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A Place to Be? Use of Winter Gardens with and without Automatic Enrichment Devices by Laying Hens

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Abstract: Since the abolition of beak trimming in laying hens in Germany, the importance of adequate enrichment material to help reduce feather pecking and cannibalism has grown. Here we tested an automatic enrichment device dosing grain via rough-coated pecking plates (PPs) on an organic farm, comparing its offer in four winter gardens (WGs). Winter garden (WG) 1 served as the control area without an automatic enrichment device, while WGs 2–4 offered different quantities of PPs, with WG 2 offering double the amount of PPs as WGs 3 and 4. The number of laying hens (Lohmann Brown Lite) per m^2 and close to the enrichment device (one hen's body length around) was determined using photo records. The usage behavior of the hens differed in the four WGs and with the animals' age. Over the whole husbandry period (60 weeks), on average, 1.48 hens/m^2 were detected in the control area (WG 1), and a mean of 2.27 hens/m^2 in the enriched WGs. Compared to WG 1, the number of hens per m^2 was higher in WG 2 (2.43 hens/m^2) and WG 3 (2.59 hens/m^2) ($p < 0.05$), but similar in WG 4 (1.79 hens/m^2). At the end of the husbandry period, fewer animals (mean of all WGs: 1.43 hens/m^2) used the WGs than from beginning to the middle of the laying period (mean of all WGs: 2.05–2.15 hens/m^2; $p < 0.05$). Our data indicate that the automatic enrichment device positively influences the animals' use of the WG.

Keywords: laying hen; automatic enrichment; winter garden; behavioral observation

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1. Introduction

Since the ban on conventional cages for laying hens in the EU in 2012 [1], alternative husbandry systems offering the hens more space and additional free-range areas have increased in popularity. In 2020, 20% of laying hens in Germany were kept in conventional free-range systems, and 12% in organic systems, both of which offer a mandatory free-range area attached to the henhouse [2,3].

For German laying hen farms with access to a free-range area, it is regulated by law that a winter garden (WG) must be installed between the henhouse and the free-range area [4]. This area is defined as an additional part of the building with outdoor climate conditions and a littered floor. Moreover, natural light and, where necessary, artificial illumination is required [5]. In organic farms, the WG can only be counted to the usable surface per hen if it is accessible 24 h per day [6]. Hence, the WG may provide additional space and is suitable for performing species-specific behavior, such as foraging, scratching, and dustbathing.

The offer of additional space, especially an outdoor run, is a well-suited option to prevent welfare problems in commercial laying hen husbandry. Flocks with access to a free-range area or a WG (or both) show less severe feather pecking behavior than conspecifics kept exclusively indoors [7]. Moreover, birds using the outdoor run more frequently show less feather pecking behavior [8,9]. However, not all hens use the additional outdoor area. A review by Pettersson et al. [10] of 14 scientific papers researching range-use found rates of hens in the free-range area ranging between 9% and 70.5%, depending on the different methodology used.

A WG may serve as a transit zone as it resembles the henhouse and introduces the hens to the outdoor conditions. Therefore, the WG could ease the transition to the free-range area. Icken et al. [11] reported between 38% and 54% of a flock using the offered WG and staying outside for an average of 1:29 h to 2:20 h per day. In another study, up to 90% of 257 hens visited the WG at least once per day [12]. Thus, even the exclusive offer of a WG can motivate the hens to go outside. Moreover, a WG can enrich the laying hens' environment by offering additional enrichment material.

Nevertheless, even in those husbandry systems perceived as animal friendly, behavioral disorders occur, such as feather pecking and cannibalism [13,14]. In addition to welfare aspects, increasing illness and mortality rates [15], as well as lower egg production rates [16] and increased feed intake [17] can also result from these behavioral problems and causing economic losses for the farmer. The occurrence of severe feather pecking resulting in plumage damage and injuries is higher in flocks with untrimmed beaks than in those with trimmed beaks [7,18]. Since beak-trimming in laying hens was abolished in Germany in 2017, the demand for measures that increase hens' welfare remains high [19].

The reasons and the likelihood of developing behavioral disorders are multifactorial. Not being able to perform behaviors that animals have a high motivation for causes stress [20]. Feed and husbandry and management conditions (e.g., the lack of dustbathing and foraging material) are further influencing factors [16,21,22]. Hence, developing feather pecking and cannibalism can be seen as misdirected exploratory or foraging behavior [23,24] and as a strategy to cope with stress and fear [25,26]. Different approaches for the reduction of these behavioral disorders exist. One approach focuses on animals that are better adapted to the environment in husbandry systems. Genetic differences also contribute to developing feather pecking under husbandry conditions [27]. Another approach is to improve the animals' environment. In addition to demand-orientated feeding [28], environmental enrichment plays an important role in these efforts [29].

A basic requirement in an enriched environment is offering an adequate amount of dry and scrapable litter, which fulfills the hens' need for dustbathing [30]. Other environmental enrichment attempts deal with the hens' need to forage by offering materials they can peck and scratch. Even when offered food ad libitum, hens still have a high motivation to show foraging behavior [31]. Environmental enrichment that rewards the hens with food has been shown to positively affect laying hen behavior more than measures that can just be pecked at [29,32]. The use of materials, such as pecking blocks and alfalfa hay bales, was shown to reduce severe feather pecking [22]. Pecking blocks and roughage, such as alfalfa hay or hay bales, are the most commonly used enrichment materials in Germany [33], but those materials can only provide enrichment to a limited number of hens simultaneously [34] and require continuous time and labor to ensure permanent supply. Therefore, automatic enrichment devices may be an alternative as they provide material to many animals at the same time. Previous studies on automatic enrichment devices providing maize silage in the WG [35] or in the scratching area inside the henhouse [36] already revealed that such systems are well suited to environmental enrichment and result in a higher frequency of hens using the area where the enrichment material is offered.

The present study evaluated an alternative approach for an automatic enrichment device in the WG. An enrichment device where pecks on a rough-coated plate correlate to the dosage of grains provided was installed. The acceptance of the device and its influence on the use of the WG by the laying hens were studied under on-farm conditions. We hypothesized that laying hens use a WG equipped with an automatic enrichment device more intensively than a WG without that equipment, and the area around the device would be well frequented.

2. Materials and Methods

2.1. Animals and Housing

Data collection took place on an organic laying hen farm in Germany with 11,993 laying hens (Lohmann Brown Lite, Lohmann Tierzucht GmbH, Cuxhaven, Germany) kept after standards of the organic association "Naturland" [37]. The pullets were reared on an organic rearing farm in groups of 4100 pullets for 18 weeks. During the rearing period, the pullets were offered alfalfa hay bales and pecking blocks indoors and wood shavings and straw in the WG, which was accessible from the age of 7 weeks on. In August 2019, at the age of 129 days, the pullets were moved to the laying farm and were split into four groups (about 3000 hens each) housed under the same conditions in four separate units in the same henhouse. Each group had access to a WG and a free-range area. Each WG covered an area of 3.20 m × 50 m (160 m^2) and served as a transit zone from the inner henhouse to the free-range area. It was accessible during the light period of the day (at minimum from 9:00 to 20:00). The free-range area opened at 10:00 latest, and on ten of the evaluated days, it was closed due to bad weather to protect the animals' health condition. Two of the winter gardens (WGs) (3 and 4) faced the eastern direction, the other two (1 and 2) faced the western direction. The litter in the henhouse and the WGs consisted of straw pellets. In the free-range area, 4 m^2 of grassland per hen was available, with additional poplar avenues offering shade and protection against predators. Each WG had ten outlets of 2 m width towards the henhouse and ten outlets of 2–4 m width enabling the hens to enter the free-range area.

Visits for data collection took place at week of life (LW) 19, 24, 28, 31, 35, 41, 54, 62, 70, and 77. Transport to slaughter took place at LW 78 in October 2020.

The automatic enrichment device (PickPuck, Big Dutchman International GmbH, Vechta-Calveslage, Germany) used in this study was installed in WGs 1–4 of the henhouse (Figure 1a). The device consisted of a silo with a 6 m^3 capacity that was placed in the anteroom of WG 1. From the silo, a pipe system was installed below the roof of the WGs and went around the henhouse. Inside the pipeline, a chain with driving plates was used to transport material from the silo through the henhouse. In WG 2–4, at regular distances (approximately 7.2 m/3.6 m), a downpipe ended in a mechanism dosing the material to a pecking plate (PP) hung below. In WG 1 no such downpipes and pecking plates (PPs) were installed. The plate was rough-coated and swung free on a pendulum that influenced the material dosage onto the plate (Figure 1b). Harsh movement on the plate caused more material to be dosed, so that the hens could influence the dosage by pecking. During the observational periods, the downpipes were filled with grain, enabling the hens to access the material ad libitum from the enrichment device. The dosing mechanism could be adjusted in three steps. During the study, step two for pellets or bigger grains was used, as this enabled a precise dosing of the grains. The automatic enrichment device was installed following the manufacturers' recommendation of one downpipe with PP for 500 hens, approximately every 7.2 m, in WG 3 and 4 (single), resulting in six PPs in each WG. In WG 2, the number of downpipes with PPs was doubled (one for 250 hens, approx. every 3.6 m; double), resulting in 12 PPs in the WG. WG 1 was used as a control, and no downpipes and pecking plates were installed (control). In addition to the automatic enrichment device, pecking blocks and hay or straw and alfalfa hay bales hanging in nets were offered to the hens in all WGs. Inside the henhouse, each group had access to two boxes, offering material for dustbathing.

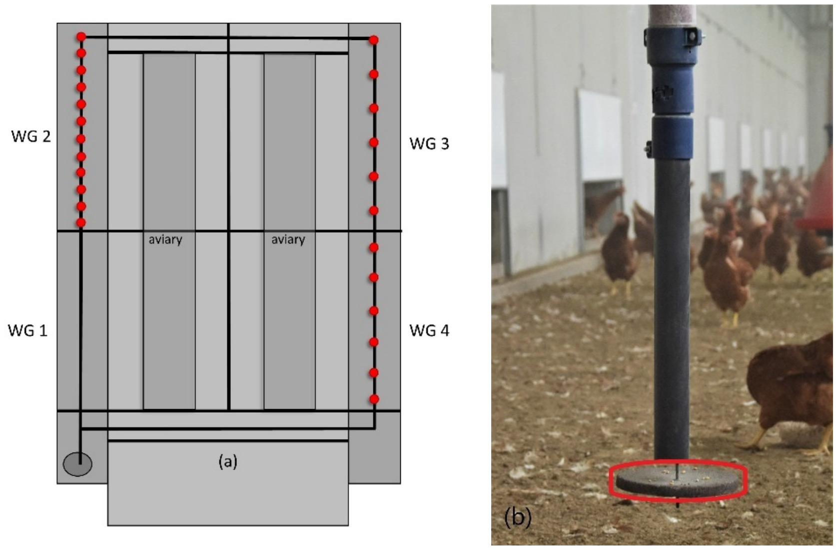

Figure 1. (**a**) Scheme of the henhouse and winter gardens (WG 1–4) with the downpipes with pecking plates as red dots; (**b**) Photograph of the enrichment device with the pecking plate circled in red (Photo: A. Riedel).

2.2. Data Collection

During the first visit to the laying hen farm in LW 19, four wildlife animal cameras (SecaCam HomeVista, VenTrade GmbH, Cologne, Germany) were installed in the four WGs to evaluate the use of the enrichment device. The cameras were programmed to take pictures every 15 min from 9:00 to 22:00, as long as animals stayed in the area. The photographed area covered an area of 3.20 m × 6.00 m (19.2 m^2) and included a PP in the WGs 2, 3, and 4.

Recordings from LW 23/24 (phase A), LW 32 (phase B), LW 40/41/52 (phase C), and LW 63/71 (phase D) were analyzed (Table 1). Due to technical errors in the recordings and a broken PP in the area, no photographs from WG 2 in phase A and WG 3 in phase D could be evaluated.

Table 1. Overview of the evaluation performed at different times during the laying period.

Phase	Weeks of Life	Definition	Time	Pictures Evaluated
A	23/24	Beginning of lay	September 19	519
B	32	Peak of Lay	November 19	608
C	40/41/51	Middle of lay	January/April 2020	596
D	63/71	End of lay	June/August 2020	536

On each photo, the number of hens located in the area were counted by one experienced observer using the "multi-point"-tool in the image processing and analysis program ImageJ (Version 1.51q, NIH, Bethesda, Rockville, MD, USA). In addition, in WGs with installed enrichment devices, the number of animals within one hen's body length proximity around the PP was counted. The program GoldenRatio (Version 3.1, Markus Welz, Krailling, Germany) was used to outline the observed area consistently in every photo.

Production Data was not recorded separately for the four groups. During on-farm visits, representative samples of 30 randomly caught hens were weighted manually in groups 1, 2, and 4 (Manual poultry scale BAT1, VEIT Electronics, s.r.o., Moravany, Czech Republic). Group 3 was left out due to time constraints and the presumed similarity to WG 4 (both with single PPs).

2.3. Statistical Analysis and Data Processing

Statistical analyses were performed using RStudio Version 1.4.1717 (Integrated Development for R. RStudio, PBC, Boston [38]). Initially, data were examined visually for normality by creating histograms, including the Gaussian distribution curve. In addition to the performance of descriptive statistics, a generalized linear mixed model was applied to identify effects of time of day, experimental group and production phase, on the number of animals per m^2 in the area. The data was poisson-distributed and therefore corrected in the model.

Model:

$$X = a + b + c + a{:}b + a{:}c + b{:}c$$

with X = differences in the number of hens per m^2; a = WG (1–4); b = phase (A–D); C = time of day (in hours, 9–22); a:b = interactions between the two factors a and b; a:c = interactions between the two factors a and c; b:c = interactions between the two factors b and c.

Afterwards, the Kruskal Wallis test for nonparametric data was carried out to compare data within the groups (WG and phase). As post hoc tests, Bonferroni adjusted pairwise Wilcoxon tests were performed, comparing the number of animals per m^2 and per PP in the different WGs and phases. An ANOVA was used to determine differences in the hens' weights at the end of the production period. Differences between the tested parameters were found to be significant if p-values were < 0.05. Daytime differences of the number of hens in the WGs were only analyzed descriptively. All results are displayed using the means and standard deviation.

The same researcher conducted all observations, but to ensure observer objectivity, inter- and intra-observer reliability tests were run, comparing the evaluation of a test set of 74 photos. The main observer evaluated this test set at two times 11 months apart to determine the intra-observer reliability. Inter-observer reliability was determined by comparing the evaluation of the test set from the main observer and a second observer. Observer reliability was calculated using Krippendorff's alpha with the 'macro' developed by Hayes and Krippendorff [39]. Each data set was calculated separately, resulting in values for the inter-observer reliability of animals per m^2 and animals per PP, as well as the intra-observer reliability for both. Reliability of Krippendorff's alpha was valued using the classification proposed by Landis and Koch [40] (<0.00 = poor; 0.00–0.20 = slight; 0.21–0.40 = fair; 0.41–0.60 = moderate; 0.61–0.8 = substantial; 0.81–1.00 = almost perfect).

3. Results

3.1. Production Data and Weight

The peak of egg production of the flock (all four groups together) was at LW 28, with a laying rate of 95.1%. At the end of production (LW 78), the laying rate was 74.1%. The average feed consumption per hen per day was 122.0 g, which lies within the breeder's recommendations (113–123 g/day/hen).

At the end of production (LW 77), the hens weighed on average 1990.42 g (SD: 133.2 g) with a uniformity of 85.6%. No significant differences were found among the groups, reaching 1971.73 g (SD: 127.0 g; WG 1) to 2000.13 g (SD: 137.4g; WG 2).

3.2. Use of the Winter Gardens

The inter-observer reliability (calculated using Krippendorff's alpha) was 0.99 for hens per m^2 and 0.93 for hens per PP. Intra-observer reliability from 11 months apart was 0.995 for hens per m^2 and 0.93 for hens per PP. Following Landis' and Koch's [40] classification, the agreement between the observers can be rated as almost perfect.

The results showed a significant influence ($p < 0.05$) of the factors "phase", "WG" and "Time of day" as well as their interactions on the number of animals per m^2.

The number of hens recorded in the WGs differed significantly between the four WGs and during the phases (Table 2). Over the whole housing period, on average, 1.48 hens/m^2 (SD: 0.88 hens/m^2) were detected in the control WG (WG 1 without automatic enrichment device). Significantly more hens ($p < 0.05$) were counted in WG 3 (2.59 hens/m^2, SD: 1.53 hens/m^2) with a single enrichment device and WG 2 (2.43 hens/m^2, SD: 1.27 hens/m^2), where the doubled amount of PPs was offered. In WG 4, where the device was also installed single, on average, 1.79 hens/m^2 (SD: 1.43 hens/m^2) were counted, significantly less ($p < 0.05$) than in WG 2 and WG 3.

Table 2. Mean (Standard deviation) number of hens per m^2 in the four winter gardens (WGs 1–4; WG 1: Control, WG 2: double offer of the enrichment device, WG 3 and WG 4: single offer of the enrichment device) and housing phases (A: beginning of lay LW 23/24, B: peak of lay LW 32, C: middle of lay LW 40/41/51, D: end of lay LW 63/71).

Phase	Mean (SD)	Hens/m^2 WG 1	Hens/m^2 WG 2	Hens/m^2 WG 3	Hens/m^2 WG 4	Hens/m^2 WG 1–4
A		1.45 (0.9) [a]	/	2.15 (1.17) [a]	2.54 (1.63) [a]	2.12 (1.37) [a]
B		1.24 (0.9) [a]	2.31 (1.62) [a]	2.71 (1.52) [b]	1.93 (1.42) [b]	2.05 (1.5) [a]
C		1.83 (0.82) [b]	2.92 (0.93) [b]	3.2 (1.83) [b]	1.62 (1.42) [c]	2.15 (1.41) [a]
D		1.24 (0.8) [a]	2.01 (0.9) [a]	/	1.29 (0.94) [c]	1.43 (0.93) [b]
A-D		1.48 (0.88)	2.43 (1.27)	2.59 (1.53)	1.79 (1.43)	/

[a, b, c] Means in the same column with different superscripts differ significantly ($p < 0.05$).

Among the different phases, the average number of hens per m^2 in WGs 1–4 remained much the same until the end of the laying period, when it was significantly lower ($p < 0.05$) than in the phases before. Except WG 4, most hens per m^2 were counted in phase C. In WG 4, the highest number of animals occurred in phase A.

The lowest use of the WGs was recorded in WG 1 during the peak of lay with on average 1.24 hens/m^2 (SD: 0.9 hens/m^2), while the highest use was recorded in WG 3 during the middle of lay with on average 3.2 hens/m^2 (SD: 1.83 hens/m^2). Figure 2 shows the number of hens per m^2 in each WG during the four phases.

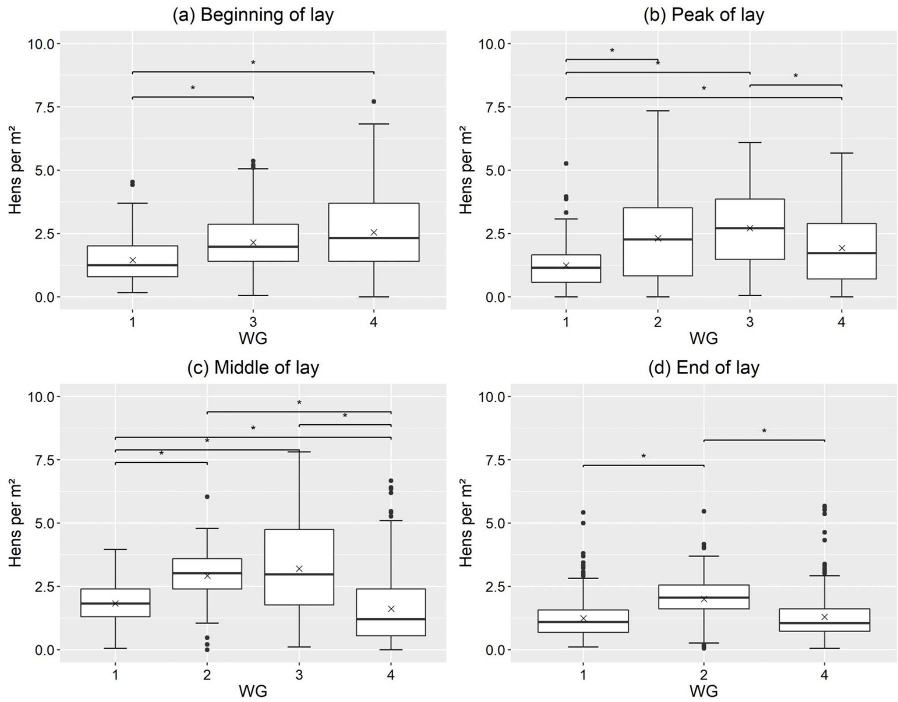

Figure 2. Boxplots (data range, median, lower upper quartile; outliers are included in the graph as dots and means as a cross) showing the number of hens per m^2 in each winter garden (WG; WG 1: control, WG 2: double offer of the enrichment device, WG 3 and WG 4: single offer of the enrichment device) during the four phases. * = $p < 0.05$.

Assuming an even distribution of animals over the whole WG area (160 m^2), the approximate percentage of hens using the area simultaneously can be calculated. In phase A, on average, about 11.3% of the whole flock stayed in the WGs simultaneously, decreasing to on average 7.6% of all hens in the WGs in phase D. The highest number of hens was counted in phase C and WG 3, when a maximum of around 17.1% of hens used the area simultaneously.

3.3. Differences during the Day

The general tendencies during the day were the same in all phases and groups. Only the length of the day (differing most during summer and winter) had an influence on the usage behavior and is therefore displayed. Continuous high numbers of hens per m^2 from the opening of the WGs until the afternoon were revealed, as shown in Figure 3. In the afternoon and evening, a decreasing number of animals was determined in all WGs.

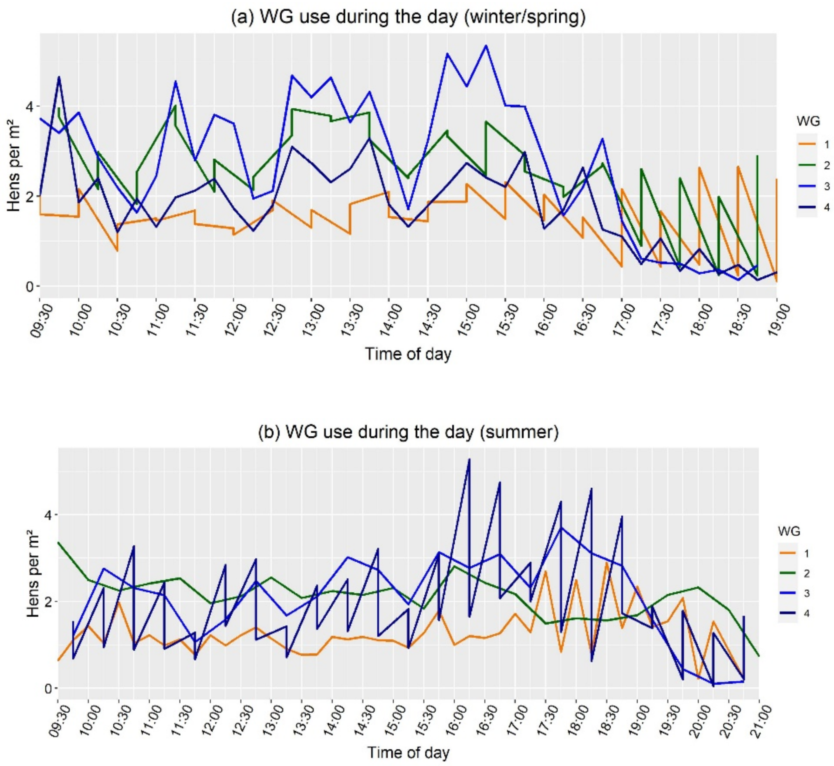

Figure 3. Mean hens per m^2 during the day in the different winter gardens (WGs; WG 1: control, WG 2: double offer of the enrichment device, WG 3 and WG 4: single offer of the enrichment device). (**a**) Phase A (beginning of lay) and D (end of lay) during the winter and spring from 9:30 to 19:00; (**b**) Phase B (peak of lay) and C (middle of lay) during the summer and autumn from 9:30 to 21:00.

Summarized for all WGs, on average, 2.1 hens/m^2 were counted from 9:00 to 14:00. From 15:00 to 16:00 on average, 2.32 hens/m^2 used the WGs, with the number of animals decreasing continuously until the evening (1.02 hens/m^2 at 21:00). Depending on the time of the year, the hens left the WGs earlier (winter) or later (summer) in the evenings, related to longer daytime hours in summer.

The number of hens per m^2 regularly peaked during the day, while lower amounts of hens were counted in the WGs during feeding times in the henhouse.

3.4. Use of the Enrichment Devices

Independent of the WG, on average, 3.37 hens used one PP simultaneously over the whole production period. During the beginning of lay (phase A), significantly more hens (3.16 hens/PP) were counted around one PP than in phase C and D ($p < 0.05$) (Table 3). In phase B, high utilization of the enrichment device was observed, resulting in a significant increase ($p < 0.05$) to an average of 5.11 hens/PP at the peak of lay. The number of hens per PP in the middle of lay (phase C: 2.77 hens/PP) and at the end of lay (phase D: 2.6 hens/PP) did not differ significantly, despite the lower overall use of the WGs in the last phase (Figure 4a).

Table 3. Mean (Standard deviation) number of hens per pecking plate (PP) in the three winter gardens (WGs 2–4; WG 2: double offer of the enrichment device, WG 3 and WG 4: single offer of the enrichment device) and housing phases (A: beginning of lay LW 23/24, B: peak of lay LW 32, C: middle of lay LW 40/41/51, D: end of lay LW 63/71). In WG 1, no PPs were installed, and no data was collected.

Phase	Mean (SD)	Hens/PP in WG 2	Hens/PP in WG 3	Hens/PP in WG 4	Hens/PP in all WGs
A		/	2.93 (1.94) [a]	3.93 (2.36) [a]	3.16 (2.18) [a]
B		5.46 (3.72) [a]	5.35 (2.93) [b]	4.52 (3.27) [b]	5.11 (3.37) [b]
C		3.11 (2.9) [b]	3.71 (2.42) [c]	2.21 (2.41) [c]	2.77 (2.62) [c]
D		3.54 (3.08) [b]	/	2.13 (1.72) [c]	2.6 (2.36) [c]
all		4.6 (3.42)	3.83 (2.59)	2.82 (2.54)	/

[a, b, c] Means in the same column with different superscripts differ significantly ($p < 0.05$).

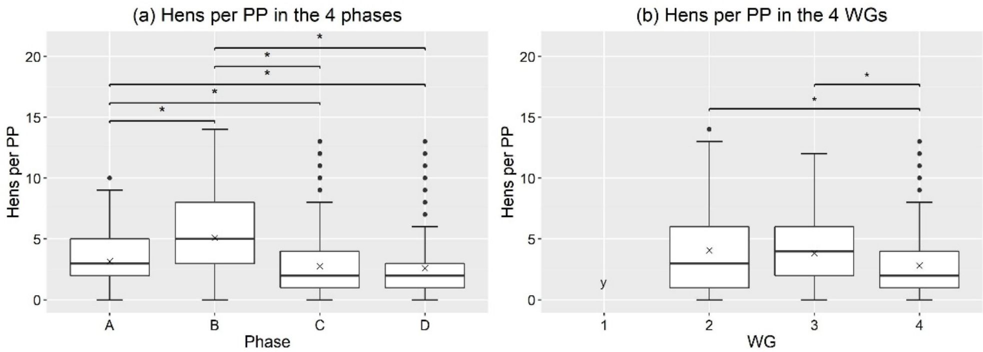

Figure 4. Boxplots (data range, median, lower upper quartile; outliers are included in the graph as dots and means as a cross) showing the number of hens per pecking plate (PP). (**a**) During the 4 phases (A: the beginning of lay, B: peak of lay, C: middle of lay, D: end of lay) and (**b**) in each winter garden (WG; WG 1: control, WG 2: double offer of the enrichment device, WG 3 and WG 4: single offer of the enrichment device). * = $p < 0.05$. y = in WG 1, no PPs were installed, and no data was collected.

The number of animals also differed between the four WGs (Figure 4b). Over the whole husbandry period, in WG 4 with a single offer of PPs, significantly fewer animals (on average 2.82 hens/PP, $p < 0.05$) occurred than in WG 3 (single PPs, on average 3.83 hens/PP) and WG 2 (double PPs, on average 4.06 hens/PP).

The maximum number of hens using the device simultaneously was 14 hens/PP.

4. Discussion

The present study aimed to evaluate an automatic enrichment device dosing grain on PPs regarding its influence on the use of WGs by the hens. Moreover, the device's acceptance was studied by counting the number of hens, which used one PP simultaneously. These parameters were evaluated by comparing four WGs and four phases during the production period. For this purpose, the use of a certain area in which the enrichment device was provided and the number of animals close to the enrichment device were chosen as indicators. Based on the present results, an influence of the presence of the automatic enrichment device and the age of the animals on their number per m^2 could be verified. The amount of offered PPs (single vs. double) did not affect the use of the WGs. However, more PPs could occupy more hens simultaneously. Other factors also influenced WG-use, such as the position of the WG.

In the first two production phases (A and B), the number of hens per m^2 was significantly lower in WG 1 without PPs than in the other WGs with the enrichment device. Likewise, concerning PP use, the highest number of hens was also determined in phases A and B. Both results indicate a positive influence of the enrichment device on the use of the WGs by the hens. Thus, the enrichment device could allow hens to become more quickly accustomed to the WG area. Such an effect of enrichment was previously found with maize-silage offered various times a day, resulting in a higher occupation of the WG area [35]. The general interest in the WGs decreased during the end of lay, which matches findings about the use of the free-range decreasing with increasing age [41]. The interest in the pecking device decreased after the laying peak but stayed on the same level afterwards until slaughter despite decreasing numbers of hens per m^2, indicating a high attractiveness of the device.

The difference in the number of animals per m^2 occurred not only between WG 1 (without an automatic enrichment device) and the other three WGs. This value also differed significantly between WG 4 and WGs 2 and 3 (all with PPs offered), especially during the peak and middle of lay. Therefore, other factors beyond the device's presence seem to have influenced the number of animals in the WGs, for example the WGs position within the henhouse. WGs 1 and 4 were positioned at the front of the henhouse, while WGs 2 and 3 were located at the back. Previous findings also revealed a correlation of the husbandry compartments' position in the henhouse and the animal behavior, in this case, severe feather pecking. It was found that laying hens housed in south-facing pens (note: southern hemisphere) showed severe feather pecking behavior earlier and to a greater extent than hens housed in north-facing pens. This observation was independent of the treatment to which the hens were exposed as pullets [42].

Furthermore, the observations of this study are in line with the experiences of the farmer, stating that the front groups tend to stay indoors more. Therefore, for further studies, prevention of an effect of position in the henhouse should be considered by regularly changing the order of treatment WGs and the control WG. The present study was conducted under practical conditions. Therefore, changing the setting of the on-farm evaluation of the enrichment device was not feasible during the limited time of one laying period.

The daytime preferences varied at different times of the year. While in phase A/D (winter/spring), the number of hens per m^2 decreased at about 17:00, in summer (phase B/C), the hens stayed outside in high numbers for about 2 h longer. The animal density peaked in the hours shortly before sunset, independent of the time of the year. Hence, daylight length influenced the hens' ranging behavior. Similar observations concerning the daytime preferences of WG use were revealed in a previous study from Icken et al. (2008), hypothesizing that in summer, the hens prefer the early evening to use the WG because of lower temperatures than around noon [43]. Interestingly, the hens stayed out in greater numbers in the WGs facing west (WG 1 and WG 2) than in those facing the eastern direction. Brighter rest light from the sunset in the west could explain this observation.

In the present study, about 6.6% to 17.1% of the hens stayed in the WGs simultaneously, depending on the WG and phase. This relatively low number of animals compared to other studies originates from the different methodologies. Hegelund et al. [41] found between 2% and 24% of flock averages using the free-range with climatic conditions influencing the percentage of hens outside. Compared with Icken et al. [43], who observed 60% of individually tracked hens visiting the WG, regardless of the time of the year, a much higher number of animals seems to use the sheltered WG than the open free-range. A study by Larsen et al. [44] found 67%/82% of hens in two flocks to use the free-range every day, but the simultaneously offered WG was frequented most of all outdoor areas. Hens that used the WG mostly also used the free-range, indicating that hens did not stop visiting the outdoor run. In addition to the different methodology, the free-range in the present study could have reduced the number of animals in the WG area.

Hens with earlier access use the free-range area more frequently. Therefore, the rearing period and early experiences after moving to the laying farm can be regarded as an important phase for developing the hens' behavior [8,45]. A design of a WG, attractive for the hens, could be the first step towards higher use of the outdoor run and towards reduced feather pecking and cannibalism in general. In the present study, the difference between the number of animals in WG 1 and WG 4 was especially high at the beginning of lay, shortly after the enrichment device was turned on, indicating its capability to motivate hens to use the WG. A similar influence of enrichment material via automatic enrichment device on WG use by hens was shown by Giersberg et al. [35]. Their study found the laying hens occupying about 50–75% of the WG floor when no enrichment material was offered and more than 75% of the floor covered by the hens when there was a regular offer of maize silage. This study could not reveal whether the WG is more used as a transit zone or as a permanent room for enrichment use. Therefore, in further studies, the behavior and the length of stay should be evaluated.

The average number of hens per PP was 3.37, while other results showed that less than three hens use one alfalfa hay bale simultaneously [34]. During the peak of lay, this number increased to 5.11 hens/PP simultaneously, indicating increased pecking needs in this phase, which can also be indicated by the occurrence of severe feather pecking increases over the laying period [7,46]. Hence, the findings imply that the automatic enrichment device may occupy more animals simultaneously than commonly used materials. Since only the use of one PP was evaluated in each WG, it is possible that the other PPs were occupied differently, depending on their location within the WG. A higher offer of PPs (in WG 2) however, did not reduce the number of animals using one PP simultaneously, thus showing that with more enrichment, a greater number of hens can be motivated to use these materials.

A limitation of the enrichment device was its dosing mechanism. The dosing step used in this study was supposed to dose grain or pellets, but not every peck at the PPs resulted in grains falling out. Sometimes several harsh pecks were needed to cause the dosing of the material, which could result in hens losing interest in the device if there was no easily obtained reward. The attractiveness of the enrichment device could possibly be increased by using a smoother dosing mechanism for the grains. On the one hand, the PPs could increase hens' interest in it if every peck resulted in grains and would result in higher animal densities around the PPs. However, on the other hand, putting effort into the feed intake can be seen as environmental enrichment and could improve animal welfare [47]. Too many grains offered at the enrichment device could lead to a supplanting of the base feeding in the henhouse. The amount of grain offered in this study did not affect the hens' weights. Other parameters, such as daily feed intake, could not be recorded separately for the different groups, but the average of all groups was within the breeder's recommendations. Enrichment materials, which promote foraging behavior, tend to suit animals' needs best, resulting in less feather pecking behavior [29].

The enrichment device studied attracted hens and functioned when pecks were delivered on its rough pecking plate. Moreover, the device may also fulfill the entirety of foraging behavior since scratching for grain that fell from the plate and searching for spilled grain is also encouraged. Observations of foraging behavior via video recordings could confirm this assumption in further investigations.

In this study, sometimes additional enrichment material, such as hay or straw bales in nets and pecking blocks, was offered in the WGs. This increased the number of animals per m^2 in a statistically significant way. Hence, enrichment material was offered in all WGs simultaneously, and no effect on the usage behavior of the PPs could be observed; its influence on the experiment was negligible. Other influencing factors, such as the status of the outlets towards the free-range area (opened/closed) and the compass direction of the WGs, did not show significant impact on the number of animals per m^2 in early statistical models. Therefore, these influencing factors on the number of animals in the WGs were excluded from the final analysis.

Further research should focus on the actual influence of the device on the animals' WG use without the effect of the WG position. Observations of a potential difference in lengths of stay in differently enriched groups and hens' behavior could give insight into the direct use of enrichment materials. In combination with plumage scoring, such research could also provide insights on the influence of the enrichment device on feather pecking and cannibalism.

In conclusion, the automatic enrichment device with PPs encouraged the use of WGs for laying hens, especially during the first weeks of egg production. However, other factors as the age of the animals and the position of the WG at the henhouse also influenced the use of the winter garden area. The device was particularly used during the peak of lay, helping to fulfill the pecking needs of the hens. The offer of more PPs in one WG did not increase the number of hens per m^2 in the area but could involve more hens simultaneously. Therefore, the tested device represents a suitable environmental enrichment option for laying hens in a commercial setting.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki. Any aspect of the work covered in this manuscript that has involved animals has been conducted according to the international and national guidelines for humane animal treatment, in compliance with relevant legislation and with the high ethical standards concerning animal welfare of the IAVE (International Association of Veterinary Editors) Guidelines. All of the animals used were housed according to the German Order on the Protection of Animals and the Keeping of Production Animals prior to slaughter. Sampling procedures were in accordance with the German Animal Welfare Act and the regulations on the welfare of animals used for experiments or for other scientific purposes. The experiments did not include any invasive procedure involving the animals. The concept of the study was reviewed and received approval from the Animal Welfare Officer of the University of Veterinary Medicine Hannover, Foundation, Hannover, Germany (TVO-2020-V-72).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy concerns.

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