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The effect of ramp provision on the accessibility of the litter in single and multi-tier laying hen housing

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ABSTRACT

Level changes in commercial laying hen loose-housing systems may be physically difficult for birds to negotiate, preventing or limiting access to resources such as the litter area and the outdoor range, and potentially increasing injury risk. The aim of this research was to investigate bird behaviour at an important level change (traversing between the raised slats/first tier and the litter), and whether it was affected by ramp provision or system. Birds were either observed at the edge of a single-tier with a full width ramp (ST-R), or at a section of tier edge without ramp in multi-tier systems (MT-NR) or in single-tier systems (ST-NR), both equipped with no ramps or only intermittent ramps throughout. Compared with single-tier systems, a greater proportion of birds that showed an initial orientation towards the litter moved away without traversing in the MT-NR group ($p < 0.05$). Traversing birds in group ST-R showed reduced incidences of behaviours indicative of hesitancy/difficulty. The behaviours that occurred significantly less frequently in group ST-R compared with both groups MT-NR and ST-NR were crouching ($p < 0.01$), multiple crouches ($p < 0.01$), pacing ($p < 0.05$) and stepping on the spot ($p < 0.01$). Multiple head orientations were lower in ST-R compared with ST-NR ($p < 0.05$). We conclude that the provision of a full-width ramp between the raised slatted area in single-tier systems or first tier in multi-tier systems could improve bird welfare by increasing the ease of access to important resources.

1. Introduction

Hen welfare is of increasing interest to consumers, and legislation to reduce the number of birds kept in restrictive cage systems can now be found worldwide. For example, following the ban on conventional cages for laying hens in the EU in 2012 (Council Directive 1999/74/EC) 49% of UK egg production now comes from loose-housing systems (DEFRA, 2016).

Commercial loose-house systems for laying hens vary widely in design but two fundamental types can be distinguished, both with littered areas at ground level. Single-tier systems have one raised slatted area on which the birds can access nestboxes, food and water. In multi-tier systems (also known as aviaries) the slatted areas are usually up to three tiers high with resources available on each of these different levels. Either system may have additional outdoor access (free-range) by providing popholes to the range, which are most commonly accessed via the litter areas. It is therefore essential in all loose-housing systems that the birds are able to traverse level changes in the house effectively if they are to reach all of the available resources. In particular, the slats (or first tier) to litter level change must be negotiated by the hens if they shall have access to foraging material and often the outdoor range.

The importance of access to these resources for bird welfare is well-documented. Feather pecking is a serious welfare issue particularly in loose-housed laying hens and access to a suitable foraging substrate is of great importance in its prevention (Nicol et al., 2013). Additionally, dustbathing can be considered a behavioural need (Weeks and Nicol, 2006) and requires a fine, friable substrate for its full performance (Van Liere et al., 1990). To enhance welfare, various enrichment items and resources are frequently provided to commercial laying hens in both the indoor environment and outdoors (if free-range). The outdoor area can provide the opportunity for birds to express their full behavioural repertoire and has been shown to be beneficial to welfare through a reduced risk of feather pecking (Nicol et al., 2003).

Access to these important resources may be compromised if level changes in the house act as barriers that are physically difficult for birds to negotiate, inhibiting bird movement. If hens find the level change difficult, they may either injure themselves trying to traverse or choose to avoid traversing the level altogether, resulting in reduced behavioural opportunity through a restricted environment. Certainly, range use is highly variable and often low

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Fig. 1. Photograph of a single-tier system with full width ramp (ramp angle: 46°). An example section for behavioural observation has been marked on the image.

on commercial farms, with inhibited bird movement within the house highlighted as a potential causal factor (Pettersson et al., 2016).

Although the behaviour of birds traversing perches in experimental setups has been described (e.g. Taylor et al., 2003; Lambe et al., 1997) there is almost no information regarding the ability of birds to move between the slats, tiers and litter areas of a commercial single or multi-tier housing unit. Recent work on a lone multi-tier unit has shown that hen movement occurs in all areas of the system but whether all birds accessed all areas was unclear (Campbell et al., 2016a). Collisions and poor landings may occur, potentially leading to injury. Recent work found that 9.1% and 21% of observed flights failed in two multi-tier flocks (Campbell et al., 2016b). Previous research has shown that the risk of injury increases when birds have to jump a distance greater than 80 cm vertically or jump an angle between 45 and 90° (for a review see EFSA AHAW Panel, 2015). The shortest transition height to the litter from multi-tiers is similar to that in single-tier houses, but multi-tier systems may be more hazardous as birds can get up very high and are therefore more likely to fall from a height. Keel bone fractures sustained during the lay cycle are highly prevalent in loose-housed hens (Wilkins et al., 2004, 2011) and more so in multi-tier systems (Rodenburg et al., 2008, Käppeli et al., 2011).

Some producers provide ramps for the birds between the slats and litter in single-tier systems and the first tier and litter in multi-tier systems with the intention of aiding them to negotiate this level change. Providing ramps at different levels in multi-tier set-ups has been associated with reduced falls, collisions and keel bone fractures and greater controlled movement (Stratmann et al., 2015). These ramps or ladders may be intermittent, narrow structures along the edge of the slats or in some single-tier systems, comprise a full width ramp along the entire border of the slatted area with the litter (Fig. 1).

Movement in commercial houses is a research area of growing interest and importance, particularly in multi-tier systems (Stratmann et al., 2015; Campbell et al., 2016a,b). Stratmann et al. (2015)'s research was based on experimental pens within a commercial house and recent work by Campbell et al. (2016a,b) studied two flocks in one commercial house. Small scale studies cannot always be widely applied due to the variety of housing designs seen commercially. It is therefore important to study multiple houses and there remains a lack of research on bird movement on this scale. This study aimed to apply existing knowledge of bird movement and flight abilities to the commercial setting with a specific focus on behaviour immediately prior to changing levels. We studied the effects of house design, specifically single vs multi-tier housing, and ramp vs no ramp provision, on (i) the likelihood of birds completing a downward traverse to the litter area after initiation of a traverse, (ii) their behaviour prior to a traverse and (iii) the time taken to reach the litter after initiation of a traverse.

2. Methods

In total 16 commercial, free-range laying hen houses were studied when the birds were approximately 40 weeks of age. Twelve of the houses were visited on two occasions (at 40 weeks in different flock cycles) as part of a wider research project. All flocks were brown genotypes with an average flock size of 13,044 (see Table 1). Stocking densities were between 8 and 9 birds/m^2 in line with UK legislation. See Table 1 for a summary of house and flock information. The four multi-tier flocks were reared in multi-tier systems and all others in single-tier systems.

This study focused on the behaviour of birds as they approached the edge of the slats (or first tier) and oriented into a position where they could move down from the slatted area (or first tier) onto the litter area. The 16 houses were split into three groups based on their design. Group ST-R (n = 7) consisted of single-tier houses with a full width ramp across the entire slat-litter level change (as in Fig. 1). These ramps were made of plastic slats. Group MT-NR (n = 4) comprised multi-tier houses with intermittent or no ramps between the first tier and the litter. Group ST-NR (n = 5) consisted of single-tier houses with intermittent or no ramps between the slats and litter.

2.1. Behavioural observations

All observations were performed by the same observer. In each house three or four 2 m sections along the edge of the slats (or first tier) were randomly selected (see Fig. 1). Where intermittent ramps were present, a section with no ramp was chosen.

For each section, focal birds within this area were studied for 10 min. It was not possible to record all birds that moved down to the litter within the 10 min as multiple birds moved at once on some occasions. The number of focal birds studied therefore varied, although a limit of 10 were observed per section.

A focal bird was selected for observation if it entered the 2 m section and was facing the litter when a direct head orientation towards the litter was observed. The time from this head orientation until birds reached the ground ('Time to litter'), or moved away ('Time to move away') was recorded using a stopwatch. A bird was considered to have moved away if it orientated away from the litter and showed no further intention behaviours for 10 s (see Table 2).

The occurrences of behaviours preceding each traverse to the litter or move away were tallied. See Table 2 for an ethogram of the behaviours recorded in this study. The behaviours 'crouch' and 'head orientation' were precursors to a jump so two additional variables were calculated in order to pick up on birds that crouched or head orientated without jumping – the percentage of birds that performed 2 or more head orientations: "multiple head orientations", and the percentage that performed 2 or more crouches: "multiple crouches". For the ST-R group it was also noted whether the bird jumped/flew or walked down the ramp.

2.2. Analysis

All data were analysed using SPSS 23.

Data from focal birds from each section were combined and percentages of individuals that performed each behaviour were calculated for each house. Mean times to litter or times to move away per house were also calculated from all observed individuals.