1995

The Forestry Authority
Forestry Commission

Research Information Note 264

Issued by the Research Division of the Forestry Commission

ASSESSMENT OF FENCE COLLISIONS BY GROUSE SPECIES IN SCOTLAND, by Steve J. Petty

Abstract

Bird collisions with deer fences were monitored for one year in forests of the Scottish Highlands. Most were considered fatal and 93% were by birds of the grouse family, with red grouse more frequent in newly afforested areas and capercaillie in native pinewoods. This study adds weight to the claim that fences are a major cause of mortality in capercaillie. Future work aims to make deer fences more 'grouse friendly', but this may not be easily achievable. Therefore, the message is clear – only fence when absolutely essential and remove fences as soon as they have served their purpose. Recent work has indicated that, where deer culling can be sustained at sufficient intensities and over wide enough areas, it is possible to establish native pinewoods without deer fencing. This approach should be favoured whenever it is practicable within the range of capercaillie.

Background

1. Electric power transmission lines are known to be hazardous to flying birds. Deaths resulting from collisions occur for many species (Beaulaurier, 1981; Faanes, 1987; Alonso *et al.*, 1994). Many such collisions have been with the thinner ground wires rather than the thicker conductive wires, suggesting the latter are easier for birds to see (Alonso *et al.*, 1994).

2. Recently it has been shown that wire mesh and multiple-line wire fences that exclude domestic stock and deer from forests also kill birds (Catt *et al.*, 1994). There is particular concern about the effects of fence collisions on the declining population of capercaillie in Scotland (Catt *et al.*, 1994; Moss, 1994; Moss and Picozzi, 1994).

3. The study by Catt *et al.* (1994) in native pinewoods at Abernethy and Glen Tanar documented collision rates for capercaillie and black grouse of 3.0 and 0.4 strikes respectively per km of deer fence per year. Habitat features associated with collision points were identified and used to provide advice on the best location for fences to reduce collision rates. From capercaillie fitted with small radio transmitters to investigate habitat use, dispersal and survival, it was estimated that annual mortality was 32% from fence collisions and 23% from other causes. In an earlier study, the annual mortality rate in adult male capercaillie was estimated at 34% (Moss, 1987). Thus, fences appear to pose a very serious problem for capercaillie.

4. In 1991, a collaborative study was established to follow on from the work of the Royal Society for the Protection of Birds (RSPB) in Abernethy and the Institute of Terrestrial Ecology (ITE) in Glen Tanar (Catt *et al.*, 1994). It aimed to investigate whether forest fences are a hazard to grouse in other Scottish forests, and then to examine ways of reducing collision rates.

5. The working group co-ordinating this study comprised staff from the Forestry Commission (FC), Game Conservancy Trust (GCT), ITE, RSPB and Scottish Natural Heritage (SNH). This note summarises some of the findings from one year of monitoring fence collisions, and the problems associated with future work.

Monitoring methods

6. The incidence of bird collisions with deer fences was assessed from a total fence length of 135 km distributed over 27 sites in the Highlands (Figure 1). Forest Enterprise rangers monitored 20 fences, each 5 km in length, selected to pass through plantations of various growth stages. Some were boundary fences with moorland on one side, while others had forest on both sides. The GCT

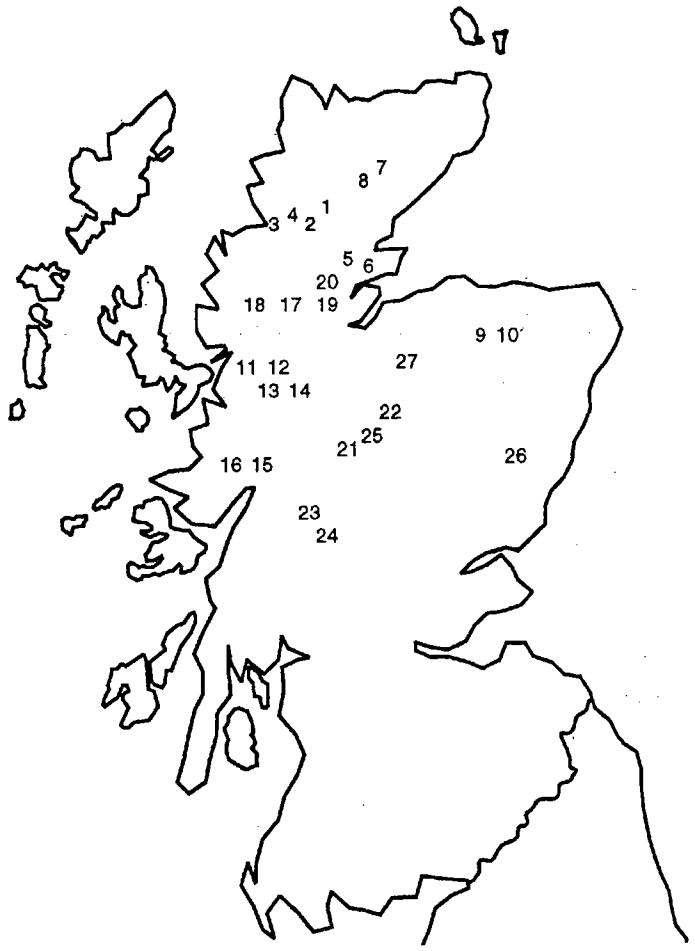

Figure 1. Locations of 27 fencelines in the study. The names of the numbered sites are given in Table 2.

monitored three fences of 4–6 km, two in pre-thicket plantations and one in a native pinewood; SNH monitored two fences, one on moorland (4.5 km) and the other in a pole-stage plantation (2 km); the GCT/SNH jointly monitored two fences (2 km and 6 km) in a native pinewood; and ITE monitored one 6 km fence in a native pinewood. Thus, the fence sites were widely dispersed and in a variety of forest habitats, but were not a random sample.

7. Observers walked along one side of a fence each month from April/May 1992 to April/May 1993. The area either side of the fence was checked for signs of bird collisions, including bodies. Visits were not made when snow covered the ground. Under such circumstances, the numbers of accumulated bird remains were equally divided between the number of consecutive months without visits.

8. When bird remains were found, a standard recording sheet was completed, and the collision point marked with a numbered plastic/metal tag attached to the fence. Collisions were placed into one of three categories;

    1. Slight – a few body feathers found but not regarded as fatal.
    2. Severe – major wing and tails feathers found in addition to body feathers, regarded as possibly fatal.
    3. Fatal – carcass found.

    These categories will under-record actual collision rates and mortality. Birds can be killed or injured in a collision without losing feathers. Some carcasses will disappear due to scavengers (e.g. foxes and humans), while injured birds may move into adjacent vegetation to die undetected. In both examples, there may be no trace left alongside the fence.

9. One trial was undertaken to determine how quickly carcasses disappeared from along monitored fences. One red grouse body was thrown against each of 20 fences so that a dent was left in the wire and some feathers detached. Nineteen of these collision points were subsequently independently recorded by a second observer, mainly from feather signs during the monthly visit, but only two bodies were recovered.

10. The species of birds involved in collisions were identified from feathers (and bodies) collected at the collision point. Feathers were compared with reference material if there was any doubt over identification.

11. Collision rates (the total number of recorded bird collisions per km per year) were calculated for each fence in the sample. When assessing collision rates, data from the first visit (the 'clean-up' round) were excluded as these remains had accumulated over an unknown period.

12. In autumn 1993, habitat features at collision points and an equal number of random points along the fence were described.

Results from the monitoring

Species involved

13. A total of 281 collisions were recorded by 14 bird species (Table 1). Most were by grouse (93%), and of the individual species, red grouse formed the bulk (67%), with fewer collisions by black grouse (13%) and capercaillie (13%). The 11 other species of birds had very low collision rates and are not considered further.

Table 1. Total number of identified bird collisions (includes remains from the clear-up visit)

Species	*Collisions (%)*	
Red grouse	188	(66.9)
Black grouse	37	(13.2)
Capercaillie	36	(12.8)
Woodpigeon	6	(2.1)
Pheasant	5	(1.8)
Others*	9	(3.2)
Total	281	

* blackbird, common gull, kestrel, redwing, short-eared owl, woodcock, fieldfare, snipe, bullfinch (all one strike)

Collision rates

14. Excluding the clean-up round, collisions by grouse were recorded from all but five of the sites (Table 2). Red grouse were recorded from 20 sites (71%), black grouse from eight (29%) and capercaillie from three (11%). Collision rates of more than one bird per km per year occurred at six sites for red grouse (maximum 4.4), three for capercaillie (maximum 7.0) and two for black grouse (maximum 2.8). The pattern of severity of collisions based on the three categories also varied between species (Table 3).

Table 2. Number of collisions and collision rates for each grouse species by fence site

Site (No.)		km	Red grouse			Black grouse			Capercaillie		
			Clear up	Month visits	col/ km*	Clear up	Month visits	col/ km*	Clear up	Month visits	col/ km*
1.	Dalnessie	5	0	1	0.2	0	0	0.0	0	0	0.0
2.	Tighcreag	5	5	1	0.2	1	3	0.6	0	0	0.0
3.	Craggie Top	5	1	3	0.6	0	1	0.2	0	0	0.0
4.	Craggie Eil	5	0	0	0.0	0	0	0.0	0	0	0.0
5.	Strathrory	5	4	5	1.0	2	0	0.0	0	0	0.0
6.	Morangie	5	6	2	0.4	0	0	0.0	0	0	0.0
7.	Truderscaig	5	1	2	0.4	0	0	0.0	0	0	0.0
8.	Rimsdale	5	0	1	0.2	0	0	0.0	0	0	0.0
9.	Glenfiddich	5	6	6	1.2	0	0	0.0	0	0	0.0
10.	Blackwater	5	17	17	3.4	0	0	0.0	0	0	0.0
11.	Affric	5	0	0	0.0	0	0	0.0	0	0	0.0
12.	Corrimony	5	4	3	0.6	1	0	0.0	0	0	0.0
13.	Phoc	5	2	8	1.6	1	1	0.2	0	0	0.0
14.	Portclair	5	0	2	0.4	0	0	0.0	0	0	0.0
15.	Ben Tee Lad	5	0	1	0.2	0	0	0.0	0	0	0.0
16.	Coreich	5	0	0	0.0	0	0	0.0	0	0	0.0
17.	Grudie	5	3	0	0.0	1	0	0.0	0	0	0.0
18.	Strathbran	5	0	1	0.2	0	0	0.0	0	0	0.0
19.	North Hill	5	2	3	0.6	0	0	0.0	0	0	0.0
20.	North Longa	5	0	1	0.2	1	0	0.0	0	0	0.0
21.	Creag Mhig	4.5	11	20	4.4	0	1	0.2	0	0	0.0
22.	Dell Wood	2	0	0	0.0	0	0	0.0	0	0	0.0
23.	Auchleeks	4	2	13	3.3	2	11	2.8	0	0	0.0
24.	Auchleeks	6.3	7	22	3.5	0	2	0.3	0	0	0.0
25a.	Rothiemurc.	6	0	0	0.0	0	0	0.0	0	0	0.0
25b.	Rothiemurc.	2	0	0	0.0	1	4	2.5	0	14	7.0
26.	Glen Tanar**	6	2	3	0.5	2	2	0.3	5	10	1.7
27.	Tomvaich	4	0	0	0.0	0	0	0.0	0	7	1.8

* col/km = bird collisions per km of fence per year
** fence partly flagged with red netting prior to monitoring

Table 3. The category of collisions (%) recorded for three grouse species

	Red grouse		Black grouse		Capercaillie	
Slight	33	(33.0)	4	(30.8)	7	(50.0)
Severe	51	(51.0)	6	(46.2)	3	(21.4)
Fatal	16	(16.0)	3	(23.1)	4	(28.6)

Seasonal trends in collision rates

15. Red grouse hit the fences each month, but two-thirds of all collisions occurred in spring (February–May) (Figure 2). The peak month was May with 23% of collisions. A similar trend was found for black grouse with a peak of 39% in May. Only one collision occurred in winter (November–January).

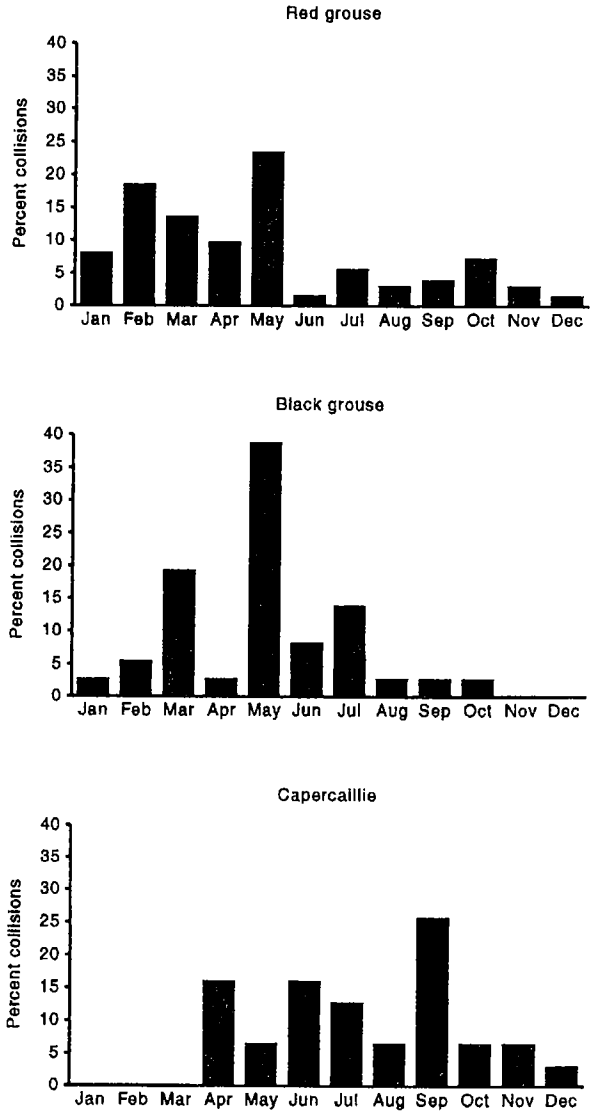

Figure 2. Seasonal distribution of fence collisions for red grouse (n=124), black grouse (n=36) and capercaillie (n=31). Data have been pooled for all 27 fencelines.

16. Capercaillie collisions tended to occur later in the year than those for the previous two species, with a peak of 26% in September and 84% during April–September (Figure 2). Data from radio-tagged birds in Abernethy and Glen Tanar also showed an autumn peak in fence collision deaths, primarily from young birds (Catt *et al.*, 1994).

Habitat relationships

17. To analyse broad differences in collision rates between habitats, sites were grouped into two forest types: pre-thicket forest (n=23) and native pinewood (n=5) (Table 4). Overall collisions rates (per km per year) were similar, with 1.2 in pre-thicket forest and 1.6 in pinewoods. However, because of differing habitat requirements, there was a difference in collision rates of red grouse and capercaillie between the forest types. Red grouse hit fences at 75% of the pre-thicket sites, at a mean rate of

1.0, but at only one of the fences in the five pinewood sites. Conversely, capercaillie were not recorded as hitting fences in pre-thicket forest, but hit fences in three of five pinewood sites at a mean rate of 1.3. Black grouse hit fences in half of both pre-thicket and pinewood sites at similar frequencies (0.2). Data from an additional pinewood site collected between June 1990 and October 1992 showed high collision rates for both capercaillie and black grouse (5.3 for both species) (RSPB, unpublished data).

Table 4. Mean collision rates (collisions per km per year) and percentage of sites recording collisions in different forest types

	Pre-thicket plantation (n=23)*		*Native pinewoods** (n=5)*	
	% collision	*mean±se*	*% collision*	*mean±se*
Red grouse	75%	1.0 ± 0.3	25%	0.1 ± 0.1
Black grouse	43%	0.2 ± 0.1	50%	0.2 ± 0.2
Capercaillie	0%	0	75%	1.3 ± 0.4

* includes one unplanted moor
** includes one pole stage plantation

18. Analysis of the habitat data is underway, and some preliminary results are available. When comparing collision points with random points along fences, there were no significant differences between the following habitat features: whether there were trees on both sides of the fence, one side or neither side; the type of netting used in the fence; the ground profile – whether on the flat, a slope, a ridge or in a hollow. More analysis is still to be done, and a measure of the topography in the vicinity of the fence may need to be incorporated.

Discussion and conclusions from the monitoring project

19. The study has clearly shown that grouse are the main bird group at risk from collisions with deer fences in Scotland (Table 1). The species of grouse most at risk is closely linked to the habitat surrounding the fence (Table 4). Red grouse hit fences mainly in young plantations prior to canopy-closure. In contrast, deer fences running through native pinewoods are hazardous for capercaillie. Black grouse appear equally at risk in both habitats.

20. In contrast to the earlier work in Abernethy and Glen Tanar (Catt *et al.*, 1994), this study has not yet identified any habitat features associated with fence collisions. This suggests that either grouse hit fences at random, or that hot-spots (where strikes are concentrated) cannot be easily identified, particularly from the relatively low collision rates encountered during this study. Much of the vegetation and topographical data collected has yet to be analysed, and may shed further light on the subject. This work will be published elsewhere.

21. The present study has a number of limitations. It was designed primarily to measure relative strike rates over a large geographical area, and gives little indication of the relationship between grouse density and collision rates or the impact of deer fences on grouse populations. To do either would involve a more detailed and costly study; this may be necessary.

22. The study does indicate where future research priorities lie. Fences in native pinewoods present a considerable hazard to capercaillie, with three out of five fences having collision rates of 1.7–7.0 per km per year (Table 2), the upper value being higher than the rate recorded by Catt *et al.* (1994).

23. While the low strike rates for red grouse should not be dismissed, results from the study suggest that fence collisions pose less of a conservation problem for this species, and one that may be largely restricted to the early afforestation phase, as red grouse are primarily a bird of open moorlands. Most of the fences monitored were in suitable red grouse habitat but had low strike rates, which could also have reflected low population densities.

24. Excluding deer by fencing creates a dilemma. Because of grazing pressure, fences are often required for the successful regeneration of native pinewoods. The expansion of this habitat is considered essential for the future of capercaillie, as pinewoods are believed to be their core habitat (Moss and Picozzi, 1994). But, in the short term, fences are a severe hazard which may be contributing to the current decline of capercaillie. The ideal solution is to reduce deer densities to a level where natural regeneration occurs without fencing (Scottish Natural Heritage, 1994). Such a policy would have a major beneficial effect on ericaceous vegetation, which is so important for adult capercaillie and black grouse and provides insect food for their chicks (Cayford, 1993; Baines *et al.*, 1994; Moss and Picozzi, 1994). However, at present it is difficult to achieve successful regeneration of pinewoods without fencing. This need not be the case. Knowledge is available on how to reduce red deer numbers, and this could be implemented quickly given the support of landowners. Successful regeneration, following increased deer culls and without fencing, has recently been demonstrated at Abernethy, Inshriach and Rannoch. This approach appears to provide the most satisfactory solution to the problem of fence collisions, particularly within the range of capercaillie.

Additional work

25. The monitoring scheme has provided baseline data on the relative frequency of fence collisions by woodland grouse. Additional work now aims to test whether modifications can be made to fences to reduce collision rates.

Problems in testing the effectiveness of fence modifications

26. The design of such an experiment would involve a series of matched pair fence sections (treatment and control). As a first step, simulations were undertaken to determine the probability of detecting a significant effect of treatment with reductions in collision rate of 2, 5, 10 and 20 fold, where the expected mean numbers of collisions in untreated sections ranged from 1 to 3.

27. The outcome showed there would be a reasonably good chance (about 80%) of observing a significant effect of treatment with a collision rate of around 2 per section, providing the true effect of treatment was a reduction of about five-fold. However, the number of fences in the monitoring programme with high collision rates by capercaillie and black grouse was low. In fact, just four fences had collision rates ranging between 1.7 and 7.0 per km per year (Table 2). To retain statistical independence between samples, only one matched pair could be selected per fence. Each treatment and control needed to be around 1 km in length, and to run for a year, to reach the minimum requirements of the simulation. Progress with testing the effects of fence modifications slowed while enough fences with high collision rates were identified. This has now been done, but it will only be possible to test one treatment at a time (see below).

Fence modifications

28. Two approaches have been taken. The first approach is to test modifications to existing fences that reduce strike rates. Traditionally, sprigs of heather have been attached to fences (flagging). This method has limitations, as heather is not highly visible and needs renewing. Some support for using coloured markers comes from the use of red PVC spirals on powerline ground wires. Alonso *et al.* (1994) showed that the frequency of bird flights and collisions decreased by about 60% around marked, compared to unmarked, spans. Therefore, it is proposed to use either squares of coloured plastic that attach to existing fences at regular intervals, or narrow strips of coloured netting attached to the top and middle of fences (modification of that in Plate 12, Moss and Picozzi, 1994).

29. The second approach is to develop a plastic netting suitable for new deer fences in areas with sizable woodland grouse populations. Collisions with plastic netting may be less severe than with wire mesh netting because of the greater surface area of the former, and fences may be more visible if brightly coloured. A fence has been constructed with plastic netting, and now awaits a larger trial to test its effectiveness both as a deer barrier and in reducing bird collisions. Before this proceeds, it is planned to undertake a trial to establish what colour/s capercaillie see best.

30. The probability of success with either of these techniques may be low for two reasons. First, some preliminary results indicate that collisions still continue after flagging, but as yet it is unknown if collision frequency declines. Second, the simulation indicated a large reduction in collision rates was required before a decline could be detected, and this may be difficult to achieve.

What can be done at present?

31. Moss and Picozzi (1994) give the most up to date advice on how to modify existing fences to reduce collisions by birds, although much of this advice is intuitive and untested. However, deer fences do kill grouse, and the likelihood of flagging techniques or colourful plastic netting substantially reducing collisions appears to be low. Therefore, there are two main considerations that could lead to a reduction in fence deaths.

    1. The removal of existing deer fences as soon as they have served their purpose. In woodlands managed under the Woodland Grant Scheme, it may be possible to offset some of the cost of fence removal through the Annual Management Grant, which supports work done to improve the environmental value of a woodland (Forestry Authority, 1994). Eligibility would depend on the importance of the area for woodland grouse and other competing interests.

    2. Consider carefully whether new fences are necessary, particularly internal fences in woodlands where capercaillie are present. Successful regeneration in native pinewoods has been achieved by increasing deer culls and without fencing.

Acknowledgements

32. The results presented are from a collaborative study which involved many people: Tony Hinde and Mick Canham (Forest Enterprise) organised the survey on Forestry Commission ground; Dr David Baines (GCT), Keith Duncan (SNH), Dr Robert Moss (ITE), Nick Picozzi (ITE) and Dr Ron Summers (RSPB) coordinated monitoring on privately-owned ground and national nature reserves; and many foresters, rangers and stalkers helped with the monitoring. The results are based on reports prepared for the Fenceline Collision Working Group by Drs David Baines and Ron Summers. Dr Rhys Green gave valued advice on the design and analysis, and Harry Pepper has provided ideas on the use of plastic netting and flagging methods.

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Issued by:
Research Publications Officer
The Forestry Commission, Research Division
Alice Holt Lodge, Wrecclesham
Farnham, Surrey GU10 4LH

July 1995

ISSN 0267 2375

Phototypeset and published by: Forestry Commission, 231 Corstorphine Road, Edinburgh EH12 7AT