SSPE-CT-2004-502315

LAYWEL

Welfare implications of changes in production systems for laying hens

Specific Targeted Research Project (STReP)

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Deliverables **D.3.1-D.3.3**
WP3 -Health

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PP	**Restricted to other programme participants (including the Commission Services)**	
RE	**Restricted to a group specified by the consortium (including the Commission Services)**	
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Work package 3, Health. Leader: SLU (partner 6)

Work package 3. Final report health

Deliverables D.3.1-D.3.3

D.3.1. The creation of a common scoring system for the integument and health of laying hens.

Applied scoring of integument and health in laying hens.

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ABSTRACT

Different methods for scoring of birds' integument are often used to describe the effects of various treatments in research on the health and welfare of laying hens. Also in commercial egg production and breeding there is need for having a tool to describe the status of a certain flock of birds or a pure line. Among the main traits to score are plumage and foot condition and pecking wounds on different parts of the body. Scores for these traits may describe problems of feather pecking, perch design and litter condition and cannibalistic or aggressive behaviours respectively. Important characteristics of a scoring system are e.g. the simplicity of the system for users to learn and to use at the same time being descriptive enough in details. The present paper describes a scoring method for six body parts as regards plumage condition and for pecking wounds on comb and rear part of the body and finally, the condition of the foot as regards bumble foot syndrome. The intention is that this system should be easy to use by scorers of different background e.g. scientists, administrators, welfare inspectors, breeders and producer organisations. When used to the system scoring a bird for all characters will not exceed 30 seconds for one person. The input of the scoring system on the internet has been successful where many visitors to learn about the use of the system have been present.

INTRODUCTION

The status of birds' integument has a considerable impact on the interpretation of their health and welfare. This applies both to research as well as in evaluation of different housing systems in commercial production. Thus, scoring methods have been frequently used in order to assess treatment effects on health and welfare, e.g. housing conditions, feed composition, genotype, beak trimming, lighting programs, etc. The most commonly studied integument is the plumage of laying hens but also the condition of feet and skin. The appraisal of birds' integument is of value in research as well as in administration and within the industry. Explaining feather pecking activities or wear being possible causes to increases in energy requirement from poor insulation of the body are examples where scores for plumage condition may be very useful.

Several methods of scoring systems have been presented during the years. For practical reasons subjective scoring is by far the most common methods although, Fölsch et al. (1980) and Grashorn and Flock (1987) used planimetry for estimating nude areas. Two general concepts have been more common as regards subjective scoring. One is application of a general score for the plumage of the whole body already used e.g. by Hughes and Duncan (1972) or Hill (1980) and another more often used method of scoring several parts of the body individually as used by (Meunier-Salaün (1983), Tauson et al. (1984), Gunnarsson et al. (1995), Abrahamsson, (1996), Kjaer (1999), Gunnarsson (2000) and Tauson and Holm (2003) and Moe et al., (2004). The first concept gives a very general but useful assessment of the bird's integument. Adams et al. (1978) found the correlation between whole body scores given by three observers to be 0.88 which was very similar to Tauson et al. (1984) using a 1-4 point scale on five body parts and pooling them to a total. Using a 4-point scale Damme and Pirchner (1984) found good correlation between scores and weight of feathers.

However, using a total body score only can hardly explain or describe possible reasons for the deterioration of the plumage, i.e. feather pecking (Freire et al. 1999; Kjaer, 2000) *or* wear from different parts of the environment (Tauson, 1984). Neither can this method give us an idea of levels of heat losses from different parts of the body (Peguri and Coon, 1993). For instance bad condition of feathers of the tail or rump tells us that feather pecking is probably the main reason to plumage deterioration however, still not causing major heat losses while the same damage to back and breast region may cause severe heat losses and excessive energy intake due to poor insulation.

There are some crucial characteristics a scoring system must fulfil – it should be simple to apply and not too time consuming as well as showing good repeatability, i.e. being able to show the same statistical differences between possible treatments compared. Tauson et al. (1984) showed that scores given by two different independent scorers were both able to detect the same statistical differences between e.g. different cage designs. They used a 1-4 point scale on 5 individual body parts. The number of parts the body is split into and the number of available scores given for each part offer different degrees of exact description of the status of a bird. Gunnarsson (2000) reported good inter-observer agreement using a very detailed scoring method for the integument of the birds using a much as 11 body parts for the plumage condition. However, the intention of obtaining a high degree of precision, i.e. scoring a high number of individual body parts as well as using many scores may be perceived as more complicated and time consuming especially for non experienced scorers.

When working in the LayWel EU-project it was found that several different scoring systems have been used in different projects. Hence, for the future it was decided to propose and describe a new and practical scoring system.

METHODS

Apart from reviewing the literature on scoring systems used, the authors representing the 3 contributors to this deliverable (SLU, DIAS and UNIVZAR) together visited practical farms with different housing systems and ages of birds in order to score birds at the spot. During this tour as well as at the different institutes a large number of documentation photos were taken illustrating different status of the integument of birds of different genotypes. During a three days work shop at SLU in 2004 all the material were thoroughly looked at on screen and a preliminary agreement was reached for the set of the scores of the different body parts. Through further exchange of views and more pictures via e-mail and meetings also at LayWel coordination occasions also with the rest of the consortium and stake holders meetings - the final system was agreed on during late 2004 (Tauson et al., 2005a).

DESCRIPTION AND USE OF A NEW SCORING SYSTEM

This comprises 6 body parts for plumage condition (neck, breast, cloacae/vent, back, wings and tail), pecking damage to skin of rear body and comb, and bumble foot lesions - all at scores of 1-4. In the present report this new system is described and photographically documented for white as well as for brown genotypes. The *higher* the score is the *better* the status of the integument. The system can be used both for comparison of scores for individual body parts (scores 1, 2, 3 or 4) or pooled for the whole body (i.e. scores 6, 7, etc. up to 24). Each score is individually illustrated for each body part by photos showing “target” birds of brown and white genotypes respectively, see Figs. 1-61. The entire documentation set including the introduction is available on the web at *www.livsmedelssverige.org/hona/scoringsystem* (Tauson et al., 2005b) for use in practical scoring and in the literature (Tauson et al., 2005a).

Individual scores of $\leq$ 2 indicate severe damage to the integument e.g. heavy feather pecking/wear, aggressive pecking to the head region or inflamed bumble foot lesions respectively. By using the sum of the *individually scored* body parts it is possible to get a good general picture of the plumage condition of a bird. Thus, a total such score of $\leq$ 10-12 indicates a severe damage to the plumage on the whole body (e.g. 6 x 2 = 12) or on almost all parts (e.g. 2+2+2+2+1+3) or on a large majority of the body (4+3+2+1+1+1). However, the last example of scores will not appear very frequently and in fact, any of these examples given for reaching a total score of 12 (or lower) will indicate a very poor plumage cover Similarly, an individual score of $\geq$ 3 and a total score of $\geq$ 18-20 would indicate a good feather cover.

CONCLUSIONS

The intention is that this system should be easy to use by scorers of different background e.g. scientists, administrators, welfare inspectors, breeders and producer organisations. When used to the system scoring a bird for all characters will not exceed 30 seconds for one person. It should provide a good picture of the integument and health of birds in research and in commercial production. It features a literature background, illustrations and a guideline for the use of the system. Until now the homepage has had an average number of visitors of 10 per day. Apart from that several educational organisations and research groups have approached with questions on more information and use of the system.

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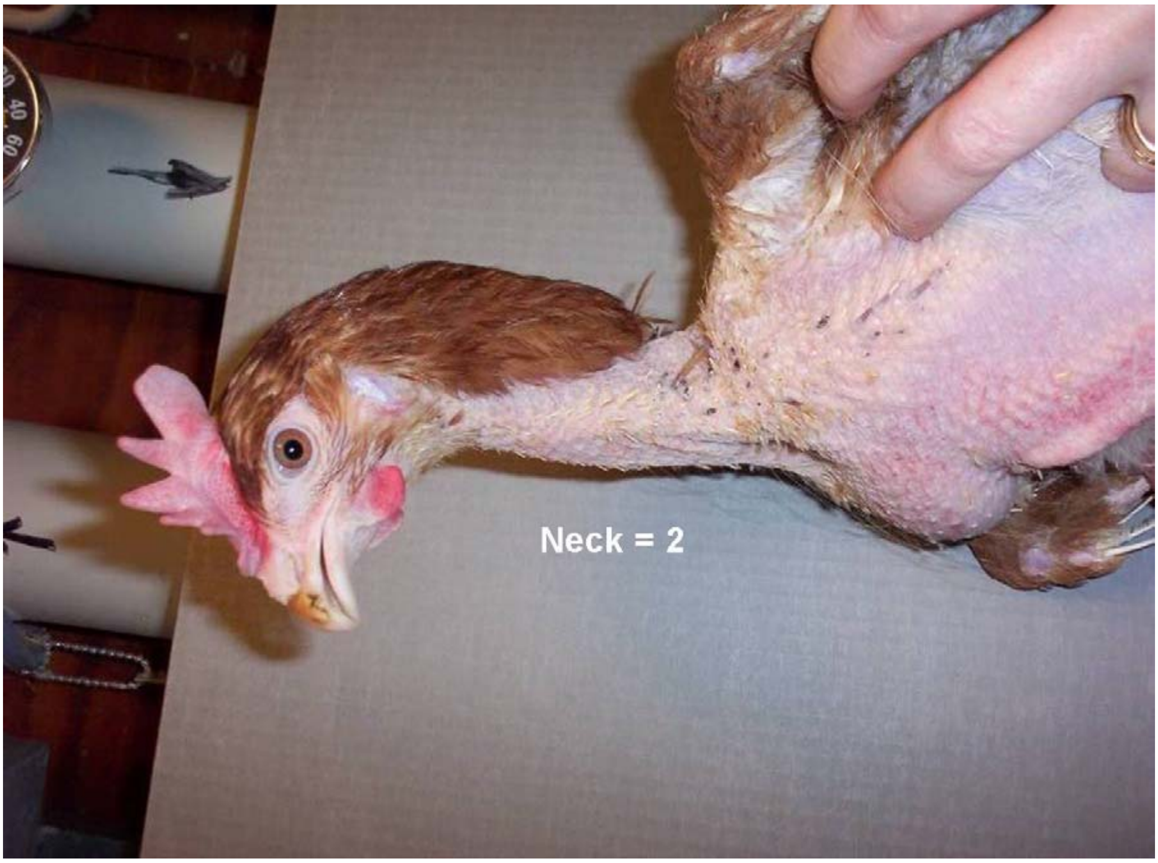
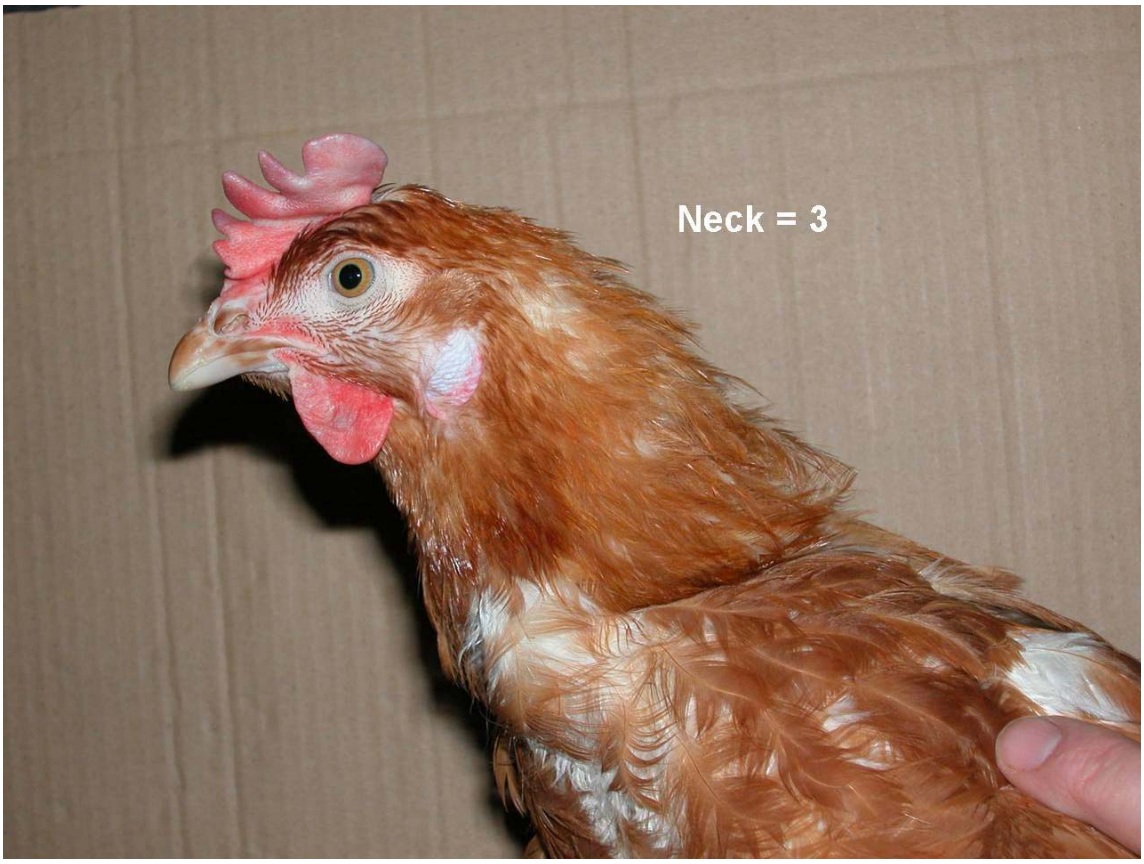
For illustrations of the scoring system (Figs. 1-61) see the following pages!

Figs. 1-2. Target birds for the scores of 1-2 on neck of brown genotypes.



Figs. 3-4. Target bird for score 3 of neck of brown genotypes.


Neck = 3

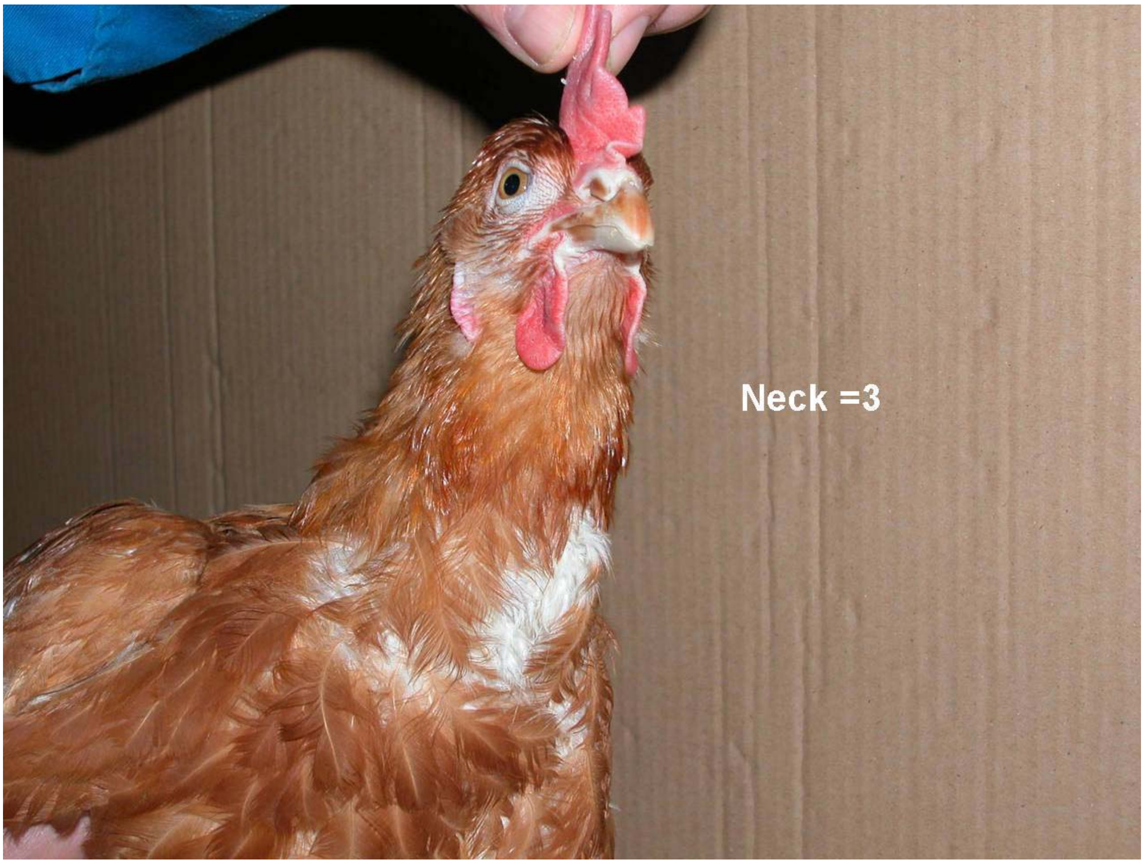
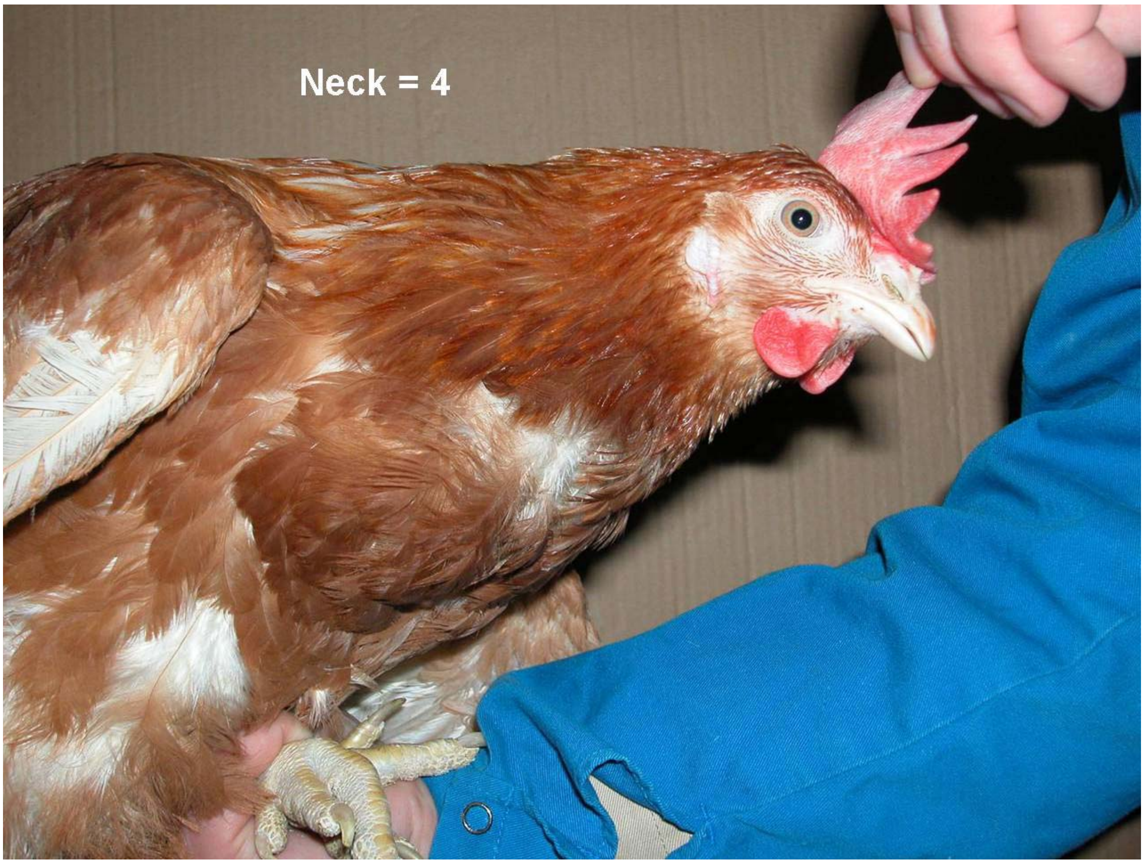
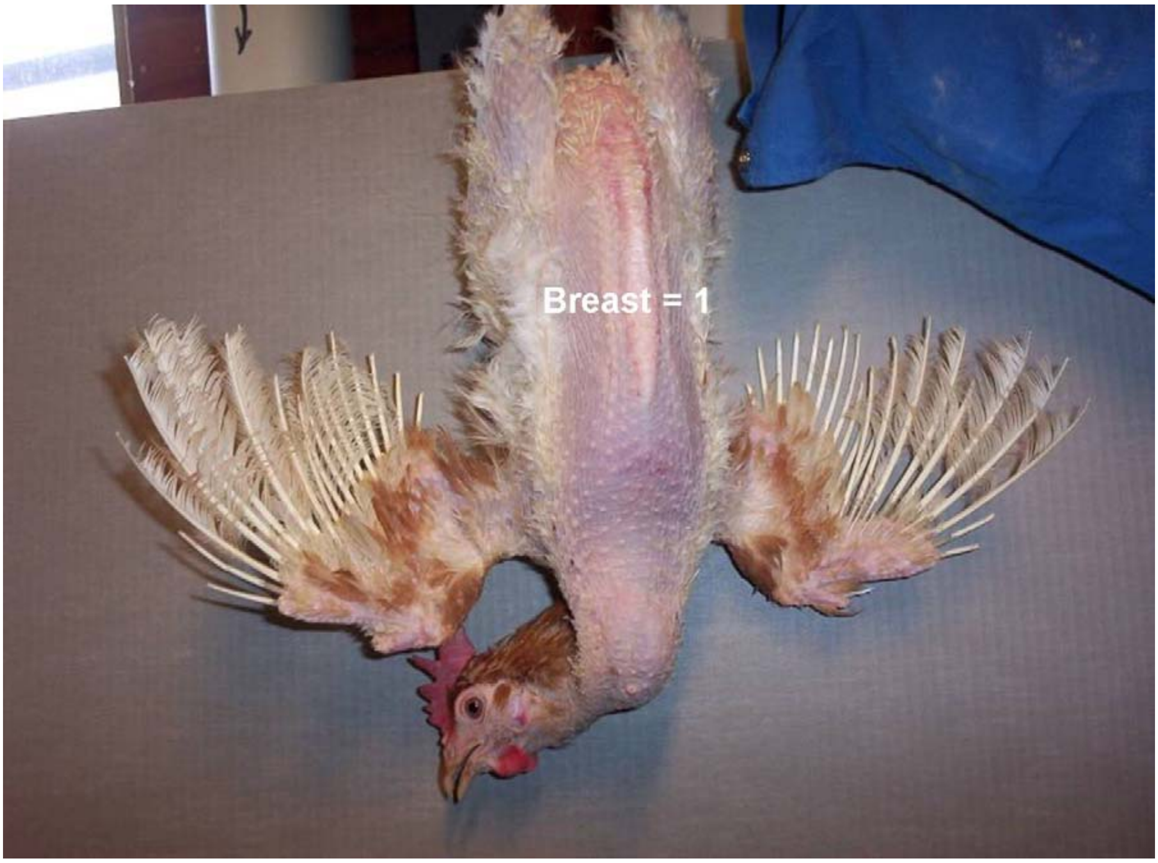

Neck =3

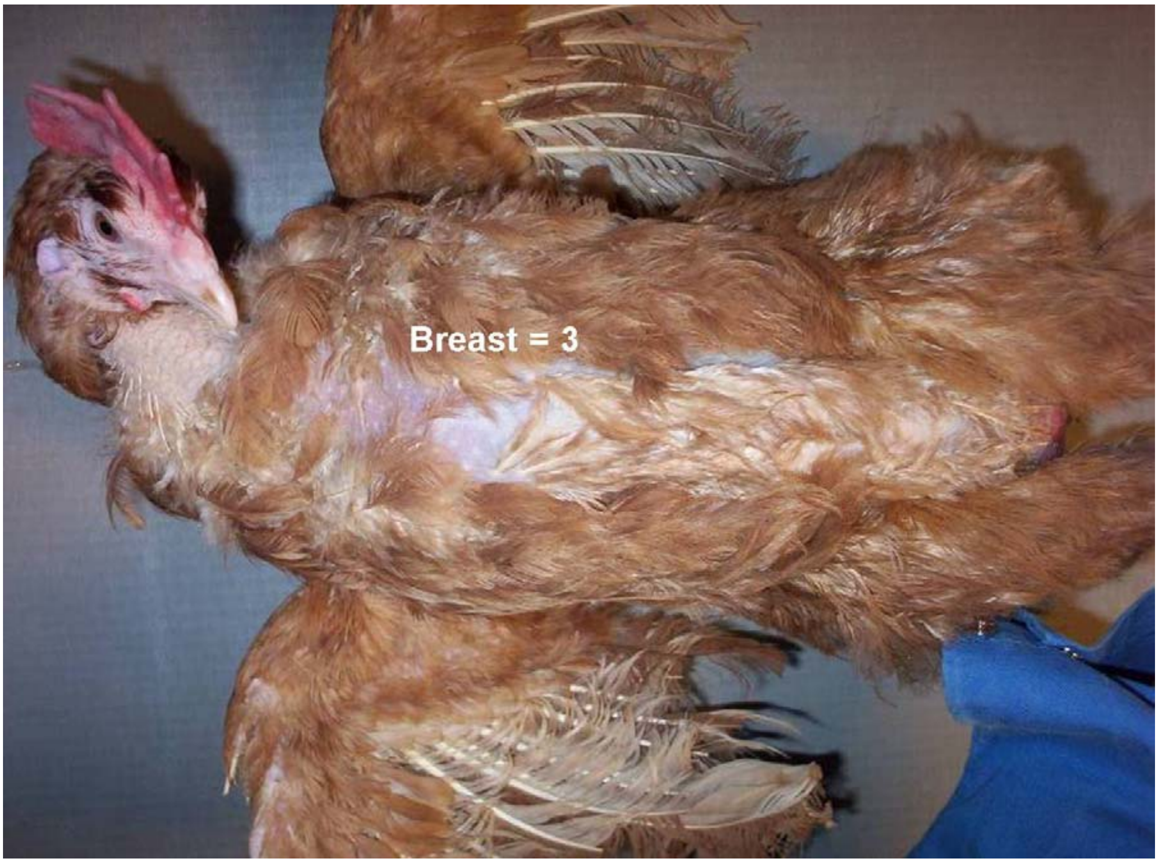
Fig. 5. Target bird for score 4 of neck of brown genotype.



Figs. 6-7. Target birds for scores 1-2 on breast of brown genotypes.

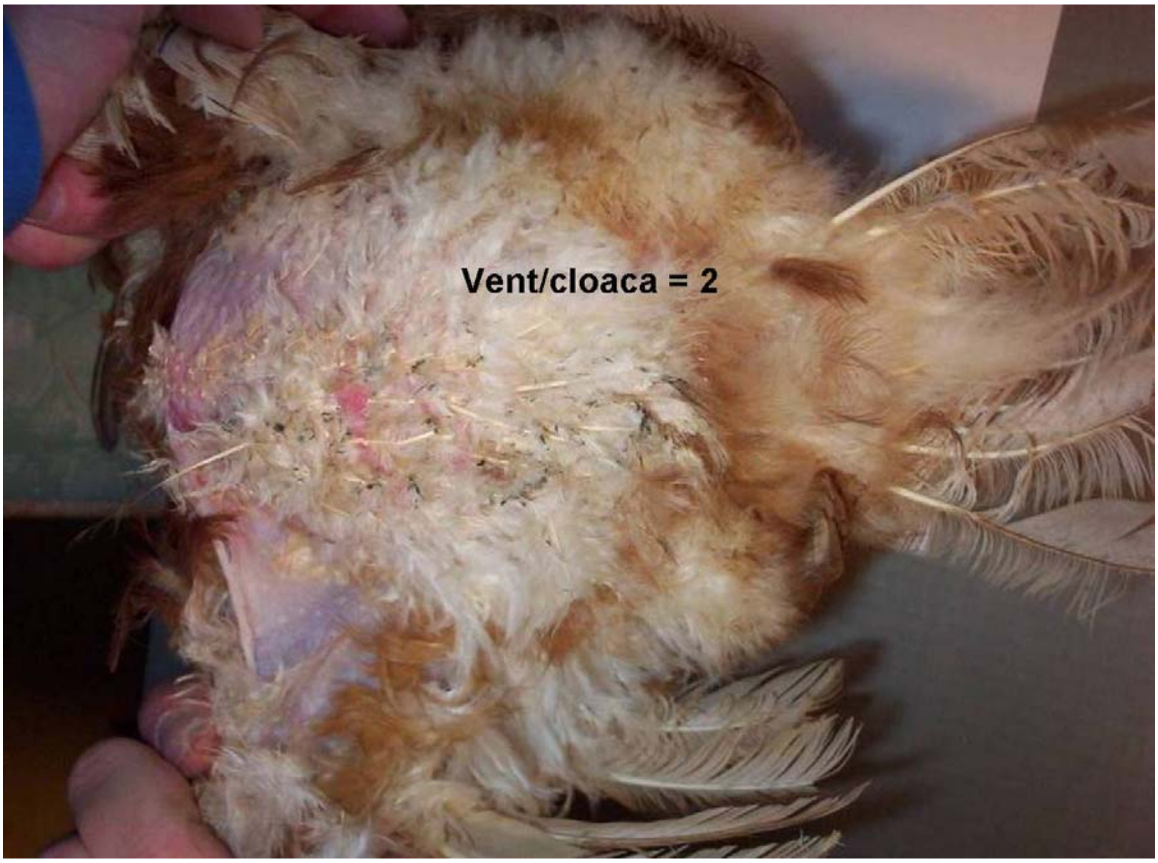


Figs. 8-9. Target birds for scores 3-4 on breast of brown genotypes.


Breast = 3


Breast = 4

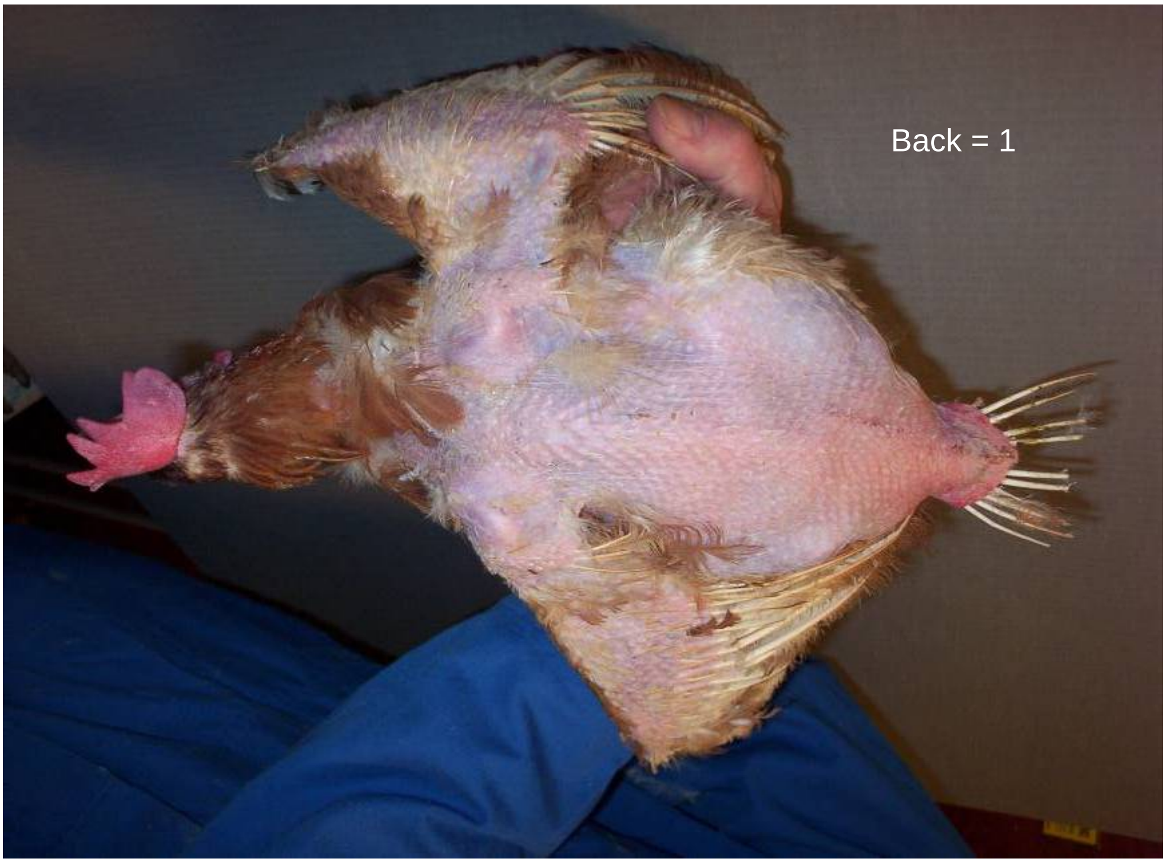
Figs. 10-11. Target birds for scores of 1-2 on vent/cloaca of brown genotypes.

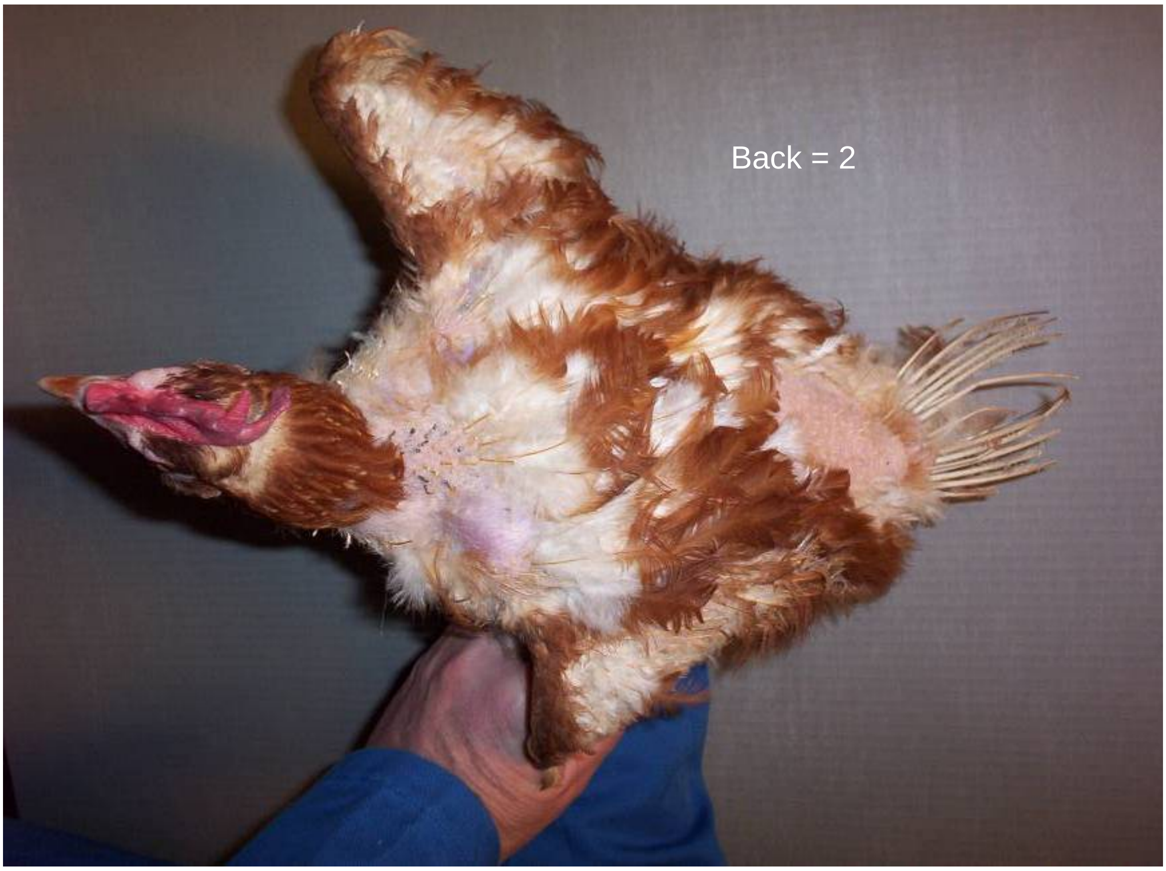

Vent/cloaca = 2

Figs. 12-13. Target birds for scores 3-4 on vent/cloaca of brown genotypes.


Vent/cloaca= 4

Figs. 14-15. Target birds for scores 1-2 on back of brown genotypes.



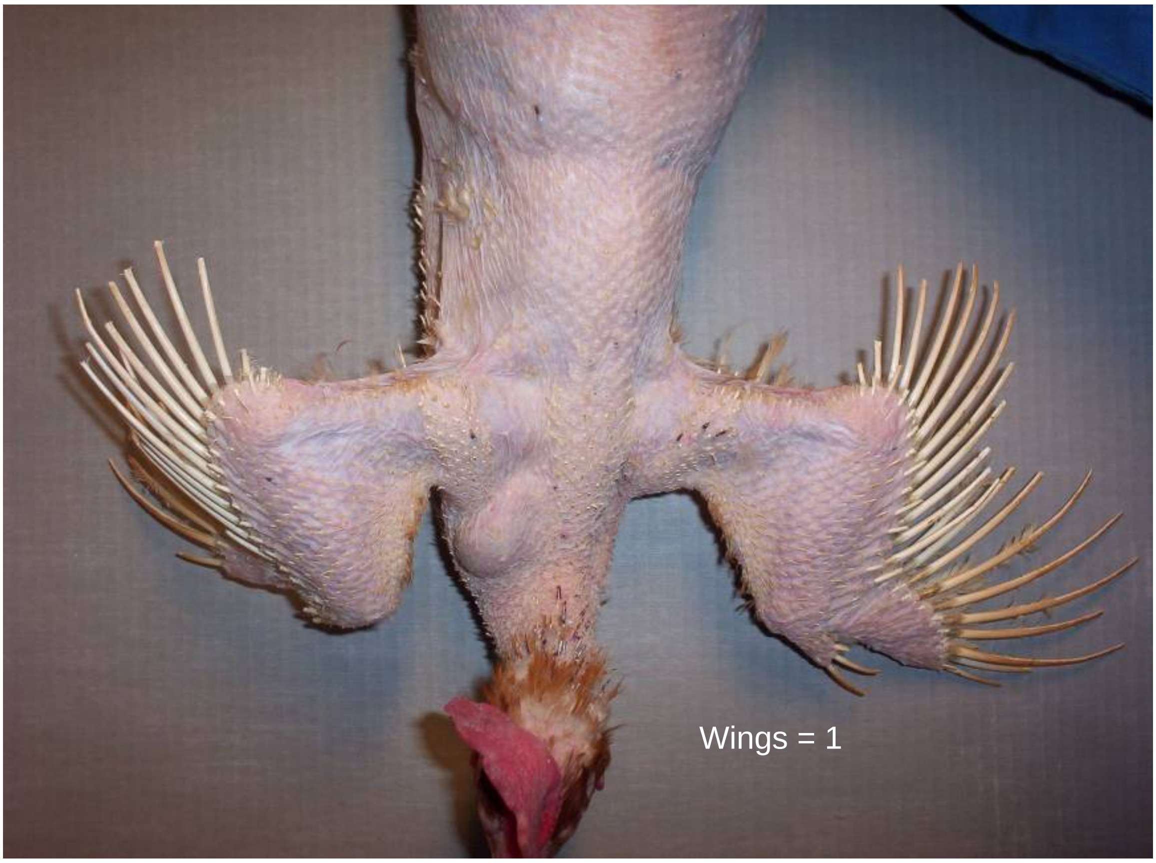


Figs. 16-17. Target birds for scores 3-4 on back of brown genotypes.


Back = 3


Back = 4

Figs. 18-19. Target birds for scores 1-2 on wings of brown genotypes.

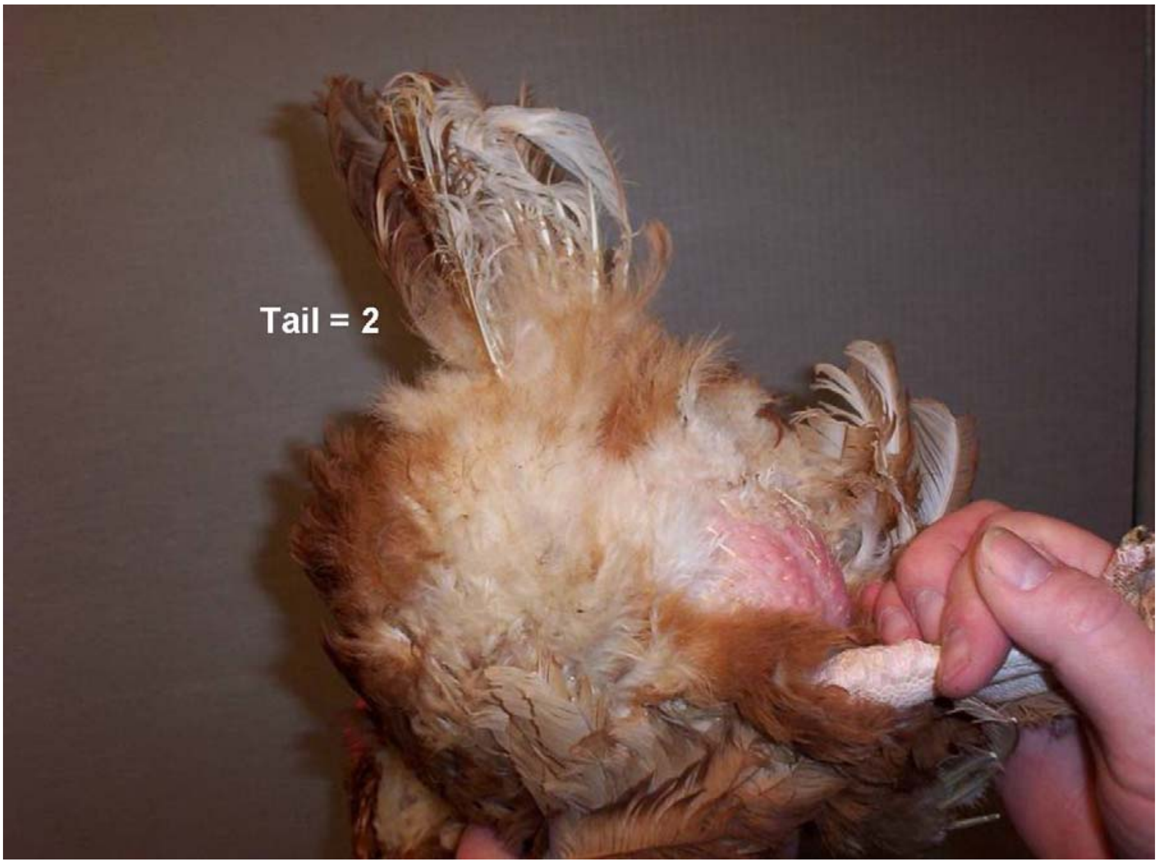


Figs. 20-21. Target birds for scores 3-4 on wings of brown genotypes.

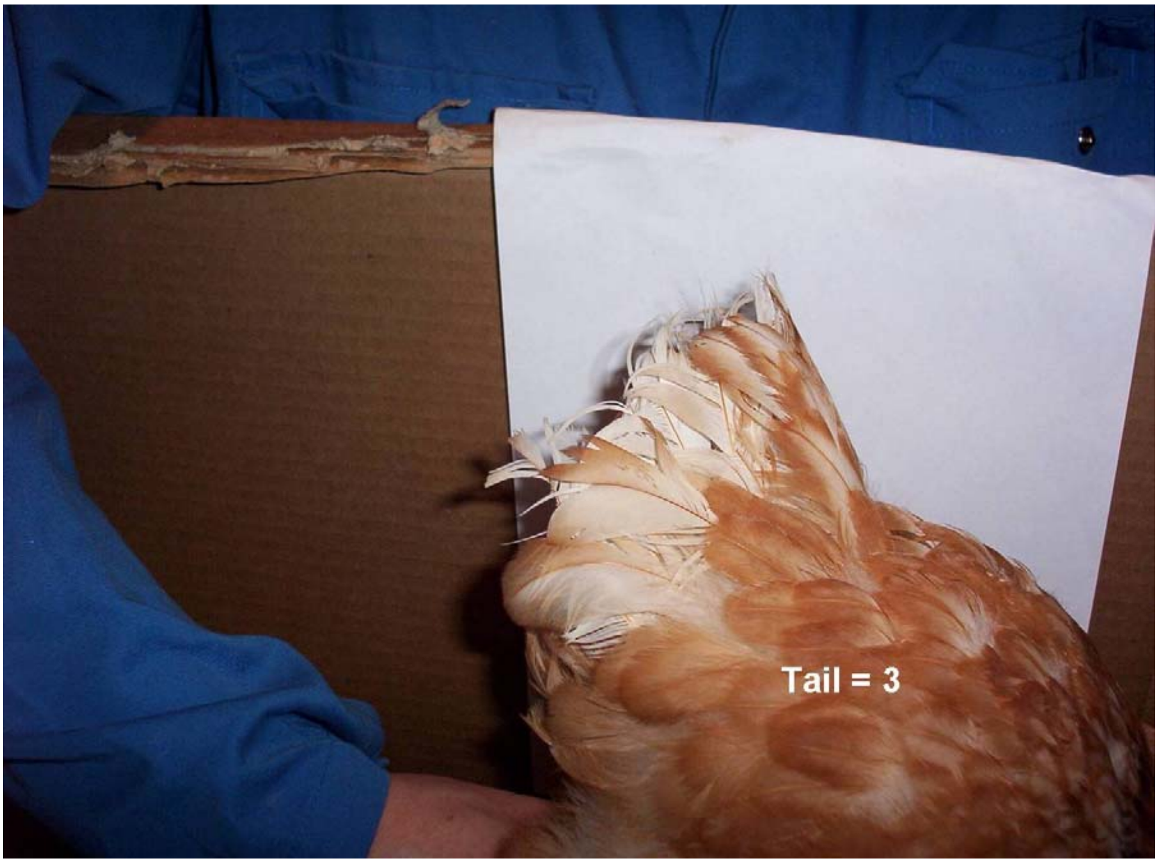

Wings = 3


Wings = 4

Figs. 22-23. Target birds for scores 1-2 on tail of brown genotypes.

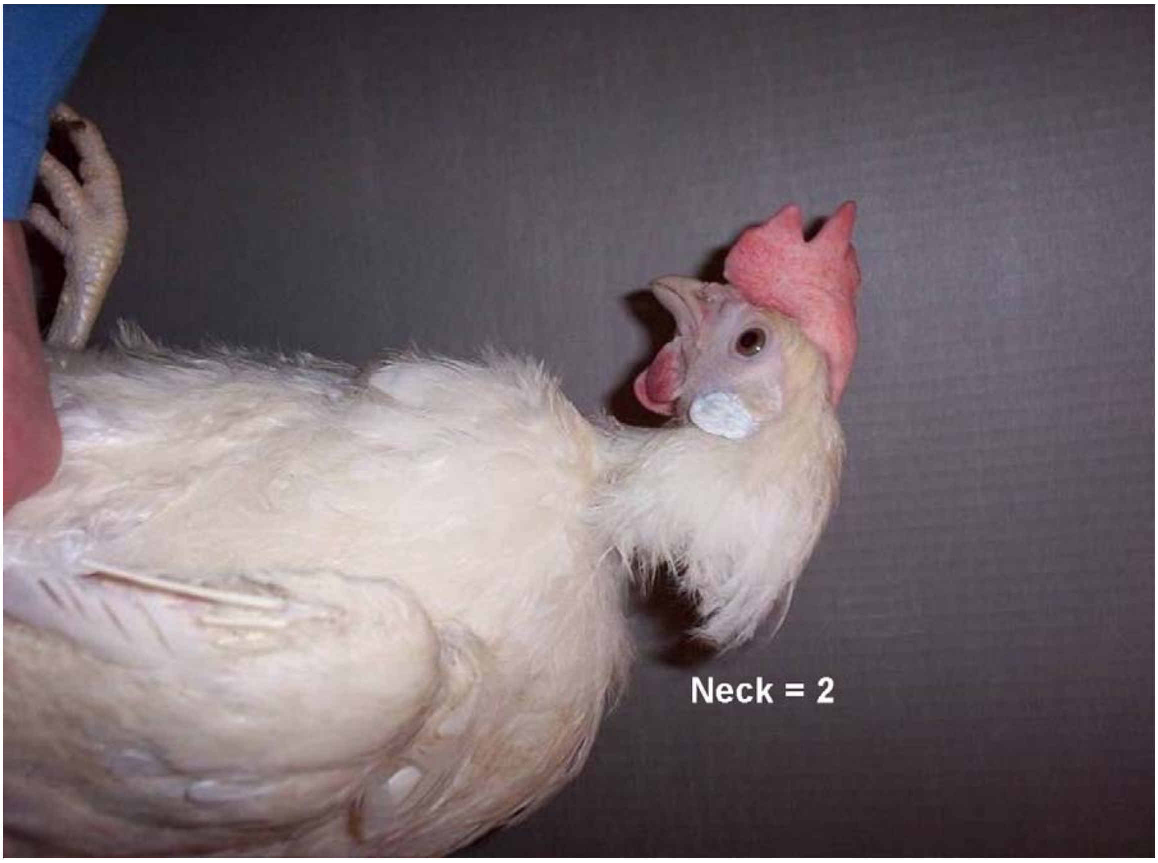

Tail = 2

Figs. 24-25. Target birds for scores 3-4 on tail of brown genotypes.

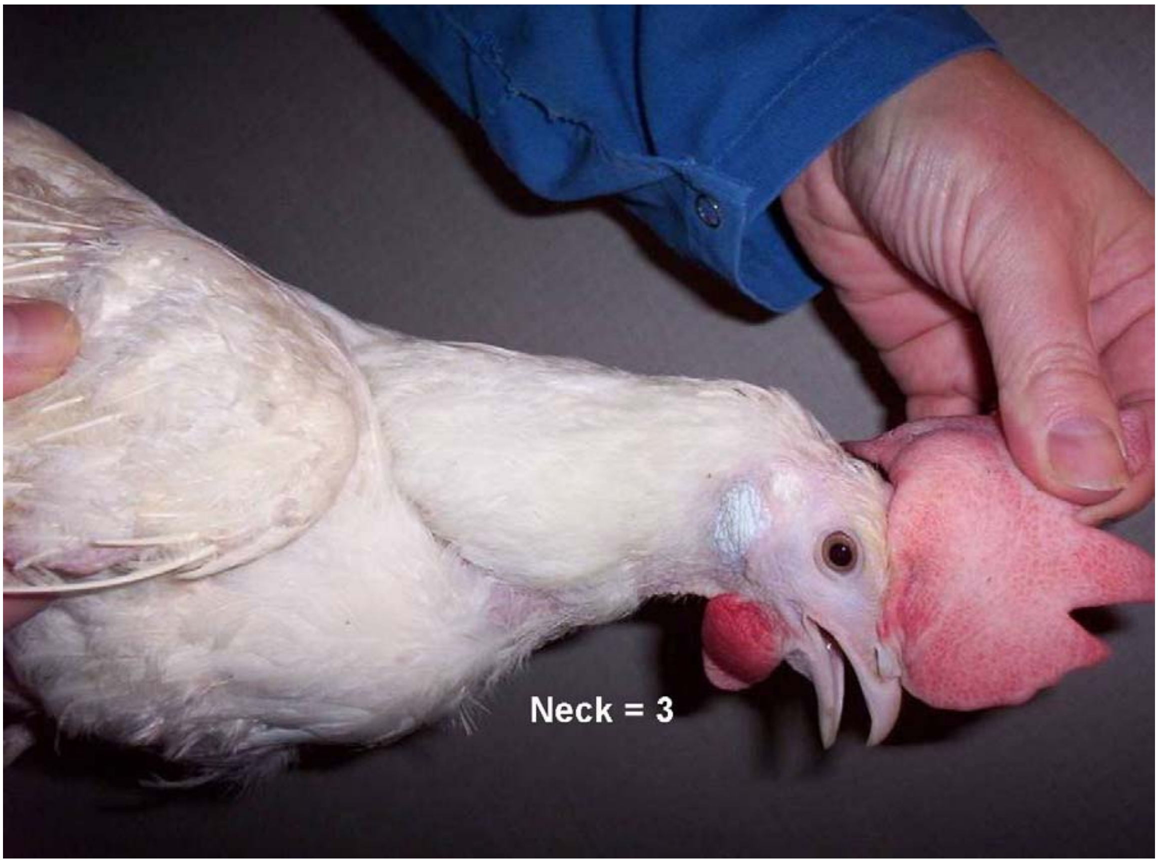



Tail = 4

Figs. 26-27. Target birds for scores 1-2 on neck of white genotypes.

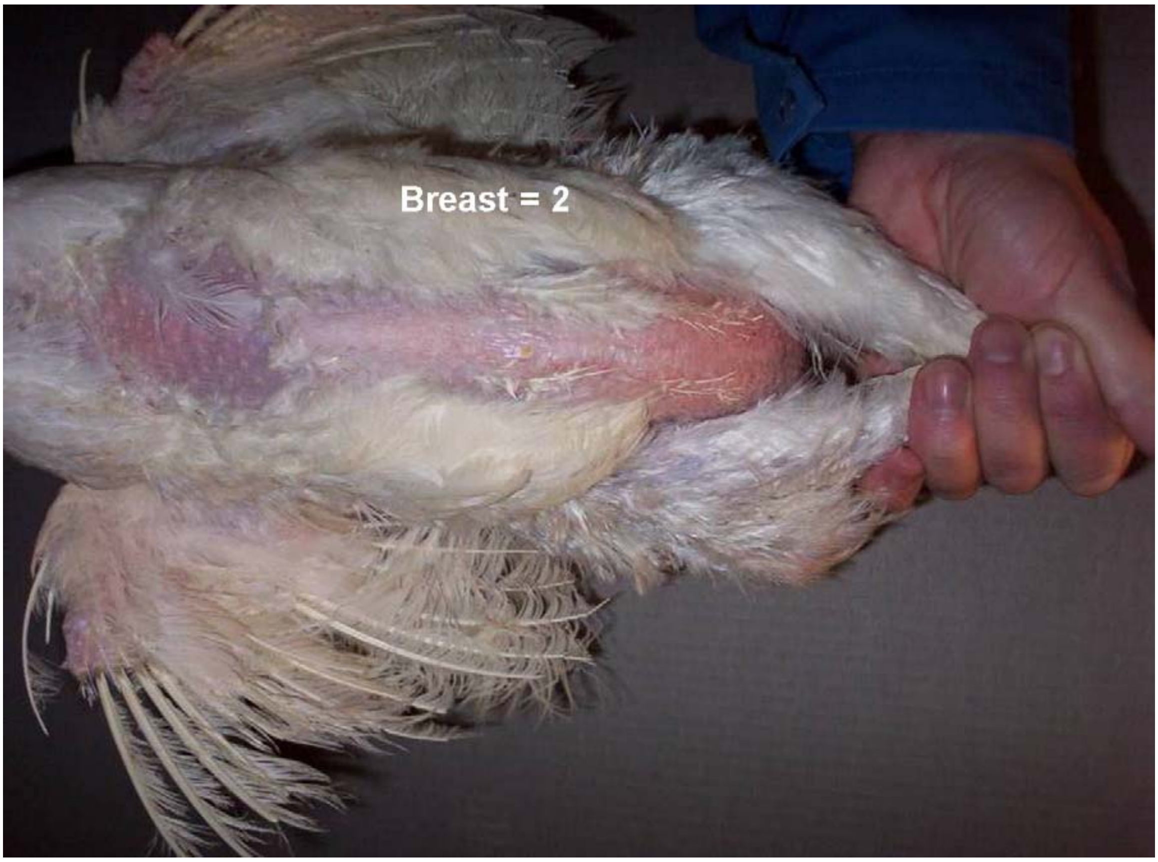

Neck = 2

Figs. 28-29. Target birds for scores of 3-4 on neck of white genotypes.

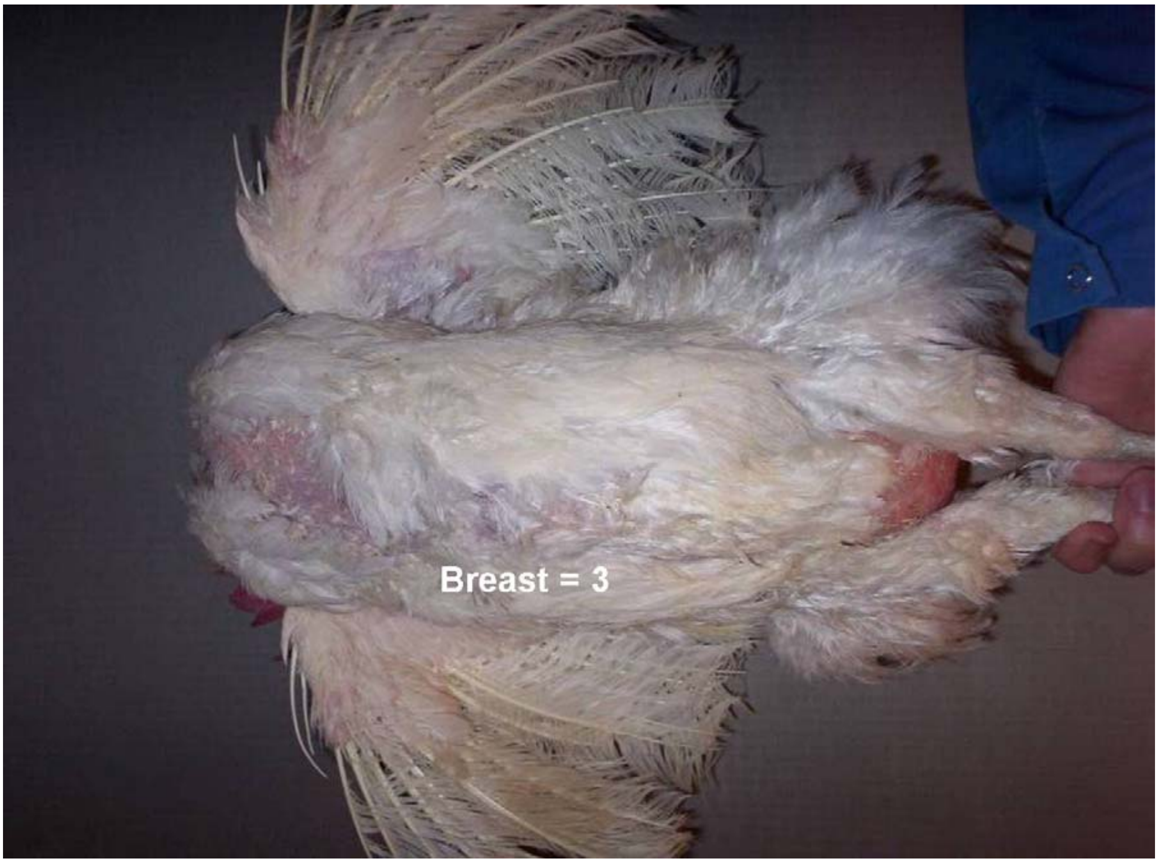


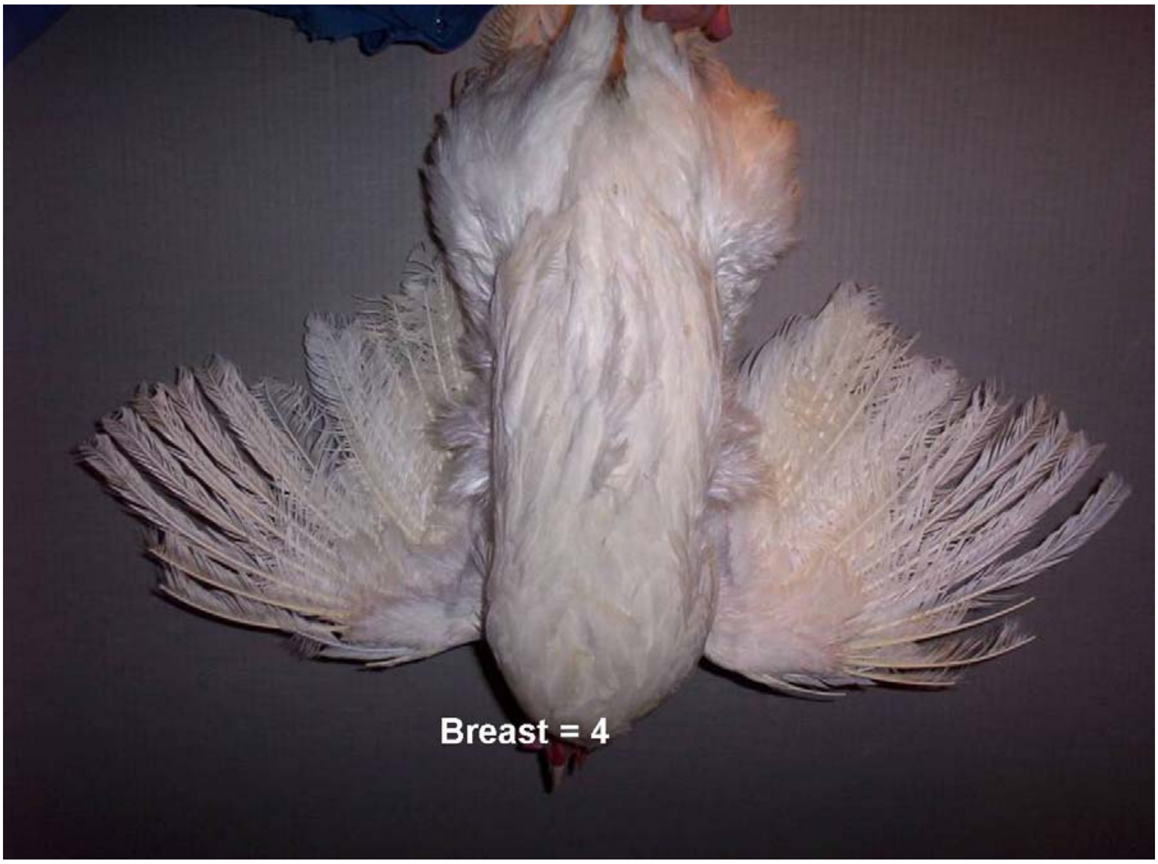
Figs. 30-31. Target birds for scores of 1-2 on breast of white genotypes.


Breast = 1

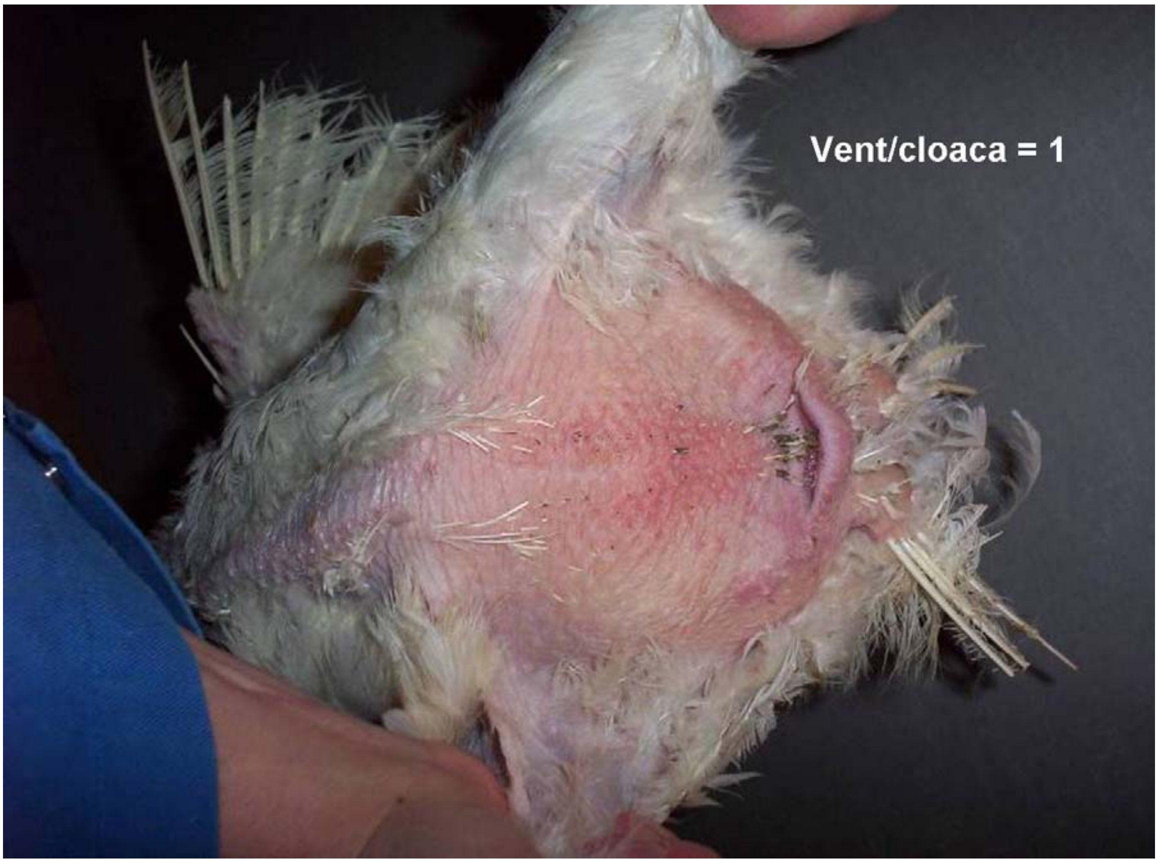

Breast = 2

Figs. 32-33. Target birds for scores 3-4 on breast of white genotypes.




Breast = 4

Figs. 34-35. Target birds for scores 1-2 on vent/cloaca of white genotypes.

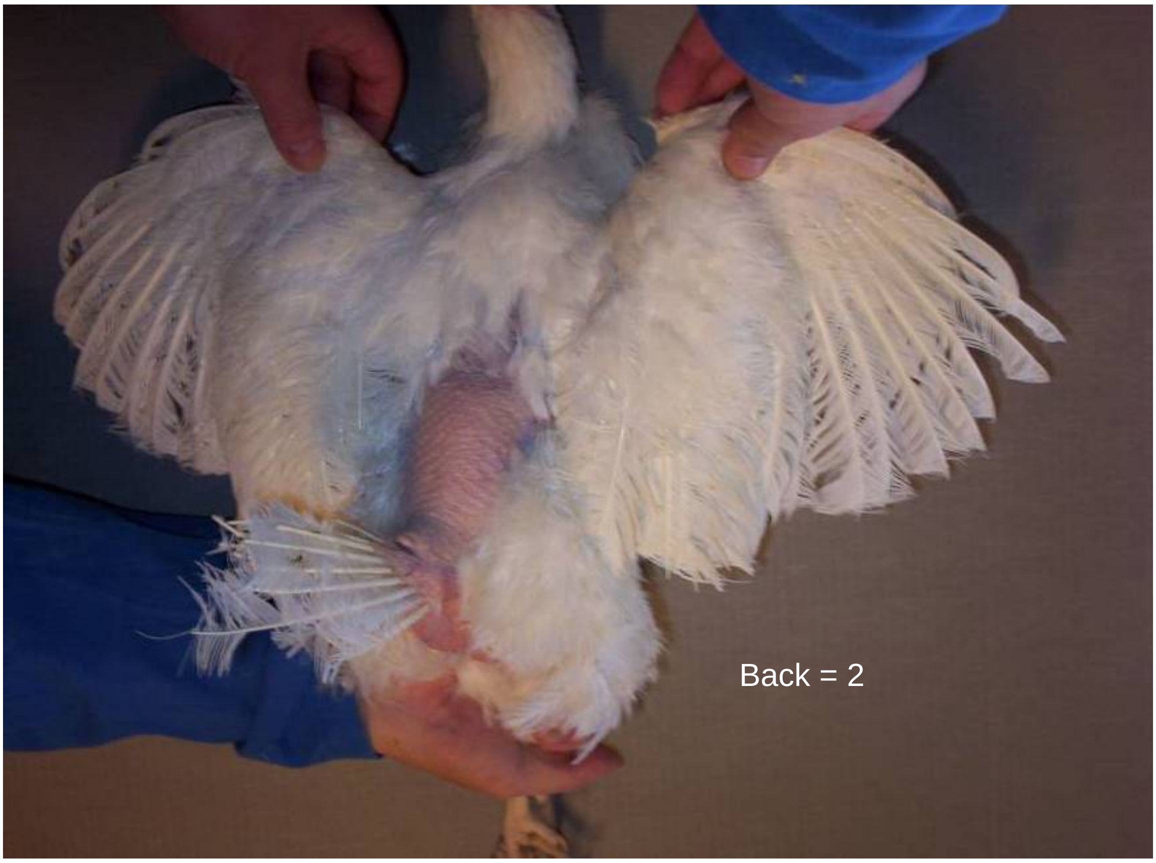



Vent/cloaca = 2

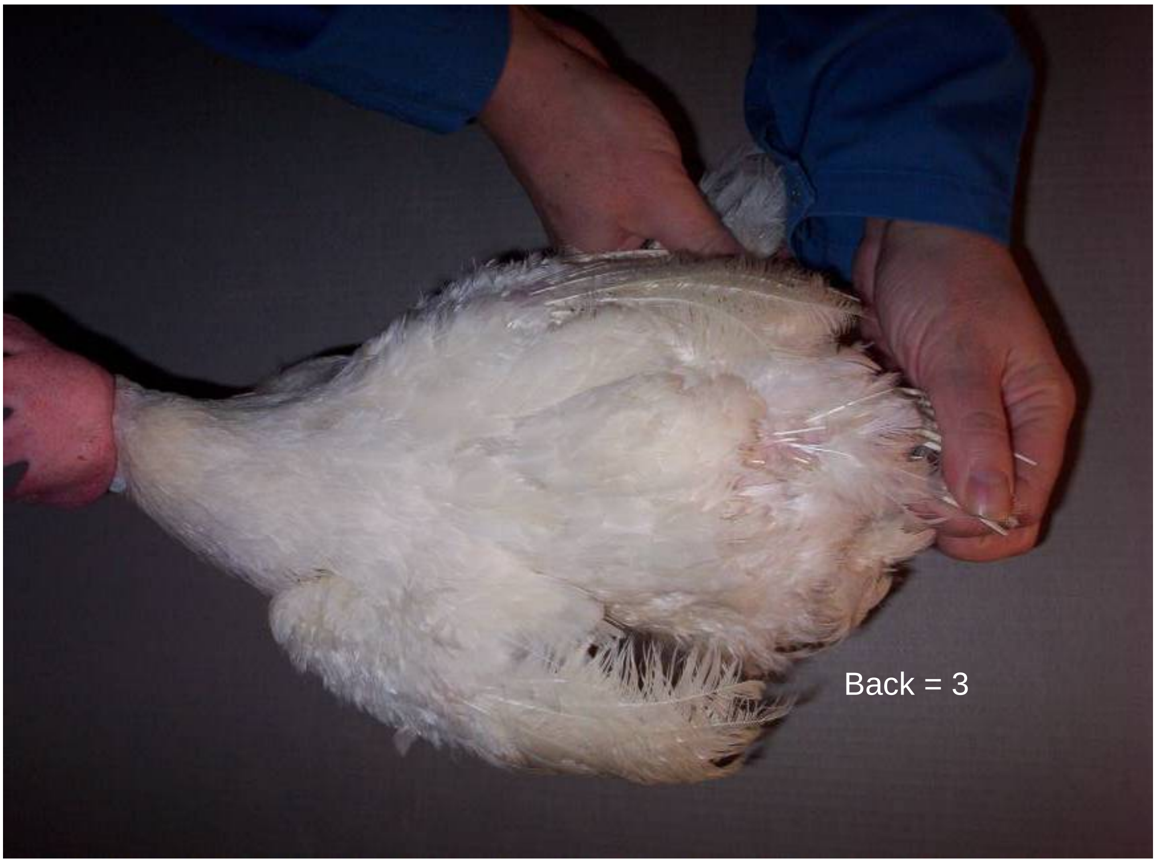
Figs. 36-37. Target birds for scores 3-4 on vent/cloaca of white genotypes.


Vent/cloaca = 4

Figs. 38-39. Target birds for scores 1-2 on back of white genotypes.

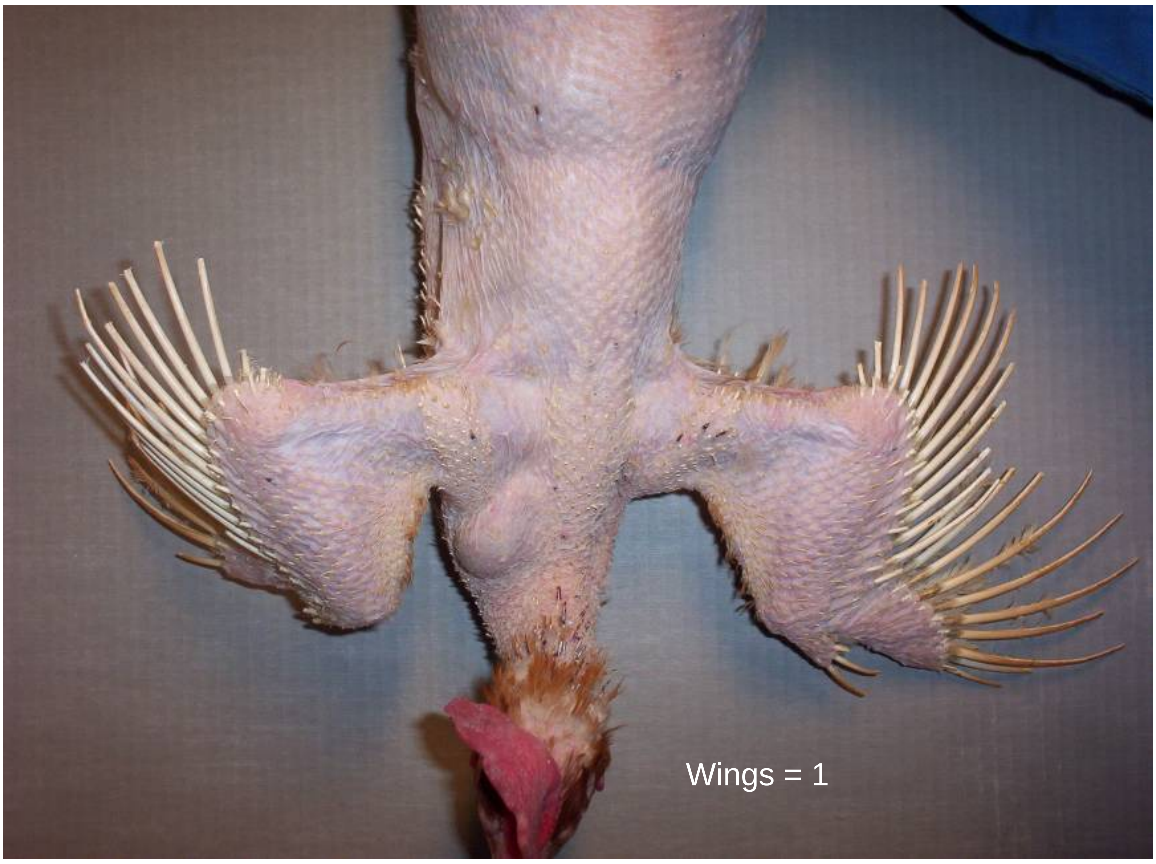


Figs. 40-41. Target birds for scores 3-4 on back of white genotypes.


Back = 3


Back = 4

Figs. 42-43 Target birds for scores 1-2 on wings of white genotypes.



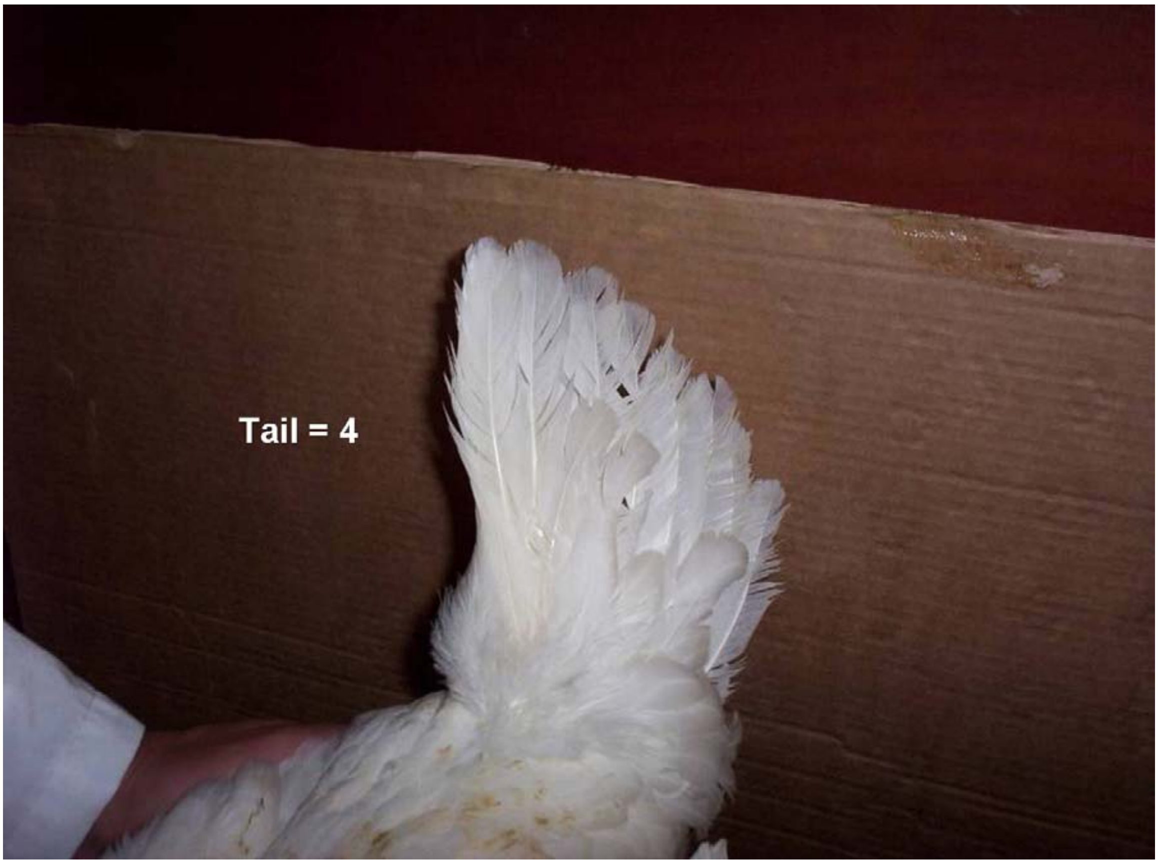
Figs. 44-45. Target birds for scores 3-4 on wings of white genotypes.

Figs. 46-47. Target birds for scores 1-2 on tail of white genotypes.


Tail = 1


Tail = 2

Figs. 48-49. Target birds for scores 3-4 on tail of white genotypes.



Figs. 50-51. Target birds of scores 1-2 for wounds on rear part of body.

Fig. 52. Target bird for score 3 for wounds on rear part of body.

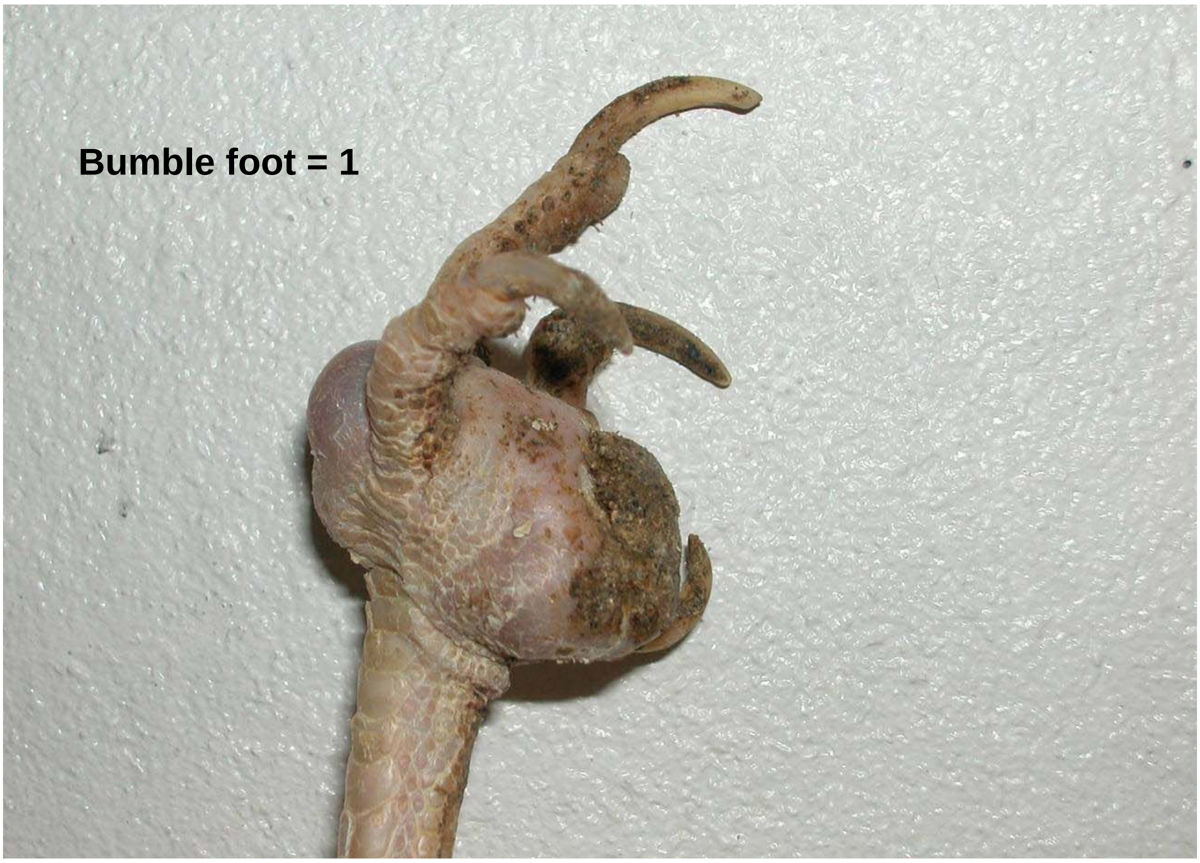

Wounds on rear part = 3

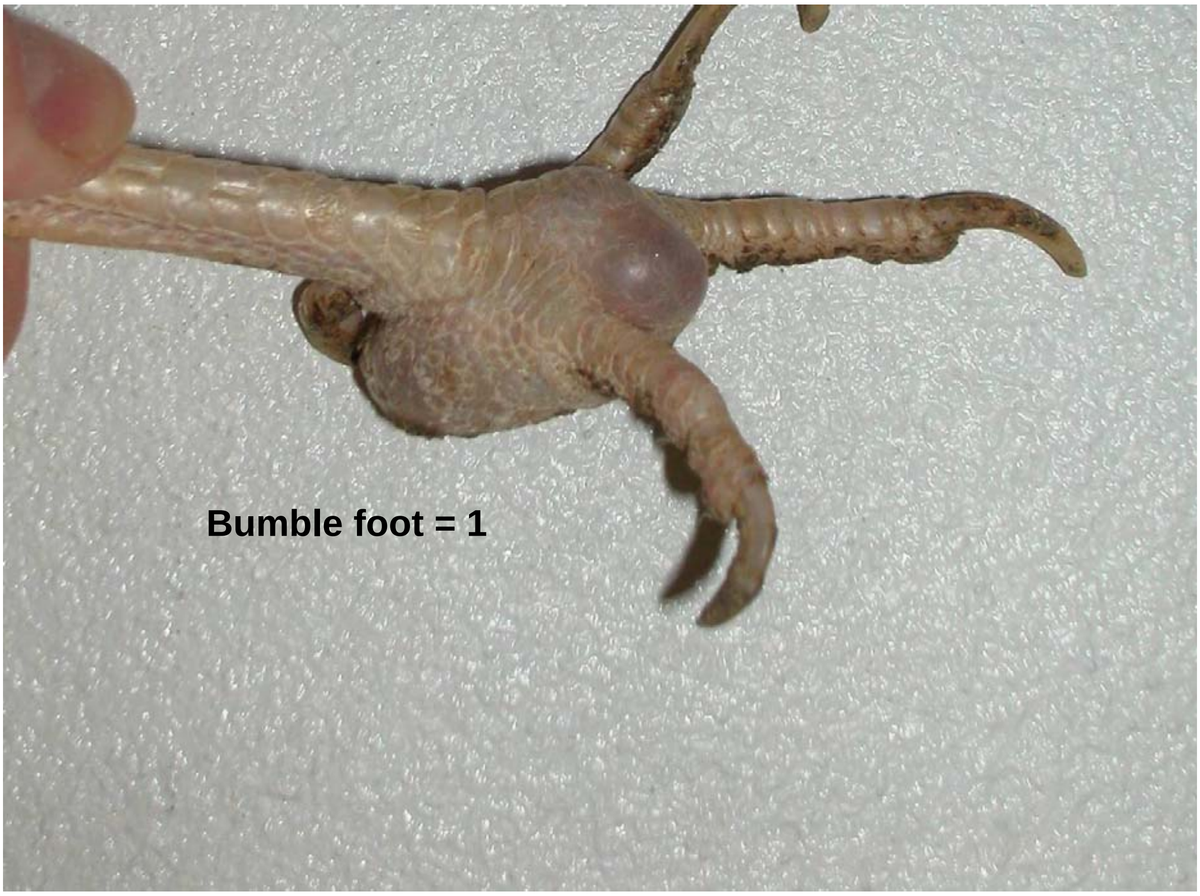
Figs. 53-54. Target birds for score 1-2 for wounds on comb.


Wounds on comb = 2

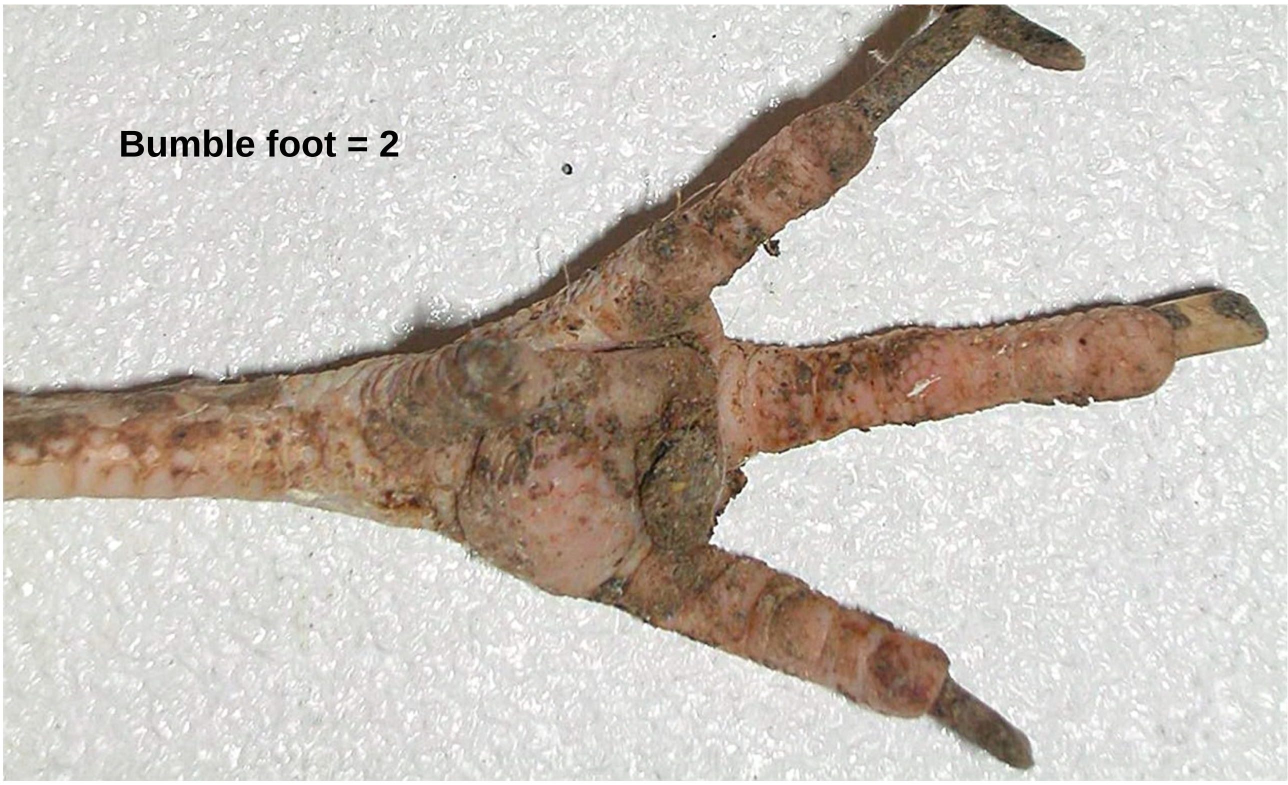
Fig. 55. Target bird for score 3 for wounds on comb.

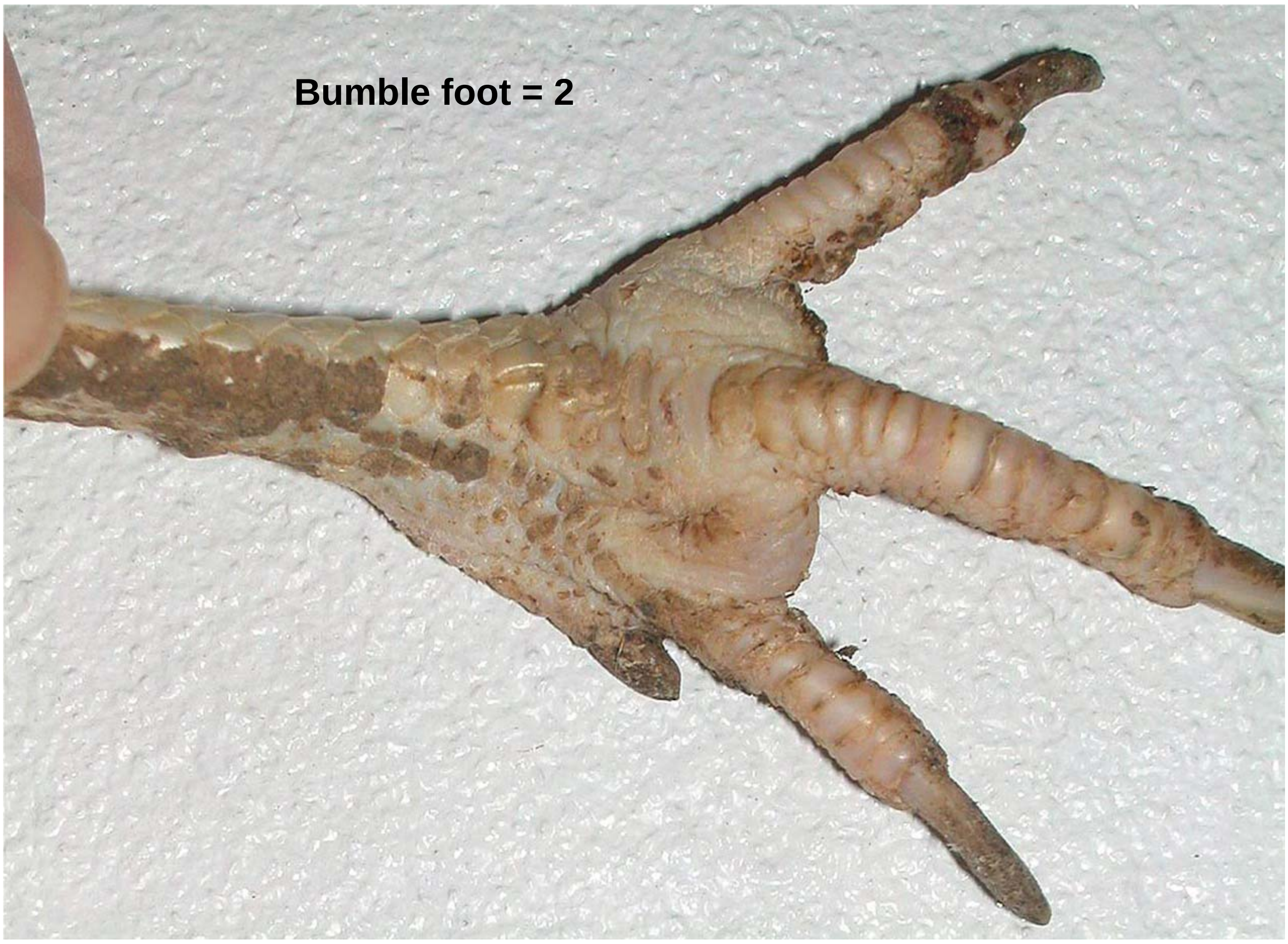
Figs. 56-57. Target bird for score 1 for bumble foot syndrome.



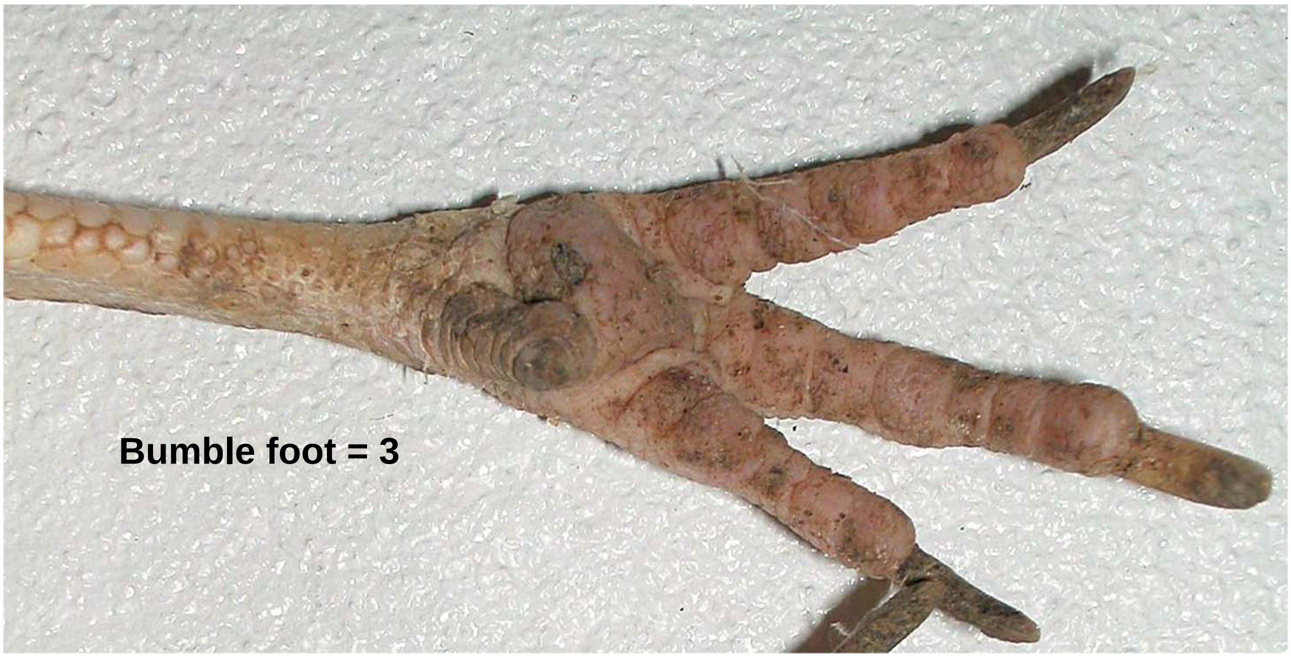

Bumble foot = 1

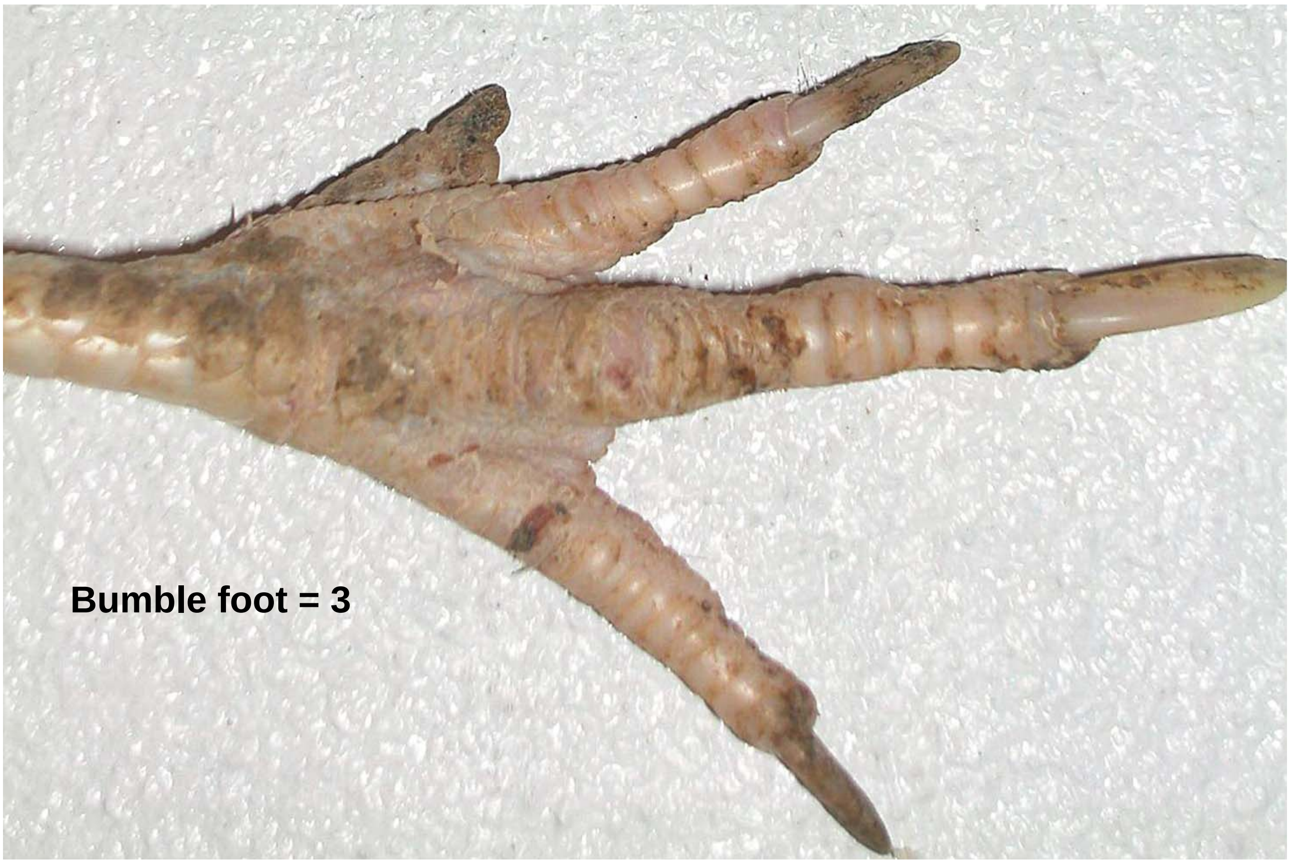
Figs. 58-59. Target bird for score 2 for bumble foot syndrome.




Bumble foot = 2

Figs. 60-61. Target bird for score 3 for bumble foot syndrome.





Deliverables D.3.2-D.3.3.

Analyses of a data base for health parameters in different housing systems

R. Tauson, K. Elwinger, Karl-Erik Holm & H. Wall

ABSTRACT

The present report (D.3.2-3.) gives the analysis of a 430 record data base sheet with health data from different housing systems including bird mortality originating from the different partners in the LayWel project. When applicable, comparisons with conclusions drawn in the EFSA report 2005 are made. The chosen model for statistical analyses represents one of several possible models to be used where a considerable unbalance exists in the recorded data. Bearing this in mind, the treatments considered for analysis of variance were quite broad consisting of PARTNER, SYSTEM (CC, FCL, FCM, FCS and NC), GENOTYPE (BROWN or WHITE) and BEAK TREATMENT (BEAK TRIMMED and non BEAK TRIMMED). For some systems, e.g. the FCL:s, there were relatively few data reported and only from 3 partners while the FCS:s were far better represented. Several significant effects from the treatments were found as well as some interaction effects. Among the main results were the lower mortality and better plumage condition in beak trimmed birds than in non beak trimmed, especially in brown genotypes. Birds in FCL:s showed higher mortality rates mainly due to pecking than in conventional cages, small- and medium sized furnished cages – the FCS showing the lowest average mortality rate. However, some recent but unpublished British data and data from Germany on more very recent designs of FCL:s - not included in the present data base - indicate much lower mortalities than in the present data base. Plumage condition was inferior in non cage systems compared to in FCS in commercial farms with non beak trimmed birds of both genotypes. As regards foot condition the NC systems were inferior to CCs and most often to the FCs. The incidence of keel bone deformities is connected to the use of perches or improper design of other places birds choose to roost on and is thus, mainly present in alternatives to CC:s. It is proposed to update the present data base at a later stage.

INTRODUCTION

A major contribution from the WP 3 is the set up and analyses of a data base for bird health traits and the following analysis of this data set mainly for the laying period. Since the health chapter in the EFSA-report represents a comprehensive and most recent review of the literature this was used as a reference (EFSA, 2005) when applicable.

MATERIAL AND METHODS

The total data base includes a total of 459 records from the partners of **ADAS, DIAS, INRA, PV, SLU, UHOH, UNIVBRIS and UNIZAR**. The number of records from each partner varied considerably as did the distribution of traits recorded over different systems and partners. For the statistical analysis of variance in WP 3 a total of 430 records were read and depending on statistical model used and traits studied between 356 and 33 records were used.

Since it was evident that in this data base some different scoring systems have been used, the scores compared were in some cases transformed to % of the maximum health score possible in the individual scoring systems used. Hence, the use of a new common scoring system launched by the WP3 within the LayWel project (Tauson et al., 2005a and b) will facilitate future possibilities to compare results in different studies.

In order to have enough records for each trait the following treatments were submitted to analysis at health condition scores at end of lay (mortality) or latest part of the cycle (other scores): **PARTNER, SYSTEM (CC, FCL, FCM, FCS** and **NC), GENOTYPE (BROWN or WHITE) and BEAK TREATMENT (BEAK TRIMMED** and **NON BEAK TRIMMED) SYSTEM, GENOTYPE, BEAK TREATMENT, PARTNER** and interactions between them where possible. (For the codes of systems, see system description provided in the D.2. deliverable of LAYWELL). The health traits eventually chosen as being possible to be subjected to analyses of variance were: **MORTALITY** (%); **WHOLE BODY PLUMAGE SCORE, FOOT CONDITION (**bumble foot**)** and **KEEL BONE DEVIATION** given as % of maximum health score. For the latter four traits as well as for **PECKING WOUNDS ON COMB AND SKIN** the % of birds with poor condition was also subjected to analysis by variance.

RESULTS AND DISCUSSION

General: The optimal way of analysing a data base like this could always be discussed. Thus, each model chosen has its advantages and drawbacks. It was agreed that the workpackage leader for each data base may choose its own model of analyses after careful considerations of the character of the individual WP data sheet. Hence, for the WP3 data base which were only recorded for at single or extremely few occasions were omitted. Still the distributions of systems, genotypes (WHITE or BROWN), beak treatment etc. are considerably unbalanced. However, by bringing e.g. PARTNER into the model of analysis of variance this helps in correcting for some of the unbalances. Also, mortality figures given in percentages were subjected to arcsine transformation to get a more normal distribution. The rough separation of "genotypes" in only white and brown may not always be ideal but was possible way of getting enough records per treatment.

Hence, the present analysis should be considered as one possible model out of several. Another possibility would have been to use mainly descriptive statistics, i.e. average figures and then discuss possible trends of means. That model was most often used in the EFSA-report 2005.

Data: Tables 1-4 give the results of treatments on **mortality** figures. It should be emphasized that although, the FCL data represent quite recently published results (>2000) they originate only from 3 partners which is different to some other systems and some of the FCL cage models may have been outdated – a fact which may apply to many models of systems in the data base. Two systems differ considerably in mortality from the others, i.e. FCL (15.5%) and NC (11.8%).When looking at the three models of FCs there is a clear trend from the present available data that larger group size increase mortality figures. The mortality for FCS is significantly lower ($p< 0.01$) than that of FCL and of NC ($p<0.001$) while the FCM is almost significantly lower than that of FCL ($p<0.07$). The higher mortalities in FCL and to some degree in NC are mainly due to pecking. The difference in mortality between NC and CC is not fully significant (p<0.10). The significant effect of beak trimming in reducing mortality (p<0.01) as well as the system x genotype interaction is not too surprising.

Without providing the present analysis of data from a larger number of trials, the present study confirms some of the general conclusions drawn on mortality figures in the EFSA-report of 2005 as regards the effects of genotypes and beak trimming and their interaction with housing systems. However, globally and with quite a considerable trend over some partners the present data tells that FCS from a mortality point of view show the lowest average mortalities. Although, a very considerable amount of the birds in the data sheet in the project were beak trimmed - as shown in Fig. 2 generally, low mortality rates mainly from white but non beak trimmed birds in FCS:s (8-10 birds/cage) have been presented in commercial flocks for a number of years by now (Tauson & Holm, 2005) and also in very recently reported Finnish experimental conditions (Valkonen, et al., 2005).

Being the most recently introduced housing system for layers it is likely that the FC:s still have a potential for further improvement. Thus, more data on FCM:s but FCL:s especially, appearing in the near future may show a different trend to the one originating from the present analysis. For example very recent but unpublished results mainly from beak trimmed and a few intact beaked commercial flocks, in Great Britain and data from Germany indicate low mortality rates in "state of the art" designed FCL:s (Elson, 2005).

Possibly using partly older data than in the present data sheet Aerni et al. (2005) in a similar study were not able to find significant mortality differences between NCs and cages while in the present study there was quite a trend for lower mortality in CCs (p<0.10). However, in that report most likely FCS:s and FCM:s were not included while in the present study these two systems both showed significantly lower mortality rates than NC:s and similar to CC:s (p<0.55 and p<0.77 respectively for FCS and FCM respectively).

There were significant effects on percentage of maximum reachable health scores for birds' **plumage condition** for the **entire body** between partners (p<0.001), of beak treatment (p< 0.001) and also an interaction between genotype x system (p<0.001). Thus, the plumage condition scores of birds averaged between 33% and 84% of maximum possible scores between partners. The corresponding figures for the beak trimmed and non beak trimmed birds were 55% and 41% respectively (Fig. 1). The results clearly indicate the effect of beak trimming on feather condition most likely to be caused by less possibility to grab a feather and pull it from the skin in BT birds. Regardless of beak treatment or genotype (corrected for in the model but only as regards BROWN or WHITE) the difference between partners' birds is surprising. Possible differences in scoring ages may be one reason or using of different genotypes within BROWN and WHITE.

For birds' **foot condition** - measured as bumble foot syndrome - there was also a difference in proportion of maximum health scores recorded between institutes (ADAS/DIAS/SLU). This varied from 94.1-100%. There were also significant effects of system (Fig. 3), i.e. the NC systems showed 95.7 % of maximum scores while the CC showed 100% (no bumble foot). The differences between genotypes were not significant although, white birds showed considerably inferior average scores than white. In fact, the present data may not provide accurate information on the general level of bumble foot since, this syndrome has its peak of development between 30 and 45 weeks of age while the present data originates from the latter or latest part of the production cycle (e.g. Oester, 1994; Abrahamsson, et al., 1996; EFSA, 2005). Even so, the inferior foot condition as regards bumble foot in floor systems compared to in CCs (normally not present) and most often also than in FCs is in line with EFSA (2005) and also Tauson and Holm (2001). It was not possible to analyse for perch design in the present experiment due to too unbalanced data and different scoring ages.

The proportion of maximum health scores reached for **keel bone condition** measured as keel bone deviation varied (81.1 % - to 98.6%) significantly between systems ($p<0.001$) but not between genotypes or institutes (Fig. 4). The NC systems with the lowest proportion score (poorest condition) were significantly different to all the others. Thus, although, there were some keel bone deviations in the FC:s too, the incidence was found lower than in the NC. The cause to this may be multi factorial, e.g. due to different perch designs and/or perch allocations used (not in the statistical model). Keel bone deviation was rarely found in the CCs which agree with EFSA (2005) the main reason being that there is no perch present to press on the keel bone.

The proportions of scored birds with **poor conditions** of plumage all originate from Swedish studies carried out in commercial farms with NCs and FCs and with only non beak trimmed birds. The **poor feather condition proportions for the whole body** varied significantly between genotypes ($p<0.001$) and between systems ($p<0.01$). Thus, the brown genotypes showed 59.9 % and the only white 26.0% birds with poor condition of plumage. For both genotypes the NC birds (52%) showed a poorer feather condition than the FCS birds (34%). The data demonstrate the increased risk of feather pecking in brown non beak trimmed birds often experienced in commercial conditions while the white birds normally manage better. (EFSA, 2005; Tauson, 2005). However, since these data do not take into account the exact year of study they do not illustrate a trend for even lower incidences of feather pecking in certain non beak trimmed white hybrids experienced among laying farms in recent years in Sweden (e.g. Berg and Yngvesson, 2005).

For clear **keel bone deformities** the birds in the FCs (7.6% deformed keel bones) showed an inferior keel bone health than the NC birds (4.9%) (not in graphs). This finding although at low incidences partly contradicts what is reported on the results where the proportion of maximum average score is used (see above). The reason is difficult to give but one possible explanation is that different perch designs were used in the two analyses in the present investigation which in turn both may have increased the use of the perch se but also have had an effect on keel bone pressure.

There were no significant effects found on the proportion of birds with severe **pecks on skin**. For **pecks on comb** there was a significant interaction so that the brown genotypes showed more comb wounds in the NCs than in the FCs while the white genotypes showed smaller differences and the other way around. The results suggest that when using non beak trimmed birds, especially the brown genotypes on average have a higher level of aggression in the larger groups in NC systems. These results globally agree with the EFSA report although, there may be differences within brown and white genotypes as stated before.

HEALTH INDICATORS AND THEIR EFFECTS ON WELFARE

In the WP3 some of the major health aspects in laying hens are analysed. To be able to evaluate these and some other health issues in relation to their effect on welfare and to describe their assessments in terms of future studies and in commercial practice it may be useful to make a brief summary of their character and importance. Information on "acceptable" levels of different health characters to appear in flocks of birds is scarce. However, one system has been in official and considerable national use since the early 1990's. This is through a compulsory evaluation process of different housing systems for laying hens in order to get them approved to be sold in the market in Sweden. It originates from the New Technique Evaluating System according to the 7§ of the Swedish Animal Welfare Ordinance (SFS, 1988; SJV, 1998). This on-farm test is organised by the Swedish Board of Agriculture (advisory board to the Government) and supervised by appointed scientists in charge. In order to get some kind of indication of the welfare status as regards some health characters described in the project, reference to applicable limits set by this Board is used below.

Mortality

Mortality rates are frequently used to describe a general status of health. However, before using this means of measuring - normally in percentage of hens housed - it is important to separate the proportion given in total percent into causes of mortality, preferably by autopsy or any other more careful examination of the dead bird. Examples of main causes of mortality are infectious and parasitic disease (mainly interior parasites), cannibalism, smothering and more seldom accidental mortality through trapping and injury. Levels of mortality in laying flocks may vary considerably between flocks, systems and genotypes and are also partly dependent on the length of production cycle. "Normal" mortality is therefore difficult to specify. In very general terms, if mortality during a full production cycle exceeds 9% (SJV, 1998) it should in most cases be considered as a higher mortality than wished for a healthy, commercial and profitable flock.

Feather pecking

In its most severe cases this abnormal behaviour may result in birds almost without feather cover. In such cases the birds by energy losses through heat dissipation may increase their feed consumption by 30-40% at 18-20 C $^{\circ}$ room temperature compared to a more normally feathered bird or one with only moderate feather loss. In outdoor birds in cooler climates this may become a welfare problem. For this reason the major parts of the body to be protected from feather pecking are the back, lower neck region, breast and cloacae region because these are major heat dissipation areas, while a poor plumage on the tail and partly also the wings in this case makes less difference. Like the case with cannibalistic pecking, feather pecking may be considerably reduced by using beak trimming although, already not allowed or proposed to be banned in some European countries. In such countries other means of reducing the incidence of pecking are considered, like being careful with the choice of genotypes, using lower light intensity and consider feed composition (e.g. Abrahamsson et al., 1996).

The most effective means to assess feather condition is by scoring the birds at different ages, as once this behaviour starts it normally continues at older ages. Using the LAYWEL scoring system ranging from 6-24 points when adding scores from 1-4 from 6 individual body parts (higher score – better plumage condition) a score lower than 12 would indicate severe feather pecking while a score of ≥18 shows little problem from this behaviour. For individual body scores this corresponds to average scores of 2 and 3 respectively. SJV sets the maximum accepted levels of proportion of scored birds with naked areas >5 cm in diameter of wings and back to 25%.

Pecking and cannibalism

Sometimes beginning with feather pecking , cannibalistic pecking is a very serious abnormal behaviour most often leading to severely impaired welfare for the birds. Thus, victim birds may suffer from all kinds of physical damage by wounds. Cloacae pecking (normally non aggressive), may proceed to gut pulling followed by death in a short while but may also lead to bacterial infections in the reproductive tract like salpingitis. Like feather pecking the larger the group of birds, the easier more hens will be targeted and hit by cannibalistic pecking spreading within a flock. Also here, there is most often a genotype x system x beak treatment interaction effect in incidence of cannibalism. In order to assess at an early stage the degree of cannibalism or aggressiveness in a flock, scoring of pecking wounds, especially at the comb/head, may be useful. Other areas of the body to study are the skin of the rump, wings and belly. Eventually, and appearing with considerable unpredictability, toe pecking behaviour may also cause suffering to birds. This is may not seldom be caused by birds pecking themselves. SJV gives the acceptable maximum levels of birds showing severe pecking wounds - ≤2 score in the Laywell scoring system- (Tauson et al., 2005b) on comb and on rear body/back to 15% and 10 % respectively. A higher acceptable level for comb wounds is set because - at least at the younger ages of pullets - a normal pecking order process may develop and provided this process gradually ends pecking wounds should not appear at a high degree any more.

Foot condition

Bumble foot syndrome is mainly found in systems where perches are present (EFSA, 2005). A poorer hygienic surrounding for the feet to move on clearly increases the incidence of this foot damage. There is also a genotype x perch design interaction. In its acute stage by 30-45 weeks of age it causes inflammation and severe swelling of the foot pad making normal walking and perching impossible. Later on the swelling normally goes down and a healing process starts leading to a much more moderate swelling by 60-80 weeks of age but the healing process may be of varying degree. Due to the clear age effect on this foot damage the flock of birds should preferably be scored between 35-45 weeks of age to get a picture of the severity for bird welfare. SJV sets the acceptable level for appearance of scores ≤2 to maximum 5% of birds.

Keel bone deformation

Damage to the keel bone may appear in systems where birds are allowed to roost on surfaces that imply long term pressure on the keel bone (EFSA, 2005). Normally this is linked to the use of perches but may also originate from other objects like edges or water pipes. The keel bone successively gets a twisted shape due to pressure from the object. In contrast to bumble foot syndrome the damage to the keel bone increases with age until slaughter. Perch designs which have an upper surface of a narrow shape press more on the keel bone than a more flat surface. In most cases the keel bone deformation is moderate although, being evident. However, if very unsuitable perches or places for roosting are present in a system and birds use these intensively, more severe damage may cause defects in the attachment of the breast muscles to the keel bone and thereby affect birds' use of these parts of the body. Because of the nature of development keel bone deformation should be scored at an older age preferably after 60 weeks of age. Scoring could be done by palpation of the keel bone under the plumage and through the skin of live birds or dissection of this bone after slaughter. SJV sets the acceptable level for appearance of scores ≤2 to maximum 5% of birds.

Parasites

Infestations of parasites are normally of two kinds – internal and external (EFSA, 2005). The most common former ones are coccidiosis and worms. Both may appear in floor kept birds in- or out-doors. While coccidiosis nowadays is normally avoided by vaccination or natural immunisation worms must be reduced by removing/change litter regularly or using de-worming programs with anthelmintic drugs. Because national legislation varies between EU-countries in the possibility to use such programs against worms in allowing medication without withdrawal times of the eggs or not, the effect on hen welfare varies accordingly. If not avoided by treatment or management, coccidiosis especially may cause severe threat to bird welfare and high mortality rates.

The most important external parasite today is probably the Red mite. Among the most common invasion media for this parasite into a flock of birds are pullets, egg trays, visitors and wild birds. Due to lack of permitted medical treatments and partly to the build up of immune Red mite strains this parasite has become a very common threat to the laying bird per se but also to egg quality and the working environment for the keeper. Apart from causing high level of distress to the victim birds at night when are invaded by the blood suckling mite, birds may die of anaemia caused by loss of blood. The irritation of the mites may also cause start of feather pecking. In order to be able to find out about the mite status at an early stage in a new flock of birds, mite traps made of plastic or corrugated cardboard may be/ should be put into attractive places for the Red mite in the house. As far as possible systems should avoid creation of cracks and crevices where the Red mite survives even longer without a host bird.

CONCLUSIONS

The data base on health parameters in WP3 originating from the contributing partners and from various housing systems described in D.2.was analysed by variance. Differences were mainly found in mortality rates and on condition of plumage, feet and keel bone. For the two former traits housing systems, beak treatments and genotypes were found to affect the incidences significantly. For the latter two characters presence of perches was important and for foot condition as regards bumble foot syndrome hygienic conditions played a significant role.

An effort was made in order to describe and evaluate/interpret the effect on birds' welfare for some main health characters. When applicable this work referred to some maximum accepted levels for the appearance of health disorders used by Swedish authorities in the compulsory evaluation of new techniques during the last 15 years.

The available data put in the data base by the individual partners show great variation in results as well as in numbers/systems present. Reasons for this of course can be multiple and could be due to differences in designs, management, genotypes, etc. It is concluded that - as with most data bases - new data within this topic are successively becoming published and available - in this case for several systems represented in the LayWel project and for FCL:s especially. Hence, an update of the existing data base would enable the provision of more knowledge on effects of improvements in systems in general as well as being able to remove older data. However, especially for the latter ones, it may be a difficult task to decide what data should be considered old.

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Fig 1. Average maximum score for plumage condition of whole body by beak treatments (LSMEANS)

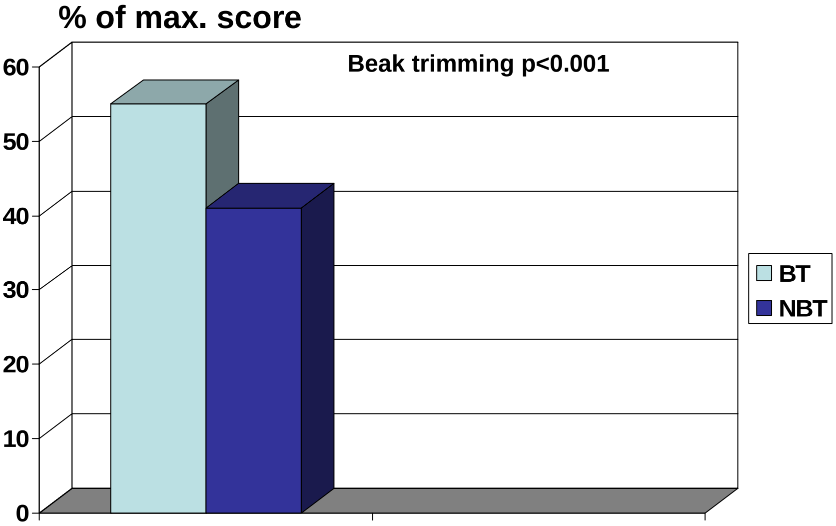

Fig. 2. Average total accumulated mortality including (higher graph) and excluding (lower graph) non-system related virus infections (leucosis and Marek) in the official testing program with 4 models of FCS:s (8-10 birds/cage) from 53 commercial non beak trimmed flocks, 32 houses and 435,000 layers in Sweden 1998-2003. From 16-76 weeks of age in 4 week periods. (Tauson and Holm, 2005).

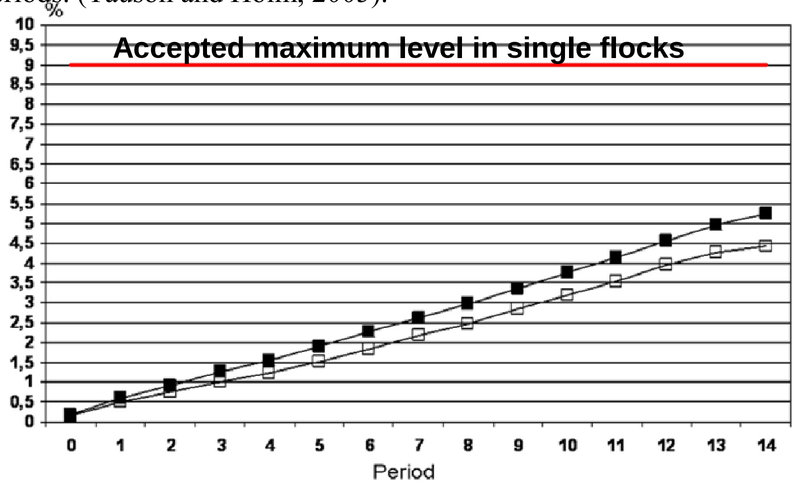

Fig. 3. Proportion of birds with poor foot condition (BFS) in commercial farms as affected by systems and genotypes (brown/white)

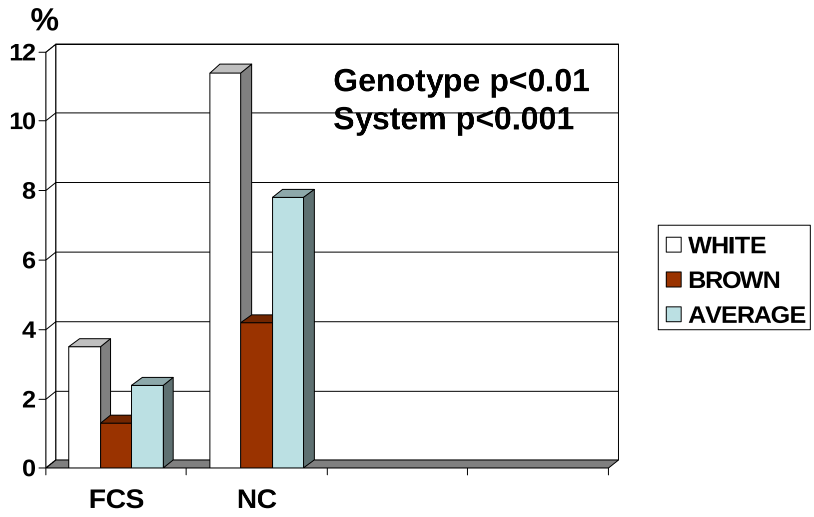

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Table 1. General analysis of variance in mortality rates as percentage of housed birds in laying hen cycles. Effects of housing system, partner, beak treatment and genotype.

Treatments	Housing system	Partner	Beak treatment	Genotype	System x Genotype	System x beak treatment	Genotype x beak treatment
Significance	**P<0.001**	**P<0.001**	**P< 0.01**	**P<0.01**	**P<0.001**	**P<0.001**	P<0.42

Table 2. Mortality rates as percentage of housed birds in laying hen cycles. Effects of housing system

System	CC	FCL	FCM	FCS	NC	Significance
Percentage	**8.3**	**15.5**	**9.5**	**7.1**	**11.8**	**P<0.001**

Table 3. Mortality rates as percentage of housed birds in laying hen cycles. Effects of partner.

Partner	ADAS	INRA	PV	SLU	UHOH	UNIVBRIS	UNIZAR	Significance
Percentage	**6.7**	**12.2**	**17.9**	**8.2**	**8.6**	**9.9**	**9.8**	**P<0.001**

Table 4. Mortality rates as percentage of housed birds in laying hen cycles. Effects of genotype and beak treatment.

Treatment	BROWN	WHITE	BEAKTR	NONBEAKTR	WHITE**BT**	BROWN**BT**	WHITE**NBT**	BROWN**NBT**
Percentage	**14.2**	**6.7**	**6.1**	**14.7**	**3.0**	**9.3**	**10.5**	**19.0**

GENERAL CONCLUSIONS OF WORKPACKAGE 3-HEALTH

This work package has focused on two items where the first was the co-ordination and documentation of a scoring system for bird health and welfare, including the condition of the integument, to make it possible to compare trials carried out at different institutes and for use both in scientific and industrial situations. Such a system was launched in May 2005 (Tauson et al., 2005a) and presented on the internet - www.livsmedelssverige.org/hona/scoringsystem (Tauson et al., 2005 b) as well as to the meeting with the LayWel stakeholders in 2004. It features a literature background, illustrations and a guideline for the use of the system. Until now the homepage has had an average number of visitors of about 10 per day. Apart from that several educational organisations and research groups have approached the scientific group asking for more information and use of the system. Hence, the dissemination of the results on this deliverable seems promising and would therefore encourage the use of a common scoring system.

The second major contribution to WP3 was the data base on health traits. The data base originating from the contributing partners and from various housing systems described in D.2. was analysed by variance. Differences were mainly found in mortality rates and on condition of plumage, feet and keel bone. For the two former traits housing systems, beak treatments and genotypes were found to affect the incidences significantly. For the latter two characters presence of perches were important and for foot condition as regards bumble foot syndrome hygienic conditions played a significant role.

An effort was made in order to describe and evaluate/interpret the effect on birds' welfare for some main health characters. When applicable this work referred to some maximum accepted levels for the appearance of health disorders used by Swedish authorities in the compulsory evaluation of new techniques during the last 15 years.

The available data put in the data sheet by the individual partners show great variation in results as well as in numbers/systems present in their studies. Of course, reasons for this are multiple and regarding obtained results may be caused by e.g. differences in degree of up to date designs used, management practices or bird genotypes. It is concluded that as is the case with most data base set ups, new data within the topic are successively becoming published - in the present case for several systems and for some groups of FC:s especially. Hence, an update of the existing data base would enable the provision of more knowledge on improvements of systems in general as well as being able to remove older data. However, especially for the latter ones, it may be a difficult task to decide what data should be considered old.

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