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The impact of variation in reporting practices on the validity of recommended birdstrike risk assessment processes for aerodromes

John Allan [a, *], Andrew Baxter [b], Rebecca Callaby [a]

[a] Animal and Plant Health Agency, National Wildlife Management Centre, Sand Hutton Campus York, YO41 1LZ, UK
[b] Birdstrike Management Ltd., Sand Hutton Campus York, YO41 1LZ, UK

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ABSTRACT

Birdstrikes are a major hazard to aviation; costing millions of pounds a year in damage and delays, as well as occasional hull losses and loss of life. The numbers and species of birds on and around airfields therefore need to be managed. To aid this process, airport staff often use risk assessments to identify which bird species cause the greatest risk and use the outcome to target their bird control effort. To this end, a number of national and international regulators, airports and other organisations recommend, or use, a derivation of a risk assessment process first published in 2006. This was developed using the UK Civil Aviation Authority's birdstrike database, employing data collected between 1976 and 1996. The risk assessment process relies on using the proportion of reported strikes that cause damage to the aircraft as a proxy for the likely severity of the outcome of strike incidents, so any change in the relative level of reporting of damaging and non-damaging strikes may significantly bias the results. The implementation of mandatory birdstrike reporting by the UK CAA in 2004 led to a significant increase in the number of strikes reported. If this involved a disproportionate increase in the number of non-damaging compared to damaging incidents reported, it may have impacted on the accuracy of the risk assessment process. This paper examines how differential reporting of damaging and non-damaging strikes can impact on the risk assessment process. It shows that changes in reporting practices since the original risk assessment was developed have impacted on the apparent birdstrike risk at UK airports, giving a false impression of increasing risk over the period. It makes recommendations for how the process can be better adapted to cope with such changes in the future, and how it should be modified for use in countries with different reporting regimes to that in the UK.

1. Introduction

Collisions between aircraft and wildlife, mostly birds, (hereinafter referred to as birdstrikes) are a serious hazard to all forms of aviation and have resulted in the loss of at least 108 aircraft and 276 lives in civil aviation (Thorpe, 2012). Less serious birdstrikes cause significant operational costs to the aviation industry as a result of repairs to damaged aircraft, delays and cancellations, insurance claims etc. The total cost to world commercial aviation has been conservatively estimated at 1.5 billion US$ per year (Allan, 2002). In order to manage these risks, the International Civil Aviation Organisation (ICAO) requires national aviation regulators to ensure the implementation of effective bird management policies on the airfields under their control via a number of Standards And Recommended Practices (SARPS) (ICAO, 2012). The guidance material provided by ICAO in support of these SARPS includes a recommended risk assessment process to help aerodrome operators target their bird management effort and resources at those species that cause the greatest risk. This process derives from a paper published in 2006 (Allan, 2006) which has subsequently been adopted, with minor modifications, by International Birdstrike Committee (IBSC, 2006) Airports Council International (ACI, 2013) and a number of national regulators such as the UK Civil Aviation Authority (CAA, 2014a).

Other birdstrike risk assessment techniques have also been developed. Most of these employ a variety of ranking processes, usually combining factors such as numbers of a particular species

* Corresponding author.
E-mail address: john.allan@apha.gsi.gov.uk (J. Allan).

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on or around the airfield, their location, their movement in relation to aircraft flight-paths, presence of single birds or flocks, mass of the species, tendency to be involved in strikes etc. The various factors are combined mathematically and weighted to provide a more or less real-time measure of risk that bird controllers can immediately respond to (Allan, 2000; Shaw and McKee, 2008; Soldatini et al., 2010; Yang et al., 2010, Zakrajsek and Bissonette, 2005). These techniques rely on regular and accurate data gathering by bird control staff, who frequently have other duties to perform leaving them unable to devote the time needed to ensure that the necessary data are gathered with the accuracy required. Although having the advantage of providing immediate tactical advice concerning if and when birds need to be dispersed, they have not generally found favour with regulators.

The process developed by Allan (2006) provides a longer term strategic view of the risk levels at a particular airport. This, combined with a 'live risk register' (a real-time dynamic assessment of immediate risks), provides both strategic and tactical guidance for bird control staff and resource managers. Allan's process relies on combining, an estimation of the probability of a strike occurring with a particular bird species (using the airports strike record over the past five years) with an estimation of the likely severity of the outcome of the strike incident (using the proportion of strikes with that species resulting in aircraft damage). The data used came from the UK Civil Aviation authority's birdstrike database for those strikes reported over the period 1976–1996.

Since 1996, the number of strikes reported at most UK airports each year has risen, with markedly more strikes reported following the UK CAA's mandating of birdstrike reporting in 2004 *(see* Table 3*)*. If this represents a real increase in strike numbers, the number of damaging and non-damaging strikes would be expected to rise by a similar proportion and the proportion of strikes resulting in damage would remain the same. Other studies produced before the introduction of mandatory reporting have shown that strikes that damage an aircraft were more likely to be reported than non-damaging ones (Linnell et al., 1999; Milsom and Horton, 1995). An unintended consequence of mandatory reporting could, therefore be the more frequent reporting of previously unreported non-damaging strikes. If this is the case the number of non-damaging strikes reported should increase by a greater proportion than the number of damaging strikes. This would reduce the proportion of strikes causing damage for a particular species, which, in turn, would balance the increase in overall strike numbers, thus giving no overall increase in risk. If the proportion of strikes causing damage is not recalculated, as has been the case in the UK, the same change in reporting behaviour would give a false impression of increasing risk.

This paper assesses whether the increase in reported strikes at UK airports has involved a differential increase in the numbers of non-damaging strikes reported, and whether these changes in reporting practices have impacted on the risk assessment process at UK airports. It then determines whether the methodology needs to be adjusted to ensure that the risk assessment outcomes remain valid, both for use in the UK and in other countries where reporting regimes may differ from those on which the technique was originally based.

2. Materials and methods

2.1. Detailed description of the current birdstrike risk assessment methodology

Table 1 shows the risk assessment matrix published by Allan (2006). The probability categories are based on a 5 year rolling mean of the number of strikes reported per year with a particular bird species at the airport being risk-assessed. The severity categories are based on national data combining all strikes for the species concerned and determining the proportion of those strikes that resulted in damage to the aircraft involved. There is a problem when calculating the severity measure for rarely struck bird species because the proportion of strikes resulting in damage varied widely due to random chance. In order to control this variation, a linear regression of proportion of strikes causing damage against mass, weighted according to the number of strikes recorded for each

Table 1
Showing the category boundaries for the probability and severity measures used to position bird species in the risk assessment matrix (after Allan (2006)).

(a) Probability categories					
5-year rolling mean of no. of strikes per year for each species (airport data)	>10	3–10	1–2.9	0.3–0.9	0–0.2
Probability category	Very high	High	Moderate	Low	Very low
(b) Severity categories					
Percentage of strikes with a species causing damage (national data)	>20%	10–20%	6–9.9%	2–5.9%	0–1.9%
Severity category	Very high	High	Moderate	Low	Very low

Table 2
The risk assessment matrix developed by Allan (2006) showing the three levels of response required from the airport depending on the position of each bird species defined by its probability and severity categories.

SEVERITY	*PROBABILITY*				
	Very High	**High**	**Moderate**	**Low**	**Very Low**
Very High	Action	Action	Action	Action	Review
High	Action	Action	Action	Review	Review
Moderate	Action	Action	Review	Accept	Accept
Low	Review	Review	Accept	Accept	Accept
Very Low	Accept	Accept	Accept	Accept	Accept