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The effects of changes in the Northern Lapwing population on the bird strike hazard in the UK

J. C. Bell
Central Science Laboratory, Birdstrike Avoidance Team, Sand Hutton, York, UK

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Birdstrike Avoidance Team
Sand Hutton, York, YO41 1LZ, UK

Introduction

Changes in bird populations have been recognised as affecting the risk to aircraft of a bird strike. However, in terms of bird strike prevention, changes are generally only considered at the local level i.e. reducing the number of birds on the airfield. At a national level, concern has been expressed about recent increases in waterfowl, particularly geese, and the implications that this may have for flight safety, and management of the risk. However, although work is currently being undertaken to investigate if higher numbers of large waterfowl are causing an increased risk to safety (Allan, Bell & Jackson in press), the work is being hampered by incomplete reporting, and lack of information on world-wide population trends.

There has been little discussion of the implications of declining populations to the bird strike risk. This is in part because it is not perceived as a problem. However, it could be argued that if the risk is not recognised to have changed, then resources will continue to be allocated to try and deter a species from using airfields, which no longer warrants a high priority because of its declining numbers.

Through this, it has been assumed that an increase in population will lead to an increase in risk and that a decrease in population will lead to a reduction of risk. However, birds are not randomly distributed across the countryside, and there may be behavioural factors which mean that this is not the case.

The Northern Lapwing (*Vanellus vanellus*) is a wader species commonly found on UK airfields. Because of its size, and its habit of forming large flocks, it is usually considered as a particularly hazardous species. It is also frequently involved in bird strikes and for the years 1976-1995 was the most commonly struck species in the UK. Between these years 1704 strikes were reported in the UK, comprising 17.4 % of all strikes.

It is fortunate that in the UK, long term population monitoring of many of the common breeding species has been carried out for a long period of time. This has allowed a long-term decline in the Northern Lapwing population in the UK to be monitored and investigated (Marchant et al 1990, Shrubb & Lack 1991 O'Brien & Smith 1992) Declines have also been reported in other areas of Europe (Hötker 1991). These declines are believed to be due to changes in agricultural practice which have limited breeding site availability and reduced breeding success (Baines 1988, Galbraith 1988). It could be expected that this would have an effect on the status of Northern Lapwings on airfields, thus reducing the risk from this species. However, it has also been suggested that the number of strikes involving Northern Lapwings would be mainly unaffected, because airfields are preferred sites (Milsom 1990) and declines might be expected to occur in other less optimal locations first.

Over the same period, airfield habitat management and bird control practices have improved in the UK (Milsom & Horton 1995). This would also reduce the number of Northern Lapwings to be found on airfields, and consequently, the number of strikes involving Northern Lapwings would be expected to decrease.

This paper examines the incidence of strikes involving Northern Lapwings between 1976-1995, and assesses firstly, if there was any change in numbers, and secondly, attempts to determine the major cause of any alteration in the strike rate.

Methods

Data were provided by the Civil Aviation Authority (CAA) on all bird strikes reported in the UK between 1976-1995. Bird strike reporting in the UK is not mandatory unless there is sufficient damage that it falls within the Mandatory Occurrence Reporting Scheme (Milsom & Horton 1995). However, the CAA actively encourages bird strike reporting (CAA 1998), and it is thought that the standards of reporting in the UK are good. Nevertheless, no attempt has been made in the UK to quantify the proportion of strikes for which reports are received, and it is thought that there are biases in the reporting of bird strikes with strikes involving either large numbers of birds, or large birds more likely to be reported as these are more likely to cause damage to the aircraft (Milsom & Horton 1995).

Only reports from airports where the air transport movement rate was also available were used. In all, data from 29 out of the 34 busiest airports in the UK were analysed. In total, 1254 strikes involving Lapwings were reported from these airports in the twenty year period. Data were assessed in both absolute numbers and were also corrected for annual air transport movement rates (CAA 1976-1995) where applicable, to allow for changes in aircraft movements over the period, which could affect the number of bird strikes reported. All rates are given per 10 000 air transport movements.

Individual airports were also placed in regions, to allow analyses of regional trends to be made. Marchant *et al* (1990) used this approach when analysing the results of nation-wide bird population censuses. By using the regions defined in Marchant *et al* 1990, direct comparisons can be made between trends in the bird strike rate, and trends in the population. The number of airports within each region is given in Table 1.

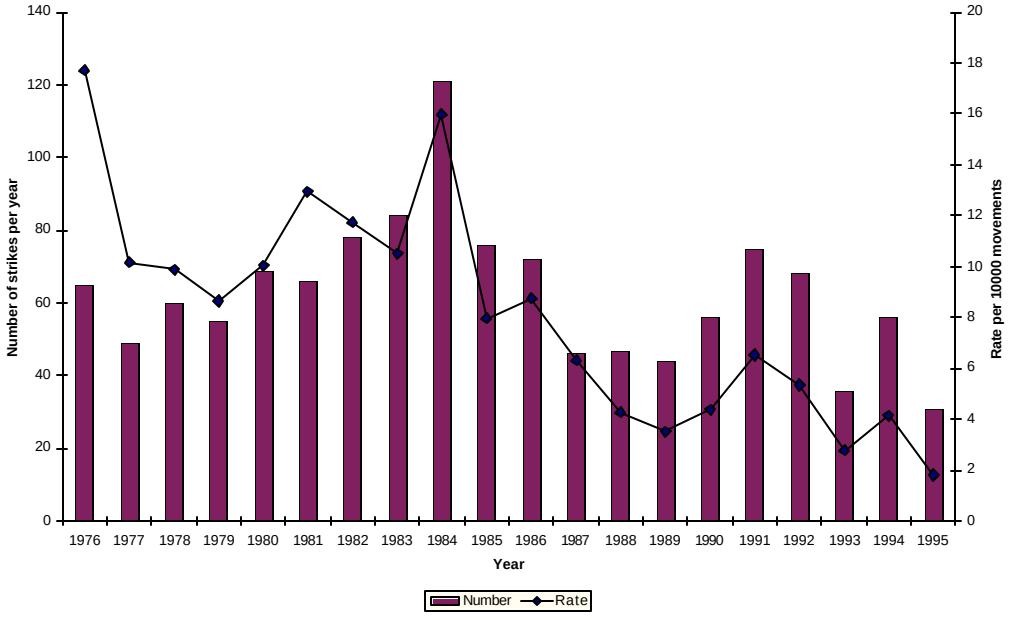
Table 1: Regions used in the analysis

Region	Number of airports within region
Scotland	6
Northern England	8
Western England	2
Eastern England	4
Southern England	6
Wales	1
Northern Ireland	2

Results

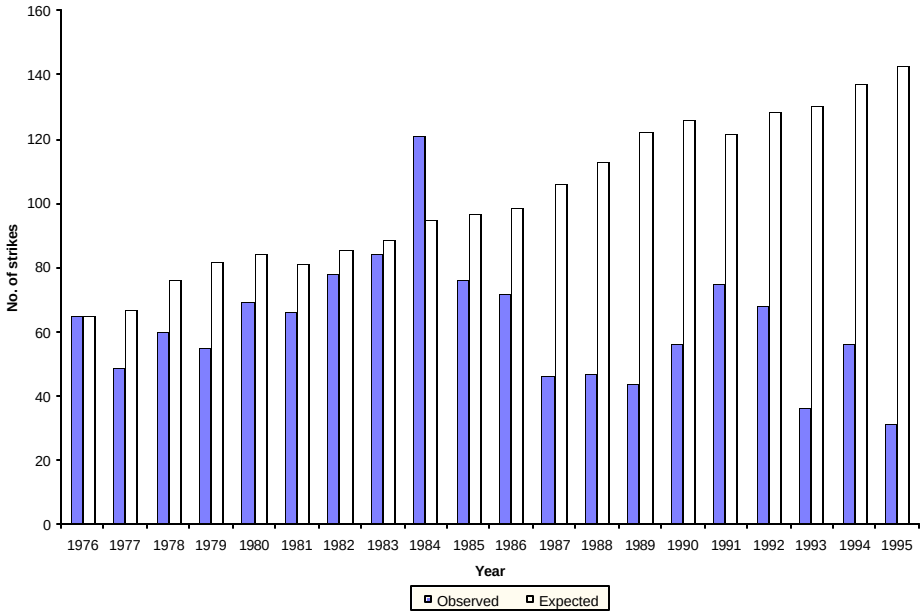
Both the annual total of strikes, and the rate per 10 000 movements show evidence of a long term decline (Figure 1). The trends in these two data sets are similar, which suggests that the trends are not due to changes in air traffic movements. If this were the case, the two trends would not be so closely associated. This in turn allows the conclusion to be drawn that it is the risk, and hence the hazard, that has declined.

Figure 1: The number of bird strikes reported annually involving Lapwings, presented as both an annual total and a rate per 10 000 movements.



To further test this, a χ^2 goodness of fit test was carried out. If the risk per flight was unchanged, then it would be expected that any changes in the number of strikes reported year-on-year would mirror the changes in air traffic movements. Using the percentage year-to year change in air traffic movements allowed an expected number of strikes to be calculated. Figure 2 shows the actual number of reports against the expected number. There is a significant difference (χ^2=453.61, df=18, p<0.01).

Figure 2 Observed and expected annual number of Lapwing strikes



If improved bird control were responsible for the decline in the risk posed by Lapwings, it would be expected that there would be no change in seasonal variation in Lapwing strikes, but that numbers would be uniformly lower throughout the year. This is not the case, as Table 2 shows. Differences in this table are significant (χ^2 Test, χ^2=51.2, df=9, p<0.01,).

Table 2: The number of strikes reported with Lapwings throughout the year. Seasons were set using the seasonal movements given in Cramp *et al* (1983)

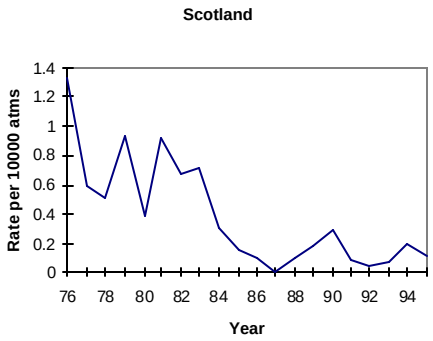
Years	December-March	April-May	June-August	September-November
1976-1980	73	8	50	164
1981-1985	109	4	76	236
1986-1990	83	6	31	145
1991-1995	124	7	24	111

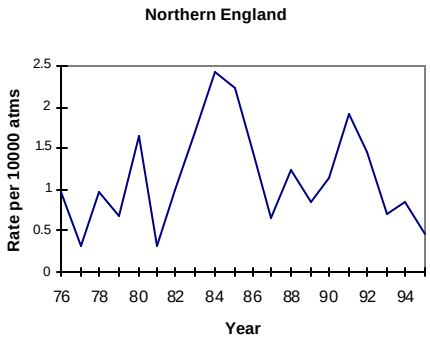
In the period June-November, the number of strikes reported has fallen. During the breeding season (April-May) the number of strikes appears to be stable, and over the winter months, the number seems to be fluctuating upwards.

Regional differences

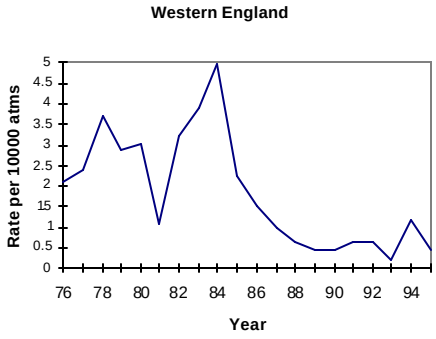
Until now, data have been analysed on a UK-wide basis. However, at least with breeding birds, the Lapwing population in the UK shows strong regional differences in population trends, outlined in Marchant *et al* 1990. Similarly, when looked at on a regional basis, it becomes apparent the that reduction in hazard is not occurring equally across the UK. Figures 3 a-g show the trends for each of the regions.

Figure 3: Regional trends in the Lapwing strike rate per 10 000 air traffic movements.
a) b)

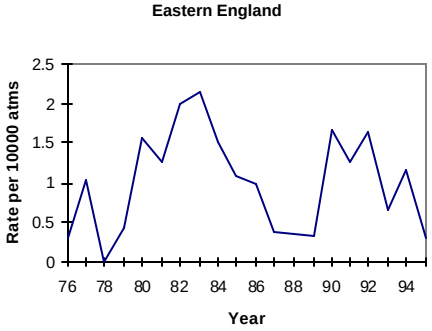

Scotland
Rate per 10000 atms
1.4
1.2
1
0.8
0.6
0.4
0.2
0
76 78 80 82 84 86 88 90 92 94
Year


Northern England
Rate per 10000 atms
2.5
2
1.5
1
0.5
0
76 78 80 82 84 86 88 90 92 94
Year

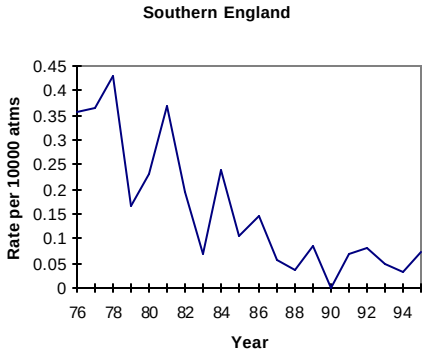
c)


Western England
Rate per 10000 atms
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
76 78 80 82 84 86 88 90 92 94
Year

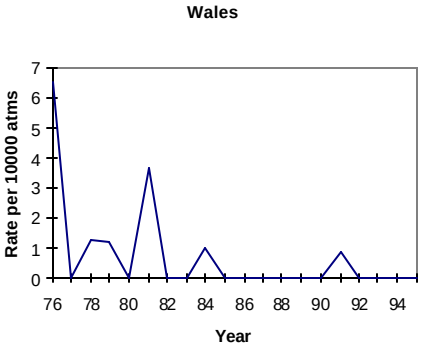
d)


Eastern England
Rate per 10000 atms
2.5
2
1.5
1
0.5
0
76 78 80 82 84 86 88 90 92 94
Year

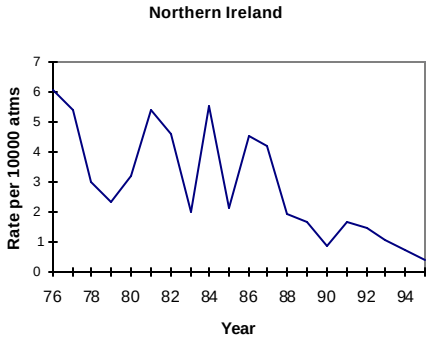
e)


Southern England
Rate per 10000 atms
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
76 78 80 82 84 86 88 90 92 94
Year

f)


Wales
Rate per 10000 atms
7
6
5
4
3
2
1
0
76 78 80 82 84 86 88 90 92 94
Year

g)



With the exceptions of northern and eastern England, all of the regions do show evidence of a decline occurring. However, the timescale for each region is different. The region with the longest running decline appears to be southern England, with a decline possibly beginning in 1979, but with the rate of decline increasing by 1982. In Scotland, the rate appeared to be stable until 1984. Western England and Wales both started to decline in 1985. In Northern Ireland, the rate fluctuated, but was relatively static until 1988, with a decline beginning in this year. The rate appeared to be unaffected by the opening of a new airport in the region in 1983.

Changes in the Lapwing strike rate through the seasons also occur regionally. Table 3 provides a summary of the trends apparent in the tables. However, because of the low numbers involved, it was not possible to test these for significance.

Table 3: Seasonal changes by region. 'Increasing' indicates that the number of strikes has risen from the first five year period until the last, 'Decreasing' that the number has fallen, and 'Stable' that there has been little change. Data were not corrected for air traffic movements.

Region	December-March	April-May	June-August	September-November
Scotland	Stable	Stable	Decreasing	Decreasing
Northern England	Increasing	Increasing	Increasing	Increasing
Western England	Increasing	Decreasing	Decreasing	Stable
Eastern England	Increasing	Stable	Stable	Increasing
Southern England	Stable	Decreasing	Decreasing	Decreasing
Wales	Stable	None	Decreasing	Decreasing
Northern Ireland	Stable	Increasing	Decreasing	Increasing

The only region which shows a continuous change throughout the year is northern England, where the number of strikes has increased throughout the four seasons. Southern England showed an increase in three out of the four regions.

Discussion

There appears to be little doubt that the hazard posed by Lapwing has reduced in the UK since 1976, and that this occurred particularly after 1984. The fact that the strike rate and the total number of strikes show a similar trend suggests that the decline is independent of changes to air traffic movements.

However, it is only by considering some of the other factors that it can be established whether this decline is principally due to improving bird control on the airfields concerned, or due to the declining Lapwing populations.

It has already been stated that if the decline was due to changes in bird control, it would be expected that the number of strikes reported seasonally would have fallen equally throughout the year. However, the number of strikes reported has not fallen equally through the year, with the number of strikes recorded between June and November falling, and the number recorded in December-March increasing.

June-November is the major migration period, with British breeding birds and adult breeding birds from northern and central Europe making summer or post-breeding movements during June and September, before autumn migration starts in earnest between September-November. British birds are likely to either remain in Britain, or move into Ireland in this period, with birds from central Europe moving to France, Iberia and the Mediterranean region. Birds wintering in the UK are likely to be British breeding birds, and Scandinavian breeding birds (Cramp 1983, Lack 1986). It is known that British breeding birds have declined seriously - for example by one third between 1984 and 1988 on lowland grassland (O'Brien & Smith 1992). Losses have been greatest in southern England, western England and Wales (O'Brien & Smith 1992). Lapwing numbers increased in northern England until 1977, and remained stable until at least 1988 (Marchant et al 1990), but Shrubb & Lack (1991) did report a decline in this region. No change was observed in breeding numbers in Scotland until at least the mid 1980's (Marchant *et al* 1990), but Galbraith (1988) suggested that the productivity of arable breeding birds was not capable of sustaining the population.

It would appear then that most of the regions do show declines in their bird strike rate which correspond with declines in the British breeding populations. However, because post-breeding movements are fairly complex in the UK, it is difficult to draw direct comparisons. Certainly, the region which appears to have the most robust population, northern England, has shown no evidence of a decline in bird strike rate, but the same is not true for Scotland, where there was no corresponding change in population until at least 1986. Western England, Wales and southern England also show declines in the bird strike rate which reflect the declines in breeding population. However evidence from the seasonality of strikes in southern England suggests that the decline in the bird strike rate in this region may be more closely linked to improved bird control than a declining Lapwing population. It is known that the introduction of bird repellent grass to one of the airports in this region in 1984 caused a large reduction in the number of Lapwing strikes on this airport (Milsom & Horton 1995). However, the stability of strikes through the winter in this region does suggest that population reduction may also have been a factor.

Additionally, it must be remembered that the birds which migrate through and winter in the UK are not solely UK birds, and that there are large numbers which arrive from the continent. Declines have been noted in German and Danish populations (Hötker 1991), which principally arrive between June and August, before moving further south for the winter. Continental birds present between August and November will include German and Danish birds, as well as central and northern European birds migrating along the western edge of Europe (Cramp 1983). Wintering birds include those from Scandinavian countries, where declines have been reported (Cramp 1983, Hötker 1991, Johansson & Blomqvist 1996), German and Dutch birds (Lack 1986). No decline has been recorded in the Netherlands (Hötker 1991). It would appear that declines in population are associated with declines in bird strikes on a European level, as well as at the national level.

It was not the case that the number of strikes declined throughout the year, in either the national totals, or for all but two of the regional totals. The changes observed differed from one season to the next, and were not uniform. However, this assumes that bird control is carried out at a similar level throughout the year. At a regional or national level, there appears to be little reason why it should not be but evidence from airport surveys suggests that bird control practice improved through the 1980s at many of the bigger airports (Milsom & Horton 1995). Because of this, improvement of bird control should not be thought to have had no effect whatsoever on strike rates. For instance, bird repellent grass became widely used on the airfields during this period. Although this is likely to have had an effect on the number of Lapwings to be found on airfields, it is unlikely to have produced the pattern of seasonal changes alone. Lapwings prefer to use grassland throughout the non-breeding season, except for July and August when they preferentially feed on arable land (Milsom 1990). Thus it probably wasn't the case that Lapwings were preferentially feeding on airfields during June-August, when most decreases occurred in the regions, but were preferentially feeding elsewhere during other times of the year.

It would therefore appear that the risk posed by Lapwings to aircraft in the UK has declined between 1976 and 1995. Much of the decline appears to have occurred because of a reduction of the Lapwing population in the UK and across Europe, rather than an improvement in control efficiency within this period.

This has implications for the management of the bird strike risk on UK airports. Lapwings continue to be struck frequently, in terms of the overall species breakdown of bird strike reports, but are likely to become scarcer on airports if the population decline continues. This may require a reassessment of the way bird control on airports is carried out, and a recognition that on some airports, Lapwings are not the hazard that they once were, and that bird control efforts should now be concentrating on other potentially hazardous species such as pigeons, which require slightly different management techniques. It is important that these population trends, and those of other potentially hazardous species, should continue to be monitored to enable the best use of resources available for bird control to be made, and thus to control the bird strike risk most effectively.

Acknowledgments

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References

Allan, J.R, Bell, J.C. & Jackson, V.S (in press) An assessment of the world-wide risk to aircraft from large flocking birds. Proc. 1st Meeting Bird strike Committee N. America.

Baines, D. (1988) The effects of improvement of upland marginal grasslands on the distribution and density of breeding wading birds (Charadriiformes) in Northern England. *Biological Conservation* **45** 221-236.

Civil Aviation Authority (1976-1995) *UK Airports Monthly statements of movements passengers and cargo* Civil Aviation Authority, London.

Civil Aviation Authority (1998) *CAP 680 Aerodrome bird control* Civil Aviation Authority, London.

Cramp, S et al (1983) *Handbook of the birds of Europe, the Middle East and North Africa: the birds of the western palearctic. Volume III Waders to Gulls* OUP, Oxford.

Galbraith, H. (1988) Effects of agriculture on the breeding ecology of Lapwings *Vanellus vanellus*. Journal of Applied Ecology **25** 407-503.

Hötker, H. (1991) Waders breeding on wet grassland in the countries of the European Community - a brief summary of current knowledge on population sizes and population trends. *Wader Study Group Bulletin* **61** Supplement 50-55.

Johansson, O.C, & Blomqvist, D. (1996) Habitat selection and diet of Lapwing *Vanellus vanellus* chicks on coastal farmland in S.W. Sweden. *Journal of Applied Ecology* **33** 1030-1040.

Lack, P.(ed.) (1986) *The atlas of wintering birds in Britain and Ireland* T & AD Poyser, London.

Marchant, J.H, Hudson, R, Carter, S.P. & Whittington, P. (1990) *Population trends in British Breeding Birds* British Trust for Ornithology, Hertfordshire.

Milsom, T.P. (1990) Lapwings *Vanellus vanellus* on aerodromes and the birdstrike hazard. *Ibis* **132** 218-231.

Milsom, T.P. & Horton, N. (1995) *Birdstrike An assessment of the hazard on UK civil aerodromes 1976-1990* Central Science Laboratory, Slough.

O'Brien, M. & Smith, K.W. (1992) Changes in the status of waders breeding on wet lowland grasslands in England and Wales between 1982 and 1989. *Bird Study* **39** 165-176.

Shrubb, M. & Lack, P.C. (1991) The numbers and distribution of Lapwings *Vanellus vanellus* nesting in England and Wales in 1987. *Bird Study* **38** 20-37.