How Meanigful are bird strike statistics

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HOW MEANINGFUL ARE BIRD STRIKE STATISTICS

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SUMMARY

Data are being collected throughout the world about bird strike incidents and many countries have established systems for collating and analysing this information. The limiting factors in those systems are the level and quality of reporting by people on the airfield and on the flight deck. A number of sources of weakness have been identified and appear to require a comprehensive education campaign. The analysis of, and interpretation of bird strikes statistics and in particular the way in which they are published can lead to misinterpretation by airport management, who may look for a simple numerical representation of their own hazard while not appreciating the statistical and biological limitations of such data.

1. INTRODUCTION

Bird Strike reporting systems have been in operation in many countries for a number of years and it is generally accepted that the statistics arising from these reports provide a valuable insight into the aviation bird hazard. However, standards of reporting vary enormously and bird strikes are comparatively rare events with the result that the data set available for statistical analysis is reasonably small. Much of the published data relate to compilations of information from a number of airports, and these can give a deceptive impression of the bird strike hazard at each and yet airport managers who are responsible for airfield safety may make operational decisions based upon these statistics without an adequate knowledge of the relevance of them to the bird hazard at their own airport.

Although there are common features to the bird hazard at different airports, each is individual in nature and while bird strike statistics can be a useful adjunct to field data collected on the behaviour and ecology of birds at a particular airport, they are too often viewed in isolation.

This paper reviews the various week points in bird strike reporting systems, the statistical analysis of bird strike reports and the presentation of those data. It aims to stimulate discussion about the way in which this valuable source of information should be collected and handled in the future.

2. STATISTICAL NOTE

The data presented below come primarily from Manchester Airport and much of the discussion is concerned with strikes which occur on the Airport, rather than en route. The sample size of the data set is small and in some cases, multivariate analysis is not possible. The data are, therefore, statistically weak. However, in order to illustrate various points, these weaknesses have been ignored.

3. BIRD STRIKE REPORTING

3.1 Where do bird strikes originate from?

Bird strike reports arise from one of three sources:

1. from pilots of aircraft which have experienced a strike.
2. from groundstaff who find a corpse on the manoeuvring area
3. from engineers who find evidence of a bird strike during a routine inspection of an aircraft.

Bird strikes may be reported directly to the national or international bird strike coordinating organisation, or indirectly through the air traffic control service at an airport.

3.2 The level of reporting

The standard of reporting of bird strikes and the quality of the bird strike reporting system varies enormously from country to country. But even within a single country the standard is better at some airports than at others. Variation in reporting standard can occur at a single airport under the same conditions with different reporters.

The probability of a bird strike being reported and the accuracy of any report is dependent upon the phase of flight when the strike occurs, how busy the air crew is and how busy the air traffic controllers are. This immediately leads to under reporting. Since the extent and nature of the bird hazard at an airport varies through the day and year, as does the number of aircraft movements, this can also lead to a sampling bias in the data.

Ground staff at many airports are not aware of the need for reporting dead birds found on the airfield and may be unwilling to trouble busy controllers for details of aircraft movements. In addition, they can face a conflict of interests. A high level of reporting by ground staff results in an increase in the number of strikes reported by a particular airport. An uninformed management may interpret this as a failure on the part of the bird control staff and this pressue can often lead to a decline in the reporting of corpses discovered on the runway in the absence of a pilot generated bird strike report.

The quality of reporting by groundstaff alone can give rise to a 40% reduction in the number of strikes reported from an airport. Before the employment of dedicated bird control staff at Manchester Airport, approximately 10% of strikes arose from groundstaff, the remainder being from pilots (Table 1). This figure is similar to that reported from other airports in Britain. Since the establishment of a Bird Control Unit, over 50% of strike reports have arisen from groundstaff.

Table 1: The Source of bird strike reports

(* From CAA 84010, 85018, 86006)

Airport	Year	% reported by ground staff	Total no. strikes
UK airports	*1982-84	10%	1073
Manchester	1982-84	11%	123
Manchester	1985-88	52%	114

This variability arises directly from the quality of the established reporting systems and the awareness of those involved of the need for reporting This awareness must extend to the management of an airport to ensure that they encourage accurate reporting.

3.3 The accuracy of reports

Pilots will often have details about the aircraft, the effect on the flight, the time of day etc. when a strike occurred, but not the species of bird involved. Groundstaff, on the other hand, may know the bird, but not the aircraft or the time of the incident. Engineers often know the effect upon the aircraft, have the bird remains but may have no details about when or where the strike occurred. A high proportion of bird strike reports will, therefore, be incomplete.

It is self evident that complete and accurate reporting of bird strikes is an essential prerequisite to the development of a meaningful and useful data base from which to carry out analysis. The coordination required to ensure complete and accurate reporting again relies upon education of the parties involved and also often, the goodwill and cooperation of the air traffic controllers at the airport.

3.4 *The reporting of serious incidents such as engine ingestions.*

Civil engine airworthiness regulations relating to bird hazards have required the development of complex and extremely expensive test routines. The way in which a bird of a particular species passes through an engine can result in some cases in no damage and in others to catastrophic failure to the engine. Because of the high costs of testing engines, it is never possible to repeat tests in sufficient quantity to take into account the many variables involved in a bird ingestion, even with the advent of modern computer simulation. A valuable source of information is, therefore, obtained from in-service incidents. This is an area where complete and accurate reporting (in particular, the collection of, and identification of bird remains) is essential, however, there is evidence that some engineers are unaware of the need to retain bird remains for identification. They may not know of the existence of bird remains identification services which are available in many countries (in Britain through the Aviation Bird Unit).

3.5 *How representative are reported strikes of the strikes which actually occurred?*

The data presented in Table 1 indicate that almost a half of the data available from bird strikes may have been missed due to the fact that the pilot did not know the strike had occurred. While it can be assumed that a number of these may have arisen from 'turbulence' and not actually as a result of the aircraft hitting the bird, there is still a suggestion that a significant proportion of strikes go unnoticed by pilots.

Data from Manchester Airport suggest that some species of bird are more often reported by pilots (as opposed to being found by groundstaff) than others (Table 2). If this tendency were to be repeated in other data sets then it would suggest that underreporting within the bird strike system is resulting in a bias in favour of some species and against others.

Table 2: The percentage of strikes reported by pilots as opposed to ground staff according to species of bird involved.

Type of bird	*% strikes reported by pilots*	*Sample size*
Lapwing	*86%*	*7*
Black-headed gull	*66%*	*29*
Kestrel	*43%*	*7*
Swifts	*33%*	*9*
Swallow	*33%*	*6*
Skylark	*30%*	*13*
Pigeons	*25%*	*8*
House martin	*0%*	*4*

A number of factors could make some birds more or less likely to be noticed or reported by pilots. These are likely to include the size of the bird, its behaviour, the time of day or night when it is on the airfield etc.

3.5.1 *Bird size*

If strike data are grouped according to the body size of the bird involved, the majority of strikes which were missed by pilots are found to be amongst the lightest birds (Table 3).

Table 3: The influence of body weight upon the likelihood that a strike would be reported by a pilot as opposed to groundstaff.

Body Weight (grams)	Report pilot	Source ground	% pilot
401 - 1000	5	4	56
201 - 400	19	10	66
101 - 200	11	5	67
51 - 100	1	3	25
0 - 50	9	27	25

3.5.2 *Flocking behaviour*

It would seem logical to assume that a pilot would be more likely to notice a strike if he had seen birds in the vicinity of the runway. A priori, therefore, it would seem likely that strikes involving a bird from a flocking species would be more likely to be noticed by a pilot than birds which tend to be solitary. Amongst the strikes reported through Manchester Airport, 47% of those involving flocking species were reported by pilots, while only 25% of those involving solitary species were reported by pilots.

3.5.3. *Other behavioural and morphological factors*

Other factors which make certain birds more likely to be noticed by pilots may include the colour of their plumage and whether they tend to spend a lot of time flying over, or sitting on the runway.

3.5.4 *Environmental factors*

Time of strike (day or night), visibility and weather conditions can all influence the likelihood of a pilot noticing or reporting that a strike has occurred. If the nature of the bird hazard (the species of birds on the airfield) varies according to these variables, then this will lead to a sampling bias.

Amongst 41 gull strikes from Manchester Airport over the past four years, 52% of those recorded during the period from dusk to dawn were reported by groundstaff, whilst only 22% of those recorded in daylight arose from this source. This would imply that better visibility may result in a better chance that a pilot would notice that a strike had occurred.

4 THE INTERPRETATION OF BIRD STRIKE STATISTICS

4.1 *The bird strike total*

The bird strike total for a particular airport is dependant upon the following factors:

1. *The extent and nature of the bird hazard*
2. *The quality of bird hazard management*
3. *The number of movements and types of aircraft*
4. *The quality of the bird strike reporting system*

All these factors must be taken into account when assessing the bird strike risk for different airports. However, the bird strike total, or bird strike rate for a particular airport is one of the most oft quoted statistics in publications. Aside from the sources of bias in strike statistics discussed above, these simple statistics tell us very little about the nature of the hazard on the airfield.

The most obvious limitation in this bald statistic is the species of birds involved. Some airports may report a large number of strikes most of which involve small birds such as skylarks (Alauda arvensis) whilst others may report only a few strikes (which may be multiple strikes) most of which involve flocks of larger birds, such as gulls (Larus spp.) and lapwings (Vanellus vanellus).

4.2 How representative are bird strike statistics of the local bird hazard?

A complete analysis of the bird strike statistics from a single airport can give an indication of the time of year, time of day, weather conditions etc. in which strikes are most frequently reported as well as the species of birds involved. However, this information is still of limited value if viewed in isolation.

The frequency with which a particular species of bird appears in bird strike statistics is a function of the numbers found in the vicinity of an airport, their behaviour, and the extent to which they are noticed by pilots (see above).

Starlings (Sturnus vulgaris) feature in a significant proportion of bird strikes reported in Europe and North, America and, indeed, were responsible for the crash of the Lockheed Electra in 1960, an incident which resulted in 62 deaths. Starlings are small birds (85 gms) which, if hit as individuals are unlikely to cause major damage to a transport size aircraft. However when hit in large flocks they are extremely dangerous.

At Manchester Airport, starling strikes are reported throughout the year, however, the extent of the hazard posed by this species is not consistent through the year. During the summer months many starlings are found nesting in hangars and airport buildings, in the latter part of the breeding season, they are restricted in the area over which they can collect food, since they have to return to the nest to feed their young. Under these conditions, several hundred birds flying alone may repeatedly cross the runway. Strikes are not infrequent, but tend to involve only a single bird. In contrast, during the winter months flocks containing tens or hundreds of thousands of birds fly across the runway at dawn and dusk en route to and from a nearby night roost (which has now been dispersed!). Here, for only a few seconds each day, the birds may cross the path of an approaching aircraft, yet if a strike were to occur, the result could be extremely serious.

4.3 National and international bird strike totals

Bird strike data are often amalgamated from a number of airports, or even a number of countries without due attention being given to the individual conditions which pertain at each airport. From the viewpoint of the individual airport, this practice may at best have limited value and at worst be misleading.

For example, while two apparently similar airports may record the same number of strikes involving gulls, at an inland site, such as Manchester Airport, this could be associated with the presence of a nearby winter roost, whilst at coastal airport it could result from the presence of a breeding colony which is only occupied during the summer months. Amalgamating data from these two airports would imply a year round hazard at each.

The value of data amalgamated from different airports lies in the fact that they provide pointers for the way in which resources (for example for research into ecology and behaviour) should be allocated at a national level. It is evident that throughout much of western Europe, gulls and lapwings appear very frequently in bird strike statistics, so these two groups of birds should receive particular attention in any proposed scientific studies.

5. CONCLUSIONS

Despite a number of shortcomings in the collection of, and presentation of bird strike statitics, these data can provide a valuable insight into the bird hazard. However, the limitations of these data must be recognised and it is essential that during the development of a bird hazard management programme for an airport, the bird strike statistics are viewed in association with field observations on the movements and behaviour of the birds at that site.

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