

## **EURBASE, LIMITATIONS AND OPPORTUNITIES**

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### Summary

This paper briefly describes the progress over the years of the European Military Bird. Strike Database. First a description is given of the growth in contributions to nearly 35,000 records from 17 Air Forces. Apart from this quantitative aspect also an overview of the quality of the contributions is presented. In general the contributions are very well suitable for analysis but careful selections of the material should be made to exclude data that do not meet the quality standards for the particular aspects to be studied.

Keywords: Statistics, Military Aviation, Reporting.

## INTRODUCTION

After extensive discussions within the Air Forces Flight Safety Committee Europe (AFFSCE) in the late 1980's it was decided that there should be a database containing information on individual bird strikes experienced by their member Air Forces (EURBASE). Such a database was considered much more valuable in understanding the phenomenon of collisions between birds and aircraft than the hitherto collected sets of aggregated information per Air Force.

The Military Low Flying Working Group of the International Bird Strike Committee (IBSC) was considered to be the specialist group most well equipped to accompany the process of setting up such a database, the RNLAFF was appointed custodian. In order to standardise the information to be collected from each bird strike a European Military Bird Strike Form (EURFORM) was developed. The final version of this form was adopted by the Military Agency for Standardisation as an annex to Standard NATO Agreement 3879 FS. A data entry program for storing the information from EURFORM was developed and made available for all AFFSCE members (Dekker & Buurma, 1992). This proved to be very important for efficiently and uniformly combining data from different Air Forces.

From the introduction of EURBASE (Dekker & Buurma, 1990) onwards data collection went along two lines. A quest for old data that was converted as much as possible to EURBASE standards and conventions and the promotion of the use of EURFORM conventions in the reporting systems of as much Air Forces as possible.

This paper describes the development of EURBASE. Apart from the growth of both the number of participating Air Forces and contributed number of bird strikes the emphasis is mainly on the quality of the contributions.

## CONTRIBUTIONS

Since the last IBSC meeting in London (May 1996) the database has extended considerably. The total number of contributed bird strikes increased from 27,754 to 34,564 while the number of actual contributing nations increased from 12 to 15 (see table 1). New contributors were HAF, POAF and ISRAF. The increase in numbers is therefore not only related to *the* addition of data from *recent years* from already participating Air Forces but also to a large extent a consequence of the contribution from 'first time contributors' and of 'historical' data from (mainly) ISRAF. The table also contains contributions, which for various reasons are not actually part of the database. These include the GAF contribution for 1996 which is only available on paper and the aggregated information from some Air Forces collected from AFFSCE minutes and hand-outs (FINAF, POAF pre 1996 and SW IAF). Furthermore, a number of contributions were added to the database but were received too late to include in the analysis for this paper (FAF 1996+1997, IAF 1997, RAF 1996+1997).

The total number of contributed bird strikes and the number of years of which data are available for each Air Force are pictured in figure 1. This figure also indicates the quality of each Air Force's dataset, this quality being defined as the number of items from EURFORM of which there is an extreme lack of information (see later). It is clear from figure 1 that independent of the quantity of the contributions there are considerable differences in quality.

FORCES	YRS	TOTAL	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	Pre 80
AAF																					
BAF	9	764		<b>80</b>	<b>67</b>	<b>66</b>	<b>70</b>	<b>64</b>	<b>76</b>	<b>95</b>	<b>115</b>	<b>113</b>									
CZAF	7	215		<b>25<sup>B</sup></b>	<b>33<sup>A</sup></b>	<b>30</b>	<b>23</b>	<b>38</b>	<b>25</b>	<b>41</b>											
FAF	19	3,498	28 <sup>D</sup>	<b>65</b>	<b>158</b>	<b>248</b>	<b>211</b>	<b>183</b>	<b>221</b>	<b>122</b>	<b>189</b>	<b>189</b>	<b>180</b>	<b>70</b>	<b>70</b>	<b>126</b>	<b>170</b>	<b>196</b>	<b>206</b>	<b>188</b>	<b>427</b>
FINAF	12	340		<b>89<sup>D</sup></b>	<b>31<sup>D</sup></b>	<b>36<sup>D</sup></b>	<b>49<sup>D</sup></b>	<b>35<sup>D</sup></b>	<b>28<sup>D</sup></b>	<b>36<sup>D</sup></b>	<b>26<sup>D</sup></b>	<b>16<sup>D</sup></b>	<b>16<sup>D</sup></b>	<b>8<sup>D</sup></b>	<b>16<sup>D</sup></b>						
GAF	18	9,000		<b>396<sup>A</sup></b>	<b>387</b>	<b>425</b>	<b>489</b>	<b>443</b>	<b>497</b>	<b>602</b>	<b>623</b>	<b>604</b>	<b>580</b>	<b>415</b>	<b>474</b>	<b>505</b>	<b>655</b>	<b>615</b>	<b>503</b>	<b>429</b>	<b>375</b>
HAF	4	77	<b>60<sup>DC</sup></b>	<b>5<sup>DC</sup></b>	<b>15<sup>DC</sup></b>	<b>7<sup>DC</sup></b>	<b>E</b>	<b>E</b>													
HUAF																					
IAF	7	1,098	146 <sup>E</sup>	155	186	174	184	64	101	66											
POAF	18	129	10 <sup>DC</sup>	8 <sup>B</sup>	8 <sup>B</sup>	2 <sup>B</sup>	11 <sup>D</sup>	7 <sup>D</sup>	13 <sup>D</sup>	6 <sup>D</sup>	12 <sup>D</sup>	4 <sup>D</sup>	4 <sup>D</sup>	12 <sup>D</sup>	8 <sup>D</sup>	8 <sup>D</sup>	1 <sup>D</sup>	5 <sup>D</sup>	5 <sup>D</sup>	4 <sup>D</sup>	
RAF	16	11,994	427 <sup>E</sup>	372 <sup>E</sup>	508	555	533	613	589	638	638	748	879	710	743	778	788	785	693	621	
RDAF	7	312				28	48	40	51	86	45	38									
RNLAF	22	3,413	77	93	105	100	93	107	92	183	243	195	181	154	151	176	224	281	175	131	649
RNOAF	11	340			33	53	36	29	28	36	37	38	13	14	25						
SAF	21	187			66 <sup>E</sup>	10	13	7	11	10	20	6	9	22	1	0	3	2	3	1	4
SKAF	3	58			22	17	19														
SWEAF					E																
SWIAF	1	11		11 <sup>D</sup>																	
USAF(E)	8	2,264						115	254	361	336	294	278	374	282						
ISRAF	14	2,466		247	194	221	170	216	247	238	262	167	138	125	112	23	104				
TOTAL		34,564	899	1495	1792	1990	1947	1983	2330	2502	2539	2380	2078	1904	1882	1616	1925	1884	1585	1374	1458
FORCES		17	6	12	14	15	14	14	14	14	12	12	10	10	10	7	7	6	6	6	4

Table 1: Available data in Eurbase per spring 1998. Figures represent the number of contributed bird strikes per Air Force and per year. Shading indicates the availability of flying hours per aircraft type for that particular Air Force and year (source: AFFSC(E) handouts). Data (per Air Force, per year) included in further analysis are printed in bold italics (N=33,418)

A Only available on paper, only limited detailed information per individual BS available  
B Only limited detailed information per individual BS available  
C Only available for part of year  
D Total numbers of BS per year are given; detailed information not or only for a limited number of BS  
E Only total flying hours available (not per AC-type)  
. Data received too late to include in this analysis

**FIGURE 1.**  
**Available EURBASE data per Air Force. Dot size indicates the quality of the data.**

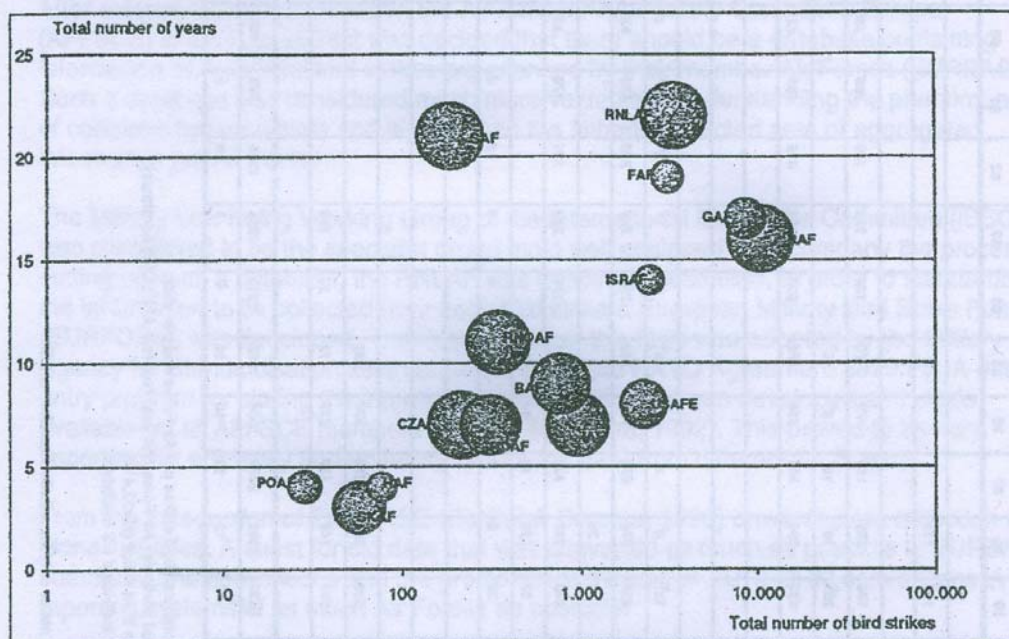


Figure 1 clearly demonstrates that 'the total database as a single source of information is very heterogeneous and should be consulted with care. Large datasets (both with respect to years and numbers) from large Air Forces are obviously dominating the database but may not always add to the usefulness if the analysis is concerning items on which there is only very limited information available. So depending on the scope of the analysis suitable datasets should be selected. In time however a growing proportion of the database will consist of contributions from recent years from Air Forces that adopt EURBASE conventions and therefore the database will in time grow closer to the EURBASE standards.

### LIMITATIONS

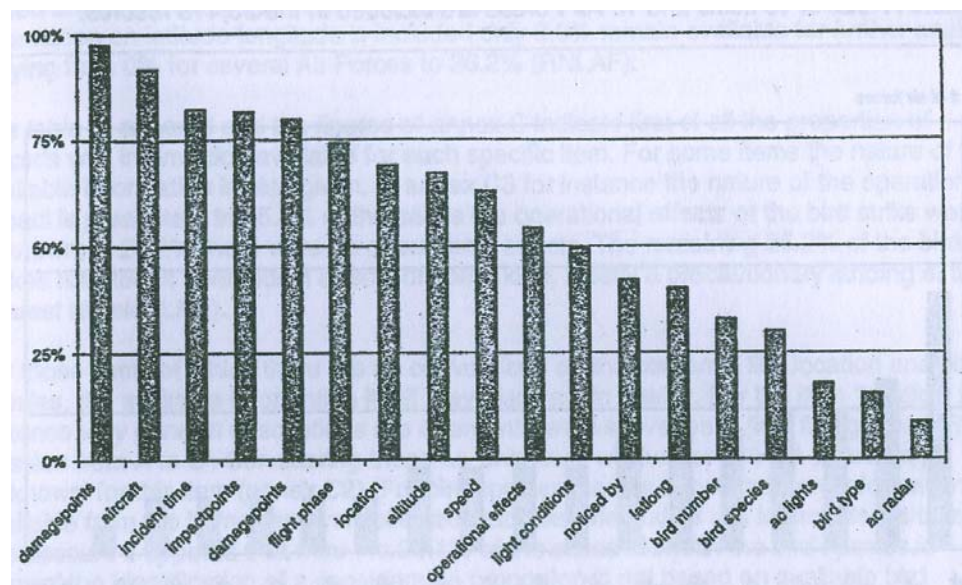
In order to get some insight in the usefulness of the data collected in EURBASE the dataset from each Air Force has been evaluated with respect to the most relevant 18 items from EURFORM. For each item this was done by establishing the proportion of the dataset scoring 'unknown'. Furthermore, for some of the items the actual content was looked at in more detail. The results are presented in annex A (absolute numbers) and annex B (percentages).

The percentages per Air Force (annex B) facilitate an overall quality establishment for each item as depicted in the five first columns:

- a. average value from the 15 Air Forces
- b. standard deviation of this average value
- c. standard deviation expressed as a percentage of the average value
- d. minimum value scored for one or more Air Forces
- e. maximum value scored for one or more Air Forces
- f. Overall total mean from the combined dataset

FIGURE 2

Overall mean percentage of records containing information for each one of 18 selected items.



In figure 2 for each of the 18 selected items the overall total mean percentage of records containing information is presented. The differences are striking. Obvious information like whether or not the bird strike resulted in damage or the aircraft involved in the bird strike have scores of over 90% (not 100%) while other items like e.g. bird species score only very low (30%).

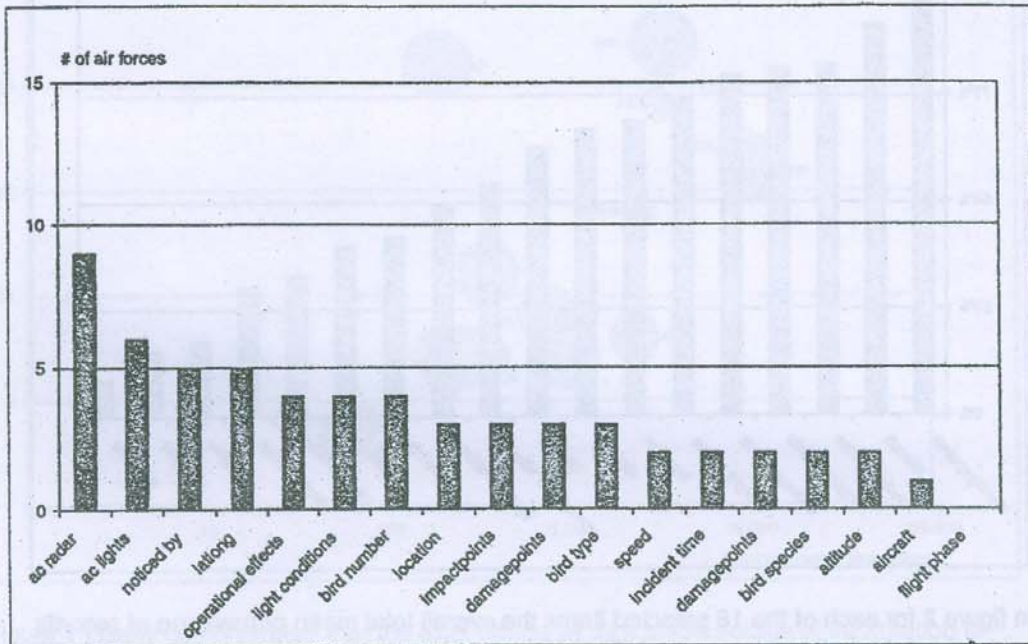
Good reporting is not always characterised by 100% scores on all items. For instance those Air Forces in which groundcrew is alert on bird strikes will have a relatively large number of bird strikes which are only reported because they were noticed by the groundcrew. This will result in a high proportion of 'unknowns' for a number of items. For each item an extreme lack of information was therefore defined as a percentage 'unknown' of more than the mean of the 15 Air Forces plus the standard deviation. Figure 3 shows for each item the number of Air Forces that score such an extreme lack of information. The number of such items per Air Force is given in figure 4. Not surprisingly, those Air Forces that are using EURFORM in their reporting system (CZAF, IAF, RAF, RNLAf, SAF and SKAF) are scoring best. Those Air Forces from which the data had to be extracted from different reporting systems show a larger number of items lacking information.

The above mentioned quality indicating values from annex B are made visible in the figures in annex C of which some will be dealt with in more detail here.

Annex C1 shows the results for some relatively good quality items. The mean of 15 Air Forces for these items all score over 65% (horizontal line). Nevertheless there are Air Forces in which no records at all contain information (dots) while other Air Forces score around 100% (triangles). This figure also indicates that information on some items may be linked. For instance 'speed' scores an overall mean of 63% and altitude 67.2%. If information on these items was randomly present in the dataset one would expect  $63 \times 67.2 = 42.3\%$  for the combination. In reality this combination scores 60.4%; so if one of these items is known the other most probably is also known.

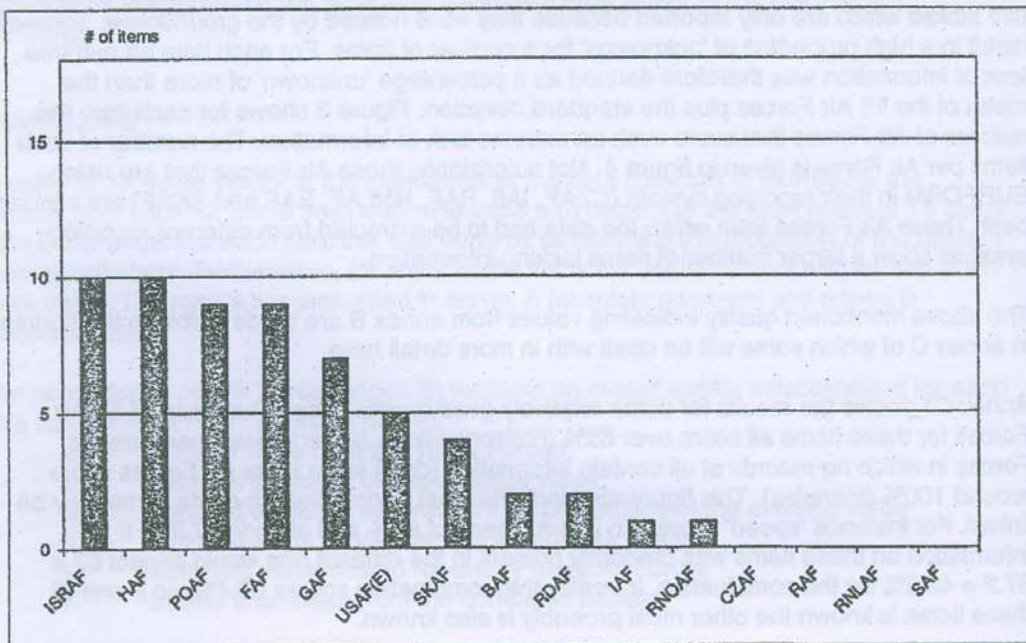
**FIGURE 3.**

Number of Air Forces per item with extreme lack of information. Extreme lack of information is defined as a number of "unknowns" being more than the total mean + standard deviation. A total of 18 items and 15 Air Forces are included in the 33,418 records.



**FIGURE 4.**

Number of items per Air Force with extreme lack of information. Extreme lack of information is defined as a number of "unknowns" being more than the total mean + standard deviation. A total of 18 items and 15 Air Forces are included in the 33,418 records.



A quite different situation is pictured in annex C14. In only 30.1 % of the cases information is available on the bird species involved in the bird strike, varying from 0 to 70.6%. If those cases of which bird remains were present and the bird species is known are combined with speed and altitude in only 11.2% of the database information is available. If also information on latitude-longitude is included only 8.9% remain available for further analysis, varying from 0% for several Air Forces to 36.2% (RNLAf).

The table of annex B and the figures of annex C indicate first of all the proportion of records with information available for each specific item. For some items the nature of the available information is also given. In annex C3 for instance the nature of the operational impact is presented. In 45.6% of the cases the operational effects of the bird strike were unknown; in 29.2% there were no operational effects. The remaining 25.2% of the bird strikes resulted in operational effects of some kind, mostly a precautionary landing at the nearest airfield (LNA).

For those items of which there are no conventions on the contents, like location and bird species, the available information itself may also vary in quality. For the item 'location' for instance very general descriptions are often entered like 'over sea'; 'low flying area NR x` or 'mission from A to B'. Considering these as 'unknown' will further rise the percentage 'unknown' for this item (annex C2). For bird species there is supplementary information available from the items 'remains collected' and 'identified by'. If this information is taken into account it appears that from the 30.1 % of the cases of which the bird species is 'known' the identification of a considerable proportion is not based on available bird remains or is otherwise obscure (annex C15).

Apart from the information in EURBASE for distinct types of analysis information on flying hours is needed. As is clear from table 1 such information could be extracted for r Forces from AFFSCE minutes. It should be kept in mind however that only totals is aircraft type and per year are given and some Air Forces even suffice in providing flying hours for all aircraft types combined.

## **OPPORTUNITIES**

The extensive enumeration of limitations might suggest that despite the large number of bird strikes that are contributed the usefulness of EURBASE is only very limited. This however is not the case; as long as the nature of the limitations are known and taken in consideration the material can very well be helpful in the better understanding of the problem of bird strikes. In the past EURBASE data have been used for studies:

The paper presented at the 21st BSCE meeting in Jerusalem 'Bird strike hazard to helicopters' (Buurma & Dekker, 1992) offered such new perspectives that it was -on invitation- also presented at the 'Eighteenth European Rotorcraft Forum' (Buurma & Dekker, 1992). Especially the strike frequency per flying hour of helicopters with birds of different weight was (and still is) a unique product of joined information from GAF, RAF and RNLAf.

For the 119<sup>th</sup> meeting of AFFSCE a comparative study was done using data from FAF, GAF, RAF, RDAf and RNLAf (Buurma, 1995). The results were also incorporated in a presentation at the 23<sup>rd</sup> BSCE meeting in London (Buurma & Dekker, 1996). The extremely deviating figures from RNLAf suggested a positive effect of the introduced bird strike warnings based on radar observations using the ROBIN system.

The altitude profile of local bird strikes for different Air Forces that was presented at the 23rd BSCE meeting in London (Buurma, 1996) indicates that the bird strike risk is changing from mainland Europe to more coastal areas. The most obvious explanation being the fact that the bird populations in wetland, coastal areas apparently are larger and flying at higher altitudes.

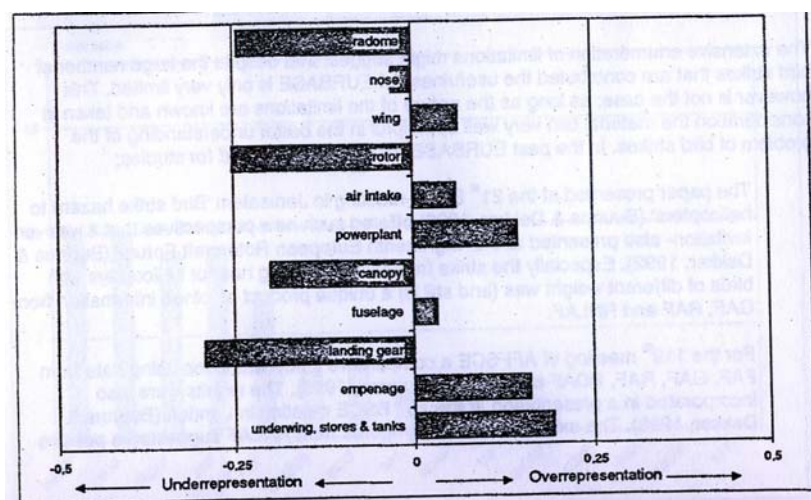
These very general studies reveal clues and hints for further, more detailed studies. With the recent increase in numbers the size of the database now is getting enough critical mass to enable this. Furthermore, the addition of more recent data will increase the proportion of the database that is fully up to EURBASE standards.

The bird strike resistance of different aircraft parts could be the subject for such a detailed study. Comparing the distribution of impactpoints with that of damagepoints shows some intriguing differences (figure 5). Aircraft parts like radome, (nose) and canopy/windscreen which are in view of the pilot are underrepresented with respect to damage. This probably not indicates a better 'bird hazard resistance' but rather points at reporting effects. In contrast the empennage, powerplant and underwing stores and tanks seem overrepresented in damagepoints which not just means that these parts are, very vulnerable but that non-

damage impacts on the aircraft parts easily go unreported. At first sight this might suggest that there are too much 'on-the-other-hands' and that the data are therefore of no use. In reality the discrepancies are so distinct that they offer possibilities for further detailed analysis. These should be focused on single aircraft types and incorporate the chance of a bird strike to be on specific aircraft parts based on the frontal area of the aircraft.

FIGURE 5.

Relative under or overrepresentation of damage cases for 11 impactpoints. Representation is expressed as perceptual distribution of damagepoints divided by the perceptual distribution of impactpoints.



Further opportunities for the use of EURBASE data can be expected from modern statistical techniques that have a very high discriminating potential. It should always be kept in mind however that using these very sensitive techniques only will reveal new information if careful selection of relevant EURBASE data will be an integral part of the process.

## CONCLUSIONS

Table 1 clearly shows that since the introduction of EURBASE at the 2e IBSC meeting in 1990 (Dekker & Buurma, 1990) huge achievements are made. Not only are the nearly 35,000 records a valuable source of information, the fact that this information is originating from 15 Air Forces and often dating back since the early 1980's is very important and indicates that a general need is felt to support EURBASE.

EURBASE's civil counterpart, ICAO's world wide bird strike information system IBIS, is already operational since 1980 and contains information on 62,000 bird strikes from 45 of ICAO's member states (Pinos, 1996). This perspective, and the fact that European military aircraft movements only form a fraction of world wide air traffic makes the success of EURBASE extra remarkable.

Unfortunately the quantitative success of EURBASE is somewhat counterbalanced by qualitative shortcomings. Although these are not necessarily prohibitive to the use of the data, full advantage from a joined database is only achieved when more contributing Air Forces adopt EURBASE standards and conventions in their reporting system. Until the time has come that bird strikes are uniformly registered in all contributing Air Forces any analysis should be preceded by a careful selection of 'valid material'.

## ACKNOWLEDGEMENTS

This paper could only be written thanks to the contributors of data. A special word of thanks therefore for all those 'points of contact' of which there are too many to be mentioned here by name. Gilbert Alicaris carefully screened AFFSCE minutes and handouts on bird strike information. Naps van Gasteren helped with the extensive computer work that sometimes is involved in converting data from national reporting systems to EURBASE standards. Finally Luit Buurma read earlier drafts and made valuable comments.



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	EURBASE absolute numbers																Page 1
Period	TOTAL	BAF	CZAF	FAF	GAF	HAF	IAF	ISRAF	POAF	RAF	RDAF	RNLAF	RNOAF	SAF	SKAF	USAFE	
Years		88-96	90-96	77-95	79-95	94-97	90-96	8396	94-97	80-95	88-94	76-97	85-95	75-95	93-95	85-92	
		9	7	19	17	4	7	14	4	16	7	22	11	21	3	8	
Records	33418	764	215	3144	8604	77	950	2466	29	10595	312	3413	340	187	58	2264	
Incline known	27513	515	215	3125	6600	77	605	0	29	10308	296	3245	301	162	24	2011	
Aircraft known	30683	535	215	3143	8604	77	948	0	29	10559	311	3413	340	187	58	2264	
AC-type known	33238	693	215	3143	8560	75	950	2423	25	10585	311	3412	340	184	58	2264	
Aircraft ?? but type known	2615	159	0	1	0	0	2	2423	0	30	0	0	0	0	0	0	
Speed known	21042	594	124	2715	4122	74	747	0	28	7957	228	2331	276	183	21	1642	
Altitude known	22465	538	166	2565	4126	74	679	1756	28	7890	222	2312	278	184	36	1611	
Speed + altitude known	20185	530	122	2510	3883	74	668	0	28	7809	221	2303	265	183	18	1571	
Location given	23054	373	143	0	6862	76	732	1788	26	9587	72	2919	291	159	26	0	
Location + lat.Long given	10673	127	96	0	6434	0	454	0	0	1596	63	1768	236	99	0	0	
Total Lat.Long given	13397	329	96	27	6479	0	469	0	1	1620	232	1919	244	112	0	1869	
Flightphase unknown	8630	139	23	530	2806	3	177	362	3	2728	83	1044	22	8	20	682	
Flightphase known	24788	625	192	2614	5798	74	773	2104	26	7867	229	2369	318	179	38	1582	
One code given	23755	603	180	1978	5798	71	760	1867	26	7867	219	2281	311	176	38	1590	
Two codes given	1022	22	12	632	0	3	12	237	0	0	9	83	7	3	0	2	
Three codes given	11	0	0	4	0	0	1	0	0	0	1	5	0	0	0	0	
Flightphase:																	
TAX	273	5	0	20	159	0	12	41	0	20	2	13	1	0	0	0	
TOF	2636	59	11	165	403	5	92	407	4	849	34	308	64	25	4	206	
CLI	375	10	5	65	127	1	21	0	1	27	8	42	20	3	3	42	
LLE	12844	374	42	904	3930	60	183	100	12	5010	25	1257	19	79	9	840	
CRU	3800	7	75	1662	0	7	266	1221	1	177	83	73	88	20	0	120	
HOL	143	6	6	0	3	0	21	0	0	63	3	16	2	12	11	0	
DES	238	5	4	114	0	0	8	37	1	17	0	25	2	4	2	19	
FAP	2550	82	10	130	795	0	82	64	4	886	22	262	52	15	1	145	
LAN	2176	87	49	163	371	4	84	471	1	274	62	309	67	16	6	212	
TGO	797	12	2	31	10	0	18	0	2	544	1	157	10	8	2	0	
Total Flightphase codes	25832	647	204	3254	5798	77	787	2341	26	7867	240	2462	325	182	38	1584	
CRU or LLE	16090	378	106	2044	3930	65	446	1321	13	5187	103	1322	107	99	9	960	
FAP or LAN	4684	167	58	382	1166	4	163	535	5	1160	82	538	119	31	7	357	



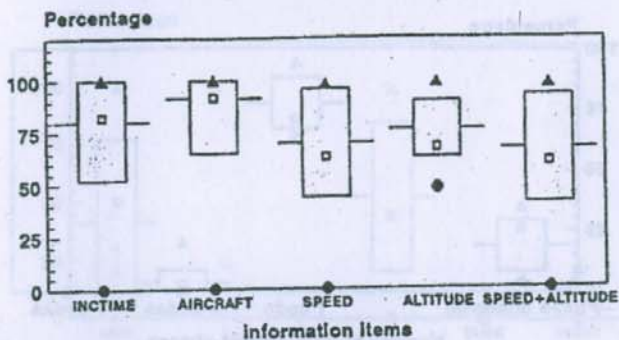






### Annex C1

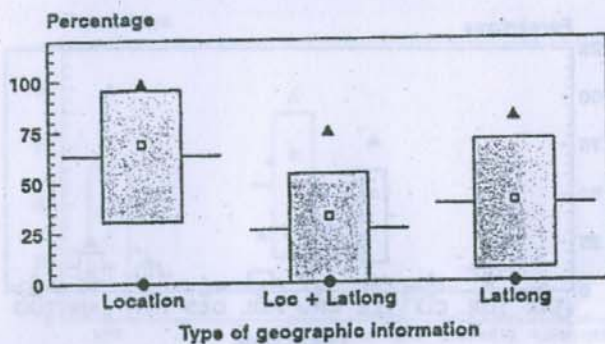
Basic information on bird strikes  
Percentages from total number of bird strikes (33,418)



Hor.line + bar: mean of 15 Air Forces + st. dev.  
Square: overall average  
Dot + triangle: minimum and maximum

### Annex C2

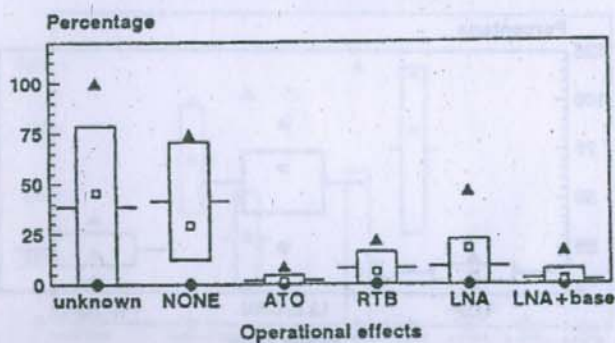
Geographic information on bird strikes  
Percentages from total number of bird strikes (33,418)



Hor.line + bar: mean of 15 Air Forces + st. dev.  
Square: overall average  
Dot + triangle: minimum and maximum

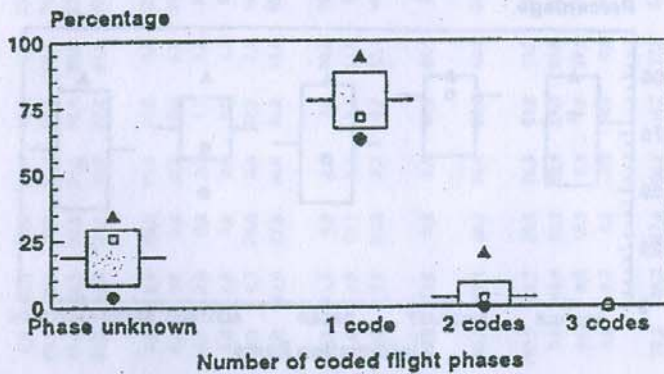
### Annex C3

Information on operational effects  
Percentages from total number of bird strikes (33,418)



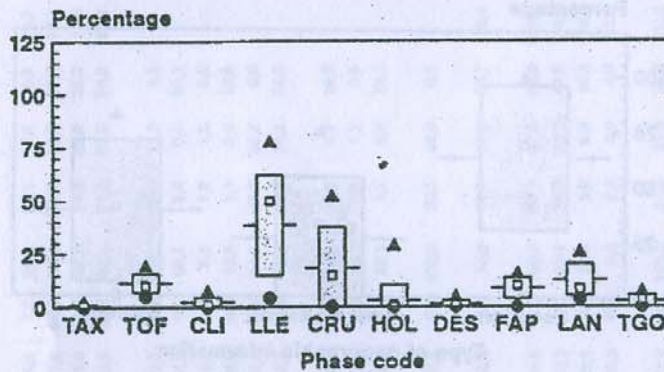
Hor.line + bar: mean of 15 Air Forces + st. dev.  
Square: overall average  
Dot + triangle: minimum and maximum

**Annex C4**  
**Number of coded flight phases**  
**Percentages from total number of bird strikes (33,418)**



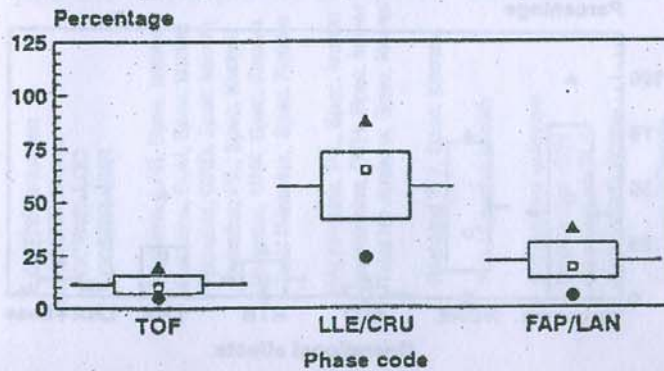
Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

**Annex C5**  
**Distribution of registered flight phases**  
**Percentages from total of registered codes (25,832)**



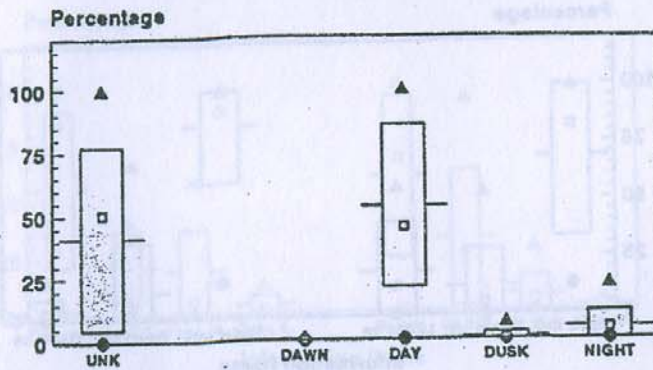
Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

**Annex C6**  
**Distribution of some combined flight phases**  
**Percentages from total of registered codes (25,832)**



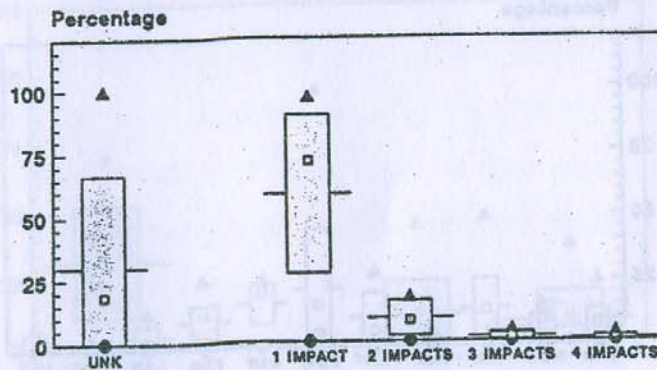
Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

**Annex C7**  
**Information on daylight conditions**  
 Percentages from total number of bird strikes (33,418)



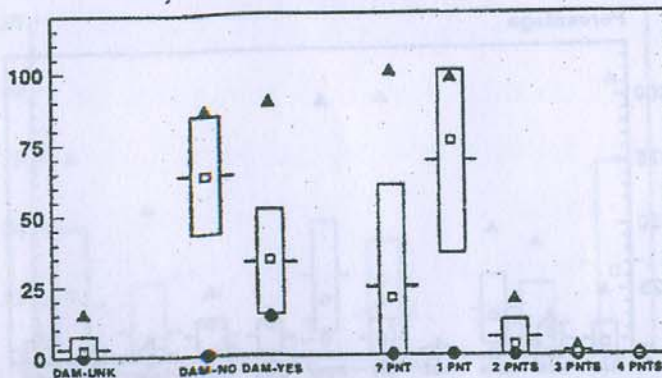
Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

**Annex C8**  
**Information on impact**  
 Percentages from total number of bird strikes (33,418)



Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

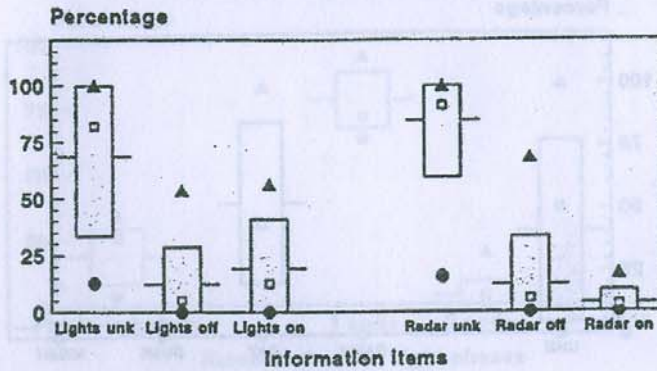
**Annex C9**  
**Information on damage**  
 Percentages from valid records (31,741) or damagecases only (10,806)



Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

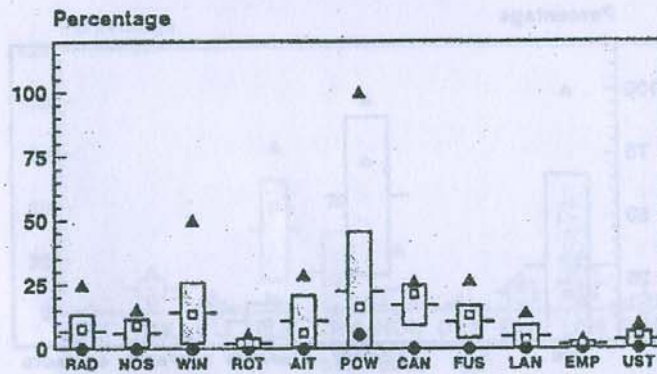


**Annex C10**  
**Information on AC-lights and AC-radar**  
**Percentages from total number of bird strikes (33,418)**



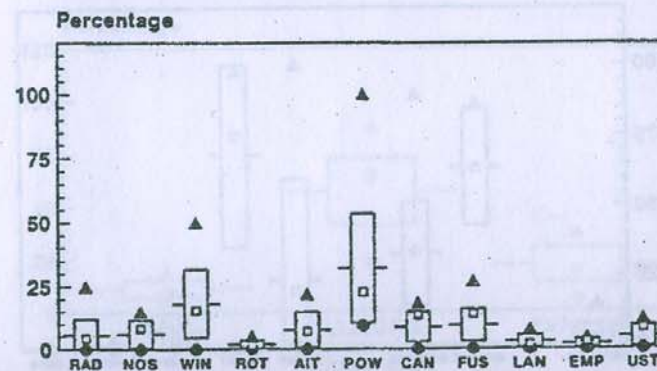
Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

**Annex C11**  
**Information on impactpoints**  
**Percentages from total number of registered impactpoints (31,429)**



Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

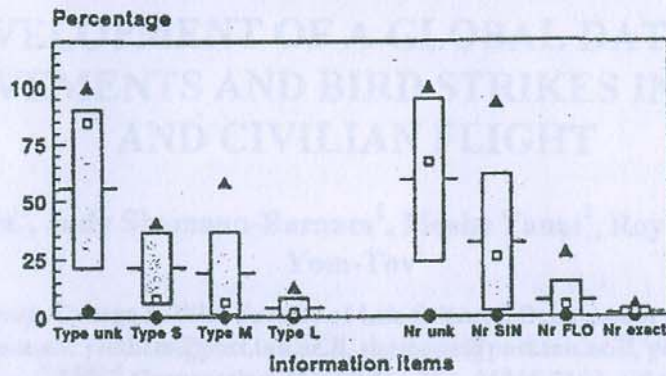
**Annex C12**  
**Information on damagepoints**  
**Percentages from total number of registered damagepoints (9148)**



Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

### Annex C13

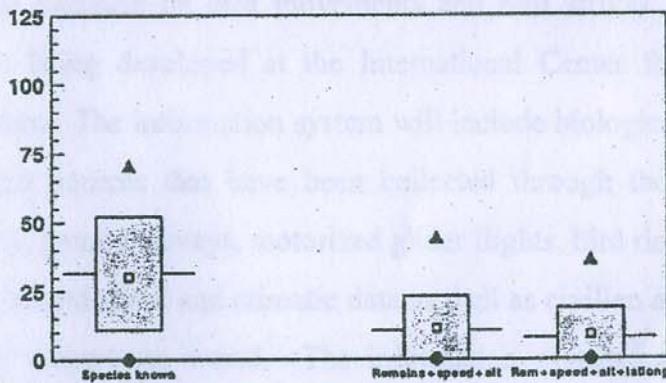
Information on bird type and bird number  
 Percentages from total number of bird strikes (33,418)



Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

### Annex C14

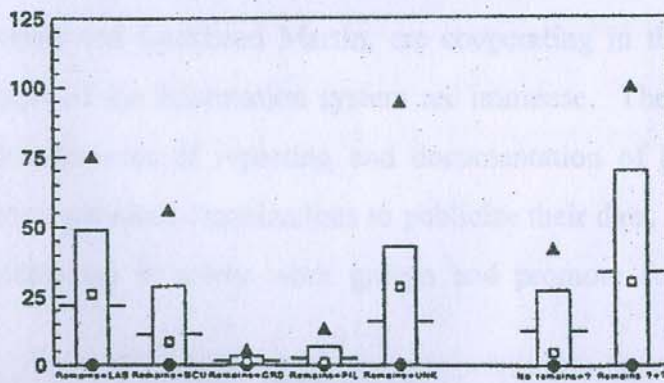
Bird species in combination with other information  
 Percentages from total number of bird strikes (33,418)



Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum

### Annex C15

Details on identification of birds  
 Percentages from bird strikes with known bird spec (10,074)



Hor.line + bar: mean of 15 Air Forces + st. dev.  
 Square: overall average  
 Dot + triangle: minimum and maximum