Effects of Housing Type and Breeding System on the Reproductive Capacity of the Red-Legged Partridge (Alectoris rufa)

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ABSTRACT Current methods of intensive breeding of the red-legged partridge (Alectoris rufa) are based on “industrial” laying practices, including removal and artificial incubation of eggs. These procedures can alter the reproductive behavior and physiology of the birds and, therefore, may not be suitable for use in breeding programs designed to increase wild populations. This study aimed to determine the effects of intensive housing and breeding methods on the laying capacity and reproductive behavior of the red-legged partridge. In Experiment 1, 70 pairs from a commercial game farm were randomly allocated into three treatment groups and placed in differing designs of breeding cages: 8 m² cages with solid sides (n = 30), 4 m² cages with solid sides (n = 30), and 4 m² cages with mesh sides (n = 10). The number of eggs laid was recorded each week. In Experiment 2, 30 pairs, placed in 30 closed 8 m² cages, were used. Fifteen pairs were birds reared under the intensive system used on game farms, and the other 15 pairs were birds adopted by pairs of foster parents when they were less than 48 h old. The total number of eggs laid during the reproductive period was recorded.

In Experiment 1, egg production was greater in pairs housed in 8 m² cages. There were no differences in egg production between birds housed in closed or open 4 m² cages. In Experiment 2, the rearing method did not affect egg production. In both experiments, regardless of rearing history or cage type, the numbers of eggs laid were considerably higher than published figures for wild red-legged partridges. This fact, together with the absence of incubation by 100% of the females, indicates the considerable physiological and behavioral modifications that red-legged partridges have undergone due to domestication.

(Key words: red-legged partridge, rearing system, handling, egg production, incubation)

INTRODUCTION

The numbers of wild red-legged partridge (Alectoris rufa) in the Iberian Peninsula have decreased considerably over the last few decades (Nadal, 1991). The causes are many: an increase in the use of farm machinery and technology, loss of habitat, increase in the number of predators, and the general use of herbicides and insecticides (Rueda et al., 1992). According to Cramp and Simmons (1982), this problem not only affects the red-legged partridge in Spain, but occurs throughout the world distribution of the bird, and to other partridge subspecies. For example, countries such as Italy (Nobilini et al., 1993), France (Aebischer and Potts, 1994), and Great Britain (Potts, 1980) have registered significant declines in numbers of red-legged partridges and grey partridges (Perdix perdix).

Because of this decrease in the wild partridge population, the number of game farms that breed birds for release has increased. Despite that captive release programs should aim to produce birds capable of integrating into the environment, surviving, pairing, and successfully producing chicks, the rearing method of these individuals is very different from natural conditions. The breeding pairs are formed using forced pairing, with pairs of male and female birds being kept in small cages. The sole aim of these forced pairings is to produce fertile eggs that are collected daily (Caucho, 1991), similar to chicken laying hen farms. Daily egg collection increases the duration of the laying period, as it removes the visual and tactile stimulus provided by the presence of eggs (Hall and Goldsmith, 1983; Lea, 1987; Hall, 1987; Redondo, 1994a). Incubation is artificial, and the chicks are reared in large groups without contact with parents. Future breeding females are selected if their dams had longer laying periods and more numerous clutches. The selection and rearing methods used in red-legged partridge production could modify the characteristics of reproductive physiology and behavior of the birds, such as their desire to incubate (Spano and Csermely, 1980; Redondo, 1994a).

The research in this paper is part of a project that aims to develop semi-extensive production systems for the red-legged partridge capable of appropriate ethological re-
sponses when they are used for repopulation. The aim of this study was to determine the influences of housing type and rearing system on the laying capacity of commercial game farm red-legged partridges and to compare the results with existing data for wild partridges.

MATERIALS AND METHODS

Experiment 1: Effects of Housing Type on Laying Patterns

Birds. In February 1996, 70 male and 70 female red-legged partridges were randomly selected from birds hatched in May of the previous year on a game farm that used an intensive breeding method. The males and the females were then allocated at random into breeding pairs (forced pairing).

Housing System. Each male-female pair was housed in 1 of 70 breeding cages. The cages were placed on earthen floors and were equipped with a drinker with a constant water supply and a feeding box with seed, cereals, or legumes.

Thirty of the breeding cages covered an area of 4 m$^2$ (4 m long × 1 m wide × 1 m high). These cages were constructed of metal mesh, allowing the birds to view the environment outside the cage. The cages were placed such that neighboring pairs of birds could not see each other. Another 10 breeding cages were of the same dimensions, but the sides were covered with galvanized metal sheeting so that the birds were prevented from seeing out. The remaining 30 cages covered an area of 8 m$^2$ each (8 m long × 1 m wide × 1 m high) and were also constructed of galvanized metal sheeting.

An artificial nest, as described by Robles et al. (2001), was placed in each of the 4 m$^2$ cages. Two nests were placed in the 8 m$^2$ cages, one at each end. All of the 4 m$^2$ cages had a 1 m$^2$ roofed section under which the nest and the feeding box were placed. In the 8 m$^2$ cages, there was a roofed section at each end of the cage.

Experimental Procedures. The forced pairings were carried out in mid-February, and in all cases, the birds were placed in the breeding cages and remained there until the end of the reproduction period in late July. All birds remained healthy throughout the study.

The number of eggs laid per cage was counted each week by direct observation, minimizing activities or manipulations that could cause stress to the birds. All eggs were left in the cages.

Statistical Analysis. The data were analyzed by one-way ANOVA (Dixon, 1983) to assess the significance of differences between housing treatments. The Newman-Keuls test was chosen for the post-hoc comparison of means. Differences with $P < 0.05$ were considered significant.

Experiment 2: Effect of Rearing Method on Laying Patterns in Adulthood

Birds. The study used two batches of reproducing red-legged partridges originating from the same game farm as in Experiment 1. Batch A comprised 15 pairs of birds that had been reared in the same intensive brooding system as for Experiment 1. Specifically, newly hatched chicks were placed in brooding rooms within protective rings with the aim of maintaining them close to a heat source for at least the first 8 to 10 d posthatch. The diameter of the circle allowed for 100 chicks per m$^2$. After 10 d, the birds were allowed access to the whole room, which was maintained at 28 to 30 °C, until they reached 25 d of age. From 25 to 60 d of age, the birds were given heat during the night and part of the day and were allowed access to a small grassy area with a bird density of 40 to 50 chicks per m$^2$. At 60 d of age, they were placed in large flight cages, until the beginning of the experiment.

Batch B comprised 15 pairs that had been reared using an alternative system. Each chick had been adopted by individual adult birds within 48 h of hatching. The young partridges were reared, until they were 2 mo old, by their adopted parents inside cages placed outdoors on the ground in a natural environment. At 2 mo of age, the young partridges were kept in large cages in groups of 10 (a similar group size to natural winter groups), until the beginning of the experiment.

Both batches were hatched in May and were tested for laying capacity from mid-February onward in the following year.

Laying Capacity Testing. Within Batch, males and females were allocated at random into 30 breeding pairs. The pairs were placed in individual breeding cages and remained there until the end of the reproduction period in late July. All birds remained healthy throughout the study. The breeding cages covered an area of 8 m$^2$ and were identical in design to those used in Experiment 1, with two nests placed inside, one at each end of the cage. All cages were placed outdoors on the ground in a natural environment. At the end of the breeding period, the total number of eggs laid in each cage was counted. All the eggs were left in the cages.

Statistical Analysis. The data were analyzed by one-way ANOVA (Dixon, 1983) to assess the significance of differences between rearing treatments. Differences with $P < 0.05$ were considered significant.

RESULTS AND DISCUSSION

In Experiment 1, the ANOVA showed that there were significant differences in the total average number of eggs laid between the cage types ($F_{2, 67} = 6.289; P < 0.01$). Pairs housed in the 8 m$^2$ cages produced more eggs than birds in the open- or closed-sided cages (4 m$^2$) and did not differ in egg production (Table 1; Newman-Keul’s test).

The differences found in egg production between cage types may be due to differences in the available surface area in the different cage designs. Béjar (1991) and Redondo (1994b) concluded that reductions in the surface area of laying cages in intensive breeding systems limit the reproductive performance of partridges, possibly due to the stress resulting from insufficient space. In this context, it is interesting to note in the present study that preventing
TABLE 1. Mean total (± standard deviation) of eggs laid in each cage type in Experiment 1

<table>
<thead>
<tr>
<th>Cage</th>
<th>Eggs observed</th>
</tr>
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<tbody>
<tr>
<td>8 m² closed sides</td>
<td>26.63 ± 15.729</td>
</tr>
<tr>
<td>4 m² closed sides</td>
<td>14.10 ± 12.133</td>
</tr>
<tr>
<td>4 m² open sides</td>
<td>14.17 ± 14.054</td>
</tr>
</tbody>
</table>

a,bValues with a different superscript are significantly different (P < 0.05).

The higher level of laying observed in the 8-m² cages could also be due to the arrangement of the two nests inside the cages. Female birds in the 8-m² cages were observed to perform a double lay 70% of the time on a weekly basis. This result closely coincides with that of Green (1984), who observed double laying in 69.80% of wild red-legged partridges older than 2 yr of age. The first nest received an average of 19.42 eggs compared with 14.92 eggs laid in the second nest. These results are similar to those of Green (1984), who recorded an average of 14.63 eggs in the first nest and 14.00 eggs in the second nest.

The laying curves for each cage type over the 14 wk of Experiment 1 are presented in Figure 1. The pattern of lay for each treatment follows that of a standard laying curve, with the greatest interval between successive ovipositions at the beginning of the reproductive period, a diminution of the interlaying interval in the middle period, and finally decreasing egg production toward the end of the reproductive period.

Nevertheless, it should be pointed out that during the period of maximum lay between Weeks 5 and 9, the laying frequency did not reach one egg daily—the normal peak for the species. This result could be related to the long duration of the laying period, which was over 12 wk. In contrast, the normal maximum duration of lay in the wild partridge appears to be between 4 and 5 wk (Green, 1984).

The egg production in Experiment 2 (Table 2) was markedly higher for red-legged partridges than results reported for pairs in the wild. Other authors have recorded approximately 12 to 18 eggs per pair under field conditions (Green, 1984; Hernandez-Briz, 1990; Nadal, 1995), whereas the conditions of the present study resulted in production closer to that reported for farm partridges, between 30 and 60 eggs per pair (Béjar, 1991). However, note that farmed breeding partridges may often be a hybrid cross between Alectoris rufa and A. graeca (rock partridge) or A. chukar (chukar), because these latter types have greater fertility and lay more eggs than the red-legged partridge (Béjar, 1991, 1992). The hybrid birds have an extremely low natural incubation percentage, which is not a problem on the game farms, where artificial incubation is practiced (Potts, 1980).

Our results differ from those of Coll (1987) and Catusse et al. (1988). These authors did not find significant differences in egg production or in the number of chicks hatched among partridges from game farms and wild red-legged partridges, although Catusse et al. (1988) indicated a lower rearing aptitude in birds from chick-breeding farms.

In the current study, the way in which the breeders were reared, whether intensively or adopted by foster parents, did not have an effect on the mean number of eggs laid, 36.9 in Batch A and 36.7 in Batch B (F(1, 28) = 0.104; P < 0.75). This result suggests that genetic increases in egg production produced by generations of selection are unlikely to be easily altered by the environmental influence of a change in rearing management of this type. Thus, our results are similar to those of Hale (1962) and Spanò and Csermely (1980), who reported that the processes of domestication and production selection of the birds involve a series of morphological, ethological, and physiological changes that can affect sexual precocity or the lengthening of the breeding period in comparison with wild types. Furthermore, these changes may not be reversible by management strategies (De Vlaming, 1979; Lea et al., 1982; Sossinka, 1982).

In comparing the total number of eggs laid in the 8-m² cages in both experiments, there were 26.6 eggs in Experiment 1 and 36.8 eggs in Experiment 2. This difference was not significant (F(1,58) = 0.791; P = 0.377). The lower number of total eggs produced in Experiment 1 could be due to the weekly inspections to measure egg production. These inspections might have caused stress for the birds.
and lowered egg production. Stress and fear-inducing situations can adversely affect the reproductive success of the red-legged partridge in captivity (Béjar, 1991), as in other bird species (Mills and Faure, 1990; Barnett et al., 1994; Hemsworth et al., 1994; Zuidhof et al., 1995).

With regard to the percentages of incubation (Table 2) achieved in our study, we should point out that they were very low in all cases, less than 10%, and were independent of the origin of the breeders. Moreover, the males always incubated eggs, and never the females. The lack of hatching (Table 2) was probably due to the producers selecting reproducing females with the largest number of eggs laid, a trait that does not always relate to optimal hatching. It was reported by Redondo (1994a) that partridges that lay an unusually high number of eggs tend to have reduced clutches. Similarly, Spanó and Csermely (1980) state that the low percentage of incubation observed in female red-legged partridges could be explained in that the genetic selection carried out on the females to increase their laying may decrease their tendency to incubate; however, this does not occur in males that are selected to contribute to the "wild" characteristics to the species.

From this study, we conclude that the laying capacity of the red-legged partridge under seminatural conditions is affected by the type of cage used and that providing an increased cage area as well as more nests or nesting places increases egg production. We also conclude that red-legged partridges from commercial game farms are able to produce large numbers of eggs, regardless of whether they are reared intensively or are adopted by foster parents within 48 h of hatching.

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REFERENCES


