Literature Featherpecking - Housing

Daigle, C. L., et al. (2014). "Use of dynamic and rewarding environmental enrichment to alleviate feather pecking in non-cage laying hens." Applied Animal Behaviour Science **161**(0): 75-85.

Abstract Feather pecking (FP) can cause feather loss, resulting in physical injuries, which may lead to cannibalism. FP appears to be a redirection of foraging behavior, which intensifies when hens have difficulty coping with stress and fear. Dynamic environmental enrichment (EE) may allow expression of natural foraging behavior thus reducing conspecific pecking behavior and alleviating hen injury. Three treatments (plastic box: BOX; hay bale: HAY; and no enrichment: CON) were randomly applied to 30 identical floor pens (10 hens/pen; 10 pens/trt). At the pen level, hen behavior, and the number of severe FP (SFP), gentle FP (GFP), aggressive pecks (AP), and enrichment pecks (EP) were recorded from video prior to (21 wk) and after (24 wk) treatment implementation, and when hens were 27, 32, and 37 wk of age. A manual restraint test (MR) was performed immediately after behavioral observations and levels of blood serotonin (5-HT) and glucocorticoids (GC) measured. Short-term (ST) and long-term (LT) analyses identified the impact of EE over the ST (21 vs. 24 wk of age) and LT (21 vs. all other ages) at the pen level. At the pen level, HAY (3.18 ± 0.33) tended to reduce GFP compared to CON (4.10 ± 0.34) over the ST (P = 0.15) and LT (P = 0.09), but did not impact the number of SFP, or AP over the ST or LT. More EP was observed in HAY (3.56 ± 0.14) than BOX (1.61 ± 0.18) throughout the study (P < 0.0001). More HAY hens perched (P = 0.05) at 24 wk (0.28 ± 0.12) compared to 21 wk (0.19 ± 0.11), and more HAY hens (3.69 ± 0.25) performed dust bathing compared to CON (4.14 ± 0.22, P = 0.05) throughout the study. CON performed more struggles (1.13 ± 0.04, P = 0.04) and were quicker to vocalize (4.87 ± 0.07 s, P = 0.05) during MR than HAY (latency to vocalize(s): 5.16 ± 0.05; number of struggles: 0.96 ± 0.05), counter-intuitively suggesting CON were less fearful. Treatment did not affect 5-HT or GC. HAY appears to be a promising EE for mitigating GFP in non-cage laying hens. Future studies should examine the impact of EE on individual, rather than group-level responses. These results suggest that the presence of a hay bale is stimulating and may reduce GFP while encouraging hens to redirect pecking towards a dynamic and manipulable EE.

de Haas, E. N., et al. (2014). "Predicting feather damage in laying hens during the laying period. Is it the past or is it the present?" Applied Animal Behaviour Science **160**(0): 75-85.

Abstract Feather damage due to severe feather pecking (SFP) in laying hens is most severe during the laying period. However, SFP can develop at an early age and is influenced by early rearing conditions. In this study we assessed the risk factors during the rearing and laying period for feather damage at 40 weeks of age, in ISA brown and Dekalb White laying hens. Variables related to housing conditions during the rearing and laying period, and variables related to fearfulness (response to novel object, stationary person, and social isolation) and feather pecking (SFP, feather damage and feather eating) were tested to affect feather damage at 40 weeks of age. Feather damage on the neck, back and belly region was assessed on 50 hens, resulting in a total body score, and averaged per flock (based on Welfare Quality ®, 2009). First, analysis was conducted by a two-way ANOVA to assess separate factors to influence feather damage at 40 weeks of age. Hereafter, the final GLM for predicting feather damage at 40 weeks of age included only variables which had P < 0.1 in the two-way ANOVA. Risk factors during the rearing period were high levels of SFP at five weeks of age and elevated fear of humans (explained variance 29% and 5.3%, resp.). Risk factors during the laying period were a large group size (explained variance: 1%), distance to stationary person (explained variance: 16%), floor housing compared to aviary housing (1.27 ± 0.18 vs. 0.75 ± 0.07, explained variance: 21%) and a standard management compared to adjusted management such as a radio, pecking blocks, round drinkers and/or roosters (0.98 ± 0.31 vs. 0.51 ± 0.04, explained variance: 26%). Approximately 49% of the laying flocks and 60% of the rearing flocks in this study showed high SFP or severe feather damage. This high incidence emphasizes the severity of the problem and the importance of finding a solution. The results of this study may aid in providing practical solutions to this serious animal welfare problem.

Dixon, L. M., et al. (2010). "The effects of four types of enrichment on feather-pecking behaviour in laying hens housed in barren environments." Animal Welfare **19**(4): 429-435.

Severe feather pecking, a potentially stereotypic behaviour in chickens (Gallus gallus), can be reduced by providing enrichment. However, there is little comparative information available on the effectiveness of different types of enrichment. Providing forages to birds is likely to decrease feather-pecking behaviour the most, as it is generally thought that feather pecking stems from re-directed foraging motivation. Yet, other types of enrichment, such as dustbaths and novel objects, have also been shown to reduce feather pecking. In order to develop a practical and effective enrichment, these different possibilities must be examined. Using a Latin Square Design, 14-week old birds were given each of four treatments: i) forages; ii) novel objects; iii) dustbaths; or iv) no enrichment. The amount of feather-pecking behaviour and the number of pecks to the enrichments were recorded. Results showed feather pecking to be highest when no enrichment was present and lowest when the forages were present, with the other two enrichments intermediate. This was despite the fact that the numbers of pecks birds gave to the forages and dustbaths were not significantly different, suggesting that they were similarly used. Thus, we suggest here that forage enrichments are most effective at alleviating feather pecking at least in the short term and attempts should be made to develop poultry housing

that allows for natural foraging behaviour. Following this, providing any kind of enrichment will increase bird welfare and is therefore still beneficial.

Drake, K. A., et al. (2010). "Influence of rearing and lay risk factors on propensity for feather damage in laying hens." British Poultry Science **51**(6): 725-733.

1. Feather pecking is one of the major problems facing the egg industry in non-cage systems and is set to become even more of an issue with the European Union ban on the keeping of laying hens in barren battery cages which comes into force in 2012 and the prospect of a ban on beak-trimming. Reducing feather pecking without resorting to beak treatment is an important goal for the poultry industry. 2. We report here a longitudinal study that included over 335 500 birds from 22 free range and organic laying farms. Accelerated failure time models and proportional hazards models were used to examine the effects of a wide range of factors (management, environment and bird) on development of substantial feather damage in lay. Particular emphasis was placed on risk factors during rear and on practices that could feasibly be changed or implemented. 3. The age at which a flock exhibits substantial feather damage could be predicted both by factors in the environment and by early symptoms in the birds themselves. Factors that were associated with earlier onset of severe feather damage included the presence of chain feeders, raised levels of carbon dioxide and ammonia, higher sound and light levels, particularly in younger birds. Increased feather damage (even very slight) in birds at 17-20 weeks of age was also highly predictive of the time of onset of severe feather damage during lay. Increased feed intake also indicated that a flock was at risk of early severe feather damage. 4. Birds that stayed on the same farm for rearing and lay showed later onset of serious feather damage than those that experienced a change in farm from rearing to lay. However, an increased number of changes between rearing and lay (feeder type, drinker type, light intensity etc) was not associated with earlier onset of serious feather damage. Further research needs to be done on the role of the transition from rearing to lay as a risk factor for FP in lay.

Hartcher, K. M., et al. "Plumage damage in free-range laying hens: Behavioural characteristics in the rearing period and the effects of environmental enrichment and beak-trimming." Applied Animal Behaviour Science(0).

Abstract Severe feather-pecking, whereby birds peck at and pull out the feathers of other birds, is one of the greatest welfare concerns and the most prevalent behavioural problem in laying hens. It can be extremely difficult to control, especially in non-cage laying flocks. Despite a multitude of studies on the topic, the principal underlying causes remain unclear and not much is known about why certain birds are affected more than others. Literature suggests that rearing is an important period for the development of behaviours later in life. Although severe feather-pecking is not usually a welfare concern in the rearing period, behavioural tests when performed early in life may be predictive of plumage damage due to severe feather-pecking in adulthood. This experiment aimed to investigate whether behavioural tests during the rearing period could be predictive of plumage damage later in life. Sixteen pens of 50 ISA Brown laying hens were used, with four birds per pen selected at random as focal birds. Focal birds were subjected to behavioural tests during the rearing period including the open-field test, tonic immobility test and tests for a novel food reward. Two treatments, beak-trimming and environmental enrichment, were applied in a 2 × 2 factorial arrangement in rearing. The non-trimmed birds vocalised more (P = 0.02, 91.5 vs. 83.6%) and at louder volumes (P = 0.02, 71.4 vs. 47.0% of vocalisations categorised as loud rather than soft or silent) in the open-field test at 5 weeks of age. There was no difference between treatments in duration of tonic immobility (P = 0.99). Non-trimmed birds exhibited more plumage damage at 43 weeks of age (P < 0.001, 5.2 vs. 72.9% of birds with feather loss or wounds). Ordinal regression with treatments and treatment interactions as fixed effects and pens and blocks (sides of the shed) as random effects indicated no significant associations between behavioural test reactions and plumage damage (all P > 0.1). Thus while beak-trimmed birds made fewer vocalisations in an open-field test and had less plumage damage in adulthood as expected, there is no evidence that reactions to the behavioural tests were predictive of plumage damage. Instead, results indicate that environmental enrichment affected bird behaviour during the rearing period but did not affect plumage damage due to severe feather-pecking later in life. The test responses including more vocalisations in the open-field test, but no difference in the tonic immobility responses, indicate that the differences may be due to motivation for social reinstatement rather than fearfulness.

Lambton, S. L., et al. (2010). "The risk factors affecting the development of gentle and severe feather pecking in loose housed laying hens." Applied Animal Behaviour Science **123**(1-2): 32-42.

Injurious pecking remains one of the biggest problems challenging free range egg producers, with both economic implications for the farmer and welfare implications for the birds. The most widespread form of injurious pecking is feather pecking, the most damaging form of which is severe feather pecking (SFP) which has, as yet unclear, links with gentle feather pecking (GFP). The current prospective epidemiological study investigates the development of GFP and SFP oil 61 free range and organic UK farms (111 flocks). Flocks were visited at 25 (20-30) and 40 (35-45) weeks, when rates of GFP and SFP respectively and levels of feather damage were recorded. Environmental and management data were collected for each flock. Factors affecting the development of these behaviours were modelled using the multilevel modelling program, MLwiN (Rasbash et al., 2004). GFP was observed in 89.2% and 73% of flocks at 25 and 40 weeks, respectively, at a mean rate of 0.65 bouts/bird/h. GFP rates decreased with increased percentage range use (coeff.: -0.001 +/- 0.0006, p = 0.025) and temperature inside the laying house (coeff.: -0.005 +/- 0.001, p = 0.001). GFP was higher in flocks with soil or grass litter (chi(2) = 13.16, df = 4, p = 0.012). flocks which had no perch access (0.010 +/- 0.001 vs. 0.007 +/- 0.002 bouts/bird/min, p = 0.047) and flocks which were beak trimmed

compared to those non-beak trimmed or retrospectively beak trimmed (0.013 +/- 0.002 vs. 0.003 +/- 0.001 and 0.002 +/- 0.001, p=0.007). SEP was observed in 68.5% and 85.6% of flocks at the 1st and 2nd visits. respectively, at a mean rate of 1.22 bouts/bird/h. SFP rates decreased with range use (coeff.: -0.001 +/- 0.0003. p = 0.003). Mean rates were highest in non-beak trimmed compared to beak trimmed flocks (0.032 +/- 0.003 vs. 0.017 +/- 0.003 bouts/bird/min, p=0.028), flocks observed to be feather pecking when they arrived oil farm compared to those that were not (0.062 +/- 0.018 vs. 0.019 +/- 0.002 bouts/bird/min, p=0.001), and flocks fed pelleted compared to those fed mashed food (0.042 +/- 0.002 vs. 0.016 +/- 0.002 bouts/bird/min, p = 0.005). Plumage damage was lower in beak trimmed compared to non-beak trimmed flocks (plumage score 1.00 +/- 0.0001 vs. 1.15 +/- 0.068, p=0.040), and flocks which were fed mashed feed, and showed a quadratic relationship with severe feather pecking (p = 0.003) which was positive over the observed ranges of the behaviours. In commercial Situations, feeding mashed feed and increasing range use may reduce severe feather pecking and therefore feather damage. (C) 2010 Elsevier B.V. All rights reserved.

Lambton, S. L., et al. (2015). "The risk factors affecting the development of vent pecking and cannibalism in free-range and organic laying hens." Animal Welfare. 24.

Injurious pecking remains one of the biggest animal welfare and economic challenges for free-range egg producers. This prospective epidemiological study investigated the development of vent pecking (VP) and cannibalism on 62 free-range and organic UK farms (119 flocks). Flocks were visited at 25 (± 5) and 40 (± 5) weeks of age. Rates of VP were recorded and farmers were asked whether they had observed cannibalism in their flocks. Environmental and management data were collected for each flock. Risk factors associated with these behaviours were modelled using MLwiN. VP was observed in 19.5 and 29.9% of flocks, at mean rates of 0.35 and 0.21 bouts per bird per h, at 25 and 40 weeks, respectively. Cannibalism was reported at 22.6% of visits. The odds of flocks showing VP or cannibalism increased with rate of severe feather pecking (SFP). VP was more likely to be observed in laying houses with more and/or longer pop holes and where feed was scattered on the floor. Providing more aerial perch length, or perches > 0.5 m in height, was associated with increased risk of VP. When SFP was excluded from the model, likelihood of VP was higher in flocks fed pelleted feed. All of these may provide a useful basis from which to derive management strategies to reduce the risk of VP and thus improve the welfare of laying hens. However, it is important to remember that this study does not elucidate the causal relationships between these variables, and further work is needed to understand the mechanism behind these associations.

Lambton, S. L., et al. (2013). "A bespoke management package can reduce levels of injurious pecking in loose-housed laying hen flocks." Veterinary Record **172**(16): 423.

This study investigated the protective effects of an on-farm management package designed to reduce injurious pecking (IP) in loose-housed laying hens. A systematic review of scientific literature generated 46 potentially protective management strategies. Bespoke management packages were designed for treatment flocks (TF) using these management strategies. IP in 53 TFs was compared with IP in 47 control flocks (CF) where the management package was not employed. Scoring of plumage damage (PD) and observations of gentle and severe feather pecking (GFP; SFP), and vent and cannibalistic pecking (VP) were completed, and management strategy use was recorded, at 20, 30 and 40 weeks of age. Differences between treatment and CF were examined using multilevel modelling. Compared with CF, TF employed more management strategies (P<0.001), had lower PD (P=0.003) and SFP (P=0.019). Regardless of treatment or control flock status, the more of the 46 management strategies that were employed the lower was the PD (P=0.004), GFP (P=0.021), SFP (P=0.043), mortality at 40 weeks (P=0.025), and the likelihood of VP (P=0.021). Therefore, the provision of a bespoke management package was protective against the majority of forms of IP in commercial laying hen flocks.

Mahboub, H. D. H., et al. (2004). "Outdoor use, tonic immobility, heterophil/lymphocyte ratio and feather condition in free-range laying hens of different genotype." British Poultry Science **45**(6): 738-744.

Movement (frequency of changes) between inside and outside housing areas, time spent in each area, tonic immobility (TI) and differential blood cell counts were studied in relation to feather condition in laying hens of two genotypes, white (LSL) and brown (LT). From 18 weeks of age, LSL and LT were kept in 4 groups of 50 birds in a poultry house with passages to a roofed scratching room and a grassland area with a stocking density of one bird/10 m². All birds had transponders to record the movements of each hen between inside and outside areas and the time spent in each area during 24 h. Feather scoring was carried out at 6 ages from 20 to 48 weeks. At 44 weeks of age, TI reactions of 40 hens (20 from each genotype) were quantified and blood smears from 20 hens (10 from each genotype) were analysed for differential leukocyte counts. LSL hens moved more frequently to outdoor areas than LT hens (44.66 vs 28.78 least square/d). However, the proportion of time spent on grassland was greater in LT than in LSL hens, whereas time (%) spent by LT hens in the roofed scratching area was less than for LSl hens. In LT hens TI was shorter while heterophil/lymphocyte ratio and basophilia were greater than in LSL hens. Total body feather score was poorer in LSL than in LT hens. Incidence of footpad inflammation was higher in LSL than LT hens. There was a positive association between TI and footpad inflammation. The percentage of time spent on grassland and feather damage were inversely correlated. More movement between the areas, as in LSL hens, was positively associated with fearfulness, whereas long periods on grassland, as in LT hens, were associated with indicators of increased stress. The negative correlation between feather damage and time spent outside suggests that feather pecking risk decreases in birds attracted to grassland.

McAdie, T. M., et al. (2005). "Reduction in feather pecking and improvement of feather condition with the presentation of a string device to chickens." Applied Animal Behaviour Science **93**(1-2): 67-80.

Feather pecking remains a serious problem in commercial egg production. It has been argued that feather pecking,occurs as a result of misdirected pecking, so a possible solution would be to increase the likelihood that such pecking was targeted at another object in the environment rather than to the feathers of conspecifics. Chickens of various strains and ages will readily peck at a device consisting of strands of white string but it is not yet known if pecking at that device would substitute for pecking at conspecifics. Therefore, the effects of providing string devices on feather pecking in an experimental situation (Experiment 1) and on feather condition under commercial conditions (Experiment 2) were examined. In Experiment 1, 300 chicks of a high-feather pecking strain of white leghorn-type layers were housed in groups of five in litter-floor pens. The 60 pens were randomly allocated to one of five treatments: devices incorporated in the chicks' pens continuously from 1 day of age till the end of the experiment at 57 days; devices presented for 4 h per day from 1 day of age; first presented from 22 days of age; first presented from 52 days of age; and finally, devices never presented. Feather pecking was virtually eliminated when the devices remained in the pens from 1 day of age or when they were presented for 4 h per day. Feather pecking was most pronounced among birds that had never received the device whereas its introduction at 22 or 52 days of age yielded intermediate results. This orderly pattern of more pecking at feathers when the device was added at later ages was significant ($p < 0.005$). In Experiment 2, 768 Lohmann LSL laying chickens were housed in rearing cages and 720 were transferred in groups of three to conventional laying cages when 16 weeks old. The birds were allocated to one of four treatments: devices present from 1 day of age; presented for 24 h every 4 weeks; continuously present from 16 weeks of age; and finally, devices never presented. At 35 weeks of age, hens with access to the device had significantly better plumage condition than those that had never received the device ($p < 0.05$). In conclusion, the addition of a simple string device to the pens of non-beak-trimmed high-feather-pecking birds decreased feather pecking behaviour (Experiment 1), and to the cages of non-beak-trimmed commercial layers significantly improved feather condition (Experiment 2).

Merrill, R. J. N. and C. J. Nicol (2005). "The effects of novel floorings on dustbathing, pecking and scratching behaviour of caged hens." Animal Welfare **14**(3): 179-186.

From the year 2012, conventional battery cages for laying hens will be banned under the European Union Council Directive 1999/74/EC Enriched cages, which include a perch, a nest area, and a pecking and scratching area will not be banned, and have certain advantages over other systems of egg production. Previous studies have shown that even when a pecking and scratching area is provided, most dustbathing occurs on the wire floor as sham dustbathing. This study investigated whether novel cage floor types could stimulate full expression of dustbathing behaviour, similar to that seen on loose litter. One hundred and forty four hens were housed in pairs in non-commercial enriched cages that differed only in that they contained one of four randomly allocated floor types. Floor types were conventional wire ('wire), wood shavings (litter), conventional wire wrapped with garden twine (string) and perforated rubber matting (rubber). Birds on litter or rubber performed fewer bouts of dustbathing than those on wire and string. However, bouts on litter were longer than those on the three other floor types. Overall, birds on litter or string showed a greater total duration of dustbathing than those on rubber, and birds on litter had a richer repertoire of dustbathing elements. Birds on litter performed significantly more pecking and scratching than those on string or rubber, which did not differ from those on wire. Birds on rubber and litter had poorer foot and feather condition than those on wire or string. Altering the cage floor produced minor changes in behaviour, and further novel floor types should be evaluated.

Miller, K. A. and J. A. Mench (2006). "Differential effects of 4 types of environmental enrichment on aggressive pecking, feather pecking, feather loss, food wastage and productivity in Japanese quail." British Poultry Science **47**(6): 646-658.

1. We examined the effects of 4 types of environmental enrichment (foraging opportunities, structural complexity, sensory stimulation/novelty, and social companionship) on aggressive and feather pecking, feather condition, food wastage, body weight, feed conversion, and egg production in adult Japanese quail. Sex differences were examined where possible. 2. GLM analysis was used to evaluate the effects of enrichment and housing, while test-retest reliability and the stability of measures over 18 d were assessed using partial correlation. 3. Foraging enrichment reduced food wastage. 4. Body weight, feed conversion, and egg production were not affected by enrichment. Rates of aggressive and feather pecking were also not significantly affected, but these behaviours were observed very infrequently in this study. 5. Socially-housed birds had poorer feather condition, lower body weight and less efficient feed conversion than singly-housed birds. Social housing did not affect food wastage. 6. There were no sex differences in feather pecking, feather condition, food wastage, or feed conversion. 7. All measures except feather pecking were reliable over 24 h, but only feather condition and body weight were stable over 18 d. The instability of the behavioural measures over time suggests that enrichment effects may vary with age.

NICOL, C. J., et al. (2013). "The prevention and control of feather pecking: application to commercial systems." World's poultry science journal **69**(04): 775-788.

Studies on the prevalence of feather pecking in different commercial laying hen systems and its welfare and economic impacts are reviewed in the following paper. Current methods for controlling feather pecking include beak-trimming and alterations to light regimes, but these methods have significant disadvantages from the perspective of bird welfare. A substantial body of research has now

identified risk factors for feather pecking during both the rearing and laying periods. It is argued that these findings can be translated into optimised management practices that can prevent and control feather pecking whilst simultaneously conferring welfare benefits. The genetic basis of feather pecking is considered, and studies that suggest group selection techniques could produce birds with a reduced tendency to feather peck in commercial flocks are highlighted.

Nicol, C. J., et al. (1999). "Differential effects of increased stocking density, mediated by increased flock size, on feather pecking and aggression in laying hens." Applied Animal Behaviour Science **65**(2): 137-152.
Six flocks of laying hens were housed in percheries at each of four stocking densities (6, 14, 22 or 30 birds m(-2)) from 14 to 30 weeks of age. Stocking density was manipulated by changes in nock size (72, 168, 264 or 368 birds) within percheries of the same floor and height dimensions. The pecking behaviour of birds was observed directly at 15, 22 and 30 weeks of age, and corrected for the number of birds in view. Egg production was recorded at 23 and 27 weeks of age, and plumage condition was scored at 30 weeks of age. At 23 weeks of age, egg production was greater at 6 birds m(-2) than at other stocking densities. The plumage condition of the birds was best at 6 birds m-2 and worsened with increased flock size and stocking density. The behavioural observations suggested that this was due to an increase in mild feather pecking with increased nock size and stocking density. Mild feather pecking increased with bird age and was most frequently observed on the perchery floor although, at higher flock sizes and stocking densities, it also occurred on the perches. Severe feather pecking was infrequent, especially at the lower flock sizes and stocking densities, but was most likely to occur near the nest boxes. Vent pecking was extremely rare. Aggressive pecking was most common in the smaller flocks at the lowest stocking densities, possibly because these birds attempted to form social hierarchies. Birds in the larger nocks at higher densities appeared to adopt non-social, non-aggressive behavioural strategies. (C) 1999 Elsevier Science B.V. All rights reserved.

Petek, M. and J. L. McKinstry (2010). "Reducing the prevalence and severity of injurious pecking in laying hens without beak trimming." Veteriner Fakultesi Dergisi, Uludag Universitesi **29**(1): 61-68.
Injurious pecking is a general term used to describe feather pecking, vent pecking, cannibalism and toe-pecking in laying hens. The severity of injurious pecking varies enormously, ranging from limited feather removal to cannibalism and death. Alternative housing systems for laying hens such as barn, free-range and aviary systems show much higher incidences of injurious pecking than with those birds housed in conventional caged system. From a welfare perspective injurious pecking can cause pain, stress, injuries, increased susceptibility to diseases, fear and death. Any major outbreak of injurious feather pecking can result in serious economic loss for the industry through decrease in egg production and feed efficiency. At present the egg industry uses both beak trimming of the birds and dim lighting methods to help reduce injurious pecking. However, both of these are being criticised from a welfare point of view. In fact a general ban on beak trimming already exists in some European Union countries, with other countries considering a ban by 2011. Moreover, The EU ban on conventional laying cages (2012), when combined with a ban on beak-trimming, will increase the risk of injurious feather pecking and cannibalism. It is therefore important for future to consider other ways of controlling injurious pecking. Injurious pecking is a multi-factorial problem, which can be caused by environmental, genetic or nutritional factors and can be largely prevented by the use of a combination of environmental and husbandry management programs. This paper is intended to give a general overview of the potential risk factors and possible control measures associated with injurious pecking in laying hens, and in particular those flocks housed in non-cage systems.

Riber, A. B., et al. (2007). "Effects of broody hens on perch use, ground pecking, feather pecking and cannibalism in domestic fowl (Gallus gallus domesticus)." Applied Animal Behaviour Science **106**(1-3): 39-51.
Previous work has shown that the tendency to feather peck in domestic fowl is influenced by experiences early in life; it was hypothesised that broody hens prevent development of feather pecking and cannibalism in their chicks by increasing their ground pecking activity and by motivating them to earlier perch use. Twelve groups of 10 layer hen chicks (Lohmann Tradition) were reared in pens (2.55 m(2)) with perches at heights of 20 and 40 cm; six groups were reared with broody hens and six with heating lamps. The hens and the heating lamps were removed when the chicks were 5 weeks old. A 13-day long stress period (i.e. increased light intensity, short-term feed deprivation) was introduced when the chickens were 25 weeks old, after which the experiment was terminated. The number of ground pecks performed during 2 min was recorded for all individuals, when they were 1, 8, and 20 weeks old. The position of each chick (floor, low perch, or high perch) was recorded using scan sampling 12 times a day on days 5-40. Feather pecking was recorded continuously for 30 min in each group when the chicks were 5, 10, 13, 17, 20, 24, and 27 weeks old. Data were analysed using repeated measures ANOVA. The brooded chicks ground pecked four times more in weeks 1 and 8 than the non-brooded chicks, whereas the amount was similar in week 20. The brooded chicks were on average 9.8 (+/- 0.6) days old when first observed on the low perch during day time and the non-brooded were 13.5 (+/- 0.8) days old. No difference was found between the two treatments in onset of night perching (low perch: brooded 19.2 (+/- 1.6) and non-brooded 22.5 (+/- 1.9) days old). Severe feather pecking was almost non-existent in both treatments throughout the experiment, although a rise in frequency was found in the non-brooded pens in weeks 20 and 24. Mortality due to feather pecking and cannibalism was found to be significantly higher for the non-brooded chickens. In conclusion, the provision of broody hens resulted in chickens having a higher ground pecking activity, an earlier day-use of perches, and a lower mortality. Because severe feather pecking only developed to a minor non-significant extent in the non-brooded chickens, no conclusion could be made on the effect of broody hens on chickens' feather pecking activity. (c) 2006 Elsevier B.V. All rights reserved.

Rodenburg, T. B., et al. (2004b). "Feather pecking in laying hens: new insights and directions for research?" Applied Animal Behaviour Science **86**(3/4): 291-298.

The aim of this paper is to present new insights and promising directions for future research on feather pecking in laying hens. Our starting point was a multidisciplinary research program on feather pecking in The Netherlands, in which ethological, physiological, ontogenetic and genetic approaches were combined. The four topics addressed in this paper are: (1) the relation between gentle and severe feather pecking, (2) feather pecking and coping strategy, (3) causation of feather pecking, and (4) the possibility to solve the problem of feather pecking through genetic selection. When the relationship between gentle and severe feather pecking was studied, it was found that both forms of feather pecking are related at the same age. Gentle feather pecking at young age, however, could not be used as a predictor of feather pecking at adult age. Birds from high and low feather pecking lines that showed differences in feather pecking also differed in other behavioural and physiological characteristics. This may reflect line differences in coping strategy. Relating coping strategy with feather pecking may help us to better understand the motivations and characteristics underlying the development of feather pecking. On the causation of feather pecking, there is some evidence that it is redirected ground pecking, deriving either from a foraging or a dustbathing background. However, evidence was found that early feather pecking could also be interpreted as social exploration. Finally, the use of molecular genetics to help solving the problem of feather pecking seems promising. Feather pecking has been shown to be heritable and the first genetic regions (QTL) involved in feather pecking have been identified. To search for a solution for the feather pecking problem it is of importance to identify the mechanisms involved in the development of feather pecking. In this paper, we have combined approaches from different disciplines in order to study feather pecking. The results indicate that combined efforts of multidisciplinary research can be very useful in looking for possible ways to reduce feather pecking in practice.

Rodenburg, T. B. and P. Koene (2007). "The impact of group size on damaging behaviours, aggression, fear and stress in farm animals. (Special issue: Too many, too few: the effects of group size and density in captive animals.)." Applied Animal Behaviour Science **103**(3/4): 205-214.

The aim of this review is to discuss the impact of group size on damaging behaviours, aggression, fear and stress in farm animals and to identify housing- and management options that can help to reduce problems caused by suboptimal group sizes. Increasing group size was found to increase the risk of damaging behaviour, such as feather pecking in laying hens and vulva biting in sows. Aggression does not appear to be a problem in large groups, because dominance relationships in these groups are not based on individual recognition, but based on other signals such as body size, avoiding costly fights. There is evidence for increased fear and stress levels in large groups compared with small groups, but fearfulness is also strongly affected by type of housing. To minimise problems in large groups, is seems helpful to offer separate functional areas and to provide cover, reducing disturbance between animals. To minimise the risk of damaging behaviour, such as feather pecking in laying hens and tail biting in pigs, stimulating foraging, exploration and manipulation behaviour by providing sufficient substrate (straw, wood shavings and sand) offers perspective. Rearing the animals in a system which allows the development of all these behaviours is very important. Other solutions can be found in optimising the diet and offering extra foraging opportunities. Furthermore, genetic selection against damaging behaviour seems promising. In conclusion, group size mainly has an effect on damaging behaviour and fear and stress in pigs and poultry. The effect on aggressive behaviour is limited. To reduce damaging behaviour, fear and stress, it is important to provide a complex environment with ample behavioural opportunities and separate functional areas.

Sedlackova, M., et al. (2004). "Feather pecking in laying hens: Environmental and endogenous factors." Acta Veterinaria Brno **73**(4): 521-531.

Feather pecking, pecking directed to and damaging the feathers of other birds, is a behavioural disorder occurring in laying hens and other poultry species and breeds. Feather pecking is both a welfare and economic problem. Pulling out feathers causes pain, a higher risk of injuries and can trigger an outbreak of cannibalism. Extensive loss of feather cover is accompanied by increased heat loss that results in increased food consumption. The 1999 EU Directive laying down minimum standards for the protection of laying hens approved banning of conventional battery cages from 2012. Thus in the next few years major changes to the housing of laying hens in Europe will occur. Therefore there is an urgent need to develop feasible alternative housing systems-An increased risk of feather pecking is a main obstruction to the wide adoption of alternative housing systems, such as free range, aviaries or percheries. There is a continuous effort of many research teams in Europe and elsewhere to expand our knowledge of this behavioural disturbance and maximize the chances to solve the problem. In this review we have attempted to summarise the present status of knowledge about feather pecking. Hypotheses on causation (redirected ground pecking or dustbathing), environmental factors (feeding, lighting, housing. group size, density) and endogenous factors (sex. age. genetic factors, physiological control mechanisms) are discussed and possible ways of prevention via changing environment, management practices or genetic selection are pointed out.

Thiele, H. H. and R. Pottguter (2008). "Management recommendations for laying hens in deep litter, perchery and free range systems." Lohmann Information **43**(1): 53-63. http://www.lohmann-information.com/content/l_i_43_artikel6.pdf