Evaluation of space requirements of broiler chickens by analysis of their spatial distribution

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Introduction

Broiler producers across the world raise about 20 billion chicks each year and the stocking densities under which this production is achieved vary greatly between countries and husbandry systems. A major criticism of intensive husbandry in general is that it compromises animal welfare by providing insufficient space per animal [1]. However, for broiler chickens it has recently been claimed that environmental circumstances may be of greater importance [2]. The spatial requirements of broiler chickens have most often been studied by looking at the adverse physical effects of high stocking densities (for instance decreased walking ability, increased contact dermatitis and mortality) or by studying changes in the behavioural repertoire. Studies on spatial distribution are scarce although they offer opportunities to investigate the animal's spatial preference more directly. For example, if close proximity of pen mates is experienced as aversive by broiler chickens, they may position themselves further away from their conspecifics when given the opportunity to do so [3] (thus, at lower stocking densities). Furthermore, it is important to study the spatial distribution in association with behaviour, as the type of behaviour being displayed depends on this distance [4].

In this experiment the spatial distribution of broiler chickens over their home pen was studied at different densities and in relation to behaviour. The aim was to determine the density at which the distance to the nearest neighbour became equal to the distance expected purely by chance. It was assumed that this point would be informative of the spatial requirement of group housed broiler chickens. In addition, the number of birds in each quadrant of the pen was assessed to study whether this simplified measure of distribution yielded similar results.

Materials and methods

Broiler chickens were housed at 8 different densities: 8, 19, 29, 40, 45, 51, 61 and 72 birds / 3.3 m^2 pen corresponding with 6, 15, 23, 33, 35, 41, 47 and 56 kg live weight / m^2 at the end of the rearing period (day 39). Males and females were mixed at a ratio of 1:1. To avoid clustering around resources, water cups and feeders were distributed evenly over all sides of each pen and no lamp brooders were supplied. The ambient temperature was 31° C at 1 day of age and was lowered by 1° C every 3 days until a temperature of 21° C was reached. Lights were on for 21 hours per day. In each pen, 8 focal birds were colour marked to allow individual recognition. Each density treatment was replicated four times.

Pens were filmed from week 2 to 6 for one day per week, using an automated digital recording system. Each pen was recorded for 5 minutes at a time, 6 times per day (twice each morning, afternoon and evening). The first image of each recording was used to determine the spatial distribution of the chickens in the pen. Images were calibrated to minimize the amount of distortion due to the wide-angle lens of the camera and coordinates of each bird were noted using customized software built in Halcon 7.1 (see Figure 1). From these coordinates, the distance between each bird and its nearest neighbour was calculated. These distances were compared to those acquired from simulations in which chickens positioned themselves regardless of their distance to other chickens. These simulations were created by taking random samples from all pooled combinations of XY-coordinates for the particular density, week and replicate in which the experimentally observed distribution was determined. The number of simulations was determined by the number needed to achieve a stable average distance. In addition, the number of birds in each quadrant of the pen was acquired and compared to an equal distribution of animal over the quadrants.

Behaviour was studied in two ways: a continuous focal sampling was carried out to assess the frequency, total duration and bout length of the different types of behaviour of one focal bird per recording. In addition, a scan sampling of the first behaviour shown was carried out on all 8 focal birds in each recording. Behavioural data from the scan sampling was linked to that of the spatial distribution to study the interaction between behaviour and inter-individual distance. In both cases, two ethograms were used simultaneously; one that documented the animal's posture and locomotion (stand, sit, lie, walk, run and adjust) and one that documented their activities (eating, drinking, ground pecking, agonistic behaviour, ground scratching, preening, dustbathing, leg stretching, head flicking, comfort behaviours (wing flapping, body shaking and tail wagging), displacing a chicken from the feeder or drinker, being displaced from feeder or drinker and "other" (all behaviour that did not fall into the previous activity categories)). The total number of behavioural transitions was calculated from the combined frequency of the other types of behaviour.

The results acquired using these methods will be presented at the conference.

References

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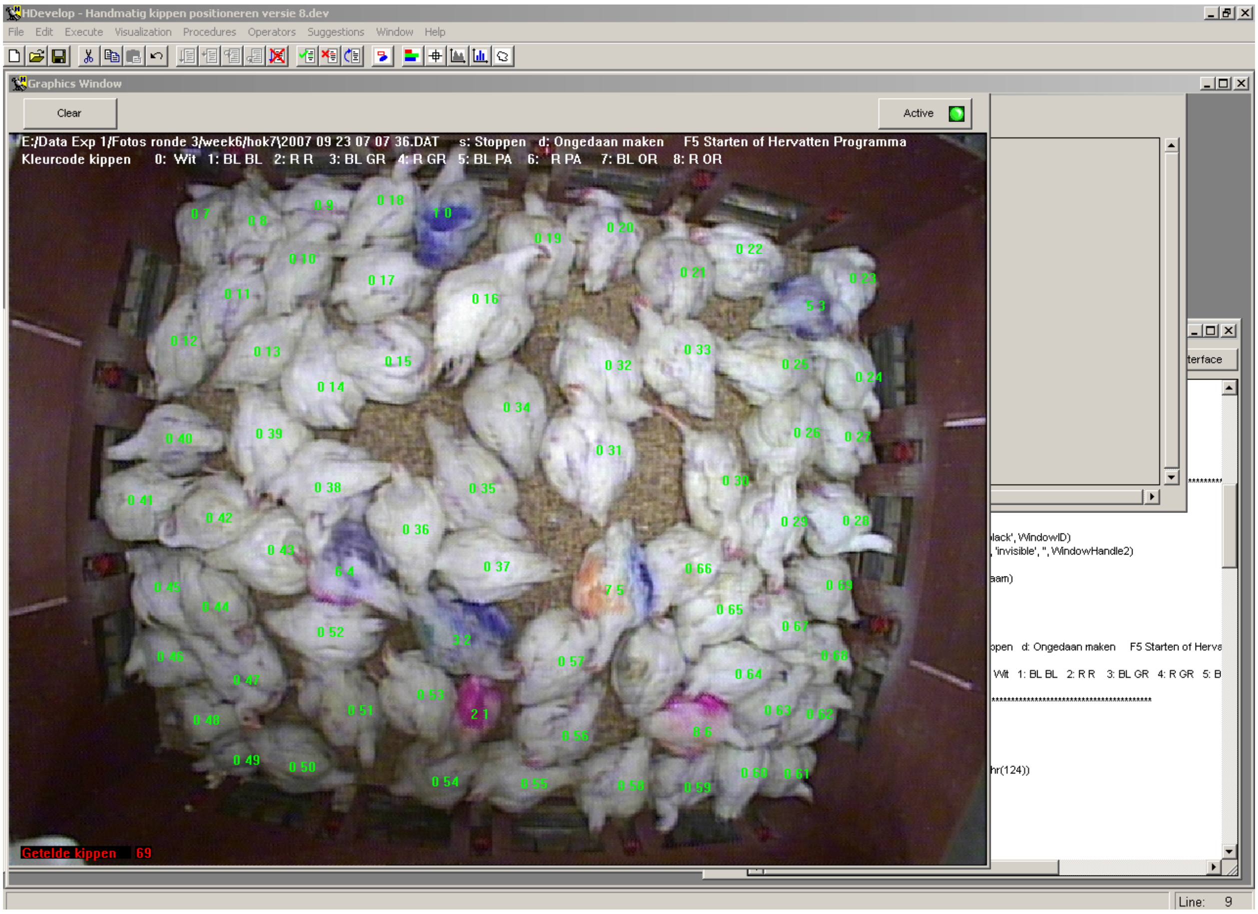

Figure 1. *The Halcon interface for the determination of the XY-coordinates of each broiler in the pen. The first figure of each number indicates the location on the bird where the coordinate was scored (i.e. centre of the animal).*