DEVELOPING SCIENCE-BASED ANIMAL WELFARE GUIDELINES

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Introduction

Because of rising public concern about the care and treatment of animals, there has been increasing interest in the development of guidelines for animal welfare and husbandry in the agricultural sector. Many of the animal industry groups have guidelines, but they vary from one industry to another both in the approach taken and the amount of detail provided. Some industry guidelines consist of simple statements about the necessity for humane treatment of animals, while others (like those produced by the National Pork Producers Council and the United Egg Producers) lay out detailed specifications for husbandry practices, transport, and/or slaughter.

To truly promote best practices and to ensure public confidence in agriculture, it is important that industry guidelines are comprehensive enough to guide management decisions, and also have a strong scientific foundation. Of course, sometimes there is not sufficient scientific information available on which to base decisions. In other cases, however, there is a large body of research that can be drawn upon to form the foundation for guidelines. We will illustrate the ways in which such research can be reviewed, evaluated, and turned into recommendations, using space requirements for caged laying hens as an example.

Evaluating research

One of the first steps in the development of science-based guidelines is to determine which types of scientific studies and measures will be considered. As far as animal welfare is concerned, there are four general measures that are widely used to provide information about well-being:

- *Physiology.* When animals are under stress, the levels of certain hormones and neurochemicals may either increase or decrease. Some of these can be relatively easily measured (for example in blood samples or by recording heart rate) and provide good evidence for short-term stress. Physiological responses to chronic stress, however, are still poorly understood, so physiological measures tend to be less useful in evaluating practices like long-term crowding than in evaluating practices like handling, painful procedures, or transport.

- *Health.* Health problems, and associated mortality, can be indicators of both acute and chronic stress, since stress hormones have a negative effect on certain components of the immune system. In addition, health problems that can cause pain or discomfort, regardless of the factors that cause them and even if they do not result in the death of the animal, are of particular concern. Examples are internal or external parasites; "production-related" disorders like osteoporosis in laying hens, which can lead to bone fractures; and recurring injuries due to poor cage or feeder design. Abnormal behaviors can also cause health and physiological problems. For example, feather-pecked hens have difficulty maintaining their body temperature and may also have breaks in their skin where feathers have been pulled out that are potential sites for infection.

- *Productivity.* Lowered productivity can also be an indicator of stress, since stress hormones can cause decreased reproduction and growth. However, since these are effects that are experienced by the individual animal, it is important that productivity measures be evaluated on a per-individual basis, not on a whole-house basis. There are situations in which overall unit productivity (and hence economic returns) can be high even though the productivity of individual animals is compromised.

- *Behavior.* Farm animals are often very restricted in their movements and other behavior patterns, and behavioral restriction is a welfare concern. For example, hens that are not provided with the opportunity to perch have poorer bone strength, which contributes to bone fractures during handling and transport. Prevention of normal behavior patterns may cause the development of abnormal behaviors like pacing, feather pecking and cannibalism, and hysteria. Changes in behavior (e.g. excessive aggression or inactivity) can also indicate stress or disease states. Tests that allow the preferences of animals to be determined (e.g. preferences for nest sites or litter material) provide a means of determining desirable environmental features.

It is generally agreed that sole measures do not provide the most reliable indicators of welfare, but that a number of different measures need to be evaluated in combination. This is the approach that is usually taken when writing science-based animal welfare guidelines, and the one taken by the United Egg Producer's Scientific Advisory Committee in making recommendations for UEP's husbandry guidelines.

<u>Building guidelines: Hen space requirements as an example</u>

One of the most difficult issues that the United Egg Producer's asked the Scientific Advisory Committee to address was that of the minimum space requirement for caged laying hens. Two general types of studies have been conducted that are relevant to determining this requirement. The first type consists of studies in which the use of space by hens, or the preference of hens for particular types or amounts of space under different conditions, is assessed. The second type involves the assessment of production characteristics, health, behavior, and/or physiological measures of stress in hens housed at different stocking densities.

Space use

Several researchers (Freeman, 1983; Bognor et al., 1979; Dawkins and Hardie, 1989) have measured the space actually occupied by a hen's body to determine the space necessary for the hen to stand, lie down, turn around, and perform other behaviors comfortably. These studies showed that light- and medium-hybrid hens need about 71-75 in^2 of space per hen just to stand and lie down, more room to turn around freely (up to 262 in^2), and even more room to carry out their normal comfort behaviors like preening and wing stretching (up to 420 in^2).

TABLE 1 Space required to perform different behaviors
(from Dawkins and Hardie, 1989)

Behavior	Mean area (in^2)	Range (in^2)
Standing	75	71-95
Ground scratching	138	106-196
Turning	205	158-262
Wing stretching	144	106-238
Wing flapping	303	175-420
Feather ruffling	141	98-220
Preening	186	121-318

When hens are placed in a large enclosure, however, they use more space than that simply required to perform these behaviors, since social factors, including social dominance, also have an important effect on the way that hens use space. Keeling and Duncan (1991) observed the use of space by a group of medium hybrid and bantam hens in a large enclosure. They found that the medium hybrid hens chose to space furthest away from the hen closest to them when they were walking (35 in), and more closely when ground pecking (18 in), standing (10 in), and preening (5.5 in). The distances that bantams maintained between themselves during these same activities were generally smaller (10.8, 12.5, 10 and 4.3 in, respectively).

Nevertheless, it has been shown hens in spacious cages do not necessarily use all of the space available to them. Doyen and Zayan (1984) observed White Leghorn (WL) and Rhode Island Red (RR) hens housed in pairs at densities ranging from 138-369 in^2/hen. They found that hens spaced further apart as cage size increased, but that the hens did not maintain the maximum possible distance from one another. The largest mean distance that hens spaced from one another during the 20-minute observation period was 2.3 in. for RR (even though the maximum possible distance was 9 in) and 4.1 in. for WL (maximum possible 11). Contact behaviors were frequent even in larger cages, and often resulted from birds approaching one another.

Preference testing has been used as a method of assessing the space requirements of hens. Dawkins (1983) studied Ross Ranger hens that were housed in 4-hen groups at a density of 104 in^2/hen. She allowed them to chose between two cages, small (247 in^2) or large (988 in^2), and measured preference by the time taken to move into each cage. Hens preferred the large to the small cage.

Studies on housing density

There is a large body of evidence demonstrating that increasing density is associated with increased mortality and decreased hen housed egg production, both indications of reduced welfare. For example, Bell and Carey (1988) summarized the results of the 23rd-27th North Carolina Random Sample tests conducted between 1982 and 1987, which involved comparisons of hens housed either in 3-bird groups given 72 in^2/hen, or 4-bird groups given 54 in^2 per hen. Mortality was higher at the higher density (11.0 vs 8.1% at the lower density), and hen housed egg production was lower (235 eggs versus

245 at low density). Similarly, Bell (1999) summarized research conducted over a thirty-year period by the University of California Cooperative Extension. Comparisons among studies need to be made carefully since the studies involved different strains of birds, lengths of trials, feeding programs, and cage types. However, there were strong and significant correlations between increasing density and increased mortality and decreased per-hen egg production.

In an analysis of the economic implications of layer management programs, Bell (undated) states that "numerous studies have demonstrated time and again that additional birds decrease hen-housed egg production and increase mortality. Our analysis of 45 experiments conducted across the US and Europe show 14 fewer eggs and 3.9% higher mortality rates for each addition of one bird per cage."

Adams and Craig (1985) analyzed the results of 30 experimental and field research reports on housing density and cage shape published between 1971 and 1983. Since densities were not identical in the different studies, ranges for comparison were established. Densities ranging from 67-86 in^2 per hen (average 80 in^2) were considered low, those ranging from 55-66 in^2 per hen (average 60 in^2) were considered medium, and those ranging from 42-55 in^2 per hen (average 48 in^2) were considered high.

Mortality was 2.8% lower at medium than high densities, and 4.8% lower at low than at medium densities (i.e., there was 7.6% higher mortality at high than at low densities). Hens housed at high densities produced 16.6 fewer eggs (per hen housed) than hens housed at medium densities, and these hens in turn produced 7.8 fewer eggs than hens housed at low densities (i.e., a decrease in 24.4 eggs per hen housed at high as compared to low densities). This demonstrated that there was a curvilinear relationship between performance and stocking density, with performance traits decreasing more rapidly at the higher densities. Many other studies conducted since 1983 confirm Adams and Craig's analysis, and furthermore point to a space allowance of about 72 in^2 per bird as the critical density beyond which the greatest increase in mortality and decrease in production is seen.   Higher densities are also generally found to be associated with increased stress indicators, fearfulness, and poorer feather cover (probably due to feather pecking), although these results are not as clear and are not seen in all studies.

In most studies, the effects of group size, housing density, and feeder space are completely confounded because density is usually increased experimentally by adding additional birds to standard-sized cages. For this reason, it is difficult to draw conclusions about the relative contributions of decreased floor area, decreased feeder space, and increased group size to reductions in welfare, although group size seems to be a less important contributor in groups of less than 12 hens. However, it seems clear that inadequate feeder space is an important contributor to the decreases in production noted as density increases. Hens show a strong preference to feed synchronously (Meunier-Salaun and Faure, 1984/5), and when feeder space is inadequate one or more birds may have difficulty accessing the feeder (Hughes and Black, 1976). This appears to be a simple physical limitation in that there is not enough space for hens to position their bodies when there is too little feeder space.

Low ranking hens are most likely to be affected by limitations in feeding space. Cunningham et al (1987) palpated hens to determine which individuals had eggs in their oviduct. They found that low dominance rank was associated with decreased egg production and lower rates of feeding in moderate (58 in^2/hen) and high (48 in/hen)

4

environments. But there is also an effect of cage density that is independent of feeder space. Cunningham et al (1988) found that hens housed at higher densities (50 versus 66) had decreased egg production even when feeder space was held constant at 4 in/bird. Production of low-ranking hens was affected at both densities, while production of high-ranking hens was affected only at the higher density.

Shallow cages provide about 40% more feeder space per hen with respect to floor area than do deep cages, and in most studies shallow cages have been found to be associated with increased feed consumption and per-hen egg production (Hughes, 1983; Bell, 1977; Bell et al., 1983; Cunningham and van Tienhoven, 1983/4; Bell, 1988). Studies summarized by Bell (1981) show that increased feeder space leads to increased egg production and decreased mortality; with an advantage for 6 in of feeder space per hen as compared to 5 in, and 4 as compared to 2.

The following evidence thus pointed toward approximately $72in^2$ of floor space per hen, when combined with adequate feeder space (4-6 inches), as a minimum standard:
- Body measurements
- Observations of the space required for white Leghorn hens to stand and lie down
- Mortality
- Individual hen egg production

Measurements of feather cover, nervousness or fearfulness, and stress indicators supported this recommendation, but were less consistent across studies than were the production, health, and basic space measurements.

<u>The Scientific Basis of Guidelines</u>

Can guidelines be based totally on science? In a word, no. Even though science can provide a foundation, professional judgement and value judgements always come into play. Animal welfare is no different in this respect from many other issues facing animal agriculture. Even if it were possible to determine the exact risk of *Salmonella* associated with certain egg handling practices, for example, a decision still needs to be made about the level of risk that is acceptable. This is a value judgement based on our notions of what is achievable and publicly sustainable, not a scientific judgement.

Similarly, when multiple scientific measures are used, they also have to be weighted in terms of their importance. From the animal welfare perspective, what is most important? Mortality, physiology, preferences? There is no concrete answer to this question, so a value judgement has to be made. In the example of space requirements above, several different indicators pointed toward 72 in^2 as a minimum. But a different decision about the minimum recommendation would have been reached had the committee given more weight to the information from the preference testing and use of space studies, since these indicate that hens need and want more space than 72 in^2. The UEP committee had to make a similar judgement about beak-trimming. It is clear that beak-trimming causes both short and long-term pain, but does this outweigh the pain and suffering experienced by a bird being cannibalized and so call for a prohibition of beak-trimming? We decided that it did not, but again this a value judgement, weighing the welfare of one bird against that of another.

Because science and values are both dynamic, guidelines must be dynamic too. New scientific evidence can call even the best guidelines into question. And changing public

values toward animals can make it necessary to rethink the criteria used to evaluate welfare and the level of "risk" to the animal's welfare that is publicly acceptable. Animal welfare guidelines constructed to address both science and public values will be more likely to stand the test of time than those built upon only one of these dimensions.

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