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LAYWEL

Welfare implications of changes in production systems for laying hens

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4.1 Literature review of laying hen preferences

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Summary

We review the behaviour and preferences of laying hens using the proposed enrichment features for furnished (modified) cages, namely perches, nesting and dustbathing areas and increased space. These facilities are also relevant for other alternative systems. Substrate needs and preferences are considered in 4.3.

Perching

A few studies have shown that hens are prepared to work to gain access to perches at night, but there has been insufficient research work to know the extent to which perching is a behavioural priority. When perches are provided, hens make use of them, with up to 100% of birds perching at night. In the absence of perches, they choose to roost on the highest fixtures and fittings available and it is possible that these could satisfy their behavioural needs. Particularly in spatially restricted environments hens may use perches to obtain more space, and social factors may influence the use of perches. The value of perches for the physical and physiological welfare of laying hens is discussed in other WP sections.

Nesting

Considerable research on nesting and pre-laying behaviour indicates that hens not only have a preference for a discrete, enclosed nest site but also that they value it sufficiently to work hard to gain access to one in the period (approximately 40 minutes) before egg-laying. They appear to have an instinctive need to perform pre-laying (nest-building) behaviour for about 20 minutes before laying. Thus in practical terms, enclosed nest-boxes should be provided with access available to hens from about an hour before the first bird is expected to start laying. The number of nesting areas provided should be sufficient to enable all hens to spend an average of about 30 minutes in a nest box. There is no need for the nest boxes to be available after all birds have finished egg laying (i.e. during the afternoon and night).

Dustbathing

Despite considerable research effort, scientists have not definitively discovered the extent to which hens value dustbathing. This is in part due to effects of rearing experience and in part to the fact that litter may be used for foraging and egg laying as well as for dustbathing. Some research has indicated that dustbathing in litter is not a behavioural priority but there is strong evidence that it is a behavioural need. So-called ‘sham’ dustbathing may be a satisfactory alternative particularly to birds that have not previously experienced dustbathing in litter, but further research is needed to be certain of this.

Space and social preferences

Experiments carried out at given stocking density, group size or available space do not usually apply to other levels of these variables because of their inevitable link. Bird preferences in one context may change in a different social and environmental context. Evidence suggests that laying hens need a reasonable 'personal space' and that priority for space may vary during the day as activity and possibly social interactions alter. The smaller the total space available to a group of birds, the larger the space per bird needs to be in order to avoid crowding and to enable behavioural needs to be met. Birds may give greater priority to space than to small group size. They may have different social strategies in small groups where they can recognise each other and in large groups (over 100) where most encounters are between strangers and this can affect levels of aggression.

Agonistic and abnormal behaviour

The presence of apparently purposeless behaviour or of high levels of aggression or redirected behaviours such as feather pecking and cannibalism are indicators that the housing system is not satisfactory for bird welfare.

Introduction

This review outlines the main findings reported in the literature on preferences of laying hens for facilities that may be provided in laying housing systems. Where possible we give indications of how relatively important these are to the birds. Much of the evidence for this comes from small scale experimental studies using 'consumer demand theory' to determine how much the birds are prepared to work for access to the resource or facility. It is important to realise that on farms, the hens are in a more complex environment, where social and other factors in colonies and large commercial flocks may alter their preferences and the relative motivational strength for enrichment components.

We also consider the behavioural consequences of denying laying hens the opportunity to express certain behaviours (i.e. behavioural frustration). A few behaviours have been identified as being associated with resource deprivation and thus indicating behavioural frustration. These include extended pre-laying behaviour in the absence of a nest, prolonged 'sham' dustbathing, aggression, increased calling (including a 'gakel' call, (Zimmerman et al, 2000)), increased locomotion and stereotypic pacing and possibly increased feather pecking. Some of these behaviours are generalised or short-term responses and often the response within a carefully-controlled experimental environment is not replicated in the complex, multifactorial commercial environment.

For commercial viability all housing systems provide most laying hens with their basic physical or biological needs not only for survival but also for good productivity. For good welfare, the possibility that hens have additional behavioural needs should also be considered. Behavioural needs are therefore usually taken to be psychological needs, i.e. the animals may experience suffering if they are unable to adequately perform relevant activities (Jensen and Toates, 1993). Whilst it can be hard to *prove*

that hens can exhibit emotional suffering, there is evidence (see later) that accessing certain resources, and exhibiting key patterns of behaviour is important to laying hens. Thus the behavioural priorities and preferences of hens should be considered when designing or assessing housing systems. Understanding the behavioural requirements of laying hens can provide strong evidence of the welfare implications of specific housing designs.

Three main types of studies of animal behaviour can provide information about animal welfare. These are (1) comparison between behaviour in a natural or ideal environment with behaviour in the environment under investigation (2) determination of animals' own needs and priorities and (3) identification of signs of poor coping in experimental situations, and detection of these signs in the environment under investigation.

1. Studies of wild or feral chickens can provide the basis for testable hypotheses, but they do not tell us much about the welfare of a hen (Cooper and Albentosa, 2003). Not all 'natural' behaviours need to be performed (Dawkins, 2003).

2. The second approach is thought by many to be the most powerful way of determining animals' needs, but it is also subject to difficulties of experimental design and interpretation of results. Considerable theoretical advances that bear on these issues have recently been made. The 'behavioural priorities' approach argues that animals are able to perform their own integration of inputs and make sensitive judgements about their own best interests. This rationale has underpinned the continued use of preference tests, measures of demand and the self-selection of medication such as analgesics (e.g. Danbury et al, 2000).

   The basic approach of assessing 'what hens want' by offering them a choice of alternatives in a laboratory setting has proved rather too simplistic. It can be useful for assessing relative preferences between, for example, substrate types (Sanotra et al., 1995) but relies on the experimenters providing meaningful and appropriate alternatives and also provides little information on behavioural priorities (Nicol, 1997).

   Behavioural priorities can be assessed by measuring motivational strength using consumer demand techniques. Work in this area has increasing scientific credibility and has been published in high impact scientific journals (Mason et al., 2001). Measuring price elasticity can assess priorities; the change in demand observed when the cost per unit consumption is raised. Such studies have been used to assess demand for resources such as nest boxes (Cooper and Appleby, 2003) and perches (Olsson et al., 2002) for laying hens. Other measures of behavioural priority such as consumer surplus or maximum price paid, can also be derived from consumer demand experiments.

   When conducting work on behavioural priorities it is essential to ensure that animals are offered choices that they are able to respond to. There is evidence that preferences can be influenced by whether or not the animal can see the resource it is working to obtain (Warburton and Mason, 2003). Increasing research on the perceptual and cognitive abilities of the domestic fowl

provides supportive evidence that chickens are able to make rational choices. Experiments have shown, for example, that chickens are able to 'plan ahead' and forego a small immediate reward in order to obtain a delayed but larger reward (Abeyesinghe et al. 2005). It is also known that chickens have some object 'permanence' ability. They are able to appreciate that an object still exists, even when it has moved out of sight (Freire et al., 2004). This background work gives us confidence that their choices in experimental situations involve integration of information about possible outcomes, and are not simply instinctive reactions to immediate stimuli.

Because the outcome of preference and consumer demand tests depends so much on factors such as the animals' previous experiences, the precise choices they are offered and the context in which they are offered, there is an increasing need to develop methods of assessing choices in real and relevant farming or commercial environments (Dawkins, 2003). This is now being done for laying hens, where choices can be assessed within commercial furnished cages (e.g. Albentosa and Cooper, 2003).

3. Assessing behavioural priorities using consumer demand techniques cannot answer all questions about animal welfare. In particular, it is not possible to determine whether an animal will 'miss' a resource that it has never experienced. Consumer demand methodologies rely on the animal gaining some experience of the resource that they are working for, either during training or testing (Cooper and Albentosa, 2003). Attempts have been made to assess how hard deprived animals will work to perform searching behaviour, but it is difficult to demonstrate unequivocally that the animals have a specific representation of a resource goal (Nicol and Guilford, 1991; Freire and Nicol 1999). Therefore it is important that work on behavioural priorities is complemented by studies of behavioural indicators of poor coping. Various behaviours are observed in laying hens that indicate states of fearfulness, aggression, frustration and deprivation.

Additionally, the presence of so-called 'abnormal' behaviour is an important outcome when evaluating welfare. Commercially housed hens in both cage and colony systems frequently show behaviours that are not observed in wild or feral chickens, occur in a slightly different form or are seen at much higher or lower rates (Blokhuis et al., 1993). These authors described such activities as abnormal behaviours in the sense that they appear to have no purpose or function. Further, as they are seen most often in restrictive and barren housing systems, the 'abnormal' behaviours may be indicative of sub optimal resource provision.

Cooper and Albentosa (2003) outline the reasons why their presence could be important for welfare as follows. "Abnormal behaviours may be the nearest possible approximation of the 'real' behaviour. They may be apparently unrelated 'time fillers', or 'displacement' activities, which occur when the real behaviour is impossible to perform. Alternatively, they may be closely associated with the real behaviour but 're-directed' in some way. The fact that they occur at all suggests that they may have some importance in themselves, even if we do not understand the reasons for their significance."

Scientists still have not determined whether these 'abnormal' or 'unnatural' behaviours are satisfactory from the birds' perspective, although by using a variety of approaches they can at least indicate whether there is a strong probability – or not – of satisfactory welfare. For example 'sham' dust bathing in a wire-floored cage may substitute adequately for dust bathing with a functional substrate (van Liere, 1992) - or it may be an unsatisfactory attempt to perform an important behaviour in the absence of an appropriate resource (Lindberg and Nicol, 2001). To continue with this example, testing hens' preferences for wire versus other substrates for dust bathing is one way of beginning to find answers. To further evaluate whether it is important for modern chickens to dustbathe in a similar way and on similar substrates to their wild ancestors, scientists have devised tests to determine, for example, whether dust bathing movements on a wire floor reduce subsequent levels of dust bathing when litter is provided - or the value to hens of different substrates (e.g. Merrill, 2005).

The LayWel project is focussing attention on furnished ('modified' or 'enriched') cages for laying hens as an alternative to the conventional 'battery' cage system. The main proposed enrichment components for such alternative cage systems, as well as alternative group housing systems, include the provision of perches, nesting areas, dustbathing areas/substrates and more space per bird. This review will therefore consider laying hen preferences and behavioural priorities for each of these in turn. Substrate needs and preferences are considered in 4.3.

Perching

Hens appear to place little value on perching during daylight but are prepared to work to gain access to perches at night (Bubier, 1996a, Olsson and Keeling, 2000). No research has compared the motivational strength for access to perches with access to other resources. Thus it is not known the extent to which perching is a behavioural priority. Social factors may interact – for example Olsson and Keeling (2000) found that half of experimental hens would no longer work a push-door to access a perch when another bird was already on it. When perches are provided, hens make use of them, with up to 100% of their time spent perching at night (Appleby et al., 1993, Olsson and Keeling, 2000) as long as there is sufficient space for all hens. When perches are provided in cages, hens may spend 25% of their time on them (Appleby et al., 1993), possibly making use of the extra space afforded. In the absence of perches, hens choose to roost on the highest fixtures and fittings available (Appleby et al., 1988) and it is possible that these could satisfy their behavioural needs. Hens do not show much preference for particular design features of perches such as width, profile, slope or material (Appleby et al, 1998).

Experiments in non cage systems have shown that hens prefer to fly up rather than down onto perches (Moinard et al, 2004). They also prefer to gain access to perches that they can see well in reasonable light levels (Taylor et al, 2003). Not only was latency to jump increased at low light intensities (e.g. 0.8 and 1.5 lux) and greater distances apart (1 m v. 0.5 m), but the hens also vocalised significantly more before jumping (Taylor et al, 2003).

Nesting and pre-laying behaviour

Nesting and pre-laying preferences of hens were reviewed in detail by Cooper and Albentosa (2003). There is considerable evidence that hens place a high value on access to discrete, enclosed nest sites and that their behavioural priority to access one increases the closer they get to the time of egg-laying (oviposition). They are prepared to 'pay' high 'costs' such as squeezing through narrow gaps (Bubier, 1996a; Cooper and Appleby, 1995, 1996a, 1997) or opening doors (Smith et al., 1990; Cooper and Appleby, 2003) to gain access to nest boxes before egg laying.

Moreover, hens have been found to work as hard for a nest site during the pre-laying period as they would for food following short periods of deprivation. Cooper and Appleby (1996a) found that hens would squeeze through narrow gaps of up to 95mm width (compared with an average hen body width of 120 mm) to access a nest-box before oviposition, but would go without food for an average of eight hours before passing through such a small gap. Using a load-recording push-door Cooper and Appleby (2003) revealed that the work rate for the nest site at 40 minutes prior to the expected time of oviposition was comparable to the work rate for food after 4 hours' deprivation. At 20 minutes prior to oviposition hens exhibited four times the work rate in order to overcome the loaded door. Even if hens have never used an enclosed nest site, they still seek and value it (Cooper and Appleby, 1995, 1997). When caged commercial hens are provided with a suitable nest site, their pre-laying locomotory behaviour decreases - i.e. they don't have to spend time walking around searching for a nest site (Appleby et al., 1992; Meijsser and Hughes, 1989). There is limited evidence that hens prefer an enclosed nest site – for example work by Cooper and Appleby (1997) showed that hens without an enclosed nest site would squeeze through narrower gaps to access another pen than those with an enclosed nest site in the home pen. They also showed that hens showed individual variation in pre-laying behaviour, including the number of visits to potential nest sites, the duration of time spent in them and the final choice of site. Earlier work (Appleby and McRae, 1986) showed that hens consistently selected enclosed nest boxes in preference to more 'natural' exposed nesting hollows, but were largely inconsistent in their choice of nestbox.

As the time of egg laying approaches (approximately 20 minutes before oviposition), laying hens show behaviours such as pecking and treading of any nest substrates and circling or keel rotation (Hughes et al., 1989) and this has been interpreted as nest building behaviour. This pre-laying behaviour seems to be important for the hen, as she will delay laying if interrupted (Freire et al., 1997), or has delayed access to her nest site (Cooper and Appleby, 2003). Individual variation in either the motivation to nest, or more probably the perception of what constitutes a satisfactory nest, may account for some hens laying on the floor. Cooper and Appleby (1996b) found that 'floor layers' performed more nest seeking and less nest-building behaviour. Floor laying declines with age and may be reduced if pullets have access to nestboxes before point of lay (Sherwin and Nicol, 1993). The mean proportion of eggs laid in a nest varied between 43% and 68% in a trial comparing four designs of furnished cages with standard cages, indicating that some designs failed to provide a satisfactory nest from the hens' perspective (Guesdon and Faure, 2004).

Dustbathing

Dustbathing appears to be a maintenance behaviour that improves feather condition by dispersing lipids (van Liere, 1992). It also can dislodge skin parasites, which may then be eaten by conspecifics that are attracted to dustbathing hens. Given the opportunity, hens will dustbathe for many minutes on most days and this may result in the excavation of dust bathing hollows in favoured locations (personal observations). In colony systems hens will engage in dust bathing activities in littered areas (McLean et al., 1986) and a number of studies have demonstrated preferences for certain dustbathing substrates over others (e.g. Vestergaard and Hogan, 1992; Sanotra et al., 1995) In cage systems without a litter substrate, hens often engage in bouts of sham dust bathing, i.e. performing the sequences of activity that replicate dustbathing, on bare wire floors (Hughes and Duncan, 1988). However, when part of the wire cage floor was replaced with perforated 'Astroturf', 74 out of 80 hens, housed in furnished cages, preferred to dustbathe on the Astroturf than the wire (Merrill, 2005).

Some researchers have argued that sham dustbathing does not fully satisfy the hens' motivation to dustbathe because they will spend a very long time dustbathing thoroughly when provided with a suitable litter substrate following a period without such substrates (Vestergaard, 1982, Vestergaard et al., 1999). In essence, others have argued that 'you don't miss what you can't see' which implies that hens are not frustrated by the absence of substrates in which to dustbathe (e.g. Nicol and Guilford, 1991). It has proved difficult to resolve, as litter or similar substrates can be used by hens both for foraging and for dustbathing and, if the cage environment is not well designed, birds may even perceive a dustbath as a suitable nest site and lay in it (Smith et al, 1993). Hens frequently 'sham' dustbathe in furnished cages that provide a dustbath (Abrahamsson and Tausson, 1997; Olsson and Keeling, 2002) and the latter authors found that this was not due to social competition for access to the dustbath. Lindberg and Nicol (1997) noted that hens were more likely to dustbathe next to the feed trough, raking feed particles over themselves, than in the area designated by humans as a dustbath.

Studies which have attempted to measure the value hens place on dustbathing have tended to show that they give it a low behavioural priority (e.g. Bubier, 1996b, Keeling, 1994, Petherick et al, 1993) and sometimes do not dustbathe when given access to substrates after a period of absence (Gunnarsson et al., 2000). There is a need for further research to establish the optimal substrate for dustbathing and, indeed, whether 'sham' dustbathing is perceived by hens to be satisfactory. There is some indication that it is not, as birds that had recently performed a bout of sham dustbathing did not reduce the amount of dustbathing when given access to litter (Olsson et al., 2002). These authors suggested that for some birds sham dustbathing may continue to be performed in the presence of litter, as they have become accustomed to sham dustbathing, owing to being reared without access to litter.

Space allowance and social requirements

There is inevitable interaction between social requirements, group size and space allowance (Keeling, 1995). Modelling shows that at a given space allowance crowding is worse in small enclosures and groups (Appleby, 2004). Often the floor space allowance per hen in colony systems is similar to that for hens in cages, but they can usually make use of vertical space and the fact that other birds do not often spread evenly over the floor of a large shed.

Laying hens seldom perform activities such as wing flapping, stretching, body shaking and tail wagging (Albentosa and Cooper, 2004). However, when space is so restricted that they cannot perform them, as in conventional cages, they exhibit rebound behaviour and perform them for much longer when subsequently given more space (Nicol, 1987). Moreover, Albentosa and Cooper (2004) found a significant reduction in the number of wing or leg stretches and tail wags in birds housed in groups of 8 in cages at 762 cm^2 each, compared with pairs of birds at 3084 cm^2 each. Other relatively infrequent activities such as dustbathing may be performed more in smaller group sizes (Abrahamsson and Tausson, 1997). So far the value to hens of infrequently performed comfort activities such as wing flapping has not been measured (for example by using consumer demand theory or operant conditioning methodology).

There is evidence that hens prefer to have personal space and where stocking densities are high will maximise this by spacing themselves out evenly both in cage systems (Albentosa and Cooper, 2003) and in colony systems (Lindberg and Nicol, 1996). At lower stocking densities hens may space more randomly or clump according to environmental resources such as feed (Albentosa and Cooper, 2003). Based on research findings and to account for the crowding effect, Appleby (2004) has suggested that minimum space allowances in furnished cages should vary with group size from at least 800 cm^2 per bird in groups of 8 or more, up to at least 900 cm^2 for groups of 3 or fewer, plus a litter area.

It is not easy to extrapolate research results for individual hens' preferences for more space both horizontally (Nicol, 1986) and vertically (Dawkins, 1985) to their preferences in a different social context with other birds and in commercial environments. Work by Faure (1986) with groups of hens trained to key peck suggested that 100 mm per bird was adequate feed trough space, and that for most of the time a cage size of 400 cm^2 per bird was sufficient. However, the hens would work to obtain a cage size of up to 6000 cm^2 per 4 birds, suggesting that they valued greater space for up to 25% of the day.

Relatively little is known about the social priorities of hens (i.e. how they value belonging to different group sizes or different group compositions). Laying hens seem to be able to discriminate between different individuals within their own social group (Bradshaw, 1991) and to associate with familiar rather than strange individuals or groups of hens (Hughes, 1977; Bradshaw, 1992). Unfamiliar hens may be aversive to others (Grigor et al., 1995; Freire et al., 1997b). Although the maximum number of flock-mates that can be recognised by each hen is not known, it is thought to be slightly less than one hundred individuals (Nicol et al., 1999) so we might expect to

find that hens prefer to belong to groups of this size or smaller. Lindberg and Nicol (1996) reported that hens showed a strong preference for a group of 5 hens over a group of 120 hens in the same-sized space, but tended to prefer the larger group in a large space over the smaller group in a small space. They concluded that whilst smaller group sizes may be preferable to hens this would need to be combined with sufficient space. Thus interpreting preference tests for group size is difficult because test outcomes appear to be influenced by the context in which testing is carried out as well as the prior experience of the test bird (Hughes, 1977).

Aggressive behaviour is infrequent in large flocks compared to that reported in small to medium-sized flocks, possibly due to hens not recognising flock mates as familiar or unfamiliar (Hughes et al., 1997). Alternatively, when kept in large groups, hens may switch from their normal social system of individual recognition and remembered social hierarchies to a 'rule of thumb' system (Pagel and Dawkins, 1997; Nicol et al., 1999). Here any aggression results from direct assessment and comparison of body and comb size (D'Eath and Keeling, 1998). Therefore, at least from a biological functioning perspective, certain individual hens might experience reduced social stress in larger flocks, though whether such factors would influence hens' choice of flock size is yet to be determined.

Conclusions

Hens appear to value the provision of perches, particularly at night, with up to 100% of birds perching, but it is not known the extent to which perching is a behavioural priority. Pre-laying and nesting behaviour is a behavioural priority for hens approaching oviposition and they place a very high value on an enclosed nest site. Whilst dustbathing appears to be a behavioural need, the requirements of hens in terms of resource provision is still unclear and needs further research. It is possible that materials provided for foraging or feed may also be satisfactory for dustbathing, and that 'sham' dustbathing may partially satisfy hens' motivational needs to dustbathe. Evidence suggests that laying hens need a reasonable 'personal space' and may give greater priority to space than to group size, although studies indicate that they prefer smaller group sizes (below 100 birds) in which they can recognise the other hens as individuals.

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