Literature Featherpecking - Risk factors - Management

Alm, M., et al. (2015). "Welfare and performance in layers following temporary exclusion from the litter area on introduction to the layer facility." Poultry Science **94**(4): 565-573.

When introduced to the laying facility, pullets are sometimes temporarily excluded from the litter area in order to help them locate food and water, and to prevent floor-laid eggs. This procedure is not permitted in Sweden, because it involves denying access to both litter and space, which may have a negative effect on bird welfare. The present study investigated how the welfare and performance of layers were affected by this temporary exclusion on introduction of hens to the laying facility. The study included 600 floor-reared Dekalb White layers obtained at 16 wk age and housed in 6 groups of 100 in a conventional single-tier floor-laying system. Birds were either given full access to the litter area during the whole study or were excluded from the litter area during the first 2 wk after transfer to the laying facility. From 18 to 72 wk age, birds in both treatments had full access to the litter area. Excluding birds from the litter area for 2 wk resulted in better feather cover and reduced fearfulness, according to novel object and tonic immobility tests. Furthermore, birds initially excluded from the litter area produced eggs with a lower proportion of shell irregularities than birds with full access to the litter area throughout. No difference was found in corticosterone metabolites in droppings rate of lay, mortality, or proportion of floor-laid eggs. In conclusion, none of the parameters studied indicated that the welfare of laying hens was compromised by temporary exclusion from the litter area on introduction to the laying facility. In fact, some of the data suggested that bird welfare had improved.

Bestman, M., et al. (2009). "Influence of farm factors on the occurrence of feather pecking in organic reared hens and their predictability for feather pecking in the laying period." Applied Animal Behaviour Science **121**(2): 120-125.

Feather pecking is one of the most obvious welfare problems in laying hens. It is seen in all types of housing systems. Although banned in some countries, beak trimming is generally used to reduce the damage caused by this behaviour. In organic farming, where beak trimming is prohibited, the animals are being kept in a less intensive way than in conventional farming in order to improve their welfare. However, feather pecking is also seen in organic laying hens. Generally, rearing circumstances play an important role in the development of this behaviour. Therefore, rearing flocks were monitored for feather pecking and the relations between rearing factors and feather pecking at a young and at an adult age were analysed. Also the correlation between feather pecking during the rearing period and feather pecking during adult life was studied. Twenty-eight commercial flocks of rearing hens were monitored. These flocks split into 51 flocks of laying hens. Flocks were scored for signs of feather damage during rearing at the ages of 7, 12, and 16 weeks and on the laying farms at 30 weeks. On the rearing as well as the laying farm, data were collected on the housing system. Logistic regression was used to analyse our data. Feather damage was seen in 13 out of 24 (54%) of rearing flocks. Logistic regression showed that a higher number of pullets being kept per square meter in the first 4 weeks of life were associated with feather damage during the rearing period (Chi square = 8.49, df = 1, p = 0.004). Moreover, the combination of not having litter at the age of 1-4 weeks and the absence of daylight at the age of 7-17 weeks was a significant predictor of feather damage during the laying period (Chi square = 13.89, df = 4. p = 0.008). In 71% of the cases that pullets did not show feather pecking damage during rearing, they did not show feather pecking damage in the laying period either. When flocks of pullets did show feather damage, in 90% of the cases they did so during adult life. These results lead to suggestions on how to improve the rearing conditions of laying hens and increase their welfare not only during rearing but also during later life. Although the observations were done on organic farms, the results can be applied for other non-cage systems too.

Bilcik, B. and L. J. Keeling (1999). "Changes in feather condition in relation to feather pecking and aggressive behaviour in laying hens." British Poultry Science **40**(4): 444-451.

1. The aim of this experiment was to describe and examine the relationship between pecks received by individual birds and the feather and skin damage of those birds at different ages. The effect of group size was also studied. 2. Laying hens were raised in floor pens in group sizes of 15, 30, 60 and 120 birds, each with 4 replicates. Behavioural observations were performed at the ages of 22, 27, 32 and 37 weeks. Detailed feather scoring was carried out at the ages of 18, 23, 28 and 33 weeks. 3. Behavioural observations focused on the number of feather pecks (gentle and severe) and aggressive pecks received, and on the past of the body that was pecked. Scoring of feather and skin damage focused on the same 11 parts of the body 4. Increasing numbers of aggressive pecks received were associated with decreased body weight and increased feather damage at the ages of 27 and 32 weeks. 5. The number of severe feather pecks received was significantly related with feather damage at all ages; however, no relation with gentle feather pecks received was found. 6. Group size had a significant effect on feather condition, with large group sizes hating most feather damage.

Bilcik, B. and L. J. Keeling (2000). "Relationship between feather pecking and ground pecking in laying hens and the effect of group size." Applied Animal Behaviour Science **68**(1): 55-66.

The aim of this experiment was to study the relationship between feather pecking and ground pecking in laying hens and the effect of group size on feather pecking behaviour. Hisex White hens were kept in floor pens in group sizes of 15, 30, 60 and 120 birds, each with four replicates. Behavioural

observations were performed at four different ages and focused on the number of feather pecks and aggressive pecks, both given and received. The part of the body pecked and the location of the bird was recorded as well as the number of pecks made to the floor, feeder and drinker. The results showed that most feather pecking activity occurred in the largest group size (120 birds) and there was some evidence of an increasing frequency of aggressive pecks with increasing group size. The parts of the body which were targets for feather pecking varied depending on the location of the bird giving the peck and the bird receiving it. When looking at the behaviour of individuals, birds doing a lot of feather pecking also showed more ground pecking. (C) 2000 Elsevier Science B.V. All rights reserved.

Donaldson, C. J. and N. E. O'Connell (2012). "The influence of access to aerial perches on fearfulness, social behaviour and production parameters in free-range laying hens." Applied Animal Behaviour Science(0).

The aim of this trial was to determine the influence of aerial perches on welfare and production parameters in free-range laying hens. Five commercial free-range houses, each containing between 7000 and 8000 birds, were used. Each house and range area was split in half to create two treatments. In half of the house the birds had access to aerial perches (P) and in the other half they did not (NP). Perches were provided from the start of the lay cycle at 16 weeks of age, and remained in place until the end of the lay cycle (at approximately 74 weeks). Behavioural observations took place over two day periods at intervals between 17 and 70 weeks of age. During day 1, tests of fearfulness and observations of aggressive and feather pecking behaviours were performed. In addition, twenty birds per replicate were randomly selected and weight, body condition, feather coverage and resistance to handling were measured. The use of the range area by birds was assessed on day 2. The percentage of eggs laid out of nest boxes ('floor eggs') was recorded continuously on three of the farms, and egg quality was assessed from a sample of eggs every 10 weeks across the production cycle on all farms. Access to aerial perches significantly reduced the level of aggression in the slatted and litter areas of the house (P < 0.05). P birds had a significantly lower flight distance from the observer than NP birds (P < 0.05). In addition, NP birds resisted more to being handled than P birds (P < 0.01). P birds were heavier (P < 0.01) and had a greater body condition score (P < 0.05) than NP birds. There was no effect of treatment on feather coverage (P > 0.05), egg quality parameters (all P > 0.05), or the proportion of floor eggs (P > 0.05). In conclusion, these results suggest that the provision of aerial perches in commercial free-range farms leads to welfare benefits in terms of reduced fearfulness and aggression, and improved body condition.

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.

Fiks-van Niekerk, T. G. C. M. and A. Elson (2005). Abrasive devices to blunt the beak tip. Poultry welfare issues - Beak trimming. P. C. Glatz. Nottingham, Nottingham University Press**:** 127-131.

Although beak-trimming is performed to minimise feather and injurious pecking in laying hens and thus will reduce stress induced by these behaviours, the treatment itself is a stressor to the birds as well, especially because part of the living tissue of the beak is removed (refer to Chapter 3 and 4). It is however very difficult to mechanically shorten the tip of the beak without touching sensitive beak tissue. Also, the treatment may need to be repeated frequently as the tip can be expected to regrow. In both the Netherlands and the UK research has been conducted to blunt the tip of the beak by using abrasive materials in the feed trough. The idea for beak blunting by abrasion came from claw shortening by abrasion, which has been a requirement of the EU Council Directive 1999/74/EC for laying hens in cages since 01/01/03. A variety of abrasive materials have been found to be effective for claw shortening when fitted to the anti-egg eating baffle plates of laying cages. The idea was that hens blunt the tips of their beaks themselves and will continue to keep the beaks blunt. The reason for placing the abrasive device in the feeder is because hens spend a lot of time pecking the feed, the feed trough and flicking their beaks over the inner surfaces of the feeder.

Fiks - van Niekerk, T. G. C. M. and B. F. J. Reuvekamp (2004). Proef met touwbosjes tegen pikkerij: afdoende afleiding blijft uit. Pluimveehouderij. **34:** 18-19.

Touwbosjes in verrijkte kooien hielpen niet tegen pikkerij. De bosjes werden weliswaar flink aangepikt, maar de uitval door pikkerij was ook hoog.

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.

Holcman, A., et al. (2008). "Porous concrete block as an environmental enrichment device increases activity of laying hens in cages." Poultry Science **87**(9): 1714-1719.

The purpose of this study was to consider the influence of simple and cheap environmental enrichment such as porous concrete on the behavior of laying hens in conventional cages. Forty brown laying hens were housed in individual wire mesh cages: 20 in experimental cages with porous concrete block provided for pecking and 20 in a control group without concrete block provided. Porous concrete block (5 cm length x 5 cm width x 5 cm height) was mounted on the side wall at the height of the hen's head. Behavior was studied from 42 to 48 wk of age. A group of 8 hens was filmed for 24 h, and the camera was moved each day so that all 40 hens were recorded over 5 d each wk. Video-taping was performed in wk 1, 3, 5, and 7 of the experiment. States (long-term behavior) were observed with 5-min interval recording (feeding, preening, resting, and remaining inactive), whereas events (short-term activities) were observed with instantaneous recording (drinking, pecking concrete, pecking neighbors, pecking cage, and attempting to escape). Data were analyzed with generalized linear mixed model with binomial distribution for states, and Poisson distribution for events. Monte Carlo Markov Chain methods were used to estimate model parameters. Because posterior distributions of quantities of interest were skewed, medians and standard errors are reported. Hens in experimental cages were more active in long-term behavior than controls (64.9 +/- 1.9 and 59.3 +/- 1.9% of the light period, respectively). Correspondingly, hens in the control group showed more long-term inactivity. In addition to pecking the porous concrete block, hens in experimental cages also showed other short-term activities with greater frequency (4.10 +/- 0.31 and 3.51 +/- 0.25 events per h, respectively). Our hypothesis that hens in enriched cages would have a greater level of activity was confirmed. Provision of a piece of porous concrete block as a pecking substrate enriched the environment of the birds at negligible cost.

Jones, R. B. (2004). Environmental enrichment: the need for practical strategies to improve poultry welfare. Cambridge, Cabi Publishing.

The banning of traditional battery cages for laying hens in the European Community from 2012 largely reflects consumers' wishes for their food to be produced with greater respect for animal welfare. However, farmers also need to make a living and alternative housing systems can generate their own welfare and production problems. Therefore, to ensure sustainability of European agriculture, we must identify practical ways of minimizing major behavioural problems, like fear and feather pecking. Environmental enrichment may help in this respect. However, the birds ignore many so-called enrichment devices and others exert undesirable effects. Rather than relying on human preconceptions to guide the development of enrichment, we should establish the birds' preferences. Enrichment procedures must satisfy critical requirements; these include practicality, sustained interest, promotion of desirable behaviours and reduction of harmful ones. This chapter provides an overview of recent findings. Televised stimuli attracted chickens; their regular presentation reduced fear, and effective

images incorporated movement, brightness, colour, and moderate complexity. Although we cannot introduce televisions into poultry houses, projecting images on to the walls might be practicable. Farmers reported that playing the radio reduced aggression, improved the birds' health and increased productivity; this strategy also enriches the farmers' environment. The presence of a familiar odorant reduced chicks' fear of novel places, birds and food; indicating that olfactory therapy might minimize certain behavioural problems. Ultraviolet light might be used as enrichment because it reduced injurious pecking in turkeys and the basal corticosterone level in chicks; this merits further investigation. Providing chickens with string promoted foraging, sustained lengthy interest, and reduced feather pecking and feather damage in the laboratory and at a commercial farm. Clearly, extraneous stimulation is important to chickens. Although environmental enrichment should not be regarded as a panacea for welfare problems, the provision of appropriate visual, auditory, olfactory and tactile enrichment is likely to improve their quality of life.

Jensen, P., et al. (2005). "Feather pecking in chickens is genetically related to behavioural and developmental traits." Physiology & Behavior **86**(1-2): 52-60.

Feather pecking (FP) is a detrimental behaviour in chickens, which is performed by only some individuals in a flock. FP was studied in 54 red junglefowl (ancestor of domestic chickens), 36 White Leghorn laying hens, and 762 birds from an F-2-intercross between these two lines. From all F-2-birds, growth and feed consumption were measured. Age at sexual maturity and egg production in females, and corticosterone levels in males were also measured. From 333 F-2-birds of both sexes, and 20 parental birds, body composition with respect to bone mineral content, muscle and fat was obtained by post-mortem examinations using Dual X-Ray Absorptiometry (DXA). In femurs of the same birds, the bone density and structure were analysed using DXA and Peripheral Quantitative Computerized Tomography (pQCT), and a biomechanical analysis of bone strength was performed. Furthermore, plumage condition was determined in all birds as a measure of being exposed to feather pecking. Using 105 DNA-markers in all F2-birds, a genome-wide scan for Quantitative Trait Loci (QTL), associated with the behaviour in the F-2-generation was performed. FP was at least as frequent in the red junglefowl as in the White Leghorn strain studied here, and significantly more common among females both in the parental strains and in the F-2-generation. In the F-2-birds, FP was phenotypically linked to early sexual maturation, fast growth, weak bones, and, in males, also high fat accumulation, indicating that feather peckers have a different resource allocation pattern. Behaviourally, F-2 feather peckers were more active in an open field test, in a novel food/novel object test, and in a restraint test, indicating that feather pecking might be genetically linked to a proactive coping strategy. Only one suggestive QTL with a low explanatory value was found on chromosome 3, showing that many genes, each with a small effect, are probably involved in the causation of feather pecking. There were significant effects of sire and dam on the risk of being a victim of feather pecking, and victims grew faster pre- and post-hatching, had lower corticosterone levels and were less active in a restraint test. Hence, a wide array of behavioural and developmental traits were genetically linked to FP. (c) 2005 Elsevier Inc. All rights reserved.

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.

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.

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.

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.

RODENBURG, T. B., et al. (2013). "The prevention and control of feather pecking in laying hens: identifying the underlying principles." World's poultry science journal **69**(02): 361-374.

Feather pecking (FP) in laying hens remains an important economic and welfare issue. This paper reviews the literature on causes of FP in laying hens. With the ban on conventional cages in the EU from 2012 and the expected future ban on beak trimming in many European countries, addressing this welfare issue has become more pressing than ever. The aim of this review paper is to provide a detailed overview of underlying principles of FP. FP is affected by many different factors and any approach to prevent or reduce FP in commercial flocks should acknowledge that fact and use a multifactorial approach to address this issue. Two forms of FP can be distinguished: gentle FP and severe FP. Severe FP causes the most welfare issues in commercial flocks. Severe FP is clearly related to feeding and foraging behaviour and its development seems to be enhanced in conditions where birds have difficulty in coping with environmental stressors. Stimulating feeding and foraging behaviour by providing high-fibre diets and suitable litter from an early age onwards, and controlling fear and stress levels through genetic selection, reducing maternal stress and improving the stockmanship skills of the farmer, together offer the best prospect for preventing or controlling FP.

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

Uitdehaag, K. A., et al. (2009). "Mixed housing of different genetic lines of laying hens negatively affects feather pecking and fear related behaviour." Applied Animal Behaviour Science **116**(1): 58-66.

Adult laying hens from Rhode Island Red (RIR) origin both express lower levels of feather pecking and lower fear responses towards a novel object than laying hens from White Leghorn (WL) origin. The present study investigated whether mixed housing of RIR and WL laying hens would affect their behaviour in both an open field (at 17-18 weeks of age) and manual restraint test (at 24 weeks of age) and their feather damage due to severe feather pecking. In experiment A. 'pure' groups contained birds from one line only throughout the rearing and laying period. 'Mixed' groups contained an equal number of RIR and WL birds. Pure and mixed groups contained four birds, which were housed in battery cages. It was found that RIR birds were more active in the open field and manual restraint test than WL birds, although RIR birds from mixed groups became less active in the open field test than RIR birds from pure groups. This would indicate that RIR birds were less fearful than WL birds, but that they became more fearful in presence of these WL birds. In experiment B, RIR and WL birds were only housed together during the laying period, in varying ratios. It was found that WL birds from mixed groups had more feather damage due to severe feather pecking than WL birds from pure groups, whereas no effect of mixing was found in RIR birds. RIR birds from mixed groups therefore appeared to have developed relatively high levels of feather pecking, targeted at WL birds. This would indicate that, together with results from experiment A, fearful RIR birds from mixed groups were at higher risk to develop feather pecking than less fearful RIR birds from pure groups. This study clearly demonstrates that social factors have a strong influence on the development of feather pecking and related behavioural characteristics. (C) 2008 Elsevier B.V. All rights reserved.