Applied Animal Behaviour Science xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Nest alternatives: Adding a wire partition to the scratch area affects nest use and nesting behaviour of laying hens in furnished cages

Michelle E. Hunniford*, Tina M. Widowski*

Department of Animal Biosciences, University of Guelph, 50 Stone Road East, Guelph, Ontario N1G 2W1, Canada

ARTICLE INFO

Article history:
Received 8 June 2016
Received in revised form 5 October 2016
Accepted 27 October 2016
Available online xxx

Keywords:
Nesting
Behaviour
Furnished cage
Layer
Cage design

ABSTRACT

Furnished cages (FC) are designed to accommodate highly motivated behaviour patterns like nesting; however, how hens perceive the resources provided in FCs is not fully understood. Our previous research of hens in FCs with a curtained nest (plastic mesh floor) and a scratch area (smooth plastic floor) indicated that hens laid more eggs outside of the nest in a design of FC that had a wire partition bisecting the scratch area. The objective of this study was to compare the egg laying behaviour of hens in the same FCs either with (W) or without (NW) the wire partition. Forty-eight groups of LSL-Lite hens (six hens/group) were each transferred from conventional cages into one of 12 FC for 5 days when they were between 20 and 23 weeks of age. Twelve new groups were observed each week over 4 weeks and treatment (W, NW) alternated between FCs each week. Egg location was logged for 5 days. Hens in top-tier cages (N = 16 groups, 96 hens) were individually identified and video recorded for 3 days. Behaviour performed in both the nest and scratch areas during the hour pre-lay was scored for hens with visible ovipositions (N = 15 groups, 55 hens). Egg location and behaviour patterns were analyzed using a mixed model ANOVA; day within week was the repeated measure. More eggs were laid in the scratch area in W (18.3 ± 1.8%) compared to NW (7.3 ± 1.3%; $P < 0.0001$). Hens in the W treatment entered (38.5 ± 5.0 vs. 19.6 ± 3.1; $P = 0.033$), spent more time in (8.0 ± 0.8 min vs. 3.5 ± 0.5 min; $P = 0.003$), and searched the scratch area more than NW treatment hens (15.2 ± 1.6 min vs. 6.1 min ± 1.2; $P = 0.006$). Hens in the NW treatment entered (26.1 ± 1.6 vs. 18.6 ± 1.7; $P = 0.016$) and spent more time in the nest (27.4 ± 1.8 min vs. 15.7 ± 2.0 min; $P = 0.001$), were more aggressive (28.5 ± 3.7 vs. 18.2 ± 2.9; $P = 0.032$), and performed more displacements than W hens (6.4 ± 0.8 vs. 3.0 ± 0.5; $P < 0.0001$). Adding a simple wire partition to the scratch area resulted in more eggs being laid outside the nest, but facilitated more settled nesting behaviour. Hens in FCs may benefit from providing more than one enclosed area for nesting that is distinct from the scratch area.

1. Introduction

Furnished cages (FC) were originally developed to support the behavioural needs of laying hens: perching, foraging, dustbathing, and nesting. Nest design in furnished cages has evolved from one discrete nest *box* for a small group of hens (e.g. the Edinburgh Modified Cage, Appleby, 1990; a nest added to existing conventional cages, Appleby and Hughes, 1995) to a larger, communal, curtained nest area that accommodates multiple hens in larger groups. In non-cage housing systems, there are negative consequences, both for egg quality and for hen behaviour, when hens lay outside of the nest (lost eggs, egg eating, and cloacal cannibalism, Gunnarsson et al., 1999; increased bacterial load, Jones et al., 2014). Egg laying on the scratch mat of furnished cages can also be problematic as it can lead to more cracked and dirty eggs (Wall, 2011; Guinebretière et al., 2012) and it may interfere with foraging or dustbathing. Some furnished cages are reported to have very high nest use (95% in Wall, 2011), while others have more variable nest use due to a variety of factors: cage design or group size (44% in 15-hen FC vs. 68% in 7-hen FC; Guesdon and Faure, 2004), strain (46% Hy-line Brown vs. 83% Lohmann Brown; Wall, 2011), cage design or cage size (77% in large FC vs. 92% in small FC; Hunniford et al., 2014), rearing environment (90% cage-reared vs. 82% aviary-reared; Hunniford and Widowski, 2016). Hens may lay outside of the nest for a number of reasons: insufficient nest space, inadequate nest design, or alternative attractive nest sites. Because FCs have been criticized for not fully supporting hen behaviour when that is one of the main goals of FC design (Rodenburg et al., 2008; Weeks and Nicol, 2006), it

* Corresponding authors.
E-mail addresses: mhunnifo@uoguelph.ca (M.E. Hunniford), twidowsk@uoguelph.ca (T.M. Widowski).

http://dx.doi.org/10.1016/j.applanim.2016.10.018
0168-1591/

is important to determine why hens may or may not use nests in some designs of furnished cages.

Research has repeatedly shown that hens look for, and will work for, two main features of a nest: enclosure (Appleby, 1990; Blokhuis et al., 2007) and surface characteristics (Struelens et al., 2005, 2008). Hens will not only perform work for a desirable nest (e.g. push a weighted door; Kruschwitz et al., 2008), they will also interact and compete with other hens for nests. Freire et al. (1997) showed that subordinate hens would pass by dominant hens, with increasing frequency as oviposition approached, to access an enclosed nest site. The authors concluded that the subordinate hens' motivation exceeded the social barrier posed by the dominant hens. Lundberg and Keeling (1999) found that hens were less likely to stay at a nest site if they received more aggressive pecks from other hens, but stayed longer at the nest site if they gave more aggressive pecks. Interestingly, the nest sites that inspired the most competition among hens were the corners of the pen, and not the actual nest area. Therefore, if the nest features that hens find desirable are present in other areas, then alternative nest spaces may be created unintentionally. For example, Guesdon and Faure (2004) investigated one type of furnished cage with both a nest and a dust bath: the nest had a mesh surface and one small entrance while the littered dust bath had two solid walls and was open during the laying period. Hens laid an equal number of eggs in both areas (43%), indicating that they perceived both the actual nest and the dust bath as attractive nest sites.

The percentage of eggs laid at a nest site is an indicator of nest use, but high nest use does not necessarily correlate with settled nesting behaviour (Hunniford et al., 2014); therefore, nest use may not be the best indicator of appropriate nest design. Pre-laying behaviour may be a better indicator of good nest design in furnished cages than nest use alone. Pre-laying behaviour has two main phases: searching and sitting. Hens may perform variations in their pre-laying behaviour patterns depending on the nesting resources provided. Settled nesting behaviour has been most commonly measured when hens are housed singly and have free choice of nests (Cooper and Appleby, 1997; Sherwin and Nicol, 1993). Settled nesting has been associated with a shorter searching phase (Freire et al., 1996; Struelens et al., 2008), fewer nest entries (Appleby and Hughes, 1995; Freire et al., 1996), more time spent at the final nest site (Appleby, 1990; Cooper and Appleby, 1995), and an uninterrupted sitting phase (Freire et al., 1996; Cronin et al., 2012). Settled nesting has also been defined as fewer nest visits without an oviposition (Stämpfli et al., 2011). Aggressive behaviour is one indicator of unsettled nesting, which may occur when nesting resources are inadequate/absent (Hughes, 1979) or when there is competition for limited desirable nest sites (Lundberg and Keeling, 1999). Behavioural indicators like these can be used to assess whether a nest is designed appropriately, with the goal of providing nest resources that result in hens performing more settled nesting behaviour.

In two previous experiments, hens housed in smaller (30-bird) cages had significantly different laying patterns than hens in larger (60-bird) cages (Hunniford et al., 2014; Hunniford and Widowski, 2016). There was higher nest use in the smaller cages, and more eggs were laid in the scratch area in the larger ones. However, higher nest use in small cages was also associated with higher levels of aggression during the pre-laying period (Hunniford et al., 2014). These results demonstrated that there was increased competition for nest space in small cages but not in large cages. These results may have been caused by differences in cage size or cage design. Although the cage designs were otherwise nearly identical, there

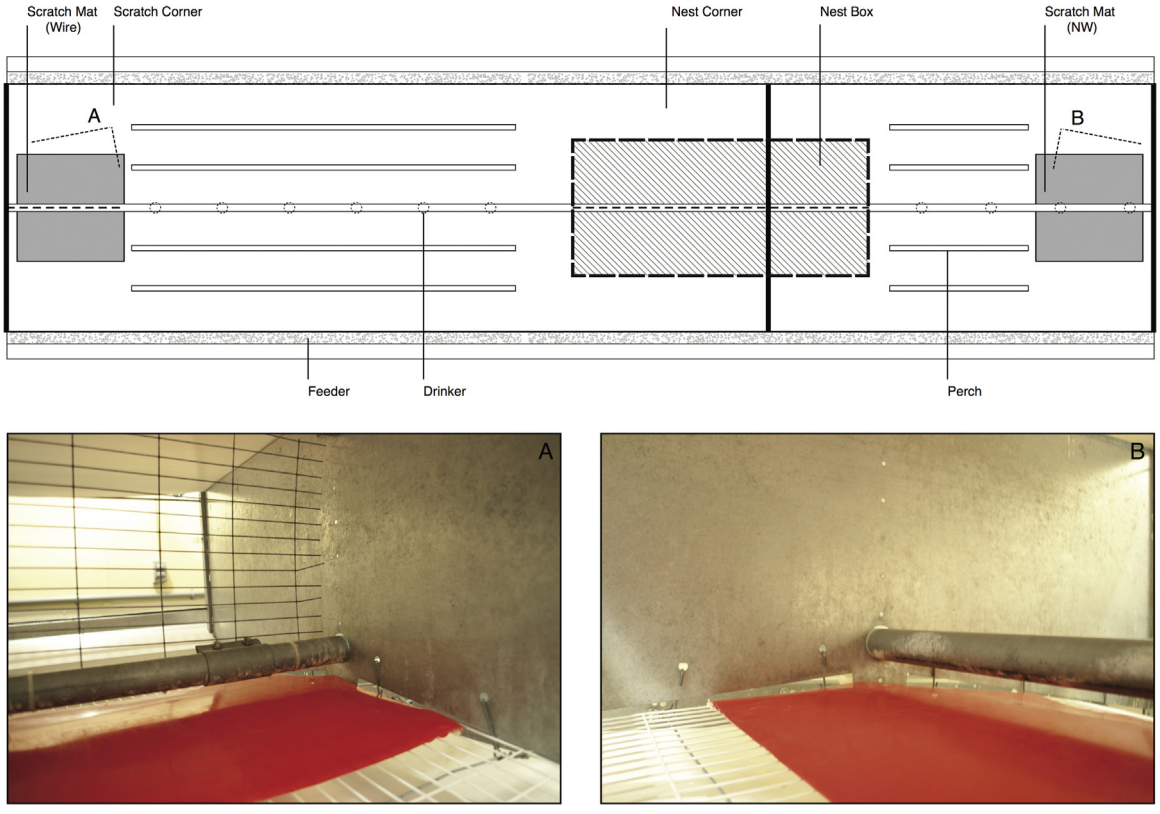

Fig. 1. Top: Top view diagram depicting one sample tier of cages with one small (right, NW) and one large cage (left, W). The scratch areas have been labeled to correspond to the photos below. Bottom: The scratch area surface was smooth plastic and was the same surface area in all cages (2500 cm^2): the Wire treatment (A) had a wire partition attached to the auger that bisected the scratch area and extended to the ceiling of the cage (50 cm × 46 cm); the NW treatment (B) did not have a partition. (Top diagram is adapted from Hunniford et al., 2014).

Please cite this article in press as: Hunniford, M.E., Widowski, T.M., Nest alternatives: Adding a wire partition to the scratch area affects nest use and nesting behaviour of laying hens in furnished cages. Appl. Anim. Behav. Sci. (2016), http://dx.doi.org/10.1016/j.applanim.2016.10.018