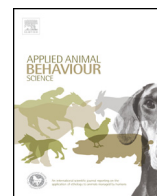




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Evidence of competition for nest sites by laying hens in large furnished cages



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ABSTRACT

Furnished cages are designed to accommodate behaviour considered important to laying hens, particularly nesting behaviour. Few researchers have studied the degree of competition for nest sites or the extent to which the amount of nest space affects nesting behaviour in large furnished cages. We explored the effect of floor (low 520 cm²/bird, high 750 cm²/bird)/nest space allowance (low 70 cm²/bird, high 100 cm²/bird) and overall cage/nest size (small 20,880/2816 cm²; large 41,296/5664 cm²) on the nesting behaviour of hens in furnished cages. There were six replicates per size × space allowance combination and four resultant group sizes of 28, 40, 55, and 80. Each cage was equipped with a nest located at one end that was fitted with plastic curtains and plastic mesh floors; a smooth plastic mat intended as a scratch area was located on the opposite cage wall. The location of each egg laid within the cage, oviposition times, pre-laying sitting and agonistic behaviours were recorded at various times during the production year. More eggs were laid in the nest area in small cages (91.7 ± 0.2%) than large (77.2 ± 0.5%; $P < 0.001$), with no significant effect of space allowance ($P = 0.46$). Most of the remaining eggs were laid in the scratch area in all treatments. The average peak oviposition time was from 08:00 to 09:00 h (lights on 05:00 h), but the distribution of eggs laid over time differed with nest location ($P = 0.02$) and cage/nest size ($P = 0.02$). There were more aggressive pecks (0.087 ± 0.010 vs. 0.045 ± 0.005; $P = 0.004$) and threats (0.032 ± 0.005 vs. 0.014 ± 0.002; $P = 0.02$) per bird per 30-min observation in small than large cages with no effect of space allowance ($P = 0.236$; $P = 0.15$). More pecks and threats occurred between 08:00 and 08:30 h than the other three time periods, which coincided with the peak oviposition time. Hens in small cages, with low floor and nest space allowance per bird, showed the highest average frequency of agonistic behaviour per bird compared to the other three treatment groups ($P = 0.04$). Nesting behaviour was mainly affected by cage/nest size but not floor/nest space allowance. Differences in cage design or group size may be factors influencing increased competition for nest space. The birds in the smaller cages appeared to be more willing to aggressively compete to lay their eggs in the curtained nest area while more birds in larger cages chose to lay their eggs in an alternative location. Further behavioural research will be able to determine how best to satisfy nesting motivation of hens housed in large furnished cages.

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1. Introduction

Numerous studies have shown that hens actively pursue enclosed spaces in which to lay their eggs (Woodgush and Murphy, 1970; Freire et al., 1997); they will squeeze through narrow gaps (Cooper and Appleby, 1996), and push through weighted doors to access a nest box (Cooper and Albertosa, 2003), and even learn how to open doors to re-appropriate dust baths for nests (Smith et al., 1993). In the absence of a suitable nesting environment, hens may exhibit stereotypic pacing behaviour (Duncan, 1970; Woodgush, 1972), an extended searching phase (Woodgush, 1972; Freire et al., 1996), and little to no sitting prior to oviposition (Sherwin and Nicol, 1993). Disturbances during nesting may also cause hens to delay oviposition (Hughes et al., 1986; Freire et al., 1997). Nesting behaviour patterns that occur during pre-laying searching, sitting and oviposition, are therefore considered behavioural priorities, and it is generally accepted that resources, such as a nest, must be provided in order for hens to experience good welfare (Cooper and Albertosa, 2003; Weeks and Nicol, 2006).

Furnished cages were originally modified conventional cages (i.e. Edinburgh Modified Cage) that included a nest box to support the sitting/oviposition phase of nesting for small groups of hens (Appleby and Hughes, 1995). Over time, furnished cages have become much larger, housing upwards of 100 hens in some designs. Compared to smaller designs, large furnished cages provide more space overall that may better support the searching phase of nesting. However larger group sizes also mean that more hens must share a restricted number of resources resulting in increased competition for them (Shimmura et al., 2008a,b); often, only a single nest is provided for a large group of hens.

The number of eggs laid in nests is often considered to be an indicator that nest design is perceived as attractive by hens (Wall, 2011) and is sometimes used as an indicator of hen welfare (WelfareQuality®, 2009). Although nests in furnished cages are generally well used (Tauson, 2005), there can be a considerable number of eggs laid outside of the nest, often in the scratch area, which increases the risk of cracked or dirty eggs (Appleby, 1984; Guesdon and Faure, 2004; Wall, 2011). Previous research into egg-laying patterns attributes laying outside the nest to a number of factors: strain (Wall, 2011), early experience (Cooper and Appleby, 1995), an absence of attractive nest site features (Cooper and Appleby, 1996), a hen's lack of individual nest preference (Staempfli et al., 2011) and the presence of attractive nest-like features elsewhere in the cage (Wall, 2011). Competition may also influence nest site selection (Riber, 2010) as well as increase the amount of aggressive pecking at potential nest sites (Lundberg and Keeling, 1999). The amount of nest space required to prevent crowding has only been predicted for small groups of hens (up to 12) using a theoretical model to integrate a measure of simultaneous nesting dependent on times of oviposition in groups of hens (Appleby, 2004). Currently, there is little information regarding the amount of nest space required for large group sizes housed in furnished cages. Furthermore, within the EU guidelines, there is no indication of the recommended nest space allotment that

Table 1

Factorial design of the two cage size (large and small) and two space allowance (low and high) treatments. The resultant group sizes, floor space allowance per bird, nest space allowance per bird, scratch mat space allowance per bird, and feeder space per bird are presented.

Group size	Cage size	
	Large	Small
Floor space (cm ² /bird)		
Nest (cm ² /bird)		
Scratch mat (cm ² /bird)		
Feeder (cm ² /bird)		
Space allowance		
Low	80	40
	516.2	522.0
	70.8	70.4
	31.3	62.5
	8.9	9.0
High	55	28
	750.8	745.7
	103.0	100.6
	45.5	89.3
	12.9	12.8

should be provided per hen, or of a limit on group size (European Commission, 1999).

The purpose of the study reported here was to investigate the impact of cage size and space allowance on nest use and nesting behaviour of hens in large furnished cages. This study was part of a larger project investigating the effects of space allowance and cage size on production, behaviour, and welfare of hens (Widowski et al., 2014). It provided an ideal opportunity to examine nesting behaviour in group sizes ranging from 28 to 80 hens when they had either 70 cm² or 100 cm² of nest space per bird in a single nest. Nesting behaviour patterns were investigated by measuring three main parameters: egg location, oviposition time, and behaviour (pre-laying sitting and agonistic behaviour). We hypothesized that space allowance of nests would affect nesting behaviour and predicted that hens in low space allowance cages with less nest space per hen would lay more eggs outside of the nest, in the scratch area, and would show more agonistic behaviour. We also predicted that crowded nests, in cages with lower space allowance, would result in more eggs laid later in the morning.

2. Materials and methods

2.1. Animals and housing

Lohmann Selected Leghorn (LSL) Lite hens were housed at 18 weeks of age in two different furnished cage sizes [large (41,296 cm²) and small (20,880 cm²)] and at two different floor space allowances [low (520 cm²/bird) and high (750 cm²/bird)] creating a factorial experiment with four treatment combinations and group sizes (Table 1). Each treatment was replicated six times. Each row of cages had three vertical tiers consisting of one small and one large cage sharing a solid wall (Fig. 1). Cages were divided between two rooms (numbered 16 and 17), each with two rows of cages, for a total of 24 cages housing 1218 hens; the arrangement alternated between rooms (i.e. small cages were closer to the door in room 16 and large cages were

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