February 2021

Scientific briefing on caged farming

Overview of scientific research on caged farming of laying hens, sows, rabbits, ducks, geese, calves and quail

COMPASSION in world farming

Contents

I. Overview

The intensive farming of animals in cages is a relatively recent phenomenon, having developed since the end of World War 2. Over recent decades, the increasing use of cages has enabled the keeping of many more animals in ever more intensive systems. This has facilitated the vastly increased consumption of meat, dairy and eggs compared with plant-based foods, as these products transitioned from being consumed in moderation to being abundantly available and at relatively low cost to consumers. Yet, today there is a global awareness that production and consumption of animal-based foods needs to urgently reduce to limit irreversible environmental damage and to provide a sustainable food system. In addition, there is now a wealth of scientific evidence that cages are severely detrimental to animal welfare; and EU citizens, increasingly aware of intensive farming systems, demand change.

Nearly 1.4 million European Union citizens recently signed the 'End the Cage Age' European Citizens' Initiative, which calls on the European Union to end caged farming. This is the first valid Initiative[1] for farmed animals to pass the target of one million verified signatures required to trigger a response from the European Commission.

This report aims to inform policy-makers of the latest scientific evidence regarding the impact of caged farming on animal welfare and regarding health, welfare and production in cage-free systems.

Space allowances

European farm animal legislation requires that:

> *"Where an animal is continuously or regularly tethered or confined, it must be given the space appropriate to its physiological and ethological needs in accordance with established experience and scientific knowledge"*[2].

No cage system yet devised provides sufficient space to provide for the ethological needs of any farm animal.

Sows kept in stalls or farrowing crates are so restricted they cannot even turn around. Rabbits are sometimes unable to stretch up or out fully and generally do not have enough space to perform a single hop[3]. Quail have insufficient vertical space to perform their natural escape behaviour, so they hit their heads on the roof[4]. Lack of space restricts play in calves which is important for their social and mental development[5]. Even an "enriched" cage for hens, given its 45cm height, provides insufficient vertical space for wing flapping[6] and prevents the birds from perching high.

Proper exercise, whether walking, running, jumping, swimming or flying, is severely restricted and often impossible for all animals kept in cage systems.

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1 Compassion in World Farming, 2021. 'End the Cage Age' European Citizens' Initiative for Farmed Animals. https://www.ciwf.eu/impact-to-date/end-the-cage-age-european-citizens-initiative-for-farmed-animals/

2 European Commission, 1998. Council Directive 98/58/EC on the protection of animals kept for farming purposes. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31998L0058

3 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to The EFSA Journal, 267: 1-31.

4 Gerken, M; Mills, AD (1993) Cited in: Buchwalder, T; Wechsler, B (1997) The effect of cover on the behaviour of Japanese quail (Coturnix japonica). Applied Animal Behaviour Science, 54: 335-343.

5 Jensen, M.B., Vestergaard, K.S., Krohn, C.C. and Munksgaard, L. (1997) Effect of single versus group housing and space allowance on responses of calves during open-field tests. Applied Animal Behaviour Science. 54, 109-121.

6 Mench, J.A. and Blatchford, R.A., 2014. Determination of space use by laying hens using kinematic analysis. Poultry Science, 93(4), pp.794-798.

Figures 1 and 2: Lack of space in a cage severely restricts even the most basic natural behaviours

Other species-specific needs

A wide range of other species-specific ethological needs are not, or cannot be, provided in a cage, enriched or otherwise.

Sows are unable to nest build in a crate[7] or to leave their lying area to urinate or defaecate in either a stall or a crate. Hens do not have sufficient space or appropriate material to dust bathe[8]. None of these animals are able to perform normal foraging behaviours. Individually-penned calves are unable to engage in close body contact.

Fearfulness

Caged hens are more fearful[9]. They are commonly unable to escape to a perceived safe distance when stockpeople enter their flight zones. Rabbits and quail are unable to hide. Ducks kept for foie gras are of a "nervous" strain and are subjected to aversive force-feeding procedures[10]. None of these animals are able to escape from aggression, feather pecking or any other unwanted attentions from their companions. Penned calves are more fearful than those kept in groups[11] and have impaired mental and social development.

Alternative systems

Alternative systems for keeping these farm animals are already used widely. Since 2019, the majority of hens kept commercially in the EU have been in alternative systems, whether barn, free range or organic[12]. The enriched cage is banned in Luxembourg, Austria and Switzerland; Germany and the Czech Republic have legislated to ban all cages for hens in the coming years. In Slovakia, industry and the Ministry have signed a Memorandum of Understanding to phase out enriched cages by 2030. In late 2020, Danish and Dutch Parliaments voted in favour of motions to end the use of cages for hens.

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7 EFSA 2007. Scientific Opinion of the Panel on Animal Health and Welfare on a request from the Commission on Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. The EFSA Journal (2007) 572, 1-13

8 Riddle, E.R., Ali, A.B., Campbell, D.L. and Siegford, J.M., 2018. Space use by 4 strains of laying hens to perch, wing flap, dust bathe, stand and lie down. PloS One, 13(1), p.e0190532.

9 Rodenburg, T.B., Tuyttens, F.A.M., De Reu, K., Herman, L., Zoons, J. and Sonck, B., 2008. Welfare assessment of laying hens in furnished cages and non-cage systems: an on-farm comparison. Animal Welfare, 17(4), pp.363-373.

10 Rochlitz, I. and Broom, D.M., 2017. The welfare of ducks during foie gras production. Animal Welfare, 26(2), pp.135-149.

11 Jensen, M.B., Vestergaard, K.S., Krohn, C.C. and Munksgaard, L. (1997) Effect of single versus group housing and space allowance on responses of calves during open-field tests. Applied Animal Behaviour Science. 54, 109-121.

12 European Commission, updated 2021. Eggs market situation dashboard. https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/eggs-dashboard_en.pdf

In Sweden, along with Switzerland, Norway and the UK, alternatives to both sow stalls and farrowing crates are widely used. All have banned the sow stall; Sweden, Switzerland and Norway have also banned routine use of the farrowing crate; and free-farrowing systems are used for over 40% of UK sows. Germany has legislated to ban the sow stall entirely and for a partial ban on the farrowing crate.

Belgium farms nearly 3 million rabbits per year[13]. Since the ban on all forms of rabbit cages in 2016, almost all Belgian growing rabbits have been kept in alternative systems such as "parks" or elevated pens; complete phase out is due by 2025 and is already almost achieved. In most EU countries which rear them, meat quail are kept in barns and there are a range of cage-free systems used commercially for laying and breeding quail. The great majority of EU countries, for which there is data, keep a substantial proportion of calves in group systems[14]; 22% were kept this way according to research covering Western Europe[15].

The keeping of ducks and geese for foie gras production is perhaps an exception to the rule that humane alternatives exist for all cage systems since the process of force feeding itself is inherently aversive and results in hepatic steatosis[16]. However, a range of fatty liver products are produced without caging or force feeding, even if they do not meet the legal definition of "foie gras".

It is objected that some alternative systems come with their own set of health and welfare problems. Indeed, there can be welfare issues in any farming system, especially if the management is poor or the breeds used lack robustness. However, there are alternative systems for all of these species which have the **potential** to provide for their ethological needs and which can be designed and managed to deliver good health and welfare. By contrast, cages, due to their inherent physical and behavioural restriction, **cannot** provide good welfare, no matter how good the management. As such, efforts and expenses invested in attempting to optimise health and welfare in cages are an inefficient use of resources and will not result in acceptable welfare or compliance with Directive 98/58/EC. Instead, such resources should be redirected to cage-free systems which have the potential for compliance with EU legislation and to deliver good health and welfare.

Indeed, much knowledge and experience exists on how to deliver good health and welfare in cage-free systems. For example, we document a wide range of measures to minimise the risk of injurious pecking or keel-bone damage in laying hens kept in alternative systems. We also describe many of the strategies which are successfully used to reduce aggression amongst recently weaned dry sows, especially during feeding and mixing. A wide range of alternatives to the farrowing crate have been developed to reduce piglet crushing[17]; indeed total piglet mortality (stillborn as well as live-born) from all causes is usually *lower* in free-farrowing systems compared to crates[18].

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13 European Commission, DG (Sante), 2017. Overview Report – Commercial Rabbit Farming in the European Union. https://ec.europa.eu/food/audits-analysis/overview_reports/act_getPDF.cfm?PDF_ID=1193

14 Marcé, C., Guatteo, R., Bareille, N. and Fourichon, C., 2010. Dairy calf housing systems across Europe and risk for calf infectious diseases. Animal, 4(9), pp.1588-1596.

15 Calculated from Marcé et al, 2010, op cit

16 Rochlitz, I. and Broom, D.M., 2017. The welfare of ducks during foie gras production. Animal Welfare, 26(2), pp.135-149.

17 Baxter et al, 2012. Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs." Animal 6.01 (2012): 96-117

18 Gu, Z., Gao, Y., Lin, B., Zhong, Z., Liu, Z., Wang, C. and Li, B., 2011. Impacts of a freedom farrowing pen design on sow behaviours and performance. Preventive veterinary medicine, 102(4), pp.296-303.

Levels of disease can be controlled in group-housed calves through such measures as providing good ventilation[19], ensuring good colostrum intake[20], and keeping groups stable and small[21]. Cross sucking can be controlled by ensuring calves have enough to eat[22] and that they can consume it *ad lib* at a naturally slow rate from a teat[23] [24]. Similarly, with good system design and management, commercial cage-free rabbit systems can achieve low levels of mortality[25].

Crucially, health and welfare in alternative systems improve as farmers gain experience in managing them. For example, recent research shows continued linear reductions in mortality over time in cage-free systems for laying hens due to improving husbandry, such that mortality is no longer significantly different compared with conventional systems[26].

Given the extensive research and experience available, as documented in this report, on how to design and manage cage-free systems, the ongoing trend of improved health, welfare and productivity for all species is expected to continue and accelerate as more farmers implement established research and best practice.

In conclusion

Extensive scientific research demonstrates that the welfare needs of farm animals, as required by the EU Farming Directive 98/58/EC[27], cannot be met in caged systems. Commercial alternatives exist which can meet these needs for all species farmed. Welfare issues can exist in all farming systems but, unlike in cages, these can be properly addressed in cage-free systems through good design, breeding and management.

Caged systems should be phased out promptly, with programmes put in place to share best practice and to ensure that alternative systems achieve their high welfare potential.

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[19] van Leenen, K., Jouret, J., Demeyer, P., Van Driessche, L., De Cremer, L., Masmeijer, C., Boyen, F., Deprez, P. and Pardon, B., 2020. Associations of barn air quality parameters with ultrasonographic lung lesions, airway inflammation and infection in group-housed calves. *Preventive Veterinary Medicine*, p.105056.

[20] Besser, T.E. and Gay, C.C., 1994. The importance of colostrum to the health of the neonatal calf. *Veterinary Clinics of North America: Food Animal Practice*, *10*(1), pp.107-117

[21] Jensen, M. (2012). Welfare Related to Feeding, Housing and Health of Dairy Calves. The First Dairy Cattle Welfare Symposium, 23-26 October 2012, Guelph, Ontario, Canada.

[22] Jung, J. and Lidfors, L. (2001) Effects of amount of milk, milk flow and access to a rubber teat on cross-sucking and nonnutritive sucking in dairy calves. Applied Animal Behaviour Science. 72, 201-213.

[23] Loberg, J. and Lidfors, L., 2001. Effect of milkflow rate and presence of a floating nipple on abnormal sucking between dairy calves. *Applied Animal Behaviour Science*, *72*(3), pp.189-199.

[24] Herskin, M.S., Skjøth, F. and Jensen, M.B., 2010. Effects of hunger level and tube diameter on the feeding behavior of teat-fed dairy calves. *Journal of dairy science*, *93*(5), pp.2053-2059.

[25] eg Compassion in World Farming (2015) Case study: Group housing for does. https://www.compassioninfoodbusiness.com/media/7427861/kani-swiss-case-study-on-group-housing-for-does.pdf

[26] Schuck-Paim, C., Negro-Calduch, E. and Alonso, W.J., 2021. Laying hen mortality in different indoor housing systems: a meta-analysis of data from commercial farms in 16 countries. Scientific Reports, 11(1), pp.1-13.

[27] European Commission, 1998, op cit.

II. The need to end the use of cages in EU laying hen production

Enriched cages, 'combination' cages and restricted access systems have inherent, severe disadvantages for hen welfare. Combination and restricted access systems are also not compatible with the definition of cage free. Extensive scientific reviews demonstrate that only non-cage systems provide the possibility for hens to express their full behavioural repertoire.

Scientific research, including reports by the European Commission's Scientific Veterinary Committee[28] and by the European Food Safety Authority[29], has established that hens have powerful drives to lay their eggs in a nest, peck and scratch in the ground (foraging behaviour), dust bathe, perch and perform wing-stretching and flapping. There are negative welfare impacts if these cannot be performed.

The enriched cage was intended to permit these behaviours, but there is insufficient space, both horizontally and vertically, to allow for the different resources which would enable this range of behaviours to be performed. To avoid the risk of high dust levels, the provision of foraging material is commonly minimal and the litter provided is unsuitable for dust bathing. Scientific research has proven that it is not possible to provide for the needs of hens in a commercial cage system. In light of the abundant evidence, several European countries have moved away from caged systems for hens.

All cage systems for hens are banned in Austria, Luxembourg and Switzerland. In Germany enriched cages will be banned in 2025, in Czechia by 2027 and in Slovakia, following a memorandum between the Ministry of Agriculture and industry, by 2030. France has banned the building of new cage systems and the refitting of old ones; and the French President has announced that by 2022, all shell eggs sold in French supermarkets will have to be free range and that the government will financially support this transition. In November 2020, the Danish Parliament voted in favour of a bill that would ban cages for egg-laying hens; the transition period is yet to be determined as of February 2021. In December 2020, the Dutch Parliament voted in favour of a motion to phase out cages for laying hens.

Enriched cages cannot meet the needs of hens

Space

There isn't enough space in a cage to perform even the most basic behaviours. 750cm^2 is provided for each hen, but up to 1190cm^2 is required for dust bathing[30]. For the brown breeds commonly kept in the EU, 2,800cm^2 is required for wing flapping[31]. As such, sufficient space will not normally be available for these behaviours.

The height of 45cm is equally restrictive. Wing flapping requires 49.5cm[32]. Perches need a clearance below of 40cm from the ground to protect resting birds from being pecked, plus an additional 20cm above to perch comfortably without crouching.

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28 European Commission, 1996. Scientific Veterinary Committee, Animal Welfare Section. Report on the welfare of laying hens. 30 October 1996. Brussels, Belgium.

29 EFSA,2005. Opinion of the Scientific Panel on Animal Health and Welfare (AHAW) on a request from the Commission related to the welfare aspects of various systems of keeping laying hens. *The EFSA Journal* 197, 1-23.

30 Riddle, E.R., Ali, A.B., Campbell, D.L. and Siegford, J.M., 2018. Space use by 4 strains of laying hens to perch, wing flap, dust bathe, stand and lie down. *PloS One*, 13(1), p.e0190532.

31 Riddle et al, 2018, *op. cit*.

32 Mench, J.A. and Blatchford, R.A., 2014. Determination of space use by laying hens using kinematic analysis. *Poultry Science*, 93(4), pp.794-798.

To feel safe at night, birds need perches higher still. Running, jumping and flying – all common and healthy behaviours of hens – are simply not possible.

Figure 3: Enriched cage, EU.

Respite areas, escape distances and fearfulness

Caged hens are more fearful[33]. Subordinate birds cannot get away from aggression and feather pecking. When stockpeople pass by, they inevitably enter the flight zones of the birds near the front of the cage. These birds may panic but find themselves unable to get away to a perceived safe distance since other birds and cage furnishings block their way.

Comfort behaviours such as wing flapping

Comfort behaviours are very restricted. Hens need 49.5cm of height to flap their wings[34]. Therefore, in a cage, hens cannot flap their wings properly without hitting the roof. The area required to wing flap is 1,693 cm^2: over double the space provided per bird. In practice, hens need more space than this to be confident that they won't hit other birds or cage furnishings.

Unsurprisingly, a study observed virtually no wing flapping in small furnished cages, even when they tried a substantially reduced stocking density[35].

[33] Rodenburg, T.B., Tuyttens, F.A.M., De Reu, K., Herman, L., Zoons, J. and Sonck, B., 2008. Welfare assessment of laying hens in furnished cages and non-cage systems: an on-farm comparison. *Animal Welfare*, 17(4), pp.363-373.
[34] Mench and Blatchford, 2014, *op. cit.*
[35] Cooper, J.J. and Albentosa, M.J., 2004. Social space for laying hens. *Welfare of the Laying Hen*, 27, p.191.

Perching

There is not enough horizontal space for all birds to perch at once[36], so, although they are all motivated to perch at night, fewer than 75% do so[37]. There isn't enough vertical space in the cage to place a perch high enough for birds to feel safe from predation. It is not even high enough to provide refuge from feather pecking. The placement of perches impedes movement of birds around the cage; placing the perches higher reduces but does not eliminate this restriction, and requires perching birds to crouch due to lack of height between the perch and the top of the cage.

Figure 4: High perches in a cage-free system keep hens which are resting safely out of the reach of foraging hens below.

Resources for scratching and pecking

Foraging behaviour, scratching and searching, is rarely fully expressed in a cage[38]. There is no minimum space requirement in the legislation for a platform for foraging, so in practice this is often minimal, sometimes with no scratching mat provided. Even if there is a platform, only small quantities of substrate are provided and are rapidly depleted[39].

Figure 5: Scratching platform provided for foraging on with a small piece of sandpaper for claw-health. There is no minimum area required for the scratching platform. It is supposed to be supplied with substrate to encourage scratching, but no minimum quantity is specified and in this case, it would fall through if provided. Substrates which are sometimes provided are generally not suitable for dust bathing. As a result, these behaviours are not effectively provided for and nearly all dust bathing is sham dust bathing.

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36 Riddle et al, 2018, *op. cit.*

37 Platz, S., Heyn, E., Hergt, F., Weigl, B., and Erhard, M., 2009. Comparative study on the behaviour, health and productivity of laying hens in a furnished cage and an aviary system. Berl Munch Tierarztl Wochenschr. 122(7/8):235-40

38 Nicol, C. J., 1987. Behavioural-responses of laying hens following a period of spatial restriction. *Animal Behaviour* 35:1709-1719.

39 Lay, D.C., Fulton, R.M., Hester, P.Y., Karcher, D.M., Kjaer, J.B., Mench, J.A., Mullens, B.A., Newberry, R.C., Nicol, C.J., O'Sullivan, N.P. and Porter, R.E., 2011. Hen welfare in different housing systems. *Poultry Science* 90(1), pp.278-294

Litter for dust bathing

Dust-bathing behaviour is highly restricted in cages – it doesn't follow the usual diurnal pattern and is invariably incomplete[40]. Due to the lack of space, dust-bathing birds are commonly interrupted, jostled or pecked by their companions[41].

Birds dust bathe to remove stale lipids from their plumage, but the litter providedusually a feed which contains fats[42 43], through increasing levels of dust.

In the absence of proper litter and of sufficient space, most dust bathing is sham dust bathing[44], taking place on the wire floor without substrate[45].

Figure 6: Dust-bathing behaviour requires space, solid ground, freedom from disturbance and suitable litter.

Nesting

Enriched cages are provided with a darkened area for birds to nest. However, nesting material is not provided. Research shows that hens prefer to lay in nests containing loose material which can be both moulded by their body and feet movements and manipulated with their beaks during nest building[46].

'Combination' cages and limited access systems

Some EU egg producers have adopted the use of 'combination' cages. These have doors and partitions within the tiers of cages. They are designed so that they can be used either as cage systems or as barns. When the doors of these cages are shut, the birds are caged and are confined at a stocking density comparable to that associated with enriched cages. When the doors are open, producers classify the system as cage free, although the welfare conditions for hens are poorer than in genuinely cage-free systems since they are a compromise between the provisions of the two systems.

Good barn systems allow maximum freedom of movement along the tiers and between the tiers. Any hen can choose a multiplicity of routes from A to B (e.g. from scratching area to feeder, nest box or perch), enabling them to avoid aggressive birds on the way. They can also more easily access the ramps which are provided in multi-tier systems to reduce the risk of injury when moving from one level to another.

In combination systems, the partitions between the cages make it harder for hens to move along the tiers[47], potentially increasing levels of stress and the risk of accidents which can lead to keel-bone fractures. There may also be compromises in relation to the positioning of the perches

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40 Platz, S. *et al.*, 2009, *op. cit.*

41 Louton *et al.*, 2016. Dust-bathing behavior of laying hens in enriched colony housing systems and an aviary system. *Poultry Science* 00:1–10

42 Scholz, B., Kjaer, J.B., Urselmans, S. and Schrader, L., 2011. Litter lipid content affects dustbathing behavior in laying hens. *Poultry Science* 90(11), pp.2433-2439

43 Nicol et al. 2017 Farmed Bird Welfare Science Review. Department of Economic Development, Jobs, Transport and Resources, Victoria. http://agriculture.vic.gov.au/__data/assets/pdf_file/0019/370126/Farmed-Bird-Welfare-Science-Review-Oct-2017.pdf

44 Rodenburg *et al.*, 2008, *op. cit.*

45 Louton et al, 2016, *op. cit.*

46 Duncan, I.J.H. and Kite, V.G., 1989. Nest site selection and nest-building behaviour in domestic fowl. Animal behaviour, 37, pp.215-231.

47 Compassion in World Farming, 2017. Do not compromise your cage-free housing Combination ('combi') housing for laying hens. https://www.compassioninfoodbusiness.com/media/7430820/compassion-opinion-combination-cages-for-laying-hens-may-2017.pdf

(perches in enriched cage systems are too low to prevent injurious pecking) and the number and quality of the nest boxes.[48]

Combination cage systems should be banned along with enriched cages since they can be used as cages, and, when the doors are open, they make for inferior barn systems. During any phase-out period, the fronts and side partitions should be removed (and structure strengthened) to improve navigation around the shed.

More information on combination cages and improved barn systems is available here:

- Compassion in World Farming Food Business opinion[49] on why 'combination' cages should not be used or permitted
- Business case study on the conversion of existing 'combination' cages[50] into better aviaries
- Business case study on better barns with Noble Foods[51]

Alternative systems can meet the behavioural needs of hens

Extensive scientific reviews demonstrate that only non-cage systems provide the possibility for hens to express their full behavioural repertoire[52] [53].

All but two of the behavioural requirements of hens missing in enriched cages are provided for in alternative systems. Nesting material is not a requirement in barn and free-range systems and the same minimum 15cm perch requirement applies.

However, alternative systems could provide nesting material and some do. Many also provide additional perching space and the UK's Lion Standard (a national food safety scheme which certifies over 90% of UK eggs) now recommends 20cm perch provision per bird in barn systems.

Improving welfare in alternative systems

Alternative free-range and barn systems have the potential, unlike cage systems, to provide for the behavioural needs of hens. However, all systems have welfare risks which need to be managed.

This includes injurious pecking, keel-bone damage and mortality. A study by Sherwin *et al.*, 2010, comparing systems, found high levels of these in alternative systems. However, they were at pains to point out that measures which almost certainly indicate poor welfare, including plumage damage and keel bone breaks, were found in all types of system.

[48] Compassion in World Farming, 2018. How to convert your combination system into a true aviary barn system for better laying hen welfare: Fattoria Roberti Case Study. https://www.compassioninfoodbusiness.com/media/7440816/fattoria-roberti_case-study-on-combiation-systems.pdf

[49] Compassion in World Farming, 2017. Do not compromise your cage-free housing Combination ('combi') housing for laying hens. https://www.compassioninfoodbusiness.com/media/7430820/compassion-opinion-combination-cages-for-laying-hens-may-2017.pdf

[50] Compassion in World Farming, 2018, op cit

[51] Compassion in World Farming, 2020. Case study – Noble Foods Higher Welfare Barn System.

[52] Nicol et al., 2017, op. cit.

[53] EFSA, 2005 *op. cit.*

Reducing injurious pecking

Stressed, bored or hungry birds will often peck each other. Injurious pecking is a problem in all systems of egg production.

Since this is a displaced foraging behaviour, strategies to reduce injurious pecking concentrate on ensuring that birds spend more time in positive foraging behaviour and have good nutrition. Anything which reduces stress and gives resting birds refuge from the depredations of those who are foraging is also likely to reduce the risk of injurious pecking.

Figure 7: Hens foraging and dust bathing under the cover of a tree. Hens forage more widely if they have cover to give them a sense of security from predators. Foraging reduces the risk of feather pecking.

Scientists from the University of Bristol operating the Featherwel project identified 46 potential management strategies from the scientific literature to reduce the risk of injurious pecking. They found that the greater the number of management strategies employed, the lower the plumage damage, the level of severe feather pecking and the mortality[54] .

Strategies developed for reducing the risk of injurious pecking, by Featherwel[55], Austrian producers[56], Noble Foods[57] and Stonegate[58] include:

- Better genetics
- Good nutrition
- Food that takes longer to eat – higher in fibre and provided as mash, not pellets
- Anything to encourage ranging and foraging, whether tree cover outside, straw bales inside, feed scattered in the litter, provision of verandas and wintergardens
- Reduced stocking density – fewer birds per square metre; providing aerial perches or good range to keep more birds out of the way also helps
- High aerial perches to keep birds who are resting out of the reach of those who might try to peck them
- Anything to reduce stress – whether better healthcare or good human-animal relationships – can help to prevent restlessness followed by feather pecking
- Good conditions at rear, as similar as possible to those at the laying house, so that pullets are properly educated to deal with the conditions they will meet as adults

Industry experts report that very good feather cover can be achieved in alternative systems with good management[59]. Better welfare can be incentivised. In Noble Foods' *Happy Egg* scheme, the system includes a feather score every 4-5 weeks. If scores persistently come out too low, the farm drops out of the scheme. Over a period of time this incentive, combined with good advice, has resulted in better feather cover as stockpeople learn better how to manage the birds.

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[54] Lambton, S.L., Nicol, C.J., Friel, M., Main, D.C.J., McKinstry, J.L., Sherwin, C.M., Walton, J. and Weeks, C.A., 2013. A bespoke management package can reduce levels of injurious pecking in loose-housed laying hen flocks. *Veterinary Record*, pp.vetrec-2012.

[55] University of Bristol, 2013. Featherwel Guide. Improving Feather Cover – a guide to reducing the risk of injurious pecking occurring in non-cage laying hens. https://www.featherwel.org/Portals/3/Documents/advice_guide_V1.2-May-2013.pdf

[56] Compassion in World Farming, 2010a. Laying hen case study – Austria https://www.ciwf.org.uk/media/3818841/laying-hen-case-study-austria.pdf

[57] Compassion in World Farming, 2020. Noble Foods Higher Welfare Aviary Barn System – video at https://www.compassioninfoodbusiness.com/case-studies/technical-case-studies/noble-food-making-cage-free-eggs-a-commercial-reality/

[58] Compassion in World Farming, 2010b. Laying hen case study – UK https://www.ciwf.org.uk/media/3818844/laying-hen-case-study-uk.pdf

[59] Stonegate, 2020, personal communication.

Preventing bone fractures

Hens can suffer bone fractures due to rough handling during catching for slaughter at the end of lay[60]. Fractures also occur earlier in life, for example due to collisions with furnishings or the floor[61]. Scientific research shows that bone fractures cause pain in hens, at least for weeks after the occurrence, and significantly impair welfare[62].

Caged hens are more at risk of fractures during depopulation[63] since their bones are weaker due to lack of exercise[64]. Despite the severe confinement, hens in enriched cages have also been reported to suffer high levels of keel bone damage during lay, ranging from 31.7%[65] to 60%[66] or 62%[67]. Hens in enriched cages suffer unacceptably high levels of keel bone damage without the benefit of being able to perform a range of highly-motivated behaviours.

Opportunities for exercise in alternative systems increase bone strength, but can increase the risk of accidents. Research from over ten years ago reported rates of keel bone fracture of 69.1% for barn and 59.8% for free range[68] and another study reported 82% for hens with floor housing and 97% for those in aviaries[69].

Since then, there has been a substantial improvement in the management, genetics and system design for alternative systems. The following measures have been shown to reduce the risk of accidents or of keel-bone fracture:

- Provision of ramps to help birds to navigate between the different tiers of multi-level systems reduced collisions by 59%, falls by 43% and fractures by 23%[70]
- Rearing pullets in aviaries, rather than cages, to build up bone strength during growth reduced fractures from 60.3% to 41.5% (adults caged)[71]
- Adding omega-3 fatty acids to the diet reduced fractures by 42-62%. Fractures were also less severe. Bone strength was increased[72]
- Providing softer plastic rather than metal grid flooring reduced fractures from 85% to 76%[73]

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60 Sherwin, C.M., Richards, G.J. and Nicol, C.J., 2010. Comparison of the welfare of layer hens in 4 housing systems in the UK. British Poultry Science, 51(4), pp.488-499.
61 Rodenburg et al,2008, op cit
62 Riber, A.B., Casey-Trott, T.M. and Herskin, M.S., 2018. The influence of keel bone damage on welfare of laying hens. Frontiers in veterinary science, 5, p.6.
63 Sherwin et al, 2010, op cit.
64 Rodenburg et al, 2008, *op. cit.*
65 Sherwin et al, 2010, *op. cit.*
66 Casey-Trott, T.M., Guerin, M.T., Sandilands, V., Torrey, S. and Widowski, T.M., 2017. Rearing system affects prevalence of keel-bone damage in laying hens: a longitudinal study of four consecutive flocks. *Poultry Science* 96(7), pp.2029-2039.
67 Rodenburg et al, 2008, *op. cit.*
68 Sherwin et al, 2010, *op. cit.*
69 Rodenburg et al, 2008, *op. cit.*
70 Stratmann, A., Fröhlich, E.K.F., Gebhardt-Henrich, S.G., Harlander-Matauschek, A., Würbel, H. and Toscano, M.J., 2015. Modification of aviary design reduces incidence of falls, collisions and keel bone damage in laying hens. *Applied Animal Behaviour Science* 165, pp.112-123.
71 Caset-Trott *et al.*, 2017
72 Tarlton, J.F., Wilkins, L.J., Toscano, M.J., Avery, N.C. and Knott, L., 2013. Reduced bone breakage and increased bone strength in free range laying hens fed omega-3 polyunsaturated fatty acid supplemented diets. *Bone*, 52(2), pp.578-586.
73 Heerkens, J.L.T., Delezie, E., Ampe, B., Rodenburg, T.B. and Tuyttens, F.A.M., 2016. Ramps and hybrid effects on keel bone and foot pad disorders in modified aviaries for laying hens. *Poultry Science* 95(11), pp.2479-2488.

Figure 8: Ramps enable easy access between the tiers, reducing the risk of accidents that can lead to keel-bone damage.

Industry practice is improving and achieves better results than were reported ten years ago. Free-range specialists, Stonegate, report levels of keel-bone fracture around 50%, ranging from 30-70%. Noble Foods keep their pullets in multi-tier barns which build up bone and muscle strength, with ramps for easy access to the tiers, all to the same layout of the laying farm. This prepares pullets for the laying house, allowing them to navigate it better and reduce risk of collisions[74]. Many breeding companies now place increased emphasis on health and bone strength. All of this should further reduce levels of bone breakage.

There remains scope for further improvement, through better breeding and the addition of omega-3 to the diet, still infrequently practised, but of potential benefit for the nutritional quality of the egg as well as for improving bone strength and reducing fractures[75]. Levels of bone damage should also continue to decline with further experience of the management of alternative systems.

Pullets would also benefit from a ban on cages, both in terms of their freedom during rear but also from the benefit of added bone strength, through exercise, in reducing risk of bone breakages later in life.

Mortality

Although many egg producers have moved to cage-free production for hens, others are reluctant partly due to concerns over mortality in alternative systems. However, recent research shows that mortality in cage-free systems has been decreasing steadily as the industry becomes more experienced in managing them.

A large meta-analysis of mortality data in alternative and caged systems for laying hens published in 2021 confirms that, looking at the most recent figures, there is no longer a significant difference in mortality between cage-free and enriched cage systems[76]. The researchers suggest that as management knowledge evolves and genetics are optimised, new producers transitioning to cage-free housing may experience even faster rates of decline in mortality.

Cage-free systems have the potential for good welfare

Poor welfare can occur in any system, but good welfare cannot be achieved in a cage. As evidenced by an abundance of scientific research, enriched cages are inherently incapable of meeting the behavioural needs of hens, however well they are managed.

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74 Compassion in World Farming, 2020. Case study – Noble Foods Higher Welfare Barn System. https://www.compassioninfoodbusiness.com/resources/laying-hens/

75 Tarlton et al, 2013 op cit.

76 Schuck-Paim, C., Negro-Calduch, E. & Alonso, W.J., 2021. Laying hen mortality in different indoor housing systems: a meta-analysis of data from commercial farms in 16 countries. Sci Rep 11, 3052.

Cage-free systems however, do have the potential to provide good welfare and many such systems already achieve this, with results continuously improving in others due to experience of farmers. Welfare is optimised by good breeding, system design and management – as demonstrated by a wealth of scientific research and successful commercial practice.

The following elements are necessary for better indoor cage-free production[77]

- No further confinement and no partitions within the tiers: No 'combi' cages and no limited access systems
- Ramps and platforms to facilitate movement between tiers in the sheds
- Limit the number of hens per shed, and the size of sub-groups of hens within a shed
- Separate air spaces for multi-storey buildings
- Enclosed and comfortable nests
- Appropriate environmental enrichment: Sufficient, comfortable perches, pecking substrates and natural light
- Cage-free pullet rearing which is fit for purpose

Higher welfare potential for hens is offered in well-managed free-range and organic laying hen systems:

- Good ranges include cover from shrubs and trees, giving hens confidence to range in safety
- The larger space allowances and much greater environmental complexity of systems with outdoor access provide many more opportunities for hens to carry out their full repertoire of vital natural behaviours

Good training and the dissemination of best practice is essential. The new DG Santé *Pilot Project on Best Practices for Alternative Egg Production Systems* has the potential to play an important role in facilitating the move from cages to well-run alternatives.

Figure 9: Organic system, France.

77 Compassion in World Farming Food Business technical information.

III. Welfare and productivity benefits of housing sows in groups

- It is well established that keeping sows in individual stalls inevitably causes poor welfare. Housing sows in stalls until four weeks after service exposes them to the same welfare hazards as confinement during the remaining gestation period, including frustration, stress and restricted movement
- A large body of research has been published showing that housing sows in groups, including the period from weaning and during the first four weeks of gestation, need not have any adverse effects on reproductive performance and, in some cases, may even have benefits
- Group housing systems should be designed and managed to minimise aggression and meet the welfare needs of sows by maintaining stable groups if possible and taking steps to reduce aggression when sows are mixed. This includes adequate space and opportunities for sows to escape from aggressive interactions, design of feeding systems to minimise competition, *ad libitum* feeding with high-fibre diets or permanent access to roughage, and good quality flooring with a substantial bedded area
- Group-housing systems for gestating sows, without the use of individual housing from weaning and in early gestation, are already being used successfully in many countries throughout Europe

Confinement of sows in individual stalls causes severe health and welfare problems

It is well established that keeping sows in individual stalls (variously referred to as sow stalls, insemination stalls, gestation crates) inevitably causes poor welfare. Stalls severely restrict the movement of sows, to the extent that they have difficulty lying down and standing up.[78]

Figure 10: Sows in individual stalls, Italy.

[78] EFSA (2007) Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. Scientific Opinion of the Panel on Animal Health and Welfare. Question no. EFSA-Q-2006-028. European Food Safety Authority. *The EFSA Journal*, 572: 1-13.

Figure 11: Stalls severely restrict the movement of sows, to the extent that they have difficulty lying down and standing up.

Confined sows show increased levels of stereotypies (abnormal repetitive behaviour), urinary tract infections, unresolved aggression, and inactivity associated with unresponsiveness (suggesting that sows may be depressed in the clinical sense), reduced muscular and bone strength and reduced cardiovascular fitness.[79] [80]

The extensive evidence that individual housing in stalls is detrimental to the physical and psychological well-being of sows, and the clear welfare advantages of housing sows in groups, led to an EU Directive (2001/88/EC) prohibiting individual stalls for the housing of pregnant sows from 1 January 2013. However, the period from weaning to four weeks after service is excluded from this prohibition. The relevant legal text is now contained in EU Council Directive 2008/120/EC and states: *"Member States shall ensure that sows and gilts are kept in groups during a period starting from four weeks after the service to one week before the expected time of farrowing".*

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79 SVC (1997) *The Welfare of Intensively Kept Pigs*. Report of the Scientific Veterinary Committee.

80 EFSA (2007) Scientific Report on animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. Question no. EFSA-Q-2006-028. European Food Safety Authority. *Annex to the EFSA Journal*, 572: 1-13.

Figure 12: The stress of being caged in individual stalls leads to repetitive behaviours such as bar biting.

Housing sows in stalls until four weeks after service exposes them to the same welfare hazards as confinement during the remaining gestation period, including frustration, stress and restricted movement.[81] Sows are highly active, restless and motivated for social contact during the pre-oestrus period (from around three to four days after weaning and the following four to five days); and during the two to three days of oestrus sows engage in high levels of social activity including sniffing, flank nosing and mounting other sows as well as standing in front of the boar if he is present; aggression is hardly ever observed during this period.[82] [83] This activity is part of the natural oestrus behaviour of sows and when sows are confined during this period this strong motivation cannot be expressed.[84] The Animal Health and Welfare (AHAW) Panel of the European Food Safety Authority (EFSA) concludes:

"Housing of sows in individual stalls from weaning and until 4 weeks after mating severely restricts their freedom of movements and causes stress. Further it does not allow sows to move and socially interact during a period of the reproductive cycle where they are highly motivated to do so" [85] and *"on the basis of established knowledge, group housing from weaning seems to imply a number of welfare advantages"*.[86]

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81 EFSA (2007) Scientific Report on animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. Question no. EFSA-Q-2006-028. European Food Safety Authority. *Annex to the EFSA Journal*, 572: 1-13.

82 Pedersen, LJ; Rojkittikhun, T; Einarsson, S; Edqvist, LE (1993) Postweaning grouped sows: effects of aggression on hormonal patterns and oestrus behaviour. *Applied Animal Behaviour Science*, 38: 25-39.

83 Pedersen, LJ (2007). Sexual behaviour in female pigs. *Hormones and Behaviour*, 52: 64-69.

84 EFSA (2007) Scientific Report on animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. Question no. EFSA-Q-2006-028. European Food Safety Authority. *Annex to the EFSA Journal*, 572: 1-13.

85 EFSA (2007) Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. Scientific Opinion of the Panel on Animal Health and Welfare. Question no. EFSA-Q-2006-028. European Food Safety Authority. *The EFSA Journal*, 572: 1-13.

86 EFSA (2007) Scientific Report on animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. Question no. EFSA-Q-2006-028. European Food Safety Authority. *Annex to the EFSA Journal*, 572: 1-13.

Good production results can be achieved with group housing from weaning and throughout gestation

Figures 13 and 14: A group housing system for sows. Individual feeding stalls minimise stress and aggression. These are also used, very briefly, for insemination. Keeping sows in small, stable groups also reduces risk of aggression.

The rationale for the exclusion of the period from weaning to four weeks after service from the requirement for group housing is concern that stress caused by mixing sows may be detrimental to oestrus expression, pregnancy rate and embryo development and survival. However, a large body of research has been published showing that housing sows in groups from weaning and during the first few weeks of gestation need not have any adverse effects on reproductive performance.

A review by Kemp *et al.* (2005)[87] found no consistent effect on the onset of oestrus when sows were grouped after weaning as compared to individual housing. Effects of group housing on oestrus detection rate and expression of oestrus were found to be small and variable. Rault *et al.* (2014)[88] compared sexual behaviour in sows grouped at weaning with sows grouped after insemination. 90% of sows displayed oestrus-related behaviour within the first week after weaning, with no overall difference between the groups. However, sows grouped at weaning showed fewer spontaneous standing responses to boar exposure, partly compensated by more responses to the back-pressure test performed by a stockperson in the presence of a boar. The authors suggest that efficient oestrus detection methods may be more important when sows are grouped before insemination.

Nielsen (1999)[89] found no difference in farrowing rate or litter size between sows grouped in dynamic groups early after insemination compared with four weeks after insemination. Van Wettere *et al.* (2008)[90] found no adverse effects on ovulation and pregnancy rate or embryo development and survival when group housed, mated gilts were remixed on days 3/4 or 8/9 of gestation compared with gilts kept in stable groups or housed individually in stalls. The authors conclude that individually housing gilts immediately after insemination did not improve embryo

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87 Kemp, B; Soede, NM; Langendijk, P (2005) Effects of boar contact and housing conditions on estrus expression in sows. *Theriogenology*, 63: 643-656.

88 Rault, J-L; Morrison, RS; Hansen, CF; Hansen, LU; Hemsworth, PH (2014) Effects of group housing after weaning on sow welfare and sexual behaviour. *Journal of Animal Science*, 92: 5683-5692.

89 Nielsen, N-P (1999) Cited in: Verdon, M; Hansen, CF; Rault, J-L; Jongman, E; Hansen, LU; Plush, K; Hemsworth, PH (2015) Effects of group housing on sow welfare: A review. *Journal of Animal Science*, 93: 1999-2017.

90 van Wettere, WHEJ; Pain, SJ; Stott, PG; Hughes, PE (2008) Mixing gilts in early pregnancy does not affect embryo survival. *Animal Reproduction Science*, 104: 382-388.

survival and that remixing gilts during the first ten days of gestation had no adverse effects on embryo development or survival.

Similarly, Cassar *et al.* (2008)[91] investigated effects on reproductive performance of grouping unfamiliar sows at 2, 7, 14, 21 and 28 days after service, compared with sows housed individually in stalls, and found no effect on farrowing rate or litter size of grouping *per se* or of day of gestation when grouped. Knox *et al.* (2014)[92] compared reproductive performance in sows grouped at 3-7 days, 13-17 days, or 35 days after breeding, or housed individually. Although there were some differences between treatments, the authors noted that reproductive performance in all treatment groups was acceptable and above industry norms. Stevens *et al.* (2015)[93] found no difference in reproductive performance (farrowing rate and litter size) between sows mixed 1-7 days after insemination or 36-42 days after insemination.

A number of studies have found no effect of induced stress[94] [95] or repeated acute stress from repeated regrouping[96] on reproductive performance. Turner *et al.* (1999, 2002 and 2005)[97] [98] [99] conclude that acute stress or repeated acute stress, even during the critical period of induction of oestrus and ovulation, do not affect reproductive performance in pigs, but that severe stress can affect reproductive performance in some pigs if this continues for a substantial period. From these results and those discussed above showing no adverse effects of mixing during early pregnancy, it appears that sows are able to adapt to the transient stress of mixing and that reproductive performance is unlikely to be adversely affected unless stress is prolonged, for example if there is severe competition at feeding or inadequate space to allow sows to escape aggressive interactions. In the UK, where individual stalls have been completely prohibited since 1999, sows are managed successfully with grouping at weaning and may be placed in individual stalls only for a short period (normally a maximum of 4 hours) during service. Sweden, Norway and Switzerland have also banned the use of individual stalls for sows. In many other countries throughout the EU, commercial farms that use group housing of sows throughout gestation are successfully in operation.

The studies reviewed here demonstrate that there is no justification for the individual housing of sows in the period from weaning to four weeks after service. Indeed, aggression is likely to be minimised if sows are returned to groups as soon as possible after any period of separation (e.g. during farrowing and lactation or for service).

Hoy and Bauer (2005)[100] investigated the frequency of aggressive interactions between sows grouped after weaning and then separated for 7 or 28 days. They found that the number of aggressive interactions was significantly lower after reunion if sows were reintroduced after 7

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[91] Cassar, G; Kirkwood, RN, Seguin, MJ; Widowski, TM; Farzan, A; Zanella, AJ; Friendship, M (2008) Influence of stage of gestation at grouping and presence of boars on farrowing rate and litter size of group-housed sows. *Journal of Swine Health and Production*, 16: 81-85.

[92] Knox, R; Salak-Johnson, J; Hopgood, M; Greiner, L: Connor, J (2014) Effect of day of mixing gestating sows on measures of reproductive performance and animal welfare. *Journal of Animal Science*, 92: 1698-1707.

[93] Stevens, B; Karlen, GM; Morrison, R; Gonyou, HW; Butler, KL; Kerswell, KJ; Hemsworth, PH (2015) Effects of stage of gestation at mixing on aggression, injuries and stress in sows. *Applied Animal Behaviour Science*, 165: 40-46.

[94] Razdan, P; Mwanza, AM; Kindahl, H; Hultén, F; Einarsson, S (2002) Effects of repeated ACTHstimulation on early embryonic development and hormonal profiles in sows. *Animal Reproduction Science*, 70: 127-137.

[95] Razdan, P; Tummaruk, P; Kindahl, H; Rodriguez-Martinez, H; Hulten, F; Einarsson, S (2004) Hormonal profiles and embryo survival of sows subjected to induced stress during days 13 and 14 of pregnancy. *Animal Reproduction Science*, 81: 295-312.

[96] Soede, NM; Van Sleuwen, MJW; Molenaar, R; Rietveld, FW; Schouten, WPG;Hazeleger, W; Kemp, B (2006) Influence of repeated regrouping on reproduction in gilts. *Animal Reproduction Science*, 96: 133-145.

[97] Turner, AI; Hemsworth, PH; Canny, BJ; Tilbrook, AJ (1999) Sustained but not repeated acute elevation of cortisol impaired the luteinizing hormone surge, estrus, and ovulation in gilts. *Biology of Reproduction*, 61: 614-620.

[98] Turner, AI; Hemsworth, PH; Tilbrook, AJ (2002) Susceptibility of reproduction in female pigs to impairment by stress and the role of the hypothalamo-pituitary-adrenal axis. *Reproduction, Fertility and Development*, 14: 377-391.

[99] Turner, AI; Hemsworth, PH; Tilbrook, AJ (2005) Susceptibility of reproduction in female pigs to impairment by stress or elevation of cortisol. *Domestic Animal Endocrinology*, 29: 398-410.

[100] Hoy, S; Bauer, J (2005) Dominance relationships between sows dependent on the time interval between separation and reunion. *Applied Animal Behaviour Science*, 90: 21-30.

days of individual housing in stalls compared with those reintroduced after 28 days of individual housing. The authors conclude that the frequency of aggressive interactions increases with increasing time interval between separation and reunion.

A number of published reviews[101] [102] and recent studies[103] [104] [105] [106] indicate that reproductive performance in group housing systems is comparable with (and in some cases superior to) that in stalls. Group housing systems vary widely in terms of group size, space allowance, provision of enrichment, flooring, feeding system and other aspects of design and management. It is therefore likely that any adverse effects on reproductive performance reported in group housing systems are the result of inadequate design or management of systems rather than the result of mixing *per se*. For example, insufficient space allowance may increase aggression and impair reproductive performance[107] [108] and the reproductive performance of low-ranking sows may be adversely affected if they are unable to gain access to sufficient feed.[109] [110] Rather than confining sows in stalls between weaning and four weeks after service, which severely impairs their welfare, a better approach to avoid any adverse effects of stress on reproductive performance is to ensure appropriate design and management of group housing systems to minimise stress, competition and aggression.

Managing group-housed sows to minimise stress, competition and aggression

Some level of aggression is inevitable when sows are housed in groups, but it can be properly managed to avoid detrimental effects on welfare and reproductive performance. Spoolder *et al.* (2009)[111] reviewed success of and risk factors for group housing of sows in early pregnancy and highlighted key factors in the management of aggression, including gradual familiarisation of unfamiliar animals, sufficient space and adequate pen structure during initial mixing, minimising opportunities for dominant sows to steal food from subordinates, the provision of a good quality floor, and the use of straw bedding. Greenwood *et al.* (2014)[112] recommend providing as much space as practical at mixing and reducing the number of any limiting resources that sows might compete for.

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101 McGlone, JJ (2013) Review: Updated scientific evidence on the welfare of gestating sows kept in different housing systems. *The Professional Animal Scientist*, 29:189-198.

102 Einarsson, S; Sjunnesson, Y; Hulten, F; Eliasson-Selling, L; Dalin, A-M; Lundeheim, N; Magnusson, U (2014) A 25 years experience of group-housed sows – reproduction in animal welfare-friendly systems. *Acta Veterinaria Scandinavica*, 56: 37.

103 Jang, JC; Hong, JS; Jin, SS; Kim, YY (2017) Comparing gestating sows housing between electronic sow feeding system and a conventional stall over three consecutive parities. *Livestock Science*, 199: 37-45.

104 Morgan, L; Klement, E; Novak, S; Eliahoo, E; Younis, A; Sutton, GA; Abu-Ahmad, W; Raz, T (2018) Effects of group housing on reproductive performance, lameness, injuries and saliva cortisol in gestating sows. *Preventive Veterinary Medicine*, 160:10-17.

105 Ren, P; Yang, XJ; Railton, R; Jendza, J; Anil, L; Baidoo, SK (2018) Effects of different levels of feed intake during four short periods of gestation and housing systems on sows and litter performance. *Animal Reproduction Science*, 188: 21-34.

106 Min, Y; Choi, Y; Kim, J; Kim, D; Jeong, Y; Kim, Y; Song, M; Jung, H (2020) Comparison of the productivity of primiparous sows housed in individual stalls and group housing systems. *Animals*, 10: 1940.

107 Kongsted, AG (2004) Stress and fear as possible mediators of reproduction problems in group housed sows: A review. Acta *Agriculturae Scandinavica Section A – Animal Science*, 54: 58-66.

108 Hemsworth, PH; Rice, M; Nash, J; Giri, K; Butler, KL; Tilbrook, AJ; Morrison, RS (2013) Effects of group size and floor space allowance on grouped sows: Aggression, stress, skin injuries, and reproductive performance. *Journal of Animal Science*, 91: 4953-4964.

109 Kongsted, AG (2005) A review of the effect of energy intake on pregnancy rate and litter size-discussed in relation to group-housed non-lactating sows. *Livestock Production Science*, 97: 13-26.

110 Kongsted, AG (2006) Relation between reproduction performance and indicators of feed intake, fear and social stress in commercial herds with group-housed non-lactating sows. *Livestock Science*, 101: 46-56.

111 Spoolder, HAM; Geudeke, MJ; Van der Peet-Schwering, CMC; Soede, NM (2009) Group housing of sows in early pregnancy: A review of success and risk factors. *Livestock Science*, 125: 1-14.

112 Greenwood, EC; Plush, KJ; van Wettere, WHEJ; Hughes, PE (2014) Hierarchy formation in newly mixed, group housed sows and management strategies aimed at reducing its impact. *Applied Animal Behaviour Science*, 160: 1-11.

Numerous studies report reduced aggression and injuries in group-housed sows with increasing space allowance.[113] [114] [115] [116] Provision of sufficient space is especially important during mixing, when the use of specialised mixing pens can provide additional space and barriers to allow subordinate sows to escape aggressors. Where sows are kept in large groups, aggression at mixing can be reduced by pre-mixing small groups of sows prior to their introduction together to the larger group.[117]

Figure 15: Sufficient space, straw and visual barriers minimise aggression.

A number of approaches have been developed to reduce competition and aggression at feeding in group-housed sows, including the use of individual feeding stalls,[118] partial stalls, [119] trickle feeders[120] and Electronic Sow Feeding (ESF) systems.[121] ESF systems permit undisturbed and individually-tailored feed consumption irrespective of a sow's social rank. Nowachowicz *et al.* (1999)[122] reported high reproductive performance in sows housed in groups with this feeding system and found no significant differences in reproductive performance between sows of

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113 Spoolder, HAM; Geudeke, MJ; Van der Peet-Schwering, CMC; Soede, NM (2009) Group housing of sows in early pregnancy: A review of success and risk factors. *Livestock Science*, 125: 1-14.

114 Bench, CJ; Rioja-Lang, FC; Hayne, SM; Gonyou, HW (2013) Group gestation housing with individual feeding – II: How space allowance, group size and composition, and flooring affect sow welfare. *Livestock Science*, 152: 218-227.

115 Hemsworth, PH; Rice, M; Nash, J; Giri, K; Butler, KL; Tilbrook, AJ; Morrison, RS (2013) Effects of group size and floor space allowance on grouped sows: Aggression, stress, skin injuries, and reproductive performance. *Journal of Animal Science*, 91: 4953-4964.

116 Hemsworth, PH; Morrison, RS; Tilbrook, AJ; Butler, KL, Rice, M; Moeller, SJ (2016) Effects of varying floor space on aggressive behavior and cortisol concentration in group-housed sows. *Journal of Animal Science*, 94:4809-4818.

117 Durrell, JL; Beattie, VE; Sneddon, IA; Kilpatrick, D (2003) Pre-mixing as a technique for facilitating subgroup formation and reducing sow aggression in large dynamic groups. *Applied Animal Behaviour Science*, 84: 89-99.

118 Arey, D.S. and Edwards, S.A., 1998. Factors influencing aggression between sows after mixing and the consequences for welfare and production. Livestock Production Science, 56(1), pp.61-70.

119 Barnett, J.L., Hemsworth, P.H., Cronin, G.M., Newman, E.A., McCallum, T.H. and Chilton, D., 1992. Effects of pen size, partial stalls and method of feeding on welfare-related behavioural and physiological responses of group-housed pigs. Applied Animal Behaviour Science, 34(3), pp.207-220.

120 Chapinal, N., Ruiz-De-La-Torre, J.L., Cerisuelo, A., Gasa, J., Baucells, M.D. and Manteca, X., 2010. Aggressive behavior in two different group-housing systems for pregnant sows. Journal of Applied Animal Welfare Science, 13(2), pp.137-153.

121 Bench, CJ; Rioja-Lang, FC; Hayne, SM; Gonyou, HW (2013) Group gestation housing with individual feeding – I: How feeding regime, resource allocation, and genetic factors affect sow welfare. *Livestock Science*, 152: 208-217.

122 Nowachowicz, J; Michalska, G; Kapelanski, W; Kapelanska, J (1999) Influence of electronically controlled individual feeding on behaviour and reproductive performance of pregnant sows. *Journal of Animal and Feed Sciences*, 8: 45-49.

different social rank. Bates *et al.* (2003)[123] reported improved reproductive performance in sows group housed with electronic sow feeders (ESF) compared with sows housed individually in stalls. In the ESF system, a greater percentage of sows remained pregnant after initial service and farrowed a litter; and a greater percentage of sows returned to oestrus within 7 days of weaning compared with stall-housed sows. The design of ESF systems should take account of the need to minimise queuing and aggression at the entrance, for example by considering the number and location of feeders, and the distance from exit to re-entry.[124]

Figure 16: Group-housed sows with individual feeding stalls.

[123] Bates, RO; Edwards, DB; Korthals, RL (2003) Sow performance when housed either in groups with electronic sow feeders or stalls. *Livestock Production Science*, 79: 29-35.

[124] Verdon, M; Hansen, CF; Rault, J-L; Jongman, E; Hansen, LU; Plush, K; Hemsworth, PH (2015) Effects of group housing on sow welfare: A review. *Journal of Animal Science*, 93: 1999-2017.

Chronic hunger and lack of opportunities to express foraging and exploratory behaviour can also contribute to stress and aggression in sows. Restrictive feeding and lack of roughage and/or appropriate enrichment can lead to increased restlessness, stereotypies and aggression, a high prevalence of stomach ulcers and frustration in sows.[125] Restrictive feeding during early pregnancy, beyond the first few days after mating, may adversely affect embryo survival and maintenance of pregnancy.[126] Levels of feed restriction commonly used commercially result in persistent high feeding motivation and oral stereotypies in sows.[127] A Finnish study found that provision of roughage increased the likelihood of sows becoming pregnant.[128]

Figure 17: Sow emerging from electronic feeding system.

Figure 18: Giving group-housed sows enough space and straw provides fibrous food, foraging opportunities and bedding and therefore minimises aggression.

Feeding high-fibre diets to sows reduces feeding motivation, oral stereotypies and general restlessness and aggression.[129] O'Connell (2007)[130] found that provision of grass silage improved the welfare of newly-introduced sows in large dynamic groups. Feeding high-fibre diets to sows during gestation may also have benefits for piglet performance. Guillemet *et al.* (2007)[131] found that piglets from sows fed high-fibre diets during gestation showed improved growth rates during their first week of life and tended to be heavier at weaning. Feeding high-fibre diets can enable sows to be fed *ad libitum* whilst controlling nutrient intake; in group housing systems where sows are fed together, *ad libitum* feeding can solve problems of aggression caused by competition for feed and of variation in

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[125] EFSA (2007) Scientific Report on animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. Question no. EFSA-Q-2006-028. European Food Safety Authority. *Annex to the EFSA Journal*, 572: 1-13.

[126] Peltoniemi, OAT; Oliviero, C; Hälli, O; Heinonen, M (2007) Feeding affects reproductive performance and reproductive endocrinology in the gilt and sow. *Acta Veterinaria Scandinavica*, 49 (Suppl. 1): S6.

[127] Lawrence, AB; Terlouw, EMC (1993) A review of behavioural factors involved in the development and continued performance of stereotypic behaviour in pigs. *Journal of Animal Science*, 71: 2815-2825.

[128] Heinonen, M; Oravainen, J; Orro, T; Seppa-Lassila, L; Ala-Kurikka, L; Virolainen, J; Tast, A; Peltoniemi, OAT (2006) Lameness and fertility of sows and gilts in randomly selected loose-housed herds in Finland. *Veterinary Record*, 159: 383-387.

[129] Meunier-Salaün, MC; Edwards, SA; Robert, S (2001) Effect of dietary fibre on the behaviour and health of the restricted fed sow. *Animal Feed Science and Technology*, 90: 53-69.

[130] O'Connell, NE (2007) Influence of access to grass silage on the welfare of sows introduced to a large dynamic group. *Applied Animal Behaviour Science*, 107: 45-57.

[131] Guillemet, R; Hamard, A; Quesnel, H; Père, MC; Etienne, M; Dourmad, JY; Meunier-Salaün, MC (2007) Dietary fibre for gestating sows: effects on parturition progress, behaviour, litter and sow performance. *Animal*, 1: 872-880.

feed intake between sows of different social rank.[132] However, in systems where sows are fed sequentially such as ESF systems, feeding high-fibre diets increases feeding time, which can cause crowding of sequential feeding systems and reduce feeder capacity.[133] Therefore, *ad libitum* feeding with high-fibre diets is best suited to systems where all sows can feed simultaneously.

A long-term study by Broom *et al.* (1995)[134] compared the welfare of sows in individual stalls, small group housing (groups of five sows in pens with 3m x 2.2m strawed lying area and 2m x 2.2m dunging area) and large group housing (38 sows in a pen with electronic sow feeders, 11.4m x 5.5m strawed lying area and 5.1m x 5.5m dunging area). The authors report that stall-housed sows had poorer welfare compared with sows in both group housing systems, especially as time went on. Analysis of data over four parturitions combined showed no significant differences in reproductive performance between the different systems. Mixing was minimised because no new animals were added during the experiment and the animals were returned to the same groups after farrowing and service. The authors report that social stability increased over time in both group housing systems and conclude that the success of the group housing systems in this study must be partly attributed to the high social stability in the groups.

In addition, stress was likely to be minimised in the group housing systems because both group housing systems included straw bedding, with fresh straw added at regular intervals, and the feeding systems were designed to minimise aggression (individual feeding stalls in the small group and electronic sow feeders in the large group). In addition, the large group housing system incorporated a free-standing wall in the lying area, behind which sows could hide to escape from aggressive interactions. This study clearly demonstrates improved welfare and no adverse effects on reproductive performance when sows are housed in well-designed group housing systems without individual housing during early pregnancy.

Group housing systems should be designed and managed to minimise aggression and meet the welfare needs of sows by:

- Maintaining stable groups if possible, with minimal mixing of unfamiliar sows
- Where sows are mixed, taking steps to reduce aggression, e.g. by pre-mixing smaller groups of sows before introduction to a larger group, allowing gradual familiarisation of unfamiliar animals (by allowing fence-line contact in an adjacent pen) and providing as much space as possible during mixing
- Where sows are separated, e.g. during farrowing and lactation or for service, minimising the period between separation and reunion
- Provision of adequate space
- Design of systems to allow opportunities for sows to escape from aggressive interactions, e.g. by providing partitions for sows to hide behind
- Design of feeding systems to minimise competition and ensure adequate feed intake in all sows
- *Ad libitum* feeding with high-fibre diets or provision of permanent access to roughage
- Good quality flooring with a substantial bedded area

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[132] Ru, YJ; Bao, YM (2004) Feeding dry sows ad libitum with high fibre diets. *Asian-Australian Journal of Animal Sciences*, 17: 283-300.

[133] Bench, CJ; Rioja-Lang, FC; Hayne, SM; Gonyou, HW (2013) Group gestation housing with individual feeding – I: How feeding regime, resource allocation, and genetic factors affect sow welfare. *Livestock Science*, 152: 208-217.

[134] Broom, DM; Mendl, MT; Zanella, AJ (1995) A comparison of the welfare of sows in different housing conditions. *Animal Science*, 61: 369-385.

IV. Welfare and productivity benefits of moving away from farrowing crates for sows

- The scientific evidence that *sow* health, welfare and productivity is severely compromised in farrowing crates has been well-established for many years
- There is now also a large body of evidence showing that *piglet* health, welfare and productivity is significantly compromised in farrowing crates and greatly improved in free-farrowing systems
- Free farrowing results in healthier sows and piglets and reduced piglet mortality from numerous causes. By coupling this with pens that are designed to reduce crushing – free-farrowing systems can, and do, deliver *lower* total piglet mortality than crates
- Numerous successful free-farrowing systems exist, many designed in the EU, and are in use in many countries across Europe and globally
- Norway, Sweden and Switzerland have all successfully banned the routine use of farrowing crates.

The farrowing crate

The farrowing crate was first introduced in the 1960s. The aim was to minimise live-born piglet mortality by controlling sow movements, to improve safety for stockworkers, to save space and make manure management easier through slatted flooring behind the sow.[135,136]

Farrowing crates confine sows within bars so that they cannot walk or turn around (see Figure 17). A crate typically measures 1.23m^2; the crate sits within a pen which houses the piglets but is unavailable to the sow: typical total pen size 3.6m^2 – 3.95m^2.[137,138] The flooring is part or fully slatted and is usually positioned above a slurry pit.[139] Bedding is normally not provided for the sow.[140] Sows are generally put into a farrowing crate about a week prior to farrowing, until their piglets are weaned at about 4 weeks after farrowing.

Figure 19: Sow in farrowing crate.

[135] Baxter, E.M., Andersen, I.L. and Edwards, S.A., 2018. Sow welfare in the farrowing crate and alternatives. In *Advances in Pig Welfare* (pp. 27-72). Woodhead Publishing.

[136] Pedersen, L.J., Malmkvist, J. and Andersen, H.M.L., 2013. Housing of sows during farrowing: a review on pen design, welfare and productivity. *Livestock Housing: Modern Management to Ensure Optimal Health and Welfare of Farm Animals; Wageningen Academic Publishers: Wageningen, Gelderland, The Netherlands*, *2*, pp.93-112.

[137] Baxter, E.M., Lawrence, A.B. and Edwards, S.A., 2011. Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs. *Animal*, *6*(1), p.96.

[138] Pedersen, L.J., Berg, P., Jørgensen, E., Bonde, M., Herskin, M.S., Knage-Rasmussen, K.M., Kongsted, A.G., Lauridsen, C., Oksbjerg, N., Poulsen, H.D., Sorensen, D., Su, G., Sørensen, M.T., Theil, P.K., Thodberg, K. and Jensen, K.H., 2010. Pattegrisedødelighed i DK: Muligheder for reduktion af pattegrisedødeligheden i Danmark. (Piglet mortality in Denmark: possibilities for reducing neonatal piglet mortality in Denmark). DJF Rapport – Husdyrbrug, vol. 86, Aarhus Universitet, Det Jordbrugsvidenskabelige Fakultet, Denmark.

[139] Baxter, E.M., Andersen, I.L. and Edwards, S.A., 2018. Sow welfare in the farrowing crate and alternatives. In *Advances in Pig Welfare* (pp. 27-72). Woodhead Publishing.

[140] Pedersen, L.J., Berg, P., Jørgensen, E., Bonde, M., Herskin, M.S., Knage-Rasmussen, K.M., Kongsted, A.G., Lauridsen, C., Oksbjerg, N., Poulsen, H.D., Sorensen, D., Su, G., Sørensen, M.T., Theil, P.K., Thodberg, K. and Jensen, K.H., 2010. Pattegrisedødelighed i DK: Muligheder for reduktion af pattegrisedødeligheden i Danmark. (Piglet mortality in Denmark: possibilities for reducing neonatal piglet mortality in Denmark). DJF Rapport – Husdyrbrug, vol. 86, Aarhus Universitet, Det Jordbrugsvidenskabelige Fakultet, Denmark.

Welfare and productivity problems relating to keeping sows in farrowing crates

There is a wealth of scientific studies demonstrating multiple severe health and welfare problems for sows housed in farrowing crates.

Confinement: extreme restriction of movement

The degree of restriction of movement in a farrowing crate, and sow stall, is more severe than any other form of confinement in European livestock farming today. A Scientific Opinion by EFSA in 2007 identified that frustration and stress due to insufficient space is a major welfare risk for farrowing sows.[141] As a result of genetic selection for greater production, modern sows are larger and over 50% heavier than they were 30 years ago.[142] Consequently, some of today's farmed sows are now the same size, or larger than, the crate itself, see Table 1.

Table 1. Size of modern hyper-prolific sows compared to farrowing crates

	Full grown sow (mean)[143]	Full grown sow (95th percentile)[144]	Space required for sow to lie down and stand up[145]	**Average farrowing crate dimensions[146]**
Length (cm)	193	202	218	**198**
Width when standing (cm)	44	48	80	**60**
Depth when lying on side (cm)	66	72	80	**60**

We can see from the dimensions in Table 1 that, an average farrowing crate is smaller in length than the larger sows, and gives only 6cm of space on each side of the sow. There is insufficient space to lie down and stand up normally (20cm too small in both length and width). This is illustrated in the image below. Research shows that modern sows in farrowing crates have difficulty in lying down and standing, and sustain injuries from the bars and flooring.[147,148,149] Furthermore, when sows spend longer periods of time lying down without changing position,

[141] EFSA 2007. Scientific Opinion of the Panel on Animal Health and Welfare on a request from the Commission on Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. *The EFSA Journal* (2007) 572, 1-13

[142] Moustsen, V.A., Lahrmann, H.P. and D'Eath, R.B., 2011. Relationship between size and age of modern hyper-prolific crossbred sows. *Livestock Science*, *141*(2-3), pp.272-275.

[143] Moustsen, V.A., Lahrmann, H.P. and D'Eath, R.B., 2011. Relationship between size and age of modern hyper-prolific crossbred sows. Livestock Science, 141(2-3), pp.272-275.

[144] Moustsen, V.A., Lahrmann, H.P. and D'Eath, R.B., 2011. Relationship between size and age of modern hyper-prolific crossbred sows. Livestock Science, 141(2-3), pp.272-275.

[145] Moustsen, V.A. and Duus, K.L., 2006. Søers 'rejse og lægge sig' bevægelse i forskellige farestier' (The laying down and getting up movements in sows in different farrowing pens). Meddelelse 733, Landsudvalget for Svin.

[146] Pedersen, L.J., Berg, P., Jørgensen, E., Bonde, M., Herskin, M.S., Knage-Rasmussen, K.M., Kongsted, A.G., Lauridsen, C., Oksbjerg, N., Poulsen, H.D., Sorensen, D., Su, G., Sørensen, M.T., Theil, P.K., Thodberg, K. and Jensen, K.H., 2010. Pattegrisedødelighed i DK: Muligheder for reduktion af pattegrisedødeligheden i Danmark. (Piglet mortality in Denmark: possibilities for reducing neonatal piglet mortality in Denmark). DJF Rapport – Husdyrbrug, vol. 86, Aarhus Universitet, Det Jordbrugsvidenskabelige Fakultet, Denmark

[147] Baxter, E.M., Andersen, I.L. and Edwards, S.A., 2018. Sow welfare in the farrowing crate and alternatives. In *Advances in Pig Welfare* (pp. 27-72). Woodhead Publishing.

[148] Bonde, M., 2008. Prevalence of decubital shoulder lesions in Danish sow herds. Internal Report 12, Faculty of Agricultural Sciences, University of Aarhus, Denmark.

[149] Harris, M.J. and Gonyou, H.W., 1998. Increasing available space in a farrowing crate does not facilitate postural changes or maternal responses in gilts. Applied Animal Behaviour Science 59: 285-296.

there is an increased risk of developing pressure sores (decubitus ulcers).[150] The below image demonstrates indentations on the sow's lower body and udder from the slatted flooring beneath her. Both slatted flooring and the deficient length of farrowing crates also increase the risk of pressure sores in sows.[151]

As such, most, if not all, farrowing crates do not comply with Council Directive 2008/120/EC which requires that: "*The accommodation for pigs must be constructed in such a way as to allow the animals to: — have access to a lying area physically and thermally comfortable as well as adequately drained and clean which allows all the animals to … rest and get up normally…*".[152]

Figure 20: Photo of a common farrowing crate with space restriction. The picture illustrates problems with limited space for the piglets to suckle. The piglets in the picture are almost new-born. In addition, the space in length is too small resulting in the sow resting her head on the trough due to limited space in the length of the crate. ©Pedersen et al., 2013 [153]

Restriction of highly motivated behaviours

Domestic sows retain a very strong innate need to nest build prior to giving birth.[154] This involves searching for nesting material, digging and rooting out a hollow, and constructing a suitable

[150] Rolandsdotter, E., Westin, R. and Algers, B., 2009. Maximum lying bout duration affects the occurrence of shoulder lesions in sows. *Acta Veterinaria Scandinavica*, *51*(1), p.44.

[151] KilBride, A.L., Gillman, C.E. and Green, L.E., 2009. A cross sectional study of the prevalence, risk factors and population attributable fractions for limb and body lesions in lactating sows on commercial farms in England. *BMC veterinary research*, *5*(1), p.30.

[152] COUNCIL DIRECTIVE 2008/120/EC of 18 December 2008 laying down minimum standards for the protection of pigs

[153] Pedersen, L.J., Malmkvist, J. and Andersen, H.M.L., 2013. Housing of sows during farrowing: a review on pen design, welfare and productivity. *Livestock Housing: Modern Management to Ensure Optimal Health and Welfare of Farm Animals; Wageningen Academic Publishers: Wageningen, Gelderland, The Netherlands*, *2*, pp.93-112.

[154] EFSA 2007. Scientific Opinion of the Panel on Animal Health and Welfare on a request from the Commission on Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. *The EFSA Journal* (2007) 572, 1-13

nest.[155] The need to perform nest building is hormonally driven and remains strongly motivated regardless of the environment.[156]

Farrowing crates, however, prevent adequate nest building.[157] This causes frustration, stress and poor welfare in sows, evidenced through behavioural and physiological measures. Sows in farrowing crates bite the bars[158], have higher stress hormone levels[159], longer farrowing durations and higher stillbirth rates.[160] Free-farrowing sows who can nest build, are shown to have lower heart rate and perform less abnormal repetitive behaviour (e.g. repetitively biting or hitting the snout against the bars).[161]

Piglet health, welfare, mortality and productivity in crates and free-farrowing systems

Insufficient space for piglets to suckle

Council Directive 2008/120/EC requires that "*piglets must have sufficient space to be able to be suckled without difficulty*." In order to accommodate this, for a moderate litter of 10 average-sized piglets, the total space of the pen should be 280cm length x 200cm width; 5.6m^2. This is based upon the average size of modern sows and piglets.[162] Yet by contrast, the median size of pens that contain farrowing crates is 3.95m^2.[163]

Piglet mortality

A common argument used against using free-farrowing systems is that piglet mortality from crushing will be higher than in crates. However, scientific studies and commercial experience show that in free-farrowing systems, which are well-designed and well-managed, piglet mortality from crushing (live-born mortality) can be comparable with that in crates, and even lower than crates when adjustments for litter size are made.[164] Coupled with this, total piglet mortality (stillborn and live-born) from all causes is usually *lower* in free-farrowing systems compared to

155 Wischner, D., Kemper, N. and Krieter, J., 2009. Nest-building behaviour in sows and consequences for pig husbandry. *Livestock Science*, *124*(1-3), pp.1-8.

156 EFSA 2007. Scientific Opinion of the Panel on Animal Health and Welfare on a request from the Commission on Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. *The EFSA Journal* (2007) 572, 1-13

157 EFSA 2007. Scientific Opinion of the Panel on Animal Health and Welfare on a request from the Commission on Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. *The EFSA Journal* (2007) 572, 1-13

158 Andersen, I.L., Vasdal, G. and Pedersen, L.J., 2014. Nest building and posture changes and activity budget of gilts housed in pens and crates. *Applied Animal Behaviour Science*, *159*, pp.29-33.

159 Lawrence, A.B., Petherick, J.C., McLean, K.A., Deans, L.A., Chirnside, J., Gaughan, A., Clutton, E. and Terlouw, E.M.C., 1994. The effect of environment on behaviour, plasma cortisol and prolactin in parturient sows. *Applied Animal Behaviour Science*, *39*(3-4), pp.313-330.

160 Gu, Z., Gao, Y., Lin, B., Zhong, Z., Liu, Z., Wang, C. and Li, B., 2011. Impacts of a freedom farrowing pen design on sow behaviours and performance. *Preventive veterinary medicine*, *102*(4), pp.296-303.

161 Damm, B.I., Lisborg, L., Vestergaard, K.S. and Vanicek, J., 2003. Nest-building, behavioural disturbances and heart rate in farrowing sows kept in crates and Schmid pens. *Livestock production science*, *80*(3), pp.175-187.

162 Pedersen, L.J., Malmkvist, J. and Andersen, H.M.L., 2013. Housing of sows during farrowing: a review on pen design, welfare and productivity. *Livestock Housing: Modern Management to Ensure Optimal Health and Welfare of Farm Animals; Wageningen Academic Publishers: Wageningen, Gelderland, The Netherlands*, *2*, pp.93-112.

163 Pedersen, L.J., Berg, P., Jørgensen, E., Bonde, M., Herskin, M.S., Knage-Rasmussen, K.M., Kongsted, A.G., Lauridsen, C., Oksbjerg, N., Poulsen, H.D., Sorensen, D., Su, G., Sørensen, M.T., Theil, P.K., Thodberg, K. and Jensen, K.H., 2010. Pattegrisedødelighed i DK: Muligheder for reduktion af pattegrisedødeligheden i Danmark. (Piglet mortality in Denmark: possibilities for reducing neonatal piglet mortality in Denmark). DJF Rapport – Husdyrbrug, vol. 86, Aarhus Universitet, Det Jordbrugsvidenskabelige Fakultet, Denmark.

164 Baxter, E.M., Lawrence, A.B. & Edwards, S.A. 2012. Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs. Animal, 6:1, pp.96-117.

crates.[165] This is because, in free-farrowing systems, there is a significantly reduced risk of death from multiple causes other than crushing.[166]

An extensive review of data, comparing 12 existing indoor free-farrowing systems against conventional crates and outdoor systems, found that designed free-farrowing pens averaged the lowest total piglet mortality (16.6%), followed very closely by outdoor (17%) and that conventional farrowing crates had the highest overall total piglet mortality (18.3%).[167] Their standardised welfare index (which accounted for both sow and piglet welfare) revealed much greater welfare in designed pens (1.64) compared to conventional crates (0.95).

Figures 21 and 22: PigSAFE Designed free-farrowing pen. © E Baxter, SRUC

In Switzerland, where farrowing crates were banned in 1997, with free-farrowing pens used exclusively since 2007, piglet losses have not increased, despite all sows being free farrowing and an increase in litter size.[168, 169]

In the UK, where outdoor free-range sows remain at about 40% of the breeding herd,[170] industry data reveals that total piglet mortality (stillborn and live-born) has been lower in free outdoor systems, compared to indoor systems (almost all of which use standard farrowing crates) for 19 of the last 20 years.[171]

There are several reasons why total piglet mortality from all causes is lower in free-farrowing systems than in crates.

165 Gu, Z., Gao, Y., Lin, B., Zhong, Z., Liu, Z., Wang, C. and Li, B., 2011. Impacts of a freedom farrowing pen design on sow behaviours and performance. *Preventive veterinary medicine*, *102*(4), pp.296-303.

166 KilBride, A.L., Mendl, M., Statham, P., Held, S., Harris, M., Cooper, S. and Green, L.E., 2012. A cohort study of preweaning piglet mortality and farrowing accommodation on 112 commercial pig farms in England. *Preventive veterinary medicine*, *104*(3-4), pp.281-291.

167 Baxter *et al*, 2012. Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs." Animal 6.01 (2012): 96-117

168 Weber, R., Keil, N.M., Fehr, M. and Horat, R., 2007. Piglet mortality on farms using farrowing systems with or without crates. ANIMAL WELFARE-POTTERS BAR THEN WHEATHAMPSTEAD-, 16(2), p.277.

169 Weber, R., Burla, J.B., Jossen, M. and Wechsler, B., 2020. Piglet Losses in Free-Farrowing Pens: Influence of Litter Size. Agrarforschung Schweiz 11: 53–58

170 Guy, J.H., Cain, P.J., Seddon, Y.M., Baxter, E.M., Edwards, S.A., 2012. Economic evaluation of high welfare indoor farrowing systems for pigs. Anim. Welf. 21, 19.

171 AHDB 2020. Pig performance trends. Available from: https://ahdb.org.uk/pig-performance-trends-and-cop-sensitivity-for-feed-and-performance. Direct link to spreadsheet: https://projectblue.blob.core.windows.net/media/Default/Pork/pig-performance-tables-and-trends-to-2019-for-web.xls

When sows have the opportunity to nest build, they have more positive maternal behaviours, higher oxytocin levels and greater suckling success.[172,173] Stillbirth rates are lower (often about half) in free-farrowing systems compared to crates.[174,175] Free-farrowing sows let down more milk; piglets also have better access to the udder. As a consequence, piglets are better fed, gain more weight, are less likely to starve or be crushed, and are heavier at weaning – all of which have positive economic benefits.[176,177]

Sows who are free at farrowing have shorter farrowing duration.[178,179] This has been shown to increase the amount of colostrum produced by the sow, meaning that piglets have a higher intake of colostrum; importantly, higher piglet birth weights and higher colostrum intake reduces the risk of piglet death before weaning.[180] Sows in free-farrowing systems may have greater feed intake than those in crates.[181] When farrowing sows have improved body condition, this can also improve colostrum yield and reduce piglet mortality and antibiotic use before weaning.[182]

Piglets in free-farrowing pens have fewer fights at the teats than those in crates, possibly due to easier access to the teats without the obstruction of the crate rails.[183] Sows who are free at farrowing are calmer, which can reduce the likelihood of savaging behaviour towards the piglets, as is sometimes seen in crates.[184]

Results improve with experience

Recent research shows that sows' prior experience of farrowing housing system affects their performance in free-farrowing pens. Sows in a free-farrowing pen who had once previously farrowed in the same pen, rather than a crate, gave better udder access to piglets, made fewer dangerous posture changes and nursed their piglets more successfully and for longer.[185] When producers make a change from crates to free-farrowing pens, performance and results tend to improve over time as not only sows, but also stockworkers, get used to the new systems and the full benefits to production are achieved.[186] In another example, a new commercial free-farrowing pen achieved 15% live-born piglet mortality on batch 1; this steadily decreased to 13% by batch

[172] Yun, J., Swan, K.M., Vienola, K., Farmer, C., Oliviero, C., Peltoniemi, O. and Valros, A., 2013. Nest-building in sows: effects of farrowing housing on hormonal modulation of maternal characteristics. *Applied Animal Behaviour Science*, *148*(1-2), pp.77-84.

[173] Oliviero, C., Heinonen, M., Valros, A., Hälli, O. and Peltoniemi, O.A.T., 2008. Effect of the environment on the physiology of the sow during late pregnancy, farrowing and early lactation. *Animal reproduction science*, *105*(3-4), pp.365-377.

[174] Gu, Z., Gao, Y., Lin, B., Zhong, Z., Liu, Z., Wang, C. and Li, B., 2011. Impacts of a freedom farrowing pen design on sow behaviours and performance. *Preventive veterinary medicine*, *102*(4), pp.296-303.

[175] AHDB 2020. Pig performance trends. Available from: https://ahdb.org.uk/pig-performance-trends-and-cop-sensitivity-for-feed-and-performance. Direct link to spreadsheet: https://projectblue.blob.core.windows.net/media/Default/Pork/pig-performance-tables-and-trends-to-2019-for-web.xls

[176] Melišová, M., Illmann, G., Chaloupková, H. and Bozděchová, B., 2014. Sow postural changes, responsiveness to piglet screams, and their impact on piglet mortality in pens and crates. *Journal of animal science*, *92*(7), pp.3064-3072.

[177] Pedersen, M.L., Moustsen, V.A., Nielsen, M.B.F. and Kristensen, A.R., 2011. Improved udder access prolongs duration of milk letdown and increases piglet weight gain. *Livestock science*, *140*(1-3), pp.253-261.

[178] Gu, Z., Gao, Y., Lin, B., Zhong, Z., Liu, Z., Wang, C. and Li, B., 2011. Impacts of a freedom farrowing pen design on sow behaviours and performance. *Preventive veterinary medicine*, *102*(4), pp.296-303.

[179] Oliviero, C., Heinonen, M., Valros, A., Hälli, O. and Peltoniemi, O.A.T., 2008. Effect of the environment on the physiology of the sow during late pregnancy, farrowing and early lactation. *Animal reproduction science*, *105*(3-4), pp.365-377.

[180] Hasan, S., Orro, T., Valros, A., Junnikkala, S., Peltoniemi, O. and Oliviero, C., 2019. Factors affecting sow colostrum yield and composition, and their impact on piglet growth and health. Livestock Science, 227, pp.60-67.

[181] Moustsen, V.A., Poulsen, H.L., 2004. Sammenligning af produktionsresultater opnået i hen606 holdsvis en traditionel kassesti og en sti til løsgående farende og diegivende søer. In. 607 Landsudvalget for Svin, Den rullende Afprøvning.

[182] Hasan, S., Orro, T., Valros, A., Junnikkala, S., Peltoniemi, O. and Oliviero, C., 2019. Factors affecting sow colostrum yield and composition, and their impact on piglet growth and health. Livestock Science, 227, pp.60-67.

[183] Pedersen, M.L., Moustsen, V.A., Nielsen, M.B.F. and Kristensen, A.R., 2011. Improved udder access prolongs duration of milk letdown and increases piglet weight gain. *Livestock science*, *140*(1-3), pp.253-261.

[184] Jarvis, S., Reed, B.T., Lawrence, A.B., Calvert, S.K. and Stevenson, J., 2004. Peri-natal environmental effects on maternal behaviour, pituitary and adrenal activation, and the progress of parturition in the primiparous sow. *Animal Welfare*, *13*(2), pp.171-181.

[185] King, R.L., Baxter, E.M., Matheson, S.M. and Edwards, S.A., 2018. Sow free farrowing behaviour: experiential, seasonal and individual variation. *Applied Animal Behaviour Science*, *208*, pp.14-21.

[186] Baxter, E. 2021. Optimising sow and piglet welfare during farrowing and lactation. In: Edwards, S. ed. Understanding the behaviour and improving the welfare of pigs. Cambridge: Burleigh Dodds Science Publishing. *In Press.* Available from: https://shop.bdspublishing.com/store/bds/detail/workgroup/3-190-89133 Publication date 26 Jan 2021.

3 and 11.7% by batch 7.[187] It is therefore important not to discount new systems based on initial results and to recognise that any change in system requires time and learning for those involved.

Outdoor (free range) farrowing systems

In some countries, dependent upon climate and land suitability, outdoor farrowing systems are used.

Compared with indoor systems (crates and free-farrowing pens), outdoor systems require significantly less initial capital investment[188], are quicker to set up, are less of a financial risk and present the lowest cost of production.[189] Outdoor farrowing has been referred to as '*the gold standard for facilitating high welfare, whilst being economically efficient*'.[190]

Figure 23: Free-range farrowing system.

Large litters are a root cause for many welfare problems, including piglet crushing

Large litter size is recognised as a significant cause of multiple welfare problems for both sows and piglets, as well as impairing production. With larger litters, the risk of piglets being crushed

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187 Andersen and Morland, 2016. Production results on the "Sow comfort" farrowing pen for loose housed sows. Proceedings of IPVS - Biennial International Congress - Ireland, 2016, Poster abstracts, Welfare and Nutrition. Also available in: Proceedings of the Free farrowing workshop 2016. Available from: https://www.freefarrowing.org/downloads/file/43/ffw_2016

188 Baxter, E.M., Lawrence, A.B. and Edwards, S.A., 2012. Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs. *Animal*, *6*(1), pp.96-117.

189 Seddon, Y.M., Cain, P.J., Guy, J.H. and Edwards, S.A., 2013. Development of a spreadsheet based financial model for pig producers considering high welfare farrowing systems. Livestock Science, 157(1), pp.317-321.

190 Baxter, E.M., Lawrence, A.B. and Edwards, S.A., 2012. Alternative farrowing accommodation: welfare and economic aspects of existing farrowing and lactation systems for pigs. *Animal*, *6*(1), pp.96-117.

increases.[191] Increasing litter size is also associated with increased piglet starvation, smaller piglets, more variable weights and decreased nursing rate, all of which can reduce profit.[192] Sows are also at greater risk of losing body condition, greater recumbency and more shoulder sores when litter size is larger.[193]

Until a few decades ago, the average litter size of the domestic sow was nine.[194] Genetic selection for litter size has increased this dramatically within a short space of time to approximately 14 total born in several European countries in 2011,[195] and as high as 16.9 live-born piglets in Denmark in 2017.[196] This is more than the number of functioning teats which is 12-14 in most Western breeds[197] and 14-15 in the very hyper-prolific Danish DanBred sow.[198]

Research shows the maximum number of piglets that a sow can take care of is no greater than the number of functional teats.[199, 200] A Scientific Opinion by EFSA on the health and welfare of sows and piglets in 2007 advised that "Genetic selection for litter size should not exceed, on average, 12 piglets born alive".[201] Despite this, genetic selection continues to increase litter size each year.[202, 203]

Because piglet mortality rate increases with litter size[204], as the number of live-born piglets increases past a threshold, the increase in successfully weaned piglets begins to flatten out, indicating that further increases in litter size are unprofitable.[205]

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191 Weary, D.M., Phillips, P.A., Pajor, E.A., Fraser, D. and Thompson, B.K., 1998. Crushing of piglets by sows: effects of litter features, pen features and sow behaviour. *Applied Animal Behaviour Science*, *61*(2), pp.103-111.

192 Ocepek, M., Newberry, R.C. and Andersen, I.L., 2017. Trade-offs between litter size and offspring fitness in domestic pigs subjected to different genetic selection pressures. Applied Animal Behaviour Science, 193, pp.7-14.

193 Rutherford, K. M. D., Baxter, E. M., Ask, B., Berg, P., D'Eath, R. B., Jarvis, S., Jensen, Karsten Klint; Lawrence, Alistair B. ; Moustsen, Vivi A. ; Robson, Sheena K. ; Thorup, Flemming ; Turner, Simon P. Sandøe, P. 2011. The ethical and welfare implications of large litter size in the domestic pig: challenges and solutions. Danish Centre for Bioethics and Risk Assessment (CeBRA). Project report, No. 17.

194 Ridgeon B 1993. cited in: Rutherford, K. M. D., Baxter, E. M., Ask, B., Berg, P., D'Eath, R. B., Jarvis, S., Jensen, Karsten Klint; Lawrence, Alistair B. ; Moustsen, Vivi A. ; Robson, Sheena K. ; Thorup, Flemming ; Turner, Simon P. Sandøe, P. 2011. The ethical and welfare implications of large litter size in the domestic pig: challenges and solutions. Danish Centre for Bioethics and Risk Assessment (CeBRA). Project report, No. 17.

195 Baumgartner 2011. Proceedings of the Free Farrowing Workshop 2011. https://www.freefarrowing.org/downloads/file/44/free_farrowing_workshop_proceedings_2011

196 Hansen C 2018. National average productivity in the pig production 2017 [In Danish: Landsgennemsnit for produktivitet i svineproduktionen 2017]. Report no. 1819. SEGES The Danish Pig Research Center, Axelborg, Copenhagen, Denmark

197 Rutherford, K. M. D., Baxter, E. M., Ask, B., Berg, P., D'Eath, R. B., Jarvis, S., Jensen, Karsten Klint; Lawrence, Alistair B. ; Moustsen, Vivi A. ; Robson, Sheena K. ; Thorup, Flemming ; Turner, Simon P. Sandøe, P. 2011. The ethical and welfare implications of large litter size in the domestic pig: challenges and solutions. Danish Centre for Bioethics and Risk Assessment (CeBRA). Project report, No. 17.

198 Moustsen VA and Nielsen MB 2017. Mammary glands and teats on Danish sows [In Danish: Mælkekirtler og patter på danske søer]. Report no. 1117. SEGES The Danish Pig Research Center, Axelborg, Copenhagen, Denmark

199 Rutherford, K. M. D., Baxter, E. M., Ask, B., Berg, P., D'Eath, R. B., Jarvis, S., Jensen, Karsten Klint; Lawrence, Alistair B. ; Moustsen, Vivi A. ; Robson, Sheena K. ; Thorup, Flemming ; Turner, Simon P. Sandøe, P. 2011. The ethical and welfare implications of large litter size in the domestic pig: challenges and solutions. Danish Centre for Bioethics and Risk Assessment (CeBRA). Project report, No. 17.

200 Andersen, I.L., Nævdal, E. and Bøe, K.E., 2011. Maternal investment, sibling competition, and offspring survival with increasing litter size and parity in pigs (Sus scrofa). Behavioral ecology and sociobiology, 65(6), pp.1159-1167.

201 EFSA 2007. Scientific Opinion of the Panel on Animal Health and Welfare on a request from the Commission on Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. *The EFSA Journal* (2007) 572, 1-13

202 Rutherford, K. M. D., Baxter, E. M., Ask, B., Berg, P., D'Eath, R. B., Jarvis, S., Jensen, Karsten Klint; Lawrence, Alistair B. ; Moustsen, Vivi A. ; Robson, Sheena K. ; Thorup, Flemming ; Turner, Simon P. Sandøe, P. 2011. The ethical and welfare implications of large litter size in the domestic pig: challenges and solutions. Danish Centre for Bioethics and Risk Assessment (CeBRA). Project report, No. 17.

203 Andersen, I.L., Nævdal, E. and Bøe, K.E., 2011. Maternal investment, sibling competition, and offspring survival with increasing litter size and parity in pigs (Sus scrofa). Behavioral ecology and sociobiology, 65(6), pp.1159-1167.

204 Baxter, E.M. and Edwards, S.A., 2018. Piglet mortality and morbidity: Inevitable or unacceptable?. In *Advances in pig welfare* (pp. 73-100). Woodhead Publishing.

205 Weber, R., Burla, J.B., Jossen, M. and Wechsler, B., 2020. Piglet Losses in Free-Farrowing Pens: Influence of Litter Size. Agrarforschung Schweiz 11: 53–58

Strategies used to compensate for the problems generated by over-large litters include the farrowing crate, cross-fostering / use of nurse sows (removing excess piglets and putting them on a different sow), early weaning (to reduce demand on the sow), artificial mothering (removal of excess piglets to be fed by a milk machine), increased antibiotic provision (particularly to compensate for effects of early weaning), and tooth grinding. All of these strategies entail welfare problems for either the piglets, sows, or both.[206, 207, 208, 209, 210] Breeding for responsible litter sizes, therefore, has potential to improve welfare in many areas as well as increasing success of free-farrowing systems.

Progress in Europe

The Danish Ministry has an animal welfare label, all three levels of which require free farrowing (the highest level requiring outdoor free-range farrowing).[211]

Austria and Germany have recently made legislative changes that will permit temporary use of crates only (for around 5-7 days in total), known as 'routine temporary crating'. However, Sweden (1988), Norway (2000) and Switzerland (banned 1997; phased out by 2007) have complete bans on the routine use of farrowing crates. In these countries, sows must be free throughout farrowing and lactation. Confinement of a sow (for a few days only) is permitted in exceptional cases only.

In Finland, a significant proportion of the industry has moved to temporary crating in the past 2 years, supported by a governmental animal welfare subsidy system.[212,213] However, recently, a Ministry of Agriculture free-farrowing working group concluded that the term 'free farrowing' does not permit routine temporary crating, and that government subsidies will now be restricted to true free-farrowing systems only.[214] As such, further investments by industry are more likely to involve true free-farrowing pens, rather than temporary crating systems.[215]

Free-farrowing success requires a true free-farrowing pen

It is important to note that pens which are designed for temporary crating of the sow during farrowing and for a few days afterwards, often do not have the appropriate design (quantity and quality of space) to function well as a true free-farrowing pen. As such, temporary crating pens that are used 'open' are more likely to yield poor results than a pen that is principally designed to be used without confinement.[216, 217] One reason for this may be the smaller size of these pens: smaller pens may prevent the sow from grouping her piglets together before she lies down, thus increasing the risk of

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206 Rzezniczek M, Gygax L, Wechsler B and Weber R 2015. Comparison of the behaviour of piglets raised in an artificial rearing system or reared by the sow. Applied Animal Behaviour Science 165, 57–65.

207 Schmitt O, Baxter EM, Boyle LA and O'Driscoll K 2018a. Nurse sow strategies in the domestic pig: I. Consequences for selected measures of sow welfare. Animal 13, 580–589.

208 Schmitt O, Baxter EM, Boyle LA and O'Driscoll K 2018b. Nurse sow strategies in the domestic pig: II. Consequences for piglet growth, suckling behaviour and sow nursing behaviour. Animal 13, 590–599.

209 Sørensen JT, Rousing T, Kudahl AB, Hansted HJ and Pedersen LJ 2016. Do nurse sows and foster litters have impaired animal welfare? Results from a crosssectional study in sow herds. Animal 10, 681–686.

210 EFSA 2007. Scientific Opinion of the Panel on Animal Health and Welfare on a request from the Commission on Animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. *The EFSA Journal* (2007) 572, 1-13

211 Ministry of Environment and Food of Denmark, 2017. https://www.foedevarestyrelsen.dk/english/Animal/AnimalWelfare/Pages/New_animal_welfare_label_will_win_the_hearts_of_Danes.aspx

212 https://snellman.fi/fi/meidan-tapamme/jo-neljasosa-snellmanin-emakkotiloista-siirtynyt-vapaaporsitukseen-yksi-viisivuotisen-strategiakauden-paakohtia/

213 https://www.atria.fi/konserni/ajankohtaista/atriablogi/blogaukset/oikeasti-parempaa-hyvinvointia/

214 https://mmm.fi/-/vapaaporsitustyoryhman-tyo-valmistunut

215 Pers. comm. Professor Anna Valros 25.11.2020

216 Baxter, E. 2021. Optimising sow and piglet welfare during farrowing and lactation. In: Edwards, S. ed. Understanding the behaviour and improving the welfare of pigs. Cambridge: Burleigh Dodds Science Publishing. *In Press.* Available from: https://shop.bdspublishing.com/store/bds/detail/workgroup/3-190-89133 Publication date 26 Jan 2021.

217 Report of the Loose Lactating Sows Workshop 2018. Discussion in: Austria restricts crating of sows in farrowing pens to the 'critical period' of piglets life – Johannes Baumgartner, pp 306-7. Available from: https://www.freefarrowing.org/downloads/file/49/lls18_proceedings

crushing.[218] Temporary crating pens also lack the other design features of true free-farrowing pens which optimise maternal behaviour and maximise performance.[219,220] Therefore, for free-farrowing success, a true free-farrowing pen design should be used, which has appropriate design features and sufficient space.[221] There is a wide range of these pens available in Europe.[222] Many are listed on the *freefarrowing.org* website, which also provides economic costing tools for producers that are considering a change of system, farrowing research, expert advice and support for the conversion to and management of free-farrowing systems.[223]

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218 Weber, R., Keil, N.M., Fehr, M. and Horat, R., 2009. Factors affecting piglet mortality in loose farrowing systems on commercial farms. *Livestock Science*, *124*(1-3), pp.216-222.

219 Baxter, E.M., Lawrence, A.B. and Edwards, S.A., 2011. Alternative farrowing systems: design criteria for farrowing systems based on the biological needs of sows and piglets. *Animal*, *5*(4), p.580.

220 Baxter, E.M., Andersen, I.L. and Edwards, S.A., 2018. Sow welfare in the farrowing crate and alternatives. In *Advances in Pig Welfare* (pp. 27-72). Woodhead Publishing.

221 Baxter, E. 2021. Optimising sow and piglet welfare during farrowing and lactation. In: Edwards, S. ed. Understanding the behaviour and improving the welfare of pigs. Cambridge: Burleigh Dodds Science Publishing. *In Press.* Available from: https://shop.bdspublishing.com/store/bds/detail/workgroup/3-190-89133 Publication date 26 Jan 2021.

222 Baxter, E.M., Andersen, I.L. and Edwards, S.A., 2018. Sow welfare in the farrowing crate and alternatives. In *Advances in Pig Welfare* (pp. 27-72). Woodhead Publishing.

223 https://www.freefarrowing.org/

V. Health, welfare and production of farmed rabbits in cage and non-cage systems

Figure 24: Conventional barren cages for growing (meat) rabbits.

- Most commercially farmed rabbits in Europe are kept in conventional barren wire cages. Meat (growing) rabbits are caged in small groups while female breeding rabbits are usually caged individually
- EFSA (2020) conclude that conventional cages have the worst welfare impact for both growing rabbits and breeding females
- Cages cannot provide enough space, either horizontal or vertical, for a range of fundamental natural behaviours, including lying comfortably, hopping, running, hiding, and performing natural vigilance behaviours
- Restriction of movement in cages can result in weakened bones
- Wire flooring causes painful sores on the feet of rabbits kept for breeding
- Rabbits housed in cages show higher levels of stereotypies (abnormal repetitive behaviours) and more fear of humans, and these problems are exacerbated if rabbits are kept in social isolation
- A variety of non-cage systems for growing rabbits are available and successfully in use commercially, including indoor pens and parks, and outdoor free range and organic systems
- In Belgium, cages for growing rabbits are banned. Legislation provides minimum standards for park systems including requirements for space, stocking density and enrichment
- For breeding females, aggression need not be a serious problem in group-housing systems if rabbits are kept in compatible groups in well-designed systems with sufficient space and adequate nesting facilities
- Unlike cages, non-cage systems for rabbits have the potential to provide good welfare if they are well-designed and well-managed

Rabbit behaviour

Rabbits were domesticated only relatively recently compared with many other farmed animals and their behaviour has been little altered by domestication.[224] [225] In a natural environment, rabbits dig a large and complex system of burrows (a warren) which they use for resting, hiding and rearing their young (kits).[226]

Rabbits are highly social animals, living in stable groups typically of between two and nine adult females (does), one to three adult males (bucks) and their offspring.[227] Fights are rare because the group hierarchy is clearly defined.[228] They spend much of their time resting in groups in close contact with other rabbits[229] and strong relationships develop between specific individuals, who will choose to remain close to each other and rest together, often in body contact.[230] Mutual grooming is an important behaviour to reinforce social bonds.[231]

Figure 25: Free-range rabbit farm, France. Rabbits need space to exercise, to escape to a perceived safe distance; and shelters to hide in.

Under semi-natural conditions, rabbits spend between 30% and 70% of their time searching for food and eating.[232] They feed mainly at dusk and dawn and at intervals during the night.[233]

Cages, including enriched cages, cannot meet the needs of rabbits

Most commercially-farmed rabbits in Europe are kept in conventional barren wire cages (see figures 22 and 24); such cages are used for females kept for breeding, a lactating doe and her litter, and for pairs or small groups of growing rabbits reared for meat. These cages are equipped only with a feeder, drinker and, in the case of breeding does with kits (baby rabbits), a nest area. In some cases, there may be a plastic 'footrest' covering part of the wire floor. No enrichment is provided except for nesting material in the nest. Some rabbits are kept in enriched cages (see figure 25), which typically have greater floor area and height, plastic footrests and elevated platforms and, sometimes, enrichment objects such as a stick for gnawing.

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224 Kraft (1979) A comparison of the behaviour of wild and domestic rabbits. 1. An inventory of the behaviour of wild and domestic rabbits. *Zeitschrift fur Tierzuchtung und Zuchtungsbiologie* 95: 140-162.

225 Sandford, JC (1992) Notes on the history of the rabbit. *Journal of Applied Rabbit Research* 15: 1-28.

226 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

227 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

228 Trocino, A; Xiccato, G. (2006) Animal welfare in reared rabbits: a review with emphasis on housing conditions. *World Rabbit Science*, 14: 77-93.

229 Trocino, A; Xiccato, G. (2006) Animal welfare in reared rabbits: a review with emphasis on housing conditions. *World Rabbit Science*, 14: 77-93.

230 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

231 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

232 Trocino, A; Xiccato, G. (2006) Animal welfare in reared rabbits: a review with emphasis on housing conditions. *World Rabbit Science*, 14: 77-93.

233 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

Figure 26: Growing (meat) rabbits, Italy. Insufficient space to lie, to rise up, to hide, let alone to exercise.

Figure 27: Enriched cage for growing rabbits. Has a platform for vigilance behaviour, but still no space to hide or exercise. Will become more crowded as the rabbits grow.

Inadequate space and height

A conventional cage for non-pregnant breeding females or for growing rabbits typically measures 38cm x 43.5-66cm, providing a total surface area of 1650-2510cm^2.[234] A standard dual-purpose cage for a breeding doe with kits or a small group of growing rabbits typically measures 38cm x 87-102cm, providing a total surface area of 3300-3900cm^2.[235] Enriched cages typically measure 38-52.5 x 95-102cm, providing a total surface area of 4370-6400cm^2.[236] Conventional cages typically have a height of 28-41cm and enriched cages 60-80cm.[237]

Rabbits typically move by hopping, with a medium-sized rabbit covering around 70cm of ground with each hop; during grazing, they move more slowly.[238] Rabbits are athletic and agile animals; they can run at speeds of up to 30km/h, jump higher than a metre and make sudden changes of direction by zigzagging.[239] They have highly sensitive senses of smell and hearing and they are very alert animals, regularly interrupting activities to check for danger by sitting or rearing up on their hind legs with ears erect in a 'lookout' posture.[240]

A single adult rabbit requires a length of at least 80cm to lie in a species-typical resting position, combined with a width of at least 68cm to allow the rabbit to turn around and change postures.[241] This would equate to a floor area of 5440cm^2. Therefore, conventional cages, and some enriched cages, do not even provide enough space for a single adult rabbit to lie down, turn around and change position easily. A much greater area is necessary to allow a rabbit to move around normally by hopping or to achieve any meaningful exercise.

The EFSA Animal Health and Welfare Panel states:[242]

> *"When housed in small groups the total area available (functional space) does not allow rabbits to express normal behaviours such as hopping - a single hop for a 2.0kg rabbit requires at least 70cm. Other locomotory behaviours and gamboling (multiple hops) are also very restricted."*

The Panel recommends:[243]

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234 EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), Saxmose Nielsen, S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gort_azar, Schmidt C, Michel V, Miranda Chueca M_A, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde Calvo, A, Viltrop A, Buijs S, Edwards S, Candiani D, Mosbach-Schulz O, Van der Stede Y and Winckler C, 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

235 EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), Saxmose Nielsen, S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gort_azar, Schmidt C, Michel V, Miranda Chueca M_A, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde Calvo, A, Viltrop A, Buijs S, Edwards S, Candiani D, Mosbach-Schulz O, Van der Stede Y and Winckler C, 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

236 EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), Saxmose Nielsen, S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gort_azar, Schmidt C, Michel V, Miranda Chueca M_A, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde Calvo, A, Viltrop A, Buijs S, Edwards S, Candiani D, Mosbach-Schulz O, Van der Stede Y and Winckler C, 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

237 EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), Saxmose Nielsen, S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gort_azar, Schmidt C, Michel V, Miranda Chueca M_A, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde Calvo, A, Viltrop A, Buijs S, Edwards S, Candiani D, Mosbach-Schulz O, Van der Stede Y and Winckler C, 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

238 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

239 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

240 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

241 Gunn-Dore, D (1997) Comfortable quarters for laboratory rabbits. In Reinhardt, V (ed.), *Comfortable Quarters for Laboratory Animals*, pp. 46-54. Animal Welfare Institute, Washington, DC.

242 EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

243 EFSA (2005) Scientific Opinion of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. *The EFSA Journal,* 267: 1-31.

"To facilitate normal locomotory abilities and physiological development, young growing rabbits should be allowed adequate space to perform their natural behaviours e.g. play, sequences of hopping steps."

Inadequate space allowance interferes with social interaction in caged growing rabbits. Vervaecke *et al.* (2010)[244] investigated hierarchy formation in groups of eight growing rabbits housed in cages from four to 12 weeks of age with a total floor area of $0.72m^2$. This is equivalent to a floor space allowance of $0.09m^2$ per rabbit. The male and female rabbits did not form separate hierarchies, in contrast to their natural tendencies. The authors suggest that this could be a result of a lack of freedom to interact normally due to the high stocking density.

Restricted opportunities for exercise in cages can also lead to weakened bones. Combes *et al.* (2010)[245] found that the fracture resistance of rabbit leg bones was significantly increased by housing in large pens (floor area $4.052m^2$) with an elevated platform compared with housing in conventional cages ($0.385m^2$). Fracture resistance was intermediate in small pens ($0.662m^2$) with an elevated platform. The stocking density was the same in all housing systems (15 rabbits/m^2).

The height of conventional cages, and many enriched cages, is insufficient to allow rabbits to adopt some normal postures, such as sitting up on the hind legs, or to make some normal movements, such as jumping. A minimum height of 75cm is necessary for rabbits to sit in the species-typical "lookout" posture.[246]

Lack of enrichment and environmental complexity

Stereotypies are abnormal repetitive behaviours.[247] Stereotypies are caused by stress or deprivation[248] thought to be associated with a lack of environmental stimuli and lack of control over the environment.[249] The occurrence of stereotypic behaviour is therefore considered to be an indicator of poor welfare.

Stereotypies, such as repetitive gnawing, nibbling or licking at the cage, are common in caged rabbits.[250] Other abnormal behaviours are also seen in caged rabbits, such as excessive grooming.[251] These stereotypies and other abnormal behaviours are associated with the barren cage environment. The EFSA AHAW Panel states:[252]

"Animals kept in restricted and unenriched conditions are more likely to show stereotypic behaviours."

Farmed rabbits are generally fed on pelleted feed which takes very little time to eat compared with more natural feed such as hay or other forages. A number of stereotypies in other species are considered to be caused by frustrated motivation to perform natural foraging and feeding behaviour. Examples include sham-chewing in sows, tongue-rolling in cattle and crib-biting in

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[244] Vervaecke, H; Bonte, L de; Maertens, L; Tuyttens, F; Stevens, JMG; Lips, D (2010) Development of hierarchy and rank effects in weaned growing rabbits (*Oryctolagus cuniculus*). *World Rabbit Science*, 18: 139-149.

[245] Combes, S; Postollec, G; Cauquil, L; Gidenne, T (2010) Influence of cage or pen housing on carcass traits and meat quality of rabbit. *Animal*, 4: 295-302.

[246] Gunn-Dore, D (1997) Comfortable quarters for laboratory rabbits. In Reinhardt, V (ed.), *Comfortable Quarters for Laboratory Animals*, pp. 46-54. Animal Welfare Institute, Washington, DC.

[247] Rushen, J; Mason, G. (2006) A decade-or-more's progress in understanding stereotypic behaviour. In Mason, G and Rushen, J (eds.), *Stereotypical Animal Behaviour: Fundamentals and Applications*, 2nd Edition, pp.1-18. CABI, Wallingford.

[248] Rushen, J; Mason, G. (2006) A decade-or-more's progress in understanding stereotypic behaviour. In Mason, G and Rushen, J (eds.), *Stereotypical Animal Behaviour: Fundamentals and Applications*, 2nd Edition, pp.1-18. CABI, Wallingford.

[249] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

[250] Broom, DM; Fraser, AF (2007) *Domestic Animal Behaviour and Welfare*, 4th Edition (Chapter 34: The welfare of farmed and pet rabbits, pp. 316-317). CABI, Wallingford.

[251] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

[252] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

horses.[253] Since rabbits would naturally spend between 30% and 70% of their time foraging for food and eating,[254] a lack of forage in the diet is also likely to play a role in the development of stereotypies in farmed rabbits.

Providing rabbits with forage, litter material and wooden objects for gnawing improves welfare and reduces the frequency of abnormal behaviours, such as cage gnawing/nibbling and over-grooming.[255] The EFSA AHAW Panel states:[256]

> *"Straw, hay or wood supplements have been shown to be a way of reducing stereotypies such as 'cage gnawing'"*

Females who are being reared for breeding and adult males are likely to be particularly badly affected by a lack of enrichment as they are often fed on a restricted diet.[257] The EFSA AHAW Panel recommends:[258]

> *"Feed restricted animals should have access to objects they can gnaw."*

The provision of litter material for farmed rabbits can reduce stereotypic behaviour and over-grooming, increase play and exploratory behaviour[259] [260] and may also reduce injuries and disease.[261]

A number of studies indicate that enrichment with wooden objects for gnawing can improve rabbit welfare, decreasing oral stereotypies,[262] [263] aggression and injuries,[264] [265] without any negative effects on productive performance.[266] Novel food items can also provide valuable enrichment for rabbits, reducing fur damage and improving productive performance.[267]

The welfare of rabbits can also be improved by providing a more complex environment with opportunities for hiding and retreat, such as elevated platforms, partitions, tunnels, pipes or

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[253] Bergeron, R; Badnell-Waters, AJ; Lambton, S; Mason, G (2006) Stereotypic oral behaviour in captive ungulates: foraging, diet and gastrointestinal function. In Mason, G and Rushen, J (eds.), *Stereotypical Animal Behaviour: Fundamentals and Applications*, 2nd Edition, pp.19-57. CABI, Wallingford.

[254] Trocino, A; Xiccato, G. (2006) Animal welfare in reared rabbits: a review with emphasis on housing conditions. *World Rabbit Science*, 14: 77-93.

[255] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

[256] EFSA (2005) Scientific Opinion of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. *The EFSA Journal,* 267: 1-31.

[257] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), Saxmose Nielsen, S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gort_azar, Schmidt C, Michel V, Miranda Chueca M_A, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde Calvo, A, Viltrop A, Buijs S, Edwards S, Candiani D, Mosbach-Schulz O, Van der Stede Y and Winckler C, 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

[258] EFSA (2005) Scientific Opinion of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. *The EFSA Journal,* 267: 1-31.

[259] Siloto, E. V; Zeferino, C. P; Moura, A. S. A. M. T; Fernandes, S; Sartori, J. R; Siqueira, E. R. de (2009) [Temperature and environmental enrichment on the welfare of growing rabbits.] *Ciência Rural*, 39: 528-533.

[260] Jekkel, G; Milisits, G; Nagy, I (2010) Effect of alternative rearing methods on the behaviour and on the growth and slaughter traits of growing rabbits. *Archiv Tierzucht*, 53: 205-215.

[261] Trocino, A (2005) [Rabbit welfare, European recommendations.] *Rivista di Coniglicoltura*, 42 (3): 9-15.

[262] Verga, M. ; Zingarelli, I. ; Heinzl, E. ; Ferrante, V. ; Martino, P. A. ; Luzi, F. Effect of housing and environmental enrichment on performance and behaviour in fattening rabbits. *Proceedings of the 8th World Rabbit Congress,* 7th – 10th September, 2004, Puebla, Mexico, pp. 1283-1288.

[263] Princz, Z; Orova, Z; Nagy, I; Jordan, D; Šuhec, I; Luzi, F; Verga, M; Szendrő, Z (2007) Application of gnawing sticks in rabbit housing. *World Rabbit Science*, 15: 29-36.

[264] Princz, Z; Zotte, A. D; Radnai, I; Bíró-Németh, E; Matics, Z; Gerencsér, Z; Nagy, I; Szendrő, Z (2008) Behaviour of growing rabbits under various housing conditions. *Applied Animal Behaviour Science*, 111: 342-356.

[265] Princz, Z; dalle Zotte, A; Metzger, S; Radnai, I; Biró-Németh, E; Orova, Z; Szendrő, Z. (2009) Response of fattening rabbits reared under different housing conditions. 1. Live performance and health status. *Livestock Science*, 121: 86-91.

[266] Verga, M. ; Zingarelli, I. ; Heinzl, E. ; Ferrante, V. ; Martino, P. A. ; Luzi, F. Effect of housing and environmental enrichment on performance and behaviour in fattening rabbits. *Proceedings of the 8th World Rabbit Congress,* 7th – 10th September, 2004, Puebla, Mexico, pp. 1283-1288.

[267] Gugolek, A; Lorek, MO; Janiszewski, P (2008) Effect of application of onion bulbs and birch twigs on production performances of rabbits. *Journal of Applied Animal Research*, 34: 189-192.

boxes.[268] Elevated platforms may be particularly important for breeding does in order to provide an area for resting and retreat where they can get away from their kits.[269] The inability of caged rabbits to hide, retreat or perform horizon-scanning vigilance behaviours contributes to increased fearfulness in caged rabbits. Fear levels have been found to be lower in rabbits in an outdoor system compared with rabbits caged indoors.[270]

Social isolation of breeding rabbits

Rabbits are highly social animals and would naturally spend much of their time in close contact with other rabbits, forming strong relationships with specific individuals.[271] [272] The housing of breeding rabbits in individual cages therefore represents a major welfare insult. Broom and Fraser (2007) state:[273]

> *"Lack of social contact is a serious deprivation for a rabbit, so the welfare of those kept in social isolation will be poor."*

Figure 28: Breeding rabbits kept in isolation, Greece. Wire floors lead to sore hocks which EFSA states are "likely to be very painful" and "a cause of chronic suffering".

Individually-caged rabbits show more abnormal stereotypic behaviour than rabbits housed in groups.[274] [275] Group housing increases the functional space available to the animals, providing

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[268] Boers, K; Gray, G; Love, J; Mahmutovic, Z; McCormick, S; Turcotte, N; Zhang, Y (2002) Comfortable quarters for rabbits in research institutions. In Reinhardt, V and Reinhardt, A (eds.), *Comfortable Quarters for Laboratory Animals*, 9th Edition, pp. 43-49. Animal Welfare Institute, Washington, DC.

[269] Stauffacher, M (1992) Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal Welfare*, 1: 105-125.

[270] D'Agata, M; Preziuso, G; Russo, C; Dalle Zotte, A; Mourvaki, E; Paci, G (2009) Effect of an outdoor rearing system on the welfare, growth performance, carcass and meat quality of a slow growing rabbit population. *Meat Science*, 83: 691-696.

[271] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

[272] Trocino, A; Xiccato, G. (2006) Animal welfare in reared rabbits: a review with emphasis on housing conditions. *World Rabbit Science*, 14: 77-93.

[273] Broom, DM; Fraser, AF (2007) *Domestic Animal Behaviour and Welfare*, 4th Edition (Chapter 34: The welfare of farmed and pet rabbits, pp. 316-317). CABI, Wallingford.

[274] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

[275] Podberscek, AL; Blackshaw, JK; Beattie AW (1991) The behaviour of group penned and individually caged laboratory rabbits. *Applied Animal Behaviour Science*, 28: 353-363.

greater opportunities for exercise and the expression of normal behaviour. Group-housed rabbits express a considerably enhanced behavioural repertoire compared with singly-caged rabbits.[276] [277] In addition, group-housed rabbits are less fearful of humans than individually-housed rabbits.[278] [279]

Does will work for access to limited social contact (contact with another doe through wire mesh); research shows their motivation for social contact comes close to that for food, indicating that this is highly valued.[280] Dal Bosco *et al.* (2020)[281] investigated the behaviour of does kept in test cages with free choice to move between a seclusion zone (each doe had access to her own seclusion zone only, by means of electronic identification) and a group zone. Feed and drink were available in both the group zone and the seclusion zone. Nests were located in the seclusion zones.

Nulliparous rabbit does spent around half of their time (50.39%) in the group area and does with kits spent more than a quarter of their time (28.1%) in the group area, on average. There were significant variations between different rabbits and at different times, with some does (probably the lower-ranking ones) preferring to spend more time in the secluded area and others (probably the higher-ranking ones) preferring to spend more time in the group area. In this experiment, the does with kits did not show any body lesions, probably due to the use of electronic identification, which prevented aggressive does from accessing nest boxes other than their own.

These findings indicate that some social contact is important to does, including low-ranking does and does with kits, but that does also choose to spend some time away from the group. Systems which allow does to choose between individual and communal areas are likely to have substantial welfare benefits.

Pododermatitis in breeding rabbits

The cage floor is often made of bare wire mesh, which is uncomfortable for resting and locomotion and can cause sores on the feet, called "sore hocks" or "*pododermatitis ulcerosa*", which are painful and can become infected.[282] Sore hocks are very common in breeding does and bucks kept for long periods on wire mesh floors. Lesions vary in severity from a simple thickening of the skin to bloody ulcers, which the EFSA AHAW Panel states are *"likely to be very painful"*.[283] Sore hocks can cause chronic poor welfare and are often so severe that it is necessary to cull the affected animal.[284] The EFSA AHAW Panel states:[285]

> *"Sore hocks, or pododermatitis ulcerosa, is a common condition related to modern production system of rabbits on cages with wire mesh floors... Sore hocks is a cause of chronic suffering."*

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[276] Gunn-Dore, D (1997) Comfortable quarters for laboratory rabbits. In Reinhardt, V (ed.), *Comfortable Quarters for Laboratory Animals*, pp. 46-54. Animal Welfare Institute, Washington, DC.

[277] Mugnai, C; Dal Bosco, A and Castellini, C (2009) Effect of different rearing systems and pre-kindling handling on behaviour and performance of rabbit does. Applied Animal Behaviour Science, 118: 91-100.

[278] Trocino, A; Majolini, D; Tazzoli, M; Filiou, E; Xiccato, G (2013) Housing of growing rabbits in individual, bicellular and collective cages: Fear level and behavioural patterns. *Animal*, 7(4): 633-639.

[279] Baumann, P; Oester, H; Stauffacher, M (2005) The use of a cat-flap at the nest entrance to mimic natural conditions in the breeding of fattening rabbits (*Oryctolagus cuniculus*). *Animal Welfare*, 14: 135-142.

[280] Seaman, SC; Waran, NK; Mason, G and D'Eath, RB (2008) Animal economics: Assessing the motivation of female laboratory rabbits to reach a platform, social contact and food. *Animal Behaviour*, 75:31-42.

[281] Dal Bosco, A; Mancinelli, AC; Hoy, S; Martino, M; Mattioli, S; Cotozzolo, E; Castellini, C (2020) Assessing the preference of rabbit does to social contact or seclusion: Results of different investigations. *Animals*, 10: 286.

[282] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

[283] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

[284] EFSA (2005) Scientific Opinion of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. *The EFSA Journal,* 267: 1-31.

[285] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

The incidence of pododermatitis can be reduced by the use of plastic 'footrests' covering part of the wire floor in cages and can be further reduced or eliminated by housing on plastic slatted flooring instead of wire.[286] Although mostly an issue associated with cage systems, pododermatitis can also affect rabbits in littered systems on solid floors[287] if the litter is not properly managed to maintain a dry surface.

Non-cage systems

Unlike cages, non-cage systems have potential to provide good welfare for farmed rabbits. They can provide greater freedom of movement, sufficient space for meaningful enrichment and opportunities to express natural behaviours. When well-designed and managed, such systems can result in vastly improved health and welfare compared to cages.

A variety of non-cage systems exist, including elevated pens (also termed park systems), floor pens, and outdoor free-range or organic systems. Elevated pen systems, designed to meet the requirements of Belgian legislation banning cage systems for growing rabbits, typically measure 212cm x 120cm (providing a total floor area of at least 800cm^2 per growing rabbit) and have an open top (no height restriction) – see figures 27 and 28). Belgian law also requires the provision of platforms, tunnels, gnawing equipment and more comfortable lying areas. Enrichment materials such as a block of wood, straw, hay, carrots and other suitable substrates must be provided.[288]

Figures 29 and 30: Park system (elevated pen) developed to meet the new requirements of Belgian law, which requires a minimum space, maximum stocking density plus the provision of platforms, tubes, gnawing blocks and enrichment material such as hay or straw. Park systems are widely in use throughout Belgium.

Systems with larger pens and more space per rabbit have also been developed (sometimes called barn systems; see figures 29 and 30). Floor pens also have an open top, with partially or completely solid flooring (see figure 31).

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[286] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), Saxmose Nielsen, S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gort_azar, Schmidt C, Michel V, Miranda Chueca M_A, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde Calvo, A, Viltrop A, Buijs S, Edwards S, Candiani D, Mosbach-Schulz O, Van der Stede Y and Winckler C, 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

[287] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), Saxmose Nielsen, S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gort_azar, Schmidt C, Michel V, Miranda Chueca M_A, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde Calvo, A, Viltrop A, Buijs S, Edwards S, Candiani D, Mosbach-Schulz O, Van der Stede Y and Winckler C, 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

[288] Belgium, 2014. Arrêté Royal relatif au bien-être des lapins dans les élevages. Moniteur Belge [C – 2014/24303], 60861–60864. http://environnement.wallonie.be/legis/bienetreanimal/bienetre004.html (accessed 11.01.21)

Non-cage systems can provide greater functional space, elevated platforms for vigilance behaviours, opportunities for hiding and retreat (e.g. tubes, space underneath platforms, covered resting areas), and access to fibrous food and objects for gnawing. Some systems provide bedding material (usually straw), which provides for comfort and natural behaviour. Currently, the majority of commercial facilities avoid this to reduce disease risk and mortality.

Figures 31 and 32: "Barn" system (large elevated pens), Germany. Includes platforms for vigilance behaviour, hiding spaces, hay-racks to provide fibrous food and space for some exercise.

Figure 33: Higher-welfare indoor floor pen system, Austria. A bedded hiding area is underneath the raised platform. ©VGT

Figure 34: Higher-welfare indoor system, Lapin & Bien, France. Includes "burrow-style" resting area. ©Lapin & Bien

Free-range systems may have fixed or movable housing with access to an outdoor area (see Figures 23 and 33). Organic systems require access to an outdoor run with vegetation, preferably pasture; a covered shelter including dark hiding places; solid-floored bedded lying area; a raised platform on which rabbits can sit; nesting material for all nursing does; feeding based on pasture and forage; use of robust breeds suited to outdoor conditions and avoidance of antibiotics.[289] Cages are banned in organic systems for all farmed animal species.

Non-cage systems (mostly elevated pens (parks) but also barn systems, floor pens, free-range and organic systems) are being used successfully for growing rabbits in several European countries, and a number of countries have introduced legislation to improve housing systems for rabbits.

Figure 35: Free-range rabbit farm, France.

Managing aggression in breeding does in non-cage systems

The use of non-cage systems for breeding does is relatively rare currently and commercial development of these systems lags behind that for most other species. Aggression between does is often cited as the main obstacle to wider adoption of non-cage systems for breeding does, however, design and management strategies can alleviate this.

When does are housed in groups, several studies have reported issues with aggression and injuries, pseudopregnancy, and double-littering (where more than one doe uses the same nest box) and subsequent high kit mortality.[290] However, it is important to note that many studies have investigated pair housing and group housing of does in relatively barren cage systems with restricted space and limited environmental enrichment – conditions that may prohibit the

[289] REGULATION (EU) 2018/848 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0848&from=EN (accessed 07.01.20).

[290] Szendro, ZS; Trocino, A; Hoy, ST; Xiccato, G; Villagra, A; Maertens, L (2019) A review of recent research outcomes on the housing of farmed domestic rabbits: Reproducing does. *World Rabbit Science*, 27: 1-14.

expression of species-typical dominance-submission displays and thus prevent the establishment and maintenance of stable social groups.[291]

One approach to try to minimise issues with aggression, injuries, double-littering and pseudopregnancy is to adopt part-time group housing, with does housed singly for the period between littering (giving birth) and insemination. This is common in commercial group housing systems for does in Switzerland.[292] This must be managed carefully to minimise the risk that isolation and subsequent regrouping triggers aggressive behaviour,[293] especially if new does are introduced at regrouping, which is common on farms using artificial insemination.[294] This is reflected in higher levels of lesions on farms where does have a period of isolation compared to farms with continuous group housing.[295]

Even if does are regrouped with the same does, the isolation process itself may trigger aggression if hierarchies are not maintained without physical contact.[296] On commercial farms with buck management, the does are usually regrouped only when several does die or fail to reproduce, so groups are usually more stable.[297] Andrist *et al.* (2012)[298] conclude that aggression, stress and injuries could potentially be reduced considerably through the refinement of reproduction management and recommend keeping the group composition of rabbit does stable for as long as possible rather than repeatedly isolating and regrouping does.

When unfamiliar does are first introduced, aggression can be minimised by providing sufficient space and barriers that allow contact whilst preventing injury.[299] Valuska and Mench (2013)[300] recorded a total of 47 bites among pairs of unfamiliar does first introduced in a small enclosure (the size of a double cage: 0.76m x 1.22m x 0.61m) compared with just a single bite among pairs first introduced in a larger enclosure (1.22m x 1.22m x 0.61m) (both enclosures contained barriers that allowed visual, auditory and olfactory contact, mutual grooming and bites to occur, but prevented animals from being pursued and attacked). Does first introduced in the larger enclosure showed less aggression and more affiliative behaviour, not only during the initial meeting, but also after separation and subsequent regrouping in a smaller enclosure.

Aggression need not be a serious problem if rabbits are kept in compatible groups (groups of does only or of does with a single buck) in well-designed systems, with sufficient space and adequate nesting facilities.[301] Several further studies demonstrate that it is possible to keep does successfully in groups without significant aggression and injuries if they are kept in stable groups

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291 DiVincenti, L Jr; Rehrig, AN (2016) The social nature of European rabbits (*Oryctolagus cuniculus*). *Journal of the American Association for Laboratory Animal Science*, 55: 729-736.

292 Compassion in World Farming (2015) Case study: Group housing for does. https://www.compassioninfoodbusiness.com/media/7427861/kani-swiss-case-study-on-group-housing-for-does.pdf (accessed 23.12.20)

293 Andrist, CA; Bigler; LM, Wurbel, H and Roth, BA (2012) Effects of group stability on aggression, stress and injuries in breeding rabbits. *Applied Animal Behaviour Science*, 142: 182-188

294 Andrist, CA; van den Borne, BHP; Bigler, LM; Buchwalder, T (2013) Epidemiological survey in Swiss group-housed breeding rabbits: Extent of lesions and potential risk factors. *Preventive Veterinary Medicine*, 108: 218-224.

295 Andrist, CA; van den Borne, BHP; Bigler, LM; Buchwalder, T (2013) Epidemiological survey in Swiss group-housed breeding rabbits: Extent of lesions and potential risk factors. *Preventive Veterinary Medicine*, 108: 218-224.

296 Andrist, CA; van den Borne, BHP; Bigler, LM; Buchwalder, T (2013) Epidemiological survey in Swiss group-housed breeding rabbits: Extent of lesions and potential risk factors. *Preventive Veterinary Medicine*, 108: 218-224.

297 Andrist, CA; van den Borne, BHP; Bigler, LM; Buchwalder, T (2013) Epidemiological survey in Swiss group-housed breeding rabbits: Extent of lesions and potential risk factors. *Preventive Veterinary Medicine*, 108: 218-224.

298 Andrist, CA; Bigler; LM, Wurbel, H and Roth, BA (2012) Effects of group stability on aggression, stress and injuries in breeding rabbits. *Applied Animal Behaviour Science*, 142: 182-188

299 Valuska, AJ; Mench, JA (2013) Size does matter: The effect of enclosure size on aggression and affiliation between female New Zealand White rabbits during mixing. *Applied Animal Behaviour Science*, 149: 72-76.

300 Valuska, AJ; Mench, JA (2013) Size does matter: The effect of enclosure size on aggression and affiliation between female New Zealand White rabbits during mixing. *Applied Animal Behaviour Science*, 149: 72-76.

301 Gunn-Dore, D (1997) Comfortable quarters for laboratory rabbits. In Reinhardt, V (ed.), *Comfortable Quarters for Laboratory Animals*, pp. 46-54. Animal Welfare Institute, Washington, DC.

and provided with sufficient space, adequate nesting facilities and environmental complexity.[302] Alternatively, does can be provided with the opportunity to move between a communal area and their own secluded area which only they can access (by means of an electronic recognition system via a transponder in the ear tag). This may provide a means to largely eliminate injuries due to aggression by allowing does to choose when they wish to be in a group and when they wish to be on their own.[303]

Figures 36 and 37: Group housing system for breeding does, Kani-Swiss GmbH, Switzerland. Does are kept in enriched pen (left) from 2 days before giving birth until 12 days after. After this they have access to the group pen. Kits are free to join the group at 18 days, and are returned at night to ensure they are fed by their mother. The system achieves very low mortality rates for both does and growing rabbits.[1]

Aggression and injuries in group-housed does can be minimised by:

- maintaining stable social groups as much as possible[304]
- careful management and close monitoring during introductions of unfamiliar does – possible strategies to reduce conflict during introductions include providing a larger neutral arena with a barrier for initial introductions[305]
- providing sufficient space and opportunities for hiding and retreat, e.g. platforms, pipes[306] [307]
- training does to recognise their own nest[308] or using an individual electronic nestbox recognition (IENR) system so that does have access to their own nestbox only by means of an individually coded transponder placed in their ear tag[309] [310] Extension of this system to provide each doe with access to their own retreat area where they can access feed and

[302] Stauffacher, M (1992) Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal Welfare*, 1: 105-125.

[303] Dal Bosco, A; Mancinelli, AC; Hoy, S; Martino, M; Mattioli, S; Cotozzolo, E; Castellini, C (2020) Assessing the preference of rabbit does to social contact or seclusion: Results of different investigations. *Animals*, 10: 286.

[304] Andrist, CA; Bigler; LM, Wurbel, H and Roth, BA (2012) Effects of group stability on aggression, stress and injuries in breeding rabbits. *Applied Animal Behaviour Science*, 142: 182-188

[305] Valuska, AJ; Mench, JA (2013) Size does matter: The effect of enclosure size on aggression and affiliation between female New Zealand White rabbits during mixing. *Applied Animal Behaviour Science*, 149: 72-76.

[306] Stauffacher, M (1992) Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal Welfare*, 1: 105-125.

[307] Rommers, JM; Reuvekamp, BJF, Gunnink, H; de Jong, IC (2014) The effect of hiding places, straw and territory on aggression in group-housed rabbit does. *Applied Animal Behaviour Science*, 157: 117-126.

[308] Mugnai, C; Dal Bosco, A and Castellini, C (2009) Effect of different rearing systems and pre-kindling handling on behaviour and performance of rabbit does. Applied Animal Behaviour Science, 118: 91-100.

[309] Ruis, M and Coenen, E. (2005) A group-housing system for rabbit does in commercial production: a new approach. *Proceedings of the 8th World Rabbit Congress,* 7th – 10th September, 2004, Puebla, Mexico, pp. 1501-1506.

[310] Rommers, J. M; Boiti, C; Jong, I. de; Brecchia, G (2006) Performance and behaviour of rabbit does in a group-housing system with natural mating or artificial insemination. *Reproduction, Nutrition, Development*, 46: 677-687.

water may provide a means to largely eliminate injuries due to aggression by allowing does to choose when they wish to be in a group and when they wish to be on their own[311]
- genetic selection of more docile strains that exhibit lower levels of aggressive behaviour

Managing hygiene and disease risk in non-cage systems

Intensive farming of rabbits in cages is heavily reliant on high antibiotic use to control disease and, despite this, disease and mortality rates are generally higher than for other livestock sectors.[312] Agnoletti *et al.* (2018) conclude:

> *"Industrial production of rabbits raised for meat, despite being limited to a few countries, appears not sustainable with the worldwide AMR [antimicrobial resistance] threat because the medication levels of this sector are the highest among FPAs [food-producing animals]"*

It is often argued that rearing rabbits on a solid floor with litter material will lead to poor hygiene and increased disease risk, with soiled bedding contributing to gastroenteric, reproductive and skin infections.[313] For this reason, most commercial non-cage systems (as illustrated) provide more comfortable flooring (e.g. plastic slatted floor) but do not provide bedding. It is worth noting, however, that if properly managed, provision of straw litter may actually improve hygiene compared with a plastic slatted floor. Windschnurer *et al*. (2019)[314] found that rabbits had cleaner fur on solid floors with straw and there were no significant differences in parasitic burden, mortality, pathological alterations or causes of loss between rabbits reared on straw and rabbits reared on plastic slatted flooring. Importantly, fresh straw was added daily to avoid the development of damp areas.

Disease and mortality in growing rabbits in non-cage systems can be minimised by:

- Ensuring adequate space with reduced stocking densities[315]
- Using more robust genetic strains and selecting for improved disease resistance[316] [317]
- Ensuring adequate ventilation to maintain good air quality and humidity levels
- Use of high-fibre diets to reduce the risk of digestive disorders[318]
- Appropriate weaning age[319]
- Maintaining stringent cleaning procedures, and high standards of biosecurity and preventive veterinary management

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[311] Dal Bosco, A; Mancinelli, AC; Hoy, S; Martino, M; Mattioli, S; Cotozzolo, E; Castellini, C (2020) Assessing the preference of rabbit does to social contact or seclusion: Results of different investigations. *Animals*, 10: 286.

[312] EFSA (2005) Scientific Report of the Scientific Panel on Animal Health and Welfare on the impact of current housing and husbandry systems on the health and welfare of farmed domestic rabbits. Annex to *The EFSA Journal,* 267: 1-31.

[313] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

[314] Windschnurer, I; Waiblinger, S; Hanslik, S; Klang, A; Smajlhodzic, F; Lowenstein, M; Niebuhr, K (2019) Effect of ground floor type on selected health-parameters and weight of rabbits reared in group pens. *Animals*, 9: 216.

[315] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), Saxmose Nielsen, S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gort_azar, Schmidt C, Michel V, Miranda Chueca M_A, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde Calvo, A, Viltrop A, Buijs S, Edwards S, Candiani D, Mosbach-Schulz O, Van der Stede Y and Winckler C, 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

[316] Gunia M, David I, Hurtaud J, Maupin M, Gilbert H and Garreau H, 2015. Resistance to infectious diseases is a heritable trait in rabbits. Journal of Animal Sciences, 93, 5631–5638.

[317] Gunia M, David I, Hurtaud J, Maupin M, Gilbert H and Garreau H, 2018. Genetic parameters for resistance to nonspecific diseases and production traits measured in challenging and selection environments; application to a rabbit case. Frontiers in Genetics, 9: 467

[318] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

[319] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

Unlike cage systems, non-cage systems have the potential for good welfare

Any housing system has potential for poor welfare if badly managed, but critically, good farmed rabbit welfare *cannot* be achieved in a cage. Cages, including enriched cages, are inherently incapable of meeting the behavioural needs of rabbits, however well they are managed. A literature review and survey of experts, reported in EFSA (2020) found:[320]

> *"For does and growing rabbits, the conventional cages numerically have the highest (i.e. worst) overall welfare impact score"*

In relation to enriched cages, EFSA also identified that restriction of movement remains an intractable problem:

> *"Restriction of movement cannot be solved without significant change of the system"*

Improvement to restriction of movement only occurred with non-cage systems such as indoor pens, outdoor free range and organic systems. Elevated pens received good welfare scores for growing rabbits, breeding does and kits. EFSA also highlighted the welfare benefits of organic systems:

> *"Welfare impact scores given by experts suggest that welfare in organic systems is generally good."*

There are challenges to be overcome in the management of non-cage systems for rabbits but these systems have the potential to provide good health and welfare if they are well-designed and well-managed. Non-cage systems for growing rabbits are already in use for millions of rabbits in the EU and are becoming increasingly common. Some non-cage group housing systems for does are operating commercially and further systems are in development. Effective dissemination of knowledge and experience from existing systems that are operating successfully will be essential to the wider adoption and successful management of non-cage systems for rabbits.

It is important to learn from the experiences of changes to housing systems for laying hens in the EU. When conventional cages for laying hens were prohibited, many farmers invested heavily in converting to enriched cages. These cages still do not satisfy the welfare requirements of the hens nor consumer expectations. As a result, several countries have already prohibited enriched cages for hens and they are being phased out in others.

Likewise, a transition from conventional cages to enriched cages would be an unwise and unsustainable investment for EU rabbit producers, given that enriched cages cannot provide good rabbit welfare and are likely to be replaced by non-cage systems within a short timeframe. Instead, investment should be directed now at those systems (such as indoor pens and parks and outdoor free-range and organic systems) that have the potential to meet the needs of rabbits, to provide good welfare and to satisfy societal expectations.

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[320] EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. EFSA Journal 2020;18(1):5944, 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

VI. Caging and force feeding of ducks and geese for foie gras – welfare effects

Ducks and geese kept for foie gras production commonly face two simultaneous challenges to their welfare during the last two weeks of their lives: confinement in group cages to facilitate handling; and force feeding to enlarge their livers.

According to industry figures, nearly 95% of EU production of foie gras in 2019 came from ducks[321]; in France, the figure was nearly 99%[322]. This briefing will mainly concentrate on the welfare of ducks, but most of the same principles are considered also to apply to geese.

Figure 38: Ducks closely confined in barren group cages during force-feeding period ©L214

The flooring of the cage

Ducks and geese in group cages are normally housed on a mesh floor, commonly of steel, less often of plastic[323]. Bare mesh or slatted flooring can result in the development of joint problems and sores such as tibiotarsal arthritis and foot calluses[324].

Slatted floors are more difficult to walk on resulting in difficulties balancing, slipping and falling and skin abrasion[325]. On purely slatted floors, ducks spend more time lying down. Given a choice of floor, they prefer walking on straw[326].

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[321] Eurofoiegras website - https://www.eurofoiegras.com/en/the-production/
[322] ITAVI website. https://www.itavi.asso.fr/content/les-palmipedes-foie-gras.
[323] Rochlitz, I. and Broom, D.M., 2017. The welfare of ducks during foie gras production. Animal Welfare, 26(2), pp.135-149.
[324] Benard, G., Bengone, T., Prehn, D., Durand, S., Labie, C. and Benard, P., 2006. Contribution à l'étude de la physiologie du canard en gavage: étude de la stéatose hépatique. Bulletin de l'Académie vétérinaire de France.
[325] Rodenburg, T.B., Bracke, M.B.M., Berk, J., Cooper, J., Faure, J.M., Guémené, D.G.U.Y., Guy, G., Harlander, A., Jones, T., Knierim, U. and Kuhnt, K., 2005. Welfare of ducks in European duck husbandry systems. *World's Poultry Science Journal*, *61*(4), pp.633-646.
[326] Leipoldt, 1992 *op cit*.

Absence of litter

Litter is required to enable highly-motivated foraging and exploratory behaviour in ducks. In barren cages with mesh or slatted floors, litter is absent. In barren environments without litter or straw, feather pecking (which is a redirected foraging behaviour) can be / is a significant problem[327]. The provision of straw reduces feather pecking in ducks since they spend time foraging in the straw rather than on each other[328].

Council of Europe recommendations state that:

- Where ducks are housed, floors shall be of a suitable design and material and not cause discomfort, distress or injury to the birds. The floor shall include an area of a sufficient size to enable all birds to rest simultaneously and covered with an appropriate bedding material
- Adequate litter shall be provided and maintained, as far as possible, in a dry, friable state in order to help the birds to keep themselves clean and to enrich the environment[329]

Since ducks in cages are not provided with litter, and ducks suffer from sores and joint problems due to the flooring provided, it is clear that neither of these recommendations are met for ducks kept in cages for foie gras production.

Geese as well as ducks are also highly inquisitive animals who, in the wild, would spend much time exploring their environment and foraging for food[330]. A barren slatted cage does not meet their ethological needs as required by the farming directive[331].

Fearfulness

Scientific evidence shows that hens in enriched cages suffer from greater fearfulness than those in non-cage systems. Not only do they have insufficient space to avoid aggression from their peers, but they cannot get away to a perceived safe distance when stockpeople pass by, inevitably entering the flight zones of the birds[332].

This problem is doubly exacerbated in foie gras production because the group cages used for ducks are smaller; and because the hybrids mostly kept for force feeding are particularly fearful, nervous and hyper-reactive[333]. The restraint and handling required for the force-feeding process inevitably add to their fearfulness.

Most of the ducks kept for foie gras production are Mulards, a hybrid between Pekin (domestic mallard-type) and Muskovy ducks. Both of the parents are very sensitive to stress and fearful, especially to human presence or handling, but research shows that the hybrids show an even greater panic response and fear of humans than their parents do (Arnaud *et al.,* 2008)[334]. The same research found they also had higher basal levels of the stress hormone corticosterone. Close confinement and force feeding would be stressful to any animal; for an especially fearful creature these practices cause particularly bad welfare.

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327 Leipoldt, A.L. (1992) Gedrag van pekingeenden met variatie in drinkwatersysteem en bodembedekking. Praktijkonderzoek voor de Pluimveehouderij, PP-uitgave no. 03.

328 Leipoldt, A.L. (1992) *op cit*

329 Council of Europe 1999 Recommendation concerning Muscovyducks (Cairina moschata) and hybrids of Muscovy and domestic ducks (Ana platyrhynchos). https://www.coe.int/t/e/legal_affairs/legal_co-operation/biological_safety_and_use_of_animals/farming/Rec%20ducks.asp

330 Duncan, I., 2009. The scientific case against foie gras. BCSPA.

331 European Commission, 1998. Council Directive 98/58/EC on the protection of animals kept for farming purposes. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31998L0058

332 Rodenburg, T.B., Tuyttens, F.A.M., De Reu, K., Herman, L., Zoons, J. and Sonck, B., 2008. Welfare assessment of laying hens in furnished cages and non-cage systems: an on-farm comparison. Animal Welfare, 17(4), pp.363-373.

333 Rochlitz & Broom *op cit*

334 Arnaud I, Mignon-Grasteau S, Larzul C, Guy G, Faure JM and Guémené D. Behavioural and physiological fear responses in ducks: genetic cross effects. Animal 2: 1518-1525

Absence of water for bathing

Ducks bathe in water to preen and clean themselves[335]. Their water trough needs to be wide enough to immerse their heads fully so that they can catch enough water to shake over their body[336]. Providing a water system like this has been shown to be vital for the for keeping eyes, nostrils and feathers clean;[337] and it reduces disease[338].

Bathing in water is not only vital for their health; it is a highly-motivated, behavioural requirement. Birds previously not provided with an opportunity to dip their heads in water to initiate preening, showed compensatory behaviour (increased preening behaviour) if later provided with a proper water supply[339]. Birds deprived of bathing water show abnormal behaviours such as head shaking and stereotypic preening,[340] perhaps as they attempt to clean themselves or get rid of irritation in the absence of the proper resource to achieve this.

Bathing water, in an animal who does not have sweat glands[341], is also important for thermoregulation, enabling the animals to keep cool in hot weather. Heat stress can be a problem in systems with an inadequate water supply, especially in hot weather[342]. The digestive pressure caused by forced feeding generates extra heat[343]; recently force-fed birds show increased levels of panting[344].

Rochlitz and Broom (2017) express concern that ducks caged for foie gras production have insufficient access to water for bathing or full immersion of the head[345]. For example, a brochure from Cepso, a foie gras professional representative body, states a recommended length for a water trough, but doesn't specify width or depth; this suggests that adequate bathing water is routinely not provided. Rochlitz and Broom note that birds are unable to keep themselves clean, especially towards the end of the force-feeding period. Indeed, photographs of barren cage housing for ducks rarely show any sign of a sufficient water facility for bathing or cooling[346].

Any failure to provide a proper water supply in caged duck foie gras production – and such a failure would appear to be the norm – is contrary to the recommendations of the Council of Europe that:

> *"ducks must be provided with water facilities sufficient in number and so designed to allow water to cover the head and be taken up by the beak so that the duck can shake water over the body without difficulty. The ducks should be allowed to dip their heads under water".*

It seems evident that this requirement is not widely observed in industry practice.

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335 Rodenburg *et al*, 2005.
336 Waitt, C., Jones, T. and Dawkins, M.S., 2009. Behaviour, synchrony and welfare of Pekin ducks in relation to water use. *Applied Animal Behaviour Science*, *121*(3-4), pp.184-189.
337 Jones, T.A., Waitt, C.D. and Dawkins, M.S., 2009. Water off a duck's back: Showers and troughs match ponds for improving duck welfare. *Applied Animal Behaviour Science*, *116*(1), pp.52-57.
338 Rochlitz & Broom 2017, *op cit*.
339 Jones *et al*, 2009, *op cit*.
340 Rodenburg *et al*, 2005, *op cit*.
341 Rochlitz & Broom 2017, *op cit*.
342 Rodenburg *et al*, 2005, *op cit*.
343 Rochlitz & Broom 2017, *op cit*.
344 Carrière ML, Roussel S, Bernadet M-D, Duvant-Ponter C and Servière J 2006 Effet du gavage sur le comportement post prandial des canards mulards. 7èmes Journées de la Recherche sur les Palmipèdes à Foie *Gras* pp 84-89. 18-19 October 2006, Arcachon, France. Institut Technique de l'Aviculture: Paris, France cited in Rochlitz &Broom 2017, *op cit*.
345 Rochlitz & Broom 2017, *op cit*.
346 For example see several at https://gers.chambre-agriculture.fr/fileadmin/user_upload/Occitanie/067_Inst-Gers/documents/volontepaysannegers/articlesvp2009-2017/Elevage/Volailles_Palmipedesgras/Annee_2010/Le_logement_collectif_en_gavage_VP_1181.pdf

As waterfowl, geese are also highly motivated to perform water-related activities including bathing and preening[347] which is also important to maintain physical health through eye and feather hygiene[348].

Restrictions of basic behaviours

The small group cages in which these ducks are kept severely restrict exercise. Space allowance for comfort activities such as wing flapping appear not to have been measured for ducks, but they are likely to be as inadequate as for hens. Flying is clearly impossible.

The surface on which the ducks are kept is unsuitable for walking[349]. Suitable substrate for foraging and exploratory behaviour is not provided[350]. As discussed, a water facility sufficient for bathing and preening would also appear not to be available[351].

The Council Directive 98/58/EC on the protection of animals kept for farming purposes states that:

> *"Members States shall ensure that the conditions under which animals … are bred or kept, having regard to their species and to their degree of development, adaptation and domestication, and to their physiological and ethological needs in accordance with established experience and scientific knowledge, comply with the provisions set out in the Annex."*

The Annex includes:

> *"The freedom of movement of an animal, having regard to its species and in accordance with established experience and scientific knowledge, must not be restricted in such a way as to cause it unnecessary suffering or injury"[352].*

It is clear from the science that the keeping of ducks for foie gras in group cages, as is true for similar reasons for other caged animals, is not compatible with compliance with this Directive.

Force feeding (gavage)

Ducks are caged in the last period of their lives to facilitate force feeding, a process which would cause very poor welfare even if it didn't involve caging. The purpose of force feeding is to increase the size and fat content of the liver.

Figure 39: Gavage. The top of the cage is pulled down to trap the heads of the ducks so that they can be force-fed. ©L214

[347] Scientific Committee on Animal Health and Animal Welfare (SCAHAW) 1998 Welfare aspects of the production of foie gras in ducks and geese. CEC, DGXXIV. Adopted December 16, 1998. European Commission: Brussels, Belgium.
[348] Duncan, I., 2009 *op cit*
[349] Rochlitz & Broom 2017, *op cit.*
[350] Rochlitz & Broom *op cit*
[351] Rochlitz & Broom *op cit*
[352] European Commission, 1998 *op cit*

Force feeding results in:

1. Abnormal level of hepatic steatosis (fatty liver disease) in force fed birds[353] which is "pathological and can limit duck survival[354] [355]
2. Higher mortality (2-6%) during the force-feeding process at a time you would expect it to be less than 1% (0.2% according to SCAHAW 1998), thus at least a two to six-fold increase in mortality[356]
3. Force feeding can cause oesophagitis and other injuries[357]
4. Birds develop posture and gait abnormalities[358]
5. Ducks show aversive behaviour towards force feeding. They recoil when approached for force feeding[359] necessitating the use of "crowd gates" to restrain them. As Rochlitz and Broom point out, the need for such restraints strongly indicates that the birds find force feeding aversive[360]
6. If mulard ducks are released from force feeding, experiments show that they don't eat for several days, taking 8-15 days before they start eating spontaneously[361]
7. The liver can take 15 days to recover its normal weight after 10 or 13 days of force feeding and a full 30 days to recover after 16 days of this treatment; the veterinarians Rochlitz and Broom consider this long period for recovery suggests that this period of gavage brings the ducks close to severe liver dysfunction and failure[362]

It is sometimes argued that the enlargement of the liver is a natural adaptation in geese developing an energy store prior to migration. Natural steatosis can be induced in geese by adjusting day-length. This does not apply to mulard ducks[363] – as for their parents, muskovies are not migratory and mallards are either sedentary or only migrate in some circumstances[364]. Even in geese, one must question whether force feeding is natural; they will voluntarily consume a natural amount of feed without any requirement for human intervention. Force feeding is also aversive in geese and leads to hepatic steatosis. Force-fed geese experimentally then allowed to feed naturally, dieted for 18 days, consuming only grass and almost no pelleted feed[365].

If the level of feed consumption involved in foie gras production was naturally motivated, the ducks and geese could be left to feed themselves without the need for gavage.

The Council of Europe recommends:

> *"Methods of feeding and feed additives which cause injury or distress to the ducks or may result in development of physical conditions detrimental to health and welfare shall not be permitted."*

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353 Rochlitz & Broom 2017, *op cit*.
354 Rochlitz & Broom 2017, *op cit*.
355 It has been argued that hepatic steatosis in ducks and geese is not pathological since, when kept experimentally, force-fed birds can recover normal function after a period of recovery. It should be noted that pathology is the study of disease; it is not uncommon to recover fully from illnesses which were pathological at the time. The veterinarians Rochlitz and Broom (cited elsewhere) argue that reversibility does not mean that the steatosis was not pathological, citing reduced survivability, reduced ability of the liver to detoxify and a range of other biochemical changes resulting from the steatosis.
356 Rochlitz & Broom 2017, *op cit*.
357 Rochlitz & Broom 2017, *op cit*.
358 Scientific Committee on Animal Health and Animal Welfare (SCAHAW), 1998 *op cit*
359 Laborde, M. and Voisin, M., 2013. Identification of breeding practices and evaluation of the impact on the behavior of feeding ducks. *Actes des 10èmes Journées de la Recherche Avicole et Palmipèdes à Foie Gras du 26 au 28 mars, 2013, La Rochelle, France*, pp.232-236 cited in Rochlitz & Broom 2017, *op cit*
360 Rochlitz & Broom 2017, *op cit*.
361 Babilé, R., Auvergne, A., Andrade, V., Héraut, F., Bénard, G., Bouillier-Oudot, M. and Manse, H., 1996. Réversibilité de la stéatose hépatique chez le canard mulard. In *Proceedings* (pp. 107-110) cited in Rochlitz & Broom 2017, *op cit.*
362 Rochlitz & Broom 2017, *op cit*.
363 Rochlitz & Broom 2017, *op cit*.
364 SCAHAW, 1998, *op cit*
365 Winnicki, S., Szarek, J., Antisik, A., Baszczynski, J., Fabczak, J., Wieland, E., Tomala, H., Skrzydlewski, A., Karasinski, D., 1995. Tucz kaczek na watroby o zwiekszonej zawartosci tluszczu-fisjologiczny, czy patologiczny ? (cz.1). Drobiartswo, 1, 4-7 cited in SCAHAW, 1998, *op cit*

As discussed above, there is ample evidence that force feeding causes both injury and distress as well as physical conditions detrimental to health and welfare. It is therefore contrary to this requirement.

It is also contrary to the requirements of Council Directive 98/58/EC which states that:

> *"No animal shall be provided with food or liquid in a manner, nor shall such food or liquid contain any substance, which may cause unnecessary suffering or injury[366]."*

Alternatives to caging and force feeding

Fatty liver pâté can be produced by processing ordinary duck or goose livers with additional fat. For example, *Foie Royale*[367] and *Happy Foie Gras*[368] are produced in this way.

Fatty liver can also be produced from geese who have naturally fattened due to their voluntary level of increased feed intake, rather than the excessive level from force feeding.

Geese, though not ducks, will naturally produce fattier livers in time for migration[369]. One example is the *Pateria de Sousa* farm in Southern Spain, where free-living geese feed naturally on carbohydrate-rich food as winter approaches, developing fattier livers naturally. Their livers grow to 450-500g.[370] This compares with 600-1000g for a force-fed bird[371] [372].

Figure 40: Geese on the commercial farm of Pateria de Sousa feeding on grass, supplemented by figs and olives, from the orchard. Other flocks of their geese feed on acorns on the Extramaduran Dehesa, making this a highly sustainable system.

Aviwell in France are also developing a system for producing fatty goose livers without force feeding[373].

366 European Commission, 1998 *op cit*.
367 Foie Royale website - https://foieroyale.com/foie-royale-product/
368 Happy Foie Gras website - https://happyfoiegras.com/pages/was-ist-happy-foie-gras
369 Rochlitz & Broom 2017, *op cit*.
370 Eduardo Sousa, 2007, personal communication
371 Food and Agriculture Organisation of the United States, 2002. Buckland, R. and Guy, G. Goose Production. Rome, FAO Animal Production and Health Paper, Issue 154, pp.1-89.
372 SCAHAW, 1998, *op cit*
373 Aviwell website - https://www.aviwell.fr/en/natural-process/

Humane systems for producing fatty liver will avoid all use of cages and force feeding. The birds should be kept in rich environments with opportunities for foraging and bathing, preferably free range. There should be a maximum liver weight based on scientific studies and that welfare outcomes such as prevalence of contact dermatitis, posture and walking difficulties, wing fractures and other body lesions should be measured[374].

It must be noted that the gavage method of producing foie gras cannot comply with the basic welfare requirements of the Council of Europe Recommendations[375] or of the EU Farming Directive[376].

Science clearly shows that the caging of ducks and geese during the last two weeks of foie gras production, together with force feeding, causes severe health and welfare problems. It also demonstrates that both practices are contrary to the binding requirements of Council of Europe Recommendations and of Council Directive 98/58/EC to prevent unnecessary suffering and avoidable injury during both feeding and housing and to provide for the animals' ethological needs.

Further reading

A comprehensive welfare analysis of the welfare aspects of foie gras production in ducks has been written by two distinguished veterinarians, Dr Irene Rochlitz and Prof Donald Broom. Don Broom is Emeritus Professor of Animal Welfare at the University of Cambridge and a former member of many EFSA animal welfare panels. See Rochlitz, I. and Broom, D.M., 2017. The welfare of ducks during foie gras production. Animal Welfare, 26(2), pp.135-149. A version can be downloaded at https://www.researchgate.net/publication/316871174_The_welfare_of_ducks_during_foie_gras_production.

A comprehensive review of duck welfare issues is to be found at: Rodenburg, T.B., Bracke, M.B.M., Berk, J., Cooper, J., Faure, J.M., Guémené, D.G.U.Y., Guy, G., Harlander, A., Jones, T., Knierim, U. and Kuhnt, K., 2005. Welfare of ducks in European duck husbandry systems. *World's Poultry Science Journal*, *61*(4), pp.633-646.

[374] Rochlitz & Broom *op cit*
[375] Council of Europe, 1999, *op cit*
[376] European Commission, 1998 *op cit*

VII. The confinement of calves in individual pens

The confinement of dairy calves in individual pens exacerbates the social isolation which follows the early separation of these calves from their mothers.

Scientific research demonstrates that this isolation leads to cognitive impairment, poor social skills, reduced ability to cope with change, a lowered resilience to stress and impaired weight gain.

The sight and limited touch of the calf in the neighbouring pen does not meet the social and motivational needs of calves and leads to poor welfare and impaired production.

Issues around respiratory diseases, diarrhoea and cross-sucking can be addressed by good system design (including ventilation), appropriate feeding which takes account of behavioural as well as physiological needs and good husbandry. Such systems are in commercial operation and can provide significant benefits for health, welfare and production.

The law should require calves to be kept in pairs or groups with sufficient space for exercise and full body access to each other. Support should also be provided for the increasing number of dairy farms maintaining contact between both calf and mother and with other calves.

Individual calf pens

Around 20 million dairy calves are born in the EU each year. From the limited data available[377], it is clear that at least 60% of these (and probably over 75%) are kept in small individual pens (see Figure 39).

Individual calf pens house calves singly with restricted social contact. Council Directive 2008/119/EC requires a calf pen to be as wide as the height of the calf (measured at the withers) and as long as the body length of the calf multiplied by 1.1. Calves are kept in this confinement for up to the first 8 weeks of their lives.

Figure 41: Calves housed in individual pens until 8 weeks of age, severely restricting natural behaviours including close physical contact, social interaction, play, and exercise.

[377] Marcé, C., Guatteo, R., Bareille, N. and Fourichon, C., 2010. Dairy calf housing systems across Europe and risk for calf infectious diseases. *Animal*, *4*(9), pp.1588-1596. Staněk, S., Zink, V., Doležal, O. and Štolc, L., 2014. Survey of preweaning dairy calf-rearing practices in Czech dairy herds. Journal of dairy science, 97(6), pp.3973-3981. https://www.sciencedirect.com/science/article/pii/S0022030214002902

Natural calf behaviour

Calves naturally form relationships shortly after birth, with their mother and with their peers, which can last for years[378,379]. The mother provides milk for her calf. Whilst their mothers move off to graze, recently-born calves often lie together in pairs or groups. They commonly lie in close body contact with each other (see Figures 40 and 41). Calves also perform social play together from 2 weeks of age (see Figure 42), and perform locomotor play in parallel with each other even earlier than this[380,381].

Figure 42: Calves commonly choose to lie together in full body contact. Relationships formed like this can last for years.

Figure 43: Research shows calves desire full rather than partial contact. Calves kept in groups, whether on pasture or housed on straw, commonly choose to lie close to

Figure 44: Calves performing social play.

The effects of keeping calves in individual pens

Social isolation and impairment of social relationships

Dairy calves are usually removed from their mothers, hours or days after birth, so that all of the mother's milk can be milked for human consumption. The additional separation of calves from their peers, by housing them in individual pens, leads to social isolation for the first eight weeks of their lives. Where the law is observed, they can see and touch calves in the pens next door, but that is the limit of their interaction. Research shows that this limited contact does not meet the motivational needs of the calves or lead to such lasting relationships.

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378 Raussi, S., Niskanen, S., Siivonen, J., Hänninen, L., Hepola, H., Jauhiainen, L. and Veissier, I., 2010. The formation of preferential relationships at early age in cattle. *Behavioural processes*, *84*(3), pp.726-731.

379 Reinhardt, V. and Reinhardt, A., 1981. Cohesive relationships in a cattle herd (Bos indicus). *Behaviour*, *77*(3), pp.121-150.

380 Wood-Gush, D.G.M., Hunt, K., Carson, K., Dennison, S.G.C., 1984. The early behaviour of suckler calves in the field. Biol. Behav. 9, 295–306.

381 Jensen, M.B., Vestergaard, K.S. and Krohn, C.C., 1998. Play behaviour in dairy calves kept in pens: the effect of social contact and space allowance. Applied Animal Behaviour Science, 56(2-4), pp.97-108.

Calves desire full, rather than partial, contact with each other. In experiments, calves were found to work harder to gain full-body contact than head-only contact through a fence[382]. Bonds are enhanced by close body contact and mutual licking. The relationships between calves raised in groups last longer than those kept next door in pens who can see and touch each other, but cannot make full body contact[383].

Calves can develop long-lasting social relationships with peers[384] and calves who have been together since birth have stronger social bonds than calves who have met at about 3 months of age[385]. Calves of the closely related Zebu breeds also form friendships which last for years[386].

Keeping calves in groups after the separation from their mother appears to provide some comfort, and pair-housed calves vocalise significantly less during this process than do individually housed calves[387]. Housing calves in groups allows them to perform their natural social behaviour and provides more space for play and general activity[388].


Figure 45: Individual pens in a Polish farm

Cognitive impairment, affecting welfare and performance

Experiments on a range of animals show that early social isolation results in cognitive impairment, such that they have difficulty in coping with novel situations, do not develop social skills properly and do not cope well with stress[389]. Experiments also now show that all of these apply to calves; calves reared in isolation do not develop social skills properly, have difficulties in coping with novel situations, and show cognitive impairment[390].

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382 Holm, L., Jensen, M.B.and Jeppesen, L.L.(2002) Calves' motivation for access to two different types of social contact measured by operant conditioning. Applied Animal Behaviour Science. 79, 175-194.

383 Broom, D.M. and Leaver, J.D., 1978. Effects of group-rearing or partial isolation on later social behaviour of calves. Animal Behaviour, 26, pp.1255-1263.

384 Raussi, S., Niskanen, S., Siivonen, J., Hänninen, L., Hepola, H., Jauhiainen, L. and Veissier, I., 2010. The formation of preferential relationships at early age in cattle. Behavioural processes, 84(3), pp.726-731.

385 Sato, S., Wood-Gush, D.G.M. and Wetherill, G., 1987. Observations on creche behaviour in suckler calves. Behavioural processes, 15(2-3), pp.333-343.

386 Reinhardt, V. and Reinhardt, A., 1981. Cohesive relationships in a cattle herd (Bos indicus). Behaviour, 77(3), pp.121-150.

387 Jensen, M. (2012). Welfare Related to Feeding, Housing and Health of Dairy Calves. The First Dairy Cattle Welfare Symposium, 23-26 October 2012, Guelph, Ontario, Canada.

388 Sutherland, M.A., Worth, G.M. and Stewart, M., 2014. The effect of rearing substrate and space allowance on the behavior and physiology of dairy calves. Journal of Dairy Science, 97(7), pp.4455-4463.

389 Costa, J. H. C., von Keyserlingk, M. A. G., & Weary, D. M. (2016). Invited review: Effects of group housing of dairy calves on behavior, cognition, performance, and health. Journal of Dairy Science, 99(4), 2453–2467.

390 Costa et al, 2016, op cit

Calves reared individually are less able to adapt to change. In cognitive tests, individually-housed calves are unable to adjust to changes as well as group-housed calves[391].

Farm animals need to adapt to change. For example, calves have to learn to eat solid food earlier than they would do naturally, so that they can be weaned off milk. Several studies show that calves kept in pairs or groups consume more food, and thus gain more weight, than those reared individually[392,393].

In addition to being more adaptable, calves kept in pairs or groups can also learn from each other to try new feeds. Social facilitation, when calves imitate each other's behaviour, can result in a higher feed intake,[394] again, resulting in a higher daily weight gain. Additional research showed that paired calves begin eating solid feed nearly two days earlier than individually-housed calves, consuming this feed more frequently and in larger amounts, again increasing weight gain[395].

Impaired development of social skills and confidence

Social experience and the ability to adapt to change are also essential for the development of social skills. Group-housed calves are both more confident and appropriately appeasing when they meet a new calf[396]. In contrast, individually-housed calves can be initially fearful and then show disruptive and contact-seeking behaviour[397].

The social skills acquired by group or pair-housed calves also give them more social confidence:

- In a study of pair-housed calves and calves housed individually with visual and tactile contact of others, the pair housed calves approached a new calf more quickly[398]
- Calves with early social experience are also more likely to become dominant cows[399]

Conversely, calves reared individually are likely to be more fearful than group-housed calves. When they were placed in a novel arena the individual calves had a higher heart rate and were more reluctant to enter and to approach a new calf[400].

Poor resilience

Social experience and social support both help calves to deal with stress. Perhaps one of the most stressful experiences in the life of a dairy calf is the early removal from the mother. This stress is further exacerbated if the calf is then placed into solitary confinement without the social support of a peer. Calves reared in pairs vocalise less after being separated from their dam[401].

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391 Gaillard, Charlotte, Rebecca K. Meagher, Marina AG von Keyserlingk, and Daniel M. Weary. "Social housing improves dairy calves' performance in two cognitive tests." PLoS One 9, no. 2 (2014): e90205.

392 Costa et al, 2016, op cit

393 Costa, J.H.C., Meagher, R.K., Von Keyserlingk, M.A.G. and Weary, D.M., 2015. Early pair housing increases solid feed intake and weight gains in dairy calves. Journal of Dairy Science, 98(9), pp.6381-6386.

394 Jensen, M. et al, 2012, op cit

395 Vieira, A.D.P., Von Keyserlingk, M.A.G. and Weary, D.M., 2010. Effects of pair versus single housing on performance and behavior of dairy calves before and after weaning from milk. Journal of dairy science, 93(7), pp.3079-3085.

396 Keyserlingk, M., Weary, D. (2012). Welfare implications of dairy cattle housing management. The First Dairy Cattle Welfare Symposium, 23-26 October 2012, Guelph, Ontario, Canada.

397 Keyserkingk and Weary, 2012, op cit.

398 Jensen, M. (2012). Welfare Related to Feeding, Housing and Health of Dairy Calves. The First Dairy Cattle Welfare Symposium, 23-26 October 2012, Guelph, Ontario, Canada.

399 Broom and Leaver, 1978, op cit.

400 Jensen, M.B., Vestergaard, K.S., Krohn, C.C. and Munksgaard, L. (1997) Effect of single versus group housing and space allowance on responses of calves during open-field tests. Applied Animal Behaviour Science. 54, 109-121.

401 Jensen, M. (2012). Welfare Related to Feeding, Housing and Health of Dairy Calves. The First Dairy Cattle Welfare Symposium, 23-26 October 2012, Guelph, Ontario, Canada.

Dairy calves are also weaned off milk at an unnaturally early age, causing nutritional stress. Once again, pair-housed calves vocalise significantly less during this process than do individually-housed calves[402]. Group-housed calves also react less to stressful procedures, including restraint and blood sampling[403].

Early pair or group-rearing can provide calves with the stress buffering benefits of social support, and the earlier that calves are paired, the more effective it is[404].

Prevention of natural behaviour and play

Studies show that calves kept in groups show more signs of positive welfare. For example, calves play more if they have enough space[405] and if they are kept in groups,[406,407] but the physical contact is the more important factor. Calves kept individually in large pens play less than groups kept in pens the same size[408].

Calves deprived of play through being given insufficient space showed a rebound effect if released into a larger area[409], whereas those used to having more space were much less energetic. The same applies to individually-penned calves when introduced to a group for the first time at eight weeks, in line with legal requirements, who showed a similarly powerful rebound effect[410].

Play-behaviour is widely seen as an important sign of well-being,[411,412] whilst reduced play behaviour is a sign that calves are not coping with their environment[413].

Reduced performance

It is clear from several different studies that calves housed in groups or pairs eat more feed and grow faster than calves housed individually.

In one study, paired calves gained more weight than those kept individually for around 6 or 10 weeks. Other studies have shown 7kg weight gains at slaughter in group-reared veal calves at slaughter[414] and greater weight gain for grouped calves during weaning from a milk diet[415]. Another showed greater weight gain in grouped calves together with greater overall feed consumption[416].

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402 Bolt, S.L., Boyland, N.K., Mlynski, D.T., James, R. and Croft, D.P., 2017. Pair housing of dairy calves and age at pairing: effects on weaning stress, health, production and social networks. *PLoS One*, *12*(1), p.e0166926.
403 Jensen *et al*, 2012, *op cit.*
404 Bolt *et al*, 2017, *op cit.*
405 Jensen *et al* 1997 *op cit.*
406 Jensen *et al* 1997 *op cit.*
407 Valníčková, B., Stěhulová, I., Šárová, R., & Špinka, M. (2015). The effect of age at separation from the dam and presence of social companions on play behavior and weight gain in dairy calves. *Journal of Dairy Science*, *98*(8), 5545–5556.
408 Jensen *et al* 1997 *op cit.*
409 Dellmeier, G.R., Friend, T.H. and Gbur, E.E., 1985. Comparison of four methods of calf confinement. II. Behavior. *Journal of Animal Science*, *60*(5), pp.1102-1109.
410 Valníčková *et al* (2015) *op cit*.
411 Jensen *et al* 1998 *op cit.*
412 Valníčková *et al* (2015) *op cit*.
413 Valníčková *et al* (2015) *op cit*.
414 Xiccato, G., Trocino, A., Queaque, P.I., Sartori, A. and Carazzolo, A., 2002. Rearing veal calves with respect to animal welfare: effects of group housing and solid feed supplementation on growth performance and meat quality. *Livestock production science*, *75*(3), pp.269-280.
415 Chua, B., Coenen, E., van Delen, J. and Weary, D.M. (2002) Effects of pair versus individual housing on the behaviour and performance of dairy calves. Journal of Dairy Science, 85, 360-364.
416 Bernal-Rigoli, J.C., Allen, J.D., Marchello, J.A., Cuneo, S.P., Garcia, S.R., Xie, G., Hall, L.W., Burrows, C.D. and Duff, G.C., 2012. Effects of housing and feeding systems on performance of neonatal Holstein bull calves. *Journal of animal science*, *90*(8), pp.2818-2825.

In a study on feed consumption, paired calves consumed more concentrate feed and in more frequent meals, compared with individually-housed calves, and this persists during weaning[417]. In another study, compared with calves in individual stalls, paired calves started to feed on solid starter food earlier, visited the feeder more often, spent more time at the feeder, consumed more starter feed and gained more weight[418].

One study showed that group-housed calves also avoid the fluctuations in weight gain commonly experienced by individually-housed calves, who may over-consume feed, causing discomfort and consequently a reduction in intake[419].

As already discussed, increases in feed consumption and weight gain in paired or grouped compared with individually-penned calves arises because they learn to eat new food by observing each other[420] or because the social isolation of very young calves reduces their cognitive ability and facility to adapt to change[421].

Preventing disease

Individual housing is practised because calves kept in crowded groups in poorly ventilated housing are subject to higher risk of digestive and respiratory infections such as diarrhoea and pneumonia. Clearly, keeping animals in solitary confinement is one means of reducing the spread of disease; but it is an extreme measure with negative consequences for both welfare and production. There are other, proven, steps which can be taken to reduce the risk of disease without the use of individual housing.

Good ventilation is key to reducing disease. Research shows that higher air velocity, lower levels of ammonia and lower temperature all reduced the risk of pneumonia in group-housed calves[422]. It should be noted that the temperatures were moderately low and the calves provided with plenty of dry bedding. Keeping calves in groups in pens with well-bedded outdoor igloos also reduced risk compared to keeping them in barns. Calves in outdoor pens and igloos grew better and had a lower incidence and persistence of respiratory diseases[423].

Provision of sufficient colostrum within the first few hours of birth is also crucial, since high levels of maternal antibodies help to protect against a range of infections including respiratory disease and diarrhoea[424].

Risk is reduced if different age groups are not mixed[425], if the groups are kept stable and not too large[426]. A practical compromise is to keep calves in pairs, reducing the risk of spreading disease whilst allowing social contact[427].

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[417] Miller-Cushon, E. K., & DeVries, T. J. (2015a). Effect of social housing on the development of feeding behavior and social feeding preferences of dairy calves. Journal of Dairy Science, 99(2), 1406–1417.

[418] Viera *et al*, 2010, *op cit.*

[419] Keyserkingk and Weary, 2012, *op cit.*

[420] Jensen *et al*, 2012, *op cit.*

[421] Costa *et al*, 2015 *op cit.*

[422] van Leenen, K., Jouret, J., Demeyer, P., Van Driessche, L., De Cremer, L., Masmeijer, C., Boyen, F., Deprez, P. and Pardon, B., 2020. Associations of barn air quality parameters with ultrasonographic lung lesions, airway inflammation and infection in group-housed calves. *Preventive Veterinary Medicine*, p.105056.

[423] Wójcik, J., Pilarczyk, R., Bilska, A., Weiher, O. and Sanftleben, P., 2013. Performance and Health of Group-Housed Calves Kept in Igloo Calf Hutches and Calf Barn. *Pakistan Veterinary Journal*, *33*(2).

[424] Besser, T.E. and Gay, C.C., 1994. The importance of colostrum to the health of the neonatal calf. *Veterinary Clinics of North America: Food Animal Practice*, *10*(1), pp.107-117

[425] Charlton, S.J. (2009) Calf Rearing Guide, Ontario Veal Association, Context Products Ltd

[426] Jensen *et al*, 2012, *op cit.*

[427] Keyserkingk and Weary, 2012, *op cit.*

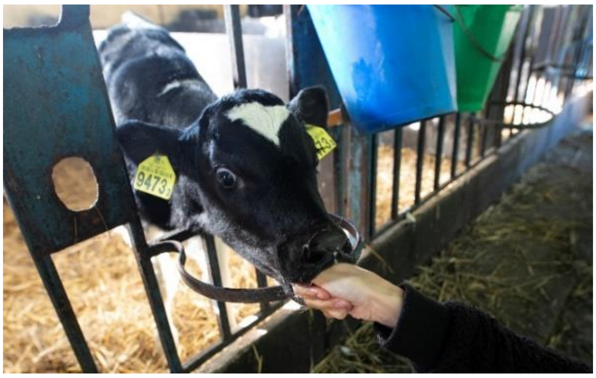
Good stockpersonship is also key, noticing those behaviour changes that sick animals exhibit and taking swift action. Reduced feeding behaviour, for example, can be predictive of illness[428]. Other researchers also showed that reduced activity was also predictive[429].

With good systems and husbandry, levels of disease can be kept low with group-housed calves. Chua *et al.* found little level of disease and, as discussed before, better weight gain in group-housed calves[430].

Reducing cross-sucking

Calves are also kept individually to prevent cross-sucking (includes navel-sucking), whereby calves suck on each other's navels and other body parts often leading to inflammation and hair loss[431]. In addition to the navel, they will also suck on each others' ears, mouth, scrotum or udder-base[432] and even a human finger or hand, if provided (see Figures 45 and 46). This detrimental behaviour is seen in calves reared artificially and not in calves reared by their mother; it is a redirected feeding behaviour[433].

Figure 46: Calves naturally suckle from their mothers eight to twelve times per day. This organic dairy farm is going one stage further, maintaining contact between mother and calf as well as calves with each



Figures 47 and 48: Calf suckling from a hand (left) and from a teat attached to an empty bucket (right). Since dairy calves are almost invariably separated from their mothers shortly after birth, their strong motivation to suckle is expressed on alternative objects or each other. Inappropriate feeding regimes also cause hunger, which increases inappropriate sucking behaviour.

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428 Quimby, W.F., Sowell, B.F., Bowman, J.G.P., Branine, M.E., Hubbert, M.E. and Sherwood, H.W., 2001. Application of feeding behaviour to predict morbidity of newly received calves in a commercial feedlot. *Canadian Journal of Animal Science*, *81*(3), pp.315-320.

429 Swartz, T.H., Findlay, A.N. and Petersson-Wolfe, C.S., 2017. Automated detection of behavioral changes from respiratory disease in pre-weaned calves. *Journal of dairy science*, *100*(11), pp.9273-9278.

430 Chua *et al*, 2002, *op cit*

431 Jensen, 2003, *op cit*

432 Jensen, 2003, *op cit*

433 Jensen, M.B., 2003. The effects of feeding method, milk allowance and social factors on milk feeding behaviour and cross-sucking in group housed dairy calves. *Applied Animal Behaviour Science*, *80*(3), pp.191-206.

Hungry calves cross-suck more frequently[434]. Animals with a higher energy balance are less likely to cross-suck[435] and increasing feed levels reduces the levels of cross-sucking[436].

Artificially-reared dairy calves are typically fed 4-6L of milk replacer per day[437], but this ration is unlikely to be sufficient to prevent hunger.

In one experiment, which compared the behaviour of calves fed on restricted quantities with those allowed to drink as much as they wanted, calves fed *ad libitum* consumed 8.5L per day from age 8-14 days[438]. Calves on the restricted diet (10% of their body weight, varying from 4.2-4.8 litres) showed clear signs of hunger, making 24 extra unrewarded daily visits on average to the feeding station and being more likely to try to displace another calf from the feeder.

As calves grow, their consumption increases to 11.9kg of milk replacer per day from age 14-35 days where it is available on demand[439]. It is unsurprising that calves on reduced rations resort to sucking each other's navels. In addition to providing milk replacer on demand, hunger can also be reduced by providing a calf starter ration and fibrous food such as hay.

Dairy calves who have been separated from their mothers suffer hunger not only because they receive less milk, but also because they are fed less often. Calves would naturally suckle from their mothers, more or less *ad libitum*, eight to twelve times per day[440]. EU law merely requires that calves who have been separated from their mothers are fed at least twice per day[441]. Whilst this may be sufficient for growth and physical health, the calves end up extremely hungry and it is unsurprising that they will attempt to suckle anything within reach.

An alternative solution to this problem is to ensure that group-housed dairy calves always have opportunities to suckle and are not kept hungry. Group-housed calves can be fed *ad libitum* on milk replacement feeds which they can obtain using artificial teats.

Using artificial teats increases the time it takes the calf to feed, especially if they are set up to release milk slowly. Natural suckling keeps the calf occupied for a long time. When a calf drinks from a bucket, he or she can consume two and a half litres in a minute[442], whereas a typical suckling bout from the mother takes 8-12 minutes[443] (and the quantity of milk consumed will be smaller). It may be that the time spent feeding is important in preventing hunger as well as the frequency and the quantity. Research shows that calves fed from a bucket cross-suck at least five

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434 Herskin, M.S., Skjøth, F. and Jensen, M.B., 2010. Effects of hunger level and tube diameter on the feeding behavior of teat-fed dairy calves. *Journal of dairy science*, *93*(5), pp.2053-2059.

435 Roth, B.A., Keil, N.M., Gygax, L. and Hillmann, E., 2009. Temporal distribution of sucking behaviour in dairy calves and influence of energy balance. *Applied Animal Behaviour Science*, *119*(3-4), pp.137-142.

436 Jung, J. and Lidfors, L. (2001) Effects of amount of milk, milk flow and access to a rubber teat on cross-sucking and nonnutritive sucking in dairy calves. Applied Animal Behaviour Science. 72, 201-213.

437 Jung & Lidfors, 2001, *op cit*.

438 Vieira, A. de P., Guesdon, V., de Passille, A.M., Keyserlingk, M.A.G. von, Weary, D.M. (2008) Behavioural indicators of hunger in dairy calves. Applied Animal Behaviour Science. 109, 180-189.

439 Hammell, K.L., Metz, J.H.M. and Mekking, P., 1988. Sucking behaviour of dairy calves fed milk ad libitum by bucket or teat. *Applied Animal Behaviour Science*, *20*(3-4), pp.275-285.

440 Costa *et al*, 2016 *op cit.*

441 EU Council Directive 2008/119/EC of 18 December 2008 laying down minimum standards for the protection of calves. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0119&from=EN.

442 Loberg, J. and Lidfors, L., 2001. Effect of milkflow rate and presence of a floating nipple on abnormal sucking between dairy calves. *Applied Animal Behaviour Science*, *72*(3), pp.189-199.

443 Lidfors, L.M., Jensen, P. and Algers, B., 1994. Suckling in free-ranging beef cattle—temporal patterning of suckling bouts and effects of age and sex. *Ethology*, *98*(3-4), pp.321-332.

times more frequently than calves fed the same quantity from an artificial teat. If the flow rate in the teat was reduced to a slow rate, cross sucking was substantially reduced again[444,445].

Cross-sucking behaviour is common just after a meal before their hunger subsides. Briefly enclosing a calf in the feeding station during feeding and for a short period afterwards greatly reduced cross-sucking behaviour[446]. While they are waiting to be let out, they are free to continue to suck on the artificial teat. Providing an enriched environment for the calves to go into just after a meal also helps[447] for example, sealed rubber teats and a bale of hay for calves who had just finished a meal to suck or chew on[448].

Numbers of animals

There are no precise figures published for the number of dairy calves born each year. There are figures for the number of dairy cows in the European Union published by Eurostat for 2018. On the assumption that the calving interval averages around 400 days, we have calculated a probable number of dairy calves born each year in the table below.

There are very few figures for the numbers of calves kept in individual pens, but Marcé *et al.*, (2010) conducted a survey in April 2009 which provided estimates for 14 EU Member States. A separate survey found that 96.7% of calves were housed individually in Czech farms[1]. For those countries for which data is available, this suggests that 77.5% of calves are kept in individual housing. At least 60% of European dairy calves, amounting to over 12 million calves, are kept individually in pens for the first weeks of life (see Table below). By extrapolation, this figure is likely to be over 15 million across the EU.

444 Loberg and Lidfors, 2001, *op cit*
445 Herskin *et al*, 2010 *op cit*
446 Weber, R. and Wechsler, B., 2001. Reduction in cross-sucking in calves by the use of a modified automatic teat feeder. *Applied animal behaviour science*, *72*(3), pp.215-223.
447 Ude, G., Georg, H. and Schwalm, A., 2011. Reducing milk induced cross-sucking of group housed calves by an environmentally enriched post feeding area. Livestock Science, 138(1-3), pp.293-298.
448 Ude *et al*, 2011, *op cit*

Table 2: Numbers of EU dairy calves kept in individual pens for first weeks of life

Country	Dairy Cow Numbers	Calves born assuming 400 day calving interval	% individual hutches	Nos individual hutches	Nos group housed	Reference
Austria	532,870	486,244	50%	243,122	243,122	Marce et al (Alps; non Alps 70%)
Belgium	529,250	482,941	100%	482,941	-	Marce et al (Flanders only)
Bulgaria	244,360	222,979		-		
Croatia	136,000	124,100		-		
Cyprus	31,880	29,091		-		
Czechia	358,600	327,223	97%	316,424	10,798	Stanek et al 2014 https://www.sciencedirect.com/science/article/pii/S0022030214002902
Denmark	570,000	520,125	80%	416,100	104,025	Marce et al
Estonia	85,200	77,745		-		
Finland	263,640	240,572	80%	192,457	48,114	Marce et al
France	3,550,070	3,239,439	85%	2,753,523	485,916	Marce et al
Germany	4,100,860	3,742,035	100%	3,742,035	-	Marce et al
Greece	95,000	86,688	35%	30,341	56,347	Marce et al
Hungary	239,000	218,088		-		
Ireland	1,369,100	1,249,304	10%	124,930	1,124,373	Marce et al
Italy	1,939,480	1,769,776	90%	1,592,798	176,978	Marce et al
Latvia	144,470	131,829		-		
Lithuania	256,200	233,783		-		
Luxembourg	53,000	48,363		-		
Malta	6,230	5,685		-		
Netherlands	1,552,000	1,416,200	80%	1,132,960	283,240	Marce et al
Poland	2,214,100	2,020,366		-		
Portugal	235,470	214,866		-		
Romania	1,162,800	1,061,055		-		
Slovakia	127,870	116,681		-		
Slovenia	102,710	93,723		-		
Spain	816,690	745,230	40%	298,092	447,138	Marce et al
Sweden	313,050	285,658	100%	285,658	-	Marce et al
United Kingdom	1,879,000	1,714,588	60%	1,028,753	685,835	Marce et al
European Union - 2	**22,908,900**	**20,904,371**		**12,640,133**	**3,665,886**	
Reference for dairy cow nos Eurostat 2018						
Reference for %ages in system Marcé, C., Guatteo, R., Bareille, N. and Fourichon, C., 2010. Dairy calf housing systems across Europe and risk for calf infectious diseases. Animal, 4(9), pp.1588-1596. except where stated otherwise						
Reference for Czech %ages Staněk, S., Zink, V., Doležal, O. and Štolc, L., 2014. Survey of preweaning dairy calf-rearing practices in Czech dairy herds. Journal of dairy science, 97(6), pp.3973-3981.						

VIII. The welfare of farmed quail in cages and non-cage systems

Japanese quail (*Coturnix japonica*) have been domesticated relatively recently in comparison with many farmed species and, apart from the loss of migratory instinct, the behaviour of domestic quail has not been substantially altered from that of wild quail.

Most commercially-farmed quail kept for breeding or egg production are housed in barren wire cages, where the space available may be as little as the size of a drinks mat (10 cm x 10cm) per bird. Quail reared for meat production may be kept in cages or in large group sheds.

Figure 49: Caged laying quail, Spain. ©FAADA

Caged quail are unable to perform most of their natural behavioural repertoire, including seeking cover, flying, foraging, dust bathing, and laying their eggs in a nest. These behaviours are highly motivated. When startled, quail respond by flying up vertically, which, in caged quail, can result in serious head injuries and mortality due to hitting the top of the cage.

Non-cage systems, including aviaries and barns, can provide greater freedom of movement and opportunities for behavioural expression. Numerous studies show that non-cage systems for quail can provide improved welfare and comparable or improved productive and reproductive performance when compared with cages.

Non-cage systems for quail reared for meat (mostly large barn systems) are already relatively common and have the potential to provide higher levels of welfare if they are well-managed, if stocking densities are not too high, and if appropriate enrichment is used to provide opportunities for hiding and expression of foraging and dust-bathing behaviour.

Some 'free-to-fly' aviary systems for laying and breeding quail are in use commercially. A high number of floor eggs (eggs laid outside of nest boxes) is often considered to be an obstacle to the wider adoption of non-cage systems for laying and breeding quail. However, quail lay up to 90% of eggs in nest boxes, provided these are properly designed. It is likely that the incidence of floor eggs could be further reduced by refinements in nest-box and pen design and management.

Cages are inherently incapable of meeting the behavioural needs of quail, however well they are managed. There are challenges to be overcome in the management of non-cage systems for quail, including optimising nest-box design to minimise floor eggs in laying and breeding quail, and optimising group size and composition to minimise problems with aggression in breeding quail, but these systems have the potential to provide higher welfare and good productive and reproductive performance if they are well-designed and well-managed.

Biology and natural behaviour of Japanese quail

The Japanese quail (*Coturnix japonica*) is a small mottled-brown ground-dwelling bird of grassy habitats, indigenous to Japan, China, Korea and Indochina.[449] Wild quail live in pairs during the breeding season but gather in large flocks during migration and in the winter.[450] During the breeding season, males are territorial and the distance between calling males is about 100m.[451] Successfully-breeding captive quail have been observed to form strong pair bonds, with the male courting only his own female.[452] When they congregate in flocks the social organisation appears to be a dominance hierarchy based on a pecking order.[453] In their natural habitat, Japanese quail feed on grass seeds, peas, grains, berries, young shoots, tender leaves, insects and other small grubs.[454]

Quail have been domesticated relatively recently compared with many farmed species.[455] In comparison with wild populations, domestic quail have increased body size, acceleration of sexual maturity, and lengthening of the reproductive phase.[456] Apart from the loss of migratory instinct,[457] the behaviour of domestic quail has not been substantially altered from that of wild quail by selection for egg and meat production traits.[458]

Cages cannot meet the needs of quail

Most commercially-farmed quail kept for breeding or egg production are housed in barren wire cages. Quail reared for meat production are most commonly kept on the floor in large barns but

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449 Taka-Tsukasa, N (1935) Cited in: Mills, AD; Crawford, LL; Domjan, M; Faure, JM (1997) The behaviour of the Japanese or domestic quail *Coturnix japonica*. *Neuroscience and Behavioural Reviews*, 21(3): 261-281.

450 Crawford, R.D. (1990) Cited in: Cheng, KM, Bennett, DC and Mills, AD (2010) The Japanese Quail. In: *The UFAW handbook on the care and management of laboratory and other research animals*, eighth edition, 655-673.

451 Schwartz, CW; Schwartz, ER (1949) Cited in Kovach, JK (1974) The behaviour of Japanese quail: a review of literature from a bioethological perspective. *Applied Animal Ethology*, 1: 77-102.

452 Orcutt, FS Jr; Orcutt, AB (1976) Nesting and parental behavior in domestic common quail. *The Auk*, 93:135-141.

453 Boag, DA; Always, JH (1980) Effect of social environment within the brood on dominance rank in gallinaceous birds (Tetraonidae and Phasianidae). *Canadian Journal of Zoology*, 58: 44-49.

454 Taka-Tsukasa, N (1967) Cited in Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (Coturnix japonica) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

455 Cheng, KM, Bennett, DC and Mills, AD (2010) The Japanese Quail. In: *The UFAW handbook on the care and management of laboratory and other research animals*, eighth edition, 655-673.

456 Mills, AD; Crawford, LL; Domjan, M; Faure, JM (1997) The behaviour of the Japanese or domestic quail *Coturnix japonica*. *Neuroscience and Behavioural Reviews*, 21(3): 261-281.

457 Deregnaucourt, S; Guyomarc'h, J-C; Belhamra, M (2005) Comparison of migratory tendency in European quail *Coturnix c. coturnix*, domestic Japanese quail *Coturnix c. japonica* and their hybrids. *Ibis*, 147: 25-36.

458 Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (*Coturnix japonica*) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

may also be kept in cages. Caged quail are unable to perform most of their natural behavioural repertoire, including seeking cover, flying, foraging, dust bathing, and laying their eggs in a nest.

Figure 50: Caged quail, Italy.

Inadequate space and height

There is insufficient space in cages, both horizontally and vertically, to allow quail to perform many basic movements such as running and flying, or to interact normally with conspecifics, let alone to achieve any meaningful exercise. The space available to caged quail may be as little as 10cm x 10cm per bird: equivalent to the size of a drinks mat.

Observations of quail in semi-natural aviaries (outdoor enclosures with a floor area of 4.9 x 3.9m and a height of 2 or 4m, with wire mesh top and sides, 40cm high visual barriers along the sides, floor of mainly natural soil with an area of woodchip and humus, and growing vegetation including willows, grasses and herbs) indicate that, unlike chickens, quail do not perch at night and spend very little time (0.5%) on elevated structures.[459] Perches are therefore unlikely to be necessary for good welfare of quail. However, quail require much greater height than can be provided in a cage because, when startled, quail respond by flying up vertically, which can result in serious head injuries and mortality in caged quail due to hitting the top of the cage.[460]

Lack of cover and opportunities for nesting behaviour

As with other confined animals, caged quail can suffer from fearfulness. Quail in barren battery cages have no possibility of seeking cover and are easily startled by passing stockpeople and sudden noises. When stockpeople pass by, they inevitably enter the flight zones of the birds near

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[459] Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (*Coturnix japonica*) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

[460] Gerken, M; Mills, AD (1993) Cited in: Buchwalder, T; Wechsler, B (1997) The effect of cover on the behaviour of Japanese quail (*Coturnix japonica*). *Applied Animal Behaviour Science*, 54: 335-343.

the front of the cage. As discussed in the previous paragraph, the natural response of quail is to fly up vertically when disturbed, which is a serious welfare problem for quail in cages.[461] Quail in semi-natural aviaries spent a large proportion of their time (average 48%) in cover, which was significantly higher than the proportion of the floor area that was covered with plants and artificial shelters.[462] Preference tests with different types of cover indicate that quail prefer to stay in cover types that are partially or fully open to the sides compared with cover types that are partially or fully open to the top.[463] When exposed to a frightening stimulus, quail showed flight behaviour significantly less often if they were in cover at the time of the stimulus, suggesting that they felt more secure in cover.[464]

Quail housed in barren battery cages show symptoms of pre-laying restlessness.[465] In their natural habitat, female quail build nests among the tufts of grass in dry grasslands.[466] When given the opportunity, domestic quail also choose a secluded site for nesting, in a grass clump or tussock.[467] The female constructs the nest from pieces of dried grass, which she plucks while sitting on the nest.[468] The female first makes a scrape within the grass clump and hollows it out to a shallow cup by the time she lays the last egg of the clutch.[469]

Quail in semi-natural aviaries show a clear preference for laying eggs in cover (91%) as well as in corners and along the border of the aviaries.[470] For egg laying, quail used cover types with a small entrance but no other openings to the side or on the top in preference to cover types with an open top or open sides or 2cm square openings perforating the top or the sides.[471]

Schmid and Wechsler (1998)[472] investigated nest-site stimuli for quail and found that nest boxes with 1.5cm wide slits in the top were preferred over nest boxes with a solid top. Nest boxes located in corners were preferred over more centrally-located nest boxes. Nest boxes containing hay were preferred over nest boxes containing artificial turf and there was a tendency for nest boxes containing chaff to be preferred over nest boxes containing hay.

Lack of opportunities for foraging and dust bathing

As the food sources of quail in the wild are likely to be dispersed, foraging activity probably accounts for a large proportion of daily activity in wild quail.[473] In semi-natural aviaries, quail spent 24% of the observation time on walking / running and 8% on pecking / scratching although they

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461 Gerken, M; Mills, AD (1993) Cited in: Buchwalder, T; Wechsler, B (1997) The effect of cover on the behaviour of Japanese quail (Coturnix japonica). Applied Animal Behaviour Science, 54: 335-343.

462 Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (*Coturnix japonica*) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

463 Buchwalder, T; Wechsler, B (1997) The effect of cover on the behaviour of Japanese quail (*Coturnix japonica*). *Applied Animal Behaviour Science*, 54: 335-343.

464 Buchwalder, T; Wechsler, B (1997) The effect of cover on the behaviour of Japanese quail (*Coturnix japonica*). *Applied Animal Behaviour Science*, 54: 335-343.

465 Gerken, M; Mills, AD (1993) Cited in: Buchwalder, T; Wechsler, B (1997) The effect of cover on the behaviour of Japanese quail (*Coturnix japonica*). *Applied Animal Behaviour Science*, 54: 335-343.

466 Taka-Tsukasa, N (1967) Cited in Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (Coturnix japonica) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

467 Orcutt, FS Jr; Orcutt, AB (1976) Nesting and parental behavior in domestic common quail. *The Auk*, 93:135-141.

468 Orcutt, FS Jr; Orcutt, AB (1976) Nesting and parental behavior in domestic common quail. *The Auk*, 93:135-141.

469 Orcutt, FS Jr; Orcutt, AB (1976) Nesting and parental behavior in domestic common quail. *The Auk*, 93:135-141.

470 Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (*Coturnix japonica*) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

471 Buchwalder, T; Wechsler, B (1997) The effect of cover on the behaviour of Japanese quail (*Coturnix japonica*). *Applied Animal Behaviour Science*, 54: 335-343.

472 Schmid, I; Wechsler, B (1998) Identification of key nest site stimuli for Japanese quail (*Coturnix japonica*). *Applied Animal Behaviour Science*, 57: 145-156.

473 Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (*Coturnix japonica*) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

had *ad libitum* access to food, suggesting that, in common with chickens, the birds are motivated to perform foraging behaviour even when fed *ad libitum*.

When provided with *ad libitum* access to a particulate substrate, quail exhibit cyclic baseline levels of dust bathing, with the bulk of dust bathing activity in the afternoon (7±2h after light onset on a 10=h light: 14-h dark schedule).[474] Individual birds vary in the amount of time spent dust bathing, from a mean of 17 ± 8 minutes to 35 ± 14 minutes per day.[475] Deprivation of dust-bathing substrate leads to almost immediate expression of dust-bathing behaviour if the substrate becomes available again, or the performance of vacuum dust bathing if the deprivation is prolonged[476] indicating that dust bathing is a strongly-motivated behaviour.

Quail will work for access to peat for dust bathing using a push-door apparatus and the level of work quail are willing to exert can exceed their own bodyweight, suggesting that the motivation to dust bathe is high.[477] Birds with prior experience of peat would work harder than naïve birds to access the peat but there was no difference in latency to reach the peat or latency to start dust bathing between experienced and naïve birds. As soon as naïve birds were given the opportunity to access peat, they worked for it.

Figure 51: Quail are strongly motivated to dust bathe.

Schmid and Wechsler (1997) recommend:[478]

> *"Housing systems that are adapted to the normal behaviour of quails should contain a substrate for scratching, pecking and dust bathing."*

Miller and Mench (2005)[479] found that pecking/foraging enrichment, structural enrichment and dust baths provided for quail reared in pens with plastic-coated wire mesh flooring were used for a substantial proportion of the day (29%, 26% and 16% of scans respectively) and use was consistent over time. Foraging enrichment increased foraging and general activity, and both foraging and structural enrichments reduced pacing. Foraging enrichments reduced feed waste. Body weight, feed conversion and egg production were unaffected by the enrichments. Rates of aggression and feather pecking were not significantly affected by the enrichments, but these behaviours were observed very infrequently in this study.[480]

Provision of enrichment objects (e.g. balls, bunches of rope, mirrors, beads) can improve quail welfare (indicated by effect on feeding, resting, comfort, social behaviours) without any negative

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474 Schein, MW; Statkiewicz (1983) Satiation and cyclic performance of dust-bathing by Japanese quail (*Coturnix coturnix japonica*). *Applied Animal Ethology*, 10: 375-383.

475 Statkiewicz, WR; Schein, MW (1980) Variability and periodicity of dustbathing behaviour in Japanese quail (*Coturnix coturnix japonica*). *Animal Behaviour*, 28: 462-467.

476 Gerken, M (1983) cited in: Mills, AD; Crawford, LL; Domjan, M; Faure, JM (1997) The behaviour of the Japanese or domestic quail *Coturnix japonica*. *Neuroscience and Behavioural Reviews*, 21(3): 261-281.

477 Cao, D; Blache, D; Malecki, IA (2014) The motivation of Japanese quails (*Coturnix japonica*) to dustbath is influenced by early experience with peat. *Australian Poultry Science Symposium*, 25: 156-159.

478 Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (*Coturnix japonica*) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

479 Miller, KA; Mench, JA (2005) The differential effects of four types of environmental enrichment on the activity budgets, fearfulness, and social proximity preference of Japanese quail. *Applied Animal Behaviour Science*, 95: 169-187.

480 Miller, KA; Mench, JA (2006) Differential effects of 4 types of environmental enrichment on aggressive pecking, feather pecking, feather loss, food wastage and productivity in Japanese quail. *British Poultry Science*, 47(6): 646-658.

effect on liveweights.[481] Enrichment with visual barriers and artificial grass can reduce behavioural changes in response to chronic stressors in caged quail. Birds with enrichment showed reduced stereotypical pacing and increased resting.[482] Enrichment of the early rearing environment of quail (foraging enrichment – hanging bottle caps, hanging coloured wool, Velcro cylinders, and structural enrichment – wooden platforms) has long-term benefits, helping to counteract some of the negative immunological consequences of stress.[483]

Mohammed *et al.,* (2017)[484] compared different litter materials (sand, dried mud, sawdust, wheat straw and rice straw) for quail. They recommend provision of sawdust bedding material for quail due to a higher incidence of most maintenance behaviours (eating, crouching, huddling, sitting, idling and preening), better performance and improved welfare indicators (lower frequency of feather pecking / better plumage score, no feet or locomotor problems, and lower mortality).

Figure 52: Caged quail, Italy. Lack of foraging opportunities leads to feather pecking.

[481] Taskin, A; Karadavut, U (2017) The effects of environmental enrichment objects on behaviors of Japanese quails at different cage stocking densities. *Indian Journal of Animal Research*, 51(3): 541-548.

[482] Laurence, A; Houdelier, C; Calandreau, L; Arnould, C; Favreau-Peign, A; Leterrier, C; Boissy, A; Lumineau, S (2015) Environmental enrichment reduces behavioural alterations induced by chronic stress in Japanese quail. *Animal*, 9(2): 331-338.

[483] Nazar, FN; Marin, RH (2011) Chronic stress and environmental enrichment as opposite factors affecting the immune response in Japanese quail (*Coturnix coturnix japonica*). *Stress*, 14(2): 166-173.

[484] Mohammed, HH; Said, EN; Abdel-Hamid, SEL (2017) Impact of different litter materials on behaviour, growth performance, feet health and plumage score of Japanese quail (*Coturnix japonica*). *European Poultry Science*, 81.

Non-cage systems can provide higher welfare and comparable or improved performance

Figure 53: Laying quail in cage-free indoor barn system. Panels provide places to hide; litter provides foraging opportunities.

Non-cage systems can provide greater freedom of movement and opportunities for behavioural expression. A variety of non-cage systems for laying and meat quail are available including indoor barns, indoor barns with attached outdoor enclosures, and entirely outdoor enclosures (see figures 5, 6 and 7 for examples). These are variously referred to as barns, aviaries, semi-natural aviaries, free-to-fly aviaries and free-range aviaries.

Nordi *et al.*, (2012)[485] compared the welfare of quail kept for egg-laying in battery cages (45 x 60 x 26.5cm; 8 birds per cage; 29.6 quail/m^2) and enriched aviaries (108 x 144 x 162cm; 8 birds per aviary; 5.2 quail/m^2). Aviaries contained 2.5cm sawdust bedding, sand-bathing area, three perches and two wooden nests. Higher levels of agonistic interactions were observed in caged quail (94 observations compared with 24 observations in aviaries). 15.6% of quail in battery cages had missing feathers and skin injuries on the head and back; all aviary birds were in good feather condition with no injuries observed.

Birds in enriched aviaries exhibited a richer behavioural repertoire, including an increase in highly-motivated activities such as pecking, sand bathing,

Figure 54: Meat quail are usually kept in cage-free barn systems, such as this one. However, in Italy, some meat quail are also kept in cages.

Figure 55: Free-range aviary system. Provides opportunities for foraging, dust bathing and hiding. Tall flexible roof reduces damage when quail exhibit vertical flight escape behaviour.

[485] Nordi, WM; Yamashiro, KCE; Klank, M; Locotelli-Dittrich, R; Morais, RN; Reghelin, AI; Molento, CFM (2012) Quail (*Coturnixcoturnix japonica*) welfare in two confinement systems. *Arquivo Brasileiro de Medicina Veterinaria e Zootecnia*, 64(4): 1001-1008.

and sitting during resting periods. Increased heterophil : lymphocyte (H : L) ratio suggested higher stress levels in caged birds. Battery cages gave no opportunities for the natural quail behavioural repertoire to be expressed, due to environmental restrictions.

Dhahir Muhammad and Aswad Mirza (2019)[486] compared quail welfare, growth performance, carcass traits and meat quality in quail reared for meat in battery cages (50 x 30 x 30cm; 7 birds per cage), floor pens (60 x 60 x 30cm; 7 birds per pen) with sawdust bedding, and free-range aviaries (200 x 200 x 140cm; 7 birds per aviary) with sand-bathing area and nests.

There were no significant differences in growth performance between the three systems and feed consumption was lower in the free-range system. Carcass weight was higher in free range and floor pens than in cages, and dressing percentage (the meat and skeletal percentage, which often determines payments) was higher in free range than in floor pens and cages. There were no other significant differences in carcass traits. Breast meat quality traits were best in free-range systems, with improved appearance, tenderness and overall acceptability.

Cages had the poorest results for these measures and floor pens had intermediate results. Agonistic behaviour was highest in cages and lowest in free range. Sand bathing, floor pecking and flying were not possible in cages and were performed more frequently in free range than in floor pens. The authors conclude that the free-range system provided greater behavioural freedom, comparable growth performance, improvements in some carcass traits and higher meat quality.

Comparisons of the productive and reproductive performance of breeding quail between cages and floor pens have produced equivocal results, with some authors reporting more favourable results in cages,[487] while others report more favourable results in floor systems.[488] [489] [490] While there is significant variation in productive and reproductive performance between systems, it is clear from these studies that performance in well-designed and well-managed non-cage systems can match, or even exceed, that of cage systems.

Minimising floor eggs in laying and breeding quail

A high number of floor eggs (eggs laid outside of nest boxes) is often considered to be an obstacle to the wider adoption of non-cage systems for laying and breeding quail. However, Schmid and Wechsler (1997)[491] found that quail laid up to 90% of eggs in nest boxes, provided these were properly designed (see earlier section on cover and opportunities for nest building). Light intensity outside the nest boxes also influenced laying behaviour, with fewer floor eggs found in pens with higher light intensity than in pens with lower light intensity.[492] It is likely that the incidence of floor eggs could be further reduced by refinements in nest box and pen design and management.

486 Dhahir Muhammad, S; Aswad Mirza, R (2019) Effect of rearing system on performance, meat quality and welfare in local quails. *ZANCO Journal of Pure and Applied Sciences*, 31(s4): 116-120.

487 Alam, MS; Abdur Rahman, MH; Mondal, A; Hossain, K; Bostami, ABMR (2008) Pattern of egg production in Japanese quail reared on littered floor and in cage. *Bangladesh Research Publications Journal*, 1(3): 239-249.

488 Roshdy, M; Khalil, HA; Hanafy, AM; Mady, ME (2010) Production and reproduction traits of Japanese quail as affected by two housing systems. *Egyptian Poultry Science Journal*, 30(I): 55-67.

489 Arumugam, R; Prabakaran, R; Silvakimar, T (2014) Hatching performance of pure bred Japanese quail breeders under cage and deep litter systems of rearing. *Journal of Global Biosciences*, 3(7): 1105-1110.

490 El-Sheikh, TM; Essa, NM; Abdel-Kareem, AAA; Elsagheer, MA (2016) Evaluation of productive and reproductive performance of Japanese quails in floor pens and conventional cages with different stocking densities. *Egyptian Poultry Science Journal*, 36(III): 669-683.

491 Schmid, I; Wechsler, B (1997) Identification of key nest site stimuli for Japanese quail (*Coturnix japonica*). *Applied Animal Behaviour Science*, 57: 145-156.

492 Schmid, I; Wechsler, B (1997) Identification of key nest site stimuli for Japanese quail (*Coturnix japonica*). *Applied Animal Behaviour Science*, 57: 145-156.

Managing aggression in breeding quail

Aggressive pecking can be a serious problem in farmed quail, mainly when adult birds are kept in mixed-sex groups for breeding.[493] Breeding quail are typically housed in battery cages with 15-20 birds per cage with a floor area of 1.0 x 0.5m and a height of 16-20cm.[494] Under these housing conditions, aggressive pecking can lead to injuries, particularly to the head and eyes, which can be serious and sometimes fatal.[495] Although injuries from aggression are a particular problem in mixed-sex breeding groups housed in cages, injuries from aggression can occur in any system where adult males are housed together.[496]

Wechsler and Schmid (1998)[497] conclude that multi-male breeding groups of Japanese quail cannot be recommended due to the occurrence of serious injuries. However, they found that fertility was satisfactory in groups with a sex ratio of 1:8 or 1:12 (92% and 84% of eggs fertilised respectively) and they note that single-male groups also have economic benefits due to reduced feed costs. In semi-natural aviaries, very few aggressive interactions were observed between female quail.[498] In these systems, aggressive behaviour is unlikely to be a problem in all-female groups of quail kept for table-egg production or in groups of several females and one cock for brood egg production.[499]

Non-cage systems have the potential for good welfare

There is potential for welfare to be poor in any system if management is poor but, even with the highest standards of stockpersonship, good welfare cannot be achieved in a cage. This is because cages are inherently incapable of meeting the behavioural needs of quail, however well they are managed.

There are challenges to be overcome in the management of non-cage systems for quail, including optimising nest-box design to minimise floor eggs in laying and breeding quail, and optimising group size and composition to minimise problems with aggression in breeding quail, but these systems have the potential to provide higher welfare and good productive and reproductive performance if they are well-designed and well-managed. Non-cage systems for quail reared for meat (mostly large barn systems) are already relatively common and have the potential to provide higher levels of welfare if they are well-managed, if stocking densities are not too high, and if appropriate enrichment is used to provide opportunities for hiding and expression of foraging and dust-bathing behaviour. Cage-free barn and aviary systems for laying and breeding quail are in use commercially [500] and effective dissemination of knowledge and experience from existing systems that are operating successfully will be essential to the wider adoption and successful management of non-cage systems for laying and breeding quail.

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493 Shanaway, MM (1994) Cited in: Pellegrini, S; Condat, L; Caliva, JM; Marin, RH; Guzman, DA (2019) Can Japanese quail male aggressions toward a female cagemate predict aggressiveness toward unknown conspecifics? *Livestock Science*, 222: 65-70.

494 Gerken, M; Mills, A (1993) Cited in: Wechsler, B; Schmid, I (1998) Aggressive pecking by males in breeding groups of Japanese quail (*Coturnix japonica*). *British Poultry Science*, 39: 333-339.

495 Gerken, M; Mills, A (1993) Cited in: Wechsler, B; Schmid, I (1998) Aggressive pecking by males in breeding groups of Japanese quail (*Coturnix japonica*). *British Poultry Science*, 39: 333-339.

496 Wechsler, B; Schmid, I (1998) Aggressive pecking by males in breeding groups of Japanese quail (*Coturnix japonica*). *British Poultry Science*, 39: 333-339.

497 Wechsler, B; Schmid, I (1998) Aggressive pecking by males in breeding groups of Japanese quail (*Coturnix japonica*). *British Poultry Science*, 39: 333-339.

498 Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (*Coturnix japonica*) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

499 Schmid, I; Wechsler, B (1997) Behaviour of Japanese quail (*Coturnix japonica*) kept in semi-natural aviaries. *Applied Animal Behaviour Science*, 55: 103-112.

500 https://www.farminguk.com/news/developing-the-market-for-quail-products_1959.html (accessed 09.12.2020).

It is important to learn the lessons from experience with laying hens. When barren battery cages for laying hens were prohibited in the EU, many farmers invested heavily in converting to enriched cages. These cages still do not satisfy the welfare requirements of the hens or consumer expectations. As a result, several countries have already prohibited enriched cages for hens and they are being phased out in others. A transition from battery cages to enriched cages would be an unwise and unsustainable investment for quail producers, given that enriched cages cannot provide good welfare and are likely to be replaced by non-cage systems in a short timeframe. Instead, investment should be directed now at non-cage systems that, as demonstrated by science, have the potential to meet the needs of quail and to provide good welfare.

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