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Summaries

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Experimental Studies on the Social Behaviour of Domestic Goats (*Capra aegagrus hircus*), Pen Design and the Resulting Implications for Goat Husbandry in Loose-Housing Systems

Dissertation University of Bern, 2008

Summary:

Due to the strict dominance relationships between goats, social conflicts can occur frequently in loose-housing systems and especially in small groups. This can lead to injuries and a reduced performance mainly in low-ranking goats. Farmers claim that loose housing of horned goats is a particular problem due to the higher risk of injuries in conflicts with horns rather than without horns. Thus, the aim of this thesis was to investigate different aspects of social behaviour of goats and based on that of pen design to derive implications for improving the loose-housing conditions for small groups of goats.

The studies were carried out with eight small groups of goats, each having nine animals. The groups were kept in identically equipped pens. Four of the eight groups were grouped as juveniles, whilst the other four groups were grouped as adults. Two each of the four juvenile and adult groups consisted of horned goats, whilst the other two consisted of hornless goats. In the home pens, data was collected regularly on the dominance relationship of each goat pair (i.e. dyad), on the rank order within the eight study groups and, based on the proximity during lying, on the quality of the social bonds of each dyad (antagonistic, neutral, amicable). These factors were included as explanatory variables in the analysis of the studies presented here.

In goats, as in other animal species, social distances are strongly linked to the dominance relationships within a group: normally, subordinate animals provoke aggressive reactions from the dominant animal if they reduce the distance to that conspecific below a certain minimum. This critical distance is termed the "individual distance". In loose-housed goats, frequent social conflicts might be caused by the limited space of a pen area not allowing the animals to respect this individual distance, so that high-ranking goats assert their rank by agonistic behaviour. However, individual distances in goats and the factors influencing their size has not been investigated before. Therefore, the first study addressed the questions about the distance goats choose freely at feeding when they have the option of keeping a large distance between each other, and the minimum distance that is possible without agonistic interactions if goats only can feed in close proximity (i.e. the individual distance). The results of this experimental study showed that the size of both types of distances was neither dependant on the presence of horns nor on the rank difference of the goats of a given dyad. But goats that were grouped as juveniles and therefore grew up together as well as goats with an amicable social bond tolerated shorter distances than goats grouped as adults and goats with a neutral or an antagonistic social bond.

As the individual distance in most of the dyads was larger than the distance between two feeding places commonly provided in farming practice, the next study investigated whether goats are stressed when they have to feed side by side in close proximity. Dyads were selected to feed once at the distance they had freely chosen in the first study (far distance) and once at a distance close to their individual distance (near

distance). During feeding, both goats of a dyad were equipped with an ECG recorder to measure heart rate (HR) and heart-rate variability (HRV) as physiological indicators of stress. Furthermore, in order to assess cardiac changes in the feeding test a separation test (known to induce stress in goats) was carried out with the same goats. It was found that low-ranking goats had a lower HRV at the far than at the near feeding distance which does indicate an increased stress level when feeding at the near distance. With high-ranking goats, however, HRV values were lower at the near feeding distance. Moreover, in contrast to expectations, only the HR but not the HRV differed between feeding and separation test.

In the third study, it was investigated what kind of modification at a feeding place make it possible that high-ranking goats tolerate the near distance of a lower-ranking goat, even though the individual distance cannot be respected. In a first experiment, dyads were fed at two adjacent hayracks which were either separated by a partition varying in length (short = 50 cm, long = 110 cm) and visibility afforded (wire mesh, solid wood), or they were not provided with a partition (control). In the platform experiment, goats of a dyad had to share one hayrack that was accessible either via an elevated platform of varying height (25 cm, 50 cm, or 80 cm above ground level) or without a platform (control). Generally, both types of modification increased the simultaneous feeding time of the dyads and its duration until the first agonistic interaction occurred, and decreased the rate of agonistic interactions. In particular, long partitions and those made of solid wood were more efficient than short partitions and than those which allowed visual contact, i.e. wire mesh, especially with horned goats, with goats grouped as adults and with dyads characterised by a large rank-index difference.

The aim of the next study was to test whether enriching pens for small groups of goats with structural elements providing visual cover (partitions, lying niches) and elevated levels (platforms) has a positive effect on feeding and resting, as well as on agonistic behaviour. In this enriched situation, the feeding bouts were generally longer and the resting bouts were less often interrupted by displacements. Furthermore, feeding bouts of low and medium-ranking goats were less often interrupted by displacements and fewer feeding and resting bouts were interrupted by medium- and high-ranking goats to initiate an agonistic interaction.

In the last study social variables were identified describing the social characteristics of small goat groups and indicating effects of an alteration to housing conditions. Initially, data of 31 agonistic and 21 affiliative variables were collected. Using a statistical analysis process developed for this study, the number of variables was reduced to a set of 8 agonistic and 5 affiliative variables. With this set of variables, it was possible to describe the variance and differences in social behaviour of the eight study groups. The set consisted mainly of variables about receiving agonistic interactions with or without physical contact, of variables about the quality of feeding and lying relationships and of variables which reflected how the goats of a group were treated by the highest-ranking goat of their group. In an experimental part of this study, ten of twelve tested variables selected to describe group characteristics were found to be sensitive to measure the effects of a short-term impairment of the housing conditions on social behaviour.

Concerning social behaviour and loose housing of small goat groups, the results of this thesis allow the following main conclusions to be drawn:

1. With most of the goat dyads tested, the dimension of the individual distance was larger than the distance between feeding places usually given in farming practice. This might make it difficult for the animals to respect individual distance and is likely to provoke agonistic interactions.
2. The size of the individual distance in horned goats does not differ from that in hornless goats. But the individual distance is smaller when goats grow up together and when they have a positive social bond. These results stress the importance of a sensible grouping management in goats aiming at grouping the animals early in ontogeny and keeping group composition stable.
3. The interpretation of cardiologic parameters and the effects of factors influencing these parameters need further investigation. The results presented here do not allow for a final conclusion about whether feeding side by side in close proximity is associated with stress in goats.
4. Both partitions at the feeding place and access to feed from different levels by platforms are effective in reducing agonistic interactions and increasing feeding time in goats feeding at near

distances. Long partitions providing visual cover or high differences in spatial levels are essential, especially for horned goats.

5. Social conflicts in small groups of goats whilst feeding and resting can be minimised and these behaviours improved by enriching loose-housing pens with structural elements providing visual cover (partitions, lying niches) and elevated levels (platforms).
6. Differences in social behaviour of small goat groups can be described mainly by variables concerning receiving agonistic interactions with or without physical contact, with variables about the quality of feeding and lying relationships and with variables which reflect how the goats of a group are treated by the highest-ranking goat of their group.
7. The agonistic behaviour of horned and hornless goats is different. With hornless goats, social conflicts frequently involve physical contact, whereas horned goats often avoid each other and resolve situations of conflict without physical contact. Thus, it seems that hornless goats respect dominance relationships less rigorously than horned goats.

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Sabine Dippel

Lameness in dairy cattle: Claw lesions, behaviour and epidemiology

Dissertation, Department of Sustainable Agricultural Systems, University of Natural Resources and Applied Life Sciences, Vienna, 2008

Summary:

Lameness in cows indicates painful diseases in the locomotory apparatus, which in recent years have had increasing impact on dairy cow health. To be able to walk free of pain is of special importance in modern cubicle housing systems where cows are required to walk in order to reach feed and water, and to be milked. In addition to reduced dairy cow welfare, lameness also causes financial losses through costs for treatment and reduced production.

Therefore, the aim of the presented study was to improve the welfare of dairy cows through reduction of lameness. This was to be achieved by answering the following two questions: A) Does cow behaviour influence the development of claw diseases? and B) Which are the most important risk factors for lameness on commercial farms?

The diseases leading to lameness are caused by a multitude of factors which in part influence each other. The behaviour of cows in their housing environment, in particular lying behaviour, is among the risk factors but up to now has been subjected to limited research only. In the first part of this study we investigated the effect of post-partial dairy cow behaviour on the development of claw lesions in an experiment. We recorded and analysed the behaviour and claw lesions (sole haemorrhages, white line separation etc.) of 32 cows during four months after calving. Cows which spent more time standing half (i.e. with front feet only) in cubicles developed more sole haemorrhages. There was no association between lesions and lying duration, yet cows had comparatively long lying times of on average 11 h/d.

The second part of the study encompassed an epidemiological survey which investigated risk factors for lameness in cubicle housed dairy cows. The dataset consisted of in total 3514 cows which had been gait-scored by four observers on 31 Austrian and 72 German dairy farms. The recording protocol included detailed scoring of single animals as well as behavioural observations, which resulted in several animal-based parameters (e.g. body condition, lying behaviour). In addition, data regarding housing and management were collected in an interview and a comprehensive barn assessment. The data were used to

construct two epidemiological risk factor models (logistic regression with GEE): one for Austrian farms only and one for all farms in the dataset. In both models increased lameness risk was associated with low lying comfort and low body condition. Also in both models significant were the factors abnormal lying behaviour and cubicle base. The model for the Austrian farms furthermore contained factors from other functional areas such as type of flooring.

The presented study documents a clear association between lying aspects and lameness in dairy cows. Lameness prevention in dairy cows should therefore strive to maximise lying comfort, particularly in order to prevent “standing half in cubicles”. Furthermore, the influence of feeding management on lameness has been confirmed in an on-farm situation.

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**Ethologische Untersuchungen zur Nutzung von offenen Wassersystemen
bei Nerzen (*Neovison vison*)**

(Behavioural studies on the use of open watersystems by mink (*Neovison vison*))

Dissertation, Ludwig-Maximilians-University Munich, 2009

Summary:

The aim of this study was to investigate which sizes, shapes and layouts of water basins in mink husbandry are suitable to allow mink to perform their characteristic behaviour to a large extent. – The first phase of the study (the fundamental research portion) took place between the end of July and the beginning of December 2007. 40 American mink (*Neovison vison*) from a commercial mink farm were housed in two identically constructed free-range enclosures (ca. 300 sqm). Each enclosure housed 20 mink (Group A and Group B). The animals were bought at nine weeks of age, and after weaning from their mother, and put into either of the two free-range enclosures aged 13 weeks. In order to investigate one of the mandatory requirements contained within German “Farm Animal Welfare Directive 2006” (Tierschutz-Nutztierhaltungsverordnung 2006), three different water basin models were investigated, to ascertain which model was favoured by the mink in the study, and therefore either confirming or refuting some of the requirements of the directive.

In the two identical enclosures studied, the mink were offered three different water basins, which differed in shape, depth and surface area. There were a rectangular “swimming pool” (surface area ca. 20.5 sqm, depth ca. 30 cm), a round “pond” (surface area 4.9 sqm, depth ca. 80 cm) and a running “creek” (length ca. 10 m, depth 3-4, cm which contained two pools/hollows along its length) available.

The animal behaviour was assessed by both direct, as well as video observation. The observations took place on an approximately monthly basis. Each time, both enclosures were observed simultaneously for a total of seven consecutive days. Five observation weeks were recorded over the course of the study.

The “scan sampling” method according to Martin and Bateson (1993) was used for the direct observation. The following behavioural patterns were assessed every 2.5 minutes: water-associated behaviour, either “at” (at least one paw on the edge of the basin) or “in” (all four paws in the water basin) one of the three basins “swimming pool”, “pond” or “creek”. The enclosure-related behaviour patterns were distinguished into social behaviour, walking/standing/running, resting, drinking (at nipple drinking troughs), digging, climbing, carrying objects and other.

For the video observation, three cameras were installed in each enclosure, one for each of the three water basins. The real-time recordings took place on seven consecutive days from sunrise until sunset. The mink have a number of “activity times” throughout the day. Two hours of the peak activity time were analysed from three days during each observation week.

The water-associated behaviour patterns (see above) were used for the evaluation. The analysis was carried out using “behaviour sampling” and “continuous recording” methods (Martin and Bateson, 1993).

To achieve information about the use of the nest boxes and the activity rhythm of the mink, all animals were micro chipped and all nest boxes of Group A were equipped with an automatic registration device (developed at the Technical University Munich, Institute for Agricultural Engineering and Animal Husbandry). Using the automatic registration device, it was possible to assess to the second for each individual mink whether it was in the nest box, in the pop tube or outside in the enclosure. It was therefore possible to evaluate the resting and activity patterns including their daily lengths and variations. This data was used to determine the evaluation times of the video-analysis. Furthermore, the automatic registration device helped to clarify whether a number of mink were using the nest boxes together and whether the animals preferred certain nest boxes for resting.

Both the results of the direct and the video observation showed that the mink in both groups (A and B) generally accepted all three water basins and used them from the beginning to the end of the study. These general observations are consistent with the behaviour of semi-aquatic living wild mink described in the literature. During the course of the study (from August to December), on the whole, an overall increase in frequency and duration of use of the basins was observed.

The results of the comparison of the three water basins showed a definite preference for the “swimming pool” style basin. This basin had the longest duration of stay over the entire duration of the study. Of the three basins studied, “the creek” was found to be the least favoured and visited for the shortest amount of time. It should be noted that the three water basins were deemed as fixed units in the statistical analysis, disregarding that they differed from each other by several factors, e.g. circumference, surface area, water volume and distance from the nest boxes.

As this study has shown that it was successful to keep young mink in groups with free access to swimming water basins, this approach should be looked into further. On the basis of the present study, it is now possible to suggest the use of an approx. 30 cm deep swimming pool, sized one square meter per animal in a commercial mink husbandry facility. Running water does not seem to be necessary according to the results of this study. These findings are largely consistent with the requirements of the current valid German “Farm Animal Welfare Directive 2006” (Tierschutz-Nutztierhaltungsverordnung 2006), which specifies a 30 cm deep water basin and a minimum size of one square meter.

The results of the automatic registration device showed that, after a few weeks of familiarisation, the mink developed a consolidated activity rhythm which had an activity peak at sunrise and sunset. In daytime, most of the animals stayed in their nest boxes and slept. During the seasonal course of the study, the time spent in the nest boxes increased, but the behaviour observed during the activity times, at and in the water basins, remained constant or tended to increase.

The mink preferred to use the nest boxes which were orientated towards the feeding place and spent less time in the boxes orientated towards the water basins. They developed (also after a familiarisation time) preferences for certain nest boxes. Certain boxes were used as “sleeping boxes” and had above average durations of stay. Other boxes served as “toilet boxes” and were only visited for very short periods. The nest box preference changed over the course of the study. However, individual animals did not develop an attachment for any particular nest box. Multiple occupancy of two to six animals occurred very often, and on a number of occasions as many as ten mink occupied a single box. The present study therefore finds that an animal/nest-box-ratio of 1:1 does not appear to be essential, despite the fact that mink are described as solitary animals in literature.

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Christiane Keppler

Untersuchungen zum Auftreten wichtiger Einflussfaktoren auf das Auftreten von Federpicken und Kannibalismus bei unkupierten Legehennen in Boden- und Volierenhaltungen mit Tageslicht unter besonderer Berücksichtigung der Aufzuchtphase

(Investigation of important influencing factors regarding feather pecking and cannibalism in non-beak trimmed laying hens kept in barns or aviaries with daylight and with particular consideration of the rearing period)

Dissertation, University Kassel, 2008

Summary:

This study aimed to gain new insights into effects of important potential risk factors for feather pecking and cannibalism in non-beaked trimmed hens kept under daylight conditions. These insights should allow to contribute to recommendations how to prevent feather pecking and cannibalism. Three potential risk factors during the rearing period, namely stocking density, perch use and protein supply, were investigated. With respect to the laying period, the effect of type of nest especially on vent pecking was studied. Breed was included in all studies, as a well known risk factor. As far as possible, already existing knowledge about factors affecting feather pecking and cannibalism was taken into account by providing the experimental animals with litter, elevated perches, dust bath and artificial brooder for the chicks. In all investigations the condition of the integument (feathers and skin) was used as a proven indicator of the extent of feather pecking and cannibalism. As a methodological part of this thesis two assessment systems of the integument from the literature were compared to the own assessment system in terms of reliability and feasibility.

With all assessment methods that were compared individual bird were picked up and scored. Methods differed in the numbers of assessed body regions and numbers of applied scores as well as regarding definitions of the scores. Integument scoring was carried out in three times 23 birds from three groups that overtly differed in their degrees of plumage damage. Inter- and intra-observer reliability between two recently trained assessors was assessed using the PABAK (prevalence-adjusted-bias-adjusted-kappa). The dichotomous measures compared were the existence of certain types of damage, for example whether there was at least one lesion or at least a naked area in the individual birds. Moreover, the consequent prevalences determined by the different assessors were compared and related to the PABAK. With one exception of a PABAK of 0.39 all other PABAKS ranged between 0.52 und 1.00. This is a range usually regarded as acceptable in terms of reliability. However, not below a PABAK of 0.75 the maximal difference between prevalences determined by the two observers will be 12 %. This leads to the recommendation that this value should at least be obtained. Intra-Observer reliability was only slightly better than Inter-Observer reliability. This might indicate that state of training of the assessors was still improvable despite intensive instructions over four days and training assessments of 200 hens. The comparisons of assessments with an experienced assessor conformed to this impression. Training should focus on body parts such as back, tail and wings that proved to be difficult to be reliably scored depending on plumage condition. Assessment systems that promote a reliable assessment are characterized by a low number of scores and high number of body regions to be assessed. However, greater differentiation of the body parts leads to higher time demands for the assessment which should be balanced against the need to assess a sufficiently high number of birds. A possible alternative is the assessment of only posterior parts of the body which concurrently led to a better reliability.

In order to investigate effects of stocking density, here combined with group size, on feather pecking and cannibalism, two different strains were kept in two different stocking densities (7 and 10 birds/m²; 160 and 230 birds per group) and three concurrent replications. Also combined with stocking density feeder, drinker and perch space were reduced by 30 % in the higher stocking density. Plumage condition and injuries were regularly assessed in a random sample of birds from their 1st to 16th week of age. Additionally they were weighed. Deaths and their presumable causes were continuously recorded.

Mortality due to cannibalism was higher in pens with the higher stocking density ($p = 0.012$). There was only a tendency for more birds showing injuries at the end of the rearing period under the higher stocking density ($p = 0.065$). More birds kept at the higher stocking density were lacking feathers due to feather pecking in the middle (5th to 8th week of life, $p \leq 0.029$) and at the end of the rearing period ($p = 0.017$). Where significance level was not reached, values still pointed into the same direction that greater problems occurred at the higher stocking density. Any differentiation between effects of stocking density, group size, feeder, drinker or perch space was not possible due to the study design. However, there was a tendency for birds kept at the higher stocking density for a lower body mass ($p = 0.087$) which could indicate that feeder space was not sufficient. Strain had a significant influence on plumage condition between the 4th and 10th week of age ($p < 0.05$), but a negligible effect on injuries. Results suggest that in rearing pens with daylight and with untrimmed birds a low stocking density and group size as well as sufficient feeder space are to be recommended. Such strains should be used that do not show feather pecking already early during rearing.

Perch use by two different strains and the effect on feather pecking and cannibalism was studied in the framework of another experiment on three different lighting programs in two replications. Group sizes were 100 birds and stocking density 8.8 birds/m². Percentages of birds on perches during lights on were scan sampled from video recordings between the 12th to 16th week of life. Percentages of birds on perches during the night were determined in direct observations. Plumage condition and injuries were regularly assessed in a random sample of birds from their 1st to 16th week of age. Additionally they were weighed. Strains differed significantly in their perch use during the day ($p = 0.002$), with light program having no effect. Birds tended to use perches more in pens with direct sun light on perches ($p = 0.062$). However, this was mainly due to the strain with the higher perch use (interaction: $p = 0.05$). These birds also tended to perch more during the night ($p = 0.065$). Plumage damage was in general relatively slight, but birds of the strain that perched more had a poorer plumage until the 10th and in the 17th week of age ($p < 0.001$ and $p = 0.026$). They were also affected by more toe injuries in the 17th week of life ($p < 0.001$) and had a higher mortality due to different causes ($p = 0.001$). In one of the pens many birds had to be separated because of injuries at the tail. The causal relationship between effective perch use and feather pecking and cannibalism is not clear. It is possible that strains showing a lower propensity for damaging pecking, have a lower general activity and consequently perch less. Further investigations are necessary on this issue, as well as on the necessary perch space. It was the impression during observations that in the pens with high perch use perch space was not sufficient to allow all willing birds to perch.

As a further research question, the relationship between perch use during rearing on the one hand, and perching during night and nest use after the transfer to the laying unit on the other hand was investigated. Nest use was indirectly determined via the proportion of floor eggs from the 21st to 24th week of life. Twelve laying pens were single-tiered and housed 42 birds per group, six pens were multi-tiered with group sizes of 100 birds. Eight weeks (single-tier) and four weeks (multi-tier) after the transfer nearly all hens in 17 out of 18 pens perched at night at elevated structures. The strain with the lower perch use during rearing laid more floor eggs in the single-tier pens in which nests were positioned above the dunging pit ($p = 0.027$), but not in the multi-tier pens with nests near to the ground where proportions of floor eggs were in general very low. As all birds had used elevated structures at least at night, the lower use of the higher positioned nests might be explained by preferences of some strains to be on the floor during the day and lay eggs near to the floor. Results indicate that different strains might have different needs with regard to the availability of perches and positioning of nests. In strains with a lower readiness to use elevated structures nests positioned near to the floor could help to reduce floor eggs.

Effects of feeding chicks and pullets only vegetable protein was examined during two batches with altogether eleven strains. Organic food rations with protein from plant sources were compared with conventional diets containing also animal protein. Measures were body mass, food consumption and conversion as well as the extent of damages due to feather pecking and cannibalism. Chicks and pullets were kept in groups of 85 with a stocking density of 7.4 birds/m². Each strain was replicated only once. Plumage condition and injuries were regularly assessed in a random sample of birds from their 1st to 16th week of age. Additionally they were weighed. In both batches no effect of diet could be found except for a tendency for a higher body mass in birds receiving also animal protein ($p = 0.059$), combined with a higher food consumption ($p < 0.001$), but worse food conversion rate ($p = 0.016$). Mortality in general was very low. Results show that organic feeding with only vegetable protein can result in a good food

consumption with an appropriate nutrient intake, but that there is some risk of a decreased food intake which may lead to lighter pullets. No increased risks for feather pecking and cannibalism were observed when only vegetable protein was fed compared to animal protein, but this was very likely due to the nearly equal contents of methionine und lysine in the rations. If food consumption is good, in principle the feeding of organic rations with only vegetable protein appears to be possible without an increased risk for feather pecking and cannibalism.

Finally, littered nests were compared with roll-away nests with sloped floor and a rubber pad in terms of possible effects on cloacal cannibalism and floor eggs. Altogether ten strains were investigated in two batches. Hens were kept in 20 single-tier pens in groups of 30 and with a stocking density of 5.3 birds/m². Half of the pens each had either littered nests or roll-away nests of otherwise same design. Additionally, in the framework of another experiment, half of the groups were fed either with organic or conventional feed. Plumage condition and injuries were assessed in a random sample of birds four times during the laying period of one year. Additionally, hens were weighed. Deaths, their presumable causes and floor eggs were recorded daily, cracked and dirty eggs weekly. Mortality due to cannibalism was significantly higher in groups with roll-away nests compared to littered nests ($p = 0.001$). Consequently, in pens with littered nests egg performance per hen housed was higher ($p = 0.001$). There were also less floor eggs ($p = 0.008$), dirty eggs ($p = 0.021$) and cracked eggs ($p = 0.019$). Plumage condition and injury prevalences were not affected. Feed type had only a minor influence in that more dirty eggs were found with organic feed. All parameters differed significantly between strains except for floor eggs and cracked eggs. There was no significant correlation (Spearman Rho = 0.22, $p = 0.18$) between mortality due to cannibalism and proportion of floor eggs. Contrary to results from some epidemiological studies this investigation showed that in barn systems with daylight and untrimmed hens littered nests, compared to roll-away nests, may exert a strong preventative effect on mortality due to cannibalism, with beneficial consequences on egg performance per hen housed. They may additionally contribute to a reduction of floor eggs. Not only from the perspective of animal welfare, but also from an economical view more attention should, therefore, be paid to the nest design in practice and research.

Altogether this piece of work shows again that feather pecking and cannibalism are influenced by a number of different factors. The common merely symptomatic measures of beak trimming and severe reductions of light quality and quantity pose severe animal welfare problems in themselves. Refraining from such measure leads to a greater pressure to provide laying hens with such an environment and to use only such strains that the adaptability of the hens is not overtaxed. Only some of the aspects that are important for the keeping of laying according to their species-specific needs could be covered in this thesis. However, some insights were gained. For instance, it was found that under the conditions described above, even relatively slight differences in stocking density during rearing may have profound effects on feather pecking and cannibalism, and that littered nests may contribute to the prevention of cannibalism. Questions arose regarding probably different needs of different strains, e.g. in relation to perch space or nest positions, that should be further pursued.

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