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Incubation success of released hand-reared pheasants *Phasianus colchicus* compared with wild ones

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We investigated previously observed but unexplained differences in incubation success between wild and hand-reared common pheasants *Phasianus colchicus*. Hand-reared birds are widely released in late summer in Britain and elsewhere to supplement wild stocks for shooting purposes. We radio-tracked 53 wild and 35 previously released reared female pheasants occupying simultaneously the same areas on a game-keepered estate in eastern England between February and mid July 1999 and 2000. Predation of adult birds was comparatively low for both wild and reared birds, and overall survival did not differ between years or between groups. However, of 52 nests incubated by wild females 49% hatched, whereas of 30 nests incubated by reared pheasants only 22% hatched. Mayfield estimates of daily nest survival probability thus differed significantly between groups. However, predation of eggs was similar for both wild and reared birds. Instead the observed difference in hatch rates was due to nest abandonment, with more reared females (41%) deserting apparently unmolested nest sites than wild females (6%).

Key words: abandonment, breeding success, desertion, hand-reared, incubation, nest, pheasant, release, survival

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Each year, around 25 million hand-reared juvenile common pheasants *Phasianus colchicus* are released in late summer into the British countryside to supplement wild stocks for shooting (Tapper 1999). The scale of pheasant rearing operations means that most of these birds hatch from eggs carried in mechanical incubators and are reared in pens without the presence of adult birds until release at, typically, 6-8 weeks old (Anon 1996). A proportion of these released birds survive the winter shooting season and go on to attempt breeding alongside wild populations in the following year.

Female pheasants nest on the ground, and after laying the clutch they incubate eggs for about 25 days (Robertson 1991a). During this period, they are exposed to predators and other hazards and nest success, though variable from one site to another depending on management, is often very low (Robertson 1991a). In many parts of the UK, even where habitat conditions are suitable (Tapper 1999), wild productivity is too low to support free-living populations (Robertson 1991a). Predation by foxes is often the major cause of death (Göransson 1980, Hoodless, Draycott, Ludiman & Robertson 1999, Sage, Robertson & Wise 2001).

Hand-reared females that survive the shooting season have a lower probability of breeding successfully than wild ones (Hill & Robertson 1988, Robertson & Dowell 1990, Brittas, Marcström, Kenward & Karlbom 1992, Lief 1994), and thus the general poor breeding performance of pheasants in the UK is due in part to the predominance of released birds in the population. In addition, there is a particularly poor survival of released birds in the year after release (Brittas et al. 1992, Lief 1994, Hill & Robertson 1988). In a review of radio-tracking data for more than 250 female pheasants, Robertson (1994) found that, before and after nesting, reared birds were at least five times more likely to die than wild birds. Like Robertson (e.g. 1991b), we define wild birds as those derived from nests in the wild, regardless of the possible released status of their parents.

Interestingly though, Robertson (1994) found no difference in survival during the nesting period. Despite this, some work has indicated that hatch rates of nests at which incubation was initiated are lower in reared than in wild birds (Woodburn 1999, Lief 1994). If predation rates during incubation between reared and wild females are similar, we do not have an explanation for the observed reduced hatching success in reared birds. Moreover, there is no evidence to suggest that released females are less likely to attempt to incubate a nest than wild females (Hill & Robertson 1988).

Therefore, our aim was to compare nest hatching rates in a large sample of radio-tagged wild pheasants with a similar sample of reared pheasants occupying, simultaneously, the same area and subject to the same conditions. By documenting the causes of nest failure, we could identify the reason for any differences in hatch rates that may be observed.

Methods

Our study was conducted on a mixed farming and shooting estate in Suffolk, eastern England, during 1999-2000. The 13-km^2 estate is split into two areas or beats, managed differently for game. On the smaller 5.7-km^2 beat, no pheasants were released. A gamekeeper, under the management of The Game Conservancy Trust, controlled mammalian predators (i.e. red foxes *Vulpes vulpes*, stoats *Mustela erminea* and weasels *Mustela nivalis*) and avian predators (i.e. crows *Corvus corone* and magpies *Pica pica*) and managed breeding habitats to maximise wild pheasant productivity on this beat (see Sage 2000, Draycott 2002). Management of foxes, in particular, was a priority, and these predators were maintained at a low density compared to many other game areas (see Sage 2000).

On the larger 7.3-km^2 beat, managed by the estate gamekeeper, several thousand pheasants were released each year, and while wild game production was encouraged, less effort was put into specific management to enhance breeding success. In particular, while predator control intensified on the wild beat during the breeding season, this would have become a secondary activity on the releasing beat as the gamekeeper focussed on husbandry associated with the released birds. To facilitate this study, all the released pheasants were fitted with metal year-specific coloured patagial wing tags for three years prior to the first year of this study, to ensure that any caught bird could be immediately distinguished as either wild (defined here as hatched from nests in the wild) or hand-reared. In August, the hand-reared birds were released into open-topped release pens in the estate woodlands at an age of 6-7 weeks, and gradually dispersed into the surrounding habitats over the following weeks. While most of these birds stayed within the boundary of the release beat, an unknown but, for the purposes of this study, sufficiently large proportion moved onto the wild beat where they coexisted with the wild birds and provided our study population.

In February of each year, following the shooting season, we captured surviving wild and hand-reared birds using funnel traps baited with grain placed by the gamekeeper across the wild beat on seven sites in 1999 and eight in 2000 (Taber & Cowan 1969). In 1999, 47 wild females and 26 hand-reared females were fitted with radio-transmitters and re-released, and in 2000, 39 wild and 34 reared females were radio-tagged. All hand-reared birds caught and radio-tagged were less than one-year old, distinguishable by the colour of their wing tag. The age of wild birds was indeterminate at tagging although subsequent analyses of proximal feathers (Woodburn 1999) indicated that 93-100% were also one-year olds. Radio-transmitters were assembled and encapsulated by the authors using circuitry (produced by Corintech UK Ltd.) with standard battery and aerial attachments. They weighed less than 17 grams and were attached to the birds using necklace collars.

Pheasants were located every two or three days prior to nesting. Any birds that could not be located were recorded as lost and did not contribute further to the study. Potential nest sites were located by noting the re-occurrence of an individual in a particular location. As soon as the bird was found away from this location, the spot was carefully approached and the nest confirmed. After this, incubating birds were located from a distance at least daily, and when birds were recorded away from their nest on two successive occasions, the nest itself was again observed, and clutch size was noted. Birds found away from intact clutches on successive occasions were intensively monitored to distinguish feeding excursions from abandonments. In most cases nest outcome was thus established, where possible from the available evidence, within two days of the event. Outcome was categorised as 'hatched', 'nest predated', 'hen predated', 'abandoned' or 'other'.

Many individuals nested again after failed attempts, and for these re-nests the procedure was repeated. Nest habitat type was also noted so that a basic comparison between groups could be made. Data collection was terminated on 15 July each year, when nesting activities by most birds had ceased. The proportion of each nest-outcome category was compared between groups using logistic regression. Group (wild or reared), year (1999 or 2000) and nest number (first or re-nest) were included as categorical explanatory variables. The proportion of radio-tagged females that were known to have survived the study period was also compared between groups, accounting for the effect of year, using logistic regression. Clutch size was compared between groups and years, using two-way analysis of variance. The statistical tests were carried out using Systat 9.0 (Anon 1999).

Estimates of daily nest survival for each bird were calculated in accordance with Mayfield (1975). The effect of group (wild or reared), year and nest number on daily nest survival (the number of successful nest days, S) was tested using a generalised linear model with binomial error term (total nest days, T) and logistic link function (Aebischer 1999). Two-way interactions between the fitted terms were included. Mayfield estimates of daily nest survival based on selected terms were calculated. This analysis was carried out using Genstat 4.2 (Anon 2000).

Results

Over our two-year study period, a total of 146 female pheasants were successfully tagged and tracked at least once during March. Of these, the fate by 15 July was known for 88, and 82 nest sites were monitored (Table 1). The large proportion of tagged birds that were lost during the study period (40%) was due to variable range and reliability of the radio transmitters.

The proportion of females captured from each group did not differ between the seven capture sites used in 1999 and between the eight sites used in 2000 ($\chi^2_6 = 6.93$, P = 0.33 and $\chi^2_7 = 13.59$, P = 0.059, respectively).

Female survival

The proportion of birds surviving to the end of the study period (Fig. 1) did not differ between years ($\chi^2_1 = 1.08$, P = 0.39) or between groups ($\chi^2_1 = 0.86$, P = 0.43), and there was no significant interaction between year and group ($\chi^2_1 = 0.76$, P = 0.44). Most birds from each group that did not survive were predated, although five reared birds died in poor condition during incubation.

Nesting

There was no difference in the selection of nest habitat types between years ($\chi^2_2 = 3.25$, P = 0.20) or groups ($\chi^2_2 = 2.06$, P = 0.36) with the majority of both wild and

Table 1. Number of radio-tagged females and associated nests available during the study period.

	1999		2000		Both years	
	Wild	Reared	Wild	Reared	Wild	Reared
No. of females tagged on 15 March	47	26	39	34	86	60
No. of females not lost during the study	33	17	20	18	53	35
No. of females found incubating at least once	26	17	15	8	41	25
No. of second nests	6	3	5	2	11	5
No. of all nests including re-nests	32	20	20	10	52	30

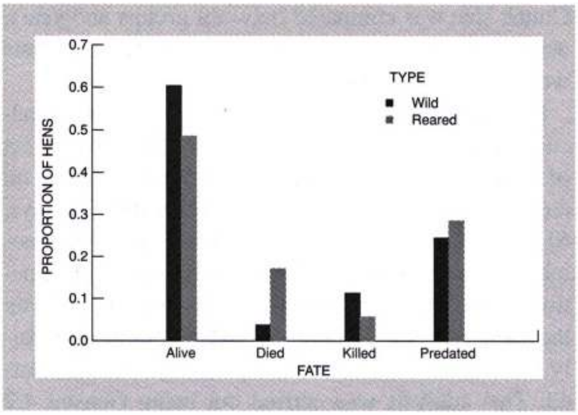

Figure 1. Proportion of hens in each fate category during the period 15 March - 15 July in 1999 and 2000. Overall, 56% of the 53 wild and 35 reared radio-tagged hens survived. This figure does not include the proportion of radio-tagged birds for which the fate was not known. The category 'Died' indicates that carcasses were found without evidence of injury. The category 'Killed' indicates hens run over by car or mower. There was no difference between groups (wild or reared, see text).

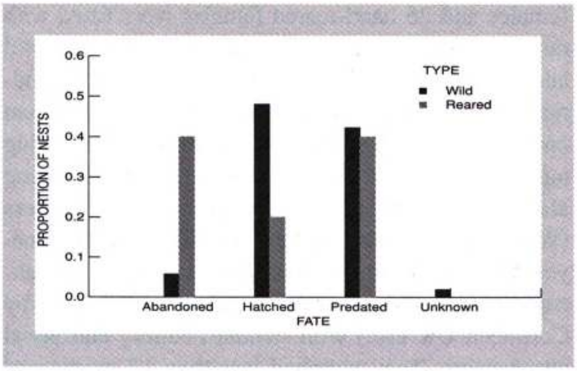

Figure 2. The proportion of pheasant nests in each fate category from the sample of 52 wild and 30 reared pheasant nests monitored in this study in 1999 and 2000 combined. More wild birds hatched nests than reared ones (see text). The category 'Predated' refers to predation of eggs.

reared birds nesting in field margin habitats rather than in the crops themselves (Table 2). The likelihood of a bird re-nesting did not differ between years ($\chi^2_1 = 0.30$, P = 0.64) or between groups ($\chi^2_1 = 0.24$, P = 0.69).

Considering both first and second nest attempts, the likelihood of a nest hatching did not differ between years ($\chi^2_2 = 1.10$, P = 0.40). In both years, wild birds were more likely to hatch a nest than reared birds (Fig. 2; $\chi^2_2 = 14.0$, P < 0.001), but there was no significant interaction between year and group ($\chi^2_2 = 3.91$, P = 0.19). Clutch size did not differ between years (first nests only; $F_{1,50} = 0.06$, P = 0.80) or between groups ($F_{1,50} = 1.36$, P = 0.25; mean ± 1 SE: wild 12.4 ± 0.8, reared 11.1 ± 0.9).

In the analysis of Mayfield estimates of daily nest survival probability, two-way interactions between nest number (first or second nests), group and year were not significant, nor were nest number and year (P > 0.05 in all cases). Daily survival probability of nests depended on group ($\chi^2_1 = 5.60$, P = 0.020) and was lower for reared birds (0.942 ± 0.012) than for wild birds (0.971 ± 0.006).

Table 2. The number and proportion (in %) of basic nesting habitat types selected by wild and reared hens for all nests from both years. There was no difference between groups ($\chi^2_2 = 2.06$, P = 0.36). Note that records of nest habitat type for three birds in each group were lost.

Habitat	Wild	Reared
Crops	6 (12.2)	6 (22.2)
Uncultivated	38 (77.6)	20 (74.1)
Grassland	5 (10.2)	1 (3.7)

The differences in hatchability and daily survival probabilities were accounted for by the greater proportion of reared birds that abandoned their nests (significant difference between groups; $\chi^2_1 = 10.56$, P < 0.001) rather than nest predation rates (there was no significant difference between groups; $\chi^2_1 = 0.02$, P > 0.05; see Fig. 2). Predation of a female during nesting was not registered for any nest. All of the females recorded as having died (see Fig. 1) were found within three days after abandoning incubated nests.

Discussion

We found no differences between wild and hand-reared pheasants in clutch size and the number of nesting attempts, as has been found by some authors (Brittas et al. 1992, Lief 1994), but not others (Hill & Robertson 1988). We observed unusually low mortality due to predation of both wild and hand-reared adult females compared to otherwise similar studies of breeding success in pheasants (Brittas et al. 1992, Lief 1994, Hill & Robertson 1988, Sage et al. 2001). This low predation rate of incubating hens in particular, may be the reason why abandonment of nests was revealed for the first time in our study as a significant activity of the group of hand-reared pheasants.

While nest searching and radio-tagging have been found to influence survival and productivity in gamebirds (e.g. Bro, Clobert & Reitz 1999, Robertson 1991a), in a comparative study such as ours, both groups would be equally affected. Also, because age may affect breeding success in gamebirds (Woodburn 1999), we aimed to compare similar aged, i.e. juvenile, pheasants. Our analysis of proximal feathers suggests, however, that a small proportion of our wild birds might not have been juveniles. This could not account for our findings though, as abandonment was still comparatively rare amongst the remaining majority of juvenile wild birds.

It has been suggested that over several decades the rearing process itself may have produced a genetically different bird, and that this may cause behavioural differences of the kind we observed (Robertson 1991b). One study did compare breeding in two groups of pheasants, both of which were hand-reared in the normal way, but one of which descended from long-term wild stocks while the other descended from a long-term game farm stock (Sage et al. 2001). This genetic difference caused differences in subtle aspects of the birds' behaviour, for example, their response to a disturbance and choice of nest habitat. Survival, however, was the same for each group over any period, and there was no difference in nest outcome although as indicated, unlike in our study, losses of incubating females to predators were high.

Another possible explanation for our findings may be related to diet. Due to the availability of cereal grain *ad libitum* during the rearing and releasing process, hand-reared and fed juvenile gamebirds have less well developed digestive tracts than wild ones (Putaala & Hissa 1995). It is likely that these differences would persist in adult birds, as other morphological characteristics did in the study of Ohlsson & Smith (2001). As a consequence, hand-reared females might be less efficient at digesting and assimilating their diet of wild seeds and shoots (Draycott, Butler & Carroll 2000, Schulze, Fehlberg & Pohlmeyer 1994). Hand-reared pheasants may also have poorly developed feeding behaviour. It has been shown, for example, that predator evasion responses are reduced in pheasants reared without the presence of adult birds (Dowell 1990).

Given poor physiological and possibly behavioural adaption to a wild diet, it is likely that hand-reared female pheasants that survive the shooting season will be especially vulnerable to poor nutrition as they try to accumulate reserves for egg-laying and incubation (Beer 1988). Britenbach & Meyer (1959) found that pheasants can lose 80% of their body fat during a 25-day incubation, while Robertson (1994) suggested that reared birds will lose around twice as much total body mass as wild birds. Recently, Draycott, Parish, Woodburn & Carroll (2002) reported that hand-reared pheasants in the UK, that were not fed during the spring, had reduced pre-incubation fat reserves compared to wild birds. They and Hoodless et al. (1999) also found that providing grain to hand-reared pheasants in spring via feed hoppers did improve aspects of their breeding performance.

In a study of daily nest attendance by pheasants during egg laying, birds in poorer condition spent less time on the nest (Persson & Göransson 1999). Though we did not study the relationship between the condition of incubating females and nest outcome, we noted that the five pheasants that had left their nests and were found dead shortly afterwards were all from the hand-reared group, and were all emaciated. Therefore, it is plausible that an inability to accumulate sufficient reserves for the incubation period caused the poor hatching in hand-reared pheasants in our study. Testing of this hypothesis should be the aim of further work in this area.

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References

Aebischer, N.J. 1999: Multi-way comparisons and generalized linear models of nest success: extensions of the Mayfield method. - Bird Study 46: 22-31.

Anonymous 1996: Gamebird Releasing. - The Game Conservancy Trust, Fordingbridge, England, 127 pp.

Anonymous 1999: Systat 9 Statistics I. - SPSS Inc., Chicago USA, 660 pp.

Anonymous 2000: The Guide to Genstat Release 4.2 - Statisitcs. - VSN International Ltd., Oxford, England, 782 pp.

Beer, J.V. 1988: Nutrient requirements of gamebirds. - In: Cole, D.J.A. & Haresign, W. (Eds.); Recent advances in animal nutrition. London, Butterworths, pp. 195-203.

Britenbach, R.P & Meyer, R.K. 1959: Effect of incubation and brooding on fat, visceral weights and body weight of the hen pheasant (Phasianus colchicus). - Poultry Science 38: 1014-1026.

Brittas, R., Marcström, V., Kenward, R.E. & Karlbom, M. 1992: Survival and breeding success of reared and wild ring-necked pheasants in Sweden. - Journal of Wildlife Management 56: 368-376.

Bro, E., Clobert, J. & Reitz, F. 1999: Effects of radio-transmitters on survival and reproductive success of grey partridge. - Journal of Wildlife Management 63: 1044-1051.

Dowell, S.D. 1990: The Ontogeny of anti-predator behaviour in game bird chicks. - Unpubl. PhD thesis, University of Oxford, 284 pp.

Draycott, R.A.H. 2002: Spring feeding of pheasants on farmland. - Aspects of Applied Biology 67: 107-112.

Draycott, R.A.H., Butler, D.A. & Carroll, J.P. 2000: Spring diet of ring-necked pheasants (Phasianus colchicus) in the UK: Implications for the condition of nesting hens. - Hungarian Small Game Bulletin 5: 29-38.

Draycott, R.A.H., Parish, D.M.B., Woodburn, M.I.A. & Carroll, J.P. 2002: Spring body condition of hen pheasants in Great Britain. - Wildlife Biology 8: 261-266.

Göransson, G. 1980: Dynamics, reproduction and social organisation in pheasant Phasianus Colchicus populations in South Scandinavia. - Unpubl. PhD thesis, University of Lund, Sweden, 112 pp.

Hill, D. & Robertson, P.A. 1988: Breeding success of wild and hand reared ring-necked pheasants. - Journal of Wildlife Management 52: 446-450.

Hoodless, A.N., Draycott, R.A.H., Ludiman, M.N. & Robertson, P.A. 1999: Effects of supplementary feeding on territoriality, breeding success and survival of pheasants. - Journal of Applied Ecology 36: 147-156.

Lief, A.P. 1994: Survival and reproduction of wild and pen-reared ring-necked pheasant hens. - Journal of Wildlife Management 58: 501-506.

Mayfield, H. 1975: Suggestions for calculating nest success. - Wilson Bulletin 87: 456-466.

Ohlsson, T. & Smith, H.G. 2001: Early nutrition causes persistent effects on pheasant morphology. - Physiological & Biochemical Zoology 74: 212-218.

Persson, I. & Göransson, G. 1999: Nest attendance during egg laying in pheasants. - Animal Behaviour 58: 159-164.

Putaala, A. & Hissa, R. 1995: Effects of captive-rearing on physiology and anatomy in the gray partridge. - Wildlife Biology 1: 27-31.

Robertson, P.A. 1991a: Estimating the nesting success and productivity of British pheasants Phasianus colchicus from nest-record schemes. - Bird Study 38: 73-79.

Robertson, P.A. 1991b: The effects of hand-rearing: An overview. - In: Whigley, A. (Ed.); Game Conservancy Trust Review of 1990. Game Conservancy Trust, Fordingbridge, England, pp 105-107.

Robertson, P.A. 1994: Better breeding pheasant. - In: Murray-Evans, J. (Ed.); Game Conservancy Trust Review of 1993. Game Conservancy Trust, Fordingbridge, England, pp. 78-80.

Robertson, P.A. & Dowell, S.D. 1990: The effects of Hand-Rearing on Wild Gamebird Populations. - In: Lumeij, J.T. & Hoogeveen, Y.R. (Eds.); The future of wild gamebirds in the Netherlands. Organisatiecommissie Nederlandse Wilde Hoenders, Amersfoort, Netherlands, pp. 158-171.

Sage, R.B. 2000: The wild pheasant project. - In: Miles, S. (Ed.); Game Conservancy Trust Review of 1999. Game Conservancy Trust, Fordingbridge, England, pp. 72-75.

Sage, R.B., Robertson, P.A. & Wise, D.R. 2001: Survival and breeding success of two ring-necked pheasant (Phasianus colchicus) strains released into the wild. - Game & Wildlife Science 18: 331-340.

Schulze, E.J., Fehlberg, U. & Pohlmeyer, K. 1994: Pen-reared pheasants: are they as fit as wild ones? - International Union of Game Biologists 21: 110-112.

Taber, R.D. & Cowan, J. McT. 1969: Capturing and marking wild animals. - In: Miles, R.H. (Ed.); Wildlife Management Techniques. Wildlife Society of America, pp. 277-318.

Tapper, S.C. 1999: A Question of Balance. - The Game Conservancy Trust, Fordingbridge, England, 288 pp.

Woodburn, M.I.A. 1999: Comparative population dynamics of wild and reared pheasants (Phasianus colchicus). - Unpubl. PhD thesis, University of Southampton, 232 pp.