Animal welfare aspects of outdoor runs for laying hens: a review

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Abstract

This review discusses animal welfare effects of providing an outdoor run to laying hens. Compared with barn systems, the provision of an outdoor run leads to higher space allowances, a higher number and diversity of behavioural and physiological stimuli, and freedom to change between different environments with for instance different climatic conditions. Evidence is presented that these factors may have positive welfare effects for the hens, although, due to the complex interaction with other factors, this is not necessarily always the case. Outdoor runs may, at the same time, impose increased welfare risks associated with an increased contact with infectious agents, greater difficulties to maintain good hygienic standards, possibly imbalanced diets and predation threats. Measures to limit these welfare risks and to take full advantage of the potentials of outdoor runs include restriction of group size, keeping cockerels with the hens, hygienic measures including rotation of runs, providing well-dispersed covers, as well as appropriate pullet rearing and breeding strategies. Fully mobile housing systems provide a promising integrated approach to concurrently implement a number of effective measures. However, it is concluded that too little research and not enough resources went into solving the problems presently besetting free-range systems and that it, therefore, would be premature to make a final judgement now on welfare effects of outdoor systems in comparison with pure indoor systems.

Additional keywords: behaviour, health, free range, mobile housing system

Introduction

The question cage or non-cage systems for laying hens is under heavy debate, but advantages and disadvantages of different non-cage systems are discussed much less frequently. The EC egg marketing regulation (Anon., 2003) subdivides non-cage systems into organic production, free-range and barn systems. In the first two, hens must either have continuous access to an outdoor run during daytime (free-range) or whenever the weather conditions permit (organic production, with possible exceptions until the end of 2010). The highest prices are paid for eggs from organic

and free-range systems, which corresponds to the higher production costs and to the consumers' expectation that these eggs are from the most welfare-friendly systems. Within all three non-cage systems, the equipment in the hen houses can differ widely, e.g. between different single and multilevel systems. Their climatic conditions and stocking densities can vary too, and they have or do not have a covered outside run (or so-called wintergarden or bad-weather run). All of this will have effects on animal welfare. However, in this review I shall limit the discussion mostly to consequences of access to an outdoor run for animal welfare regardless of specific housing conditions. Following Fraser *et al.* (1997), public ethical concerns regarding animal welfare include that animals should lead natural lives, that they should feel well and that physical and physiological systems should function normally. Therefore, the aspects taken into account will include the degree to which the hens can express their natural behaviour, the consequences this may have in terms of emotions and biological functioning and how their health may be affected in general.

Welfare potentials of an outdoor run

Indoor and outdoor production systems for laying hens differ with regard to the number and quality of behavioural and physiological stimuli, the space allowances and the freedom to choose between different environments. In the following it will be discussed whether there is evidence that the differences in these three areas affect hen welfare.

Depending on their quality, outdoor runs have a much higher number and diversity of stimuli than any indoor housing environment can provide. Additionally, the presence of natural light will affect the visual perception of the stimuli (and of the other birds), as many of them particularly reflect UV radiation, to which hens are sensitive (Prescott & Wathes, 1999). Indoors, windows will have filtered most UV radiation, if natural daylight can enter at all. Especially exploratory and foraging behaviour is stimulated by such a rich environment. The diversity of plant species present in an outdoor run may elicit pecking, scratching, tearing, biting and harvesting of seeds. Additionally, small animals such as insects, worms or mice may stimulate hunting and digging. Foraging is a high priority behaviour (Cooper & Albentosa, 2003) that under near natural conditions makes up a major proportion of the birds' active time (Savory *et al.*, 1978; Dawkins, 1989). Insufficient opportunity to perform foraging behaviours is widely considered a cause of the severe problem of feather pecking, which is addressed as redirected foraging behaviour (Blokhuis, 1986; Huber-Eicher & Wechsler, 1998). The same may apply to cannibalism, which is often a major cause of mortality (Abrahamsson *et al.*, 1996; Preisinger, 1997). The underlying mechanisms of the development of cannibalism are not yet completely understood (Yngvesson *et al.*, 2004). It nevertheless appears that many factors that stimulate or prevent feather pecking have the same effects on cannibalism, and the following findings on feather pecking may, therefore, partly be transferable to cannibalism. Because a wide variety of foraging behaviours can be displayed, access to an outdoor run theoretically has the potential of decreasing the risk of feather pecking. Indeed, several studies found

a preventive effect of a good use of the outdoor run on the prevalence of feather pecking (Green *et al.*, 2000; Bestman & Wagenaar, 2003; Nicol *et al.*, 2003; Mahboub *et al.*, 2004). For instance, Nicol *et al.* (2003) reported that a high use of the outdoor range (over 20% of birds outside on a sunny day, as estimated within one scan) reduced the risk of feather pecking nine times, whereas Mahboub *et al.* (2004) found on an individual basis that hens spending more time outside had less feather damage. When flocks with and flocks without access to an outdoor run were compared, different results were found. In Switzerland, Häne *et al.* (2000) compared 28 free-range with 31 barn systems and found no differences in plumage condition. On the other hand, in Germany, Mußlick *et al.* (2004) compared 18 free-range with 10 barn systems and found less feather damage and less feathers in the digestive tract of dissected hens from the free-range systems, although the data were not statistically analysed. Inconsistent results can be due to differences in the use of the outdoor run, to uneven distributions of beak trimmed and non beak trimmed flocks over systems, or to enrichments of the barn systems with a covered outside run, for which Mußlick *et al.* (2004) found indications of a positive influence on plumage condition. A factor that has the potential of decreasing feather pecking problems in indoor systems is the often much lower light intensity. However, although dim light is a very efficient means to reduce severe feather pecking (Kjaer & Vestergaard, 1999), at the same time it may impair welfare by preventing the hens from normal activities (Anon., 2005).

Other natural behaviours that are especially stimulated in the outdoor run are sunbathing (Duncan *et al.*, 1998; Van Rooijen, 2005) and locomotion, which is associated with enhanced levels of exploratory and foraging behaviour, but also running and flying are often observed. Outdoors, hens may walk and run distances of up to approximately 2500 m per day, whereas in an aviary without an outdoor run walking distances of not more than 1000 m per day per hen have been registered (Keppler & Fölsch, 2001).

Since exercise is known to enhance bone strength (Whitehead, 2004), increased bone breaking resistance is to be expected in hens with access to an outdoor run. However, no comparisons with non-cage indoor systems are available. Compared with conventional or furnished cages, outdoor hens had significantly stronger *tibia* and *humeri* (Leyendecker *et al.*, 2002). The relatively fragile bones of layers due to osteoporosis are a risk factor for fractures caused either during the laying period or during depopulation (Knowles & Wilkins, 1998). The actual prevalence of fractures also depends on housing equipment, on the hens' navigation skill, which is influenced by rearing experience (Gunnarsson *et al.*, 2000), the catching method (Gregory *et al.*, 1993) and the birds' fear during catching (Reed *et al.*, 1993). With regard to the latter, free-range hens are probably less fearful than birds kept inside, as found for caged birds (Scott *et al.*, 1998). However, Gregory *et al.* (1990) found more old fractures in free-range systems than in battery systems, but less than in aviaries without access to an outdoor run.

In outdoor runs it is often observed that great numbers of hens dustbathe simultaneously (Sewerin, 2002). This may be ascribed to the concurrent individual stimulation of many birds by a high quality, deep dustbath with friable material (Van Liere,

1992) in combination with natural light (Duncan *et al.*, 1998). However, the joint dust bathing very likely also has an important social component (Van Liere, 1992; Duncan *et al.*, 1998), although the underlying mechanisms leading to the synchronous dust-bathing are not unambiguously clear (Olsson *et al.*, 2002; Lundberg & Keeling, 2003).

The use of an outdoor run leads to lower stocking densities indoors. While the minimum space allowance indoors according to the EC organic production regulation (Anon., 1999b) and the EC laying hen directive (Anon., 1999a) is 0.17 m^2 per hen for organic and 0.11 m^2 per hen for conventional single-tier housing, outdoors at least an additional 2.5 m^2 or 4 m^2, respectively, are required per hen during day time (Anon., 2003). A lower stocking density during the laying period may decrease the prevalence of feather pecking (e.g. Simonsen *et al.*, 1980; Hansen & Braastad, 1994; Nicol *et al.*, 1999). Reasons may be the enhanced ability of victims to move away efficiently from pecking animals or the minimized likelihood of encountering a pecking bird. Additionally, increased space may reduce stress in general, which by itself may affect the feather pecking tendency (El-lethey *et al.*, 2001).

Increased space may also be advantageous in maintaining sufficient inter-individual distances during activities such as foraging and walking as part of the normal social behaviour (Keeling & Duncan, 1989; 1991; Keeling, 1995).

The freedom to choose between different environments may be important with regard to climatic conditions. In non-cage systems the presence of (soiled) litter in the hen house leads to increased dust and ammonia levels. This problem may be alleviated by offering the possibility to enter areas with fresh air according to the motivation of the hen. It has been shown that domestic fowl does not only prefer environments with lower ammonia concentrations, but is also motivated to seek fresh air after ammonia exposure (Kristensen *et al.*, 2000; Jones *et al.*, 2005). Currently no information is available on the question of whether the access to an outdoor run has also positive consequences for the physical condition of for instance the respiratory tract.

Welfare risks of an outdoor run

If the outdoor run is only minimally used, as is often reported (Bubier & Bradshaw, 1998), the hens can only benefit minimally of its welfare potentials. While a low use of the run is caused by a number of factors that can be influenced (see below), not all farmers consider a high use of the run desirable. Their concerns mainly relate to the destruction of the run and to the risk of predation and infection. A fourth aspect, the difficulty of balanced feeding, will be dealt with in the next chapter.

The considerable destruction in a short time of actively used runs, especially near the hen house, leads to a less attractive run for the hens (and for consumers who expect a green and not a brown hen run). An associated problem is the hygienic deterioration, e.g. in the form of muddy areas. Besides, environmental problems of high nutrient loads can arise when no green plants are present to utilize the nutrients (Menzi *et al.*, 1997), and the intake of soil by the hens can increase, with concurrent potential carry over problems with soil contaminants such as dioxin.

Losses due to predators vary widely between regions, but figures may also differ

due to different flock sizes, lengths of production period and methods of survey. From questionnaire surveys carried out in Switzerland, average losses of 6.7 birds per year per farm have been reported, which is about 0.22% of the average number of hens per farm, but this number also includes indoor systems (Häne *et al.*, 2000). Losses in the United Kingdom have been reported to amount to 1.97% or 170 birds per farm over an average production period of 54 weeks (Moberly *et al.*, 2004). Losses exceeding 20 birds per production period on 9% of the Swiss farms have been reported by Häne *et al.* (2000) and of 10 birds per year on 73% of the UK farms by Moberly *et al.* (2004). From differences between production and slaughter records on six German free-range farms, Gayer *et al.* (2004) calculated that predation losses within one laying period ranged from 0.8% to 12.5% (96 to 445 hens) per farm. The economic significance of predation for the farmer will largely depend on the size of his flock, with larger flocks being proportionally less affected than smaller ones.

Important infectious agents are endo- and ectoparasites. Worm eggs or coccidial oocysts are found more frequently in droppings from flocks with access to an outdoor run than in droppings from pure indoor flocks (Permin *et al.*, 1999; Häne *et al.*, 2000; Gayer *et al.*, 2004). The welfare assessment of this situation is not clear-cut. Endoparasitic infestation is not necessarily a threat to animal welfare as long as infestation levels remain low. On the contrary, the hen is allowed to develop and maintain natural immunity against some of the parasites in question (Thamsborg *et al.*, 1999). While feed efficiency is very likely impaired, neither laying performance nor mortality need to be affected (Häne *et al.*, 2000; Gauly *et al.*, 2002). However, with parasitic infestation there is a risk of clinical diseases developing under unfavourable conditions and of worms that act as vectors of pathogens (e.g. *Heterakis gallinarum* for *Histomonia meleagridis* and *Ascaridia galli* for *Salmonellae*). Also for ectoparasites, namely red mites, higher populations are reported under free-range conditions (Guy *et al.*, 2004). As the mites considerably harass the birds and in severe cases may even cause death due to anaemia (Kilpinen *et al.*, 2005), they are of considerable welfare concern. In general, contact with or ingestion of wild animals and difficulties of cleaning and disinfection of the natural soil may increase the risk of infectious diseases and subsequent death. In fact, mortality data from outdoor and indoor systems usually show higher rates for the outdoor systems (e.g. Morgenstern, 1997; Häne *et al.*, 2000; Gayer *et al.*, 2004). Häne *et al.* (2000) for instance found mortality rates of 0.83% over a period of 28 days in systems with outdoor access compared with 0.59% over 28 days in systems without. Other sources report higher percentages. The large variation points at a high potential for improvement. The contribution of losses due to predators is often not transparent in the data. However, this type of losses needs to be evaluated separately from death due to disease or cannibalism, as the latter presumably involves greater suffering.

Measures to limit risks and take full advantage of outdoor runs

In order to stimulate good use of the outdoor run by the hens, mainly group size,

cover and stimuli, as well as husbandry should be optimized. It generally appears that the larger the groups the less the hens go outside (Bubier & Bradshaw, 1998; Harlander-Matauschek *et al.*, 2003; Mußlick *et al.*, 2004; Zeltner *et al.*, 2004; Hegelund *et al.*, 2005), although the levels of outdoor use vary between investigations, pointing at the significance of further influencing factors. For an appropriate interpretation of the figures on the outdoor run use, it should be considered that there is significant traffic between house and run (Mahboub *et al.*, 2004), and that there are times when only few hens are outside (e.g. after disturbances or during bright sunshine). So the average proportions of hens being outside over the day do not reflect the proportion of hens going out at all. The lowest mean daily percentage of hens outside reported is 4.0% for a flock of 16,000 hens (Mußlick *et al.*, 2004), and the highest 42.1% for two flocks of 490 hens (Bubier & Bradshaw, 1998). Dividing flocks into smaller groups is, therefore, a possible measure to improve the run use. As for the provision of cover and stimuli, experimental approaches are as yet unconvincing (Zeltner & Hirt, 2003; Zeltner *et al.*, 2004; Grigor *et al.*, 2005). However, from an epidemiological (case-control) study on feather pecking, including 100 free-range flocks, Nicol *et al.* (2203) concluded that outdoor ranges were better used when they had more trees or hedges. Cockerels might act as a social stimulus as their run use is generally higher than that of hens (Harlander-Matauschek *et al.*, 2003) and they provide some protection for the hens (Bassler *et al.*, 2000; Bestman & Wagenaar, 2003). As regards the rearing environment, Grigor *et al.* (1995), in an experimental study, showed that regular exposure to an outdoor enclosure at an age of 12 to 20 weeks enhanced the hens' readiness to emerge from a familiar box into this enclosure and tended to reduce fear levels as measured in tonic immobility tests. Among the novel stimuli possibly eliciting fear outside, the comparatively high outdoor light levels and light quality that differs from indoors may play a role (Prescott & Wathes, 1999), as in rearing units often very low light levels are used. There may also be differences between hybrids in their readiness to use the outdoor run (Mahboub *et al.*, 2004), but currently there is not enough information available on this aspect.

To arrive at a better distribution of hens within the run, so as to reduce run destruction and hygienic deterioration, well-dispersed cover and stimuli are clearly effective (Hörning *et al.*, 2002; Zeltner & Hirt, 2003). A wide variety of natural and artificial structures are available (Bubier & Bradshaw, 1998; Hörning *et al.*, 2002; Bestman & Fürmetz, 2004). Artificial structures have the advantage that they can be moved, enhancing an even use of the run. In general, such structures should provide additional stimulation for natural behaviour such as dustbathing (covered dustbath) or foraging (e.g. berries), provide shade or protection from winds and possibly from predators. However, while the cover very likely provides the hens with an important feeling of safety, at the same time it may enable hawks to hunt more efficiently as they may use the bushes or trees as a hiding place for their hunting. No information is available on the question of whether an improved cover of the run actually affects the extent of predation losses. Ground predators, on the other hand, can be controlled relatively easily by good fencing, including an electric fence, and nightly indoor housing (Bassler *et al.*, 2000; Hörning *et al.*, 2002; Bestman & Fürmetz, 2004), although Moberly *et al.* (2004) report that in their survey some egg producers regarded fences as ineffective.

For hygienic reasons, the area around the hen house should be designed in such a way that water cannot accumulate, that it can be cleaned after the laying period and that the substrate can be replaced. Practical experience shows that also a covered outside run is an excellent means to prevent hens from carrying too much mud into the house. It provides a sheltered outside area that can be used even under unfavourable weather conditions. An important preventive measure, amongst other things in parasite control, is the rotation of runs. For an efficient endoparasitological control, long resting periods before the reuse of any area are probably needed. Thamsborg *et al.* (1999) suggest that a resting period of one year is necessary to prevent transmission between batches, whereas Bassler *et al.* (2000) propose an interval of two to three years.

An integrated approach to achieve a better use of the run, at the same time avoiding destruction and deterioration, is the use of a mobile housing system. Such a system can be used to follow other grazing animals with free-range hens on pasture (Bassler *et al.*, 2000) or within crop rotation. Also on areas solely intended for free-range hens it helps to achieve a better rotation. Partially and completely mobile systems are available. Partially mobile systems will only be moved after each laying period while completely mobile systems are moved frequently during the laying periods. Fürmetz *et al.* (2005a), scientifically monitoring the introduction on a farm of one of the latter systems, reported that during the growing season a rotation interval of about two weeks is needed to fully maintain a green run without permanent loss of vegetation. During winter, the interval could be extended to 6 weeks without any harm to the sward. Simultaneously, nitrogen input from the faeces was efficiently distributed over the area (Fürmetz *et al.*, 2005b). Interestingly, in this experiment the use of the run by the hens was good although no cover was provided: on average 35% for a flock of 750 birds (Fürmetz *et al.*, 2005a). Apparently, the good vegetation and the mostly central position of the mobile house in the run were sufficiently stimulating for the hens to go outside. Moreover, the hens had been reared with daylight and with access to a covered veranda from 12 weeks onwards (Fürmetz *et al.*, 2004). However, because of the good use of the run a larger area was needed than laid down in the EC egg marketing regulation (Anon., 2003). Fürmetz *et al.* (2004) concluded that under the conditions of the study at least 15 m^2 outdoor area per hen should be available to properly run such a mobile system. Also labour demands are higher (Fürmetz *et al.*, 2004), but a completely mobile system apparently can provide some solutions to the problems discussed in this review.

Some of the health problems, including feather pecking and cannibalism may also be tackled by altered breeding strategies, selecting hens that are adapted to systems with outdoor access instead of cages (Sørensen, 2001). For instance, it is possible that cage-selected hens have greater difficulties to cope with unbalanced diets. Utilization of the outdoor food sources of plant and animal origin means a less controllable food supply that, moreover, varies over time. The current high-yielding hens with an extremely good conversion rate of feed to egg mass appear to be very susceptible to nutritional imbalances with possible consequences such as feather pecking, cannibalism or reduced disease resistance. It is possible to select hens that are better adapted to, for instance, low protein supplies and that under such conditions perform better than current hybrids (Wilhelmson & Carlgren, 1996; c.f. Sørensen, 2001). It is

also documented that lines differ significantly with regard to their feather pecking or cannibalistic propensity (e.g. Craig & Muir, 1996; Savory & Mann, 1997; Keppler *et al.*, 2001; Kjaer & Sørensen, 2001; 2002; Van Hierden *et al.*, 2005) or susceptibility to parasites (Gauly *et al.*, 2002). However, improvement of the management, as well as the introduction and use of new prevention and treatment strategies will certainly be necessary to improve the health situation of hens with access to outdoor runs.

Conclusions

Providing laying hens with access to an outdoor run yields the highest welfare potentials of all housing systems, both in terms of behavioural freedom and with regard to some health aspects. However, at the same time, the risks of infectious diseases and death from predation are also highest. From some of the information presented, it appears that some of the advantages of letting hens outside can already be reached by extending the indoor system, using a covered outside run. For farmers who do not succeed in managing an outdoor system well, for example because of constraints in area availability or in labour capacity, a covered outside run might be a good alternative. Where resources permit, an even better welfare state may be achieved in a free-range system. Hence, different farm situations will require different solutions. With respect to a general comparison of outdoor with pure indoor systems, at present it would be premature to make a final welfare judgement. Research and practical experience with disease control under outdoor conditions are at a rather early stage. Already there are some promising approaches, such as the use of a completely mobile housing system, which should be followed and extended. It is necessary, however, to do more research on and allocate more resources to solving problems associated with free-range systems.

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