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Indoor side fidelity and outdoor ranging in commercial free-range chickens in single- or double-sided sheds

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ABSTRACT

The ranging behaviour of broiler chickens kept in free-range housing systems remains poorly understood, despite access to the outdoor range being their main feature. We investigated the impact of allowing chickens to have range access on both sides *vs.* one side of the shed, using 24 flocks of approximately 40,000 Ross 308 chickens of mixed sex on one commercial farm across winter and summer. Sheds were identical and pseudo-randomly allocated to either double-sided (no modification) or single-sided (by keeping one side closed at all time) range access treatment. Flocks were first provided with range access from 15 to 17 and 21 to 27 days of age for summer and winter flocks, respectively. Live outdoor observations were conducted daily for the first week after first range access and every other day from the second week onwards until the day prior to depopulation (44 days of age), twice daily in each morning and evening during anticipated peaks of range use. Indoor side fidelity was also assessed by spray marking 320 chickens in total on the right- and left-hand side of the shed, one colour each side, and conducting two to four repeated counts of the colour-marked individuals in each location over the week following marking. Indoor count results showed that colour-marked chickens had 50% chance of being found on either side of the shed ($P < 0.001$ from a side preference), and therefore did not support the hypothesis that chickens show indoor side fidelity in commercial conditions. Consequently, we could not elucidate whether an individual chicken would cross to the opposite side of the shed to access the range. Winter flocks had infrequent range access and low number of birds on the range (49 ± 175 chickens outdoor at any one time). For summer flocks, the ANOVA model explained 72.5% of the variance, with the number of chickens observed on the range being affected by the interaction of treatment and age ($P < 0.001$); more chickens were observed on the range when range access was available on both sides of the shed compared to a single side, from the seventh day of range access onwards. Hence, shed design can limit ranging in broiler chickens during the period of high ranging activity. For double-sided sheds, the number of chickens on the range steadily increased until an average of 28% of the flock could be seen on the range at one time, by 44 days of age prior to depopulation.

1. Introduction

The ranging behaviour of free-range chickens remains poorly understood, despite access to the outdoor range being the main feature of this housing system. Free-range production has increased rapidly, driven by consumer perceptions of free-range housing as more animal-welfare friendly (de Jonge and van Trijp, 2013; Howell et al., 2016). However, free-range farms vary markedly in housing design, range design and management. There is still much to learn about the animal, housing and management factors that influence ranging behaviour in broiler chickens.

For instance, it is not known whether offering range access on a single side of the shed affects ranging behaviour compared to range access on both sides of the shed. Various mechanisms may result in increased ranging behaviour when range access is offered on both sides of the shed, such as an increased number of entry and exit points of the shed onto the range, often referred to as 'pop-holes', which is linked with increased range use in laying hens (Gilani et al., 2014), or a shorter distance to travel to access the range.

Broiler chickens may also be reluctant to move away from their 'home' environment in order to access the outdoor range. For instance, laying hens took longer to access a resource when they were required to pass or interact with an unfamiliar conspecific (Grigor et al., 1995). It has been hypothesised that chickens in large flock sizes, as seen in commercial conditions, remain within a limited 'home' area where they can recognise their neighbours and avoid or minimise agonistic

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interactions (McBride and Foenander, 1962). However, there has been evidence to disprove the theory of 'home' areas within commercial flocks of broiler chickens (Estévez et al., 1997), showing that they utilise large areas within commercial sheds (Preston and Murphy, 1989). Interestingly, Newberry and Hall (1990) showed that broiler chickens stayed in small 'home' areas but these areas move over time.

An additional feature of providing range access on both sides of the shed is usually a greater surface area for ranging. Broiler chickens increase space use when additional space is provided in larger pens (Newberry and Hall, 1990) or via an outdoor patio (Estévez et al., 1997); although such observations have not been investigated in flock sizes above 3000 individuals, which are most common on commercial farms. Broiler chickens are also motivated to access areas of low stocking density in controlled experiments (23 or 32 kg/m^2)(Buijs et al., 2011), and decreased stocking density was found to be linked to higher ranging behaviour in laying hens (Campbell et al., 2017).

We hypothesised that providing access to an outdoor range on two sides of the shed would result in more chickens using the range as compared to providing access on a single side of the shed. We also investigated the effect of a potential shed 'home' environment on ranging behaviour, hypothesising that chickens located in areas closer to the pop-holes would range more than chickens further away in the shed.

2. Materials and methods

This experiment was approved by the South Australian Research and Development Institute Animal Ethics Committee in accordance with the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

2.1. Site and subjects

The study was conducted on one commercial farm in South Australia with twelve sheds, grouped in blocks of six parallel sheds across two sites 1 km apart. Twenty-four flocks were studied across two replicates; 12 winter flocks and 12 summer flocks. All sheds had chickens from the same hatchery, same feed, and comparable management practices but with a different manager on each site. Placement of the chickens was made progressively over eight days, with placement day counted as day 0. Each flock contained approximately 39,740 Ross 308 broiler chickens placed at day-old, at a stocking density less than 34 kg/m^2 maintained through partial depopulation (also called thinning or first pick-up) of approximately 35% of the flock around 35 days of age. All sheds were identically built, 160 m × 16 m, with tunnel ventilation and cooling pads. Brooding occurred in the front half of the shed.

Each shed had separate 156 m × 17.3 m outdoor ranges on each side (*i.e.* double-sided), accessible through 14 pop-holes (3.8 m × 0.4 m) spaced every 3.8 m on each side, apart from one pop-hole which was located at the middle length between the cooling pads occupying the front 57.2 m of the shed. The range was fenced, with a fence shared across two adjacent shed range areas. Six 0.8 m high 12 m × 3.5 m rectangle horizontal shade cloth artificial covers were located on the range 6.1 m from the shed walls, and trees (1–2 m high at Site 1 and 1 m at Site 2) were present 12 m from the shed walls and spaced out approximately 5–10 m apart along the shed.

2.2. Chicken indoor side fidelity

To study whether broiler chickens maintain side fidelity or conversely move randomly between sides within the shed, 320 chickens in total on the right-hand side (n = 160 chickens) and left-hand side of the shed (n = 160 chickens) in ten summer flocks and nine winter flocks were marked either blue or green using livestock spray-paint (FIL Tell Tail, GEA, New Zealand) within four days prior to first range access (around 12 and 18 days of age in summer and winter flocks, respectively). The colour markings were randomly allocated between sides across flocks. Chickens were sampled from various locations in the shed to obtain a representative sample of the population, at regular intervals approximately 20 m apart, alternating between an alley within 1.3 m to the wall side, and another alley between 2.6 and 4.0 m from the wall side on each side (the 'alleys' being visible based on feeder and drinker lines spacing). Hence, the 50% of the shed floor surface in between each side was ignored as it was a less clear-cut area. Chickens were caught by corralling approximately 25–40 individuals at the sampling location using portable fences, then randomly picking up and marking 20 chickens with livestock spray-paint on the tips of their wings and top of the rump where most adult feathers were present at this age.

2.3. Pop-hole treatments

The sheds were allocated to either the double-sided pop-hole treatment without modification or to the single-sided pop-hole treatment by keeping one side closed at all times. Sheds were allocated to treatment groups to ensure an equal representation of treatments across sites. The sheds were oriented West-East, with pop-hole openings on the North and South sides. Single-sided pop-hole sheds were split equally between sides opening on the North or South sides across sites. Pop-hole opening times were automatically programmed but were at times manually overridden at the manager's discretion according to outdoor temperature forecast and feathering of the chickens. Chickens always ventured outside on their own will and were never forced outside.

2.4. Data collection

2.4.1. Indoor counting

In order to assess indoor side fidelity, live indoor observations were conducted twice within one week for winter flocks and every second day for one week for summer flocks, starting from the day after marking. One of three observers, blind to treatment, walked slowly to minimise disturbance in the middle of the shed and counted the number of marked chickens of each colour on one side of the shed. The 25% of floor space in the middle of the shed was ignored as this could not strictly be said to be on the right or left sides. The observer then walked back counting the number of marked chickens from each colour on the opposite side of the shed. Indoor counting was conducted after the outdoor count to avoid interfering with the number of chickens seen outside.

Chickens in 19 out of the 24 flocks were colour-marked due to some flocks being too young for marking at the time, with 54 counts conducted. However, in three of the summer flocks, chickens started feather pecking colour-marked conspecifics, with a strong bias toward pecking green-marked conspecifics. Hence, green-marked chickens were segregated in these flocks for animal welfare reasons, and data for these flocks collected after a feather pecking event (8 counts) were discarded as they were significantly lower than other data points for the number of non-segregated green-marked chickens recorded ($t_{(7)} = 2.33$, $P < 0.05$). This left 46 counts from 17 flocks: six summer flocks with full dataset of four counts, a summer flock with three counts, another summer flock with one count the day after marking, and nine winter flocks with full dataset of two counts. Other chickens were noticeably scared of the blue-marked conspecifics upon release, with a visible flight zone surrounding blue-marked conspecifics when they moved, but they appeared to settle the following day with no notable pecking marks on blue-marked chickens.

2.4.2. Outdoor counting

Live outdoor observations were conducted daily for the first week after range access was first permitted and every other day from the second week onwards until the day prior to depopulation (44 days of age). Observations were conducted twice daily at anticipated peaks of