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Identification reliability of laying hens at the wide electronic pop hole

An automatic identification and registration system has been developed for registering the ranging behaviour of laying hens using high-frequency-RFID-transponders. Results from one flock for a period of 28 days and another flock with over more than half a year, are presented. More than 98 % of the laying hens were correctly identified while passing through the pop hole, including the direction they passed. Evaluations regarding the ranging behaviour showed that the winter garden was used by nearly all hens. When ranging, the hens alternated between the barn and the winter garden on an average of between 21 and 32 times per day and remained outside for between 3 ¼ to 5 ¼ hours, depending on the season.

Keywords
Identification reliability, laying hens, pop hole

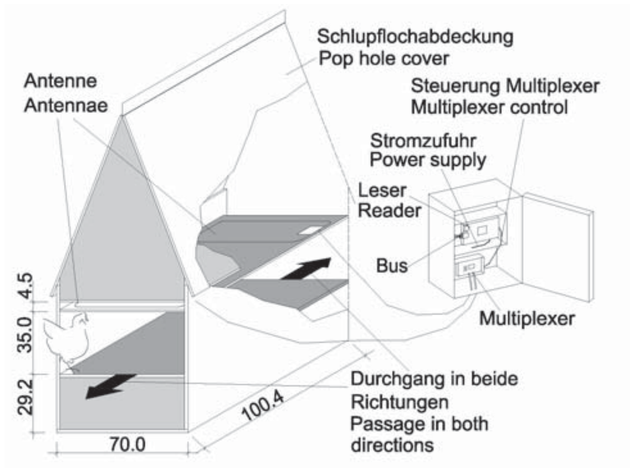
Abstract
Landtechnik 65 (2010), no. 2, pp. 139-141, 2 figures, 8 references

Since 2004, the number of laying hens housed in free range systems has an annual rise of more than 10 %, from 4.2 mill. heads in 2004 to 6.5 mill. in 2008 [1]. The ban on conventional cages in Germany which came in effect in January 2009 and the upcoming ban throughout the EU starting January 2012, will result in a further increase of these numbers. The number of hens in such systems, which can be observed on the free range area, varies highly and decreases with an increasing flock size [2]. This information is based on direct observations and related to the behaviour of the whole flock but not of the individual. So far, only few studies have been carried out regarding the individual ranging behaviour of laying hens [2; 3; 4; 5; 6]. Direct observations are too laborious for the evaluation of the individual ranging behaviour and additionally, technologies for the automatic recording have only been available for a few years now. Since 1999, the individual ranging behaviour of laying hens can be very reliably (identification reliability 96.5%) and automatically recorded with the narrow electronic pop hole (EPH), based on low-frequency-transponder-technology (134.2 kHz, ISO 11784 and ISO 11785) [3]. The major disadvantage of the EPH is the size of the passage with only 16 × 27 cm (width × height). The narrow passage assures that only one hen after the other can pass through the pop hole which is essential due to the radio-frequency-identification- (RFID) technology used. However, the ranging behaviour of the flocks observed, was influenced by the narrow passage in such a way that varying numbers of hens (14 to 40 % [5]) never used the free range area. A wide electronic pop hole, also based on low-frequency-transponder-technology, is being developed at the Centre for Proper Housing for Poultry and Rabbits in Zollikofen (Switzerland) since 2007 [2; 4]. With the aid of several small receiving antennae, located within a large transmitting antenna, it is possible to register the ranging behaviour with a wide pop hole. This technology still does not use an anti-collision system (similar to the EPH) and therefore, each small receiving antenna can only read one transponder at the same time. An evaluation of the registered data resulted in 96.8 % correctly registered data with the right antennae sequence [4]. So far, an accurate evaluation of the identification reliability, e.g. with video recordings, was not performed for this system. In the same period, an alternative technology for a wide electronic pop hole, based on high-frequency-transponder-technology with an anti-collision system, was developed and tested at the Institute for Agricultural Engineering and Animal Husbandry at the Bavarian State Research Centre for Agriculture in Freising (Germany) [6]. After finding very good results with a prototype (identification reliability between 94.4 % and 99.8 % [7], depending on passage width and passage variant), several wide electronic pop holes (WEPH) with a passage opening of 70 × 35 cm (width × height) and a depth of 100 cm were built and implemented. The aim of this study was to evaluate the identification reliability of the WEPH with the help of video recordings and on-site-controls (VOK) in different flocks over a longer period.

Material and Methods

Two WEPH's, serving as a connection between the barn and the winter garden, were available in one section (floor system with an aviary) at the experimental station Thalhausen (Technische Universität München). The evaluations were carried out with two Lohmann Silver flocks, one with 225 hens (older hens with pop hole experience = flock 1, data recording for 28 days in March and April, thereof video recordings during five days) and the other with 328 hens (thereof 189 older hens with pop hole experience = flock 2A and 139 younger hens without pop hole experience = flock 2J, data recording from May until December (194 days flock 2A and 183 days flock 2J), thereof on-site-controls during four days). Each hen was tagged at the wing with a round transponder with a centric hole (IN TAG 300 I-Code SLI, 30 mm diameter, 13.56 MHz, ISO 15693, HIDGlobal, trademark: Sokymat), using a wing tag (WonderBand Large Tag, RoxanID). Both pop holes were equipped with two antennae made of copper tubes that were bent to a coil measuring 63.0 × 23.5 cm (length × width) and tuned to the carrier signal frequency of 13.56 MHz with an antenna tuning board (ID ISC.MAT-A, Feig Electronics). The transponders are registered during the passage of a hen at both antennae with the aid of a long-range-reader (ID ISC.LR2000-A, Feig Electronics) and a multiplexer (ID ISC. ANT.MUX 8 times, Feig Electronics) (**figure 1**). The antennae are thereby powered from the multiplexer one after the other. The schedule for switching between the antennae depends on the number of transponders that are located in the reading area of each antenna. If there is no transponder in the reading area of an antenna, it will be switched to the other antenna within 50 ms. If there are several transponders in the reading area of an antenna, it will be switched to the other antenna after

Fig. 1



Sketch of wide electronic pop hole (WEPH)

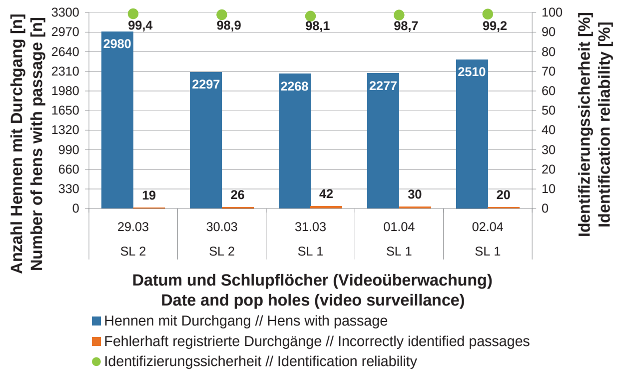
a maximum time of 500 ms. This results in a total duration of between 100 ms and 1 s for a whole reading cycle at both antennae.

The registered data from the transponders was used to evaluate the passage direction of the hens, according to the chronology of the readings, and the ranging behaviour. Video recordings, taken over five days with two CCD cameras (WV-CP480, Panasonic) and a digital long-term recorder (DLS 6 S1 edition, Dallmeier), were used for the evaluation of the identification reliability. The video recordings from both pop holes were manually compared to the automatically recorded and evaluated data from the RFID-system. Additionally, the hens were painted with different colours on different parts of their body in order to correctly identify them for the video evaluation. For the on-site-controls, the pop holes were closed shortly after 1 p.m. on four days and data from all hens that were in the winter garden at that time, were manually recorded using a hand-held reader (Scanndy basic with Tecpack 13.56 MHz, Panmobil). Afterwards, the location of the hens that were registered with the WEPH were compared with the manually registered whereabouts of the hens.

Results of the identification reliability

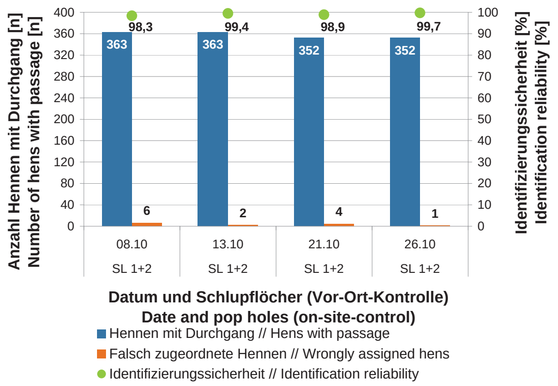
Within the scope of the video evaluations, a total of 12,195 passages were scanned. Thereby, 137 incorrectly registered passages were detected, resulting in an average identification reliability of the hens with the WEPH of 98.9 %. The identification reliability for the single days ranged between 98.1 % und 99.4 % (**figure 2**). For the on-site-controls, a total of 1,417 hens were controlled although, 13 hens were assigned to the wrong side of the pop hole. Thereby, the identification reliability varied between 98.3 % and 99.7 % and averaged at 99.1 % (**figure 3**).

Fig. 2



Identification reliability at WEPH: results of video evaluation

Fig. 3



Identification reliability at WEPH: results of on-site-control

Results regarding the ranging behaviour

In both flocks, only a few hens (eight hens (3.6 %) in flock 1 and three hens (0.9 %) in flock 2 (A+J)) were found to have never used the winter garden during the whole observation period. In contrast, most of the hens used the winter garden regularly on more than 60 % of the possible ranging days (> 90 % of flock 1 and > 82 % of flock 2 (A+J)). However, a clear differentiation was found between the older, experienced hens (>96 % flock 2A) and the younger, inexperienced hens (>64 % flock 2J). The number of passages and the duration of the stays in the winter garden varied according to the season and flock. The lowest numbers per hen and day over the whole observation period could be found for flock 2J (20.9 ± 18.2 passages; 3:18:03 ± 2:40:01 hours). However, the experienced hens from flock 2A alternated most frequently between the barn and the winter garden (31.7 ± 23.2 passages) and spent most of the day in the winter garden (5:15:41 ± 3:16:23 hours). Flock 1 passed the WEPH (23.5 ± 15.2 passages) as frequently as flock 2J did. Nevertheless, the staying time in the winter garden (4:19:55 ± 2:58:19 hours) for flock 1 was between flock 2A and flock 2J. Generally, the large standard deviation for the number of passages and the duration of winter garden stays per hen and day, shows a high variation between the ranging behaviour of the individual hens.

Conclusions

In comparison to the EPH, nearly all hens used the ranging area with the WEPH. Even the younger, inexperienced hens which, based on experience, should be at the very bottom of the hierarchy in the group of the older experienced hens, were all in the winter garden except for two of them. Therefore, the wide electronic pop hole allows the recording of the "normal" ranging behaviour without any restrictions. Thus, the recording of the ranging behaviour with the EPH, which then (1999) could be realised only with the small pop hole size due to the state of the art in technique, is unnecessary. Furthermore, the ranging behaviour data are recorded very reliably with the WEPH and the highly achieved identification reliability could not be attained by any other system until date.

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