THE NEEDS OF LAYING HENS AND SOME INDICATORS OF POOR WELFARE

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SUMMARY

In order that the welfare of hens will be good, they need conditions which are more than just sufficient for them to survive. For example they should have adequate exercise, opportunities to peck and dust-bathe, a nest site and an environment in which aggression and injury are unlikely. Indicators of poor welfare include bone weakness, bone breakage and other injury, feather pecking, stereotyped pacing, high adrenal cortex activity, immunosuppression and a high disease incidence. Since the evidence for poor welfare in battery cages is now substantial, knowledge concerning the welfare and protection of hens in other systems must be shared so that the housing systems which are best for hen welfare can be utilised in an economically viable way.

During the last ten years, those involved in the egg production industry in Europe have come to realise that egg sales were being affected by public concern about hen welfare. One source of information was public opinion surveys like the survey in 1986 by the Dutch Foundation for Statistics and the TROS Broadcasting Corporation, in which questions asked included the following:

Do you think that the keeping of laying hens in batteries should be completely forbidden or do you think that this is not necessary?

- yes, should completely be forbidden: 70%
- no, not necessary: 24%
- do not know/no opinion: 8%

If we consider the rearing of pigs and chickens; would you be prepared as a consumer to pay more for pork or chicken for the sake of the welfare of the breeding animals, or would you not be prepared to do this?

- would be prepared: 86%
- would not be prepared: 8%
- do not know/no opinion: 6%

Consumers in most EC countries show more concern in 1992 about the welfare of farm animals than they did in 1986. Such opinions and the public image of the industry are important but so are the present and future sales of eggs. In recent years there has been a rapid increase in the number of vegetarians, many of whom quote their dis-
like of the keeping of hens in battery cages as a reason for not eating eggs. In general, egg sales should have been higher and there have been increases in the sales of eggs labelled 'free-range' in the shops. By 1990, 12% of egg sales in the south of the UK were of free-range eggs.

Politicians were also aware of the public concern since the welfare of animals is, on average, the topic most frequently referred to in letters to Members of the European Parliament. Scientific evidence concerning hen welfare was accumulating and in 1987 the European Parliament Resolution on Farm Animal Welfare Policy stated that the use of the battery cage for the housing of laying hens contravened the Council of Europe Convention on the Welfare of Animals Kept for Farming Purposes because the welfare of the hens was not good enough. Since that time, further scientific information about the welfare of laying hens has been collected which specifies the extent of the welfare problem for the hens. In this paper the needs of hens, as assessed from studies of their preferences and from those situations which result in poor welfare, are briefly reviewed. Some important evidence concerning the welfare of laying hens will then be presented.

The needs of laying hens

A need is a deficiency in an animal which can be remedied by obtaining a particular resource or responding to a particular environmental or body stimulus (Fraser & Broom 1990, Broom 1991). Each need is a consequence of the general biology of the animal, especially its motivational systems (Baxter 1988, Hughes & Duncan 1988, Broom 1988 a). If an animal is not able to satisfy a need, the consequence, either in the short-term or eventually, will be poor welfare. The welfare may be poor because there is a reduction in fitness or because the animal has difficulty in coping with the situation (Broom 1985, 1986, 1986 b).
Most needs arise directly from the motivational state of an individual. For example there may be high levels of causal factors which promote drinking behaviour and hence a need to drink. One possible causal factor is that which results from too high a concentration of body fluids, so the deficiency is easily identifiable. However another causal factor is that which arises from the intention of the individual to drink in order to prevent future dehydration. In this latter case there is a psychological deficiency but there is not necessarily a physiological deficiency concerning behaviour. It is important to realise that needs are just as important if they result from a psychological component of one of the functional systems controlling life. Failure to satisfy a need may result in death but for many needs, death does not ensue but welfare is poor if they are not satisfied.

As a consequence of the link between the concepts of needs and that of motivational state, it is clear that many needs can be ascertained by observing the preferences of animals and that much of our knowledge of the needs of laying hens arises from studies of preferences, including those which demonstrate the importance of a resource to the hen (e.g. Dawkins 1983, Duncan & Kite 1987, Nicol 1987 b). Other information about needs comes from measurement of the extent to which poor welfare is indicated by measures of behaviour, physiology, growth, reproductive output, disease or injury. Indeed some deficiencies must be considered to be needs even if the animal's body regulating systems are not adapted to deal with them. For example the animal needs to avoid harmful irradiation even if it cannot detect that irradiation and an individual which happened to have inadequate pain receptors needs to avoid being burned even if the sensation of burning is not present.

Hens need:

- to obtain adequate nutrients and water,
- to grow and maintain themselves in such a way that their bodies can function properly,
- to avoid damaging environmental conditions, injury or disease,
- and to be able to minimise the occurrence of pain, fear and frustration.

In order to achieve these ends, hens carry out a variety of activities, respond to certain stimuli and maintain certain physiological states. Hence they have other needs such as:

- to show certain foraging and investigatory movements,
- to have sufficient exercise,
- to show preening and dust-bathing behaviour,
- to explore and respond to signs of potential danger,
- to interact socially with other hens,
- to search for, or create by building, a suitable nest-site.

These various needs are discussed further by de Wit (this volume).
Welfare problems for laying hens in the various housing systems

Feeding and drinking

The quality of the diet and the quantity of food which the average laying hen is able to obtain is good for most or all of its life, irrespective of the housing system. Lack of food can occur when injury, crowding, fear of aggression, or an inadequate availability of feeders prevents birds from reaching the feeder. Breakdowns in automatic food supply systems can also lead to food deficiency. A management procedure in which food is withdrawn, or effectively withdrawn because a completely new food is offered and the hens are unwilling to eat it, is carried out as part of a way of inducing moulting. Such procedures are carried out in battery cages where no other material is available for hens to eat. A period of starvation for several days clearly results in poor welfare and should not be permitted.

Water supply is also adequate for most laying hens but there is a greater chance, than for food supplies, that breakdowns will occur, especially where there are long lines of nipple drinkers. Drinkers in battery cages require frequent checking in order to ensure that water deprivation does not occur, for although birds in large groups usually have potential access to many drinkers, those in a cage are dependent on the one or two drinkers in their own cage. Induced moulting also involves water withdrawal. Water deprivation has adverse effects on hens quicker than does food deprivation.

The major food searching behaviour of hens involves pecking at objects with characteristics rather like those of a seed. In natural conditions, hens spend long periods showing pecking behaviour directed at a wide range of objects encountered in the environment. Free-range birds and, to a lesser extent, those provided with an adequately large littered area, can still do this but hens in battery cages have food particles whose characteristics are not very varied, and may have no particles to peck at except faeces and feathers for long periods. The hen needs to show pecking behaviour even if nutrient intake is sufficient, hence some substratum should be provided. A further aspect of investigatory pecking behaviour is that inadequate provision for such pecking may increase the likelihood of the sort of pecking at other birds which causes wounding. Such pecking is not very common in battery cages, so it may be that the hen must be able to stand back from the stimulus before damaging pecking is very likely to occur.
### Table 1  Incidence of broken bones after catching

<table>
<thead>
<tr>
<th></th>
<th>Battery hens</th>
<th>Perchery hens</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>982</td>
<td>456</td>
</tr>
<tr>
<td>Nos. of farms</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>% birds with broken bones</td>
<td>24.0</td>
<td>10.1</td>
</tr>
<tr>
<td>Broken bones per bird</td>
<td>0.35</td>
<td>0.11</td>
</tr>
</tbody>
</table>

data from Gregory et al (1990)

### Table 2  Broken bones in battery hens during handling and processing

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>% of birds with broken bones</th>
</tr>
</thead>
<tbody>
<tr>
<td>After removal from cages</td>
<td>446</td>
<td>24</td>
</tr>
<tr>
<td>After removal from crates</td>
<td>207</td>
<td>31</td>
</tr>
<tr>
<td>After handling on shalckling line</td>
<td>375</td>
<td>39</td>
</tr>
<tr>
<td>STUNNING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After scalding</td>
<td>225</td>
<td>87</td>
</tr>
<tr>
<td>After chilling</td>
<td>167</td>
<td>98</td>
</tr>
</tbody>
</table>

data from Gregory and Wilkins (1992)
Seeing

Requirements, additional to food and water, for normal growth and maintenance include receiving sufficient sensory input and having adequate exercise. Some aspects of sensory functioning require certain levels of sensory input. Hence hens kept in darkness or in very bright lights for long periods can have eye abnormalities. Dim lighting conditions (<30 lux) have been reported to result in more fear responses, particularly when group size was large (Hughes & Black, 1974). Hens given the opportunity to switch lights on or off kept the lights on for 80% of the time (Savory & Duncan, 1982).

Bone and muscle maintenance

The muscles of hens in battery cages which have little exercise are different from those of hens in housing systems which allow exercise and it is suggested that muscle weakness may be a problem (Martin, 1987) but there is no clear evidence that this is relevant to welfare. The effects of lack of exercise on bone strength in laying hens, however, have been one of the most significant findings relevant to hen welfare in recent years. The general concept here is that if a housing system has effects on an animal such that the bones are much weaker than normal and more susceptible to breakage, then the welfare of birds in that system is poorer. Danish studies involving measurements of a limited number of bones indicated that the bones of hens kept in battery cages were more likely to break than those of birds in other conditions, probably because of lack of exercise (Meyer & Sunde 1974, Simonsen 1983). Extensive studies by Gregory & Wilkins (1989) and Gregory et al (1990) in which all bones were dissected out of hen carcasses after slaughter, showed that 24-38% of hens from battery cages had at least one freshly broken bone before stunning, but nearer to 10% of hens from percheries or free-range had a broken bone. These breakages are caused by rough handling in part, but they are due especially to the weaker bones of hens housed in battery cages. Knowled & Broom (1990 a) reported that birds which could and did show wing flapping or flying had wing bones almost twice as strong as birds in cages which could not flap. Nørgarrd Nielsen (1990) obtained a similar result. Hughes & Appleby (1989) had demonstrated that the provision of a perch in a cage resulted in greater leg strength. There was also a greater leg strength in the Elson Terrace system, where much walking occurred, than in a battery cage, where far fewer steps were taken (Knowles & Broom loc. cit).

Table 3, Table 4
### Table 3  
**Median bird movements within systems**

<table>
<thead>
<tr>
<th>Types of movement/bird/hour</th>
<th>Cage</th>
<th>Terrace</th>
<th>Perchery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight</td>
<td>0.0</td>
<td>0.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Flap</td>
<td>0.0</td>
<td>0.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Steps</td>
<td>72.0</td>
<td>1058.3</td>
<td>208.2</td>
</tr>
</tbody>
</table>

Data from Knowles and Broom (1990a)

### Table 4  
**Mean bone strength in systems (N)**

<table>
<thead>
<tr>
<th></th>
<th>Cage</th>
<th>Terrace</th>
<th>Perchery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humerus</td>
<td>176</td>
<td>241</td>
<td>325</td>
</tr>
<tr>
<td>Tibia</td>
<td>303</td>
<td>348</td>
<td>325</td>
</tr>
</tbody>
</table>

Data from Knowles and Broom (1990a)

### Table 5  
**The incidence of old breaks by husbandry system**

<table>
<thead>
<tr>
<th></th>
<th>Free Range</th>
<th>Perchery</th>
<th>Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>418</td>
<td>456</td>
<td>4700</td>
</tr>
<tr>
<td>% of birds with old breaks</td>
<td>12.0</td>
<td>25.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Data from Gregory *et al* (1990)

Gregory *et al* (1990) found a high level of old breaks which had mended in the bones of some perchery-housed hens. This probably occurs when hens fail to land properly on perches since it is the furculum and keep which are most often broken. It is now clear from further work by Gregory (pers. comm.) and Blokhuis (pers. comm.) that the

*Table 5*
distribution of perches and the amount of perch space available are likely to be of major importance in determining how often clumsy landings, with a risk of bone breakage, occur. A perch space of 20cm per bird is not enough to prevent birds from having difficulty in finding a perching space and landing on it. In the Tiered Wire Floor system, with rows of perches at staggered heights so that the birds can hop up as on a ladder, bone breakages are rare.

A housing system which results in weak bones such that breakages are much more likely to occur during collection of birds before slaughter is unacceptable. Systems which give birds more freedom of movement will normally occur without a high risk of bone breakage.

Studies of what hens prefer to do, also emphasize that wing-flapping is necessary in order that the welfare of hens can be good. Hens in battery cages cannot flap their wings but those in percheries flapped 1.9 times per bird per hour and flew twice in every five hours (Knowles & Broom, 1990 a). Wennrich (1975, 1977) found that birds removed from a battery cage and put into a larger area showed much more flapping and Nicol (1978 b) found that birds confined in a cage for longer periods flapped for longer when given room to do so, than those caged for shorter periods.

Preening and dust-bathing

Preening is of great importance for hens, as evidenced by the long periods spent on this activity and the occasional interruption of almost all other activities in order to preen.

The space required for preening and stretching is described by Dawkins & Hardie (1989)* and it is clear that if five hens are present in a 2250cm² battery cage, four would have to crowd close together in order that one could preen. Normal preening movements must often be difficult in such a space and it may be that some individuals are not able to take the necessary space because the others will not let them. Dawkins & Hardie (loc. cit.) also report that in 25% of head movements by unconstrained hens the head is above 40cm, but the present EC Directive allows 35% of the cage to be 35cm high and the rest of the cage to be 40cm high. Most hens are severely restricted in their preening movements by such a cage (Nicol, 1987 a) as well as being unable to flap their wings or walk more than a few steps.

Dust-bathing has long been known to be a highly preferred behaviour of hens (Vestergaard 1980, 1982) but it has recently become clear that feather pecking may occur principally because the hen is not able to dust-bathe. Feather pecking can be very frequent in battery cages but is much less frequent where much litter is provided for the hens and even the provision, for hens kept on a wire floor, of

* Table 6
straw in baskets, reduced feather pecking (Norgaard-Nielsen, 1989). The sequence of movements involved in dust-bathing also occurs in the early part of feather pecking. It is clear that the inability to dust-bathe is a real deprivation for hens and it seems that adequate litter on the floor can solve the feather pecking problem (Vestergaard, 1989).

Scratching movements also occur if litter is provided on the floor. Inability to scratch on a surface which can abrade the claws leads to excessive claw growth, often accompanied by claw breakage or claws being trapped in wire floors etc. In cages, the provision of an abrasive strip can solve this problem (Tauson 1986, 1988).

<table>
<thead>
<tr>
<th></th>
<th>Range cm²</th>
<th>Mean cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing</td>
<td>428-592</td>
<td>475</td>
</tr>
<tr>
<td>Ground scratching</td>
<td>655-1217</td>
<td>856</td>
</tr>
<tr>
<td>Turning</td>
<td>978-1626</td>
<td>1271</td>
</tr>
<tr>
<td>Wing stretching</td>
<td>660-1476</td>
<td>893</td>
</tr>
<tr>
<td>Wing flapping</td>
<td>1085-2606</td>
<td>1876</td>
</tr>
<tr>
<td>Feather ruffling</td>
<td>609-1362</td>
<td>873</td>
</tr>
<tr>
<td>Preening</td>
<td>800-1977</td>
<td>1151</td>
</tr>
</tbody>
</table>

data from Dawkins and Hardie 1989
Perching above the floor

Free-range hens with trees available to them will perch in the trees at night and almost all hens in systems with perches in them perch at night. This clear preference would have an anti-predator function in feral conditions. As mentioned earlier, the provision of perches in cages results in greater leg strength. If perches are provided during rearing, levels of aggression are reduced (Frölich, pers. comm.). Poorly designed perches cause foot problems and birds which perch for long periods are more prone to bumble-foot. Such birds perch for larger proportions of the day than do birds in more varied and less crowded environments and it may be that they are loathe to leave their perches because of shortage of perching space. It is clear that hens prefer to perch on something raised above the floor and derive some benefit from doing so.

Regulating temperature and responding to atmospheric conditions

In general the thermal characteristics of the environments provided for hens are good, although failure of ventilation systems can result in poor welfare in any system. Prolonged exposure to high dust or ammonia levels can cause lung lesions and other problems (Oyetunde et al., 1987) and these are least likely to occur in battery houses. Any other housing system for laying hens must be managed in such a way that both dust and ammonia levels are kept below the threshold at which serious problems occur.

Avoiding pain and injury

The problems of bone breakage have been discussed above. Pain and injury due to hens becoming trapped in inadequately designed cages, or to foot abnormalities resulting from floors which have too steep a slope on them, have been discussed in detail by Tauson (1977, 1978, 1985, 1988). Many improvements in cages can be made and have been made during the last ten years as a consequence of this work.

Injurious pecking of one hen by another is one of the most important problems in laying hen housing. It appears that it is usually carried out by a small proportion of individuals in a group, so the keeping of hens in groups of five in cages, rather than in much larger groups, reduces the likelihood of severe problems. In general, it is in more varied environments with extensive litter areas and a stocking density which is not too high, that injurious pecking and cannibalism are more likely to occur. However it is also clear that if there are bright patches of light in which birds congregate, injurious pecking or suffocation can occur (Huber & Föltsch 1985, Gibson et al 1985) so even lighting is preferable. Temporarily reducing overall light level can sometimes reduce the occurrence of injurious pecking, but it is better to try to remove the individuals showing the behaviour. Designing buildings so that corners are rounded off and hence it is unlikely that one bird can trap another, can also be helpful in
reducing injury. We still do not understand the causes of this injurious pecking but some systems such as the Hans Kier system in Denmark (Norgaard-Nielson, 1985) the Tiered Wire Floor system in Holland (Blokhuis pers. comm.) and several systems in Switzerland (Amgarten & Mettler, 1989) have little or none of it.

The standard method of minimising the incidence of injurious pecking is beak-trimming. Although there is still some debate about the relative merits of beak-trimming at different ages, the work of Gentle (1986) and Gentle & Hill (1987) makes it clear that chickens have nociceptors in the beak including the part which is removed. Their response characteristics are similar to those of mammals like ourselves, so any trimming operation must be painful. After beak-trimming, neuromas appear and may well be painful throughout the life of the bird. Beak-trimming also has an effect on pecking at food, etc. (Blokhuis & van den Haar, 1989). In the light of this evidence, hens should be housed and managed in such a way that beak-trimming is not necessary. Other aspects of avoiding pain and injury are to have adequate inspection possibilities and to avoid fire or ventilation system failure. Inspection takes a long time in battery cages, and low and high rows of cages may be inadequately inspected, but it should be possible to look at every bird. Despite current laws, inspection is hardly ever adequate. If 2s is spent looking at every cage of five birds in a house holding 20,000, the inspection would take 2h 13 minutes, plus any time needed to look more carefully or take action. Other housing systems should allow all birds to be seen without undue disturbance. With regular quiet visits by farm staff this is certainly possible in some systems and birds can be scanned to look for individuals with problems much quicker than in a battery house. However with a poor design of house, injured or sick birds could be missed during an inspection. The evacuation of birds during a fire is always difficult and is usually impossible in a battery house. Measures to be taken during fires in poultry houses need more consideration. Alarms for fires and ventilation system failure, are clearly important in relation to bird welfare.

Avoiding disease

There was a gradual increase in chronic infections of poultry over the period when the frequency of intensive production practices was increasing (Sainsbury, 1974) and some poultry diseases are only contained now by widespread use of preventive measures, e.g. coccidiostat in food. As Sainsbury emphasises, we should be aiming at the use of systems which do not require such measures. The welfare of diseased animals is clearly poorer than that of healthy animals so any system must be evaluated in relation to disease incidence on welfare as well as economic grounds. Battery cages separate birds from their faeces quite effectively and several other systems also do this. However there is no clear evidence of higher disease risk
when litter is present. It may be that any increase in contact with pathogens is counteracted by improved immune system function. It is clear, however, that free-range hens must be moved to new ground every few months, especially if the indoor housing conditions are crowded.

Avoiding fear

Hens must often be frightened of other hens but the problems of injurious pecking have been mentioned already. They are certainly disturbed by the close approach of people (Duncan & Filshie, 1979). The most disturbing time for hens in this respect is when they are removed from their housing condition and handled prior to and after transport to slaughter. It is the handling which has the greatest effect on the birds and any housing system for laying hens should be designed so as to facilitate handling and minimise its adverse effects (Knowles & Broom, 1990 b).

Nest building

During the period immediately before egg-laying, domestic fowl show elaborate nest-searching and nest-building behaviour, similar to that of wild jungle fowl (Wood-Gush 1954, 1971, McBride et al 1969, Fölsch 1981). High levels of stereotypies (Wood-Gush & Gilbert 1969, Brantas 1980) and other abnormalities are shown if no nest site is available (see review by Kite, 1985). The evidence that welfare is poor at this time if no nest site is available is clear and the problem is obviously worst in a battery cage or other system with no nest site available.

Conclusions

One conclusion from this review of scientific evidence concerning hen welfare must be that it is even clearer now than it was at the time of the European Parliament Resolution in 1987 that the welfare of hens in battery cages is too poor and a different system must be used. When the welfare of the hens is considered, the principal advantages of the battery cage: separation from manure, small groups, ammonia and dust control; are outweighed by the principal disadvantages: prevention of movements and exercise leading to bone weakness, preening impaired and dust-bathing prevented, investigatory pecking and scratching prevented, no nest available. Many systems for housing hens in large groups also result in poor welfare for too many birds because there is too much injurious behaviour. However the best of these systems can be managed so that welfare is considerably better than in battery cages. Expertise on how to design and manage these systems should be shared so that the welfare of hens can be improved whilst an economically viable egg-producing industry is maintained. Surveys indicate that most members of the public are willing to pay the small extra cost which would be necessary to achieve this objective.
REFERENCES


