The effects of group size on the proportion of nest box eggs laid by hens in cages

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We previously found that only 66% of hens in cages with a nest box became ‘consistent’ nest-box layers, that is laying at least 80% of their eggs in the nest box. To begin to understand how social factors might limit nest box use in ‘modern’ cages, we housed birds either singly or in groups of eight and recorded the incidence of nest box and floor eggs. The proportion of nest box eggs was greater (P = 0.022) for singly- compared to group-housed birds between 19 and 33 weeks of age (84.2 vs. 66.6% of eggs). The experiment confirmed that social factors contribute to the reduction in the proportion of eggs laid in nest boxes.

I. INTRODUCTION

The welfare of laying hens in cages is a current international topic of ethical, political and scientific debate. From 2013 in the European Union, egg production from caged hens will only be acceptable if ‘furniture’ (viz. a nest box, dust bath and perch) is provided in the cage. Australian research on furnished cages by Barnett and Cronin (2005) however, reported only 62% of eggs were laid in nest boxes. Cronin et al. (2007) reported that 45% of ‘first eggs’ were laid in the nest box by hens in cages. The proportion of nest box eggs increased linearly to about 70% at the eighth egg and thereafter remained relative static. The literature suggests hens are highly motivated to lay in a nest box. With the possible exception of the study by Cooper and Appleby (1997), most experiments measuring motivation of hens to reach a nest box selected hens on the basis that they were already ‘consistent’ nest-box layers. With this in mind, it is perhaps not surprising that the reported high motivation of hens to lay in a nest box does not necessarily reflect the proportion of nest box eggs reported in observational studies.

The incidence of nest box eggs in cages has been reported to range from 43-100% (Wall et al., 2002; Guesdon and Faure, 2004; Tauson and Holm, 2005: Cronin et al., 2007). A number of factors have been shown to affect both the attractiveness and access to nest boxes by hens, including specific features of the nest, strain, age and rearing experience of the bird and social factors. Social factors are reported to affect both access to a nest site (Sherwin and Nicol, 1993; Friere et al., 1997, 1998) and the time hens remain at the site after oviposition (Lundberg and Keeling, 1999). During observations of hen behaviour in 25 commercial aviaries, Odén et al. (2002) reported considerable aggression occurred outside nest boxes, suggesting competition for nest boxes. Similarly, Shinmura et al. (2007) found that dominance status of hens influenced use of resources in furnished cages. Since the timing and synchrony of egg laying in hens tends to be regulated by light (Appleby et al., 2004), increased competition for preferred egg-laying sites may occur in cages with a single nest box. These authors suggested that nest boxes should accommodate multiple hens simultaneously engaged in pre-laying behaviour and they presented a theoretical model of nest area requirement of 300 cm2 per hen. Thus, a group of eight hens would require 2,400 cm2 of nest space, double that provided in ‘modern’ furnished cages (see below). As a first step to investigate the attractiveness of nest boxes for laying hens in cages, the present experiment examined the effects of group size on utilisation of nest boxes.

II. MATERIALS AND METHODS

A total of 96 Hy-Line Brown hens were housed either singly or in groups of eight in cages measuring 1.2 m wide, 0.5 m deep and 0.45 m high at the rear. All cages contained a nest box located on the right side (viewed from the front), which measured 0.24 m wide, 0.5 m deep and 0.27 m high at the front. The floor of the nest box was overlain with 'Astro turf' (0.22 m x 0.37 m x 15 mm thick). The cages were located within an insulated shed divided into two experimental rooms. Thermometers positioned at four locations in each room recorded the daily minimum and maximum temperatures to assist in the manual control of room temperature, which was independently controlled in each room. Each room contained a bank of 20 cages, with ten cages per tier arranged as two rows of five cages in a back-to-back formation. The two tiers (i.e. upper and lower) were separated by the height of a cage. Both tiers of each bank were used in the experiment, providing a total of 40 cages.

Birds were transported to the Werribee facility at 13 weeks of age, beak trimmed and placed at random in the cages. Nest boxes were present but access was closed off for the first two weeks. At entry to the cages, birds were exposed to a 12 h L:12 h D (light:dark) schedule, which was increased to 16 h L:8 h D by 24 weeks of age. Treatments were allocated at random to tiers within rooms, so that within each tier there were eight cages containing single birds and two cages of eight birds. Egg locations were recorded daily to determine the occurrence of eggs laid in the nest box compared to on the wire floor. Data were collated and differences due to group size were analysed using Analysis of Variance in Genstat 11.1 (VSN International Ltd.), after blocking for room, tier and row. The experimental unit was the cage. Proportional data, i.e. hen day production (HDP) and eggs laid in the nest box between 19-33 weeks of age, were analysed following angular transformation of percentage values. Due to a strong positional effect on the proportion of nest box eggs, the effect of group size on the proportion of nest box eggs was also analysed after omitting the data for one row (Row 4).

III. RESULTS

HDP between 19-33 weeks of age did not differ due to group size (angular transformed means {ATM} with back-transformed means {BTM} in parentheses were 77.23 (95.1%) and 74.16 (92.4%) degrees, respectively; sed 2.491, $P = 0.23$). The change in HDP per week for the two group size treatments is shown in Figure 1. Group size however, affected the proportion of nest box eggs between 19-33 weeks of age (ATM with BTM in parentheses were 71.5 (89.9%) and 54.1 (65.6%) degrees, respectively; sed 6.57, $P = 0.012$). Figure 2 shows the change in the mean proportion of nest box eggs per week in the two treatments. From 19-33 weeks of age, the proportion of nest box eggs ranged from 4.1-100% (median 95.3%) and 48.6-93.8% (median 69.3%) respectively, for 1- and 8-bird cages.

Further investigation of the data showed a strong positional effect on nest box eggs, with most cages in Row 4 (in Room 2) having a low proportion of nest box eggs. Of the ten cages in this row, nine housed single birds with a mean proportion of nest box eggs of 53.3% (std dev 40.64). Minimum and maximum values were 4.1% and 100%, respectively. Although the three cages with the lowest proportion of nest box eggs (4.1%, 4.8% and 5.5%) were end-cages, the fourth end-cage in this row had 100% nest box eggs. Of the remaining 1- bird cages, three were considered 'inconsistent' nest box layers (46.8%, 54.6% and 73.2% nest box eggs). In comparison, the mean proportion of nest box eggs for the seven 1-bird cages in the adjacent row (Row 3) was 97.1% (std dev 5.77) and the minimum and maximum values were 84.2% and 100%, respectively. There was only one 8-bird cage in Row 4 andthis cage had the lowest proportion of nest box eggs (48.6%) recorded for group treatment cages. In comparison, there were three 8-bird cages in Row 3 and these averaged 69.3% (std dev 2.16) nest box eggs. After omitting the data for Row 4 cages, the difference due to the group size treatment was stronger (ATM with BTM in parentheses were 79.3 (96.6%) and 59.7 (74.5%) degrees, respectively; sed 3.58, $P < 0.001$). The mean (std dev) maximum and minimum temperatures recorded in Room 1 were 23.7°C (1.39) and 21.2°C (1.71), and in Room 2 were 25.6°C (1.78) and 21.6°C (1.66), respectively.

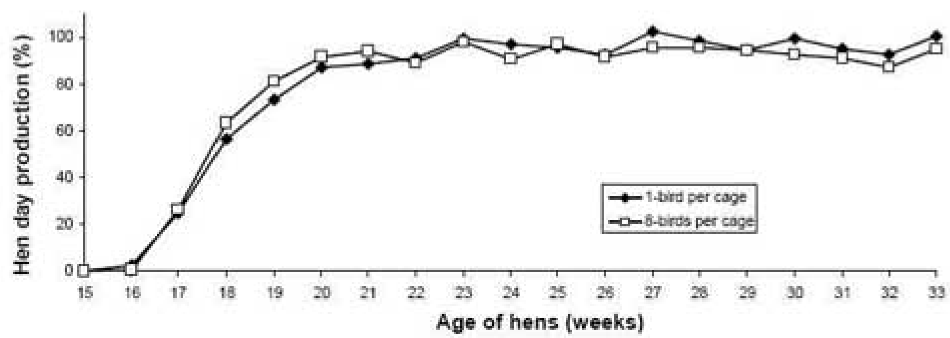

Figure 1 Hen day production per week for the two group size treatments.

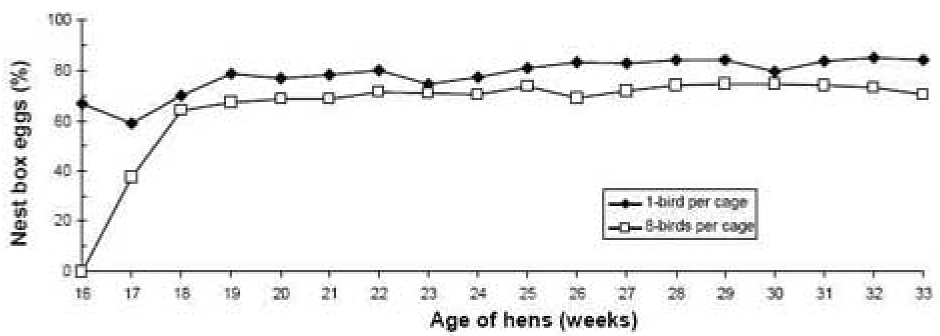

Figure 2 Proportion of eggs per week laid in nest boxes in the two group size treatments.

IV. DISCUSSION

The proportion of nest box eggs recorded for group-housed hens in the present experiment was similar to findings in our previous experiments using the same cages and similar Hy-Line Brown birds (62%, Barnett and Cronin, 2005; 70%, Cronin et al., 2007). Nevertheless, the proportion was lower than overseas studies by Tauson and Holm (2005), in which almost 100% nest box eggs were reported using cages of the same design as the present experiment. Sherwin and Nicol (1993) and Friere et al. (1997, 1998) have suggested that social factors contribute to hens laying outside the nest box. The results of the present experiment support this suggestion. Group-housed hens laid proportionally fewer eggs in the nest box than singly-housed hens. We did not video record bird behaviour in this experiment and thus are not able to conclude whether those group-housed birds that did not use the nest box were subordinate, as suggested by Shinmura et al. (2007). If subordinate birds avoid using the nest box, Appleby et al. (2004) recommended increasing the nest box floor area. Whether this 0 20 40 60 80 100 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 Age of hens (weeks) Hen day production (%) 1-bird per cage 8-birds per cage 0 20 40 60 80 100 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 Age of hens (weeks) Nest box eggs (%) 1-bird per cage 8-birds per cage Aust. Poult. Sci. Symp. 2009...20 151 would be effective requires testing. For example, subordinate hens may not enter the nest box if a dominant is near the entrance or inside the nest box. Potentially a second entrance or two separate nest boxes per cage might be required. While the cages in the present experiment were designed for eight birds, Appleby (1984) stated that ratios of up to eight birds per nest box were used in industry for breeder flocks. In the latter situation however, larger groups of hens and multiple nest boxes were involved, providing hens with a choice of nest boxes.

An interesting result in this experiment was the lower incidence of nest box eggs from cages in Row 4. Rows 1 and 4 were mirror images and were equidistant (~1.2 m) from the shed's outer east and west walls, respectively. While the recorded mean maximum temperatures between the rooms differed by less than 2°C averaged over the experiment, Row 4 faced west and may have received radiant heat from the afternoon sun (although the shed wall was insulated). Nevertheless, how this would affect choice to lay in the nest box, which typically occurs in the morning, is unclear. Other possibilities are that hens were affected by other (human?) activities in Row 4 within the shed, or by noise from outside the shed (human, livestock, nocturnal animals). Whilst there was a laneway for moving cattle or sheep outside the west of the shed, it was rarely used during this experiment. In conclusion, while social factors strongly contributed to hens not laying in the nest box, it was apparent other (unknown) factors also influenced birds' choice of egg-laying site.

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