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Recording of oviposition by weighing hens with RFID detection

To improve the breeding of laying hens for alternative housing systems, the aim of the present study was, to record the oviposition of individual hens in group housing systems with family nest boxes by the change of body weight caused by the oviposition. Therefore, a weighing perch was developed. ¾ of the ovipositions were found, but major changes in body weight were also measured in nest visits without oviposition. It is possible to detect the oviposition of individual hens with the weighing perch in group housing systems with family nest boxes, but the recognition rates have to be improved.

Keywords

Family nest box, group housing system, body weight change, laying performance, RFID

Abstract

Landtechnik 68(2), 2013, pp. 122–125, 3 figures, 1 table, 6 references

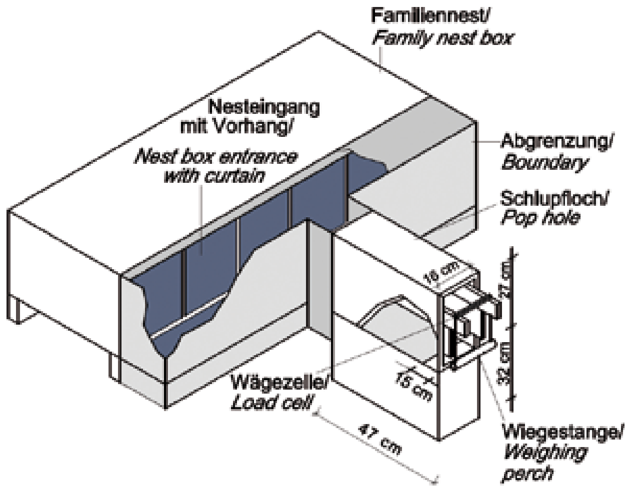
The importance of group housing systems for laying hens is increasing throughout Europe [1]. To improve breeding traits concerning the laying performance as well as the nesting behaviour of hens in group housing systems, it is necessary to attain data of individual laying performance and individual behaviour traits in the same housing systems. It has already been shown, that the individual laying performance can be obtained in group housing systems with the "Funnel Nest Box" [2]. Besides the recording of the individual laying performance this system allows the automatic and individual recording of the nesting behaviour. For this purpose the hens have to be isolated in a single nest box during oviposition, whereby also the nesting behaviour is different in the single nest box as compared to a family nest box [3]. Differences in the individual laying performance between the single nest boxes and family nest boxes have not been investigated so far. Until today, it is not possible to record reliable data about the individual laying performance of hens in group housing systems with family nest boxes. Therefore the aim of this study was to get information about the oviposition of individual hens in group housing systems with family nest boxes. The hypothesis is, that the loss of body weight should be at least 40 g between the nest entrance and nest exit for each hen after oviposition.

Material and methods

The investigations were carried out in November 2012 at the experimental station "Thalhausen" of the Technische Universität München. Thirty Lohmann Brown laying hens were housed in a two- tier aviary with one family nest box. The hens were tagged with low frequency glass transponders (ISO 11784/11785), which were integrated into a leg ring and additionally coloured backpacks for visual differentiation were used. A so called weighing perch was fixed to a pop hole (dimensions: 16 cm wide, 27 cm high and 47 cm deep), which was placed directly in front of the family nest box (**Figure 1**).

The hens had access to the family nest box only via the pop hole with the integrated weighing perch. Also while leaving the nest box they had to pass the pop hole. Two antennas were integrated into the pop hole to detect the passage direction. One antenna was located in the weighing perch, so the detected body weight could be assigned to an individual hen. The second antenna was placed in the approaching board of the pop hole towards the family nest box. A fourfold reader unit was used to record the information of the transponders in the reading range of the antenna [4]. The recording frequency of the transponder data was 2.6 Hz. The weighing perch was suspended on a load cell (Manufacturer: HBM, Type: PW4KRC3) and the weighing data were recorded with 67 Hz. To ensure that the hens do not step over the weighing perch without being weighed, the weighing perch was fixed with a distance of 15 cm to the board inside the pop hole. The weighing perch was located at a height of 32 cm above the littered area, so the hens had to jump on the weighing perch from the barn. For this study on five days direct observations and additional video recordings with two cameras (Manufacturer: Panasonic, Type: WV-CP480) were carried out. For processing video data the video- management-software "Eytron VMS" (Manufacturer: ABUS) was used. During the direct observations the ovipositions as well as the correct time of entering and leaving the nest box were captured. Video data were used for verification of the analysis. In total 98 nest visits with oviposition and 178 nest visits without oviposition were analyzed on the basis of data generated from the weigh-

Fig. 1



Sketch of the pop hole with an integrated weighing perch

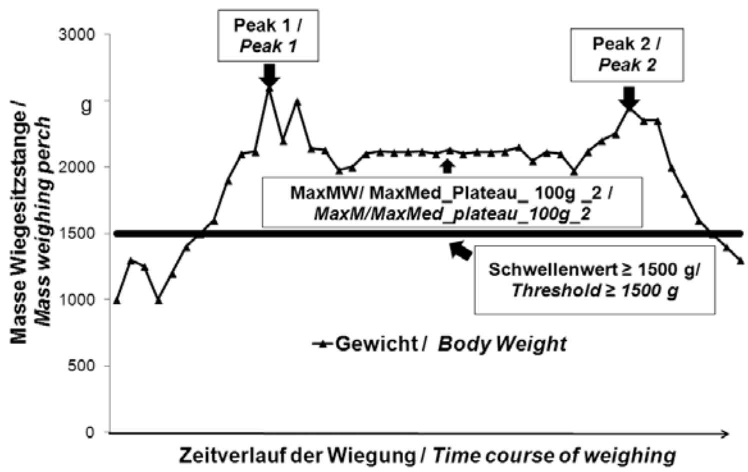
ing perch, video and direct observations. Thirty-five different algorithms were programmed for weighing data analysis with VBA in MS Access. And all weighing data of every passage were tested with all 35 algorithms. Single weighing data, which could not be analyzed with a particular algorithm, were analyzed with a combination of two algorithms to fill data gaps. The weighing data were not selected in advance. Based on the parameters sensitivity, specificity and error rate the three best methods of data analysis were chosen and presented in **Figure 2**.

A weight of 1500 g was set as the lower threshold. For the first method of data analysis two peaks were determined and the mean of them was calculated (MW_PP). The peaks were defined as follows: the first peak was the maximum at the beginning of weighing and the second the maximum at the end of weighing. The plateaus of the weighing curves were examined in the two other methods of data analysis. Thereby a plateau was determined as follows: the difference between two consecutive weighing datasets is not allowed to exceed a maximum value of 100 g and has to include at least two data sets. For each plateau, which met the requirements, an average value as well as a median was calculated. For this investigation the maximum mean of all plateaus per passage (MaxMW_Plateau_100g_2) and the maximum median of all plateaus per passage (MaxMed_Plateau_100g_2) were chosen. Finally, the calculated weights between each nest entrance and exit were subtracted and based on that the body weight change (Δ BW) for every nest visit, with or without oviposition, was calculated. As the lowest egg weights are around 40 g, the threshold for a nest visit with oviposition was set to 40 g, too. The nest visits were divided into four categories for the calculation of the hit ratio. Cases were classified as "True Positive" (Tp), when oviposition took place and Δ BW ≥ 40 g. If oviposition occurred and Δ BW < 40 g the cases were classified as "False negative" (Fn). When no oviposition could be observed the cases were divided into "True negative" (Tn) when Δ BW < 40 g and into "False positive" (Fp) when Δ BW ≥ 40 g. The weighing results were evaluated by the parameters sensitivity, specificity and error rate. The calculation of the parameters is shown in **Figure 3** [5].

Results

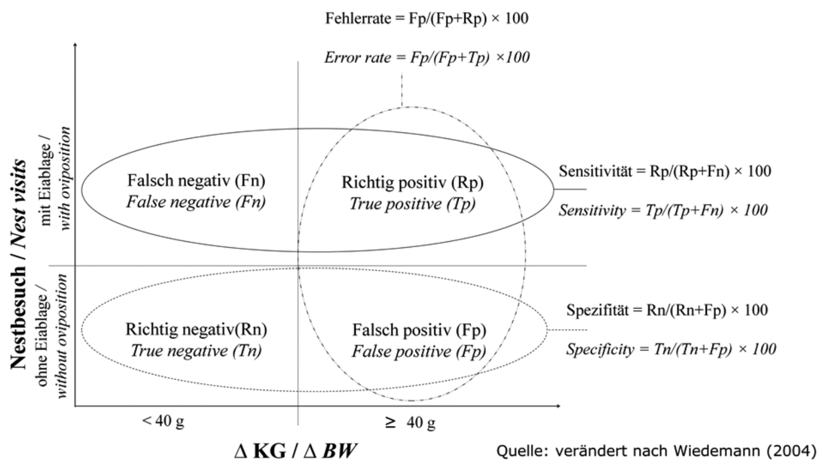
Table 1 shows the results of the three chosen methods for data analysis. In total 98 nest visits with oviposition and 178 nest visits without oviposition were analyzed, that implies that the family nest box was visited on average nearly twice without laying an egg besides nest visits with oviposition. Therefore, on average three nest visits per hen and day were recorded, which is a high number compared to other investigations [3; 6]. Sen-

Fig. 2



Example of a weighing curve with presentation of chosen methods for data analysis

Fig. 3



Evaluation of the parameters sensitivity, specificity and error rate on the base of body weight change and observed nest visits with and without oviposition [5]

sitivity corresponds with the share of nest visits, which were classified as ovipositions with Δ BW ≥ 40 g. With a sensitivity rate of 76 % three quarters of the observed ovipositions could be identified correctly as ovipositions with the weighing perch. Specificity indicates the percentage of correctly classified nest visits without oviposition in regard to all nest visits without ovipostion. In this investigation the specificity reached 35.4 %, 36.5 % and 40.4 % and is therefore lower than the calculated sensitivity. This means that the probability of classifying nest visits with oviposition correctly is higher than classifying nest visits without oviposition correctly. As the aim of the study was to detect the ovipositions of individual hens, a higher sensitivity is more important in that case. The error rate describes the relation between the nest visits without oviposition and a body weight change ≥ 40 g, and all nest visits, with or without oviposition and Δ BW ≥ 40 g. Thus the probability that with a body weight change ≥ 40 g actually an oviposition occurred. The error rate was 60.8 %, 61.4 % and 60.2 % and therefore high in the three chosen methods of data analysis. All in all the analyzed parameters sensitivity, specificity and error rate showed only small differences for the three chosen methods of data analysis.

Conclusions

With the weighing perch it is possible to obtain information about the oviposition of an individual hen in group housing systems with family nest boxes for the first time. The alternative group housing system with family nest boxes is a common husbandry system in practice. To improve laying performance genetically, it is necessary to test layers under similar conditions; the closer the test environment for data recording corresponds with the later production environment, the lower are potential genotype-environment interactions. Although the achieved results with the weighing perch were not satisfactory, this investigation shows that the change of body weight can be used for detecting the oviposition of individual hens. Therefore, the weighing perch should be further developed and advanced methods for data analysis should be tested. Perhaps the combination of weighing data and “the time spent in the nest box” could lead to higher hit rates.

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Table 1

Results of the three chosen methods for data analysis of the weighing perch of totally analysed 98 nest visits with oviposition and 178 nest visits without oviposition and a threshold of 40 g

Methoden zur Datenanalyse ***Methods for data analysis***	**Sensitivität/*Sensitivity* [%]**	**Spezifität/*Specificity* [%]**	**Fehlerrate/*Error rate* [%]**
MW_PP	75.5	35.4	60.8
MaxMW_Plateau_100 g _2	72.4	36.5	61.4
MaxMed_Plateau_100 g _2	71.4	40.4	60.2

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