THE BEAK TRIMMING ACTION GROUP'S REVIEW

Introduction

Laying hens have a tendency to peck, which, if redirected to the plumage and skin of other birds, leads to injury. 'Injurious pecking' is defined by FeatherWel[1] as comprising gentle and severe feather pecking, vent pecking and cannibalism. If left unchecked, it can lead to substantial feather loss, serious injury and death, and potentially, significant welfare and economic implications. Injurious pecking is unpredictable and, once started, problems are difficult to resolve. In order to prevent injurious feather pecking and cannibalism in commercial laying flocks, Member States may take advantage of a derogation permitting beak trimming (i.e. removal of the tip of the beak) in EU Council Directive 1999/74/EC[2] which lays down minimum standards for the protection of laying hens. The vast majority of UK laying hens housed in caged, free range or barn systems are routinely beak trimmed. In the past, beak trimming was carried out with the use of a hot blade to remove not more than a third of the lower and upper beaks, thereby reducing the sharpness of the beak, and limited management strategies were used to enrich the birds' environment in an attempt to minimise injurious pecking behaviour.

The Beak Trimming Action Group (BTAG) was first convened in 2002, following domestic legislation which set the timetable for a unilateral ban on the routine beak trimming of laying hens to come into force on 1st January 2011. However, progress in the control of injurious pecking under commercial conditions in England was not sufficient to implement a ban on beak trimming at that time. Following a recommendation[3] by the Farm Animal Welfare Council, the Mutilations (Permitted Procedures) (England) (Amendment) Regulations 2010 removed the ban, but restricted routine beak trimming to birds under 10 days old, using infra-red technology only. Similar legislation applies in Scotland, Wales and Northern Ireland. In practice, this procedure is carried out on day-old chicks in a hatchery and involves focusing a high intensity infra-red beam at the tip of the beak. During treatment, the chick's head is firmly retained in a rubber holder that prevents movement of its head, enabling precise and reliable treatment of the beak. One to three weeks later the tissue behind the damaged area heals and the beak tip falls off. Permitting routine beak trimming using infra-red technology was intended only as an interim

[1] http://www.featherwel.org/

[2] Council Directive 1999/74/EC of 19 July 1999 laying down minimum standards for the protection of laying hens

[3] http://webarchive.nationalarchives.gov.uk/20121007104210/http://www.fawc.org.uk/pdf/beaktrimming.pdf

arrangement, whilst efforts towards a long-term solution to the issues were developed.

Following the Coalition Government's commitment[4] to review the policy on the routine beak trimming of laying hens in 2015, with a view to banning this procedure in 2016, BTAG was reconvened in 2011. It was tasked with reviewing the policy on routine beak trimming of laying hens and developing and implementing an action plan to ban this procedure in 2016, without detriment to overall bird welfare.

Ministers have now asked BTAG to undertake a review of all the available evidence and make recommendations to them, including whether beak trimming could be banned in 2016.

BTAG representation

BTAG is made up of representatives from the poultry industry, animal welfare NGOs, veterinary and scientific specialists, retailers, the Farm Animal Welfare Committee, Defra officials and devolved administrations. Further details of BTAG's membership can be found at Annex 1. Compassion in World Farming was represented on BTAG, but after the final meeting withdrew its support for the review.

Evidence

Since reconvening BTAG in 2011, members have shared experience from the UK and overseas on the extent of the problem of injurious pecking and consideration of intervention procedures identified by research and practical implementation. This has included study tours; literature reviews; consideration of current and previous domestic research; the success or otherwise of management interventions and consideration of other contributory factors or solutions, including those associated with genetic or nutritional influences.

Study tours

In 2011, members of BTAG carried out study tours to Austria and Sweden, where they do not beak trim laying hens, to assess how this has been achieved. The visits were useful, but there are difficulties in translating the lessons learned to the majority of UK flocks. The UK tends to have larger flock sizes than either Austria or Sweden, there is consumer demand for larger eggs in the UK and a pressure to use brown strains of birds compared to the white strains of birds favoured in Sweden. Both Austria and Sweden claim they have stopped the severe feather pecking that leads to cannibalism, but they have not fully resolved the injurious pecking which can cause significant feather loss. Significant feather loss is not acceptable to the UK

[4] Written statement: Official Report, 12 November 2010, Vol. 518, c. 4MC.

industry, consumers, retailers or enforcement bodies, although current levels are higher than would be considered acceptable in some flocks.

Literature reviews

Two comprehensive reviews of the feather pecking literature were published by external researchers in 2013 (Rodenburg et al 2013[5]; Nicol et al 2013[6]), the abstracts of which are at Annex 2. To bring the evidence base up-to-date and identify any key research developments following these reviews, Defra carried out a literature review in September 2015 and considered all relevant papers published in the intervening period; this is enclosed at Annex 3. It identified that there was a high level of research interest in feather pecking and other injurious behaviour, and that recent publications had focused more on understanding the genetics of injurious pecking and testing management techniques designed to reduce its prevalence in commercial production.

University of Bristol study

In 2012, Defra commissioned a research project at the University of Bristol (Executive Summary at Annex 4), aimed at assessing the effectiveness of management strategies in reducing injurious pecking in non-cage flocks of birds with intact beaks. 20 commercial flocks, of which 19 were free range and one barn, were recruited to participate in the study by the laying hen industry. The volunteer flock sizes ranged from 1,200 to 16,000 hens, with an average size of 6,329 hens. Information for comparative purposes was obtained from 18 flocks that had preceded the study flocks on the same farms (12 beak trimmed flocks and six intact-beak flocks) and from six beak trimmed flocks housed at the same time, on the same farms as six of the intact-beak flocks. Management strategies were then suggested for the study flocks to prevent outbreaks of injurious pecking. These strategies included the use of pecking distractions, such as pecking blocks and nets containing straw; highly absorbent compressed wood pellets to improve litter condition, and methods of encouraging range use, such as providing artificial shelter. Data on mortality, bodyweight, plumage condition and behaviour were obtained at 40 weeks, with 19 flocks followed until end of lay (due to the late recruitment of one flock).

One of the objectives of the study was to develop a communication strategy predominantly aimed at disseminating practical information to farmers on interventions aimed at reducing the risk and likelihood of injurious pecking.

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[5] Rodenburg TB, van Krimpen MM, de Jong IC, de Haas EN, Kops MS, Riedstra BJ, Nordquist RE, Wagenaar JP, Bestman M and Nicol CJ (2013) The prevention and control of feather pecking in laying hens: identifying the underlying principles. Worlds Poultry Science Journal 69/ 2: 361-373

[6] Nicol CJ, Bestman M, Gilani A-M, de Haas, EN, de Jong IC, Lambton S, Wagenaar JP, Weeks CA and Rodenburg TB (2013) The prevention and control of feather pecking: application to commercial systems. *Worlds Poultry Science Journal 69/4: 775-788*

The key findings of the study were:

- No problems with mortality, bodyweight or injurious pecking behaviour were experienced by intact-beak flocks during rear. More effort was invested in rearing intact-beak flocks than the industry norm.

- Outcomes for study flocks during lay were highly variable in terms of the extent of injurious pecking and mortality levels (which mirrors what happens in specialist flocks which are not beak trimmed and to a lesser extent in the UK beak trimmed population). Some flocks performed very well with low mortality and some were kept on beyond 72 weeks of age, one until 90 weeks. At approximately 25 weeks, two of the 16,000 bird intact-beak flocks experienced substantial problems with injurious pecking and very high mortality levels. One of these flocks had to be emergency beak trimmed.

- At 40 weeks, 18 of the 20 flocks achieved acceptable levels of mortality (according to a 5% threshold that had been previously agreed by BTAG). By 71 weeks, only 12 out of 19 flocks achieved acceptable levels of mortality (according to a 9% threshold agreed with BTAG).

- When injurious pecking did occur, the consequences in the intact-beak flocks were far more serious than in beak trimmed flocks, in terms of direct skin and tissue damage, subsequent chronic infection and reduced bird welfare.

- More effort was invested in managing intact-beak laying flocks than the industry norm. The average recurrent cost of the management strategies actually implemented on each farm was calculated using slightly different methods as either £260/1,000 birds or £313/1,000 birds.

- Study flocks that had been preceded by a previous <u>intact-beak</u> flock showed a significant improvement in end of lay mortality, plumage condition and a tendency towards an improvement in financial performance. This suggests that, with experience and increased uptake of management strategies, levels of mortality can be reduced and kept within acceptable limits. It is therefore possible that the additional costs of the management strategies may be outweighed by improved margins on these farms.

- Overall, study flocks that had been preceded by a previous <u>beak-trimmed</u> flock showed no significant difference in end of lay mortality or financial performance. This suggests that any positive effects of the management strategies were countered by the increased risks of making the transition from beak-trimmed birds. We consider that the strategies probably ameliorated the risks of transition, but were insufficient to produce improvements in performance in intact-beak study flocks relative to previous beak-trimmed flocks.

- The two flocks that had the worst injurious pecking were both large, 16,000 bird flocks, which is becoming the norm in the UK. We detected no overall significant relationship between total mortality and flock size, but a study on a larger scale would be required to examine effects of flock size in more detail.

- Further uptake of the management strategies was considered generally beneficial for all flocks by the farmers and stakeholders involved in the study. This uptake was promoted by the development of the 'FeatherWel' website and guide 'Improving Feather Cover: A guide to reducing the risk of injurious feather pecking occurring in non-cage laying hens'. These were produced by the University of Bristol, in consultation with the British Egg Industry Council (BEIC), the RSPCA, the Soil Association and AssureWel. In conjunction with the assessments, benchmarking and feedback being provided by AssureWel (see below) this offers producers opportunities to reduce injurious pecking in all flocks, regardless of whether they are trimmed or have intact beaks. The University of Bristol also contributed to a number of advisory sessions with farmers throughout England and more formal presentations to farmers, veterinarians and poultry scientists.

SRUC studies on enriched cages

The Scottish Government funded similar research (summary at Annex 5) to that outlined above, but in birds housed with intact beaks in enriched cages. This was carried out by Scotland's Rural College (SRUC). The aim of Study 1 was to assess the effects of two bird strains (commonly used Hyline Brown and less common Lohmann Classic, which has been used successfully without beak trimming in non-cage systems), two beak treatments (trimmed or not), and the provision of extra enrichment or standard enrichment, on mortality, behaviour, and feather condition in a commercial environment. Sixty-four cages of 80 birds each were used within a commercial hen house that housed a further 1,476 cages. The house was managed to suit the majority of birds in the flock, i.e. Hyline Brown.

Two cages of hens (both non-beak trimmed, Lohmann strain, one with and one without extra enrichment) were depopulated at 48 weeks of age due to pecking-related mortality. (The Home Office licence governing this work required that the birds had to be beak trimmed or removed, and the farm opted for the latter, although this culling would not have been carried out in typical commercial practice.) In one of these cages, 5 birds (6.25% of the cage) died due to injurious pecking-related mortality over a period of 6 months; in the other, 7 birds (8.75% of the cage) died due to injurious pecking-related mortality over a period of 4 weeks. As a result, injurious pecking mortality was assessed in two ways: by taking into account remaining healthy birds that were subsequently culled in the two problematic cages ('maximum') and by estimating how many further losses might have occurred if those cages had been allowed to progress until the end of the trial at 71 weeks, based on the rate of deaths to 48 weeks ('estimated').

Overall, maximum injurious pecking mortality was significantly affected by breed x beak treatment, with Lohmann non-beak trimmed hens having greater mortality (12%) than any other group (<1%), however estimated injurious pecking mortality was similar across all four breed x beak treatments. Estimated injurious pecking mortality was only affected by overall breed effects (1.25% in Lohmann birds; 0.12% in Hyline), and overall beak treatment effects (1.02% in non-beak trimmed birds; 0.35% in beak trimmed). Extra enrichments used had no effect on injurious pecking-related mortality.

It is important to note that:

- Since this shed of hens was managed as a Hyline flock, the way in which the injurious pecking might have been managed (by dimming the lights) could not be carried out because it would have affected the egg production rate of the majority of the hens in the shed; and
- Not trimming the standard strain (Hyline) resulted in doubling the maximum injurious pecking mortality (0.16% in non-beak trimmed; 0.08% in beak trimmed), although this was still low. Observations of pecking behaviour were too sparse to analyse, however feather condition deteriorated more quickly over time at certain body sites, both with Lohmann hens and with non-beak trimmed hens.

This small scale study suggests that the Hyline Brown strain could be managed in furnished cages without beak trimming, but that injurious pecking-related mortality would increase. The results for the Lohmann strain should not be over-emphasised, because management techniques that might have mitigated injurious pecking could not be implemented.

SRUC's Study 2 focussed on the effect of alternative diets on performance of non-beak trimmed hens and also further explored the use of extra enrichments, and their effects on mortality, behaviour, and feather damage (as an indicator of feather pecking) in a research facility.

The dietary treatments (protein, fibre) had some effects on bird production. Extra fibre reduced, and control fibre levels increased, weight gain in animal-based diets compared to plant-based diets. Treatments had no significant effect on egg production, which closely followed the breed standard, but there were some significant effects of protein source and fibre levels on egg quality. There were some small but statistically significant effects, in that extra enrichment led to less feather damage than for hens without extra enrichment, and hens fed extra fibre showed reduced pecking at inanimate objects. However, because of the overall low occurrence of feather pecking and pecking damage in this study, there was no conclusive evidence of the efficacy of these treatments on injurious pecking behaviour. It would be important to trial the treatments again, in a commercial environment and over a longer period.

Assurewel

AssureWel[7] is a collaborative project led by the University of Bristol, RSPCA and Soil Association supported by the Tubney Charitable Trust. The project is aimed at developing a system of welfare outcome assessments for the major farm animal species, so that welfare can be measured and the impact of management interventions evaluated. For laying hens, these assessments have been developed for use by both assurance schemes and individual producers, to monitor feather cover in non-cage systems.

A comparison of data from years 1 and 2, across Freedom Food and Soil Association flocks, demonstrates overall improvements in feather score on the farms in the schemes. Data were available from 830 farms assessed in year 1 and 743 farms in year 2. Of these, 81% of flocks were free-range, 17% organic and 3% barn; 79% of flocks were beak trimmed. The mean age of the birds at assessment was 45 weeks and the mean flock size was around 7,750 birds. The number of birds recorded with feather loss reduced by a third from year 1 to year 2, from 33% (13% moderate/severe) to 23% (6% moderate/severe) for the back and vent regions (indicative of injurious pecking), and 32% (10% moderate/severe) to 22% (6% moderate/severe) for the head and neck regions (indicative of aggressive interactions or mechanical wear).

A full analysis of year 3 data is not yet complete; however, draft results suggest there was little overall improvement in feather score between years 2 and 3. The average percentage prevalence of birds with feather loss was 23% (8% moderate/severe) for the back and vent regions, and 22% (6% moderate/severe) for the head and neck. 744 flocks were assessed, with an average flock size of around 8,900 birds.

Data are continuing to be amassed. These data enable producers to compare their results with other producers and benchmark their own performance with previous flocks, to identify targets for improvements, particularly on feather loss and mortality. The data additionally provide a robust assessment of feather loss at scheme level, allowing the monitoring of non-cage industry prevalence.

[7] http://www.assurewel.org

Other solutions

Genetics

The breeding Industry has been investing in balanced breeding programmes over the last 15 years, but a genetic solution where efficiencies, animal welfare and sustainability have to be balanced is not a ‘quick fix’. The advances in genomic selection and breeding technologies have enabled the choice of breeding candidates to be made much earlier in life due to determination of a “genomics based” breeding value. However this is still in the very early stages of development and has yet to establish benefits on selection traits, including behaviour.

In fact, selection for bird survival has been implemented in company breeding programmes for several decades and companies include survival as a breeding goal trait in their breeding programmes. Most initial field studies have used bird survival to a given age as the trait for selection for higher survival in individuals. However, unless family information is included (i.e. using information on related animals housed in groups), higher mortality rates and lower productivity result as, inadvertently, more aggressive birds are selected for breeding. The most recent research suggests that to reduce mortality due to cannibalism, selection should not only consider the direct effect of an animal’s own genes, but also the indirect (or ‘associative’) effect of an individual on its group members.

A bird’s chance of survival is highly influenced by the cannibalistic behaviour of its cage or colony members, and survival in purebred laying hens is known to be influenced by social interactions with others. New breeding programme research is aiming for the genetic improvement of laying hens so that they become more ‘sociable’.

Dr Joanne Conington, a genetics expert serving on the Farm Animal Welfare Committee, was co-opted to advise BTAG on the current state of play into genetics research aimed at reducing the likelihood of injurious pecking in laying hen strains. She visited the Hendrix Genetics (ISA) and Hy-line (Wesjohann) breeding companies to assess current and planned research in this area. Areas being investigated include the assessment of sociability and robustness in genetic selection. Genomic selection technology is also being used to improve bird survival and may accelerate progress on genetic improvements in this area. Dr Conington concluded that the greatest influences on survival remain non-genetic, meaning that management and feeding strategies continue to be key components in the evaluation of survivability of laying hens. She advised that the earliest commercially available strains, with a significantly reduced propensity to peck, could become available is 2025. This has a significant impact on setting timetables for improvements in reducing injurious pecking using genetic interventions, whilst accepting that such interventions would not, in isolation, be likely to eliminate injurious pecking.

Nutrition

(See also Study 2 in earlier section on SRUC studies on enriched cages.)

There are numerous published studies that highlight a whole range of potential nutritional 'trigger factors' that can be responsible for outbreaks of injurious pecking. These factors are well understood and as such great care is taken to provide the bird with a nutritionally balanced diet to ensure that simple nutritional deficiencies do not occur.

Beyond the direct nutrient effects there have also been a number of studies that have indicated that the interaction of diet density and fibre levels in the diet can have an impact on plumage condition and mortality caused by injurious pecking. In simple terms birds fed on lower density diets with higher fibre levels spend more time feeding and less time on other pecking behaviour.

The industry is now more aware of the benefits of fibre but it is clear from both published research and commercial experience that lower density, higher fibre diets cannot fix the problem of injurious pecking in isolation. For this type of diet to work under commercial conditions, a flock needs to be managed to ensure that it increases its feed intake sufficiently both to achieve expected performance and the distraction from other pecking activity.

The nutritional and management inputs during the rearing phase have also been shown to be important again with reference to diet density and fibre level. There is also interest in the impact of dietary changes on subsequent bird behaviour but this area would need more research before it could be applied to the commercial situation.

Economic analysis

Any unilateral ban on beak trimming of laying hens at this stage would be viewed as re-instating 'gold plating', following the removal of the ban from legislation in 2010. It would currently be very likely to put England's laying hen industry at a competitive disadvantage, compared with producers in the rest of the UK and other Member States who can make use of the derogation permitting beak trimming in the EU laying hens directive. There would be implications if England went ahead with a ban, but the Devolved Administrations did not. All four UK pullet hatcheries are located in England, so it could mean that a de facto ban would come in, in the Devolved Administrations. Alternatively, the hatcheries could be driven to move into Scotland, Wales or Northern Ireland or chicks/pullets could be sourced from other European countries (such as France, which still permits hot blading), which would severely undermine the hatcheries and damage the Lion Quality Scheme. The cost of any potential ban on beak trimming in England would depend on how the legislation was phrased, e.g. whether any ban was on the keeping of routinely beak trimmed birds rather than, or as well as, the procedure itself. If the keeping of beak trimmed birds was not banned, hatcheries outside England could supply beak trimmed birds to English producers, defeating the purpose of any ban, as well as disadvantaging hatcheries in England. The cost of a ban would have to be set against the economic savings that would result if the industry no longer had to beak trim and the range of welfare benefits that may result by implementing the management strategies.

Beak trimming in the European Union

The majority of Member States make use of the derogation in the laying hens directive, which permits beak trimming (i.e. removal of the tip of the beak) to prevent feather pecking and cannibalism. There is no move to ban beak trimming in France, Spain, Italy, Portugal, Greece or Eastern Europe where hot blade beak trimming is still allowed. The Republic of Ireland permits infra-red beak trimming. In practice its day-old chicks come from England, so any proposed ban on beak trimming in England would lead to a de facto ban in the Republic of Ireland or to them sourcing chicks from elsewhere.

Austria (a brown egg market) does not make use of the derogation due to the requirements of its assurance scheme, and Finland and Sweden (both of which have a white egg market) have legislation which bans beak trimming. Denmark (also predominantly a white egg market) extended its voluntary industry-led ban on beak trimming caged hens to barn and free range birds in July 2014. In certain German Länder (with a brown egg market), the industry has signed a 'voluntary binding agreement' with the Government to stop beak trimming from 1st August 2016 and to stop stocking pullets with trimmed beaks from 1st January 2017. Egg producers will receive a premium of €1.70 per bird if they do not beak trim. The Netherlands (40% brown and 60% white birds) plans to ban beak trimming from 1st September 2018, dependent on a satisfactory outcome of trials on non-trimmed, non-cage birds being reviewed in 2017.

Beak trimming outside the European Union

Norway and Switzerland have both banned beak trimming of laying hens. In Australia, beak trimming is banned in one state – the Australian Capital Territory, where there are very few laying hen flocks. In the remaining states, hot blading is permitted, but infra-red is the most common method used. In the USA, beak trimming is still permitted and the most common method used is hot blading. In New Zealand, its laying hen welfare code permits beak trimming using infra-red technology only on chicks up to 3 days old. In the vast majority of non-EU countries, there is no legislation in place governing beak trimming.

Conclusion

BTAG members have worked hard over the last four years to study the issue of injurious pecking in both rearing and laying flocks. Progress has been made in a number of areas:

- Further understanding the extent of the issue in both rearing and laying flocks, its causes and possible approaches to further improving laying hen welfare.
- Helping to establish practical and successful management intervention strategies to reduce the incidence of injurious pecking in all flocks – both trimmed and non-trimmed.
- Recognising the importance of managing the transition from rearing to laying house to reduce, as far as possible, the number of changes to the hen's environment.
- Exploring methods for producers to assess the extent of injurious pecking in their flocks, benchmark their progress against previous flocks and compare their progress with other producers.
- Considering the potential impact of genetics and nutritional factors on injurious pecking, and possible solutions.
- Understanding the animal welfare, economic, social and practical repercussions if there was to be a ban on the beak trimming of laying hens in England.

Despite this considerable progress, BTAG concludes that an imminent ban on beak trimming could result in significant welfare problems through outbreaks of feather pecking and cannibalism.

Once injurious pecking establishes itself in a flock, it can be difficult to resolve, leading to chronic and sometimes irreversible injury and damage. As was the case in two of the large pilot flocks in the University of Bristol study, the consequences of injurious pecking in intact-beak flocks is far more serious in terms of direct skin and tissue damage, subsequent chronic infection and reduced bird welfare. It can also result in a significant economic loss to the producer. In one of these large flocks, emergency beak trimming using the hot blade method was necessary to help control a severe outbreak of injurious pecking, which is stressful for the birds and for everyone involved. Evidence to date indicates that unlike infra-red beak trimming, hot blading causes chronic pain and therefore bird welfare may be severely compromised.

In other flocks, excessive mortality, as measured by agreed thresholds, although not directly attributable to injurious pecking *per se*, was related to secondary systemic bacterial infection which gained access through skin damaged by injurious pecking.

The inability to predict when injurious pecking is likely to occur and its high variability in laying hen populations - both beak trimmed and non-beak trimmed - means that in our view a ban on beak trimming should not be introduced in 2016 for free range, barn or caged flocks. It still cannot be reliably demonstrated that under commercial conditions all laying hen flocks can be managed without the need to beak trim, without a greater risk to their welfare than that caused by beak trimming itself.

However, BTAG also believes that the deferring of any ban on beak trimming of laying hens should only be an interim step. Our view is that progress must continue to be made in a stepwise fashion to accelerate the timeframe within which the widespread use of beak trimming in commercial flocks could be avoided. We believe there is considerable scope for further improvement in the control of injurious pecking through greater efforts by producers to implement further mitigating management interventions. A requirement to demonstrate progress formally in this area should be incorporated into all farm assurance schemes for laying hens and in any revision of the welfare code for laying hens.

All BTAG members agree that progress in this area is already being made and that further improvements in bird welfare could be achieved through strengthening current farm assurance scheme standards and regular audit of such standards. The RSPCA and Compassion in World Farming members consider that this should be further supported by legislation, requiring significant and sustained attempts to prevent injurious pecking to be implemented before placing a trimmed flock. However, industry members disagree that legislation is necessary, noting that the progress already being made could be best moved forward via assurance schemes.

Recommendations

In making the following recommendations, BTAG emphasises that the primary consideration is to safeguard the welfare of laying hens:

Recommendation 1 - A ban on beak trimming of laying hens should not be introduced in 2016, as, on the basis of practical experience and available research, it is considered that this could be detrimental to overall welfare in an unacceptable number of laying hens. Compassion in World Farming disagree with this recommendation. They believe that a ban on beak trimming should be introduced in 2016, with an implementation date to be determined by the Secretary of State, based on further reviews of progress.

Recommendation 2 – Producers and the industry as a whole should nevertheless continue to make efforts to avoid the need for beak trimming, particularly by reducing injurious pecking (as in the following recommendations), to the point where there is sufficient confidence to stop beak trimming. This may be achieved in some systems more readily than in others. Progress should be formally reviewed by Government. If significant progress is not being made, then it should consider further formal action, including legislation.

Recommendation 3 – To take forward Recommendation 2, all laying hen producers should draw up bespoke action plans to implement the management strategies drawn up by FeatherWel. BTAG recognises that these management strategies have been incorporated into the latest version of the BEIC's Lion Code of Practice[8] and the RSPCA Welfare Standards for Laying Hens[9] (implemented by RSPCA Assured scheme, Freedom Food) and recommends that all laying hen farm assurance schemes should monitor uptake of the management strategies by their members. RSPCA and Compassion in World Farming members expressed their minority view that the requirement for such action plans should be laid down in legislation.

Recommendation 4 - All farm assurance scheme audits/inspections should monitor mortality, feather cover and records of injury attributable to injurious pecking in all laying hen production systems so that producers can benchmark their own performance with previous flocks and identify targets for improvement. Progress should be assessed on a flock-by-flock basis as part of the review of the farm's veterinary health and welfare plan. The aim should be for continuous improvement in mean feather loss scores, using the AssureWel scoring system (already in place in non-cage systems), and injuries attributable to injurious pecking. Failure to make such improvements should be seen as possible non-compliance with the scheme requirements.

Recommendation 5 – BTAG (or a similar independent body, such as the Laying Hen Welfare Forum) should continue to monitor progress in reducing the incidence of injurious pecking in the national flock. Such a body should report to Ministers on a biennial basis with the results of assurance scheme monitoring of feather cover and mortality attributable to injurious pecking along with updates on the proportion of beak trimmed flocks and uptake of management strategies.

Recommendation 6 - Knowledge transfer aimed at disseminating developing research and practical information to farmers on interventions aimed at reducing the risk and likelihood of injurious pecking should continue. For this to happen, FeatherWel and other resources will need to be updated as new knowledge and findings emerge from a growing body of work around the world, and industry should show a robust commitment to implementation of relevant advice in all production systems. A funding source should be identified.

[8] https://www.egginfo.co.uk/british-lion-eggs/about/british-lion-code-practice
[9] http://science.rspca.org.uk/sciencegroup/farmanimals/standards/layinghens

Recommendation 7 – Industry should continue to consider other approaches to reduce the likelihood of injurious pecking. These could include nutrition, genetics (including choice of white versus brown egg laying strains) and other management and husbandry strategies. The breeding companies should keep up the momentum and make use of genomic technology to accelerate progress to reduce the likelihood of injurious pecking in laying hen strains. It may be appropriate for these approaches to be considered on an EU-wide basis. Further research is warranted into nutritional trigger factors and the impact of dietary changes on the incidence of injurious pecking, and into approaches to reduce injurious pecking through various dietary inputs.

Recommendation 8 – The Government should support research which is needed to establish sensitive and cost-effective methods for the earliest possible detection of injurious pecking, and to develop evidence-based protocols to respond promptly with the aim of avoiding the escalation and spread of this behaviour.

November 2015

Annex 1

MEMBERSHIP OF THE BEAK TRIMMING ACTION GROUP

Stephen Lister	Chair of the BTAG Steering Group, Crowshall Veterinary Services
Michael Appleby	World Animal Protection; Farm Animal Welfare Committee
David Brass	Lakes Free Range Egg Company
Steve Carlyle	Country Fresh Pullets
Phillip Crawley	National Farmers' Union, Sunrise Eggs
Franceska Drummond	Animal and Plant Health Agency
Stephen Edge	ADAS
David Evans	Morrisons
Mia Fernyhough	Royal Society for the Prevention of Cruelty to Animals
Alistair Fillingham	Hy-Line UK / EW Group
John Fitzpatrick	Tesco
Gary Ford	National Farmers' Union
Robert Gooch	British Free Range Egg Producers Association
Andrew Joret	British Egg Industry Council, Noble Foods
Richard Kempsey	Stonegate
Charlie Kerr	Country Fresh Pullets, Lloyds Animal Feeds
Christine Nicol	University of Bristol
Jake Pickering	Sainsburys
Steve Pritchard	Premier Nutrition
Vicky Sandilands	Scotland's Rural College
Duncan Sinclair	Waitrose
Charles Stephenson	British Free Range Egg Producers Association
Peter Stevenson	Compassion in World Farming
Stephen Turner	Hendrix Genetics (ISA)
Jeff Vergerson	British Free Range Egg Producers Association
Mark Williams	British Egg Industry Council

Department for Environment, Food and Rural Affairs
Department of Agriculture and Rural Development, Northern Ireland
The Scottish Government
The Welsh Government

Annex 2

REVIEWS OF FEATHER PECKING LITERATURE PUBLISHED BY EXTERNAL RESEARCHERS IN 2013

The prevention and control of feather pecking in laying hens: identifying the underlying principles (Rodenburg et al 2013)

Abstract

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.

The prevention and control of feather pecking: application to commercial systems (Nicol et al 2013)

Abstract

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.

Annex 3

Feather pecking behaviour in laying hens: a review of research findings published between 2013 and 2015

1. Introduction

Feather pecking in laying hens is an important welfare and production concern and a large number of research studies have been carried out to try to understand this multifaceted behaviour more fully and to identify practical methods of reducing its prevalence in commercial production. Two comprehensive reviews of the feather pecking literature were published in 2013 (Rodenburg *et al* 2013; Nicol *et al* 2013), and the aim of the current paper is to provide an update on research findings that have been published since these reviews in order to identify key developments in knowledge and establish the current scientific evidence base with regard to feather pecking behaviour.

2. Protocol

Literature searches were carried out in July 2015 using a range of online bibliographic databases (Web of Science, ScienceDirect, Pubmed and Google Scholar[1]). Searches were restricted to literature published between January 2013 and July 2015, and search terms were constructed to ensure that all citations relevant to feather pecking in laying hens would be returned. A total of 180 papers were shortlisted as potentially significant, and, after consideration of titles and abstracts, 38 of these papers were found to be directly relevant and were obtained and read in full. An additional check was made in early September to identify whether any further papers had been published since the initial search, and one additional paper was identified and reviewed.

3. Key findings

The key findings from the literature reviewed are presented below against similar categories to those used in Rodenburg *et al* (2013) and Nicol *et al* (2013). The findings are divided into two main categories, (1) findings relevant to understanding the underlying principles of severe feather pecking (SFP), primarily by looking at how birds differ in their propensity to develop SFP; and (2) findings relevant to understanding how production and management conditions influence SFP behaviour.

Within the first section (findings relevant to understanding the underlying principles of SFP), a large number of the studies cited looked at birds of two specific lines divergently selected over many generations for high (HFP) and low (LFP) levels of feather pecking behaviour (see Kjaer *et al* 2001 for further details). Whilst findings from these studies are useful in terms of understanding the mechanisms that might underlie SFP, it is not known to what extent these findings can be generalised to

[1] https://apps.webofknowledge.com/; http://www.sciencedirect.com/; http://www.ncbi.nlm.nih.gov/pubmed; http://scholar.google.co.uk/

birds currently used in commercial production. For this reason, whilst important to include, findings based on these highly selected bird lines have been clearly identified below (referred to as 'highly selected HFP/LFP bird lines').

Priority has been given to presenting evidence related to SFP, but account has been taken of gentle feather pecking (GFP), vent pecking and aggressive pecking where considered appropriate (see Rodenburg *et al* 2013 for definitions).

3.1 New findings relevant to understanding the underlying principles of SFP

The behaviour of an individual is determined by its genotype and by the physical and social environment that it is exposed to throughout its life. Recent studies have explored SFP in relation to maternal effects, the expression of specific behavioural traits, measures of brain functioning and genetic effects. The key findings of these studies are outlined below.

3.1a Maternal effects

With regard to the influence of maternal effects, de Haas *et al* (2014a) assessed behavioural and physiological measures of anxiety and SFP in parent stock in order to determine how these related to levels of the same measures in their offspring during the rearing period. Significant associations were found, although most effects were true for white hybrid (Dekalb White) but not brown hybrid (ISA Brown) birds. In white birds, high levels of maternal corticosterone, feather damage and whole-blood serotonin were positively related to levels of SFP and anxiety (assessed in a social isolation test) in offspring. This finding demonstrates that careful management of parent flocks in order to minimise stress for these birds may have beneficial effects on their offspring, including a reduced propensity to perform SFP.

Key finding: Enhancing the management of parent flocks to minimise the stress they experience may reduce levels of SFP in their offspring.

3.1b Relationship with specific behavioural traits

Certain behavioural traits observed in individual birds during the rearing and/or laying period have previously been shown to be associated with levels of SFP (reviewed by Rodenburg *et al* 2013). Studies published between 2013 and 2015 provide further evidence for and against a number of these links.

<u>Ability to cope with fear & stress</u>

With regard to birds' ability to cope with fear and stress, de Haas *et al* (2014a) reported a positive association between fearfulness/anxiety (assessed in a social isolation test) at one week of age and greater feather damage at five weeks of age. In a separate study, Haas *et al* (2014b) found that an enhanced fear of humans during either the rearing or the laying period was a significant risk factor for feather damage at 40 weeks of age. It is possible that the link between fearfulness and SFP may be mediated by stress, as high levels of fear exhibited by laying hen chicks have been shown to have a long-term effect on stress sensitivity (de Haas 2014, Ch2).

In contrast to the findings of de Haas *et al* (2014b), Hartcher *et al* (2015b) found no association between behavioural measures of fearfulness (tonic immobility, open-field, novel food and competition tests) during the rearing period and feather damage during the laying period. The authors acknowledge that this result conflicts with several other studies, and suggest that future research should investigate fearfulness at the time that SFP is being performed to better understand the behavioural motivations underlying SFP.

Studies on highly selected HFP/LFP bird lines by Bőgelein *et al* (2014 & 2015) looked at the relationship between SFP and behavioural measures of fear (tonic immobility, open-field, emerge box and pencil tests) in adult HFP and LFP birds and also in F2 crosses of these lines. Contrary to what they had expected, they found that the responses of the HFP birds on some of the tests indicated that they were less fearful than the LFP birds. However, in general, birds' responses on the different tests were not in agreement and the authors concluded that no consistent relationship existed between SFP and fear in this population of birds.

Overall, the studies reviewed above point to an inconsistent relationship between fear/stress and SFP. The time at which these traits are assessed may be one factor underlying this inconsistency, since some studies have looked for associations at a given point in time, whereas others have looked at whether one trait is predictive of the other later in the bird's life in an attempt to establish cause and effect. Additionally, differences may be due to different bird strains and behavioural tests being used and to variable interpretations of birds' responses on these tests.

Key finding: Inconsistent relationships are reported between fear/stress and SFP (perhaps due to different methodologies and differing interpretations of birds' responses on these tests).

<u>Aggressive behaviour and aggressive pecking</u>

Bessei *et al* (2013) looked at differences in aggressive behaviour between two highly selected HFP/LFP lines of birds selected over nine generations. When birds from the two lines were mixed together in pens from 26 weeks of age, HFP individuals showed higher levels of threat behaviour and delivered and received more aggressive pecks (in addition to performing more SFP behaviour). There was no correlation between aggressive pecks and severe feather pecks within individuals however, and whilst LFP birds effectively avoided aggressive encounters they were not able to avoid receiving feather pecks. These findings support the hypothesis that SFP and aggressive pecking stem from different underlying motivations.

In further support of the dissociation between feather pecking and aggressive pecking, in their study of highly selected HFP/LFP bird lines, Grams *et al* (2015) reported a low correlation between these two behaviours illustrating that individuals that perform SFP do not necessarily perform aggressive pecking and vice versa. However, these authors did find a genetic correlation between these two behaviours, as did Bennewitz *et al* (2014), again, using highly selected HFP/LFP bird lines. Therefore selection against feather pecking may also act to reduce aggressive pecking.

Key finding: SFP and aggressive pecking appear to have different underlying mechanisms. However these two behaviours are genetically correlated hence selection against SFP should also act to reduce aggressive pecking.

Vent pecking behaviour and cannibalism

In an epidemiological study of vent pecking (VP) and cannibalism in 119 commercial flocks in the UK, Lambton *et al* (2015) reported clear associations with SFP behaviour. Within flocks where VP was observed, the rate of VP increased with the rate of SFP, and across all flocks the likelihood of cannibalism increased with rates of SFP. Although clear relationships were found, the authors caution that it is not yet possible to identify whether SFP leads to VP or vice versa, or whether these behaviours are associated simply because they share risk factors.

Feather eating behaviour

In line with previous studies that have shown that birds that feather peck often eat the feathers that they remove, Bőgelein *et al* (2015), using HFP/LFP bird lines, reported that in a feather eating test HFP birds consumed more feathers than LFP birds. Relatedly, Meyer *et al* (2013) again using HFP/LFP bird lines, noted a higher number of feather parts and particles in the gizzards of laying hens selected for high as opposed to low feather pecking activity. Additionally, differences between these two lines were found for levels of microbial metabolites in the intestines, leading the authors to question whether differences in metabolite levels might alter bird behaviour and thus play a role in feather pecking behaviour.

The link between SFP and feather eating is further supported by the finding of Bennewitz *et al* (2014) that these two traits are genetically correlated in highly selected HFP/LFP bird lines (see section 3.1d).

Key finding: A clear relationship exists between SFP and feather eating for birds from highly selected HFP/LFP bird lines.

3.1c Relationship with measures of brain functioning

In support of previous studies, recent findings on highly selected HFP/LFP bird lines demonstrate clear differences in brain functioning related to the performance of SFP.

Kjaer *et al* (2015) measured levels of recurrent perseveration (a form of stereotyped responding suggestive of altered brain activity) on a two-choice guessing task to determine whether birds from highly selected HFP/LFP bird lines differed. Clear differences were found, but unexpectedly HFP birds showed lower levels of perseveration than LFP and control birds (i.e. their responses were less stereotyped). This result not only illustrated a fundamental difference in brain activity between HFP and LFP/control birds, but also led the authors to discount the classification of feather pecking as a stereotypic behaviour (a behaviour pattern that is repetitive, invariant and has no obvious function; see Mason 1991). Instead, the authors note that their findings support the hypothesis that feather pecking is related to a higher level of general activity, possibly due to changes in the dopaminergic system.

Recent studies on highly selected HFP/LFP bird lines by Kops *et al* (2013a, 2013b & 2014; also see Kops 2014) have shown SFP to be associated with differences in the activity of both the serotonergic and dopaminergic systems. For example, birds that feather pecked and victims of feather peckers were found to have a higher turnover of serotonin in the dorsal thalamus region of the brain compared to non-peckers, while non-peckers had higher levels of serotonin in the medial striatum area than was the case for victims (Kops *et al* 2013a). In a separate study, HFP birds were found to have higher baseline levels of serotonin in the caudal nidopallium area of the brain compared to LFP (Kops *et al* 2014).

While it is currently difficult to identify whether the differences in brain functioning reported above are a cause or consequence of SFP behaviour, and to what extent they impact on commercial strains of birds, the findings suggest that birds that feather peck differ at a neurochemical level with resulting effects on their stress responsiveness and locomotor activity.

Key finding: SFP in highly selected HFP/LFP bird lines is associated with differences in brain functioning, particularly in the activity of the serotonergic and dopaminergic systems.

3.1d Genetic effects

A large number of the papers published on feather pecking between 2013 and 2015 focused either solely or partially on the genetics of feather pecking and associated behaviours. The main findings are outlined below.

<u>Breed/hybrid differences</u>

- In a study of 47 commercially reared flocks, de Haas *et al* (2014a) reported that at ten weeks of age white hybrid birds (Dekalb White) were more fearful of humans than brown hybrids (ISA Brown), as shown by the minimum distance they kept from a human observer in a standardised test (DW: 152.9±17.8cm vs. ISA: 57.9±11.0cm; P=0.002). In general the brown hens appeared more affected by environmental conditions as opposed to the white hens, which were more strongly influenced by parental effects.
- In their study of rearing and laying factors, de Haas *et al* (2014b) observed feather damage on all body regions of brown hens (ISA brown) but found that damage was mainly confined to the neck and belly regions of white hens (Dekalb White), suggesting that brown hens exhibit more forms of injurious pecking than white.
- In a study of injurious pecking in caged birds, Sandilands (2015) reported higher levels of injurious pecking mortality in Lohmann Classic birds compared to Hyline Brown (Lohmann: 1.25% vs Hyline 0.12%; both are brown hybrids). This comparison is caveated by the fact that birds of both hybrids were housed in the same shed and were managed as a Hyline flock, and that due to commercial constraints it was not possible to implement management techniques that may have reduced injurious pecking.

<u>Estimates of the heritability of SFP/feather condition and genetic correlations with other traits</u>

- Brinker *et al* (2014) estimated the heritability of feather condition score in caged birds of two purebred White Leghorn layer lines using both a classical animal model and a direct-indirect effects model. The former takes account of the individual bird's genotype only, whereas the latter additionally considers the indirect effects of the genotypes of other birds within the flock (including their genetic predisposition to feather peck). When indirect effects were accounted for (the direct-indirect effects model), heritability estimates were up to 9x greater than suggested by the classical animal model, demonstrating that breeding programs that accommodate both direct and indirect effects will more quickly lead to improvements in feather condition. This finding is in line with earlier work carried out by Ellen *et al* (2007, 2008).

- Similarly, Sun *et al* (2014) reported higher estimates of heritability for feather condition score in White Leghorn hybrids when using a direct-indirect type model (which they term 'direct and associative genetic effects') as opposed to a traditional animal model that accounts for direct effects only (e.g. estimates of heritability of 0.42 vs 0.2 respectively for non-beak trimmed birds). The authors note that ignoring the associative effect and the genetic correlation between direct and associative effects may lead to inappropriate breeding strategies (again in agreement with Ellen *et al* 2007, 2008).

- In a study of highly selected HFP/LFP bird lines, Grams *et al* (2015) estimated the heritability of feather pecking to be 0.16, and the heritability of fear test traits to range between 0.07 and 0.14. These authors note that it would be possible to utilise fear traits (such as tonic immobility) that are easier to measure and could be measured earlier in life than feather pecking to select indirectly for reduced SFP (although note that the relationship between fear and SFP is not always consistent, see section 3.1b). However they caution that this approach would be less effective than selecting on feather pecking behaviour directly.

- Bennewitz *et al* (2014) estimated the heritability of feather pecking in birds of highly selected HFP/LFP lines to be 0.11 (using a model that included associative effects). These authors also looked specifically at the heritability of receiving feather pecks and found a heritability of zero for this trait. They additionally reported genetic correlations between SFP and (1) feather eating and (2) the number of eggs laid. This latter result suggests that selection against SFP might result in reduced egg production. An additional finding of interest from this study was the high level of permanence to the behavioural traits of delivering and receiving feather pecks: hens that delivered feather pecks once were likely to continue to do so, and hens that were victims of feather pecking typically remained victims.

- In their study of birds of highly selected HFP/LFP lines, Bessei *et al* (2013) reported that while HFP birds delivered significantly more feather pecks than LFP, there was no difference between the lines in the number of feather pecks received. This observation suggests that the traits of delivering and receiving feather pecks are determined by different genetic mechanisms (supported by the findings of Bennewitz *et al* [2014] above).

<u>Differences in gene expression</u>

- Wysocki *et al* (2013) reported differences in gene expression between birds of highly selected HFP and LFP lines. Four genes were identified as of particular interest and the authors suggest that more detailed investigations of these might help to uncover the genetic basis of SFP.

Key finding: Selection programmes aimed at reducing SFP/feather damage should take associative as well as direct effects into account and should monitor for unintended effects due to genetic correlations between SFP and other traits.

3.2 New findings relevant to understanding the influence of production and management conditions on SFP

3.2a The importance of litter and foraging opportunities

Further evidence is now available regarding the impact of litter availability during the rearing period on feather pecking behaviour. De Haas *et al* (2014a) found that disrupting (removal for 7-10 days) or limiting (provision of chick paper remnants only) litter availability during the first four weeks of age increased SFP (& GFP) at five weeks of age. Litter disruption additionally resulted in increased feather damage, fearfulness and whole-blood serotonin levels during rearing. There was an additive effect on SFP during rearing when flocks experienced both litter disruption and limitation. Interestingly these litter effects were more prominent in brown hybrid (ISA Brown) than white hybrid (Dekalb White) hens, leading the authors to conclude that brown hybrid hens might be more affected by environmental conditions and that different approaches to preventing SFP might be required for brown and white flocks. Whilst this publication did not report on effects observed during the laying period, a later paper, de Haas *et al* (2014b), provided data on a subset of flocks followed through to 40 weeks of age and found that a high level of SFP at five weeks of age was a significant risk factor for feather damage during lay. This supports previous findings, linking a lack of foraging substrate during rearing and feather damage during lay (see de Haas *et al* 2014b), and further supports the hypothesis that SFP is a form of redirected foraging behaviour. Relatedly, Gilani *et al* (2013), in their study of 34 commercial flocks (comprising 8 different breeds) in the UK, reported foraging-related factors to be key to reducing feather pecking. In terms of litter availability, flocks with a higher percentage of litter area (as opposed to slat area) available to them during rear had a lower percentage of missing feathers at 16 weeks of age.

Hartcher *et al* (2015a) carried out an enrichment study that involved manipulating litter availability and attractiveness in order to encourage foraging behaviour during the rearing period. Pullets (ISA brown) were reared in either standard or enriched pens, with enrichments consisting of deeper litter (50mm of wood shavings rather than 10mm), scatterings of whole oats over the litter 3-5 times per week, and bundles of baling twine for pecking. Whilst birds in enriched pens performed more ground-scratching behaviour, there was no overall effect on SFP, GFP or on feather score at 43 weeks of age. This result contrasts strongly with the large number of studies that have found that foraging enrichments provided during the rearing period decrease feather pecking during the laying period (see examples in Rodenburg *et al* 2013). The authors note that the impact of the enrichments in this study may have been limited by the timing of their provision since enrichments were not provided until 12 days of age, whereas previous studies have suggested that rearing factors during the first full 4 weeks of life play a critical role in the development of feather pecking in the laying phase (e.g. Johnsen *et al* 1998). A further explanation for this non-significant finding could be that the level of enrichment experienced by the two groups did not differ appreciably: the environments of the control birds were relatively enriched and the additional enrichments provided were quite minimal. In a separate study, Daigle *et al* (2014) focused on encouraging natural foraging behaviours in White Shaver birds during the laying rather than the rearing period. Hens provided with hay bales from 22 weeks of age performed more environmental pecking and showed a tendency to exhibit less GFP but there was no effect on levels of SFP, aggressive pecking or on feather score.

Key finding: Access to litter during the rearing period has beneficial effects on SFP and feather condition.

3.2b Dietary factors

Since the Rodenburg *et al* (2013) review, further evidence has been published indicating the positive effects of feeding pullets an insoluble non-starch polysaccharide (NSP) diluted diet during rearing. Diluted diets provide birds with less energy hence they consume a greater quantity of food and therefore spend more time performing highly motivated feeding-related behaviours. Qaisrani *et al* (2013) fed Lohmann Brown pullets one of four different diets: a) control diet; b) a 7.5% diluted diet – sunflower seed extract & barley; c) a 15% diluted diet – sunflower seed extract; or d) a 15% diluted diet – oat hulls. Birds were observed until 17 weeks of age and those fed the diluted diets performed more feeding-related behaviours, spent more time eating and exhibited lower levels of SFP, comb pecking and feather damage. No negative effects on performance were found. Oat hulls were found to be more effective for preventing feather damage than sunflower seed extract. These results provide further evidence that SFP represents redirected foraging behaviour (see previous section). Interestingly, the different dietary treatments tested had very little effect on GFP and no effect on aggressive pecking, supporting the hypothesis that these different forms of pecking behaviour have quite different underlying motivations (also see section 3.1b).

In line with previous studies, Gilani *et al* (2013) reported a detrimental effect of diet changes during the rearing period: a higher number of diet changes during the rearing period was associated with a much higher probability of SFP during rearing and an increased level of GFP at lay.

Key finding: Providing a diluted diet and minimising the number of diet changes during the rearing period have the potential to reduce SFP.

3.2c Other management-based risk factors

Several publications have reported new findings or reiterated previous findings in relation to management-based risk factors for SFP and/or feather damage. Findings in relation to litter, foraging opportunities and diet have been reviewed above, but further risk factors and associations have been identified and these are summarised below.

- Management system – Gilani *et al* (2013) reported a reduced probability of SFP during the rearing period in free range and barn flocks as opposed to organic flocks. The authors suggest that differences in litter availability and hence foraging opportunities might underlie this finding. During the laying period, de Haas *et al* (2014b) found lower levels of feather damage in flocks housed in aviary systems compared to floor housing systems, probably as a result of aviary housed birds being able to make better use of the vertical space and escape from feather pecking conspecifics.

- House environment – Gilani *et al* (2013) reported that the probability of SFP during the rearing period was reduced when birds experienced a longer light period and in houses with a higher minimum ceiling height. Additionally, the probability of SFP being exhibited during the laying period was lower for flocks that experienced a reduced range of noise levels at the end of the rearing period. This effect of noise level on feather pecking has rarely been reported previously and the authors suggest that the birds may have found mechanical noises within the house aversive.

- Type of feeder – Gilani *et al* (2013) found that the rate of SFP during the laying period was higher when compartmentalised pans were used compared with chain feeders, perhaps due to the former increasing feeding competition between birds. Interestingly the rate of SFP was reduced when more than one type of feeder was provided.

- Age of access to a range area – Petek *et al* (2015) reported that allowing free range laying hens access to a range area at an earlier age (18 or 20 weeks as opposed to 22 weeks) resulted in less feather damage at 32, 40 & 48 weeks of age. This result conflicts with that of Gilani *et al* (2014, cited in Petek *et al* 2015), who found no effect of age of first access on levels of feather pecking.

- Group size/stocking density – de Haas *et al* (2014b) found a large group size during the laying period to be a risk factor for feather damage at 40 weeks of age. Alms *et al* (2015) reported a positive effect of maintaining a similar stocking density (SD) between the rearing and laying environments. Birds moved from a SD of 15 hens/m^2 (rearing) to 12.2 hens/m^2 (laying) for the first two weeks upon entering the laying facility were found to have better feather cover and were less fearful than those that experienced a drop in SD from 15 hens/m^2 to 7.8 hens/m^2. The birds also differed in their access to litter, but the authors were able to demonstrate that the observed effects were more likely to be due to the smoothness of the transition in SD.

- Stockmanship – Gilani *et al* (2013) found that the probability of SFP during the rearing period was reduced when the chicks' main caretaker had more years of experience with chickens. Relatedly, the same study found that the percentage of birds with missing feathers at 35 weeks of age was lower for flocks inspected by a greater number of caretakers. The authors suggest that this might be due to problems being identified and resolved earlier when more than one person works with the birds, and additionally due to the birds showing greater habituation to humans, resulting in a positive effect on stress response.

- Specific management techniques – In their study of the rearing and laying factors associated with feather pecking, de Haas *et al* (2014b) found that flocks on farms that utilised specific management techniques (radio noises to diminish sound disturbances, aerated concrete pecking blocks, round bell drinkers in addition to nipple drinkers and/or roosters within the flock), exhibited lower levels of feather damage at 40 weeks of age. The authors suggest that these techniques may have worked by reducing fearfulness and competition between birds and facilitating foraging behaviour. These findings reinforce the results of Lambton *et al* (2013) who showed that implementing a bespoke package of management strategies during the laying period could successfully reduce SFP and feather damage.

- Beak trimming – In line with previous studies, Gilani *et al* (2013), Sun *et al* (2014) and Hartcher *et al* (2015a) reported that beak trimming reduced SFP and/or feather damage during the rearing and/or laying periods. Sun *et al* (2013) additionally reported higher survival rates in beak-trimmed as opposed to non-trimmed hens. In terms of the effect of beak trimming on other behaviours, Hartcher *et al* (2015a) reported reduced ground pecking and increased GFP in beak trimmed flocks during rearing.

- Seasonal effects – Gilani *et al* (2013) reported a reduced rate of SFP at lay during the summer.

Key finding: A wide range of management factors during both the rearing and the laying periods can potentially influence levels of SFP

4. Conclusion

This review of recent feather pecking research has identified that this topic receives a high level of research interest, and that the focus of research published over the past couple of years has been on understanding the genetics of SFP and testing management techniques designed to reduce its prevalence in commercial production. Important findings stemming from a range of research disciplines (e.g. animal behaviour, neurobiology, nutrition, genetics and on-farm epidemiology) have been reported during this time, most of which support and extend the evidence reviewed by Rodenburg *et al* (2013) and Nicol *et al* (2013). The key findings from the studies reviewed in the current paper are listed below.

1. Enhancing the management of parent flocks to minimise the stress they experience may reduce levels of SFP in their offspring.
2. Inconsistent relationships are reported between fear/stress and SFP (perhaps due to different methodologies and differing interpretations of birds' responses on these tests).
3. SFP and aggressive pecking appear to have different underlying mechanisms. However these two behaviours are genetically correlated hence selection against SFP should also act to reduce aggressive pecking.
4. A clear relationship exists between SFP and feather eating for birds from highly selected HFP/LFP bird lines.
5. SFP in highly selected HFP/LFP bird lines is associated with differences in brain functioning, particularly in the activity of the serotonergic and dopaminergic systems.
6. Selection programmes aimed at reducing SFP/feather damage should take associative as well as direct effects into account and should monitor for unintended effects due to genetic correlations between SFP and other traits.

7. Access to litter during the rearing period has beneficial effects on SFP and feather condition.
8. Providing a diluted diet and minimising the number of diet changes during the rearing period have the potential to reduce SFP.
9. A wide range of management factors during both the rearing and the laying periods can potentially influence levels of SFP

Given the multifaceted nature of SFP, understanding this behaviour necessitates drawing together contributions from a wide range of research disciplines hence it is important that reviews such as this are carried out at appropriate time intervals to help provide the fullest possible picture of SFP. A clearer understanding of this behaviour will facilitate efforts to reduce its prevalence leading to benefits for both animal welfare and production.

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Defra Animal Welfare Team
September 2015

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Defra, Strategic Evidence and Analysis
E-mail: StrategicEvidence@defra.gsi.gov.uk

Department for Environment Food & Rural Affairs

Evidence Project Final Report

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Project identification

1. Defra Project code: AW1145
2. Project title: A study to test the effectiveness of management strategies in reducing injurious pecking of laying hens with intact beaks in non cage systems.
3. Contractor organisation(s):
   University of Bristol
   School of Veterinary Science
   Langford House
   Langford
   BS40 5DU
4. Total Defra project costs (agreed fixed price): £ 464,055
5. Project: start date .... 1 May 2012
   end date .... 1 Dec 2015

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Executive Summary

7. The executive summary must not exceed 2 sides in total of A4 and should be understandable to the intelligent non-scientist. It should cover the main objectives, methods and findings of the research, together with any other significant events and options for new work.

The aim of this project was to contribute towards a review of policy on the routine beak trimming of laying hens. The specific objectives are given in the full report but the aims were to provide advice on management strategies for farmers running their first flocks on intact-beak birds, and then to monitor the mortality, production, plumage condition and behaviour of these flocks throughout rear and lay. Comparisons were made with data from previous flocks kept on the same farms and from other database sources. Another aim was to conduct an economic cost-benefit analysis for each farm and to develop a generic package of advice that could be used by all farmers.

Twenty intact-beak non-cage flocks (average size 6329 hens) were recruited and followed to 40 weeks of age, with 19 flocks followed to end of lay. Information for comparative purposes was obtained from 18 flocks that had preceded the study flocks on the same farms ("previous flocks"). Because flock recruitment was difficult we were not able to include only farms keeping intact-beak birds for the first time. The "previous flocks" therefore included 12 beak-trimmed flocks as planned, but also 6 intact-beak flocks. In addition, 6 farms volunteered comparison groups of beak-trimmed flocks housed concurrently on the same farms as the intact beak flocks. Previous flocks were visited at 65 weeks of age. Management strategies, such as the use of pecking distractions, highly absorbant compressed wood pellets to improve litter condition, methods of encouraging range usewere then proposed for the study flocks with the aim of preventing outbreaks of injurious pecking. A fuller description of management strategies to reduce feather pecking was made available in a guide that can be freely downloaded from www.featherwel.org. Study flocks were visited at 8, 20, 40 and 65 weeks, and more frequently if problems arose. Data on mortality, bodyweight, plumage condition and behaviour were obtained, with additional information coming from processing plant records at the end of lay.

No problems with mortality, bodyweight or feather pecking behaviour were experienced by intact-beak flocks during rear. Outcomes during lay were highly variable. At approximately 25 weeks of age, two intact-beak flocks experienced the onset of major problems with injurious pecking and rapidly increasing rates of mortality. However, many flocks progressed to the end of the trial with good outcomes and some were kept on by the farmers beyond 72 weeks of age. The overall mean flock mortality at 40 weeks

was 4.47% (median 2.14%) and at 71 weeks was 10.81% (median 6.27%). At 40 weeks 18/20 flocks achieved acceptable levels of mortality (according to a 5% threshold that had been previously agreed with the beak trimming action group), but by 71 weeks only 12/19 flocks achieved acceptable levels of mortality (according to a 9% threshold that had been previously agreed with the beak trimming action group) .

When study flocks were compared with the previous flocks there was significantly lower study flock mortality towards end of lay ($p<0.03$) and a tendency towards improved financial performance ($p = 0.075$) for farms whose previous flocks had intact beaks (n= 6). There was no significant difference in mortality or financial performance for farms whose previous flocks had been beak-trimmed (n=11; $p >0.05$). When study intact-beak flocks were compared with their concurrently-managed beak-trimmed flocks there was significantly higher mortality in the intact-beak flocks at 40 and 71 weeks of age (n=6; $p<0.05$). Both of the two farms that had major problems were represented in this analysis. Plumage condition deteriorated with age, was variable between flocks and not significantly different from the plumage condition of previous flocks. Rates of severe feather pecking were lower than in previous studies, possibly reflecting the positive influence of the management strategies designed to reduce this behaviour. The average annualised gross margin (£/bird) for the previous flocks was £3.25. The average annualised gross margin (£/bird) for the intact study flocks was £3.69 before the costs of the additional management strategies were taken into account.

On average study farms adopted 5.4 management strategies more than they had employed for their previous flocks. The recurrent cost per flock of the strategies adopted on each farm included direct material costs, an estimate for labour costs and an element of depreciation for additional capital costs. The average gross cost of the management strategies actually implemented on each farm was calculated using slightly different methods as either £260/1000 birds or £313/1000 birds, although most farms did not implement all of the strategies that were suggested. The average gross margin (£/bird) for the intact study flocks was £3.43 once these costs were deducted.

Study flocks that had been preceded by a previous intact-beak flock showed a significant improvement in end of lay mortality, plumage condition, and a tendency towards an improvement in financial performance. This suggests that with experience and increased uptake of management strategies, levels of mortality can be reduced and kept within acceptable limits. The additional costs of the management strategies may be (greatly) outweighed by improved margins on these farms. This conclusion was not confounded by any changes in breed between previous and study flocks in this subset. However, this conclusion applies only to the improvement that may be obtained by farmers already keeping intact-beak birds, and not to the transition from beak-trimmed to intact-beak birds.

Overall, study flocks that had been preceded by a previous beak-trimmed flock showed no significant difference in end of lay mortality. The strategies adopted were not sufficient to improve mortality and financial outcomes on farms that transitioned from beak-trimmed to intact-beak flocks for the first time. Changes in breed between previous and study flocks act as a confounding influence in this case. It seems, however, that the increased risk in keeping intact-beak birds is a counter-influence to the influence of the management strategies.

When pecking did occur the consequences were rapid and severe with the sharp beaks causing acute tissue damage and opening routes to subsequent infections.

Further uptake of the management strategies was considered generally beneficial for all flocks by the farmers and stakeholders involved in the study. This uptake was promoted by knowledge transfer events and the development of the Featherwel website. The management strategies are now advocated in the new Lion code for British eggs.

Examination of processing plant records suggested that only approximately 80% of true mortality is recorded on farm and methods of improving on-farm counts of mortality, including losses due to predation and smothering, are needed for any future evaluation of beak-trimming policy.

Management strategies have been designed to reduce the occurrence of feather pecking behaviour but not the damage caused once pecking begins. They have also not been devised to address other significant causes of flock mortality (notably predation and smothering). New strategies are needed to address these issues.

Overall, the work provides further support for the use of management strategies as a way of reducing feather pecking in both beak-trimmed and intact-beak laying hens. However, the real risks associated with moving from beak-trimmed to intact-beak birds are not fully mitigated by the use of such strategies. Managing a transition from beak-trimmed to intact-beak birds will require additional strategies to reduce beak damage and infection and to identify and manage problems at an early stage. Longer-term studies are required to assess whether the risks of keeping intact-beak flocks can be reduced with time and experience.

Project Report to Defra

8. As a guide this report should be no longer than 20 sides of A4. This report is to provide Defra with details of the outputs of the research project for internal purposes; to meet the terms of the contract; and to allow Defra to publish details of the outputs to meet Environmental Information Regulation or Freedom of Information obligations. This short report to Defra does not preclude contractors from also seeking to publish a full, formal scientific report/paper in an appropriate scientific or other journal/publication. Indeed, Defra actively encourages such publications as part of the contract terms. The report to Defra should include:

- the objectives as set out in the contract;
- the extent to which the objectives set out in the contract have been met;
- details of methods used and the results obtained, including statistical analysis (if appropriate);
- a discussion of the results and their reliability;
- the main implications of the findings;
- possible future work; and
- any action resulting from the research (e.g. IP, Knowledge Exchange).

Please see attached

References to published material

9. This section should be used to record links (hypertext links where possible) or references to other published material generated by, or relating to this project.

The prevention and control of feather pecking: application to commercial systems
By: Nicol, C. J.; Bestman, M.; Gilani, A-M.; et al.
WORLDS POULTRY SCIENCE JOURNAL Volume: 69 Issue: 4 Pages: 775-788 Published: DEC 2013
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The prevention and control of feather pecking in laying hens: identifying the underlying principles
By: Rodenburg, T. B.; van Krimpen, M. M.; de Jong, I. C.; et al.
WORLDS POULTRY SCIENCE JOURNAL Volume: 69 Issue: 2 Pages: 361-373 Published: JUN 2013
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Annex 5

Welfare of non-beak trimmed laying hens in furnished cages

Victoria Sandilands, Krysta Morrissey

Background

Across Europe, there is widespread concern over manipulating animals to suit the artificial environments in which we place them. As a result, some countries have banned, or are intending to ban, routine mutilations in some farm species, such as beak trimming in poultry. The EU directive affecting laying hens (1999/74/EC) prohibits mutilations (but allows Member States to authorise beak trimming to prevent feather pecking and cannibalism). As a result, all four UK administrations intended to ban beak trimming in laying hens from 1 January 2011. However, concerns expressed by FAWC among others over the ability to control injurious pecking (which includes feather, vent, and cannibalistic pecking) resulted in amendments which continued to permit beak trimming, but using infra-red methods only, after this date. In England, the Explanatory Memorandum to the Mutilations (Permitted Procedures) (England) (Amendment) Regulations 2010 stated that this would be reviewed by Government in 2015 with a view to banning routine beak trimming of laying hens in 2016.

Although this commitment applies to England only, the devolved administrations are also interested in the possibility of banning beak trimming, providing bird welfare can be safeguarded. As a result of this, Scotland's Rural College (SRUC), through Scottish Government funding, undertook a programme of research investigating the welfare of non-beak trimmed hens housed in furnished cages. This is because while much research on non-beak trimmed hens focusses on free-range or other loose-housed birds, about half of all hens in the UK are kept in cages, and any ban would also affect this large proportion of the UK flock.

Study 1

Hen strain is related to the propensity to show feather pecking behaviour. In those EU countries where hens are housed successfully without beak trimming, white strains of hens (which typically lay white eggs) are often used, but Austrian flocks are typically Lohmann Classic brown hens (which lay brown eggs, the dominant egg colour sold in the UK) in loose-housed systems without beak trimming.

The aim of Study 1 was to assess the effects of bird strain, beak treatment, and extra enrichment on mortality, behaviour, and feather condition in a commercial environment (which is likely to give more commercially-applicable results). Thus, treatments were beak trimmed or non-beak trimmed, Hyline Brown (common strain used in the UK) or Lohmann Classic hens, and extra enrichments (8 pecking ropes, 2 pecking mats, and 2 beak blunting boards positioned on the vertical cage supports) or not (thus, a 2 x 2 x 2 design, giving 8 treatments). Eighty hens were housed in each of 64 furnished cages in the centre of one bank of cages at a commercial farm (which contained a further 1476 cages, all Hyline Brown), from 16-71 weeks of age, with 8 cages allocated to each treatment.

Two cages of hens (both non-beak trimmed and Lohmann strain, one with and one without extra enrichment) were depopulated at 48 weeks of age due to pecking-related morality. In one of these cages, 5 birds (6.25% of the cage) died due to injurious pecking-related mortality over a period of 6 months; in the other cage, 7 birds (8.75% of the cage) died due to injurious pecking-related mortality over a period of 4 weeks. Culling the remainder of the cage may or may not be done in typical commercial practice, but in order to prevent further welfare insults as a result of the imposed treatment (non-beak trimmed), this was agreed with the farm. As a result, injurious pecking mortality was assessed in two ways - taking into account remaining healthy birds that were subsequently culled in the two problematic cages ('maximum') and by estimating how many further losses might have occurred if those cages had been allowed to progress until the end of the trial at 71 weeks, based on the rate of deaths to 48 weeks ('estimated').

Overall, maximum injurious pecking mortality was significantly affected by breed x beak treatment, with Lohmann non-beak trimmed hens having greater mortality (12%) than any other group (<1%), however estimated injurious pecking mortality was similar across all four breed x beak treatments. Estimated injurious pecking mortality was only affected by overall breed effects (with Lohmann birds having higher injurious pecking mortality, 1.25%, than Hyline, 0.12%), and overall beak treatment effects (with non-beak trimmed having higher injurious pecking mortality, 1.02%, than beak trimmed 0.35%). Extra enrichment had no effect on injurious pecking-related mortality. It is important to note that a) this shed of hens was managed as a Hyline flock (as this strain made up the majority of the flock) and thus the way in which the injurious pecking might have been managed (by dimming the lights) could not be carried out because it would have affected the egg production rate of the majority of the hens in the shed; and b) the Hyline birds had maximum injurious pecking mortality of only 0.16% in non-beak trimmed hens, but half that (0.08%) in beak trimmed hens. Therefore, not trimming the standard strain (Hyline) resulted in doubling the injurious pecking mortality, although this was still very low. Observations of pecking behaviour were too sparse to analyse, however feather condition deteriorated more quickly over time at certain body sites, both with Lohmann hens, and with non-beak trimmed hens.

This study suggests that the Hyline brown strain could be managed in furnished cages without beak trimming, but that IP-related mortality would increase. The results for the Lohmann strain should not be over-emphasised, because management techniques that might have mitigated injurious pecking could not be implemented here.

Study 2

Diets have been shown to influence pecking behaviour in laying hens, and so this study focussed on non-beak trimmed hens housed with alternative diets and also further explored the use of extra enrichments, and their effects on mortality, behaviour, and feather damage (as an indicator of feather pecking).

Although hens are naturally omnivorous, standard laying hen diets are based on plant materials (e.g. soya bean meal, wheat, maize etc.), due to regulations restricting the use of meat and bone meal in animal diets introduced following BSE. However, evidence suggests that feeding hens diets with animal protein can be beneficial in reducing dietary-deficiency related injurious pecking. Furthermore, diets that are higher in fibre require hens to eat more to obtain adequate nutrients, thus fulfilling pecking-related motivation, which may result in hens pecking one-another less. In addition, we sought to improve the extra enrichment treatment from Study 1, by providing greater enrichment-to-bird ratios and different positioning. Thus, treatments were: standard (plant-based) or 5% pork meat and bone meal diet (which required special permission under the Animal By-Products (Enforcement) (Scotland) Regulations 2013), normal fibre levels or extra fibre (10% oat hulls), and extra enrichment (8 pecking ropes, 2 pecking mats, and one beak blunting board positioned in the food trough) or not (thus, a 2 x 2 x 2 design, giving 8 treatments). Twenty-one Hyline Brown non-beak trimmed hens were housed in each of 64 furnished cages at the research unit at SRUC, from 16-34 weeks of age, with 8 cages allocated to each treatment.

Across all treatments, mortality was low (0.7% of the flock; breed standard to 34 weeks is 1%). No mortality was attributed to injurious pecking. Feather damage was also low across all treatments, and behaviour observations indicated that bird-to-bird pecking was infrequent.

The dietary treatments (protein, fibre) had some effects on bird production. Extra fibre reduced, and control fibre levels increased, weight gain in animal-based diets compared to plant-based diets. Treatments had no significant effect on egg production, which closely followed the breed standard, but there were some significant effects of protein source and fibre levels on egg quality. There were some small but statistically significant effects in that extra enrichment led to less feather damage than for hens without extra enrichment, and hens fed extra fibre showed reduced spot-pecking at inanimate objects.

In order to robustly test the positive effects of the novel diets and extra enrichments used here, feather damage and pecking behaviour would have been relatively higher in the control group (i.e. plant-based, control fibre diet with no extra enrichment), to demonstrate whether some or all of the treatments designed to mitigate pecking were working. However, because of the overall low occurrence of injurious pecking, and the lack of consistency of egg quality effects of diets, there is little conclusive evidence of the efficacy of these treatments. It would be important to trial the treatments again, but in a commercial environment and over a longer period, where their true effectiveness is more likely to be realised.