

**SOME CHARACTERISTICS OF BIRD STRIKES TO
MILITARY AIRCRAFT IN NORWAY 1985-1995**

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Summary

For an eleven year period, the occurrence of bird strikes to Norwegian military aircraft are analysed in the paper. From 1985 to 1995, the RNoAF experienced 345 collisions with birds, one of which resulted in the loss of an F-16. Two strikes caused major damage to the aircraft whereas 29 caused minor damage. No pilots or other air crew personnel were killed during these years. Annual fluctuations and seasonal peak(s) in bird strike frequency are presented. The distribution of strikes by phase of flight and by altitude are also shown, as well as the types of aircraft that were involved. Of strikes in which the bird species or bird group was identified, gulls accounted for the greatest number (43 %), and they were also responsible for a disproportionately high frequency of the strikes resulting in damage. Gulls thus confirm their position as the most troublesome birds to aircraft in Norway.

Key Words: Statistics, Military Aviation, Mishap Investigation, Country

1. INTRODUCTION

Norwegian bird strike statistics have recently been presented together with statistics from other countries (Dekker and Buurma 1992, Dekker 1994, Richardson 1994, Thorpe 1994). More comprehensive analyses of Norwegian bird strike data, however, are older (Lid 1973) as is also a characterization of bird strike problems on one particular Norwegian airport (Bentz 1984). Seen in association with this, I here present an analysis, which includes eleven years of Norwegian military bird strike data, from 1985 to 1995.

Operating rather far north in Europe, and consequently located more towards the end of the migratory routes, Norwegian military aircraft may not be as exposed to heavy bird intensities than other European air forces. The Royal Norwegian Air Force (RNoAF) has, however, lost 3 fighter aircraft and one fighter pilot to bird collisions. Two of the crashes occurred prior to the study period of this paper: in 1971, when a Lesser black-backed gull penetrated the windshield of an F-5 at low level, killing the pilot (Lid 1973), and in 1981 when a Crane penetrated the windshield of an F-16 at high altitude (Bentz 1982, Buurma 1982). The third aircraft loss occurred in May last year (see below). The frequency of Norwegian military aircraft crashes due to bird strikes, is thus a little less than once every 10 years.

2. METHODS

In Norway, a bird strike report is always filled in by the pilot, or sometimes by other aircrew - or maintenance personnel, whenever a collision between bird and military aircraft takes place. All military bird strike reports from 1985 to 1995 were included in this analysis.

Bird remains found on airfields were included only if they corresponded to a particular bird strike report. The bird remains were identified mainly macroscopically, and microscopically on occasions. The main reason why not *all* bird remains were considered is that there are differences in reporting standards between airfields. The birds listed in Table 1 were identified according to bird remains found on airfields or on the aircraft, or in some cases visually identified by the pilot. In the latter case, only those observations where the pilot was certain of the species, were considered.

Three levels of damage to the aircraft were used: *Minor damage* (10-450 man-hours spent in repair), *major damage* (more than 450 man-hours spent in repair) and *written off*. Small damages to an aircraft, resulting in less than 10 man-hours repairing time, were therefore considered as *no damage* in this paper.

3. RESULTS AND DISCUSSION

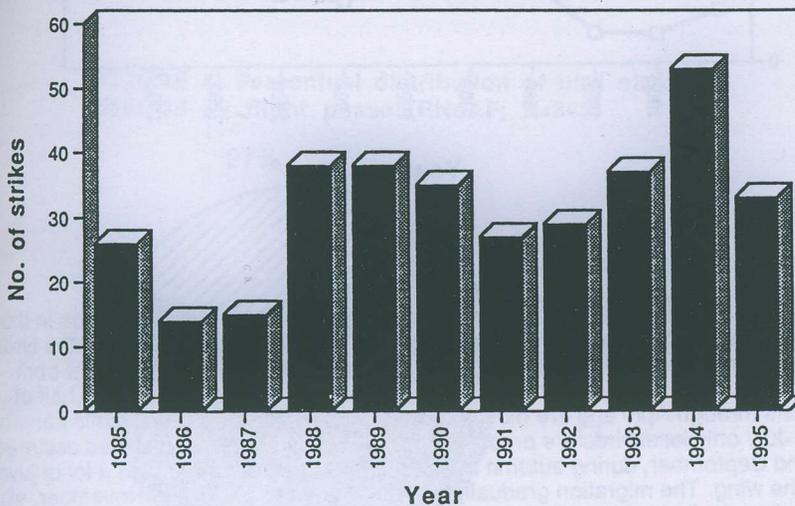
3.1 Annual distribution of strikes

In the eleven year period from 1985 to 1995, RNoAF experienced 345 collisions with birds (and one with a mammal, see 3.6 below). Each year the number of bird strikes varied between 14 and 53, with low numbers in 1986 and 1987 and a peak in 1994 (Fig.1). Only 9.3 % (32 strikes) of these were causing damage to the aircraft, whereof three were responsible for more than *minor damage* (see Methods for damage categories). The bird related incidents or mishaps from this period which resulted in *major damage* or a *written off* aircraft, were:

- Feb. 1988: An F-16 hit a Great black-backed gull in 700 ft above sea, causing minor damage to the fuselage and major damage to the engine. After the strike, the pilot landed safely on the home air base.

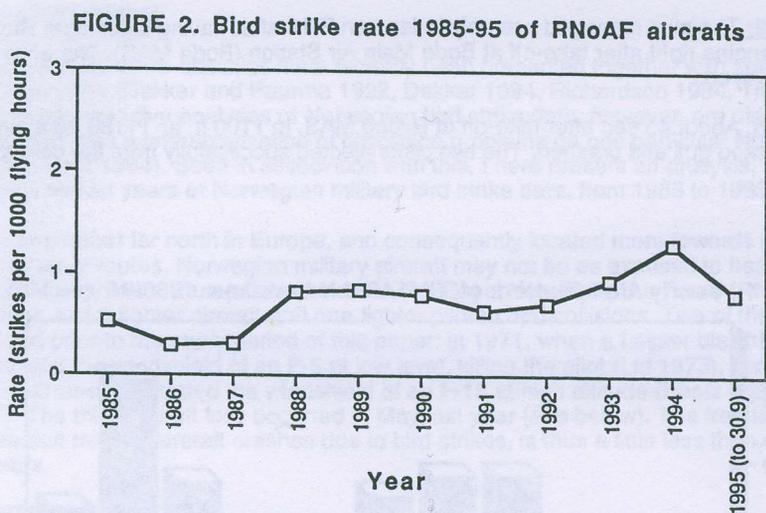
- May 1992: The pilot managed scarcely to land an F-16 after having ingested a Raven into the engine right after take-off at Bodø Main Air Station (Bodø MAS). The engine was destroyed.
- May 1995: About 45 sec after take-off at Rygge MAS, in 1100 ft, an F-16B hit a Great black-backed gull and crashed. The two pilots ejected successfully from the downgoing aircraft.

FIGURE 1. Yearly distribution of RNoAF bird strikes 1985-95 (n=345)



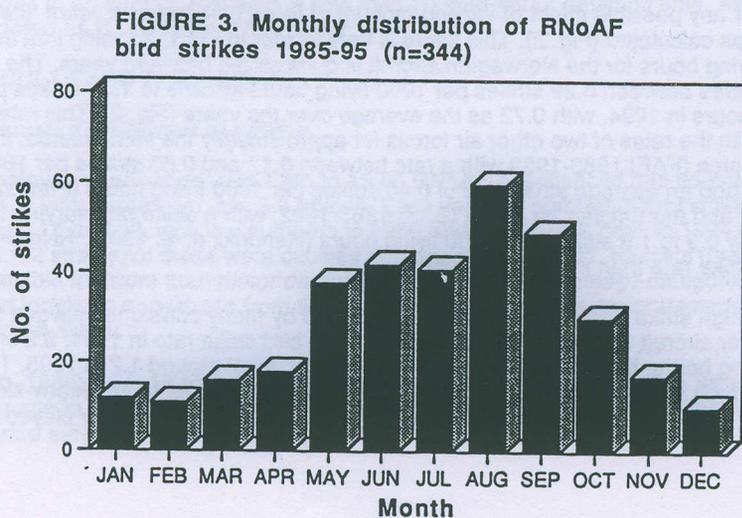
To control for any possible effect of varying amount of flying time between years, the bird strike rate was calculated (Fig. 2). This figure is very similar to Fig.1, showing that the amount of flying hours for the Norwegian aircraft is quite stable between years. The bird strike rate varies between 0.29 strikes per 1000 flying hours in 1986 to 1.30 strikes per 1000 flying hours in 1994, with 0.72 as the average over the years (Fig. 2). This rate was compared with the rates of two other air forces for approximately the same period: the French Air Force (FAF) 1983-1993 with a rate between 0.17 and 0.63 strikes per 1000 flying hours, and an average strike rate of 0.40 strikes per 1000 flying hours (French Air Force 1994), and the Belgian Air Force (BAF) 1983-1992, with a strike rate varying from approximately 0.9 to 1.8 strikes per 1000 flying hours (Hendrikkx et al. 1992). RNoAF had a higher bird strike rate than FAF, but lower than BAF.

The relative high strike rate in 1994, was partly caused by many collisions between birds and F-5 fighter aircraft that year. F-5's had a very high bird strike rate in 1994, 5.2 strikes per 1000 flying hours, but the rate decreased to "normal" level around 1.2 in 1995. The cause of the high strike rate of F-5's in 1994 can be partly explained by the many strikes at Rygge MAS, the home air base of that aircraft. In addition, chance has likely played a part.



3.2 Differences during the season

The bird strike frequency per month shows that there were generally few strikes in the winter time, from December to mid-March (Fig. 3). This is not surprising since the birds most frequently involved in bird strikes (see 3.5 below and Table 1), are absent from Norway during these months. Spring migration in Norway starts in the second half of March, lasts through April and are most intense in May. The figure reflects this pattern. In June and July only local birds are present. The highest number of bird strikes occurred in August and September, during autumn migration. In August there are also a lot of juvenile birds on the wing. The migration gradually abates through October and November, with a corresponding decline in bird strike numbers. This one-peaked graph is in contrast to other countries (e.g. Arrington 1994, Leshem 1994), which have typically two peaks.



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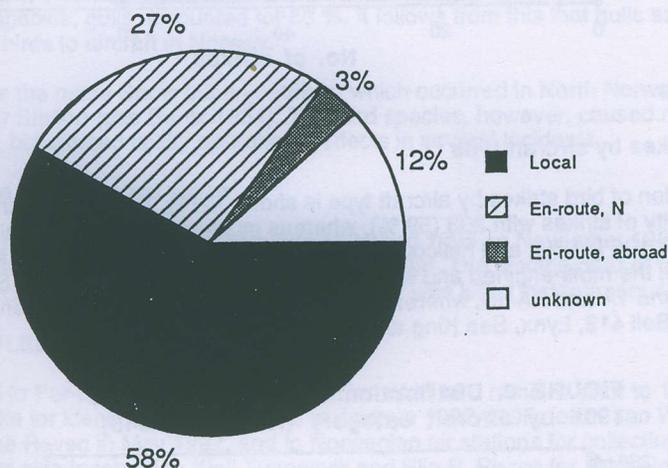
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3.3 Where do the bird strikes occur?

The main body of bird strikes to Norwegian military aircraft were local, that is they occurred on or near the airfields (Fig. 4). 58 % of the bird strikes happened here, and this is in accordance with the Norwegian data shown by Dekker (1994). He also showed that eight other air forces had experienced less than 40 % local bird strikes, and GAF and FAF even less than 20 % local strikes. One possible explanation to the differences between RNoAF and other air forces in this respect, could be that the other air forces are operating low level at a higher proportion. The primary role of RNoAF is Air Defence, which implies operations at all altitudes, and often at high altitudes. Flying at high altitudes reduces the risk of having en-route strikes, which in turn leads to a shift towards local bird strikes (Fig.4).

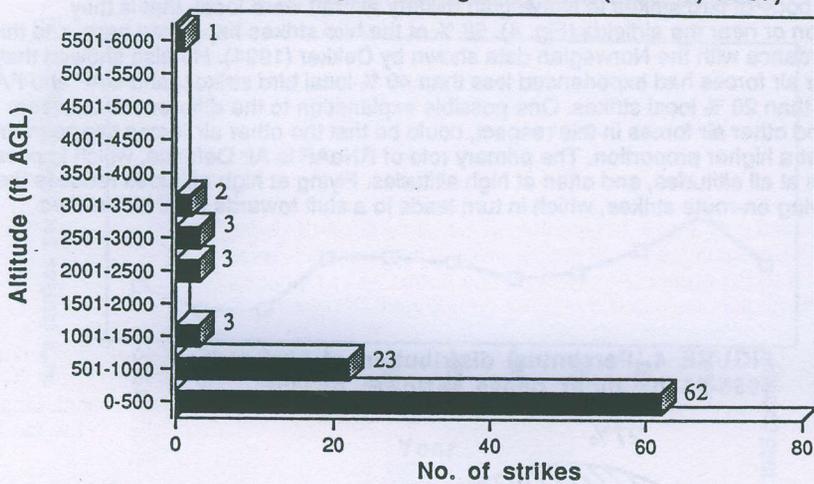
FIGURE 4. Percentual distribution of bird strikes 1985-95 by flight phase (RNoAF; n=345)



Other air forces or armies with a high proportion of local bird strikes are the US Air Force (65 % between 1989 and 1993; Arrington 1994), and the Czechoslovak People Army (between 1987 and 1992; Murár 1994).

The altitudes at which the aircraft hit the birds in this data sample, are shown in Fig. 5. Only data from en route strikes were included. It is apparent that as much as 84 strikes out of 96 (88 %) where the altitude is known, occurred below 1000 ft. One bird strike occurred above 3500 ft: On 30 May 1991 a P-3C collided with a Great - or Lesser black-backed gull at 6000 ft in North Norway. Even though the amount of time that the RNoAF is operating in the different altitude levels is not known, it becomes clear that the possibility of colliding with birds decreases markedly with increasing height (Fig. 5).

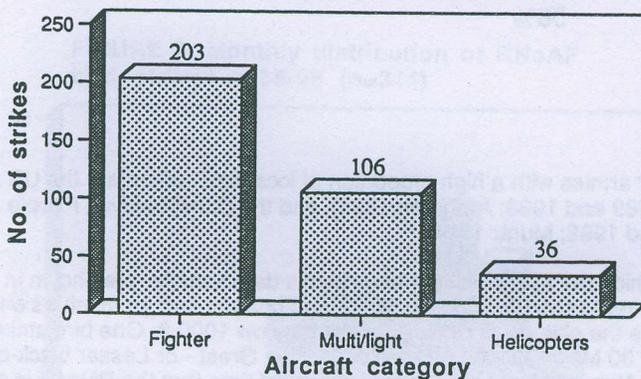
FIGURE 5. Distribution by altitude of bird strikes occurred during "cruising" 1985-95 (RNoAF; n=97)



3.4 Bird strikes by aircraft type

The distribution of bird strikes by aircraft type is shown in Fig. 6. Fighter aircraft accounted for the majority of strikes with 203 (59 %), whereas multi-engined and light aircraft accounted for 106 (31 %), and helicopters for 36 (10 %). The type of fighter aircraft were F-16 and F-5, the multi-engined and light aircraft involved were P-3, C-130, Safari, DA-20, DHC-6, Cessna 1A and PA-18, whereas the type of helicopters that experienced bird strikes were Bell 412, Lynx, Sea King and UH-1B.

FIGURE 6. Distribution of bird strikes 1985-1995 by aircraft category (RNoAF; n=345)



The P-3 were the type of aircraft that had the highest share of damaging bird strikes: 47 %. The kind of operations that the P-3's are carrying out (Coastguard, Anti-shipping and

Anti Submarine Warfare), makes the aircraft more exposed to birds, especially gulls. P-3's are thus more prone to collide with birds that causes damage (see 3.5 below), than other aircraft types. Two other aircraft types were damaged due to birds, F-16 (31 %) and F-5 (22 %). These three aircraft types accounted thus for *all* damaging bird strikes, but they accounted for only 80 % of all the 345 bird strikes in the period. Interestingly, helicopters that struck birds at a 10 % share during these years, were not damaged by them.

3.5 Bird species involved in bird strikes

When looking at the bird species involved in the data sample, it becomes clear that gulls were the ones most frequently struck by aircraft (Table 1). Of strikes in which the bird species or bird group was identified, gulls accounted for 43 % (90 strikes), whereas passerines were involved in 27 % (57 strikes), waders in 21 % (45 strikes), hawks and gallinaceous birds each in 2 % (5 strikes), terns in 1 % (3 strikes), fulmars in 1 % (2 strikes), and puffin, owls and doves accounted for 0.5 % each.

Gulls were also responsible for most damage to the aircraft: 86 % of the damaging strikes. Other birds that caused damage to the aircraft, were Raven, Buzzard and Puffin which were involved in 1 damaging strike each. Of all damaging strikes, that is those including unidentified species, gulls accounted for 56 %. It follows from this that gulls are the most troublesome birds to aircraft in Norway.

Noteworthy is the many Snow bunting-strikes, which occurred in North Norway, especially at Andøya Air Station (see Bentz 1984). This bird species, however, caused no damages in the period, but caused costly operational effects in several incidents.

3.6 One case of a mammal strike

Only one mammal strike occurred between 1985 and 1995, in November 1991, when an F-16 hit a roe-deer during landing at Ørland Air Station. The landing gear of the aircraft (the part struck) was not damaged, but the roe-deer was killed instantaneously.

4. ACKNOWLEDGEMENTS

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Table 1. Birds involved in 345 collisions with Norwegian military aircraft from 1985 to 1995.

Bird species	Scientific name	Approx. weight (g) ¹	No. of collisions
Herring gull	<i>Larus argentatus</i>	1020	14
Common gull	<i>Larus canus</i>	420	12
Kittiwake	<i>Rissa tridactyla</i>	390	4
Great black-b. gull	<i>Larus marinus</i>	1690	3
Black-headed gull	<i>Larus ridibundus</i>	275	3
Gull, unk. species	<i>Larus</i> sp.	275-1690	54
Arctic tern	<i>Sterna paradisaea</i>	105	2
Tern, unk. species	<i>Sterna</i> sp.	105-120	1
Lapwing	<i>Vanellus vanellus</i>	215	11
Golden plover	<i>Pluvialis apricaria</i>	185	10
Ringed plover	<i>Charadrius hiaticula</i>	54	8
Curlew	<i>Numenius arquata</i>	770	4
Dunlin	<i>Calidris alpina</i>	50	2
Whimbrel	<i>Numenius phaeopus</i>	400	1
Oystercatcher	<i>Haematopus ostralegus</i>	500	1
Ruff	<i>Philomachus pugnax</i>	139	1
Curlew sandpiper	<i>Calidris ferruginea</i>	52	1
Wader, unk. species	<i>Charadriiformes</i> sp.	(50-500)	6
Fulmar	<i>Fulmarus glacialis</i>	750	2
Puffin	<i>Fratercula arctica</i>	425	1
Buzzard	<i>Buteo buteo</i>	800	2
Honey buzzard	<i>Pernis apivorus</i>	785	1
Goshawk	<i>Accipiter gentilis</i>	1026	1
Sparrowhawk	<i>Accipiter nisus</i>	190	1
Wood pigeon	<i>Columba palumbus</i>	465	1
Grouse, unk. species	<i>Lagopus</i> sp.	480-620	5
Owl, unk. species	<i>Strigidae</i> sp.	150-2813	1
Raven	<i>Corvus corax</i>	1193	1
Hooded crow	<i>Corvus corone cornix</i>	530	1
Jackdaw	<i>Corvus monedula</i>	234	1
Skylark	<i>Alauda arvensis</i>	39	2
Swift	<i>Apus apus</i>	41	4
Swallow	<i>Hirundo rustica</i>	19	2
House martin	<i>Delichon urbica</i>	17	1
Swallow/martin/swift	<i>Hirundo/Del./Riparia/Apus</i>	13-41	7
Starling	<i>Sturnus vulgaris</i>	80	2
Redwing	<i>Turdus iliacus</i>	67	3
Fieldfare	<i>Turdus pilaris</i>	99	1
Song thrush	<i>Turdus philomelos</i>	73	1
Thrush, unk. species	<i>Turdus</i> sp.	67-125	2
Wheatear	<i>Oenanthe oenanthe</i>	26	1
Meadow pipit	<i>Anthus pratensis</i>	18	2
Tree pipit	<i>Anthus trivialis</i>	22	1
Finch, unk. species	<i>Fringillidae</i> sp.	12-29	1
Snow bunting	<i>Plectrophenax nivalis</i>	35	12
Yellowhammer	<i>Emberiza citrinella</i>	27	3
Passerine, unk. species	<i>Passeriformes</i> sp.	10-100	9
unknown	-	-	137
Total ²			347

¹From Brough (1983).

²Two different bird species were involved in two of the collisions, thus making the total in this table 347.