BRIEF COMMUNICATION: Assessing the behaviour of pastoral poultry in an integrated system on a commercial dairy farm

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Abstract

The aim of this study was to determine the ranging behaviour and dispersal patterns of layer hens on a commercial pastoral dairy farm. One thousand seven hundred and sixty layers housed across three different flocks varying in age and shed type were observed weekly. Their outdoor area was classified into three zones based on the distance from their shed. Hens in each zone were observed for one hour at dawn, midday and dusk. There was no effect of time of day on bird dispersal patterns, but when hens were outdoors, the effect of location was significant ($P<0.001$) with the majority (26.77%) of hens in the apron with the remaining visible hens observed in the outer range (21.99%) and mid-range (16.33%). In integrated pastoral systems with hens, management of hen excreta dispersal can be achieved through regular relocation of housing, feeders and water.

Keywords: free-range; flock; location; zones; integrated farming system

Introduction

As a result of Government legislation for better welfare conditions, the battery-cage egg-production system in New Zealand will soon be phased out, encouraging alternative egg-production systems such as free-range (MPI 2018). However, conversion from cage eggs to free-range may present other challenges such as access to land and unwanted environmental consequences as dispersal of excreta is shifted from an indoor managed area to soils in the outdoors.

For some producers, accessing land may present an opportunity to integrate with other farming enterprises such as ruminant production systems. By diversifying existing farming systems, there may be benefits to both enterprises, for example, hens in pastoral systems contribute to fertilisation, weed control, insect control, and scratching and separation of animal manure (Miao et al. 2005). Hens in pastoral free-range systems are unlikely to have fenced boundaries, as subdivision used for cattle and sheep will not limit hens, so voluntary stocking densities of hens in these systems are likely to enable their natural behaviour.

In New Zealand, the code of layer hen welfare (MPI 2018) stipulates that free-range hens have a maximum outdoor stocking density of 2,500 hens/ha (0.25 hens/m^2) with recommended best practice at no more than 900 hens/ha (0.09 hens/m^2, MPI code of welfare). While these stocking densities seem relatively low, the behaviour of hens would indicate that they are unlikely to randomly use all areas of a range. Campbell et al. (2020) found that 3% of free-range hens never ventured outside the shed while Pettersson et al. (2016) noted that hens from larger flocks limited their use of the range compared to smaller flocks. However, no study to date has investigated the behaviour and dispersal patterns of pastoral hens in an integrated farming system. Behaviour and dispersal patterns of hens has implications on soil nutrient load and on the range and subsequent environmental impacts if nutrients run off the land or leach into waterways. Therefore, the purpose of this research was to investigate the dispersal patterns of layer hens in a pastoral free-range system.

Materials and methods

Research Site

As part of a wider investigation into the impact of hens in ruminant pastoral systems, a case study approach was used for this research to document hen dispersal behaviour under large-scale, natural conditions. A relatively unique relationship between a dairy farmer and free-range egg producer has provided the platform to conduct the analysis. The owner of the poultry enterprise pays a lease ($/hen/year) to the dairy farmer who has permitted the housing of up to 1800 hens on his property. The dairy farm is located in Greenpark, Canterbury and has an area of 125 ha and supports 400 dairy cows in a conventional rotational grazing system. All paddocks on the farm are between 2.5 and 5.0 ha in size and are separated using permanent fencing material consisting of double wire electric fencing designed to contain cattle. The pastures are of variable age, established with perennial ryegrass and white clover pasture. The paddocks are rotationally grazed according to pasture growth and cow numbers.

The free-range enterprise consists of approximately 1,760 brown shaver hens over three flocks varying in size, age and shed management. The poultry farmer replaces each flock approximately annually, purchasing point-of-lay hens at 18 weeks of age and replacing them after 60 to 70 weeks of production. Consequently, the ‘batch’ buying of hens is a means of managing risk and generating age distribution across all three flocks. These flocks are then housed in sheds which are either fixed or mobile. Each shed (21 m^2 floor area) has perch space for up to 400 hens. Details of flocks and shed management are provided in Table 1.

The sheds were constructed of wood and used corrugated galvanised steel for a pitched roof. Each shed was furnished with perches and nesting boxes, the fixed

Table 1 Description of hen and shed management for the three flocks used in an integrated poultry and commercial dairy farm system between October 2020 and January 2021.

	Flock 1	Flock 2	Flock 3
Shed type	Stationary	Mobile weekly shift	Mobile 3 weekly
No. of sheds	1	2	2
Paddock area (ha)	4.6	2.6	2.6
Peak number of hens	360	600	800
Age of hens 9 October, 2020	25 weeks old	81 weeks old	48 weeks old
Flock replacement during observation period	none	19 November, 2020	20 January, 2021

shed had an inbuilt floor while the four mobile sheds were floorless. All sheds had openings (pop holes of 0.0045 m^2) cut into the walls to allow hens access to outside, as well as doors (1.8 x 1.4 m) which always remained open. The stationary shed had six pop holes, and the mobile sheds had four pop holes each. The four mobile sheds were built on skids and moved up to 20 m within the paddock every seven to 21 days by pulling the shed along the ground with a tractor. Two feeders, which had a holding capacity of 180 kg (0.9 m high and 0.46 m in diameter), were filled by the owner every four days, and were located within 10 m of each shed. Sufficient feed was always available in the feeders to allow *ad libitum* intake. Hens had access to drinking water through livestock reticulated trough water which were located within 100 m of all sheds.

Measurements

Observations reported here were collected between October 2020 and January 2021 (Lincoln University AEC 2020-23) to determine hen's behaviour. Weekly observations were carried out by observing each flock for 60 minutes at dawn, midday and sunset. Using the approach of Chielo et al. (2016), the area around the sheds were classified into distinct zones representing increasing distances from the shed and recording the number of visible hens in those zones. The zones were: the apron (0- 10 m from the shed); the mid-range (10-50 m from the shed); and the outer range (beyond 50 m from the shed). Flagged markers to the north, south, east and west of the sheds were used to identify the zone boundaries. There was always a large proportion of the flock inside the shed during the observations and, in the case of Flock 3, also inside a pump shed which was located within 50 to 100 m of the shed. The hens indoors were not counted. To account for the total number of hens in each flock, a combination of three methods where used: the number of hens that were purchased and the proportion remaining at slaughter, along with a general head count once per month, and by the hen-day egg production. Hens outdoors were counted by visual assessment and a video of the hens on the range was also used to ensure accuracy in the number of hens in each location.

Statistical analysis

A linear mixed-effects model was used to analyse the location of hens around the shed and range using: flock, time of day, location, season and their interaction terms as fixed terms in the model. Subject was fitted as a random effect to account for the repeated measures of observations. Statistical significance was set at $P<0.05$ and all data analyses were performed in STATA 12 (StataCorp, Texas, USA).

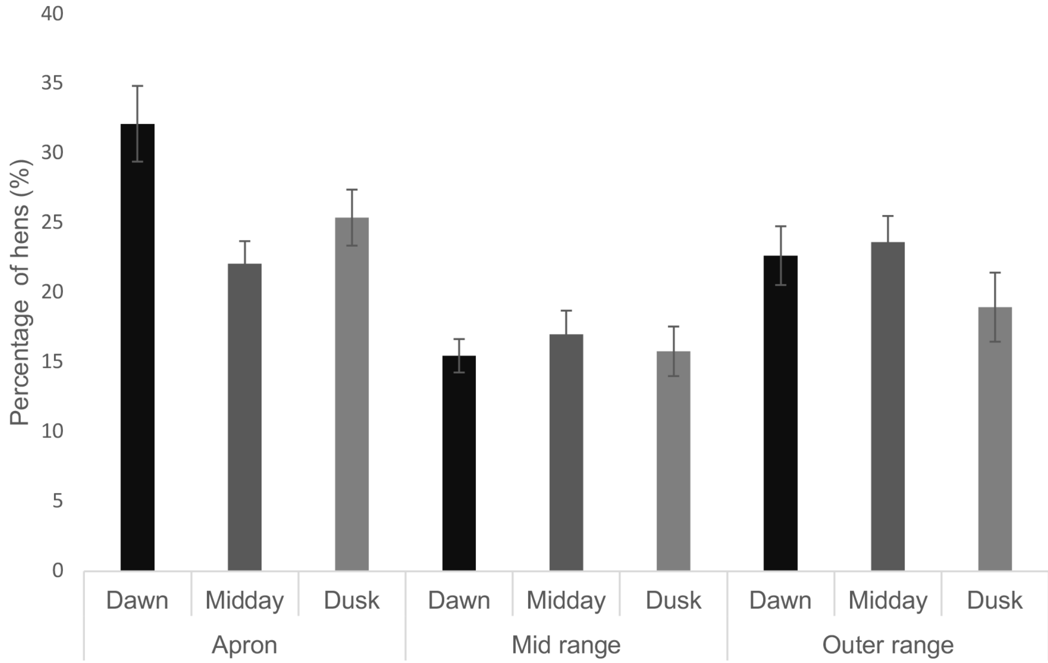
Results and discussion

Irrespective of flock-housing system, hens spent most of their time in and around the shed and feeder in the apron area as the proportion of hens in the mid and outer range was less than half the number of hens in each flock. During the morning, 45% of hens were in the mid and outer range, which declined to 40% and 30% of hens at midday and dusk (Fig. 1). Consequently, there were differences in the density of hens in these areas which were 0.325±0.235, 0.009±0.008 and 0.004±0.004 hens/m^2 in the apron, mid, and outer range respectively ($P<0.001$). These results agree with other research in commercial free-range laying systems where most of the hens were located close to the shed (Hegelund et al. 2005; Larsen et al. 2017) and fewer in the mid-range (Chielo at al. 2016). The low percentage of hens in the mid-range in the present study may be due to lack of overhead cover and, therefore, fear of predation from the local swamp harriers.

In this study, flocks varied slightly in their dispersal patterns across the mid-and-outer range depending on nearby enrichment (e.g., trees, feeders, troughs and other farm sheds). For instance, Flock 3 which had pine trees within 100 m of the shed, had a higher proportion of the hens located in the outer range compared with Flock 1 or 2 where most hens were observed in the apron ($P<0.01$, data not shown). Flock 1 hens in the stationary shed had the fewest hens further from the shed which suggests lack of motivation to roam either as a result of lack of cover or being a young flock they were still learning a new environment. These findings support the conclusions of Rault et al. (2013) who observed that variation in structures on the range attracted hens and encouraged wider distribution. Additionally, we also noted differences in behaviour associated with the age group of hens where young hens were observed less frequently in the mid-and-outer range compared with older hens ($P<0.05$). For maturing hens, increasing use of the range probably reflects growing familiarity with their environment (Campbell et al. 2020).

The findings from this study show that the use of

Figure 1 showing the mean percentage of hens in each location (apron, mid-range and outer range) at different time of the day (dawn, midday and dusk).



the range varies with different flocks. Hens outside the sheds were not evenly distributed on the range, with most of them located in the apron zone. Singh et al. (2016) recorded a higher-than-normal concentration of N, Ca and S required for pasture production on free-range poultry farms, with higher levels of Ca in flocks that have a fixed shed compared to ones with a mobile shed. Dispersal of hens, and therefore their excreta is not random. Hens staying close to the shed can contribute greatly to nutrient loading around the shed: having mobile sheds can allow for distribution of nutrients across the range. Consequently, the location of hens and stocking density is likely to impact nutrient loading, leaching and runoff and future research will need to evaluate these risks. The absence or presence food pathogens was not carried out in this study; this is an area for future research that will add confidence to consumers.

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