Effects of spring supplementary feeding on population density and breeding success of released pheasants Phasianus colchicus in Britain

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ORIGINAL ARTICLES

Effects of spring supplementary feeding on population density and breeding success of released pheasants *Phasianus colchicus* in Britain

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The release of hand-reared ring-necked pheasants *Phasianus colchicus* in summer is a common practice in Britain to increase the number of birds available to hunters in winter. The breeding success of the birds which survive the shooting season is poor. Traditionally, birds are provided with supplementary wheat grain from release until the end of the shooting season (1 February) to maintain body condition and to help hold birds in areas for hunting. During 1997-2000 we assessed the effect of continuing supplementary feeding into spring on pheasant density and breeding success on seven private shooting estates. On each estate we randomly selected two distinct 1-km^2 plots and provided wheat grain via feed hoppers for birds in breeding territories in one of the plots on each estate while the other plot acted as an untreated control. Food was provided from mid-February to mid-May. We crossed-over the treatment and control plot on each estate each year. We conducted pre- and post-breeding pheasant counts in the plots during April and September. During April, densities were higher in treatment plots than in control plots for territorial males: (mean ± SE) treatment = 22.6 ± 1.5 birds/km^2, control = 14.8 ± 1.2 birds/km^2, ($P < 0.001$) and for females: treatment = 40.6 ± 5.8 birds/km^2, control = 24.1 ± 3.8 birds/km^2 ($P < 0.001$). In September we found no statistical effect of treatment on densities of adult birds or on brood size. However, more young were observed on treatment plots: 10.8 ± 1.5 birds/km^2, than in control plots: 5.6 ± 1.0 birds/km^2, ($P = 0.02$). In order to improve the breeding potential of released pheasants, we recommend that spring supplementary feeding is undertaken on shooting estates in Britain.

Key words: breeding success, diet, Great Britain, Phasianus colchicus, ring-necked pheasant, supplementary feeding

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Approximately 20 million ring-necked pheasants *Phasianus colchicus* are hand-reared & released each summer in Britain to supplement wild stocks for shooting (Tapper 1999). Over-winter mortality of these birds is high, but due to the large number released, many survive to the following spring (Robertson & Dowell 1990, Woodburn 2001). Compared with wild birds, the breeding performance of the released pheasants is often poor (Hill & Robertson 1988, Brittas et al. 1992, Leif 1994, Woodburn 1999). Although a wide range of reasons for this have been proposed, one contributing factor could be poor body condition during the nesting period (Draycott et al. 1998, Draycott et al. 2002).

Although pheasants are typically fed supplementary wheat grain throughout winter to provide nutrition and hold birds in required areas to aid shoot management, feeding often stops when the shooting season ends on 1 February (Draycott et al. 1998). This has been shown to result in a 40-50% drop in fat reserves of females between February and April (Draycott et al. 1998, Draycott et al. 2002).

Most pheasants in Britain are released on farms with landscape features conducive to driven pheasant shooting. These include managed woodlands, rolling hills and planted game cover blocks. However, most of these farms are also highly mechanised, intensively managed arable farming enterprises where availability of natural foods for granivorous birds is now low (Stoate 1996, Campbell et al. 1997, Draycott et al. 1997). Despite this, fat reserves of nesting female pheasants can be maintained at winter levels by providing supplementary grain in breeding territories (Draycott et al. 1998, Draycott et al. 2002). The aim of this study was to determine the impact of supplementary feeding in spring on the population density and breeding success of released pheasants in the wild.

Study sites

We conducted fieldwork on seven privately managed driven pheasant shoots in England between 1997 and 2000. Four were located in southwest England, two were in the north of England and one in eastern England (Fig. 1). All estates were involved in mixed crop arable farming, growing primarily winter wheat and barley. The proportion of woodland varied between estates. Although the primary game management objective on all estates was for released pheasants, all estates wished to increase the breeding potential of their pheasants; the ultimate aim being to reduce the reliance of their shooting on annual releases.

Typical management on these estates was as follows: machine-incubated chicks were reared in brooder houses and transferred to woodland release pens at six weeks of age during July and August each year at least six weeks before the start of the shooting season on 1 October. Birds dispersed from pens over a 3-week period. They were first fed commercial grower pellets and then wheat from hoppers in woodlands and game

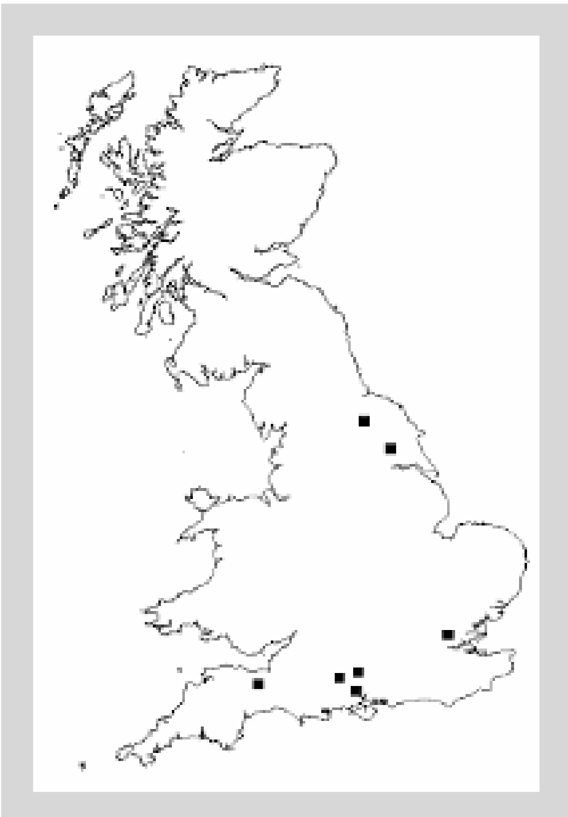

Figure 1. Location of the seven pheasant shooting estates in Great Britain where experimental spring supplementary feeding trials were conducted during 1997-2000.

cover blocks until the end of the shooting season. Naturalised pheasants, (birds surviving two shooting seasons following release) and truly wild pheasants probably constituted no more than 10% of the population on any of the estates. Corvids *Corvidae* and red foxes *Vulpes vulpes*, which are important nest predators of pheasants, (Trautman et al. 1974, Robertson 1991), were controlled on all estates during the breeding season, although there was considerable immigration from surrounding areas. Game cover plots were provided for birds in winter, but there was little or no provision of brood-rearing cover.

Methods

On each estate we randomly selected two 1-km^2 plots that were ≥ 250 m from each other. Game managers provided supplementary wheat grain in one of the plots chosen at random via feed hoppers placed in male breeding territories using the method outlined in Draycott et al. (1998). We chose wheat grain as the food source as it is this type of high energy food which is required by pheasants in spring (Draycott et al. 2000) but is often limited in availability on modern farmland (Draycott et al. 1997). Feeding commenced in mid-February and terminated in mid-May. In the second, third and fourth years, we crossed-over the treatment and control plots to account for habitat and natural food availability differences between plots and years. Due to logistical constraints, not all estates were studied in all four years. Of the four estates in southwest England, we worked on two estates in 1997 and 1998 and the other two in 1999 and 2000. We worked on the two estates in northern England and the one in eastern England during all four years.

We assumed that movement of pheasants between plots was small and did not influence results because hand-reared female pheasants move only short distances (typically < 250 m) in spring once they have settled in male breeding territories (Robertson 1986, Woodburn & Robertson 2000). Our assumption that birds would not move between plots once they had settled in breeding territories was based on our previous research using a similar experimental design which showed that out of 201 radio-tagged female pheasants only three moved between plots located < 350 m apart during the breeding season. (Draycott et al. 1998, Hoodless et al. 1999). We estimated the densities of pheasants by counting territorial and non-territorial males and females in each plot during three visits to each estate in April after females had settled in particular male breeding territories following the method of Robertson et al. (1993). This involved surveying all woodland edges, glades, hedgerows and fields with binoculars from a vehicle for two hours after dawn or before dusk. Males were classified as being territorial or non-territorial based on their behaviour and plumage characteristics (Ridley 1983). The number of females in each male territory was also noted. After three counts had been conducted, counts were combined to produce a summary map, in much the same way as maps of songbird territories from the Common Bird Census are constructed (Baillie 1991). In late August and September, after harvest of annual crops, we conducted counts of adults and juvenile pheasants in the study plots to estimate population density and breeding success. Densities were determined as the maximum from three counts in each plot during the two hours after dawn or before dusk (Hoodless et al. 1999). The accuracy of the population estimates from these counting procedures has not been verified except for territorial males which Robertson et al. (1993) determined as identifying 85% of individuals. The data presented are not calibrated and therefore should be considered as relative indices only.

Analyses of count data were conducted using a generalised linear model with Poisson errors and a logarithmic link function in GENSTAT (Lawes Agricultural Trust 1993). Overdispersion of data with respect to the Poisson distribution was corrected for by assigning the dispersion parameter a value equal to the residual deviance divided by its degrees of freedom. We tested both main effects (year, feeding, estate and plot) and interactions between independent variables. To stabilise the variance of percentage data we used the arcsin transformation and analysed the data using ANOVA in Systat 9.0 (SPSS Inc. 1999). To determine if there were any long-term effects of the treatment on breeding densities, we use paired t-tests to test for differences between control plots used before or after the first year of the treatment.

Results

We found no significant year*feeding interaction effects for any of the measured variables. The effect of year was significant for territorial males ($F_{3,14} = 4.59$, $P = 0.02$), non-territorial males ($F_{3,14} = 5.38$, $P = 0.01$) and females ($F_{3,14} = 7.11$, $P = 0.004$) in the breeding season. There were no significant effects of year on post-breeding densities of adults or young. The densities of territorial males, non-territorial males and females varied significantly between estates (Table 1), as did the densities of young birds (see Table 1). Spring supplementary feeding resulted in higher densities of territorial males (60% increase) and females (65% increase; see Table 1). Feeding

Table 1. Mean (± SE) breeding and post-breeding densities (birds/km^2) of released pheasants on seven private hunting estates in Britain in April and September 1997-2000 in relation to supplementary feeding. (Treatment = with feeding, Control = without feeding).

Birds/km^2		N	$\bar{x}$	SE	Feeding $F_{1,14}$	Feeding P	Estate $F_{6,14}$	Estate P
Breeding densities								
Territorial males	Treatment	20	22.6	1.5	19.98	<0.001	26.88	<0.001
	Control	20	14.8	1.2				
Non-territorial males	Treatment	20	8.3	1.2	0.001	0.98	14.15	<0.001
	Control	20	8.3	1.2				
Females	Treatment	20	40.6	5.8	18.38	<0.001	35.2	<0.001
	Control	20	24.1	3.8				
Post-breeding densities								
Males	Treatment	19	11.1	1.6	1.65	0.22	2.13	0.12
	Control	19	8.3	1.3				
Females	Treatment	19	6.4	1.1	0.05	0.83	1.40	0.29
	Control	19	6.8	1.2				
Young	Treatment	19	10.8	1.5	6.62	0.02	3.05	0.05
	Control	19	5.6	1.1				

did not influence the density of non-territorial males (see Table 1). There were no significant differences in the post breeding densities of adult males or females in relation to treatment or estate (see Table 1). Supplementary feeding did not significantly influence brood sizes (treatment: 2.2 ± 0.3, control: 1.9 ± 0.3, $F_{1,11} = 0.59$, $P = 0.46$) or the proportion of females with young (treatment: 67.1% ± 8.7, control: 52.3% ± 8.6, $F_{1,11} = 1.4$, $P = 0.26$). However, densities of young birds were nearly 85% higher under treatment conditions, with more observed in treatment plots than in control plots in all four years of the study (see Table 1, Fig. 2). When comparing control plots used in the first year (before treatment) and control plots used in the second year (after treatment) there were no differences in territorial males ($t_6 = 1.26$, $P = 0.25$), non-territorial males ($t_6 = 1.18$, $P = 0.28$) or females ($t_6 = 0.73$, $P = 0.49$).

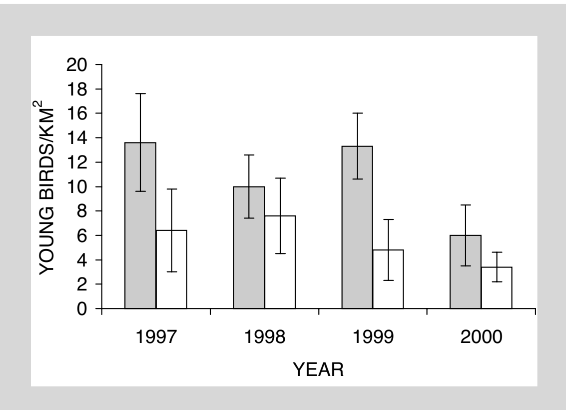

Figure 2. Mean (± SE) recruitment of pheasants on 1-km^2 plots with ( ) and without ( ) supplementary feeding in Britain during September 1997-2000. (1997: treatment N = 5, control N = 5; 1998: treatment N = 5, control N = 5; 1999: treatment N = 5, control N = 5; 2000: treatment N = 4, control N = 4).

Discussion

The results from our trial suggest that the provision of supplementary grain alters the density of released pheasants and can help improve aspects of their breeding success in the wild. Almost twice as many chicks were produced to fledging in plots with supplementary grain compared with control plots (see Table 1 and Fig. 2). Hoodless et al. (1999) found that time taken to renest was shorter and females were more likely to renest when pheasants were provided supplementary grain. However, this is the first study to demonstrate that spring supplementary feeding can help increase autumn densities of pheasants.

We also found that supplementary feeding resulted in higher densities of territorial males in April. This is in accordance with Hoodless et al. (1999) who found that provision of grain via food hoppers in spring influenced the location and increased the density of male territories in a study on one estate. The effect of year with respect to densities of breeding birds is likely to be due to between-year differences in either pheasant release density or shooting pressure. The density of females in April was also higher when supplementary grain was available, in contrast to Hoodless et al. (1999) who found no effect of feeding on female density. In our study supplementary feeding either reduced post-winter dispersal, decreased mortality or attracted birds from surrounding areas.

The mechanism for improved recruitment in the treatment plots in our study is not clear. It could have been a function of the higher density of females observed in the treatment plots being attracted to better quality male territories due to the presence of feed hoppers, or, this combined with improved female body condition. Previous research has shown that fat reserves of breeding females provided supplementary grain are up to 50% larger than unfed birds (Draycott et al. 1998, Draycott et al. 2002). Although not significant, the differences in the proportion of females with broods and brood sizes under treatment and control conditions suggest that improved productivity due to feeding may have been a factor influencing recruitment. There were no differences in breeding densities between control plots used in the first year (before treatment) or second year (after treatment), indicating that supplementary feeding did not have any long-term influence on population density or breeding success. This is perhaps not surprising considering that on each estate there was an annual release of pheasants in autumn and shooting in winter.

Nevertheless, our results show an improvement in recruitment of released birds due to supplementary feeding, suggesting that food availability is a limiting factor in the intensively managed cropland ecosystem in Britain. Spring feeding is likely to provide a cost-effective technique to increase autumn densities of pheasants. Compared with hand rearing and releasing, it is a low maintenance and non-intensive system encouraging wild-bred birds that survive and breed much better than hand-reared birds (Hill & Robertson 1988, Leif 1994). However, the average number of pheasants shot on driven pheasant shoots in Britain is currently 150/km^2 (Tapper 1999). Therefore, given the number of extra birds produced by spring feeding in this study, driven pheasant shooting clearly could not be maintained at current levels without the continued release of hand-reared birds.

In Britain many pheasants (including the pheasants on estates in our study) are released into habitat which although suitable for overwintering, are suboptimal for breeding (Sage & Robertson 2000). Thus an improvement in the breeding habitat, in particular the provision of insect-rich brood rearing cover to increase chick survival (Hill 1985) would be expected to increase the productivity of released birds above the levels recorded in our study. Wild pheasants in optimal habitats can achieve densities of 90-100 young/km^2/year (Sage 2000, Boatman 2000). Released pheasants would not be expected to achieve this level of productivity due to the physiological (Putaala & Hissa 1995, Liukkonen-Anttila 2001) and behavioural (Dowell 1990, Anttila et al. 1995) deficiencies that exist in hand-reared birds. However, supplementary feeding, habitat improvement and predation control could provide a mechanism for improving the breeding success of released pheasants, resulting in a reduction in the dependence on released birds for shooting.

Management implications

Our results suggest that in order to improve the breeding potential of released pheasants shooting estates should extend their winter feeding programmes into spring. Spring feeding enables hen pheasants to maintain body condition throughout the nesting season (Draycott et al. 1998, Draycott et al. 2002). Feed hoppers should be moved from winter-feeding sites in woodland and game cover blocks to woodland edges and hedgerows where males typically set up territories in spring (Robertson et al. 1993, Hoodless et al. 1999). Feeding is likely to confer the greatest benefits when carried out in conjunction with other important game management techniques such as efficient predation control and adequate provision of suitable breeding, nesting and brood-rearing habitats.

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