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A Travel Report Presented to the RIRDC

Evaluation of alternative egg laying production systems in Europe (August/September 1999)

by

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TRAVEL REPORT

Summary

I was part of an overseas delegation to examine and comment on alternative egg laying production systems in Europe. The delegation comprised Mr. Brian McErlane (organizer and editor of Poultry Digest), Mr. Theo Verstedens (poultry farmer) and Mr. Barry Twist (poultry farmer). My role was to assess the systems from a scientific perspective. However, it needs to be understood that most people visited were (deliberately) not scientists, and therefore my interpretations of systems are based on the limited data I saw and predominantly from the information and opinions provided to me during the numerous visits. Thus, the comments and recommendations below are based on my knowledge of the egg industry and things I saw and heard while overseas.

Details of the legislative changes in the European Union (EU) and the timeframes are provided in the report. A number of different variations of alternative systems were seen, and these systems have been described in the report in a generic way. However they fell into 3 categories in commercial environments and 1 category (furnished cages) in a research environment:

- barn
- aviary
- free range*
- furnished cages

* free range used barn or aviary as the housing component plus access to a prescribed outdoor area.

A number of issues and comments both from people seen overseas and the systems are provided to provide a 'feel' for their thinking. Issues particularly relevant to Australia are detailed and these are:

1. There appeared to be an uncritical acceptance within industry (and some scientific) circles of the 'five freedoms', particularly 'freedom to express normal behaviours'. Thus, there was an acceptance that any change closer to the 'natural environment', such as natural light in the shed or availability of nest boxes, inherently improves welfare. Nevertheless, this particular approach of assessing welfare, the nature-based approach, has little scientific credibility because of the value judgements that are required when using this approach. For example with the above example of light, many farms were covering some windows to reduce shadows and overcome problems with floor eggs.

2. Until the proposed change in legislation there appeared to be a strong belief in 'market driven change'. An underlying assumption is that consumers are educated on the issues and facts and thus can make an informed choice; this did not appear to be the general case and there did not appear to have been any major effort in this area. Current marketing included misconceptions e.g. free range has the implication that all birds are outside on grass for some part of the day, some systems e.g. organic systems producing healthier (for the consumer) eggs, provision of windows, presumably to ensure natural light, is a requirement in some countries even though the windows may be covered to

ensure even distribution of light, and improved welfare in alternative systems while ignoring higher mortalities that can occur; all these points lead to consumers possibly being misled. If consumers are either misled or unaware of benefits and practices within any system, it is likely that such systems are probably not sustainable in the long term.

3. Based on the above 2 points there are at least three options for Australia. Firstly, we could do nothing and continue with an industry that, until recently, has shown little inclination to change; this will result in ongoing conflict. Secondly, Australia could follow what has occurred in Europe and ban the conventional cage with the advantages that the political issue of conventional cages will disappear and that clear signals are given to industry that the conventional cage is no longer acceptable and that alternatives must be developed. However, this option carries the risk that the welfare of birds may not be improved and may, in the short term, worsen. Also, the issue of product safety requires a thorough examination as this is the paramount criterion, particularly if a particular production system is to be banned. Thirdly, Australia could continue with a market driven approach to change, provided that this is accompanied with a serious effort at both industry and public education. Whichever option or combination of options is/are followed, it is important that any change is demonstrated to bring benefit to the birds.

4. There was considerable concern in Europe over losing markets to countries with less stringent controls. For example, in countries visited within the EU there was the belief that about 10 other European countries that wish to become members of the EU will be given a 10-year transition period, including beyond 2013 depending on when they enter the EU. During this time they could provide eggs (from cages) at a lower cost than eggs from alternative systems. Also, non-EU countries (with cages) will be allowed to export into EU countries unless welfare can be used as a trade barrier. This is to be discussed in Europe prior to the end of this year, but there are conflicting opinions on whether such barriers will be allowed. In Australia, recent examples of pork, chicken meat and salmon imports would suggest that such barriers are unlikely to be imposed in Australia. A further consideration is the sale of egg product (non-shell eggs) is forecast to increase from around 17 % of the market to 40 % of the market within 5 years (as is anticipated in Australia). Based on cost, particularly if cages are banned, it is likely these products will be imported into Europe, which would further undermine the sustainability of the local egg industries as it is unlikely they could survive only on the shell-egg sector of the market. If local European industry proves to be unsustainable, the end result is an export of welfare problems to another country; this is not ethically defensible.

5. Some areas of improvement noted since a previous visit several years ago were:
   - A slight reduction in the dust levels in the aviaries, although a sufficient number were of concern to raise doubts about the working environment.
   - The incorporation of nest boxes onto the platforms of aviary systems as opposed to the side walls seemed to be a logical progression from development of the barn system where the nest boxes were at the back of the platform.
   - Light levels in all alternative sheds were generally high and sheds and birds generally looked good.

- Some farms were not beak trimming and this was associated with rearing in very low light levels for 8 weeks prior to rearing from 8-16 weeks in 'subsequent system's' light levels e.g. a barn with access to a verandah for barn/free range egg production.

6. Some areas of concern were:
   - While some reasonable aviaries were seen they still seemed to result in some human discomfort. The dust levels and the difficulties of inspection of birds, bird pick-up and handling for vaccinations in aviaries are of concern.
   - The low level of real information provided to consumers (e.g. eggs may be marketed on the basis that birds are fed a combination of 4 grains, organic food or are free range) and the apparent lack of interest in welfare.
   - The potential compromises to welfare from purely market-driven production systems (i.e. those organic free range systems associated with a high mortality).

7. Some areas of conflict were:
   - Future price premiums, if any, were unclear. Based on current market shares, approximately 80 % of all consumers bought eggs on the basis of price (i.e. currently purchase cage eggs). However, assuming the cost of production in alternative systems is higher it is unknown how price increases will be handled i.e. the prices could be absorbed by the farmer by increasing efficiency, by the supermarkets cutting margins or by consumer paying a higher price.
   - Some supermarket chains in some countries (The Netherlands and UK) did not sell cage eggs. However, I had the strong impression this was for both marketing reasons and higher margins per unit of shelf space rather than for any concern over welfare.
   - There appeared to be a conflict between food safety and perceptions of welfare. It is likely that biosecurity in free range and barn system is at a greater risk of compromise than in cages, but I do not know the level of risk and this type of information is not provided to the consumer. While Salmonella control programmes were undertaken in several countries and they were considered effective, I do not know how effective they are or whether consumers are being fully informed over risks. (These aspects require clarification).
   - It is not known if the number of birds that actually access the outdoor area in a free range system (i.e. a range from 17-70 % in favourable weather) is likely to be an issue for consumers in Australia.
   - Public education in Australia is considered essential if a 'market driven' approach is to be sustained.
   - Farmer education in Australia on compliance with welfare and production standards is essential to provide public reassurance about standards within industry.
   - Furnished cages were undergoing considerable evaluation and it is likely that some design modifications will be recommended as a result of this work. Therefore, they cannot be considered a currently viable alternative production system.

There were a number of **recommendations arising from the visit**:

- Some barn and aviary farms were not beak trimming and this was associated with rearing in very low light levels for 8 weeks. Past experience in Australia has indicated this has not worked, nevertheless it would appear worthwhile to conduct a reevaluation. *It is recommended that the impact of low light levels during rearing on the need to beak trim birds for both cage and alternative systems be reevaluated.*

- There appears to be a potential conflict between food safety and perceptions of welfare. It is likely that biosecurity in free range and barn system is at a greater risk of compromise than in cages. However, the level of risk does not appear to be known. Also, while Salmonella control programmes are undertaken in several countries and they are considered effective, it is not known how effective they are or whether consumers are being fully informed over risks. *It is recommended that the bird health and product hygiene risks associated with different production systems and the need for programmes similar to the Salmonella control programme be evaluated, perhaps using a HACCAP approach.*

- If industry is to remain market driven without similar bans on systems as is occurring in Europe, public education is considered essential. *It is recommended that a strategy be developed, probably in association with some other animal industries, to develop and disseminate unbiased information on the welfare issues and the advantages and disadvantages of all production systems so that consumers are able to make an 'informed choice'.*

- In association with public education, consumers need to be reassured about industry compliance with high welfare and production standards. *It is recommended that welfare standards be developed and a process/strategy developed to include such standards in an industry quality assurance programme.*

There were a number of **other recommendations and comments** arising from the report:

- The barn system can provide an effective alternative although it is not inherently better (in terms of welfare) than cages; the system may improve with experience and R&D. There are advantages and disadvantages in both systems and any interpretation is an individual value judgement based on whether an individual believes the currently consistently lower mortalities and higher egg production in cages are more or less important than increased freedom and behavioural opportunities. The barn system appears to be an appropriate alternative in Australia, particularly as industry has considerable experience with similar systems that are used in Australia for both broiler and layer breeders. However, it needs to be demonstrated that mortality and morbidity data are not highly variable.

- Research needs to be undertaken to incorporate the feelings based approach to assess welfare into the widely accepted homeostasis approach. This involves the need to conduct research to establish the consequences of emotions experienced by birds on the magnitude of behavioural and physiological responses and the cost of these responses, for example, on growth, reproduction and health.

- On current scientific evidence there is no demonstrable welfare benefit, on the basis of improved fitness, from incorporating nests into cages as recommended in the EU Directive.

- On the basis of fitness there appears to be no scientific evidence that incorporating dust baths into cages, as recommended in the EU Directive, will improve bird welfare. However, there may be welfare benefits, on the basis of increased fitness from reduced mortalities, from incorporating certain enrichment devices into cages. *It is recommended that the welfare benefits of enrichment devices be further researched.*

- Based on the physiological benefits to fitness of perches to improved bone strength, and notwithstanding some potential production problems, *it is recommended that perches should be incorporated into cages.*

- Notwithstanding the above statements regarding the incorporation of nest boxes, perches and dust baths into cages, reports indicate better physical condition and either no differences in mortality or a lower mortality of birds in furnished cages that incorporate all 3 items of furniture. Thus, there may well be an interaction between the items of furniture that improves fitness. *It is recommended that research be conducted to determine if furnished cages per se improve fitness.*

The report includes appendices on the EU Directive, part of a recently prepared document on the scientific assessment of welfare that gives a scientific perspective to the views held by some people, a review of the literature on some items considered important in the EU Directive on furnished cages i.e. nest boxes, dust baths and perches, photographs of some of the alternative systems and a proposed strategic plan to provide the framework for housing research and development by RIRDC.

Itinerary

1999	
August 30th	Travel from Melbourne to Amsterdam.
August 31st	Visit free range/barn shed unit with Erik Helmink from Fancom, Visit aviary unit with Peter Lichtenbeld from VDL Agrotech and Jo Voet from Ministry of Agriculture.
September 1st	Visit an aviary system with Harry Luimes from Vencomatic, Visit Vencomatic factory and showroom.
September 2nd	Visit aviary unit with Lutz Cramer from Farmer Automatic.
September 3rd	Travel to Vecht, Germany. Visit Big Dutchman factory and offices and meet with Bernd Meerpohl (chairman) and Bo Molin.
September 4th	Visit aviary production and rearing systems with Bo Molin and Friedrich Lubker (product manager, Big Dutchman).
September 5th	Travel from Germany to Stockholm.
September 6th	Meet with Mary Ann Sorensen at Swedish Farmer's Federation in Stockholm, Visit aviary unit with Mary Anne Sorensen.
September 7th	Visit Laus Elwinger and Helena Wall at the Funbo-Lövsto Research Centre to discuss both aviary and alternative cage systems, Visit free range/barn shed system with Mary Anne Sorensen.
September 8th	Travel to Birmingham, UK, Attend end of meeting of Free Range Farmers Association held at Hy-Line, UK, Visit free range/barn shed system with Andrew Hignett, Meet with David Tromans, Operations Director of Dean's Farms, Visit free range and barn systems at Dean's Farms.
September 9th	Visit free range/barn shed system at Daylay farms with Stuart Haley, Attend part of evening meeting of local National Farmers Meeting with Andrew Hignett; included discussion of EU regulations.
September 10th	Visit Stonegate Farms with Arthur Stockwin, Discuss Freedom Foods with Mike Sharpe, General Manager, Freedom Foods, Visit free range/barn shed system with Arthur Stockwin, Travel to London.
September 11th	Complete notes prior to departure.
September 12th	Travel from London to Australia.

Details of Report of Travel

Purpose of travel and background

The delegation of Brian McErlane, John Barnett, Barry Twist and Theo Verstedens visited alternative (to the conventional cage) egg laying production systems in Holland, Germany, Sweden and the UK. Members of the delegation had different agendas although the overall focus was to evaluate the advantages and disadvantages of such systems and the possibility of developing such systems in Australia. My major focus was on the science underpinning the alternatives to determine if the principles were likely to 'work under Australian conditions', however it was not possible to do this without consideration of the political and social imperatives and these will also be discussed in the report.

This study tour to examine alternative housing for the egg industry was very timely. This issue is controversial in Australia. Firstly, while the predominant form of housing is conventional cages, the RSPCA (Australia) and other animal welfare organizations would like to see this form of housing banned, particularly as there is an RSPCA accredited alternative production system (barn system). And secondly, the recent decision in the European Union to ban conventional cages by 1st January 2013 has led to welfare groups calling for similar action in Australia and to meet this demand the Agriculture Ministers recently agreed on another review of the issue.

The European Directive

A copy of the European Directive is provided as an appendix (appendix 1) of this report (see page 25). Important dates and details of the above Directive are indicated in the following table:

Variable	current	2003 (current cages)	2003 (new cages)	2005	2013
space allowance (cm^2/hen)	450	550	750*	Veterinary Commission to reassess recommendations	750*
feeding space/hen (cm)	10	12	12		12
cage height (cm)	40	40	45		45
perch (cm/hen)	na	na	15		15
abrasive strip	na	na	present		present
nest box	na	na	present		present
dust bath	na	na	present		present

* includes 600 cm^2/hen free space and an additional 150 cm^2/hen of nest and dust bath space;

In relation to the above recommendations for cages and assuming they will not be changed at the review time in 2005, some possible options area:

- Use current cages until 2013.
- Use an existing style of cage that has a 45 cm cage height. This cage could be used as a normal cage for 13 years at which time part of every other cage division could be removed

and a nest, dust bath, perch and abrasive strip installed. (**Note:** It is likely that this type of modification would have a dust bath that required manual cleaning and thus labour costs would increase).
- Use a commercial convertible cage without the nest, dust bath, perch and abrasive strip. These could be installed as required and fully automated.
- Install furnished cages now.
- Use an alternative (non-cage) system (e.g. barn/aviary or free range). (**Note:** It is unknown how long price premiums that have been available in some countries for alternative systems will continue).

Details of alternative systems

A number of different variations of alternative systems were seen, however they fall into 3 categories in commercial environments and 1 category (furnished cages) in a research environment:
- barn
- aviary
- free range*
- furnished cages

* free range used barn or aviary as the housing component plus access to a prescribed outdoor area.

Barn

Shed and equipment

All sheds that were seen had full concrete bases and walls were either timber, tin sheet or brick. They all appeared solidly built and were presumably well insulated. Sheds were either fully slatted (timber or recycled plastic battens, wire mesh, or plastic panels with slots) with an additional undercover scratching area, or partially slatted with a scratching area of about 1/3rd the floor space and held 3,500-14,000 hens. Some partially slatted sheds had ladders (wire-mesh with wooden frames) between the floor and slatted areas. One requirement in the UK for one accredited system was for a maximum of 4,000 hens per compartment; this was sometimes achieved by considering the shed to be divided in half (lengthwise; separated by the nests) containing 2 colonies, each of 4,000 birds and an assumption that any cross-over by birds from one side was compensated by a similar number of birds crossing over from the other side. Some sheds had compartments (to reduce smothering from panic), the most being 10 in one shed with 1000 birds/compartment. The slats were generally about 60-80 cm off the ground, if there was no manure removal system, or 36-46 cm off the ground if there was a (semi-) automated manure removal system. Nest boxes were usually down the centre and were either single or double tier, generally with a bird excluder (e.g. Janssen or Vencomatic), and had either a front or rear roll-out to the nest belt. For sheds with <4,000 birds the nest boxes were towards one side of the shed (at the end of the slats); there was a narrow walkway behind the boxes for those with rear egg belts). Feed and water were provided on the slatted area, either bell feeders or chain feeders, with the latter being more popular, and water was provided via bell drinkers, nipple drinkers or shallow open drinkers (e.g. Impex drinkers; as an alternative to bell drinkers when there was a supply commitment to provide open water). Some barns had additional A-frame or single perches (generally timber although one farm had metal perches), providing about 15 cm

perching space/bird, while others did not have any additional perches other than that provided by equipment, although wires on drinker lines and rollers on the top of the nest boxes were generally used to discourage perching. However, in some systems birds were able to perch on the front egg roll-out covers or the chain feeder troughs. If distribution of eggs along the nests was considered a problem, some farms used baffles about every 8 nests to prevent birds walking to the ends of the shed. Some farms indicated they achieved an even spread of eggs while others, if there were 2 tiers of nests, had about 60 % of eggs in the lower tier. It was common for sheds to have electric wires in the corners to prevent floor eggs in those apparently preferred locations. All sheds had automated ventilation systems, although none had any artificial cooling in spite of periods of hot and humid weather. However, in the countries visited, in spite of day time heat loads, the night time temperature invariably falls to a comfortable level. In winter, some farmers indicated that shed temperatures fall below target at night e.g. 14 °C. Sheds were generally well-lit, particularly because most barn sheds were incorporated as the shedding component for free range egg production and thus often had windows. However, in Sweden, although windows were a requirement, they were often blocked out or window space was reduced by blocking out 2 of every 3 windows to reduce uneven lighting and control floor eggs. Nevertheless, most sheds visited had an estimated artificial light level of at least 100 lux.

There were two types of litter flooring associated with barn sheds. The one we are familiar with in Australia where there was a litter area at floor level within the shed that occupied about 1/3rd of the width of the shed and one that was a verandah (3-4.5 m wide) attached to the side of the shed; this was either associated with a litter area within the shed or more commonly with a fully slatted floor shed. The verandah area (also termed a 'winter garden' or 'sun-room') was roofed (often as a continuation of the shed roof-line) and the walls were generally covered with a shade cloth or wire mesh that let in light and breeze. Material used on the floor was wood shavings, wood chips or chopped straw with considerable variation in the amount given. In some sheds the litter seemed to be predominantly dry manure. Access to the verandah from the shed was generally via pop-holes placed at intervals along the length of the shed. In some fully slatted floor sheds there were 'ladders' down to the verandah area. Water was available on only a few of the internal litter areas and water (but no food) was generally available in the verandah area. One of the verandahs that was seen incorporated a 'sick-pen' compartment at one end of the verandah.

Birds and management

Strains of birds in use were Isa Brown, Lohman Selected Leghorn, Shavers, Hyline and Hyline Plus (similar to the conventional Hyline bird in body weight but produces a heavier egg), and they were housed at a density of 7-12/m^2, based on shed floor space within the shed. Pullets were introduced at 16 weeks of age and to discourage floor eggs the birds were generally locked onto the slatted area for about 5 weeks until laying had commenced; in the UK a common practice was to allow the birds to use the entire shed from about 16-19 weeks and then lock the birds in just for a 2 week period. A cycle was from 16 weeks to about 14 months of age when sheds were cleaned out and birds replaced; moulting did not appear to be practiced. If birds were beak-trimmed this was generally done as a single trim at about 6 weeks of age; in the UK they used the term beak tipping, but my observations of adult birds suggested that it was similar to beak trimming as practiced in Australia.

Aviary

Shed and equipment

A number of aviary facilities were visited in Holland, Germany and Sweden. Some sheds have been operational since 1991 and others were very new. The newer facilities are a logical progression from the barn system in that, instead of having nests on the outside walls (as occurred during early development of the aviaries) the nests were incorporated onto the platforms. Thus, as in barn systems, there is a logical movement of birds from the scratching area to the slats, to the feeders, drinkers and nest boxes. The main difference from the barn system is the 3-dimensional use of space (commonly there are three tiers of platforms for the birds) and hence a higher density of birds. A typical shed would hold around 14,000 birds (range = 13,500 – 24,000) at 16 birds/m^2 of floor space (range = 10-25) and would have 3 tiers of birds (range = 3-5). Depending on farmers' experiences and preferences, sheds were either subdivided into compartments, particularly for those sheds with numbers at the higher end of the range (24,000 birds in 4 compartments), or the entire shed was a single space available to all birds (14,300 birds in 1 shed without compartments). Nests in the newer buildings were similar to barn systems; some of the older sheds had side wall nests without bird excluders and these were generally considered unsatisfactory by the farmers. Aviaries all used a manure belt collection system. The construction and ventilation systems were similar to the barn systems, i.e. well constructed, solid-looking buildings. Light levels were more variable than in the barns varying from very low to good. A number of aviaries had more than adequate lighting. Dust levels were variable, but generally greater than in barn systems. In some aviaries there was a significant dust haze that made it difficult to see clearly from one end of the shed to the other. As in the barn systems electric wires were used to keep birds out of corners. Whenever it becomes necessary to treat birds in a shed (e.g. vaccinations during pullet rearing) and at de-stocking, the process is complicated by the additional freedom the birds have. False walls are installed and in some systems these are an inherent part of the design with overhead tracks to locate them into position in the shed. Once false walls are installed it is possible to collect birds within a sub-compartment and if necessary treat them and pass them through a hole in the false wall into an emptied sub-compartment. However, there is no denying the increased labour requirement and the difficulties in sheds where birds have access to the entire shed.

Birds and management

Strains of birds used in aviaries included Lohman Selected Leghorn, Lohman Brown, Shaver, Hyline (brown), Hyline (classic), Hyline Plus and Isa Brown. There was a general understanding that the success of aviary systems, particularly the component of minimum number of floor eggs, required specialist pullet rearing facilities with components (such as platforms and perches) similar to the system used for laying hens (except for nest boxes). While there was this evident understanding, insufficient pullet rearing facilities were a limitation. Pullets from specialized rearing facilities were generally introduced into the laying facility at about 17 weeks of age. Most birds would have been beak-trimmed at 6 weeks of age. A typical rearing involved introducing one-day old chicks onto the middle platform of a 3 tier system and locking them in by lifting up the front 'platform'. Some farms would also put in additional side panels to minimize panicking i.e. it is essentially a large cage. After 3 weeks the platform is opened and ladders are used so that birds can access the ground and the lower tier. Later on, as the birds grow, they are given access to the top tier and perches on the side wall are also made available. An alternative was to rear birds for the first 8 weeks on the floor with access to A-frame and side wall perches and transfer them to a pullet aviary rearing facility at 8 weeks of age. In this latter system of rearing it was possible to control light levels and by providing very low light levels for the first 8 weeks it was unnecessary to beak trim the birds. Mortalities were considered acceptable to clients if they

were no more than 1-2 % greater than in cages. While previous experience in Australia has found that rearing in low light does not obviate the need to beak trim birds, it is worthwhile to reevaluate this strategy.

To encourage birds to roost at night at the top of the aviary, lights are generally progressively turned off at night starting at the floor and progressing up the tiers. Eggs are collected either once or twice daily to maintain quality (i.e. to prevent crowding on conveyors and high numbers of eggs in 'preferred' nest boxes). More eggs appeared to be layed at the ends of the cage rows and therefore 'baffles' were sometimes used to minimize the distance travelled by birds (i.e. they increased the number of 'ends' of rows of nest boxes and thus high numbers of eggs per nest becomes less of a problem). One farmer in Holland coloured the nest flaps in different colours as he believed this helped birds to identify their preferred nest.

Free range

Free range systems generally used either barn or aviaries as the housing component and there was access to an outdoor area via pop-holes. Access was either directly to outdoors or via an enclosed verandah area. From either the shed or the verandah area there were pop-holes, that were manually opened daily, to the free range area. The free range component had several configurations and birds' access to the free range area was variable, depending on the sheds' location. For sheds that were close to other sheds one option was to access the free range area directly on one side and on the other side access was generally via a dirt strip from which birds could walk around the end of the shed and access the grass area at the back and on the other side. Some farms with a central shed within a paddock or on one side of a paddock rotated access to the outside areas. For example, one good system was 4 paddocks that were separated by electric (net) fences and birds could access one paddock for a 12 week period before rotating to the next paddock. This tended to keep the outside areas grassed. While most farms I visited had good grass cover, it was generally accepted, if rotation was not possible or practiced, this would disappear in time and become a dirt area. Some farms had an electric perimeter fence, although one farm provided free range by having access to his neighbours pine-shrub nursery and there did not appear to be fencing around this area.

Water and limited shade were available outdoors. There was no feed supplied outdoors as this would have encouraged wild birds and also discourage a return to the sheds at night. The amount of time birds had access to outdoors varied. Some farms had access during all of the daylight hours and in some instances this involved a farmer being present late in the evening to shut the pop-holes. To avoid this, one farm in the UK shut the pop-holes at the end of the working day, but left a single pop-hole open. This pop-hole had bars about 10-12 cm apart to exclude foxes. This apparently worked well unless there was an identified fox problem, in which case control programmes were required. At other farms birds were not given access until after egg-laying was finished. At some, but not all, farms birds were not given access to feed in the afternoon but given access to feed in the late afternoon/early evening. This was to encourage birds back into the shed at night. Similar encouragement was from leaving lights on in the shed for a period after dark. It is presumed that some birds stayed out all night.

To minimize the amount of dirt carried back into the sheds a number of farms had wire mesh grates in front of the pop-holes. A large number of farms also had some material (small rocks, gravel, wood chips, wood shavings) along the length of the shed sides for about 5-10 metres away from the shed. This was to prevent this area becoming muddy from excess bird

activity. It was also removable, to improve parasite control, and was either performed routinely e.g. at the end of the flock, or when required e.g. if there was a problem.

Comparative production
Because most systems visited were a hybrid of barn/aviary for housing and an outdoor area for free range production it was not possible to determine comparative production figures for barn, aviary and free range.

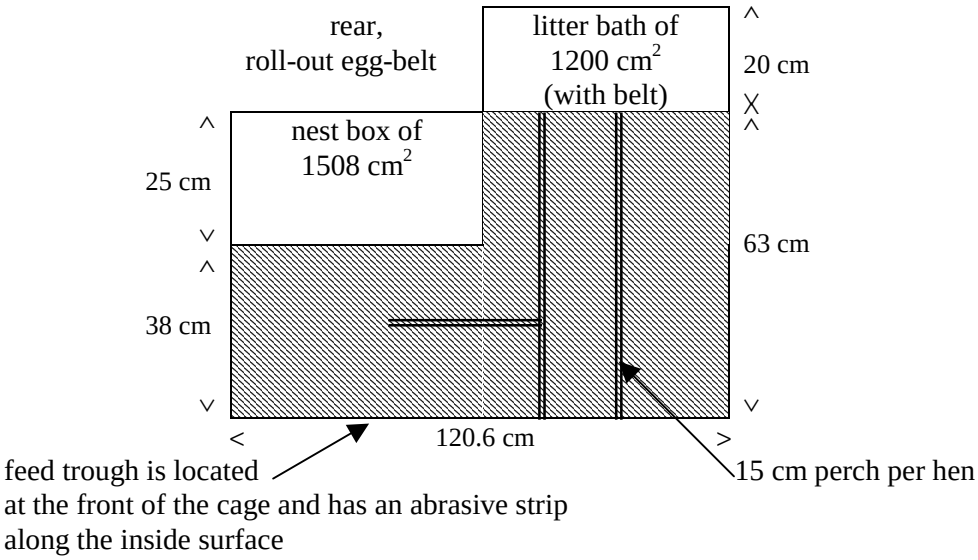
Some comparative figures for cage and aviary production (including free range) were: egg numbers from 17-80 weeks of age were 320 vs. 310, egg weight was 63 vs. 62 g, feed/hen was 110g vs 125 g and mortalities were 5 vs. 5-8 %. In sheds with untrimmed birds mortalities of 7-10 % were reported in Germany. However, the higher premiums for non-cage eggs, particularly if it was a free range system, made the differences enconomically worthwhile. In Sweden, one aviary system for non beak-trimmed hens has been under evaluation since 1988. Mortalities have varied from 4-23 % versus 4-5 % in cages and the mortalities were predominantly due to cannibalism. Germany appears to be reporting lower mortalities with non beak-trimmed birds and the differences may be due to variation not having had time to show in newer buildings in Germany or the newer buildings and their design associated with specialized pullet rearing contributing to reduced mortality. One of the main potential problems with aviaries (and barns) is floor eggs. Floor eggs in aviary systems depend on rearing environments for pullets. They can regularly be less than 1 % (+ another 1 % on the platforms). Thus, the issue of floor eggs should not be considered a problem and the reports of high floor eggs e.g. 20 % is often associated with conventional rearing (floor or cage) of birds for the aviary. The poorer production in the aviary was partly due to periods of broodiness in the hens. Some farms reported 10 broody hens/week for about a 5 week period, particularly in winter. Labour requirements were reported as 33-50 % higher for the aviary system.

Some production figures for barn (free range) systems were mortalities of 3-4 % and floor eggs of less than 1 %. Others reported mortalities of around 10 % and a lower egg production 290 (vs. 310 for cages). Labour requirements were similarly higher, as for aviary systems, with one man being able to provide labour for about 5 sheds comprising about 30,000 birds, although contract staff were used for activities such as pest control and shed clean out.

Furnished cages
Commercial cages were seen at a manufacturers in Germany and cages from the same company (an earlier version) and some prototype commercial cages from Germany and Sweden were seen in a research environment in Sweden. A specific manufacturer's cage is shown as it is the one I have information on; the cage is the Aviplus cage from Big Dutchman and a diagram is provided below (Figure 1). The cage meets the EU regulations for new cages post 1st January 2002. The cage accommodates 10 hens with 756 cm^2, 15 cm of perch space and 12 cm of feeder space per bird, an abrasive strip on the feed trough, a nest box with a rear roll-out egg belt and a litter bath with litter on a litter-belt above the egg-belt, that in the model I saw in Sweden, used sawdust. A picture of the cage is shown in Appendix 4.

Figure 1: Diagram of furnished cage for 10 hens that meets the new EU Directive (not to scale)

< 60.3 cm >



While the furnished cages I saw in Germany were a commercial unit, they were under current trial in Sweden along with other European prototype/commercial units. While cages are still not approved in Sweden, it is expected furnished cages will receive Agricultural Board approval next year. Current on farm and research station trials involve 63,000 birds in furnished cages in 10 houses on 9 farms. Furnished cages for a further 100,000 hens have been ordered but cannot be installed until the systems (e.g. each furnished cage system from different manufacturers) are approved.

At the research station (at Uppsala) in Sweden, a number of aspects of furnished cage are under study, e.g. cages from different manufacturers, methods (nest curtain, egg-saver wire) to slow down egg roll-out distance to reduce the incidence of cracked eggs, nest entrance (front or back), different strains, single (5 birds/cage) vs. double (10 birds/cage) (back to back) cages with pop-holes connecting the two cages, to provide escape areas, sawdust vs. sand, size of nest box and size of dust bath. In spite of the apparent availability of a commercial cage, because of the number of variables currently being tested in Sweden, it is difficult to recommend these cages for immediate use. However, when the testing is complete they may well provide the required environment without compromising bird welfare.

General issues relevant to Australia

1. There appeared to be an uncritical acceptance within industry (and some scientific) circles of the ‘five freedoms’, particularly ‘freedom to express normal behaviours’. Thus, there was an acceptance that any change closer to the ‘natural environment’, such as natural light in the shed or availability of nest boxes, inherently improves welfare. Nevertheless, this particular approach of assessing welfare, the nature-based approach, has little scientific credibility because of the value judgements that are required when using this approach. (**Note:** For the 4 approaches used to assess welfare see appendix 2 on the ‘scientific study of animal welfare’ page 29). For example with the above example of light, many farms were covering some windows to reduce shadows and overcome problems with floor eggs.

2. Until the proposed change in legislation there appeared to be a strong belief in 'market driven change'. An underlying assumption is that consumers are educated on the issues and facts and thus can make an informed choice; this did not appear to be the general case and there did not appear to have been any major effort in this area. Current marketing included misconceptions e.g. free range has the implication that all birds are outside on grass for some part of the day, some systems e.g. organic systems producing healthier (for the consumer) eggs, provision of windows, presumably to ensure natural light, is a requirement in some countries even though the windows may be covered to ensure even distribution of light, and improved welfare in alternative systems while ignoring higher mortalities that can occur; all these points lead to consumers possibly being misled. If consumers are either misled or unaware of benefits and practices within any system, it is likely that such systems are probably not sustainable in the long term.

3. Based on the above 2 points there are at least three options for Australia. Firstly, we could do nothing and continue with an industry that, until recently, has shown little inclination to change; this will result in ongoing conflict. Secondly, Australia could follow what has occurred in Europe and ban the conventional cage with the advantages that the political issue of conventional cages will disappear and that clear signals are given to industry that the conventional cage is no longer acceptable and that alternatives must be developed. However, this option carries the risk that the welfare of birds may not be improved and may, in the short term, worsen. Also, the issue of product safety requires a thorough examination as this is the paramount criterion, particularly if a particular production system is to be banned. Thirdly, Australia could continue with a market driven approach to change, provided that this is accompanied with a serious effort at both industry and public education. Whichever option or combination of options is/are followed, it is important that any change is demonstrated to bring benefit to the birds.

4. There was considerable concern in Europe over losing markets to countries with less stringent controls. For example, in countries visited within the EU there was the belief that about 10 other European countries that wish to become members of the EU will be given a 10-year transition period, including beyond 2013 depending on when they enter the EU. During this time they could provide eggs (from cages) at a lower cost than eggs from alternative systems. Also, non-EU countries (with cages) will be allowed to export into EU countries unless welfare can be used as a trade barrier. This is to be discussed in Europe prior to the end of this year, but there are conflicting opinions on whether such barriers will be allowed. In Australia, recent examples of pork, chicken meat and salmon imports would suggest that such barriers are unlikely to be imposed in Australia. A further consideration is the sale of egg product (non-shell eggs) is forecast to increase from around 17 % of the market to 40 % of the market within 5 years (as is anticipated in Australia). Based on cost, particularly if cages are banned, it is likely these products will be imported into Europe, which would further undermine the sustainability of the local egg industries as it is unlikely they could survive only on the shell-egg sector of the market. If local European industry proves to be unsustainable, the end result is an export of welfare problems to another country; this is not ethically defensible.

5. Some areas of improvement noted since a previous visit several years ago were:

- A slight reduction in the dust levels in the aviaries, although a sufficient number were of concern to raise doubts about the working environment.
- The incorporation of nest boxes onto the platforms of aviary systems as opposed to the side walls seemed to be a logical progression from development of the barn system where the nest boxes were at the back of the platform.
- Light levels in all alternative sheds were generally high and sheds and birds generally looked good.
- Some farms were not beak trimming and this was associated with rearing in very low light levels for 8 weeks prior to rearing from 8-16 weeks in 'subsequent system's' light levels e.g. a barn with access to a verandah for barn/free range egg production.

6. Some areas of concern were:
   - While some reasonable aviaries were seen they still result in some human discomfort. The dust levels and the difficulties of inspection of birds, bird pick-up and handling for vaccinations in aviaries are of concern.
   - The low level of real information provided to consumers (e.g. eggs may be marketed on the basis that birds are fed a combination of 4 grains, organic food or are free range) and the apparent lack of interest in welfare.
   - The potential compromises to welfare from purely market-driven production systems (i.e. those organic free range systems associated with a high mortality).

7. Some areas of conflict were:
   - Future price premiums, if any, were unclear. Based on current market shares, approximately 80 % of all consumers bought eggs on the basis of price (i.e. currently purchase cage eggs). However, assuming the cost of production in alternative systems is higher it is unknown how price increases will be handled i.e. the prices could be absorbed by the farmer by increasing efficiency, by the supermarkets cutting margins or by consumer paying a higher price.
   - Some supermarket chains in some countries (Holland and UK) did not sell cage eggs. However, I had the strong impression this was for both marketing reasons and higher margins per unit of shelf space rather than for any concern over welfare.
   - There appeared to be a conflict between food safety and perceptions of welfare. It is likely that biosecurity in free range and barn system is at a greater risk of compromise than in cages, but I do not know level of risk and this type of information is not provided to the consumer. While Salmonella control programmes were underway in several countries and they were considered effective, I do not know how effective they are or whether consumers are being fully informed over risks. (These aspects require clarification).
   - It is not known if the number of birds that actually access the outdoor area in a free range system (i.e. a range from 17-70 % in favourable weather) is likely to be an issue for consumers in Australia.
   - Public education in Australia is considered essential if a 'market driven' approach is to be sustained.
   - Farmer education in Australia on compliance with welfare and production standards is essential to provide public reassurance about standards within industry.

- Furnished cages were undergoing considerable evaluation and it is likely that some design modifications will be recommended as a result of this work. Therefore, they cannot be considered a currently viable alternative production system.

Issues and comments and opinions of people in individual countries

The Netherlands

- The definition of an outside area for a free range system is that 'birds have access to the appropriate-sized outdoor area'. Whether the birds actually go outside or not does not appear to be an issue. It is unknown whether this is an issue for Australian consumers.
- There are some potential biosecurity issues for both human health and bird health associated with free range production and some of the marketing requirements of other systems. For example, some marketing systems require free water and thus the biosecurity of bird health from water available from a cup (i.e. free water) versus water available via nipples needs to be determined. Similarly, the biosecurity of bird health from litter available within barn and aviary systems and access to outdoor areas needs to be determined.
- The manure belt system in aviaries and manure removal in some barns (scrapers) was considered to benefit biosecurity as it prevented manure build-up and reduced vermin and sheds were more likely to be Salmonella free when tested.
- Some comparative figures for cage and aviary production were: egg numbers from 17-80 weeks of age were 320 vs. 310, egg weight was 63 vs. 62 g and feed/hen was 110g vs 125 g.
- Predator control appeared to be cursory.
- Nest boxes were not evenly used within the barn system.
- Pullets reared in aviaries compared to cages had slightly higher feed costs and mortalities. Labour was more expensive and it was calculated that 1 person can manage 100,000 caged pullets but only 75,000 aviary pullets. However, the costs were offset by a premium for aviary reared pullets.
- 35 % of egg consumption was from alternative systems and this varied with changes in the economy.
- Consumers appeared unwilling to pay more for non-shell egg products from alternative systems (e.g. bread, biscuits, shampoo, etc). Thus, when cages are banned it is likely that egg product will be imported.
- The market driven approach was based on public perceptions not welfare. Thus, the small export market for a sector of the organic market for eggs in Germany which requires no beak trimming and no additives to the feed can result in mortalities of 25-30 %. If true, this demonstrates the predominant focus of alternative systems is market share not bird welfare.
- Eggs from both barns and aviaries can be marketed as free-range, provided there is an appropriate outdoor area. Therefore, there was some opinion that aviary sheds will replace barn sheds because of increased returns per unit area.
- Cleaning out of aviaries and inspecting, treating (e.g. vaccinations) and pick-up of birds in aviaries appeared complicated.
- The majority of farms still had cages.

- The majority of farmers were unhappy with the EU Directive and there was some belief that egg production will move to 'cheaper' countries to the detriment of the Dutch poultry industry. Notwithstanding this comment and the few people seen, there appeared to be a general acceptance of the Directive and its intent.
- There were no education programmes on the benefits and disadvantages of different production systems and thus consumers were poorly educated on the issues.
- There was a belief that the consumer has the right to choose and thereby drive the market, but the Directive goes well beyond this and politics was likely to have been involved.
- The Directive was seen as a market opportunity for alternative equipment supplies.
- Land is so valuable in The Netherlands that importing eggs, even though Holland is currently a net exporter of eggs, may be a hidden agenda to make more land available.
- Poultry producers are well-serviced by European equipment manufacturers.

Germany

- Possible problems of free ranges versus cage include:
  - The health risks to birds is likely to be increased compared to cages.
  - There were increased environmental risks.
  - There were increased mortalities (by 1-2 %; i.e. 7-8 % at 74 weeks of age), (pecking and cannibalism; mainly at end of lay) and feed costs and decreased production (by 3-4 %).
  - Labour was increased by about 50 % for 12,000 birds.
  - Beak trimming was an issue in all systems and its permissibility will come under review. Some farms did not currently beak trim e.g. those accredited for some forms of organic production.
- Aviary sheds had a large number of lights to provide an even distribution of light and no shadows to minimize floor eggs. An indirect advantage of this was the high light levels made the sheds 'feel more comfortable'.
- The number of floor eggs in aviary systems depended on rearing environments for pullets. Floor eggs of less than 1 % (+ another 1 % on the platforms) can be regularly achieved. However, because of a shortage of appropriately reared pullets some sheds used a mixture of pullets from aviary or floor/cage rearing. In the latter situation if 20 % of birds were from inappropriate systems it could result in 20 % floor eggs.
- There was a problem of definition of the different systems compared to the terminology in Australia. In Germany the 4 systems were cage, deep litter, barn (which included aviary systems) and free range which were the deep litter or barn housing system plus access to a specified outdoor area. Thus, barns and aviaries were not distinguished.
- Free range production, based on aviary accommodation, will increase at the expense of solely barn production, because of the premium.
- 11 % of the current market was for free range eggs.
- The cage egg sector of industry were not consulted over the EU Directive and there was an expectation this sector may start putting their case to the detriment of the whole industry (i.e. by focussing on health and their perceptions of free range production).
- There was an awareness by the manufacturing industry of furnished cages but there was a need for a 'name' if eggs from such a system are to be marketed (i.e. it is still a cage).
- Poultry producers are well-serviced by European equipment manufacturers.
- Public opinion was a 90 % preference for free range or barn eggs but buying behaviour was mainly on price i.e. 80 % of the market was for cage eggs.

Sweden[1]

- Beak trimming has not been permitted since 1988.
- Windows, presumably to provide natural light was a requirement in sheds, particularly for non-cage systems. However, many of the windows were often covered up to ensure an even light distribution within sheds.
- 80 % of shell eggs sold in Sweden were from cages even though there was considerable public support for alternative production, indicating that public opinion was not translated into buying behaviour.
- Other market sectors were deep litter (10-12 %), organic (2 %), aviary (< 2 %), furnished cages (1 %) and small flocks (3 %). It was envisaged that deep litter, organic and furnished cage production would increase in the future at the expense of cages and small flocks. The major expansion is likely to be in furnished cages.
- Contrary to other countries visited there has been some attempt at public education (see footnote[1]), although I do not know the nature of the information supplied or the success of the programme.
- Only one supermarket chain in Sweden did not supply cage eggs.
- Shell eggs were not washed in Europe and floor eggs from barn/free range systems were not sold on the shell egg market.
- Conventional cages are to be phased out in Sweden by 2002 and this will put Sweden at a disadvantage compared to both EU and non-EU countries.
- Due to a current Government programme of welfare assessment of all cage farms, approximately 9 % will go out of the industry this year and a total of 13 % by next year. Those farms that pass the assessment will be permitted another 3 batches of hens i.e. total phase out of conventional cages by 2002. While free range is likely to increase, it is not known if this will pick up the lost 'cage' production (see next dot point).
- In 1994, to protect the Swedish industry, it was agreed that net egg production should not decrease. It is likely that this decision will require considerable funds for compensation; alternatively the decision may be reversed.
- In 1996, particularly because of the requirement for no beak trimming, it was recognized that aviaries were unlikely to work in Sweden, and that modified cages may be acceptable. However, there has been no public opinion/research on attitudes to furnished cages. While cages are still not approved in Sweden, it is expected furnished cages will receive Agricultural Board approval next year. Current on farm and research station trials involve 63,000 birds in furnished cages in 10 houses on 9 farms. Furnished cages for a further 100,000 hens have been ordered but cannot be installed until the systems (e.g. each furnished cage system from different manufacturers) receive Government accreditation; this process is predominantly based on meeting welfare standards.
- A number of aspects of furnished cage were under study, e.g. cages from different manufacturers, methods (nest curtain, egg-saver wire) to slow down egg roll-out distance to reduce the incidence of cracked eggs, nest entrance (front or back), different strains, single vs. double (back to back) cages with pop-holes connecting the two cages,

[1] The following paper describes some of the experiences in Sweden and I can provide a copy if required:
Keeling, L. and Svedberg, J. (1999). Legislation banning conventional battery cages in Sweden and subsequent phase-out programme. In: 'Regulation of Animal Production in Europe'. (Weisbaden, May: KTBL), pp. 73-79.

to provide escape areas, sawdust vs. sand, size of nest box and size and location of dust bath.

- Aviary systems in Sweden have not worked because of variable mortalities of 4-23 % (cf. 4-5 % in cages), predominantly due to cannibalism, increased dust levels and ammonia concentrations providing unsatisfactory working environments, problems of parasite control (coccidiosis and red-mite), high levels of bumblefoot due to poor perch design (there is a peak at about 30 weeks and it resolves by slaughter) and keel bone deformation due to the long time resting on perches and perch design.
- Floor eggs at commercial aviary farms varied from 3-20 %; as elsewhere, the level of floor eggs largely depended on the rearing environment for the pullets.
- One commercial producer's preference (he had experience in all systems) was barn, then cages and then aviary.
- Potential import threats were from Finland and Denmark but currently Sweden was protected via Salmonella restrictions. Denmark was currently implementing a very rigorous Salmonella control programme and when completed it will be able to export to Sweden. Cost of production in Finland was 33.3 % cheaper than in Sweden and produced 25 % in excess of its own requirements.
- In relation to the lack of birds going outdoors and the times of year they go outdoors in free range systems, the public did not expect birds to be outdoors in winter or, for example, when it was raining.
- European regulations have a 'best before' date of 28 days after lay and a 'sell by' date of 21 days after lay and 18 days after packing. Therefore, eggs need to be collected from farm twice per week, except in Sweden where they are collected weekly, because of the large distances. In Sweden eggs must be cooled on farm and during transport; the need to keep eggs cool is not rigorously enforced in other countries.
- The Salmonella control programme appeared to be effective. If it was introduced in Australia, this may provide some leverage for supermarkets to provide better temperature control and advice to consumers on the benefits, particularly to 'shelf-life', of keeping eggs cool.
- There was believed to be little political support for agriculture in Sweden.
- The egg industry in Sweden was facing very difficult and uncertain times.

England

- In England, farmers considered themselves more caring and concerned about their animals than their continental counterparts. Certainly, welfare was mentioned more often than elsewhere.
- There seemed to be a lower level of awareness of the changes outlined in the European Directive and its implications compared to other countries visited.
- A major concern was overproduction of free range eggs and the dominance of the supermarkets in setting prices.
- No one was happy (overproduction, EU regulations, gas emission controls) and there was a feeling of being let down by the Government.
- Labelling eggs on-farm with the system of production was a current issue and difficult to comply with. It was hoped they will be able to label cartons rather than eggs and do it at the packers rather than at the farm. If labelling is approved it will prevent the 'cascade' of eggs to a lower price category e.g. from free range to barn and from barn to cage. This would result in an overproduction in all sectors unless markets can be found for egg product from specific systems. However, it is my opinion the current system

that permits a 'cascade' to a lower price category is deceptive for those (admittedly probably very few) consumers who deliberately choose cage eggs.

- In barn systems (no aviaries were seen in the UK) red-mite infestation was either worse or just commented on more often than in other countries. Weekly treatment was required because of the compromise between the chemicals they are allowed to use without withdrawing eggs for sale and their effectiveness.
- The use of stone filler for a few metres near the shed to minimize bird damage to the ground near the shed and to improve biosecurity by its annual removal appeared more common than overseas.
- Even lighting in sheds was considered important to reduce floor eggs.
- The biosecurity of free range systems was an issue: One farm had ducks on a nearby pond and wandering near the shed. The comment was that pigeons were a greater risk than ducks!
- Public were not well educated on the issues. There was a belief, as in the rest of Europe, that free range eggs were a healthier product. Also, there was a common belief that meat chickens were reared in cages.
- The electric fences to keep out foxes looked quite sophisticated.
- A comment was that cage farms required a systems manager while a free range farm required a skilled stockperson.
- Some comments regarding the best barn sheds were:
    - They work better with chain feeders on the floor compared to pan feeders (cast uneven shadows that encourage floor eggs) and raised chain feeders.
    - Additional perches should not be provided as they encourage birds to perch both on them and under them and this inhibited free movement of birds walking across the slats.
    - Removal of manure improved air quality but most farms still had pits.
    - Plastic or wooden battens were the best form of slats.
    - Density should be kept as low as possible. A working recommendation was 11.7 hens/m^2.
- Freedom Foods, the RSPCA alternative production marketing system (for hens, ducks, turkeys, beef cattle, dairy cows and pigs), accredited 119 farms in 1994 and now involves 4,000 producers. They were currently spending £0.5 M over a 6-8 week period on an advertising campaign and £2 M is the forecast advertising budget for next year.
- According to one of the production managers from a large farm business that included a number of free range farms it was difficult to get farmers to keep proper records to satisfy the auditing procedures for Freedom Foods. While any deficiencies at a farm were supposedly for use for purposes of training and continued improvement, the audit was seen as a threatening process and farmers feel intimidated.

Discussion

Two obvious questions arising from the visit are: Are the alternatives to conventional cages effective and is welfare improved? Another related question is, are there welfare benefits from furnished cages?

My answers to these questions based on the visit and the supplementary information provided in appendices 2 and 3 are:

1. The barn system can provide an effective alternative although it is not inherently better (in terms of welfare) than cages; the system may improve with experience and R&D. There are advantages and disadvantages in both systems and any interpretation is an individual value judgement based on whether an individual believes the currently consistently lower mortalities and higher egg production in cages are more or less important than increased freedom and behavioural opportunities. The barn system appears to be an appropriate alternative in Australia, particularly as industry has considerable experience with similar systems that are used in Australia for both broiler and layer breeders. However, it needs to be demonstrated that mortality and morbidity data are not highly variable.

2. The aviary system presents problems of dust (an OH&S issue), adequacy of inspection and difficulties of collecting and handling birds for treatment or at the end of lay. There appears to be a discrepancy between the experiences in Sweden of variable and sometimes high mortalities and elsewhere in Europe where lower mortalities are reported. However, other than in Sweden, information appears to be unavailable on variation in mortality in aviaries. These negatives indicate considerable caution should be applied when deciding on their current use as an alternative that can meet both production and welfare criteria in Australia. Notwithstanding the above, the equipment available from European manufacturers appears to be of an excellent quality and considerable thought has gone into its development. Development of better equipment is an ongoing process in Europe.

3. The major problem with furnished cages are they are still cages. The major objection to conventional cages is the lack of space and while space allocations are considerably larger, when the cages contain birds there is certainly no 'feeling' of the birds having a freedom to move around, i.e. the space allocations do not meet their goal.

   Perches

   The literature suggests that perches can overcome some welfare problems associated with the very high calcium turnover and mobilization in laying hens without seriously affecting egg quality. Notwithstanding some potential problems with perches if they are incorrectly designed and placed, such as an increase in cracked and dirty eggs and keel bone deformation, they are inexpensive and appear to contribute to 'fitness' by reducing the potential for injuries. They should be included in cages.

   Nest boxes

   The literature suggests that birds are highly motivated to use a nest box (particularly if they have experience of laying eggs in a nest box) and some data on the behaviour of birds without nest boxes is used as evidence of frustration. However, an argument that their use is not warranted is the very high reproductive rate (a sensitive indicator of welfare) in cages without nest boxes. Thus, while nest boxes may result in an improvement in some subtle aspects of welfare, there is no evidence that fitness is improved. i.e. the magnitude and cost/benefit of any improvement has not been demonstrated and there are no data available on the magnitude of any adverse consequences for welfare of not having a nest. Until these latter data are available, and

it is unclear whether it will be forthcoming from Europe, it is difficult to evaluate the merit of the European recommendation that nests are a requirement in cages.

Dust baths
The literature on dust baths is less convincing than for nest boxes. It is likely that any welfare benefits are relatively small and as for nest boxes there are no data on the magnitude, on the basis of fitness variables, of any adverse consequences of not having a nest box or any improvement in welfare from the presence of nest boxes. These lack of data make it difficult to agree with the European recommendation that dust baths are a requirement in cages.

Recommendations to RIRDC arising from the visit

Some barn and aviary farms were not beak trimming and this was associated with rearing in very low light levels for 8 weeks. Past experience in Australia has indicated this has not worked, nevertheless it would appear worthwhile to conduct a reevaluation. *It is recommended that the impact of low light levels during rearing on the need to beak trim birds for both cage and alternative systems be determined.*

There appears to be a potential conflict between food safety and perceptions of welfare. It is likely that biosecurity in free range and barn system is at a greater risk of compromise than in cages. However, the level of risk does not appear to be known. Also, while Salmonella control programmes are undertaken in several countries and they are considered effective, it is not known how effective they are or whether consumers are being fully informed over risks. *It is recommended that the bird health and product hygiene risks associated with different production systems and the need for programmes similar to the Salmonella control programme be evaluated, perhaps using a HACCAP approach.*

If industry is to remain market driven without similar bans on systems as is occurring in Europe, public education is considered essential. *It is recommended that a strategy be developed, probably in association with some other animal industries, to develop and disseminate unbiased information on the welfare issues and the advantages and disadvantages of all production systems so that consumers are able to make an 'informed choice'.*

In association with public education, consumers need to be reassured about industry compliance with high welfare and production standards. *It is recommended that welfare standards be developed and a process/strategy developed to include such standards in an industry quality assurance programme.*

Other recommendations and comments arising from the report

Research needs to be undertaken to incorporate the feelings based approach to assess welfare into the widely accepted homeostasis approach. This involves the need to conduct research to establish the consequences of emotions experienced by birds on the magnitude of behavioural

and physiological responses and the cost of these responses, for example, on growth, reproduction and health. (see Appendix 2).

On current scientific evidence there is no demonstrable welfare benefit, on the basis of improved fitness, from incorporating nests into cages as recommended in the EU Directive.

On the basis of fitness there appears to be no scientific evidence that incorporating dust baths into cages, as recommended in the EU Directive, will improve bird welfare. However, there may be welfare benefits, on the basis of increased fitness from reduced mortalities, from incorporating certain enrichment devices into cages. *It is recommended that the welfare benefits of enrichment devices be further researched.*

Based on the physiological benefits to fitness (see Appendix 2) of perches, and notwithstanding some potential production problems, *it is recommended that perches should be incorporated into cages.*

Notwithstanding the above statements regarding the incorporation of nest boxes, perches and dust baths into cages, reports indicate better physical condition and either no differences in mortality or a lower mortality of birds in furnished cages that incorporate all 3 items of furniture. Thus, there may well be an interaction between the items of furniture that improves fitness. *It is recommended that research be conducted to determine if furnished cages per se improve fitness.*

Dissemination of report

A number of people have asked for copies of the report including:
Dr. Linda Murphy DPI, Qld.
Professor David Adams, AFFA, Canberra
Dr. Kim Critchley, SARDI, South Australia
Dr. Peter Penson, BAW, Victoria
Ms. Meg Parkinson, VFF
Dr. Phil Glatz, SARDI, South Australia
Ms. Glenys Oogjes, Animals Australia, Melbourne
Mr. Peter Barber, RSPCA (Victorian Branch)

Copies will be provided to AgVic poultry team staff and managers and I will be giving a talk on the visit at the Poultry Information Exchange in April 2000. In addition a number of comments in the report will be included in a special issue of Poultry Digest on the visit.

Acknowledgements

I gratefully acknowledge RIRDC for their financial support of my participation in the visit. My especial thanks go to Mr. Brian McErlane who organized the entire itinerary and executed it with incredible precision and success. A number of people overseas gave us considerable time and made local arrangements for our visit that enabled us to maximize what we saw in the minimum of time. They also entertained us in a very generous manner. I am particularly grateful to the following companies/organizations and their representatives who assisted us. I

was most impressed by the equipment I saw for both conventional and alternative production systems and the high level of expertise of staff. The companies and their representatives were:

Erik Helmink from Fancom, The Netherlands
Peter Lichtenbeld from VDL Agrotech, The Netherlands
Jo Voet from The Ministry of Agriculture, The Netherlands
Harry Luimes from Vencomatic, The Netherlands
Lutz Cramer from Farmer-Automatic, Germany
Bernd Meerpohl, Bo Molin and Friedrick Lubker from Big Dutchman, Germany
Mary Anne Sorensen from The Swedish Farmer's Federation, Sweden
Klaus Elwinger and Helena Wall from Funbo-Lövsta Research Centre, Uppsala, Sweden
Andrew Hignett from Hyline, UK
David Tromans from Dean's Farms, Heatherton, UK
Stuart Haley from Daylay Foods, North Scarle, UK
Arther Stockwin from Stonegate Farmers Ltd., Sussex, UK
Mike Sharpe from Freedom Food Ltd., West Sussex, UK

In addition I am extremely grateful to the numerous farmers and farm managers and their staff who both showed us around their enterprises and willingly imparted information on the trials and tribulations of being a poultry farmer in Europe.

COUNCIL DIRECTIVE 1999/74/EC

of 19 July 1999

laying down minimum standards for the protection of laying hens

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 37 thereof,

Having regard to the proposal from the Commission (1),

Having regard to the opinion of the European Parliament (2),

Having regard to the opinion of the Economic and Social Committee (3),

Whereas:

(1) On 7 March 1988 the Council adopted Directive 88/166/EEC (4) complying with the judgement of the Court of Justice in Case 131/86 (annulment of Council Directive 86/113/EEC of 25 March 1986 laying down minimum standards for the protection of laying hens kept in battery cages);

(2) Article 9 of Directive 88/166/EEC requires the Commission to submit, before 1 January 1993, a report on scientific developments regarding the welfare of hens under various systems of rearing and on the provisions in the Annex to the Directive, accompanied by any appropriate adjustment proposals;

(3) Council Directive 98/58/EC of 20 July 1998 concerning the protection of animals kept for farming purposes (5), drawn up on the basis of the European Convention for the Protection of Animals kept for Farming Purposes, lays down Community provisions designed to give effect to the principles laid down in the Convention, which include the provision of housing, food, water and care appropriate to the physiological and ethological needs of the animals;

(4) In 1995 the Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes adopted a detailed recommendation, which includes laying hens;

(5) The protection of laying hens is a matter of Community competence;

(6) Differences which may distort conditions of competition interfere with the smooth running of the organisation of the market in animals and animal products;

(7) The Commission report referred to in recital 2, based on an opinion from the Scientific Veterinary Committee, concludes that the welfare conditions of hens kept in current battery cages and in other systems of rearing are inadequate and that certain of their needs cannot be met in such cages; the highest possible standards should therefore be introduced, the light of various parameters to be considered in order to improve those conditions;

(8) However, for a period to be determined, the use of unenriched cage systems may be continued under certain conditions, including improved structural and space requirements;

(9) A balance must be kept between the various aspects to be taken into consideration, as regards both welfare and health, economic and social considerations, and also environmental impact;

(10) It is appropriate, while studies on the welfare of laying hens in various systems of rearing are carried out, to adopt provisions that allow the Member States to choose the most appropriate system or systems;

(11) The Commission must submit a new report together with appropriate proposals that take account of that report;

(12) Directive 88/166/EEC should therefore be repealed and replaced;

HAS ADOPTED THIS DIRECTIVE

Article 1

1. This Directive lays down minimum standards for the protection of laying hens.

2. This Directive shall not apply to:

- establishments with fewer than 350 laying hens;
- establishments rearing breeding laying hens.

Such establishments shall, however, continue to be subject to the relevant requirements of Directive 98/58/EC.

Article 2

1. The definitions in Article 2 of Directive 98/58/EC shall apply where necessary.

2. In addition, the following definitions shall apply for the purpose of this Directive:

(a) 'laying hens' means: hens of the species Gallus gallus which have reached laying maturity and are kept for production of eggs not intended for hatching;

(1) OJ C 157, 4.6.1999, p. 8.
(2) OJ C 128, 7.5.1999, p. 78.
(3) OJ C 101, 12.4.1999.
(4) OJ L 74, 19.3.1988, p. 83.
(5) OJ L 221, 8.8.1998, p. 23.

(b) 'nest' means: a separate space for egg laying, the floor components of which may not include wire mesh that can come into contact with the birds, for an individual hen or for a group of hens (group nest);

(c) 'litter' means: any friable material enabling the hens to satisfy their ethological needs;

(d) 'usable area' means: an area at least 30 cm wide with a floor slope not exceeding 15% with headroom of at least 45 cm. Nesting areas shall not be regarded as usable areas.

Article 3

According to the system or systems adopted by the Member States, they shall ensure that the owners and holders of laying hens apply not only the relevant provisions of Directive 98/58/EC and of the Annex to this Directive but also the requirements specific to each of the systems referred to below, namely:

(a) either the provisions laid down in Chapter I as regards alternative systems;

(b) or the provisions laid down in Chapter II as regards unenriched cage systems;

(c) or the provisions of Chapter III concerning enriched cages.

CHAPTER I

Provisions applicable to alternative systems

Article 4

1. Member States shall ensure that from 1 January 2002 all newly built or rebuilt systems of production referred to in this chapter and all such systems of production brought into use for the first time comply at least with the requirements below.

All systems must be equipped in such a way that all laying hens have:

(a) either linear feeders providing at least 10 cm per bird or circular feeders providing at least 4 cm per bird;

(b) either continuous drinking troughs providing 2,5 cm per hen or circular drinking troughs providing 1 cm per hen.

In addition, where nipple drinkers or cups are used, there shall be at least one nipple drinker or cup for every 10 hens. Where drinking points are plumbed in, at least two cups or two nipple drinkers shall be within reach of each hen;

(c) at least one nest for every seven hens. If group nests are used, there must be at least 1 m^2 of nest space for a maximum of 120 hens.

(d) adequate perches, without sharp edges and providing at least 15 cm per hen. Perches must not be mounted above the litter and the horizontal distance between perches must be at least 30 cm and the horizontal distance between the perch and the wall must be at least 20 cm;

(e) at least 250 cm^2 or littered area per hen, the litter occupying at least one third of the group surface.

2. The floors of installations must be constructed so as to support adequately each of the forward-facing claws of each foot.

3. In addition to the provisions laid down in points 1 and 2;

(a) if systems of rearing are used where the laying hens can move freely between different levels,

(i) there shall be no more than four levels;
(ii) the headroom between the levels must be at least 45 cm;
(iii) the drinking and feeding facilities must be distributed in such a way as to provide equal access for all hens;
(iv) the levels must be so arranged as to prevent droppings falling on the levels below.

(b) If laying hens have access to open runs,

(i) there must be several popholes giving direct access to the outer area, at least 35 cm high and 40 cm wide and extending along the entire length of the building; in any case, a total opening of 2 m must be available per group of 1000 hens;

(ii) open runs must be;

- of an area appropriate to the stocking density and to the nature of the ground, in order to prevent any contamination;
- equipped with shelter from inclement weather and predators and, if necessary, appropriate drinking troughs.

4. The stocking density must not exceed nine laying hens per m^2 usable area.

However, where the usable area corresponds to the available ground surface, Member States may, until 31 December 2011, authorise a stocking density of 12 hens per m^2 of available area for those establishments applying this system on 3 August 1999.

1. Member States shall ensure that the minimum requirements laid down in paragraph 1 apply to all alternative systems from 1 January 2007.

CHAPTER II

Provisions applicable to rearing in unenriched cage systems

Article 5

1. Member States shall ensure that from 1 January 2003 all cage systems referred to in this chapter comply at least with the following requirements:

1. at least 550 cm^2 per hen of cage area, measured in a horizontal plane, which may be used without restriction, in particular not including non-waste deflection plates liable to restrict the area available, must be provided for each laying hen;

2. a feed trough which may be used without restriction must be provided. Its length must be at least 10 cm multiplied by the number of hens in the cage;

3. unless nipple drinkers or drinking cups are provided, each cage must have a continuous drinking channel of the same length as the feed trough mentioned in point 2. Where drinking points are plumbed in, at least two nipple drinkers or two cups must be within reach of each cage;

4. cages must be at least 40 cm high over at least 65 % of the cage area and not less than 35 cm at any point;

5. floors of cages must be constructed so as to support adequately each of the forward-facing claws of each foot. Floor slope must not exceed 14 % of 8 %. In the case of floors using other than rectangular wire mesh, Member States may permit steeper slopes;

6. cages shall be fitted with suitable claw-shortening devices.

2. Member States shall ensure that rearing in the cages referred to in this chapter is prohibited with effect from 1 January 2012. In addition, with effect from 1 January 2003 no cages such as referred to in this chapter may be built or brought into service for the first time.

CHAPTER III

Provision applicable to rearing in enriched cages

Article 6

Member States shall ensure that after 1 January 2002 all the cages referred to in this chapter comply at least with the following requirements:

1. laying hens must have:
   (a) at least 750 cm^2 of cage area per hen, 600 cm^2 of which shall be usable; the height of the cage other than that above the usable area shall be at least 20 cm at every point and no cage shall have a total area that is less than 2000 cm^2;
   (b) a nest;
   (c) litter such that pecking and scratching are possible;
   (d) appropriate perches allowing at least 15 cm per hen;

2. a feed trough, which may be used without restriction, must be provided. Its length must be at least 12 cm multiplied by the number of hens in the cage;

3. each cage must have a drinking system appropriate to the size of the group; where nipple drinkers are provided, at least two nipple drinkers or two cups must be within the reach of each hen;

4. to facilitate inspection, installation and depopulation of hens there must be a minimum aisle width of 90 cm between tiers of cages and a space of at least 35 cm must be allowed between the floor of the building and the bottom tier of cages;

5. cages must be fitted with suitable claw-shortening devices.

CHAPTER IV

Final provisions

Article 7

Member States shall ensure that the establishment covered by the scope of this Directive are registered by the competent authority and given a distinguishing number, which will be the medium for tracing eggs placed on the market for human consumption.

The arrangements for implementing this Article shall be determined before 1 January 2002 in accordance with the procedure laid down in Article 11.

Article 8

1. Member States shall take the necessary measures to ensure that the competent authority carries out inspections to monitor compliance with the provisions of this Directive. These inspections may be carried out on the occasion of checks made for other purposes.

2. From a data to be determined in accordance with the procedure provided for in Article 11, Member States shall report to the Commission on the inspections carried out in accordance with paragraph 1. The Commission shall submit summaries of these reports to the Standing Veterinary Committee.

3. Before 1 January 2002 the Commission shall, in accordance with the procedure laid down in Article 11, submit proposals for harmonisation of the following:

(a) the inspection referred to in paragraph 1;

(b) the form and content of the reports referred to in paragraph 2 and the frequency with which they are to be submitted.

Article 9

1. Whenever uniform applications of the requirements of this Directive renders it necessary, veterinary experts from the Commission may, in conjunction with the competent authorities:

(a) verify that the Member States are complying with the said requirements;

(b) make on-the-spot checks to ensure that the inspections are carried out in accordance with this Directive.

2. A Member State in whose territory an inspection is made shall provide the veterinary experts from the Commission with any assistance they may require for the performance of their tasks. The outcome of the checks made must be discussed with the competent authority of the Member State concerned before a final report is drawn up and circulated.

3. The competent authority of the Member State concerned shall take any measures, which may prove necessary to take account of the results of the checks.

4. Detailed rules for the application of this Article shall be adopted, if necessary, in accordance with the procedure laid down in Article 11.

Article 10

Not later than 1 January 2005 the Commission shall submit to the Council a report, drawn up on the basis of an opinion from the Scientific Veterinary Committee, on the various systems of rearing laying hens, and in particular on those covered by this Directive, taking account both of pathological, zootechnical, physiological, and ethological aspects of the various systems and of their health and environmental impact.

That report shall also be drawn up on the basis of a study of the socio-economic implications of the various systems and their effects on the Community's economic partners.

In addition, it shall be accompanied by appropriate proposals taking into account the conclusions of the report and the outcome of the World Trade Organisation negotiations.

The Council shall act by a qualified majority on these proposals within 12 months of their submission.

Article 11

1. Where the procedure laid down in this Article is to be followed, the matter shall be referred without delay to the Standing Veterinary Committee set up by Decision 68/361/EEC ([1]), hereinafter referred to as 'the committee', by its chairman acting either on his own initiative or at the request of a Member State.

2. The representative of the Commission shall submit to the committee a draft of the measures to be taken. The committee shall deliver its opinion on the draft within a time limit, which the chairman may lay down according to the urgency of the matter. The opinion shall be delivered by the majority laid down in Article 205 (2) of the Treaty in the case of decisions, which the Council is required to adopt on a proposal from the Commission. The votes of the representatives of the Member States within the committee shall be weighted in the manner set out in that Article. The chairman shall not vote.

3. (a) The Commission shall adopt the measures envisaged if they are in accordance with the opinion of the committee.

   (c) If the measures envisaged are not in accordance with the opinion of the committee, or if no opinion is delivered, the Commission shall without delay submit to the Council a proposal relating to the measure to be taken. The Council shall act by qualified majority.

If, on the expiry of a period of three months from the date of referral to the Council, the Council has not acted, the Commission shall adopt the proposed measures and implement them immediately, save where the Council has decided against the said measured by a simple majority.

Article 12

Directive 88/166/EEC is hereby repealed with effect from 1 January 2003.

Article 13

1. Member States shall brink into force the laws, regulations and administrative provisions, including any penalties, necessary to comply with this Directive not later than 1 January 2002. They shall forthwith inform the Commission thereof.

   When Member States adopt these measures, they shall contain a reference on the occasion of their official publication. The methods of making such reference shall be laid down by Member States.

2. The Member States may, while respecting the general rules laid down in the Treaty, maintain or apply within their territories provisions for the protection of laying hens which are more stringent than those envisaged by this Directive. They shall inform the Commission of any measure taken to that end.

3. Member States shall communicate to the Commission the text of the main provisions of national law, which they adopt in the field covered by this Directive.

Article 14

This Directive shall enter into force on the day of its publication in the *Official Journal of the European Communities.*

Article 15

This Directive is addressed to the Member States

Done at Brussels, 19 July 1999.

For the Council
The President
K. HEMILA

SCIENTIFIC STUDY OF ANIMAL WELFARE[2]

In making a decision on whether or not an animal's welfare is seriously compromised, individuals will integrate moral views with biological facts. Thus science has the important role of establishing the facts on how animals biologically respond to the practices under question, whether they are farming, laboratory or general community practices for animals. However, the assessment of welfare is a controversial subject. Even within scientific disciplines, variations in definitions of animal welfare exist and this combined with variations in methodology and in turn interpretation lead to disagreement (Hemsworth and Coleman, 1998).

This disagreement over what is important for the welfare of animals led to attempts to study and conceptualise animal welfare in more scientific ways. It is generally accepted that there are three broad approaches used by scientists in studying animal welfare: the "feelings-based", the "nature of the species" and the "functioning-based" approaches (Duncan and Fraser, 1997). A more descriptive title for the third approach, the functioning-based approach, which will be used here is the "homeostasis" approach. There is also a fourth approach, the "animal preferences" approach, which is sometimes included in the feelings approach but does not necessarily provide direct information on feelings or emotions. This approach involves studying the animal's choice for resources. These four approaches will be briefly considered.

Feelings

This approach defines animal welfare in terms of emotions and thus it emphasizes reductions in negative emotions such as pain and fear, and increases in positive emotions such as comfort and pleasure (Duncan and Fraser, 1997).

The modern notion of emotions in both the animal behaviour and psychology literature highlights the linkage between visceral or bodily arousal and cognitive processes (Bolles, 1981; Mandler, 1998). Any disceprancy or any interruption of expectations or of intended actions, produces undifferentiated visceral (autonomic) arousal and the associated sensation of the emotion, whether positive or negative, depends on the cognitive evaluation of this discrepancy or conflict between the state of the world and the expectations of the individual. While it is accepted that humans have a great variety of emotions, animal behaviourists generally consider that animals are restricted to a few basic emotions such as anger, fear, joy and happiness. This is predicated on the view that animals probably only have emotions to deal with certain kinds of survival problems, for which there is some strong evolutionary benefit. For example, while we might expect animals to show fear because of the adaptive value of being frightened in a dangerous situation, there is no reason to expect animals for example, to show pity to other species because there would be no clear adaptive advantage if they did (Bolles, 1981).

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[2] This paper by P.H. Hemsworth and J.L. Barnett was part of the following report to the Pig Research and Development Corporation:
Barnett, J.L., Hemsworth, P.H., Cronin, G.M., Jongman, E.C. and Hutson, G.D. (1999). Review of Sow Housing. (PRDC, Canberra).

The difficulties in studying emotions as though they were objective states of bodily arousal is well recognised in the literature (Cacioppo *et al*., 1993). While each emotion may reflect a different pattern of arousal, the visceral response to many emotions is reasonably uniform in animals. Most animals react physiologically in essentially the same way whether the arousal is sexual, fear provoking or if there is the anticipation of play or food. It is obviously a major challenge to study and understand emotions in animals, however there are some examples in the literature that indicate that it is possible to assess the strength of emotions in animals in intuitively negatively- and positively-emotional arousing situations. Behavioural and physiological correlates of fear of humans by pigs demonstrate our ability to quantify the level of fear towards a specific stimulus in pigs (Hemsworth and Barnett, 1987). Some of the motor patterns and neural changes presumably associated with emotions in humans and animals appear to be highly specific. Brain lesion studies and studies involving electrical stimulation of the brain indicate that particular neural circuits such as components of the limbic system appear to mediate or control emotions (Rosenzweig *et al*., 1999). For example, rats learn to press a lever when the reward (reinforcement) was a brief burst of electrical stimulation of the septal area of the limbic system. Such studies indicate the potential to associate positive and negative emotions with specific behavioural and neural changes. Defining emotions to further develop the feelings-based assessment of welfare is likely to occur in the next five years and will provide a major contribution to the welfare debate.

Preferences

Animals have functional systems controlling, for example, body temperature, nutritional state and social interactions. By investigating these functional systems and the associated motivational mechanisms, there is opportunity to identify the resources or stimuli in the environment that are required by or are important to animals, and thereby learn something about an animal's needs. Some of these motivational systems can be regulated by physiological consequences (eg consumption of food), whereas others require the display of a particular behaviour (eg rooting behaviour in pigs). Driven by the view that animal choices may indicate the existence of important underlying needs, there has been and continues to be considerable interest in studying the preferences of animals for resources, such as space, flooring, and a parturition or nest site. The preferences of animals for resources can be studied by allowing the animals to choose between resources, and preference is measured in either the time the animal spends with the resources or the resource that is selected. The simplest preference study involves allowing the animal to make a choice between two situations in which the resource is varied. For example, Hughes (1975) found that laying hens preferred a spacious cage to a confined cage and that neither time of day nor strain of bird was influential in this choice. Observing animals in complex environments that provide a range of activities will also provide details of the animal's preference for habitats and resources.

In an attempt to measure the strength of an animal's choice, scientists have incorporated tasks in which the animal has to expend energy or take risks in gaining access to an alternative resource. For example, operant conditioning techniques, in which an animal learns to perform a response, such as a lever pressing, to gain access to an alternative resource, have been used to measure the value that the animal puts on the resource. Hutson (1992) found that pre-parturient sows worked harder on the basis of lever lifting to gain food than access to straw. Consumer demand theory has been used with preference testing to put a value on the

animal's choice (Dawkins, 1983): The strength of motivation ("need") for a resource can be measured through the animal's willingness to consume ("work" for) the resource as the "price" of the resource increases. Thus, by measuring consumption at increasing prices, needs can be classified as necessities where the animal works harder to maintain consumption (called an inelastic demand function) or luxuries where the animal does not maintain consumption by working harder (elastic demand function). Using this approach needs can be ranked in terms of their demand functions.

Preference or choice testing has been criticised on several grounds and further research, not only on methodological issues, but also on understanding the principles underpinning the animal's decision is required (Lawrence and Illuis, 1997). For example, one of the most serious challenges to this approach is that an animal's short term choice may reflect its proximate (immediate) needs, which are likely to vary markedly over time, rather than the animal's ultimate needs or those necessary for survival, growth and reproduction (Lawrence and Illius, 1997). For example, since an animal's choice between feed and space will be markedly affected by short term changes in hunger, the choice of space is more likely immediately after feeding rather than later.

Nature

The principle underlying this approach is that animals should be raised in "natural" environments and allowed to behave in "natural" ways. This approach is reflected in the much quoted proposal that has been incorporated into the "five freedoms" requirement for animals: animals should have the "freedom to perform most types of natural behaviour" (Webster and Nicol, 1988). However, of all the approaches to assess welfare, the nature approach has least scientific credibility because it fails to define both "natural" and the welfare risks if such "natural" conditions are not provided.

The view that animals should perform their full "repertoire" of behaviour was common in early welfare research, but there a number of shortcomings as a criterion for animal welfare (Dawkins, 1980). "Wild" behaviour often represents an animal's efforts to survive in a life and death struggle and therefore many of these responses are adaptations to cope with extreme adverse situations. Such situations clearly reduce animal welfare and are thus situations from which domestic animals should be spared. Furthermore, mortality rates are generally higher in wild populations than in domestic ones. For example, piglet mortality in the wild boar (*Sus scrofa*) often exceeds 25% (Kirkwood *et al.*, 1987), a situation that clearly would be unacceptable in commercial pigs. Thus the "natural behaviours" that are desirable or undesirable in terms of animal welfare require definition together with the rationale for their inclusion or exclusion. To date there are no such agreed definitions or rationales.

The more general idea that we can improve animal welfare by respecting the "nature" of animals is intuitively appealing. However modern domestic animals are the product of thousands of generations of selective breeding and consequently the behaviour and physiology of domestic animals have been modified during domestication (Mills *et al.*, 1997). While the behaviour of domestic animals in wild or semi-wild conditions is often similar to their wild relatives, there are differences in the behavioural response to a number of stimuli such as sexual stimuli, novel stimuli, humans and environmental conditions (Craig, 1981; Broom and Johnson, 1993).

Homeostasis

The definition of animal welfare that underpins this approach is "The welfare of an individual is its state as regards its attempts to cope with its environment" (Broom, 1986). In this definition, the "state as regards attempts to cope" refers to both how much has to be done by the animal in order to cope with the environment and the extent to which the animal's coping attempts are succeeding. Attempts to cope include the functioning of body repair systems, immunological defences, physiological stress response and a variety of behavioural responses. Therefore, using such a definition, the risks to the welfare of an animal by an environmental challenge can be assessed at two levels: firstly the magnitude of the behavioural and physiological responses and secondly the biological cost of these responses (Barnett and Hutson, 1987; Broom and Johnson, 1993; Hemsworth and Coleman, 1998). These behavioural and physiological responses include the stress response while the biological cost includes adverse effects on the animal's ability to grow, reproduce and remain healthy.

A subtle but important component of this approach is that welfare is considered within the concept of biological fitness (Fraser and Broom, 1990; Broom and Johnson, 1993; Hemsworth *et al*., 1996). This concept of biological fitness generally applies to natural populations and refers to "fitter" animals having a greater genetic contribution to subsequent generations (Pianka, 1974); this is based on their abilities to successfully survive, grow and reproduce. While the last attribute may not always apply to individual farm animals since reproduction is either controlled or absent for many farm animals, the ability to grow, survive and reproduce could be considered measurements of "fitness" within the limits of the management system. Most production systems in agriculture have breeding and growing components and these can generate considerable data on reproductive success of individuals. For example, conception rates and mortality, morbidity and growth of offspring can be used as a measure of "fitness". Similarly, Beilharz and Zeeb (1981) and Beilharz (1982) have linked reproductive performance of domestic species with welfare.

An attribute of the "homeostasis" approach that affords this approach credibility within scientific circles is that it contains some widely accepted criteria of poor welfare. Furthermore, there are some excellent examples of the value of this "homestasis" approach in assessing animal welfare (Hemsworth and Coleman, 1998). For example, handling studies on both young and adult pigs have shown that fearful pigs have a sustained elevation of plasma free corticosteroid concentrations (Hemsworth and Barnett, 1991; Hemsworth *et al*., 1981, 1986). The consequences of this chronic stress response in these fearful animals include depressions in the growth and reproductive performance (Hemsworth and Barnett, 1991; Hemsworth *et al*., 1981, 1986).

A counter argument is that this example involves extreme effects and our current knowledge may not allow detection of more subtle or less serious risks to welfare. This example clearly demonstrates the consequences of animals failing to cope with an environmental change: such biological changes and biological costs for the animal clearly enable the interpretation with some considerable degree of confidence that the welfare of these animals was seriously compromised. Nevertheless, less serious challenges should be reflected in biological changes, admittedly of lower magnitude, with consequent effects on fitness variables such as

growth, reproduction, injury and health. Short term challenges can also be studied with this approach. Lay *et al.* (1992) studied the behavioural and physiological responses of cattle to two branding procedures to assess the relative aversiveness of the procedures and Hemsworth *et al.* (1996) utilised behavioural and physiological responses together with growth performance to assess the welfare implications of a husbandry procedure regularly imposed (daily injections) on pigs.

Repetitive and stereotyped behaviours are part of the biological response of animals to a long term challenge and it is appropriate to consider stereotypies within the homeostasis approach to welfare assessment. Stereotypic behaviour can be defined as those behaviours that consist of morphological identical movements that are regularly repeated, have no obvious function, or are unusual in the context of their performance (Cronin *et al*., 1986). Examples of these behaviours are bar biting, sham chewing, head weaving and excessive drinking.

There has and continues to be considerable controversy on the causation and function of stereotypies in farm animals. A brief review of some of examples from the literature demonstrates this controversy. Excessive chain manipulation by sows is a stereotypy seen in gestating sows housed on tethers and Terlouw *et al*. (1991) have shown that food restriction contributes to the development of this stereotypy. The authors have postulated that the appetitive behaviour of foraging may persist and develop into a stereotypy in these sows because these appetitive sequences are positively reinforcing and there is also insufficient negative feedback from the consummatory behaviour (feeding) and its functional components (food). Unavoidable fear or stress and barren and restrictive environments have also been implicated in the development of other stereotypies. Mason (1991) refers to examples of body-rocking in mentally handicapped patients when distressed and where the incidence of stereotypies increases with increasing confinement. Cooper and Nicol (1991) have proposed that some forms of stereotypies reduce responses to aversion by affecting the animal's perception of the situation. Thus it is clear that different forms of stereotypies may have different causes, such as frustration, stress and lack of control and stimulation, however our understanding of the motivational basis of stereotypies is poor.

A similar controversy exists in relation to the function of stereotypies. Based on early evidence of associations between stereotypies and physiological signs of coping such as reduced corticosteroid concentrations, reduced adrenal gland weights and reduced ulceration, there is a view that stereotypies may be a coping response. However more recent studies and re-interpretation of some of the early evidence, questions this general coping hypothesis for at least some forms of stereotypic behaviours (Mason, 1991; Rushen, 1993). Furthermore, while some evidence exists to indicate that stereotypies may be coping mechanisms in the short term, it is unknown whether they exert benefits in the long term. Irrespective of the function of stereotypies, the existence of a stereotypy is indicative at the least of a past problem for the animal in coping with its conditions. Stereotypies that result in physical damage to or illness in the animal (e.g. the development of lesions in stall-housed sows that persistently rub their tail roots from side to side against stall fittings or wind-sucking in horses where persistent wind-sucking can lead to gastrointestinal catarrh and colic) have obvious and immediate implications for the welfare of farm animals. Thus stereotypies should not be used alone to assess risks to animal welfare: they should be used together with other biological responses and consequent effects on biological fitness.

Conclusions on welfare assessment

With our present knowledge, the "homeostasis" approach appears to offer science the best assessment of the welfare of animals. As a research tool, this approach involves comparing housing or husbandry systems and risks to welfare are assessed on the basis of relative changes in biological (behavioural and physiological) responses and corresponding decreases in fitness. Assessing motivation using preference testing has the potential to measure the animal's important underlying needs, and thus provides a valuable addition to the homeostasis approach in studying animal welfare.

In the future, there are obvious opportunities to integrate the "feelings" approach within the "homeostasis" approach. If we accept that emotions in animals are important adaptive responses that assist survival, it is an easy step to recognise that the visceral or bodily arousal, the cognitive processes and the associated sensation of the emotion are part of the animal's biological response to the challenge. Indeed, Broom (1998) considers that emotions may have some adaptive advantage such as acting as a reinforcer, which makes it more likely that the individual will learn to carry out the adaptive action. Further indication of the adaptive function of emotions is that they can modulate memory formation in several ways (Reisberg and Heuer, 1995). Studies principally on laboratory rodents have shown that a fear-provoking stressor, presumably via its effects on hormones in the sympathetic-adrenomedullary axis and hypothalamic-pituitary-adrenal axis, may play an important role in memory formation and recall (Mendl, 1999). Some of these effects can be viewed as having adaptive value in helping the organism to search, scrutinise and remember threatening stimuli or situations.

Along similar lines, Wiepkema (1985) proposed that feelings or emotions are involved in monitoring the effectiveness of regulatory actions, being positive when the regulation is successful (homeostasis is achieved) and negative when it is not. Spruijt and von Frijtag (1999) similarly consider an emotion, such as pleasure or anxiety, as a functional state of the organism induced by specific signals which rapidly organize response systems (approach or avoidance) relevant to broad categories of relevant stimuli. Interestingly, Spruijt and von Frijtag (1999) have extended this general view by suggesting that the animal's tolerance or sensitivity to rewarding and aversive stimuli may be closely related to the state of the animal in terms of welfare. In fact, the authors have proposed that, together with neurobiological knowledge, an increased insight into the welfare of the animal can be gained by measuring the anticipatory behaviour of the animal for rewards in a Pavlovian conditioning paradigm: animals deprived of essential stimuli react more readily not only to stimuli that they are deprived of but also rewarding and aversive stimuli in general.

Such philosophical discussions accompanied by experimental validation will assist in further developing the concept of welfare. These attempts to conceptualise animal welfare will lead to further development and refinement of the methodology to study animal welfare. This limited discussion on integrating the two research approaches, the feelings and homeostasis approaches, demonstrates not only how the concept of welfare has and will continue to develop, but that increased agreement amongst scientists on the concept of welfare will lead to greater consensus on ways to study animal welfare. With our present knowledge, the most scientifically credible approach to welfare assessment involves measuring the magnitude of the biological responses to the challenge and also the consequences of these behavioural and physiological responses on the animal's ability to grow, reproduce and remain healthy.

Information on the animal's preferences for resources should provide valuable information complementing this approach.

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LITERATURE REVIEW ON 'FURNITURE' IN CAGES

Introduction

The following review is largely based on a review by Barnett and Newman (1997) and a quick review of more recent literature. While there is often a focus on particular methods of production, particularly intensive animal production, it must also be borne in mind that there is a recognition that no housing system, whether cage or non-cage systems, meets all aspects of welfare and production criteria (Elson, 1992; Craig and Swanson, 1994; Gerken, 1994) and thus poultry production, as for any animal production system, involves a series of compromises that impact on welfare, production and economics. While there appears to be an inability of scientists and others to agree on the need for non-cage systems (e.g. see Carter and Carter, 1992), alternative housing systems are being actively promoted in some countries. For example, Switzerland has banned the cage, Sweden was due to ban cages in 1999 (now to be 2002), the EU is to ban conventional cages from 2013, The Netherlands have been encouraging producers to use non-cage systems and in the UK, Australia and New Zealand, marketing initiatives surrounding programmes such as 'Freedom Foods' preclude the use of conventional cages. While it is sometimes difficult to fully understand the motives for some of these initiatives, as they are often a complex intermingling of economics, public perceptions and political expediency, there is a desire either to improve the welfare of birds or remove the issue from the political agenda. Some Australian producers recognise the 'pressures' on conventional cage housing and are pursuing alternatives to the conventional cage e.g. barn systems with the 'Freedom Foods' concept being applied to egg production and marketing in Australia.

Overseas, the proponents of alternatives to conventional cages are in two main camps: Those proposing non-cage systems and those proposing furnished cage systems (i.e. cages that may include perches, dust baths and nest boxes). Again, these persuasions can be affected by the political agenda. For example, in Sweden where conventional cages are to be banned, there has been on-going research on non-cage alternatives (Tauson *et al.,* 1992; Abrahamsson and Tauson, 1995). Nevertheless, as Sweden does not permit beak trimming, the performance and welfare of birds in the non-cage systems (in the above studies) is poorer than in cages. The result is support, by default, for furnished cages as an acceptable alternative to the conventional cage (Tauson and Abrahamsson, 1994; Tauson, 1995) and in the UK, where enriched modified (furnished) cages were developed (Appleby, 1993*b*; Hughes and Sherwin, 1994) there appears to be considerable support for this system(s). Also, on the basis that the five freedoms (see Appleby 1991) prescribed in 'Freedom Foods' (UK, RSPCA marketing initiative, see above) cannot all be met in conventional cages (Appleby, 1993*a*; Baxter, 1994), this tends to lend support for furnished cages. However, it must be recognised there is some circularity in this latter argument as included in the five freedoms concept is the perception that close confinement is unacceptable. In the USA the welfare pressures on the laying industry appear less than in Europe (see Craig and Swanson, 1994).

There has been considerable research on modifying conventional cages. This has included simple modifications such as inclusion of a perch to reduce the risk of bone breakage by increasing bone strength or volume (Appleby *et al.,* 1992b; Abrahamsson and Tauson, 1993; Hughes *et al.,* 1993; Sherwin, 1993; Wilson *et al.,* 1993; Alvey and Tucker, 1994; Fleming *et al.,* 1994), an abrasive strip to maintain claw length to reduce the risk of entrapment, based on the work of Tauson (1986a; Niekerk and Reuvekamp, 1994) or modifying cage fronts, by

having horizontal bars to increase concurrent feeding behaviour (Sherwin *et al.,* 1993; Tanaka *et al.,* 1993). There are more sophisticated systems that also include nest boxes and/or dust baths, to provide birds with the opportunity to perform nesting and dust bathing behaviours (Nicol, 1992; Petersen, 1992; Reed and Nicol, 1992; Sherwin and Nicol, 1992; Appleby *et al.,* 1993, 1994; Hughes and Sherwin, 1994; Sherwin, 1993; Reed, 1994; Petherick *et al.,* 1995). The welfare implications of some of these furniture items are reviewed below.

Nest boxes and dust baths

The review by Ekstrand and Keeling (1994) provides evidence they believe supports the inclusion of nest boxes in cages i.e. furnished cages. Duncan (1992) considers the lack of a nest site in conventional cages is the biggest welfare problem in this system of housing. The importance of the nest box is based on evidence of preference tests and evidence of frustration in the absence of a nest box (see review by Ekstrand and Keeling, 1994) and the strong motivation of hens to use a nest (Smith *et al.,* 1990; Freire *et al.,* 1997). The latter studied also showed that encountering an unfamiliar or dominant hen on the way to a nest is aversive. While nest usage in furnished cages appears high (see below) this may have implications for nest usage, particularly in non-cage systems. Cooper and Appleby (1995) have considered the controversy as to whether animals can be frustrated or experience a sense of deprivation by not having certain resources they have never experienced. For nesting, they found no differences in the motivation of birds to use a nest between birds previously experienced or inexperienced with a nest, although it is not known if this leads to chronic frustration. However, Hughes *et al.* (1994) showed that naive birds did not recognise a visual stimulus with some features of a nest, although it must be recognised that the birds in this study were unable to physically interact with the 'nest'. A study by Webster and Hurnik (1994) suggests that birds may synchronise their behaviours within cages and this may have welfare implications if nest sites are limited. As birds perform nesting behaviours in cages that do not have nests and reproductive performance (one important indicator of welfare) in cages is high, it is likely that the need to provide nest boxes will remain controversial until the adverse consequences of not having a nest can be demonstrated. On current scientific evidence there is no demonstrable welfare benefit, on the basis of improved fitness (see Appendix 2), from incorporating nests into cages as recommended in the EU Directive.

While there has been considerable work on nest boxes, there are no current clearly accepted design recommendations that satisfy both the hen and industry requirements. Aspects examined have been nesting material where a preference was shown for artificial-turf nests over roll-away nests or those with litter (Appleby *et al.,* 1993), nest floor preferences (plastic floors were preferred although there was no aversion to wire floors; Sherwin and Nicol, 1994), nest design (closed nests were preferred to open nest; Walker and Hughes, 1998) and size and quantity of nests, nest height, nest floor surface and nest partitions (Reed, 1994). The latter author has provided design recommendations on a nest/cage design for 4 birds: Three nests were incorporated at the rear of the cage, in the form of pre-moulded, roll-away, plastic, flat-floored nests with hollows (25 x 31 cm/nest) and with the floors flush with the cage floors. Attractiveness was enhanced by lining the hollows with smooth neoprene rubber. To compensate for the lack of a peckable substrate, strips of artificial grass were attached to the rear of each nest. A perch was provided to reduce nest soiling. Nevertheless, in spite of the above recommendations, the problems to be overcome include laying eggs outside of nest boxes, the higher incidence of cracked eggs and using the nesting material, when it is provided, for a dust bath. The problem of roosting in the nest boxes and their subsequent

soiling has been solved by nests being available that can be automatically closed to exclude (and push out) birds.

To reduce the use of the nest box as a dust bath, dust baths have generally been provided in furnished cages although the welfare evidence for their inclusion appears less than for nest boxes. For example, Petherick *et al.* (1993) suggest birds are not highly motivated to dustbathe, while Liere (1992) suggests that dust baths are essential to maintain feather integrity and for welfare. Notwithstanding any possible direct effects of dust baths on welfare, dust baths appear to increase the effectiveness of nest boxes, by separating nesting and dust bathing behaviours to different areas of the cage. Studies have shown that hens do not make any great effort to obtain access to litter or sand (Faure, 1991; Faure and Lagadic, 1994), although they prefer litter to wire mesh (Lagadic, 1992). In experiments with young chickens, Sanotra *et al.* (1995) indicate a risk of pathological feather pecking when straw or wood-shavings are used as a substrate, although Norgaard-Nielsen *et al.* (1993) showed that rearing with access to sand or peat reduced subsequent feather pecking and that access to straw, as an environmental enrichment, during the layer phase also reduced feather pecking. Rudkin (1996) has also shown positive effects of hay, both during rearing and the laying period in reducing feather pecking. Other forms of environmental enrichment such as adding objects to feed troughs are considered to improve welfare (Sherwin, 1995) and coloured plastic enrichment devices placed in cages reduced mortalities through a redirection of pecking behaviour (Bell *et al.*, 1995). If these enrichment devices are practical, they may be a simple way of reducing mortalities. On the basis of fitness (see Appendix 2) there appears to be no scientific evidence that incorporating dust baths into cages, as recommended in the EU Directive, will improve bird welfare. However, there may be welfare benefits, on the basis of increased fitness from reduced mortalities, from incorporating certain enrichment devices into cages.

Perches

There has been a comprehensive review of perches in conventional cages (Ekstrand and Keeling, 1994). These authors concluded that, because of the potential benefits of perches in relation to increasing leg bone strength, reducing feed intake and keeping birds calmer, and their low cost of installation, cages should contain a suitable perch. However, the perch has to be correctly positioned, although the data are equivocal and there is still the risk of bone breakage during the depopulation process. Abrahamsson and Tauson (1993) suggest that perches should be 17 cm from the back rather than centrally placed (24 cm from the back) to improve cage hygiene without restricting bird movement. However, Alvey and Tucker (1994) showed reduced bone breakages on depopulation when perches were 18 vs 13 cm from the back of the cage (cage dimensions were not reported). In the latter study, the presence of perches had no effect on the strength of the tibia. Thus, while the mechanism for reducing bone breakages is unclear, Knowles *et al.* (1993) have shown a reduced risk of bone breakages (from birds in cages) in birds with stronger bones. Also, to add to the confusion in the literature, birds reared up to 18 weeks of age in cages had stronger humeri bones and fewer broken bones at the end of lay compared to floor reared birds (Gregory *et al.* 1991).

A study by Barnett *et al.* (1997a) confirmed that perches (21 and 24 cm from the back and front of the cage, respectively) resulted in increased strength of the tibia and also resulted in increased dirty and cracked eggs (Glatz and Barnett, 1996). While placing the perch further back in the cage may reduce the incidence of dirty eggs, most studies agree that the incidence of cracked eggs is increased. An economic assessment of the production data from this

experiment based on the variable, egg income minus feed costs showed that perches on their own reduced the financial return compared to conventional cages (financial returns were 1.49 vs 1.52 cents/bird/day) although if solid sides were also included in the cage returns were improved (1.68 cents/bird/day) (Barnett *et al.*, 1997b). Further validation of this economic analysis of perches in cages under Australian conditions is required if the welfare advantages of incorporating perches into cages are to be maximised by industry. As mentioned previously, the risk of bone breakage is still generally apparent when cages are depopulated, notwithstanding the presence of a perch. Removing birds from cages by both legs significantly reduced the percent of femur breakages from 7.4 to 0.6 % of birds (Gregory *et al.*, 1992) and if validated in the Australian industry should be a recommended procedure during depopulation. Other factors such as lighting regimes have not affected bone strength (Gregory *et al.*, 1993), while using drugs (bisphosphonates) developed for treatment of osteoporosis in humans improve bone morphology (Thorp *et al.*, 1993) and a study by Koelkebeck *et al.* (1993) showed an increase in bone strength by providing carbonated drinking water during warm weather. Also, the relationships between diet, growth rate, egg production and osteoporosis, being developed into a model of osteoporosis by Parkinson *et al.* (1996), should result in practical methods of dietary manipulation to reduce the incidence of osteoporosis. Innovations such as these should be researched to help minimise the impact of low bone strength on bird welfare.

Current recommendations for perches are for elliptical wooden perches with flattened tops and bottoms (vertical cross section of 3.1 cm and horizontal cross section of 3.6 cm) installed 17 cm from the back of a 48 cm deep cage and 7-7.5 cm above the floor and with sufficient perch space (15 to 18 cm per hen, although Appleby (1995) indicates 14 cm is adequate for medium weight hybrids) so that all birds can perch simultaneously. This shape of perch reduces the incidence of bumble foot compared to rectangular perches. Plastic perches increase the incidence of bumble foot (Oester, 1994). In the study of Glatz and Barnett (1996) where rectangular perches were used, the foot condition, which was subjectively assessed using the 4 point scoring system of Tauson (1984), was worse in cages with perches, but the differences were only small (3.6 *v*. 3.8 for birds in cages with and without perches, respectively).

Based on the physiological benefits to fitness (see Appendix 2) of perches, and notwithstanding some potential production problems, they should be incorporated into cages.

Conclusion

While many of the practical problems of nest boxes and dust baths have been overcome, furnished cages appear to require some development prior to their introduction into the commercial industry. Studies have been conducted in the UK and studies are continuing in Sweden. In a UK study (Appleby, 1998) the only problem encountered was an outbreak of red mite and some labour and potential equipment issues associated with the use of sand in the dust bath. Egg production and mortalities were similar to conventional cages and there was an improved physical condition of the birds on the basis of feather condition, claw length and foot condition in furnished cages; 94 % of eggs were laid in the nest. In Sweden hens in furnished cages compared to conventional cages had more cracked eggs and fewer dirty eggs, better plumage condition, shorter claws, a stronger humerus and dirtier feet; 86 % of eggs were laid in the nest (Abrahamsson and Tauson, 1997). It has been estimated (Elson, 1994) that these modifications will increase egg production costs by 10-20 % over conventional

cages. Also, surveys of public opinion suggest that modified cages are only slightly more acceptable than conventional cages (Rogers, *et al.*, 1989) and this needs to be taken into account in a cost benefit analysis for the Australian industry, although as indicated by Duncan (1992) more focus should be put on bird welfare rather than public perceptions.

Notwithstanding the above statements regarding the incorporation of nest boxes, perches and dust baths into cages, reports indicate better physical condition (Appleby, 1998; Abrahamsson and Tauson, 1997) and either no differences in mortality (Abrahamsson and Tauson, 1997) or a lower mortality (Tauson and Abrahamsson, 1996) of birds in furnished cages that incorporate all 3 items of furniture. Thus, there may well be an interaction between the items of furniture that improves fitness and this apsect requires further research.

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PHOTOGRAPHS OF ALTERNATIVE EGG PRODUCTION SYSTEMS
(Most of the photographs were provided by Brian McErlane)

Aviary Systems

Birds in an aviary.

Birds in an aviary.

Birds in an aviary.

Birds in an aviary
(birds at ‘ground’ level)

Pullet rearing in an aviary

Free Range Systems

Birds being let out of a barn.

Free range from barn showing area of ‘fill’ next to shed and non-trimmed birds.

Free range showing electric fence.

Free range from a 15 year old barn shed.

Free range.

Free Range Systems cont.

Free range with ‘shelters’ attached to shed.

‘Foot scrapers’ at entrance to ‘pop-holes’.

Furnished Cages