, Switzerland and Sweden) have provided information on costs. From this it is estimated that the engineering cost to all European operators is at least [illegible] million US dollars (similar to that estimated for the two previous years) to which must be added the value of a B737 (about £4.5 million).

3.8 AIRCRAFT OPERATORS (see Table 8)

This table provides a guide to the reporting rates of individual airlines. It is probable that it is considerably affected by the airport(s) at which the airline has its main base.

4 CONCLUSIONS

4.1 The overall rate for the 1488 strikes reported during this period by European operators is 5.5 strikes per 10,000 movements This rate is the same as in the previous year.

4.2 There does not appear, from the available data, to be any close correlation between the strike rate and the aeroplane type, in terms of speed, engine type, etc. However, despite considerable variations between types, there is a distinct correlation between strike rate and aircraft size. There is no evidence that the strike rate of executive jet aeroplanes is above that which would be expected for their frontal area. It may be that aircraft types which appear to be similar to humans are not similar to birds, and there are other factors, such as noise patterns, which may affect the strike rate. The continued long term collection of statistics may provide fuller information.

4.3 There are some airports outside Europe where the number of bird strikes reported by European operators is high even though movements by European registered aircraft at these airports are believed to be low.

4.4 Gulls (Larus spp) were struck more frequently than other birds, being involved in 46% of incidents. Less than 1% of strikes were known to involve birds of greater than 1.8 kg (4 lb). The application of measures to keep gulls away from aerodromes is therefore of prime importance.

4.5 The nose section including windscreen and radome were struck in 49% of incidents, followed by the fuselage with 14%. Approximately 1% of all incidents involved more than one engine.

4.6 The major effect was the destruction of a Boeing 737. There was also damage to 60 engines, approximately 1 in 4 of the engine strikes, and 12 cases of radome damage, approximately 1 in 10 radome strikes.

4.7 Based on information provided by four countries, the estimated minimum engineering cost of bird strikes to European airlines was at least 3.2 million US dollars in the year, to which must be added the value of a Boeing 737 (about £4.5 million).

Table 1 National Reporting - 1978

(All airlines in each country, reporting world-wide)

Reporting Nation	Number of Incidents World Wide	Number of Movements World Wide	Rate per 10,000 Movements
Austria	12	40,400	3.0
Belgium	38	125,804	3.0
Denmark	52	121,[illegible]	4.0
France	92 (5)	258,618	3.6
Germany	439	449,060	9.8
Netherlands	125	196,605	6.4
Norway	23 (7)	121,190	1.9
Portugal	2	[illegible],172	0.9
Sweden	64	122,[illegible]96	[illegible]
Switzerland	237	191,192	12.3
United Kingdom	402	989,602	4.1
Total	1488 (12)	2,689,321	[illegible]

Notes:

1.1 Other European countries not reporting at all: Czechoslovakia, Finland, Greece, Hungary, Italy, Poland, Spain, Turkey, Yugoslavia, Luxembourg, Romania, Bulgaria.

1.2 Movement data for Germany is from ICAO-sources and is for Lufthansa only.

1.3 Data from Switzerland is for Swissair only.

1.4 Helicopters are excluded from this table.

1.5 The figures in brackets are strikes for which no movement data is available.

1.6 Table 8 gives a breakdown by airlines.

Table 2 Aircraft Type - 1978

Type	Aircraft	Number of countries Reporting	[illegible]	[illegible]	Rate per 10,000 movements
JET					
4 engined	McDonnell Douglas DC 8	7	[illegible] (-)	[illegible]	10.4
	Boeing 707	6	[illegible]	183,229	5.4
	BAC VC 10	1	11	[illegible]	4.9
	Boeing 747	8	[illegible]	113,227	4.6
	HS Comet 4	1	[illegible]	14,984	1.4
	Concorde	1	0	[illegible]	0
3 engined	McDonnell Douglas DC 10	6	113 (2)	96,161	11.7
	Boeing 727	5	181	278,240	6.5
	HS Trident	1	82	143,674	5.7
	Lockheed 1011 Tristar	2	10	25,784	3.9
2 engined	Boeing 737	5	211	295,252	7.1
	McDonnell Douglas DC 9	7	279 (16)	419,189	6.6
	A 300 B Airbus	3	44	70,842	6.2
	Fokker F28 Fellowship	2	27	48,335	5.6
	Cessna 500 Citation	1	1	1,800	5.6
	[illegible]	1	16	42,898	3.7
	HS 125	3	10	33,472	3.0
	BAC 1-11	2	70	238,098	2.9
	SE 210 Caravelle	5	10 (12)	37,324	2.7
	SN 601 Corvette	1	1	16,000	0.6
	Falcon 20	2	0 (3)	1,260	0
	Corvette	2	0	850	0
	Lear Jet	1	0	2,282	0
	VFW 614	1	0	13,288	0
	Lear 35	1	0	836	0
	Lear 24	1	0	96	0
TURBOPROP					
4 engined	HS Argosy	1	2	3,270	6.1
	BAC Viscount	1	53	114,332	4.6
	BAC Merchantman	1	5	12,298	4.1
	Canadair CL44	1	2	6,642	3.0
	L188 Electra	1	1	550	-
	BAC Britannia	1	0	2,996	0
2 engined	HS 748	1	18	50,628	3.5
	HP Herald	1	12	76,418	1.6
	Fokker F27 Friendship	4	23	154,258	1.5
	Nord 262	2	1	7,486	1.3
	DHC 6 Twin Otter	2	1	119,250	0.1
	Embraer Bandeirante	1	0	1,300	0
	Short Skyvan	1	(1)	-	-

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Table 2 Aircraft Type - 1978 (Continued)

Type	Aircraft	Number of Countries Reporting	Number of Incidents	Number of Movements	Rate per 10,000 Movements
PISTON					
	DH 114 Heron	1	3	3,030	3.3
	Convair 440	1	3	11,460	2.6
	ATL 98 Carvair	1	0	1,282	0
	Douglas DC3 Dakota	1	0	14,934	0
	Douglas DC6	2	0	54,544	0
UNKNOWN		2	34	-	-
TOTAL		10	1418 (40)	2,842,458	5.0
HELICOPTERS	Sikorsky S61	2	7 (3)	52,165	1.3
	Agusta Bell 206A	1	(1)	-	-
	Others	1	-	-	-
	TOTAL HELICOPTERS	3	7 (4)	52,165	1.3

Table 2A Summary of Aeroplane Types

	Number of Incidents	Number of Movements	Rate per 10,000 Movements
Jet	1296 (38)	2,193,844	5.9
Turboprop	118 (2)	563,174	2.1
Piston	4	85,440	0.5
Unknown	- (35)		
TOTAL	1418 (75)	2,842,458	5.0

Notes: 2.1 Because of the low altitude of operation, and difficulty in collection of movement data, helicopter operations are quoted in hours.

2.2 The figures in brackets are for aircraft for which movement data is unavailable.

Table 3 Aerodromes - 1928

Aerodrome/Country	Incidents	Movements	Rate per 10,000 Movements	Incidents to other European Aircraft	Total Incidents
EUROPEAN AERODROMES					
Austria					
Klagenfurt				1	1
Linz				6	6
Salzburg				1	1
Vienna				7	7
Belgium					
Brussels	16			10	26
Gosselies	1			1	2
Ostend	1				1
Czechoslovakia					
Prague				4	4
Denmark					
Aalborg	1	2,573	3.89	3	4
Copenhagen	14	48,091	2.06	16	30
Esbjerg	4	2,843	14.07		4
Odense	2	3,096	6.46		2
Thisted	1	1,133	8.83		1
Eire					
Cork				3	3
Dublin				3	3
Shannon				1	1
Finland					
Helsinki				6	6
France					
Ajaccio	2	10,349	1.93		2
Bastia				3	3
Bordeaux-Merignac	3	20,255	1.48		3
Lille	2	11,980	1.67		2
Lyon-Satolas		42,190	1.43	1	8
Marseille		46,090	0.89	1	2
Nice	6	44,236	1.35	1	7
Paris (Charles de Gaulle)	6	104,429	0.92	10	16
Paris Le Bourget	4	15,381	1.95	1	5
Paris Orly	5	172,381	0.29	16	21
Pau-Pont	2	5,293	3.78	-	2
Toulouse-Blagnac	4	17,497	2.27	1	5

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Table 3 Aerodromes - 1978 (Continued)

Aerodrome/Country	Incidents	Movements	Rate per 10,000 Movements	Incidents to other European Aircraft	Total Incidents
Germany					
Berlin-Tegel				5	5
Bremen	15				15
Cologne	16			2	18
Düsseldorf	37			8	45
Frankfurt	65			6	71
Hamburg	42			3	45
Hanover	22			4	26
Munich	34			?	36
Nüremberg	8				8
Saarbrücken	?			1	3
Stuttgart	15			1	16
Greece					
Athens				?	?
Rhodes				6	6
Hungary					
Budapest				1	1
Italy					
Genoa				4	4
Milan				18	18
Naples				1	1
Rimini				1	1
Rome				10	10
Turin				1	1
Venice				3	3
Netherlands					
Amsterdam	29	72,216	4.02	18	47
Enschede	1				1
Groningen	1				1
Maastricht				1	1
Rotterdam	2	6,896	2.90		2
Norway					
Bergen				3	3
Bodo				2	2
Stavanger-Sola	1	61,898	0.16	3	4
Poland					
Warsaw				1	1
Portugal					
Faro				4	4
Lisbon	?			6	8

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Table 3 Aerodromes - 1978 (Continued)

Aerodromes/Country	Incidents	Movements	Rate per 10,000 Movements	Incidents to other European Aircraft	Total Incidents
Spain					
Alicante				3	3
Barcelona				3	3
Gerona				7	7
Ibiza				10	10
Madrid				2	2
Malaga				1	1
Minorca				13	13
Palma de Mallorca				3	3
Reus				1	1
Seville				3	3
Tenerife					
Sweden					
Ängelholm	5	3,200	15.6		5
Gothenburg-Landvetter	4	31,000	1.3	3	7
Halmstad	4	3,400	11.8		4
Jönköping				1	1
Kalmar	4	3,400	11.8		4
Karlstad	2	5,100	3.9		2
Malmö-Sturup	5	15,300	3.3	5	10
Stockholm-Arlanda	6	69,000	0.9	3	9
Stockholm-Bromma	5	33,500	1.5		5
Västerås-Hässlö	2	1,000	20.0	1	3
Växjo-Kronoberg	2	3,600	5.6	1	3
Switzerland					
Basle	19	10,599	17.9		19
Geneva	32	35,573	9.0	4	36
Zürich	69	55,388	12.5	8	77
Turkey					
Ankara				3	3
Instanbul				14	14
United Kingdom					
Aberdeen	4	63,794	0.6		4
Belfast-Aldergrove	27	22,844	11.8		27
Belfast-Harbour	2				2
Birmingham	23	25,839	8.9	2	25
Blackpool	2	10,044	2.8		2
Bournemouth-Hurn	6	11,850	5.1		6
Bristol-Lulsgate	3	5,569	5.4		3
Cardiff	2	7,950	2.5		2
East Midlands	4	15,216	2.6		4
Edinburgh	13	21,125	6.1		13
Exeter	2	5,600	3.6		2
Gatwick	13	83,865	1.5	1	14
Glasgow	8	39,229	2.0	2	10
Guernsey				4	4
Hatfield	2				2
Heathrow	30	143,126	2.1	12	42

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Table 3 Aerodromes - 1978 (Continued)

Aerodrome/Country	Incidents	Movements	Rate per 10,000 Movements	Incidents to other European Aircraft	Total Incidents
United Kingdom (Contd.)					
Inverness	3	13,034	2.3		3
Jersey				1	1
Kirkwall	3	11,284	2.6		3
Leeds-Bradford	7	11,179	6.3		7
Liverpool	6	10,911	5.5		6
Luton	11	20,016	5.5		11
Manchester	14	41,309	3.4		14
New Castle	3	16,856	1.8		3
Norwich	5	16,081	3.1		5
Prestwick	12	16,969	7.1		12
Ronaldsway	7	14,964	4.7		7
Stansted	3	8,666	3.5	2	5
Sumburgh	2	n/a	n/a		2
Tees-side	4	15,794	2.5		4
Yugoslavia					
Belgrade				1	1

List of Aerodromes where more than one strike has been reported by European Operators

OTHER AERODROMES

Delhi (India)	13	Toronto (Canada)	3
Bangkok (Thailand)	12	Montreal (Canada)	3
Nairobi (Kenya)	11	Bangui (Rep.Cent. Africa)	2
New York-JFK (U.S.)	8	Banjul (Gambia)	2
Dakar (Senegal)	7	Beirut (Lebanon)	2
Lagos (Nigeria)	7	Buenos Aires (Argentine)	
Tunis (Tunisia)	7	Dar es Salaam (Tanzania)	2
Karachi (Pakistan)	6	Entebbe (Uganda)	2
Bombay (India)	5	Freetown (Sierra Leone)	2
Alger (Algérie)	5	Kinshasa (Zaire)	2
Baghdad (Iraq)	5	Las Palmas (Péru)	2
Boston (U.S.)	5	Lima (Péru)	2
Tel Aviv (Israel)	5	Lusaka (Zambia)	2
Chicago (U.S.)	4	Mombasa (Kenya)	2
Kilimanjaro (Tanzania)	4	Moscow (USSR)	2
Abidjan (Ivory Coast)	4	Nara (Mali)	2
Hongkong	3	Santiago	2
Khartoum (Sudan)	3	St. Maarten (Neth. Antils)	2
Kigali (Rwanda)	3	Tokyo (Japan)	2
Larnaca (Cyprus)	3	N'Djamena	2
Panama (Panama)	3	Tahiti	2
Quito (Ecuador)	3	Ouagadougou	2

Total Strikes	50
Total Route	50

Table 4 Bird Species - 1976

Scientific Name	[illegible]	[illegible]	[illegible]	[illegible]	% used on 488
Anseriformes					
Anas Crecca	Teal	[illegible]	A	1	-
Anas sp.	Duck	0.60-1.40	B	3	0.6
Anser sp.	[illegible]	up to 1.00	-	1	-
Apodiformes					
Apus apus	Swift	0.03	A	49	7.1
Charadriiformes					
Pluvialis apricaria	Golden plover	0.20	B	4	0.7
Vanellus vanellus	Lapwing	0.25	B	77	11.2
Haematopus ostralegus	Oyster catcher	0.50	B	2	0.3
Larus argentus	Herring gull	1.10	B	13	1.9
Larus canus	Common gull	0.40	B	16	2.3
Larus fuscus	Lesser black-backed gull	0.80	B	6	0.9
Larus marinus	Great black-backed gull	1.80	B	1	-
Larus ridibundus	Black headed gull	0.30	B	40	5.8
Larus sp.	Gull	0.30-1.80	B	208	30.2
Sterna hirundo	Common Tern	0.30	B	1	-
Calidris sp.	Sandpiper sp.	0.10	A	2	0.3
Ciconiiformes					
Ardea cinerae	Grey heron	up to 1.80	B	2	0.3
Ciconia sp.	Stork	up to 3.00	C	1	-
Columbiformes					
Columba livia	Rock dove	0.25	B	6	0.9
Columba oenas	Stock dove	0.25	B	2	0.3
Columba palumbus	Woodpigeon	0.45	B	11	1.6
Columba sp.	Pigeon	0.45	B	19	2.8
Streptopelia turtur	Turtle dove	0.15	B	12	1.7
Falconiformes					
Accipiter gentilis	Goshawk	1.00	B	3	0.4
Aquila sp.	Eagle	4.00	C	1	-
Buteo buteo	Common Buzzard	0.88	B	12	1.7
Buteo sp.	Buzzard	up to 0.88	B	2	0.4
-	Vulture	up to 5.00	C	1	-
Gyps vulvus	Griffon Vulture	2.00	D	1	-
Milvus milvus	Kite	1.00	B	8	1.2
Milvus sp.	Common african kite	1.00	B	1	-
Falco sp.	Falcon	up to 0.80	B	16	2.3
Falco tinnunculus	Kestrel	0.30	B	6	0.9
Fringillidae					
Fringilla montifringilla	Brambling	0.05	A	1	-

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Scientific Name	English Name	Weight/ Weight Category in kg	Weight Category	Number of Incidents	% Based on 688
Galliformes					
Perdix perdix	Partridge	0.30-0.40	B	7	1.0
Phasianus colchicus	Pheasant	1.2	B	6	0.9
Passeriformes					
Corvus corone corone	Carrion crow	0.55	B	8	1.2
Pica pica	Magpie	0.22	B	2	0.3
Corvus sp.	Crow	0.50	B	6	0.9
Passer domesticus	House sparrow	0.01-0.04	A	26	3.8
Alauda Arvensis	Skylark	0.04	A	7	1.0
Hirundo Rustica	Swallow	0.01	A	54	7.9
Anthus Pratensis	Meadow pipit	0.02	A	6	0.9
Sturnus vulgaris	Starling	0.08	A	12	1.7
Turdus iliacus	Redwing	0.06	A	1	-
Turdus merula	Blackbird	0.10	A	1	-
Turdus Pilaris	Fieldfare	0.10	A	1	-
Turdus sp.	Thrush	0.10	A	5	0.7
Strigiformes					
Athene noctua	Little owl	0.10	A	6	0.9
Tyto Alba	Barn owl	0.20	B	1	-
-	Owl	0.17-0.38	B	7	1.0
Asio Otus	Long eared owl	0.30	B	1	-
Asio flammeus	Short eared owl	0.38	B	1	-
Unknown				816	
TOTAL				1504	

Notes: 4.1 Bird weights and Scientific Names are based on information supplied by Aviation Unit, Worplesdon Laboratory, Agricultural Science Service, MAFF, Worplesdon, England and the average weight has been assume.

4.2 The bird Categories based on current Civil Airworthiness requirements are:

A below 110 g ($\frac{1}{4}$ lb)
B 110 g to 1.81 kg ($\frac{1}{4}$ lb to 4 lb)
C over 1.81 kg to 3.63 kg (4 lb to 8 lb)
D over 3.63 kg (8 lb).

4.3 Those birds not positively identified are tabled as Unknown. Except where there is evidence that they are Large (C or D).

4.4 Percentages are based on incidents where birds are identified.

Table 5 Part of Aircraft Struck - 1978

Part Struck	Number of Strikes by Bird Weight Category					% Based on 1524
	Unknown	A	B	C&D	Total	
Fuselage	48	44	121	1	214	14.0
Nose (excluding radome and windscreen)	123	85	157	0	365	24.0
Radome	36	30	65	1	132	8.7
Windscreen	87	63	100	0	250	16.4
Propeller	2	1	10	0	13	0.8
1 engine struck	81	11	124	1	217	14.2
2 out of 3 struck	2	0	0	0	2	0.1
2 or more of 4 struck	1	3	8	0	12	0.8
all engines struck	0	0	3	0	3	0.2
Wing/Rotor	59	30	142	1	232	15.2
Landing Gear	16	2	57	0	75	4.9
Trail	1	1	7	0	9	0.6
Part Unknown	32	21	101	0	154	
TOTAL	488	291	895	4	1678	100%

Notes: 5.1 The totals in Table 5 are higher than other tables, as several parts can be struck in one incident.

5.2 The percentages are based on incidents where the part struck is known.

5.3 Where both landing gear, or both wings are struck, two incidents are recorded.

Effect	Number of Strikes by Bird Weight Category						& Based on 1133
	Unknown	A	B	C	D	Total	
Loss of life	-	-	-	-	-	-	-
Loss of Aircraft	-	-	-	-	-	1	0.1
Flight Crew injured	-	-	-	-	-	-	-
Engine damage requiring repair on:-							
2 engined aircraft	5	1	6	1	-	13	1.1
others	20	-	17	1	-	47	4.1
Windscreen cracked or broken	2	-	2	-	-	4	0.4
Vision obscured	3	-	2	-	-	5	0.5
Radome changed	5	-	7	-	-	12	1.1
Deformed structure	2	-	3	-	-	5	0.4
Skin torn/light glass broken	4	1	13	-	-	18	1.6
Skin dented	14	1	19	-	-	34	3.0
Propeller/Rotor/ transmission damaged	-	-	-	-	-	-	-
Aircraft system lost	2	1	4	-	-	7	0.6
Take off aborted	-	-	-	-	-	-	-
Unknown						987	87.1
TOTAL	66	4	74	2	-	1133	100%

Notes: 6.1 If, for example, skin is torn in two places, or both windscreens are broken, two incidents are recorded.

6.2 The percentages are based on known effects.

Table 7 Cost

	Aircraft Movements	Cost (US dollars)
Where cost is known	484,000	0.572 million
Where cost is not known	2,194,000	-
LIKELY TOTAL COST	2,678,000	3.2 million

Notes: 7.1 The known cost is the engineering cost from four countries.

7.2 The value of a Boeing 737 (Ø4.5 million) must also be added to the above.

Operator	Number of Incidents	Number of Movements	Rate per 10,000 Movements
Austria			
Austian Airlines	12	36,400	3.3
Montana Austria	-	4,000*	-
Belgium			
Sabena	37	84,400	4.4
Sobelair	1	7,478	1.3
Trans European Airways	-	14,232	-
Delta Air Transport	-	13,746	-
Young Cargo	-	2,038	-
Int	-	54	-
Sotramat-Hessenatie	-	488	-
Abelag	-	1,422	-
CER	-	226	-
Semtas	-	860	-
Denmark			
Cimber Air	-	14,420	-
Conair	10	5,760	17.4
Maersk Air	5	18,476	2.7
SAS	28	92,787	3.0
Sterling Airways	9	40,866	2.2
Others	-	34,357	-
France			
Air France	45	313,960	1.4
Air Inter	29	152,798	1.9
U.T.A.	17	31,856	5.3
T.A.T.	1	50,904	0.2
E.F.S.	2	5,601	3.6
Others	3	-	-
Germany			
Lufthansa	430	449,050	9.8
Netherlands			
KLM	96	117,944	8.1
Martinair	13	17,558	7.4
NLM	7	50,910	1.4
Transavia	9	10,593	8.5
Norway			
S.A.S.	23	121,190	1.9
Helikopter Service	3	313,264	0.1
A/S Fred. Olsens Flyselskap	1	950	10.5
Widerøe	1	112,304	0.1
Mørefly	1	6,804	1.5
[illegible]	1	[illegible]	1.5

Continued overleaf

Table [illegible] [illegible] Operators Reporting Strikes - [illegible] (Continued)

Operator	Number of Incidents	Number of Movements	Rate per 10,000 Movements
Portugal			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	4.[illegible]
[illegible]	[illegible]	[illegible]	6.4
[illegible]	[illegible]	4,717	4.6
Switzerland			
[illegible]	247	[illegible]	[illegible]
United Kingdom			
Air Anglia	8	[illegible]	2.4
Air Bridge Carriers	2	8,908	2.2
Alidair	1	9,478	1.0
Bristow Helicopters	2	41,679 hrs	[illegible]
[illegible]	[illegible]	45,944	4.8
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	-	-
[illegible]	3	[illegible]	1.3
[illegible]	220	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.0
British Island Airways	8	[illegible]	[illegible]
British Midland Airways	23	[illegible]	[illegible]
[illegible]	1	-	-
Clarke Chapman	1	-	-
Dan-Air	25	[illegible]	[illegible]
Fair Flight	1	-	-
IAS Air Cargo	5	[illegible]	8.[illegible]
[illegible] Aviation	1	-	-
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	-	-
[illegible] Aviation	[illegible]	-	-
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		-	-
[illegible]	[illegible]	-	-
[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]

Notes: [illegible] [illegible] movements

[illegible] [illegible] included against the operator.

Brief Details of Serious 1978 Bird Strike Incidents

(World Wide, Aircraft over 5,700 Kg & Executive Jets)

9.1.78	Falcon Fan Jet		Merced California			Crew: Pass:	0 0	0 0	? ?	Minor

Aircraft descending through 2,000 feet and in the clouds struck a goose. The bird penetrated the right wing leading edge, damaging wing spars and puncturing the fuel cell. Aircraft made a successful landing.

23.1.78	Boeing 707	Air Carrier	Ben Gurion Tel Aviv			Crew: Pass:	0 0	0 0	? ?	Minor

During take-off, the aircraft hit a flock of gulls with an unknown number of birds entering the No 2 engine, causing an engine fire. Aircraft returned and landed. Loss of engine caused by fan and compressor failure. (Source -

26.1.78	Boeing 707	TWA	Tel Aviv Israel			Crew: Pass:	0 0	0 0	? ?	Minor

During take-off a flock of gulls (Larus spp) caused an engine fire and the aircraft's return. (Source - Lloyds List)

11.2.78	Boeing 727	Air Carrier	San Diego California			Crew: Pass:	0 0	0 0	? ?	Minor

On approach to Lindbergh Field, the aircraft struck a golden eagle, destroying the radome. Aircraft made a successful landing. The bird was found lodged in the pressure bulkhead behind the radar antenna. (Source - FAA)

18.2.78	Boeing 747	Air France	Lyon (Satolas) France	Scheduled Freight	3	Crew: Pass:	0 0	0 0	3 0	Substantial

The aircraft was taking off when it struck two very dense flocks of gulls (Larus spp). The take-off was abandoned at 152 kts (V_1 was 154 kts). No 3 engine had failed and No 4 was surging, and the windscreen was totally obscured by bird remains. The runway was wet and the aircraft was stopped only 150m from the end of the 3900 metre runway, with 3 tyres deflated. In addition to changing engines 3 and 4, engine 1 needed 12 replacement fan blades, and engine 2 four fan blades. (Source - ICAO ADREP Report 4/78 and French sources)

20.2.78	Boeing 707	Egyptair	Sharjah UAE	Scheduled Passenger	97	Crew: Pass:	0 0	0 0	7 90	Minor

Just after take-off at only a few hundred feet, the aircraft struck a flock of birds. The birds badly damaged the engines and sections of the fuselage, but the pilot managed to return for an emergency landing. There were no injuries to the 97 occupants. (Source - Lloyds List).

29.2.78	DC-10	Air Carrier	San Francisco			Crew: Pass:	0 0	0 0	? ?	Minor

On take-off, the aircraft struck a flock of gulls, breaking the nose radome and ingesting birds into the No 1 engine. The aircraft returned and landed. Inspection of the CF-6 engine revealed that 20 fan blades had failed. (Source - FAA)

15.3.78	VC10	Air Malawi	Nairobi Kenya	Scheduled Passenger		Crew: Pass:	0 0	0 0	1 ?	Minor

At approximately 400 ft just after take-off the aircraft struck a large bird, later identified as a Marabou Stork (Leptoptilos crumeniferus, average weight 4 kg). The co-pilot's windscreen was crazed, but not penetrated, however particles from the inner pane caused minor injuries to the co-pilot's face. The aircraft jettisoned fuel and returned. (Note:- On this date at Nairobi an Alitalia B707, and two British Airways B747s suffered engine damage).
(Source - UK Occurrence Reporting System)

16.3.78	Falcon Fanjet 20		Newark N Jersey			Crew: Pass:	0 0	0 0	? ?	Minor

At 200 feet on take-off climb, the aircraft struck a flock of birds. One bird tore a hole in the right flap while another bird entered the right engine resulting in failure of the blades in the first, second, and third stage compressor. (Source - FAA)

4.4.78	Boeing 737	OO-SDH	Sabena	Gosselies Belgium	Training	3	Crew: Pass:	0 0	0 0	3 0	Destroyed

A trainee pilot was making a touch and go landing under the supervision of an instructor, and was about to become airborne again when the aircraft struck a flock of wood pigeon (Columba palumbus). The take-off was abandoned at a speed higher than V_1 and the aircraft could not be stopped before it overran the runway. The right main gear collapsed and the right engine was torn from the aircraft. The aircraft stopped 300 metres beyond the runway after crossing a road, having spun through 180°. The aircraft was destroyed by fire. Examination of the left-hand engine found that several birds had been ingested. (Source - ICAO ADREP Report and Belgium sources)

19.4.78	Lear 24			Pal Waukee Airport Chicago			Crew:	0	0	?	Minor
							Pass:	0	0	?	

On take-off roll, birds were ingested into both engines. Take-off aborted when both engines flamed out. (Source - FAA)

7.6.78	Boeing 737		Air Carrier	Stockton California			Crew:	0	0	?	Minor
							Pass:	0	0	?	

Climbing through 2,000 feet, the aircraft hit a single bird, bending the inboard trailing edge flap. Damage was sufficient to jam the flaps in a split flap configuration, affecting aircraft performance. (Source - FAA)

--.78	Boeing 747						Crew:	0	0	?	Minor
							Pass:	0	0	?	

During take-off at approximately 130 kts, a small bird crossed in front of the aircraft. Soon afterwards there was a loud compressor stall, and engine 4 fire warning came on. The take-off was abandoned at 144 kts, the fire check list completed and the warning stopped after approximately 15 seconds. The aircraft stopped safely, but the runway had to be closed because of engine debris, including the tailcone. The bird (estimated to weigh one pound), broke two solid-type fan blades, causing imbalance and titanium fire. The engine casing was burned through near the 10th compressor stage, the engine was described as "a total loss". (Source - PIA Air Safety, June 1978)

9.7.78	Boeing 747		KLM	Amsterdam Netherlands			Crew:	0	0	?	Minor
							Pass:	0	0	?	

During take-off roll, engine 4 suffered bird ingestion and fire warning. Take-off abandoned. Found two fan blades broken, causing severe imbalance. The pieces were contained, although the HP compressor casing suffered a burn-through at 10th stage manifold. (Source - Netherlands and UK Defect System)

25.7.78	Convair 580	N4825C	North Central AL	Kalamazoo USA	Scheduled Passenger	43	Crew:	0	1	2	Destroyed
							Pass:	0	2	38	

At 0702 hrs EDT, just as the aircraft passed V4, a sparrow hawk (Accipiter nisus) struck the left engine, and the left propeller auto-feathered as the aircraft lifted off. The aircraft turned to the left and flew for 1 minute 19 seconds before it crashed into a cornfield.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the captain to follow the prescribed engine-out procedures during instrument meteorological conditions, which allowed the aircraft to decelerate into a flight regime from which he could not recover. Contributing to the accident were inadequate cockpit co-ordination and discipline. (Source - NTSB-AAR-79-4)

26.7.78	DC3	TG-ATA	Aviateca	Peten Guatemala		10	Crew:	0	0	2	Substantial
							Pass:	0	0	8	

During take-off struck flock of birds, force landed with no injuries to 10 occupants. (Source - Lloyds List)

13.8.78	Boeing 727		Air Carrier	Nr Houston Texas			Crew:	0	0	?	Minor
							Pass:	0	0	?	

While holding at 10,000 feet MSL, aircraft hit a flock of ducks. Two access doors were torn loose on the left side of the aircraft. On post flight inspection, three fuselage dents and one three-inch diameter hole in the fuselage were also found. (Source -

3.9.78	DC-8		Air Carrier	Tampa Florida			Crew:	0	0	?	Minor
							Pass:	0	0	?	

Immediately after landing, the aircraft rolled through a flock of gulls that were rising off the runway. Birds were ingested into engines No 3 and No 4, the fire warning lights flickered, and the engines were shut down immediately. Maintenance inspection revealed no engine damage. (Source - FAA)

9.9.78	Boeing 707		Pacific Western	Vancouver Canada			Crew:	0	0	?	Minor
							Pass:	0	0	?	

Gulls (Larus sp) were struck during take-off, engine 3 was severely damaged and failed, while engine 4 sustained damage and had to be shutdown. A total of 29,000 lbs of fuel was jettisoned before the aircraft could return for a two-engined landing. Engines 3 and 4 were changed. (Source - Canadian Bird Committee)

21.9.78	DC-3			Oakland California			Crew:	0	0	?	Minor
							Pass:	0	0	?	

Immediately after take-off, the DC-3 collided with a large bird, possibly a hawk, shattering the co-pilot's windshield. Glass fragments cut the co-pilot's face and eyes causing permanent vision impairment. Second officer received cuts about the face and hands. Pilot landed aircraft without further incident. (Source - FAA).

22.9.78	Boeing 737	Air Carrier	Flint Michigan	Crew:	0	0	?	Minor
				Pass:	0	0	?	

On take-off roll, aircraft ingested gulls in both engines, an immediate power reduction was made and aircraft aborted the take-off. The engines were cleaned and released for service with no damage. (Source - FAA)

2.10.78	Boeing 747	Air Carrier	San Francisco	Crew:	0	0	?	Minor
				Pass:	0	0	?	

On take-off roll, aircraft experienced two compressor stalls following ingestion of domestic pigeons into two engines. Aircraft aborted the take-off. Engines were checked and no damage was found. Two tyres were replaced because of the high-speed abort. (Source - FAA)

7.10.78	Boeing 707	British Airways	Prestwick	Crew:	0	0	?	Minor
				Pass:	0	0	?	

During a training flight a touch and go landing was made, during which engine 1 throttle was closed between V_1 and V_R to simulate an engine failure. At 50 ft the aircraft passed through a large flock of Lapwings (Vanellus vanellus) causing engines 2, 3 and 4 to surge. No 1 was opened up, while No 4 continued to surge, and had to be shutdown. After landing damage was found to engine 4. (Source - UK Reporting System)

28.10.78	Boeing 737	Air Carrier	Cleveland Ohio	Crew:	0	0	?	Minor
				Pass:	0	0	?	

Descending through 8,000 feet at 290 knots, the aircraft struck a flock of ducks. One duck passed through the right side fuselage. Remains were found in the forward baggage hold. (Source - FAA)

30.10.78	Falcon Fanjet 20		Fort Lauderdale Florida	Crew:	0	0	?	Minor
				Pass:	0	0	?	

At 800 feet on take-off climb, the aircraft struck a brown pelican. The right engine nacelle was destroyed, the bird was ingested, destroying the right engine, and the engine mount was bent, tearing the fuselage skin aft of the engine mount. The pelican weighed about eight pounds. (Source - FAA)

2.11.78	Boeing 727	Air Carrier	Portland Oregon	Crew:	0	0	?	Minor
				Pass:	0	0	?	

Aircraft aborted take-off after hitting a hawk. The hawk broke the stall warning sensor resulting in stall warning stick shaker activation just prior to V_1. (Source - FAA)

24.11.78	Fairchild FH227	Air Carrier	Des Moines Iowa	Crew:	0	0	?	Minor
				Pass:	0	0	?	

During the approach to Des Moines Airport, the aircraft struck a goose at 2,500 feet, causing damage to the nose gear door. The nose gear could not be lowered requiring a nose gear up landing. No injuries were reported; however, extensive damage was done to the forward undercarriage of the aircraft. (Source - FAA)

11.12.78	Cessna Citation		Lebanon New Hampshire	Crew:	0	0	?	Minor
				Pass:	0	0	?	

During landing, the aircraft hit a snowy owl that was hunting by the light of the approach lights. The bird made a large hole in the leading edge of the left wing, rupturing the fuel cells. (Source - FAA)

Minor

Minor

Minor

Minor

Minor

Minor

Minor

Minor

BIRD STRIKE COMMITTEE EUROPE

Brussels, May 1981

Ref: BSCE/15 WP 4

(not presented at Meeting, but included in Report for benefit of Members)

BIRD STRIKES DURING 1979 TO EUROPEAN REGISTERED CIVIL AIRCRAFT
(Aircraft over 5700 kg Maximum Weight)

J Thorpe - UK
R van Wessum - Netherlands

Summary

Bird strikes reported throughout the World in 1979 by operators from fourteen European countries have been analysed. The analysis includes rates for countries, aircraft types and aerodromes based on aircraft movements. It also covers bird species, part of aircraft struck, effect of strike, cost and airlines affected.

The strike rate in 1979 was slightly lower than in the previous year. Gulls (Larus spp.) were involved in nearly half the incidents. The major effect was damage to 70 engines. During the year bird strikes were estimated to have cost European airlines at least 1.1 million US dollars in direct repairs.

CONTENTS

This study is based on information supplied and the accuracy and detail is only as good as that reported.

1 DISCUSSION

1.1 ANNUAL RATE/COUNTRY (see Table 1)

(a) Information has been obtained from a total of 14 European countries. A few of these were not able to provide full information, and their data, therefore, appears in some tables and not in others.

(b) The overall strike rate for the 1428 incidents contained in this analysis is 4.2 per 10,000 movements (two movements per flight). This is slightly less than the rate of 5.5 recorded during 1978.

(c) The strike rate reported by each country is dependent upon two major factors -

- reporting standard

- the bird strike problem at airports within that country, and that country's airlines route structure.

(d) The country with the highest reported strike rate is Switzerland with 11.7 per 10,000 movements, followed by Germany and Eire, both with 7.8.

1.2 AIRCRAFT TYPES (see Table 2)

(a) Jet Aeroplanes

(i) For several years there appears to have been no consistent correlation between aircraft of similar design, eg DC8 and B707, BAC 1-11 and DC9. It may be that aircraft which appear similar to humans are not similar to birds, and there are other factors such as noise patterns, which can affect the strike rate.

(ii) Again in the 1979 data there is a distinct correlation between strike rate and aircraft frontal area, the rate for the four wide-bodied aircraft being 6.9, well above the mean for all jets of 4.4, although there are considerable variations between some aircraft of similar size. The most glaring discrepancy, for which no explanation has been found, is between the rates for the DC10 and L1011 Tristar, the reported DC10 rate being much greater than that for the L1011 Tristar.

(b) Turboprop Aeroplanes

The average strike rate for all turboprops is significantly less than that for jets.

(c) Piston Aeroplanes

Very few strikes were recorded to piston engined aeroplanes.

(d) Helicopters

The number of strikes reported to helicopters is very low, only fifteen. Because helicopters fly mainly at low altitude where birds are most frequently found, they are continuously exposed to the risk of a strike. Therefore flying hours have been used to determine a strike rate. For reasons which are not at present known, the rate is low at 1.3 per 10,000 hours.

1.3 AERODROMES (see Table 3)

(a) The aerodrome data is of particular importance as it may indicate where bird control measures need to be taken. Some countries were able to provide aerodrome movement data for their nationally registered aircraft, so that a national rate could be quoted.

The total number of strikes at each aerodrome, reported by all European sources has also been included.

(b) Strikes reported on aerodromes are influenced by one or more of the following:

(i) reporting standards

(ii) the prevailing bird situation which may vary according to place and time

(iii) the number of aircraft movements

(iv) the effectiveness of bird control measures

(v) local factors, perhaps beyond control of the aerodrome, eg a rubbish dump or bird roost site in the vicinity.

(c) Because of factors outlined in (b), direct comparison of the reported strike rates for different aerodromes is likely to be misleading.

(d) Significant numbers of strikes have been reported at some aerodromes outside Europe. Nineteen strikes were reported at Bangkok, and the numbers at Delhi and Istanbul appear to be rather high, since the number of movements by European aircraft at most of these aerodromes is comparatively low.

(e) There were 167 incidents where the aircraft was considered to be en-route.

1.4 BIRD SPECIES (see Table 4)

Some knowledge of the bird species involved was available in 772 incidents (54%). The identification standard ranged from examination of bird remains by a trained ornithologist, to the fleeting glance of a pilot. [illegible]% of strikes involved gulls (Larus spp), of which the black-headed gull (Larus ridibundus) and Herring gull (Larus argentatus) were the most frequently identified. Next on the list were the combinations of swifts, swallows and martins with 18%, followed by Lapwings (Vanellus vanellus) with 10.2%, birds of prey at 7.9% and pigeons (Columba spp) with [illegible]. The percentage of gull and lapwing strikes was similar to the previous year. Less than 1% of incidents ([illegible] cases) were thought to involve birds of greater than 1.8[illegible] kg ([illegible] lb).

1.5 PART OF AIRCRAFT STRUCK (see Table 5)

(a) From the figures it can be seen that the parts most frequently reported as being struck were nose with 25%, windscreen with 13%, engines 16%, followed by fuselage with 17%. It should be noted that there were 6 incidents where more than one engine was struck, of which two involved all engines.

1.6 EFFECTS OF STRIKES (see Table 6)

(a) During the period covered by this paper 70 engines were damaged such as to require repair or replacement. Of these 39 were on twin-engined aircraft. 30% of engine strikes involved engine damage.

(b) Only one windscreen was changed, a small number when compared with 186 windscreen strikes.

(c) There were 5 cases of radome damage, out of 134 radome strikes, (4%). In most cases the radome was only delaminated, but in a few cases it was shattered. The radome strength is limited by the need for dielectric properties enabling satisfactory operation of the weather radar.

1.7 COST (see Table 7)

Only five countries (Belgium, Denmark, Norway, Switzerland and Sweden) have provided information on costs. From this it is estimated that the annual damage cost to all European operators is at least [illegible] million [illegible] dollars [illegible] considerably less than that estimated for the two previous years.

1.8 AIRCRAFT OPERATORS (see Table 8)

This table provides a guide to the reporting rates of individual airlines. It is noticeable that it is considerably affected by the [illegible] its main base.

2 CONCLUSIONS

2.1 The overall rate for the 1490 strikes reported during this period by European operators is 4.2 strikes per 10,000 movements. This rate is somewhat less than that for the previous year.

2.2 There does not appear, from the available data, to be any close correlation between the strike rate and the aeroplane type, in terms of speed, engine type, etc. However, despite considerable variations between types, there is a distinct correlation between strike rate and aircraft size. There is no evidence that the strike rate of executive jet aeroplanes is above that which would be expected for their frontal area. It may be that aircraft types which appear to be similar to humans are not similar to birds, and there are other factors, such as noise patterns, which may affect the strike rate. The continued long term collection of statistics may provide further information.

2.3 There are some airports in Western Europe where the number of bird strikes reported by European operators is high even though movements of European registered aircraft at these airports are believed to be low.

2.4 Gulls (large spp.) were struck more frequently than other birds, being involved in 41% of incidents. Less than 1% of strikes were known to involve birds of greater than 1.8 kg (4 lb). The application of measures to keep gulls away from aerodromes is therefore of prime importance.

2.5 The nose section including windscreen and radome were struck in 47% of incidents, followed by the fuselage with 17%.

2.6 There was damage to 70 engines, approximately 30% of the engine strikes, and 7 cases of engine damage.

2.7 Based on information provided by five countries, the estimated minimum engineering cost of bird strikes to European airlines was at least 1.3 million to 2 million in the year.

BIRD STRIKE ANALYSIS

EUROPEAN OPERATORS 1979

CIVIL AIRCRAFT OVER 5700 kg (12 500 lb) MAXIMUM WEIGHT

Notes: 0.1 The following are excluded from this Analysis:

(a) aircraft of maximum weight 5700 kg (12 500 lb) and under, except for those few executive jets, which have been included, eg Lear and Citation.

(b) all military type and operated aircraft.

0.2 All Tables are for strikes reported world-wide.

0.3 The Total columns of many of the Tables are different, as some countries have not been able to provide full information for every table.

0.4 There are two movements per flight.

0.5 Where the number of incidents, or number of movements are small, and particularly where they are both small, the derived rate should be treated with caution.

Table 1 National Reporting - 1979
(All airlines in each country, reporting World Wide)

Reporting Nation	Number of Incident World Wide	Number of Movements World Wide	Rate per 10,000 Movemen
Austria	12	45,600	2.6
Belgium	27	126,874	2.1
Denmark	34	177,478	1.9
Eire	56	71,346	7.8
Finland	15	127,208	1.2
France	121 (4)	444,312	2.7
Germany	346 (2)	441,902	7.8
Italy	9	174,464	0.5
Netherlands	101	192,716	5.2
Norway	31 (2)	148,118	2.1
Portugal	17	56,394	3.0
Sweden	52	116,311	4.5
Switzerland	225	192,896	11.7
United Kingdom	582	1,069,562	3.6
Total	1428 (8)	3,389,205	4.2

Notes:
1.1 Helicopters are excluded from this Table.
1.2 Data from Switzerland is for Swissair only.
1.3 The figures in brackets are strikes for which no movement data is available.
1.4 Table 8 gives a breakdown by airline.

Table 2 Aircraft Type - 1979

Type	Aircraft	Number of Countries Reporting	Number of Incidents	Number of Movements	Rate per 10,000 Movements
Jet					
4 engined	McDonell Douglas DC 8	8	56	79,800	7.0
	Boeing 747	10	75	134,853	5.6
	HS Comet 4	1	4	7,544	5.3
	BAC VC 10	1	8	20,654	3.9
	Boeing 707/720	8	76	208,128	3.6
	Concorde	2	1	7,910	1.3
	Total		220	458,889	4.8
3 engined	McDonnel Douglas DC 10	11	124	116,881	10.6
	Boeing 727	6	164	316,218	5.2
	Lockheed 1011 Tristar	2	11	23,887	4.6
	HS Trident	1	62	153,336	4.0
	Total		361	610,322	5.9
2 engined	A 300 Airbus	3	47	98,348	4.8
	Boeing 737	6	194	411,592	4.7
	McDonnel Douglas DC 9	9	286	712,159	4.0
	Fokker F28 Fellowship	4	29	78,584	3.7
	DA 01 Mercure	1	13	40,430	3.2
	Caravelle	4	54	186,476	2.9
	HS 125	3	8	30,796	2.6
	BAC 1-11	3	55	250.311	2.2
	Cessna 500 Citation	1	0	1,084	0
	DA 20 Jet Falcon	1	0	1,224	0
	SN 601 Corvette	2	0	1,730	0
	Mystere 20	3	0(1)	2,820	0
	Learjet	3	0	5,520	0
	VFW 614	1	0	8,288	0
			686(1)	1,829,362	3.7
Turboprop					
4 engined	BAC viscount	1	51	123,874	4.1
	BAC Britannia	1	1	2,672	3.7
	BAC Merchantman	1	3	8,890	3.4
	Canadair CL 44	1	1	5,128	2.0
	DHC Dash 7	2	0	3,008	0
	HS Argosy	1	0	3,030	0
	Short Belfast	1	(1)	———	———
			56(1)	146,602	3.8

Type	Aircraft	Number of Countries Reporting	Number of Incidents	Number of Movements	Rate per 10,000 Movements
2 engined	EMB 110 Bandeirante	1	9	18,428	4.9
	Beech 200 Super King Air	1	1	2,572	3.9
	Fokker F 27 Friendship	5	37	128,124	2.9
	HS 748	1	13	49,120	2.6
	HP Herald	1	11	81,074	1.4
	DHC 6 Twin Otter	2	1(2)	25,964	0.8
	HP Jetstream	1	0	320	0
	Nord 262	2	0(2)	438	0
	Short SD 330	1	0	1,478	0
	Fairchild FH 227	1	0	13,186	0
	Short Skyvan	1	(1)	———	—
	Total		72(5)	320,704	2.2
Piston	DH 114 Baron	1	1	500	20.2
	Convair 440	1	4	14,688	2.7
	DC 3 Dakota	1	2	7,570	2.6
	McDonnel Douglas DC 6	2	0	314	0
	ATL 98 Carvair	1	0	254	0
	LR 23	1	(1)	———	—
	Total		7(1)	23,326	3.0
Unknown		1	(24)	———	—
Total		1402(36)	1402(32)	3,389,205	4.1

Type	Aircraft	Number of Countries Reporting	Number of Incidents	Number of Hours	Rate per 10,000 Hours
Heli-copters	Westland Wessex	1	1	3,889	2.6
	Sikorsky S 61	2	11	76,438	1.4
	Aerospatiale SA 330 Puma	1	0	9,468	0
	Sikorsky S 58T	1	0	2,519	0
	Westland Commando	1	(1)	———	—
	BO 105	1	(1)	———	—
	SE 315	1	(1)	———	—
	Total Helicopters		12(3)	92,314	1.3

Table 2A Summary of Aeroplane Types

	Number of Incidents	Number of Movements	Rate per 10,000 Movements
Jet	1,267(1)	2,898,573	4.4
Turboprop	128(6)	467,306	2.7
Piston	7(1)	23,326	3.0
Unknown	24		
Total	1,427	3,389,205	4

Notes:

2.1 Because of the low altitude of operation, and difficulty in collection of movement data, helicopter operations are quoted in hours.

2.2 The figures in brackets are for aircraft for which movement data is unavailable.

Table 3 Aerodromes - 1979

Aerodrome/Country	Number of Incidents	Number of Movements	Rate per 10.000 Movements	Incidents to other European Aircraft	Total Incidents
EUROPEAN AERODROMES					
Austria					
Vienna				6	6
Domestic	7	40,000	1.8		7
Domestic	3				3
Belgium					
Antwerp	2			1	3
Brussels	12			14	26
Ostend					
Czechoslovakia					
Prague				4	4
Denmark					
Aalborg	1	2,624		1	2
Aarhus				1	1
Copenhagen/Kastrup	6	70,240	0.9	28	34
Esbjerg	1	2,899		1	2
Karup	1	1,011			1
Ronne	2	1,284			2
Stauning	1	1,100			1
Tirstrup				1	1
Finland					
Helsinki	2			2	4
Kokkola	1				1
Mariehamn	3				3
Mikkeli	1				1
Pori	1				1
Tampere	3				3
Vaasa	1				1
France					
Bastia				1	1
Belfort				2	2
Bordeaux	3	11,239	2.7		3
St Etienne	2	914	21.8		2
Lille	5	9,667	5.2		5
Limoges				1	1
Lourdes				1	1
Lyon	10	27,327	3.7		10
Marseille	7	29,206	2.4	3	10
Montpellier	4	9,338	6.2		4
Nice	9	24,485	4.0	2	11
Paris-Ch.de Gaulle	4	66,435	1.0	7	11
Paris-Orly	14	73,252	1.9	8	22

Table 3 (Continued)

Aerodrome/Country	Number of Incidents	Number of Movements	Rate per 10,000 Movements	Incidents to other European Aircraft	Total Incidents
Germany					
Berlin				1	1
Bremen	4				4
Cologne	3			2	5
Dusseldorf	19			7	26
Frankfurt	12			7	19
Hamburg	8			1	9
Hannover	5				5
Munich	8			1	9
Nurenberg	4				4
Saarbrücken	1				1
Stuttgart	3				3
Hungary					
Budapest				3	3
Italy					
Catania				1	1
Genoa				2	2
Milan	1			6	7
Naples				3	3
Olbia				1	1
Rome	4			6	10
Venice	1				1
Ireland					
Cork	11			2	13
Dublin	30			1	31
S Hannon	11			1	22
Netherlands					
Amsterdam	23	65,088	3.5	9	32
Eindhoven	1				
Groningen	1				
Rotterdam	1	6,834	1.5	1	2
Norway					
Bergen				1	1
Bödö	2	24,910	0.8	3	5
Flesland	2	37,319	0.5	1	3
Orland	1	2,012	5.0		1
Oslo-Fornebu	2	59,995	0.3	3	5
Oslo-Gardermoen				2	2
Sola	3	41,724	1.0		4
Stavanger				1	1
Svolvaer-Helle	1	4,830	2.1		1
Tromsö	2	16,342	1.2		2
Vaernes	1	16,187	0.6	1	2

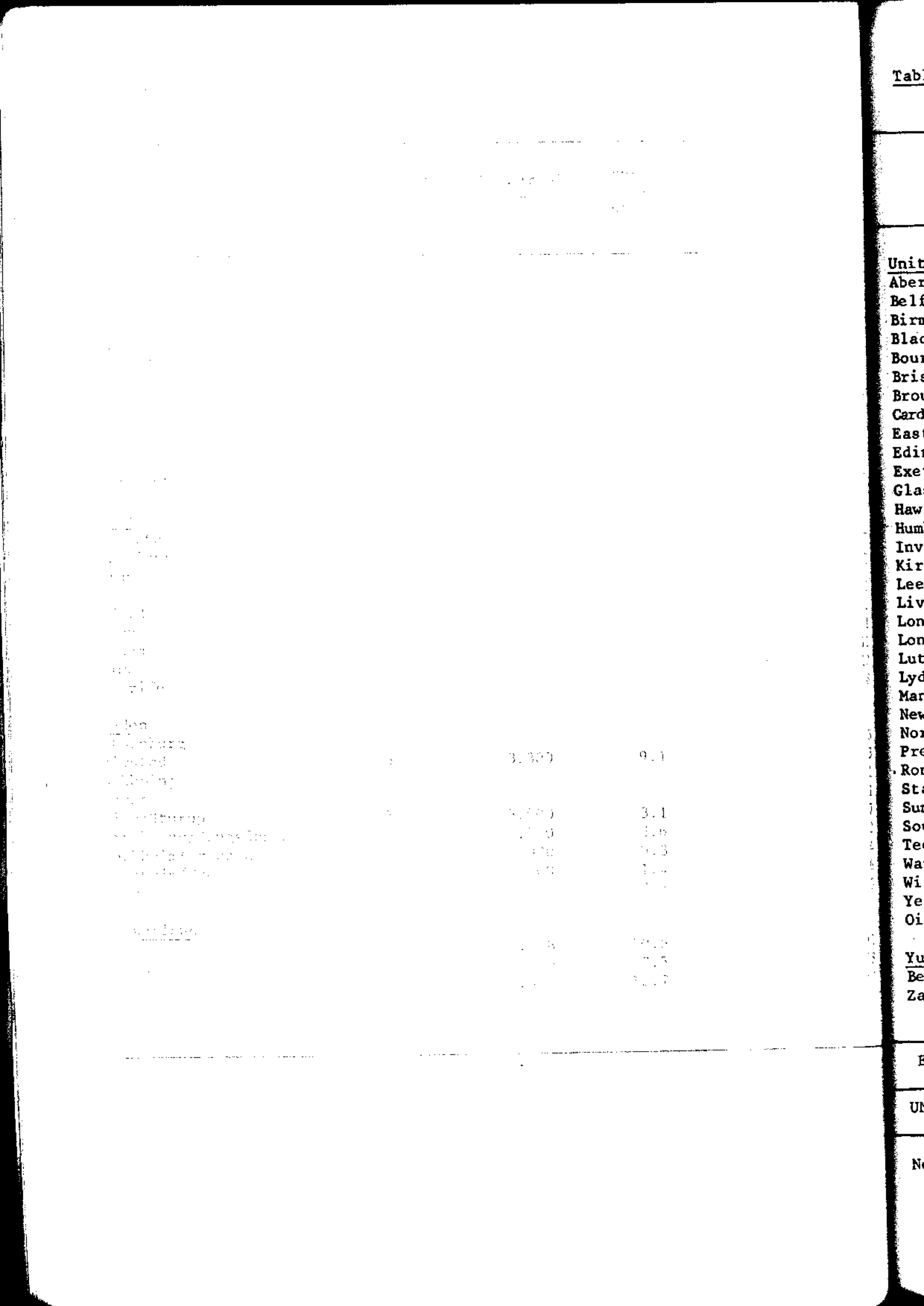

Table 3 (Continued)

Aerodrome/Country	Number of Incidents	Number of Movements	Rate per 10,000 Movements	Incidents to other European Aircraft	Tot
United Kingdom					
Aberdeen	9	65,596	1.4		
Belfast	18	24,489	7.3	1	
Birmingham	15	28,386	5.3	1	
Blackpool	1				
Bournemouth	2	11,209	1.8		
Bristol	1				
Brough	1				
Cardiff-Wales	4	8,916	4.5		
East-Midlands	3	16,222	1.8		
Edinburg	9	25,729	3.5		
Exeter	2	6,916	2.9		
Glasglow	11	44,231	2.5	1	
Hawarden	1				
Humberside	3	7,019	4.3		
Inverness	11	11,008	10.0		
Kirkwall	1				
Leeds/Bradford	9	12,505	7.2		
Liverpool	6	15,772	3.8	3	
London Gatwick	8	94,765	0.8		
London Heathrow	21	148,615	1.4	13	
Luton	10	24,027	4.2		
Lydd	1				
Manchester	5	39,528	1.3	6	
New Castle	8	17,288	4.6		
Norwich	10	17,730	5.6		
Prestwick	8	14,276	5.6		
Ronalds Way	7	16,614	4.2		
Stansted	2	13,482	1.5	1	
Sumburgh	4	25,882	1.5		
Southend	2	14,475	1.4		
Tees-side	1				
Warton	1				
Wick	10	5,303	18.8		
Yeovil	1				
Oil Riggs	5				
Yugoslavia					
Belgrade					
Zagreb					
En route					
UNKNOWN					

Notes: 3.1 Because of variability in reporting, bird population, aircraft movement pattern, control measures and features beyond control, any comparison between the rates calculated for different aerodromes is likely to be misleading.

Table 3 (continued)

List of Aerodromes where more than one strike has been reported by European Operators

Other Aerodromes

Bangkok	19	Johannesburg	3
Istanbul	16	Karachi	3
New Delhi	13	Kuala Lumpur	3
Bombay	8	Montreal	3
Dakar	8	Cairo	2
Jersey	7	Guayaquil	2
New York JFK	6	Kilimanjaro	2
Tunis	6	Malta	2
Dar es Salaam	5	Manila	2
Geurnsey	5	Moscow	2
Kano	5	Panama	2
Mombasa	5	Singapore	2
Nairobi	5	Tel-Aviv	2
Chicago	3	Toronto	2
Dakar	3		

Table 4 Bird Species - 1979

Scientific Name	English Name	Weight/ Weight Category	Weight Category	Number of Incidents	% Based on 71
Anseriformes					
Anas Platyrhynchos	Mallard	900 g	B	2	2.8
Anas sp.	Duck	0.3-1.5 kg	B	4	5.6
Anser sp.	Goose	up to 2.5 kg	C	3	4.2
Cygnus	Swan	13 kg	D	2	2.8
Apodiformes					
Apus Apus	Swift	30 g	A	27	
Charadriiformes					
Charadrius Hiaticula	Ringed Plover	55 g	A	1	1.4
Haemotopus Ostralegus	Oyster Catcher	550 g	B		4.2
Larus Argentatus	Herring Gull	1.1 kg	B	15	21.1
Larus Canus	Common Gull	400 g	B	8	11.3
Larus Fuscus	Lesser Black-Backed gull	800 g	B	2	2.8
Larus Marinus	Great Black -Backed gull	1.8 kg	B	3	4.2
Larus Melanocephalus	Mediterranean Gull	300 g	B	1	1.4
Larus Ridibundus	Black Headed Gull	300 g	B	50	70.4
Larus sp.	Gull	0.3-1.8 kg	B	233	328.2
Numenius Arquata	Curlew	800 g	B	2	2.8
Pluvialis Apricarius	Golden Plover	200 g	B	3	4.2
Sterna Hirundo	Common Tern	200 g	B	2	2.8
Vanellus Vanellus	Lapwing	250 g	B	78	109.9
Ciconiiformes					
Ardea Cinerea	Grey Heron	up to 1.8 kg	B	2	2.8
Columbiformes					
Columba Livia	Rock Dove	250 g	B	5	7.0
Columba Oenas	Stock Dove	250 g	B	1	1.4
Columba Palumbus	Wood Pigeon	450	B	11	15.5
Columba sp.	Pigeon	450	B	37	52.1
Columbidae	Dove	135-480 g	B	1	1.4
Falconiformes					
Accipiter Gentilis	Goshawk	1.0 kg	B	2	2.8
Accipiter Nisus	Sparrow Hawk	200 g	B	1	1.4
Aquila sp.	Eagle	4 kg	D	2	2.8
Buteo Buteo	Common Buzzard	880 g	B	2	2.8
Buteo Sp.	Buzzard	up to 880 g	B	24	33.8
Falco Sp.	Falcon	up to 800 g	B	12	16.9
Falco Tinnunculus	Kestrel	200 g	B	5	7.0
Milvus Migrans	Black Kite	1.0 kg	B	8	11.3
Milvus Milvus	Kite	1.0 kg	B	4	5.6
	Hawk	-	B	1	1.4
	Vulture	up to 5 kg	C	2	2.8

Table 4 (Continued)

Scientific Name	Englisch Name	Weight/ Weight Category	Weight Category	Number of Specimens	[illegible]
Galliformes					
Alectoris Rufa	Red-Legged Partridge	420 g	B	1	
Gallinago Gallinago	Snipe	250 g	B	1	
Perdix Perdix	Partridge	300-400 g	B	5	
Phasianus Colchicus	Pheasant	1.2 kg	B	7	
Gruiformes					
Gallinula	Moorhen	250 g	B	1	
Passeriformes					
Alauda Arvensis	Skylark	40 g	A	7	
Acantis Cannabina	Linnet	18 g	A	7	
Corvus Albus	Pied Crow		B	1	
Corvus Corone Corone	Carrion Crow	550 g	B	4	
Corvus Frigilegus	Rook	475 g	B	1	
Corvus sp.	Crow	550 g	B	22	
Delichon Urbica	House Martin	20 g	A	28	
Emberiza Calandra	Corn Bunting	30 g	A	1	
Emberiza Citrinella	Yelow Hammer	27 g	A	1	
Hirundidae	Martin	15 g	A	1	
Hirundo Rustica	Swallow	15 g	A	85	
Motacilla Alba	Pied Wagtail	20 g	A	1	
Passer Domesticus	Sparrow	18-40 g	A	22	
Pica Pica	Magpie	220 g	B	1	
Sturnus Vulgaris	Starling	85 g	A	2	
Turdus Merula	Black Bird	95 g	A	1	
Strigiformes					
Asio Flammeus	Short Eared Owl	380 g	B	1	
Asio Otus	Long Eared Owl	300 g	B	1	
Athene Noctua	Little Owl	100 g	A	1	
Tyto Alba	Barn Owl	200 g	B	1	
	Owl	170-380 g	B	2	
Total Known				772	
Unknown				640	
Total				1412	

Table 4 Bird Species -1979 (Continued)

Notes: 4.1 Bird weights and Scientific Names are based on information supplied by Aviation Unit, Worplesdon Laboratory, Agricultural Science Service, MAFF, Worplesdon, England and the average weight has been assumed.

4.2 The bird Categories based on current Civil Airworthiness requirements are:

A Below 110 g (¼ lb)
B 110 g to 1.81 kg (¼ lb ot 4lb)
C over 1.81 kg to 3.63 kg (4 lb to 8 lb)
D over 3.63 kg (8 lb)

4.3 Those birds not positively identified are tabled as Unknown. except where thereis evidence that they are Large (C or D).

4.4 Percentages are based on incidents wherebirds are identified.

Table 5 Part of Aircraft Struck

Part Struck	Number of Strikes by Bird Weight Category					% Based on 1444
	Unknown	A	B	C&D	Total	
Fuselage	77	44	122	—	243	16.8
Nose (excluding radome and windscreen)	152	80	130	1	363	25.1
Radome	49	33	51	1	134	9.3
Windscreen	73	53	60	—	186	12.9
1 Engine Struck	98	12	118	1	229	15.8
2 Eniges out of 3 struck	—	—	—	—	—	—
2 Eniges out of 4 struck	1	—	1	—	4	0.3
All engines struck	1	—	1	—	2	0.1
Wing/Rotor	63	12	105	2	182	12.6
Tail	1	-	5	-	6	0.4
Propellor	1	-	13	-	14	1.0
Landing Gear	16	12	49	-	77	5.3
Empennage	3	-	1		4	0.3
Part Unknown	26	23	100	1	150	
Total	561	269	758	6	1594	99.96%

Notes:

5.1 The totals in Table 5 are higher than other tables, as several Parts can be struck in one incident.

5.2 The percentages are based on incidents where the part struck *is known.*

5.3 Where both landing gear, or both wings are struck, two incidents are recorded.

Table 6 Effect of Strike - 1979

Effect	Number of Strikes by Bird Weight category					% Based on 1014
	Unknown	A	B	C&D	Total	
Loss of life/aircraft	-	-	-	-	-	-
Flight crew injured	-	-	-	-	-	-
Engine damag requiring repair on:						
2 engined aircraft	18	1	17	3	39	3.8
others	22	-	9	-	31	3.1
Windscreen cracked or broken	-	-	1	-	1	0.1
Vision obscured	2	-	-	-	2	0.2
Radome changed	1	-	3	1	5	0.5
Deformed structure	7	1	2	-	10	2.9
Skintorn/light glass broken	13	-	14	-	27	2.7
Skin dented	14	-	20	-	34	3.4
Propeller/Rotor/ transmission damaged	-	-	-	-	-	-
Aircraft system lost	5	1	5	-	11	1.1
Take of aborted	5	-	4	-	9	0.9
Nil damage	267	161	412	5	845	83.3
Unknown	38	28	51	-	117	
Total	392	192	538	9	1131	100%

Notes: 6.1 If, for example, skin is torn in two places, or both windscreens are broken, two incidents are recorded.

6.2 The percentages are based on known effects.

Table 7 Cost 1979

	Aircraft Movements	Cost (US Dollars)
Where cost is known	670,000	.221 million
Where cost is not known	2,719,000	-
TOTAL LIKELY COST	3,389,000	1.1 million

Notes: 7.1 5 countries reported bird strike cost

7.2 The cost is for engineering repairs

Table 8 Aircraft Operators Reporting Strikes 1979

Operator	Number of strikes	Number of Movements	Strikes per 10,000 Movements
Austria			
Montana Austria	1	3,000	3.3
Austrian Airlines	11	36,000	3.7
Belgium			
Sabena	22	79,372	2.8
Sobelair	1	10,560	0.9
Trans European Airways	4	16,488	2.4
Denmark			
Cimber Air	2	15,870	1.3
Conair	3	6,026	5.0
Maersk Air	3	22,838	1.3
SAS	20	97,450	2.1
Sterling Airways	6	36,396	1.7
Ireland			
Aer Lingus	56	71,346	7.8
Finland			
Finnair	15	127,208	1.2
France			
Air France	47	313,680	1.5
Air Inter	59	146,498	4.0
U.T.A.	12	29,414	4.1
Italy			
Alitalia	9	174,464	0.5
Netherlands			
KLM	83	112,858	7.4
Martinair	7	20,774	3.4
NLM	11	59,084	1.9
Norway			
S.A.S.	28	100,466	2.8
Braatens Safe	3	90,408	0.3
Wideröe's Flyveselskap A.S	2	134,256	0.2
Helikopter Service A.S.	3	47,500	0.6
Porugal			
T.A.P.	17	56,394	3.0
Sweden			
S.A.S.	31	78,493	3.9
Linjeflyg A.B.	21	44,284	4.7

Table 8 (Continued)

Operator	Number of Strikes	Number of Movements	Strik 10,0 Move
Switzerland			
Swissair	225	192,896	
United Kingdom			
Air Anglia	23	42,630	
Air Europe	2	5,934	
Air Ecosse	7	-	
Bristow Helicopters	3	38,925 Hrs.	
Britannia	23	56,374	
British Aerospace	2	-	
British Airways	184	493,344	
British Airways Helicopters	7	28,330 Hrs.	
British Caledonian	20	73,308	
British Cargo	5	5,658	
British Island Airways	12	76,564	
British Midland Airways	21	63,152	
Brymon	1	13,900	
C.A.A.	3	-	
Dan Air	23	108,654	
Intra	1	5,968	
Invicta	1	1,204	
Laker	6	21,312	
M.A.M. Aviation	3	-	
Mc Alpine	1	-	
Monarch	6	19,970	
Private Operators	8	-	
Scimitar	1	1,638	
Vernair	1	-	
Others & Unknown	33	-	

Notes: 8.1 Leased Aircraft are included against the operators.

Brief Details of Serious 1979 Bird Strike Incidents

(World Wide, Aircraft over 5,700 Kg & Executive Jets)

Date	Aircraft	Regn	Operator	Location	Total Aboard	Injury to Occupants	Damage to Aircraft
16.3.79	B747	5RMFT	Air Madagascar	Marseilles France	122	NIL	Substantial

During landing, at 50 feet, aircraft ingested gulls (Larus argentatus) into engines No 1, 2 and 3. Engine No 1 was changed (4 fan blades torn) and engines 2 and 3 repaired locally. (Engines P & W JT9D-70A).
(Source: French Reporting System)

10.4.79	DC9	HB-IST	Swissair	Zurich Switzerland	-	NIL	Slight

Abandoned take-off at about V1 due to running into a flock of birds. Runway was wet and aircraft over-ran by 20 metres. There was slight damage.
(Source: Lloyds List)

1.5.79	A300B	-	Indian Airlines	New Delhi India	-	NIL	-

During flight from Bombay to New Delhi struck bird causing extensive damage to left-hand wing. Plane landed safely at New Delhi.
(Source: Lloyds List)

25.8.79	DC10	-	-	Detroit USA	-	NIL	Substantial

During take-off struck flock of starlings (Sturnus vulgaris) causing damage to 14 blades in engine 1 and 16 blades in engine 3. Over 700 birds were killed.
(Source: FAA)

2.10.79	B747	N622US	Northwest Orient	Prestwick UK	340	NIL	Substantial

At rotation struck flock of lapwings (Vanellus vanellus). One engine shut down, aircraft returned. One engine changed due to fan and suspected core damage. Two other engines required fan blade and cowling changes. Aircraft showed at least 9 impacts of which 6 on wings and gear. (Engines P & W JT9D-7Q)
(Source: UK Reporting System)