

January 2013



# Science and Sense

THE CASE FOR ABOLISHING SOW STALLS

[www.voiceless.org.au](http://www.voiceless.org.au)

This report was written by Dr Malcolm Caulfield and reviewed by Voiceless's Scientific Expert Advisory Council. It is endorsed by the World Society for the Protection of Animals, Compassion in World Farming and Animals Australia.

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## ABOUT VOICELESS

Voiceless is an independent and non-profit think tank dedicated to alleviating the suffering of animals in Australia. Established in 2004 by father and daughter team, Brian Sherman AM and Ondine Sherman, Voiceless:

- Creates and fosters networks of leading lawyers, politicians, businesspeople and professionals to influence law, policy, business and public opinion;
- Conducts quality research on animal industries, exposing legalised cruelty and informing debate;
- Creates a groundswell for social change by fortifying the Australian animal protection movement with select Grants and Prizes;
- Grows animal law as a mainstream practice area to advocate for change in the courts and in legislation; and
- Informs consumers and empowers them to make animal-friendly choices.

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Pigs have long had a bad rap in Australia. Not only are they used in derogatory statements like “You eat like a pig!” and “Filthy pig!”, they have also been a part of our country’s favourite meals: bacon and eggs for breakfast; ham and cheese sandwich for lunch; and roast pork for dinner.

Fortunately, their reputation is on the mend. Due to Voiceless's and many other organisations' work advocating on behalf of pigs, many Australians are now aware that pigs are highly sensitive, clean, intelligent and extremely social animals. With greater strength and frequency, the Australian public is making its voice heard: speaking out against a system in which pigs are kept permanently confined indoors on concrete and surrounded by metal bars, mutilated without pain relief and denied all meaningful social contact like building nests (yes – pregnant pigs make nests), raising their young or rooting in the earth.

It seems common sense that to keep pigs in this manner is inhumane. After all, we know that doing this to a dog would be criminal. However, the companies who run these large-scale operations and their related industry associations, despite science to the contrary, still claim that sow stalls are good for

the pigs' welfare. Sow stalls that prevent a pregnant pig from turning around. Absurd.

Despite this denial, and only due to mounting consumer pressure, the Australian pork industry has voluntarily agreed to phase out the use of sow stalls by 2017. This follows many other countries around the globe that have committed to phasing them out. It is an indication of the immense power that consumers wield over animal industries, and seems to be cause for celebration.

However, here at Voiceless we've seen the poor results of industry self-regulation, most recently in last year's live export debacle and the 2010 abandonment of the promise to end the mulesing of sheep. We therefore retain a certain scepticism regarding whether the pork industry will in fact follow through on its pledge to forgo sow stalls when the time comes five long years from now. In light of these changing policies and



conflicting claims confronting a concerned public who are simply trying to make responsible purchasing decisions, Voiceless thought the time was ripe to conduct an in-depth examination of the scientific and academic research on the use of sow stalls; thus the genesis of this year's report.

The pork industry has justified its use of the devices by arguing that the alternative of group housing is more damaging to animal welfare. *Science and Sense* assesses the scientific basis of that claim, not to herald group housing as a perfect alternative, but to reveal the facts upon which this debate must be decided.

In searching for the right person to survey the scientific work in this area and write the report that would come from it, Voiceless was fortunate enough to enlist Dr. Malcolm Caulfield, an Australian lawyer who also holds a PhD in Pharmacology from the University of London, has extensive experience as the founder of the Animal Welfare Community Legal Centre, and who serves as the Science Writer for Voiceless's Scientific Expert Advisory Council. Voiceless is grateful that he graciously agreed to give the project much of his time and then applied his considerable experience and integrity to create this report, one that Voiceless feels provides the definitive last word on the topic of sow stalls. We are exceptionally grateful, too, to the eminent members of our Scientific Expert Advisory Council, who reviewed this report in detail prior to its publication: Professor Marc Bekoff, Professor Clive Phillips, Professor Lesley Rogers, Professor Bernard E. Rollin and Professor AJF (John) Webster. Our thanks also to the Voiceless team members who managed this major editorial project through its many stages of development, in particular Dr Annemarie Jonson, Elaine Morris, Ruth Hatten, Jacob Hunt and Eleanor Nurse.

We hope all who read this report will use it as a tool to inform their purchasing decisions and to keep up the pressure on pork producers and the supply chain, and will pass it on to others in a position to make a lasting difference in the laws and business policies concerning the treatment of factory farmed pigs. On the basis of good science as well as common sense and compassion, we as a community are in a position to improve the lives of these sentient beings, who are totally at our mercy, and for whom we are the voice.

**Brian Sherman AM and Ondine Sherman,  
Managing Directors and Co-Founders,  
and Dana Campbell, CEO**

In Australia, most pregnant pigs (sows) are confined individually in sow stalls (small cages barely bigger than a pig's body)<sup>1</sup> for at least some of each 16 week pregnancy. These sows are repeatedly impregnated and are killed when they no longer produce enough viable piglets.

In 2005 the pig industry initiated a review of the Commonwealth Code governing the welfare of pigs (the 'Pig Code'). The review, which was based on an inaccurate and incomplete statement of the relevant science, recommended that the Pig Code should be amended to allow sows to be kept in stalls for up to 6 weeks of any pregnancy. The main reason for this recommendation was that the review claimed the science indicated housing sows in groups during early pregnancy caused abortions or loss of foetuses.

The provisions of the Pig Code, including permitting keeping sows in stalls for the first six weeks of pregnancy (with effect from 2017) have now passed into law in New South Wales, South Australia, Queensland, Victoria and Western Australia. After a detailed analysis by his Animal Welfare Advisory Committee, the responsible Tasmanian Minister announced in 2010 he would not accept the Pig Code provision relating to sow stalls, and that sow stalls would be banned in Tasmania

from 2017. More recently, the government announced that a partial ban will be implemented in July 2013.

Also in 2010, major food retailer Coles announced that from 2014 its own brand of pork products (including imported pork products) would not be sourced from any supplier that uses sow stalls. In 2012, Coles announced that this commitment would be met in January 2013; one year earlier than planned.

Probably in response to this 2010 announcement, the pig industry said that it will voluntarily ban sow stalls from 2017. However, a voluntary industry-wide ban is unlikely to occur for three reasons: the decision of the industry body is in no way binding on individual pork producers; the industry states that it based its decision to voluntarily ban sow stalls on consumer concerns, which it describes as devoid of "real science"; and it continues to make the contradictory claim that sow stalls are beneficial to welfare.

<sup>1</sup> The current permitted minimum dimensions of sow stalls are 2 metres by 0.6 metres for stalls created after 2007. See *Model Code of Practice for the Welfare of Animals – Pigs Third Edition*, p 23.

Moreover, more than a year after the announcement of the voluntary ban, the industry has said its definition of “sow stall free” will allow sows to be kept in stalls for up to 12 days during any pregnancy, and possibly more. This confirms the view that the pig industry will be unable to impose a true ban on the use of sow stalls.

In making this decision, the pig industry has restated the position reflected in the review of the Pig Code – that sow stalls are good for pigs during the first six weeks of pregnancy, and that group housing during this period has negative impacts on sow welfare. The pig industry has said repeatedly that this position is based on the available science in the area. However, its confidential report on sow housing takes a different view, saying that group housing can be as good as stall housing so far as sow welfare and productivity are concerned.

Given the industry position that continued sow stall use is justified by the science, it is important to clarify the position by reviewing the available science relating to sow housing. That is what this report does.

A particular feature of the pig industry stance on the science of sow stalls, and its assertion the science says that keeping sows in stalls in early pregnancy is good for their welfare, is a reliance on the work of a Melbourne-based group led by Professor Paul Hemsworth. This group has received extensive funding from the pig industry for many years. The pork industry relies in particular on one published scientific paper from this group. This report finds that the conclusions of that paper are significantly flawed and do not support the industry position that housing sows in stalls for the early part of pregnancy is good for their welfare.

In our view, the dominance of this industry-funded group suggests that it may be difficult to obtain impartial or unbiased scientific material in this area in Australia.

This report demonstrates there is good scientific justification for giving farmed animals housed intensively “the benefit of the doubt” where there is reason to suppose they may be suffering – even though that cannot be proved scientifically.

This report describes the animal welfare science available on pregnant sow housing, emphasising the particular relevance to sow housing of considerations relating to the needs of the sow, frustration of which may be reflected in her psychological state.

This report shows that the scientific consensus is that:

- **Indications of poor welfare include poor health, growth or reproduction. Measures of production cannot be used alone as an indicator of poor welfare (that is, a sow showing good reproductive ability is not necessarily in a**

good state of welfare).

- Measures of welfare can also include physiological measures, such as hormones which may in some circumstances reflect levels of stress (particularly cortisol – although there are serious doubts regarding the validity of cortisol levels as an indicator of stress in some situations), measures of the immune system and assessments of behaviour. Any attempt to measure welfare must use a range of these different types of measures.
- Sow stalls are too small to allow sows to easily move from a lying to a standing position (and vice versa) – thereby failing to comply with the Pig Code requirement which requires that sows should be able to freely undertake the movements of getting up and lying down.
- Behavioural studies have shown that:
  - sow stalls frustrate many aspects of a sow's natural behaviour (such as exploring and socialising with other pigs);
  - group housing can be associated with high levels of aggression between sows, particularly at feeding times. However, aggression can be reduced by various strategies, including avoiding mixing unfamiliar pigs and providing individual feeding areas;
  - sows housed in stalls exhibit a high level of stereotypies, which are repetitive, unvarying and apparently functionless behaviours (such as biting the bars of the sow stall); they are thought to show poor welfare, indicating the sow is having difficulty coping with confinement in a sow stall.
- Measures of the ‘stress hormone’, cortisol, have been shown to be an unreliable indicator of poor welfare in circumstances of chronic stress, including extended confinement in a sow stall.
- The claim that stall housing of sows is necessary in early pregnancy, to prevent loss of embryos, is based on the proposition that group housing of sows at that time results in fighting, which causes stress, which in turn increases cortisol, which has been suggested to impair reproduction. Overall, the available data do not support this conclusion. Studies have shown that starvation of sows in the early part of pregnancy produces very large elevations of blood cortisol, without any negative effect on reproduction.

- Health measures have indicated that housing sows in stalls may reduce bone strength and muscle mass, because of lack of exercise. Overall, there is no evidence that housing sows in groups, compared to stalls, has a detrimental effect on the immune system of sows.
- Studies of productivity (i.e. reproductive ability) likewise do not provide any indication that sow stall housing increases productivity compared to well-managed group housing of sows. This is borne out by national productivity figures showing that sow productivity in countries where sow stalls have been banned for many years (UK, Sweden) is at least as good, if not better than sow productivity in Australia, where the majority of sows spend at least some of their pregnancies in stalls.

The conclusion of this detailed consideration of the relevant science is that housing sows for the first six weeks of pregnancy in well-managed group housing systems can produce better welfare outcomes and at least as good productivity outcomes as housing sows in stalls during that early pregnancy period. Consequently, in our view, the industry claim that sow stalls are essential for welfare is misleading.

Given this, it is apparent that the Commonwealth Minister for Agriculture, Fisheries and Forestry ought to revise the Pig Code to prohibit the use of sow stalls. This will in any case reflect the proposed voluntary ban by the pig industry. This should in turn be reflected by the introduction or amendment of legislation by state governments to prohibit the use of sow stalls.



# 1. Background

## 1. Background

### 1.1 HISTORY OF INTENSIVE CONFINEMENT OF PIGS

Intensive confinement of farm animals was adopted after the Second World War as a way of increasing the economic efficiency of animal production. It was a response by livestock producers to the demand by consumers for cheap meat and other animal produce.<sup>2</sup> One of the practices introduced as part of the intensification of pig production was the confinement of pregnant sows<sup>3</sup> in 'sow stalls' (also called gestation stalls or gestation crates) during their pregnancies, which last just under 16 weeks. These 'stalls' are small cages, usually made of steel bars, with concrete floors<sup>4</sup> and dimensions just larger than the body of an adult sow. The use of sow stalls maximises the number of sows which can be kept in a given area and decreases the labour required to manage and monitor the animals; this system also allows individual feeding of animals according to their requirements and reduces inter-sow aggression around feeding times.<sup>5</sup> Disposal of waste is also facilitated by this housing system.<sup>6</sup> Sow stalls were first introduced in Australia in about 1962.<sup>7</sup> In Australia, the other main form of housing for pregnant sows is in group pens.<sup>8</sup>

### 1.2 VOICELESS'S 2005 REPORT ON THE PIG INDUSTRY

In 2005, Voiceless produced its report *From Paddocks to Prisons*, which, by providing detailed information on intensive pig production including reference to some of the key scientific findings, aimed to increase consumer awareness about the animal welfare issues inherent in the use of sow stalls.<sup>9</sup>

The report received national media coverage and a positive response from 24 political representatives, who expressed their support to Voiceless. The Hon. Robert Such cited the report's findings when he moved that the South Australian Parliament express its concern for intensive factory farming and its cruelty to animals<sup>10</sup>. Yet Australian Pork Limited (APL), the producer representative body, refuted the report's findings by claiming that "published scientific literature and practical farm management experience demonstrates that housing sows in dry sow stalls during early pregnancy provides the best net animal welfare outcome within many pig production operations."<sup>11</sup>

2 Loew (1972) p 229. Marchant-Forde (2009a) p 333.

3 Also known as 'dry sows'. Pregnant pigs about to have their first litter are called 'gilts'.

4 Typically with a slatted area at the rear to facilitate removal of faeces and urine.

5 Professor John Webster has pithily described the sow stall as "an engineer's approach to aggression that fails to take any account of sentience." (Personal communication with Voiceless, 6 September 2011). In his book "Animal Welfare – Limping Towards Eden" he said "the case [for sow stalls] rests on the premise that it is acceptable to prevent an undesirable pattern of behaviour by restricting all forms of behaviour. It would be as valid to claim that prisons would be so much more manageable if all the inmates were kept in solitary confinement": see Webster (2005) p 112.

6 Marchant-Forde (2009b).

7 Senate Select Committee on Animal Welfare (1990) *Intensive Livestock Production*, p 177.

8 'Group housing'. See Marchant-Forde (2009b) p 100-104 for a review of the different forms of group housing.

9 Voiceless, *From Paddocks to Prisons: Pigs in New South Wales, Australia. Current Practices, Future Directions* (December 2005). <[http://www.voiceless.org.au/sites/default/files/Voiceless\\_Report%2C\\_From\\_Paddocks\\_To\\_Prisons\\_Dec\\_05.pdf](http://www.voiceless.org.au/sites/default/files/Voiceless_Report%2C_From_Paddocks_To_Prisons_Dec_05.pdf)>

10 South Australia, *Free Range Farming* House of Assembly 29 June 2006 702 (Robert Such).

11 See <<http://www.theage.com.au/news/National/Leave-Christmas-ham-off-menu-group/2005/12/05/1133631193662.html>>

## Australian and worldwide moves away from sow stalls

- Rivalea, with 17% of the breeding sow herd and as the biggest pork producer in Australia,<sup>12</sup> has said: “Rivalea is committed to the removal of all pregnant sow stalls, with the goal of having this major project completed by 2017... Currently more than two thirds of our sows spend all or most of their pregnancy in group housing.”<sup>13</sup>
- Smithfield Foods of the USA, the largest pork producer in the world,<sup>14</sup> has also committed to phasing out sow stalls.<sup>15</sup> Cargill, another large US pig producer, has announced similar moves away from the use of sow stalls (although not amounting to a complete phase out).<sup>16</sup>
- The US states of Arizona, California, Colorado, Florida, Maine, Michigan and Oregon have passed legislation to, at least partially, ban sow stalls.<sup>17 18</sup>
- Sow stalls are already banned in the United Kingdom<sup>19</sup> and Sweden.<sup>20</sup> Switzerland,<sup>21</sup> The Netherlands<sup>22</sup> and Finland<sup>23</sup> have implemented partial bans – restricting the use of sow stalls to limited periods after mating and before farrowing – and a European Union Directive restricts the use of sow stalls to the first four weeks of any pregnancy by 2013.<sup>24</sup>
- The New Zealand government in December 2010 announced that sow stalls would be banned in that country after 2015. This ban was based on a detailed analysis of the relevant science by the New Zealand Animal Welfare Advisory Committee.<sup>25</sup>
- In 2010, Coles announced that from 2014 it would not sell, under its own brand, fresh pork in its butcheries or processed ham and bacon products produced in Australia and overseas that are sourced from suppliers that use sow stalls.<sup>26</sup> In October 2012, it announced that this commitment would be met in January 2013; one year earlier than planned.<sup>27</sup>
- In January 2011, the South African Pork Producers’ Organisation announced that its members would phase out sow stall use in that country, probably from 2017.<sup>28</sup>

12 Western Australia, *Animal Welfare (Pig Industry) Regulations 2010, Regulation 13(4) – Motion*, Legislative Council, 5 April 2011, p 2150-55 (Lynn MacLaren).

13 Rivalea Australia Animal Welfare Policy, p 2 <<http://www.rivalea.com.au/LinkClick.aspx?fileticket=t5xIX6q9IP0%3d&tabid=1540>>

14 Western Australia, *Animal Welfare (Pig Industry) Regulations 2010, Regulation 13(4) – Motion*, Legislative Council, 5 April 2011, 2150-55 (Lynn MacLaren).

15 Smithfield Corporate Social Responsibility Report 2009/2010, p 53; Also see <[www.smithfieldcommitments.com/core-reporting-areas/animal-care/on-our-farms/housing-of-pregnant-sows/](http://www.smithfieldcommitments.com/core-reporting-areas/animal-care/on-our-farms/housing-of-pregnant-sows/)>

16 Centner (2010) p 469.

17 *Arizona Revised Statutes*, Title 13, Chapter 29, Section 13-2910.07 (A) (2006); *California Health & Safety Code*, Chapter 13.8, Section 25990 (2008); *Colorado Revised Statutes*, Title 35, Article 50.5, Section 102(1)(b) (2008); *Florida Constitution*, Article X, Section 21(a) (2002); *Maine Revised Statutes*, Title 7, Chapter 739, Section 4020(2) (2009); *Michigan Compiled Laws* 287.746, Section 46(2) (2009); *Oregon Revised Statutes*, Section 600.150(2) (2007).

18 In most cases the respective laws of the relevant US states make exception for sows to be kept in stalls for a week before the expected birth date. Maine only prohibits confinement to sow stalls for all or the majority of the day and permits use until the sow’s litter is weaned (*Maine Revised Statutes*, Title 7, Chapter 739, Section 4020(3)(G)). Oregon only prohibits confinement for more than 12 hours out of every 24 hours (*Oregon Revised Statutes*, Section 600.150(2) (2007)). Ohio has introduced standards that will phase out sow stalls by 2026 (*Ohio Livestock Care Standards: Swine* 2011 <<http://www.agri.ohio.gov/LivestockCareStandards/docs/OLCS%20Swine%20-%20Final.pdf>> )

19 *The Welfare of Farmed Animals (England) Regulations 2007*, paragraph 5(e) and Schedule 8, paragraphs 5 and 6; *Welfare of Farmed Animals (Wales) Regulations 2007*, paragraph 5(e) and Schedule 8, paragraphs 5 and 6; *Welfare of Farmed Animals (Scotland) Regulations 2010*, paragraph 6(e) and Schedule 6, paragraphs 5 and 6; *Welfare of Farmed Animals Regulations (Northern Ireland) 2000*, paragraph 8 and Schedule 6, paragraphs 6 and 7, as amended by *Welfare of Farmed Animals (Amendment) Regulations (Northern Ireland) 2003*.

20 *Animal Welfare Ordinance 1988:539* (Sweden), 1 January 2009, section 14 and State Board of Agriculture Regulations and Guidelines on Animal Husbandry in Agriculture (Sweden), 6 May 2010, Chapter 3.

21 *Animal Protection Ordinance* 1981 (Switzerland), Article 22(2).

22 *Health and Welfare of Animals Act – Pig Decision 1994* (The Netherlands), Article 2.

23 *Animal Welfare Decree* 1996 (Finland), Section 17(2).

24 Council Directive 2001/88/EC of 23 October 2001 amending Directive 91/630/EC laying down minimum standards for the protection of pigs. Official Journal L316, 1.12.2001, pp 1-4.

25 See <[www.beehive.govt.nz/release/new-pig-welfare-code-phase-out-sow-stalls](http://www.beehive.govt.nz/release/new-pig-welfare-code-phase-out-sow-stalls)>

26 See <<http://www.pigprogress.net/Breeding/Management/2010/11/Australia-Pork-farmers-welcome-Coles-decision-on-gestation-stalls-PP004740W/>>

27 See <<http://www.coles.com.au/Portals/0/content/pdf/News/Sow%20Stall%20and%20Caged%20Eggs%20Media%20Release%20Oct%202012.pdf>>

28 There are 100,000 breeding sows in South Africa. See <[http://www.ciwf.org.uk/news/pig\\_farming/sow\\_stalls\\_to\\_be\\_phased\\_out\\_in\\_south\\_africa.aspx](http://www.ciwf.org.uk/news/pig_farming/sow_stalls_to_be_phased_out_in_south_africa.aspx)>



## 1. Background

### 1.3 REVIEW OF THE COMMONWEALTH PIG CODE, 2005

The Voiceless report coincided with the Commonwealth government's review of its Code of Practice relating to the welfare of pigs<sup>29</sup> ('the Pig Code'). Part of that Commonwealth process included the production of a Regulatory Impact Statement, which purported to summarise the relevant science on sow stalls.<sup>30</sup>

That review made several arguably incorrect statements about science, including that the UK had banned sow stalls "on the basis of ethical preferences rather than science"<sup>31</sup> and that the main reasons for the continued use of sow stalls included that they increased productivity compared to group housing of sows.<sup>32</sup>

It concluded that keeping sows in sow stalls for the first six weeks of pregnancy is "not only the best option in terms of pig welfare but is also the best option in terms of pig productivity" and there is "insufficient scientific justification to ban the usage of stalls completely." The Commonwealth Regulatory Impact Statement was prepared by economic consultants, not by independent animal welfare scientists.

An updated version of the Pig Code was duly endorsed by the Primary Industries Ministerial Council on 20 April 2007; it permitted continued use of sow stalls, but limited their use to the first six weeks of a sow's gestation period. Since then, the parliaments of New South Wales,<sup>33</sup> South Australia,<sup>34</sup> Victoria<sup>35</sup> and Western Australia<sup>36</sup> have passed legislation which, in effect, adopts this provision from April 2017 (or signals the intention to do so).

By contrast, the Tasmanian Minister for Primary Industries acted on the advice of his Animal Welfare Advisory Committee and announced that sow stalls would be banned in that state from 2017. The Committee's advice to the Minister was based on information including a detailed consideration of the relevant science pertaining to welfare and productivity of intensively reared sows.<sup>37</sup>

The Tasmanian Government later announced it would fast-track this plan to July 2013,<sup>38</sup> however, it has also come to light that this so-called 'ban' has been compromised to allow the confinement of sows in stalls for ten days after mating.<sup>39</sup>

29 *Model Code of Practice for the Welfare of Animals – Pigs Third Edition*.

30 Tim Harding & Associates, for the Primary Industries Standing Committee. *Proposed Model Code of Practice for the Welfare of Animals – Pigs; Regulatory Impact Statement 2006*. Note this document is no longer available.

31 *Proposed Model Code of Practice for the Welfare of Animals – Pigs; Regulatory Impact Statement 2006* p iv. Professor Donald Broom, of Cambridge University, a world-renowned animal welfare scientist who, at the time of the UK sow stall ban (in 1999), was chairman of the EU Scientific Veterinary Committee and a member of the UK Farm Animal Welfare Council, has said that while one can never be sure why a government ever takes a particular action, he recalls that the relevant UK government department referred to relevant scientific information in its press release announcing the sow stall ban (personal communication to Malcolm Caulfield, 5 May 2011).

32 See Caulfield and Cambridge (2008) for further criticisms of this document.

33 *Prevention of Cruelty to Animals (General) Regulation 2006* (NSW) reg 19; Schedule 2 (incorporating the *Animal Welfare Code of Practice – Commercial Pig Production 2009* <[http://www.dpi.nsw.gov.au/\\_data/assets/pdf\\_file/0003/313158/animal-welfare-code-of-practice-commercial-pig-production.pdf](http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0003/313158/animal-welfare-code-of-practice-commercial-pig-production.pdf)> )

34 *Animal Welfare Regulations 2000* (SA) reg 28.

35 *Livestock Management Regulations 2011* (regulation 5) and *Livestock Management Act 2010* (sections 6 and 46).

36 *Animal Welfare (Pig Industry) Regulations 2010* (WA) regs 2(d) and 13(4).

37 Letter dated 19 May 2010 from Professor Rob White, Chairman of the Tasmanian Animal Welfare Advisory Committee to Minister Bryan Green, obtained by Voiceless from the Tasmanian Department of Primary Industries, Parks, Water and Environment.

38 See <[http://www.premier.tas.gov.au/media\\_room/media\\_releases/consumer\\_urged\\_to\\_buy\\_tasmanian\\_pork](http://www.premier.tas.gov.au/media_room/media_releases/consumer_urged_to_buy_tasmanian_pork)>

39 Wednesday 30 May 2012 - Estimates Committee A (Green) - Part 1 <<http://www.parliament.tas.gov.au/ctee/Council/Archived/Transcripts/cestawed1-2012.pdf>>

## Significant developments in the USA

Professor Bernard Rollin<sup>40</sup> of Colorado State University has been at the forefront in driving the change away from sow stall use in the USA.

He is a member of the prestigious Pew Commission on Industrial Farm Animal Production,<sup>41</sup> which reported on matters including the use of sow stalls.<sup>42</sup> The report noted the issues with extreme animal confinement, including sow stalls, and remarked on increasing consumer demand for change. The Commission concluded that sow stalls and similar close confinement methods used in agriculture should be banned within 10 years.

In 2007 Professor Rollin was instrumental in convincing Smithfield Foods (which is the largest pork producer in the world) to survey the ethical attitudes of consumers to sow stall use.<sup>43</sup> The result was that Smithfield decided to phase out sow stall use – thereby setting an example which was subsequently followed by other major pig producers (see Box 1).

Professor Rollin makes some further interesting points about the situation in the USA regarding sow stall use, based on his extensive knowledge and experience in the field<sup>44</sup>:

- He notes every US state referendum aimed at eliminating sow stalls has been passed by voters;
- His work with Dr Tim Blackwell (chief pig veterinarian for Ontario) has shown that group housing systems can be as productive as stall systems, with savings of up to 50% on capital costs;
- He has observed that increasing numbers of pig producers are changing from using sow stalls to group housing without losing productivity;
- The Pew Commission, in its review, recommended public funding of research on animal welfare in farming, expressing concern over bias and undue influence exerted by industry when it funds research.

40 Bernard Rollin is a member of Voiceless's Scientific Expert Advisory Council.

41 Whose members include senior scientific experts and senior former members of the US Executive.

42 See <<http://www.ncifap.org/bin/s/a/PCIFAPSmry.pdf>>

43 Personal communication from Professor Rollin to Malcolm Caulfield 6 September 2011.

44 Ibid.



## 1. Background

### 1.4 THE CHANGED POSITION OF AUSTRALIAN PORK LIMITED

Since around the time of the endorsement of the Pig Code, there have been many events both in Australia and internationally which seem to provide further justification for banning sow stalls altogether, including the decision by major food retailer Coles to phase out pork sourced from sow stalls from its own branded products by 2013 (see Box 1).

The influence of ethical considerations and associated consumer pressure is particularly evident in the USA, where input from senior scientists such as Professor Bernard Rollin has persuaded leading pig producers, in particular Smithfield, to adopt a policy favouring a change away from housing pregnant sows in stalls. This has been paralleled by legislation banning sow stalls in several US jurisdictions and reports from high level committees condemning the use of sow stalls (see Box 2).

Apparently in response to these events (and particularly the initial ban by Coles), APL announced that its November 2010 Annual General Meeting had voted to “commit to pursuing the voluntary phasing out of the use of gestation stalls by 2017”. However, curiously that same meeting also resolved that “Australian pork producers recognise the welfare benefits of gestation stalls...”<sup>45</sup>

The caveats in this statement are worthy of close examination, particularly the mention that the “commitment” will “pursue” getting rid of sow stalls, and pork producers “recognise the welfare benefits of gestation stalls”, the very devices they are putatively committed to phasing out. Moreover, the vote of the APL Annual General Meeting is in no way binding on individual pork producers. All APL could do if a producer refuses to get rid of sow stalls by 2017 is revoke their membership. This suggests that a voluntary industry-wide ban is unlikely.

The most recent development indicating that the industry is unwilling or unable to impose a ban on sow stalls is that APL (on about 19 December 2011) published on its website<sup>46</sup> a “definition” of “gestation stall free” which says: “sows and gilts should be kept in loose housing from five days after service until one week before farrowing, where service refers to the last mating...” Note that this “definition” was arrived at more than a year after the November 2010 resolution at the APL Annual General Meeting, which was not qualified in

any way. What the “definition” means is the purported ban (if it ever happens) will not involve getting rid of sow stalls, but will arguably allow the voluntary participants in the ban to use sow stalls for up to 12 days and possibly more (if a sow has multiple matings).

The reality appears to be that pig producers are unwilling and unable to get rid of sow stalls completely.

Central to industry resistance to banning sow stalls is the asserted belief that using sow stalls in the first six weeks of pregnancy has welfare benefits, that alternatives are not available, and that both of these assertions are based on science.

This position is made clear in a series of statements made by APL, including those immediately following a *60 Minutes* program in November 2009 exposing cruelty in a Tasmanian piggery (see Box 3). Those statements repeatedly claim that published scientific research shows that sow welfare is improved by keeping them in stalls for the first six weeks of a pregnancy. By contrast, APL claims that housing pregnant sows in groups produces unavoidable inter-sow aggression and stress, which in turn leads to foetal loss and decreased productivity.

In summary, APL says that the published science shows improved welfare in stalls and loss of productivity without them. APL also claims that in the UK, which abolished sow stalls in 1999, “...business is ruined and they’re importing all their pork.”<sup>47</sup> The latter statement is, of course, incorrect.<sup>48</sup>

45 See <[www.australianpork.com.au/pages/images/Resolutions.pdf](http://www.australianpork.com.au/pages/images/Resolutions.pdf)>

46 See <[www.australianpork.com.au/pages/page233.asp](http://www.australianpork.com.au/pages/page233.asp)>

47 Andrew Spencer, APL CEO, *60 Minutes* interview, Part 3 <<http://www.australianpork.com.au/pages/page182.asp>>

48 APL’s ‘Australian Pig Annual’ gives performance figures for the UK pig industry that belie this exaggeration. <[www.australianpork.com.au/pages/images/Australian%20Pig%20Annual%202009-10%20Amended%2006052011%20LR.pdf](http://www.australianpork.com.au/pages/images/Australian%20Pig%20Annual%202009-10%20Amended%2006052011%20LR.pdf)> p 66. A representative picture can be obtained from the December 2008 report of the House of Commons Environment, Food and Rural Affairs Committee report entitled ‘The English pig industry’ <[www.publications.parliament.uk/pa/cm200809/cmselect/cmenvfru/96/9604.htm](http://www.publications.parliament.uk/pa/cm200809/cmselect/cmenvfru/96/9604.htm)> It said: “The British pig industry comprises about 470,000 breeding sows producing just over nine million pigs a year equating to approximately 800,000 tonnes of bacon and pork...” and “...between 1997 and 2007 the size of the UK pig herd decreased by some 40%, although by 2006-7 the national herd size appeared more stable...over half the pork meat eaten in the UK is imported.”

## APL statements about the science relating to sow stalls

- “Pigs prefer sow stalls in early pregnancy. The scientific evidence clearly indicates that sows are least stressed and feel safe and less threatened if they are in sow stalls for the first six weeks of pregnancy. The scientific research is clearly documented and has been replicated and peer reviewed. ...it does not make sense to suggest that farmers would place pigs in an environment where they are stressed and therefore unproductive.”<sup>49</sup>
- From a series of statements made by APL Chief Executive, Andrew Spencer, in an interview with Liam Bartlett of *60 Minutes*:<sup>50</sup>
  - “...it’s all about understanding the animal, understanding its needs and addressing those needs. Sow stalls do that. They are good for pigs. A lot of people don’t understand that... [t]hat’s what’s backed up by the science...”<sup>51</sup>
  - “... You can have an animal with a broken leg, broken pelvis, that’s been the subject of severe aggression or you can put it in a protective area. It doesn’t require a lot of movement, it’s a big pregnant animal that’s not looking to frolic around; it wants to eat and sleep. That’s pig heaven. Sow stalls are good for sows. The research shows it. There are multiple scientific papers that actually back up exactly what’s in that code about the period of time that is allowable in the stall and the transition into group housing”;<sup>52</sup>
  - “...the research says when you compare in early pregnancy sows in stalls versus sows in group housing the ones in stalls are less stressed, less injured, have fewer pregnancies lost, compared to the ones in group housing. Late in pregnancy, the ones in stalls are more stressed and have lameness issues. So it’s better to have them in group housing...”<sup>53</sup>
- “...the science tells us consistently that early use of stalls is the best outcome for sows”;<sup>54</sup>
- “...we have tested pigs side by side in group housing and in stalls in early pregnancy and the ones that aren’t injured, the ones that keep their pregnancy, the ones that show the lowest levels of stress, are the ones in stalls”;<sup>55</sup>
- Liam Bartlett: “They’re banned in the UK because they came to the conclusion, quite simply, they are cruel...”  
Andrew Spencer: “They were wrong. And the alternative to sow stalls, which is group housing in early pregnancy, is cruel. And that’s where you’re going to find injured sows, broken legs, broken pelvises...”<sup>56</sup>
- “We know – and the science is clear – the stalls are good for newly pregnant pigs, and that pigs prefer them. They ensure the sows are protected from other aggressive sows during the early stages of pregnancy, before the embryo attaches to the uterus”;<sup>57</sup>
- [referring to the vote of APL’s 2010 Annual General Meeting to phase out sow stalls] “the vote... was not in response to scientific evidence of animal cruelty... the debate has always been driven by consumer concerns. It’s not about animal welfare and there’s no real science to that position held by consumers”;<sup>58</sup>
- “...the research around livestock husbandry, around pigs, clearly shows, that sow stalls are a welfare benefit. In fact they’re a welfare benefit to the sow and its unborn piglet at a very early stage of pregnancy; that time of pregnancy where we’re most vulnerable, where we can lose the unborn piglets very early...”<sup>59</sup>

49 Australian Pork Limited (APL) Media Statement ‘Misrepresentation of Australian pig farmers on *60 minutes*’ <[www.australianpork.com.au/pages/images/APL%20Statement-%20Misrepresentation%20on%2060%20Mins.pdf](http://www.australianpork.com.au/pages/images/APL%20Statement-%20Misrepresentation%20on%2060%20Mins.pdf)>

50 YouTube postings by APL of the complete interview between *60 Minutes* presenter Liam Bartlett and APL Chief Executive Officer Andrew Spencer <<http://www.australianpork.com.au/pages/page182.asp>>

51 Andrew Spencer, APL CEO, *60 Minutes* interview, Part 1 <<http://www.australianpork.com.au/pages/page182.asp>>

52 Andrew Spencer, APL CEO, *60 Minutes* interview, Part 2 <<http://www.australianpork.com.au/pages/page182.asp>>

53 Andrew Spencer, APL CEO, *60 Minutes* interview, Part 3 <<http://www.australianpork.com.au/pages/page182.asp>>

54 Ibid.

55 Andrew Spencer, APL CEO, *60 Minutes* interview, Part 4 <<http://www.australianpork.com.au/pages/page182.asp>>

56 Ibid.

57 Andrew Spencer, APL CEO, ‘Crisis management for pig welfare’ in *Australian Pork Newspaper* 13 (12) 12 December 2009.

58 Andrew Spencer, APL CEO, quoted in *Pledge to end sow stalls*, Tasmanian Country, 26 November 2010.

59 ABC *PM* Monday 23 April 2007; statement by Kathleen Plowman, APL at <[www.abc.net.au/pm/content/2007/s1904623.htm](http://www.abc.net.au/pm/content/2007/s1904623.htm)>

## 1. Background

Even though many of those statements were made in 2009 and 2010, and are still on the APL website, APL stated in a submission to the Productivity Commission made in June 2010 that there are “few rigorous recommendations in the scientific literature [which] exist as regards sow group housing with respect to reduction of sow aggression”. The submission noted that APL was therefore funding a large scale project involving several thousand sows to examine the effect of parameters including space allowance and group size on (amongst other things) aggressive behaviour, injuries and reproductive success.<sup>60</sup>

So, the energetic assertion by APL that use of sow stalls in the first six weeks of pregnancy is clearly beneficial to the welfare of sows (and to sow productivity), and that is what the science shows, appears to be undermined by its view that this research is needed. If, as APL asserts, the science favours sow stall use, why do they need to fund this enormous research project into group housing of sows? Also, the Commonwealth Regulatory Impact Statement associated with the development of the Pig Code reveals that APL’s position concerning the scientific consensus on sow stalls shifted dramatically prior to the publication of the Statement. The Statement says:

“APL has advised that it fully supports all the minimum standards in the proposed model code except 4.1.6, which states: *From 10 years after the making of the code a sow must not be confined in a stall for more than 6 weeks of her gestation period.*”

It continues:

APL originally contended that this minimum standard is unduly restrictive at an industry level, and should be amended to the following: *“From 15 years after the making of this code a sow must not be confined in a stall for more than 10 weeks of her gestation period.”* APL based this view on a detailed analysis, which included: “...comprehensive reviews of...scientific research.”

Thus, at the time that submissions were being made regarding the Pig Code, APL stated that the science supported keeping sows in stalls for 10 weeks of the gestation period.

APL then changed its mind. The Regulatory Impact Statement goes on to say that:

“APL has now moved to support the 6-week standard... because objective and well-founded data is now showing that the 6-week sow stalls option is a reasonable overall solution for pig welfare.”<sup>61</sup>

The Regulatory Impact Statement document is dated 29 May 2006. This position is confirmed in a letter from APL (signed by CEO Andrew Spencer) to its members dated 9 May 2006, in which it was stated that APL had changed its position in March 2005.<sup>62</sup> However, what that letter said (and this was not said in the Regulatory Impact Statement) was “APL recognises that there is diversity of views both within and outside the industry about dry sow housing and *that the science in this area is not definitive* (emphasis added).”

In other words, after reviewing the science as it stood in March 2005, APL did not regard the science as definitive. This is not what APL has been saying in public since.

In fact, APL was saying in private that it does not regard the science as definitive well before March 2005. In July 2004 it produced an in-house paper entitled ‘Future use of dry sow stalls in the Australian pork industry – update on policy development.’<sup>63</sup>

That paper said (relevantly – under the heading ‘What does the science say?’) “[n]umerous scientific and technical reviews of sow housing methods have shown that there are clear and measureable animal welfare and productivity benefits from housing sows in individual stalls, particularly in the first 4-6 weeks of pregnancy. On the other hand, *well-managed group housing systems have been shown to be capable of delivering similar animal welfare and productivity outcomes to those obtained in stalls*” (emphasis added).

Therefore, the position APL has adopted in public statements up to and including the present (see Box 3) does not reflect what APL was saying in private. APL’s public statements are that the science is definitive and that sows must be kept in stalls for the first six weeks of pregnancy to avoid compromising their welfare, which in turn reduces productivity. APL’s private statements directly contradict this position, particularly its statement that group housing can be as good as stall housing in welfare and productivity terms.

60 APL submission to the Productivity Commission Inquiry into Rural Research and Development Corporations, <[http://www.pc.gov.au/\\_data/assets/pdf\\_file/0004/99427/sub117.pdf](http://www.pc.gov.au/_data/assets/pdf_file/0004/99427/sub117.pdf)> p 16.

61 *Proposed Model Code of Practice for the Welfare of Animals – Pigs; Regulatory Impact Statement 2006*, p 10-11.

62 Personal communication to Malcolm Caulfield from Glenys Oogjes, Animals Australia.

63 Ibid.

## 1.5 INDUSTRY FUNDING OF SOW STALL SCIENCE – RELIANCE ON DATA FROM THE HEMSWORTH GROUP

In claiming that the science supports use of stalls for the first six weeks of pregnancy, APL appears to give particular weight to a peer-reviewed report, Karlen et al (2007), of a study by the group of Professor Paul Hemsworth, the Animal Welfare Science Centre, Victoria.<sup>64</sup>

The study compared sows housed in stalls with those housed in groups, measuring parameters including number of injuries, reproductive efficiency, cortisol (the “stress hormone”) levels and blood cells involved in the immune system. The paper reporting the results claimed a higher number of scratches, a higher rate of failure to become pregnant (“return to oestrus”), a “trend” to higher cortisol levels early in pregnancy and slight changes in blood cells interpreted as reduced immune function in stalled sows later in pregnancy. The authors claimed that the reproductive parameters measured resulted in sows in stalls weaning “the equivalent of 39 more piglets per 100 mated sows”. Detailed consideration of the variation inherent in these findings (set out in detail later in this report) indicates that many of these conclusions are not justified by statistical analysis of the data.<sup>65</sup>

The study was funded by APL and the Victorian Department of Primary Industries. Annual Reports of the Animal Welfare Science Centre show that in the period 2006-08 Professor Hemsworth’s group received over \$400,000 from APL.<sup>66</sup> Professor Hemsworth appears to act as the scientific spokesperson for APL on the sow stall issue.<sup>67</sup> For example, at the instigation of the pig industry, he briefed the Tasmanian Animal Welfare Advisory Committee on his view of relevant science.<sup>68</sup> Immediately after his presentation

the Committee voted by 9:2 to recommend to the Minister that sow stalls be banned, notwithstanding Professor Hemsworth’s support for the retention of sow stalls in early pregnancy.<sup>69</sup> Contrary to the claims by the industry, the Committee had given detailed consideration to the most recent scientific evidence.<sup>70</sup>

64 See <<http://www.australianpork.com.au/pages/page182.asp>>  
There is also a copy of an abstract, which has not been published in a peer-reviewed journal, but was presented at the 2006 International Congress of the International Society for Applied Ethology <[http://www.applied-ethology.org/hres/2006%20isae%20in%20bristol\\_%20uk.pdf](http://www.applied-ethology.org/hres/2006%20isae%20in%20bristol_%20uk.pdf)>

65 See Box 4 for a critical appraisal of the statistics in this context.

66 See <<http://www.animalwelfare.net.au/~awsc/sites/default/files/Centre%20Report%200809.pdf>>

67 See, for example, ‘Setting free the pigs’ (27 July 2010), an ABC interview where he said “I think some of the moves away from sow stalls were not necessarily based on science, they were based more on public perceptions...some of our research suggests that grouping sows early in gestation results in more aggression amongst the sows in the group than if they’re grouped later in gestation.” However, in that same interview he concedes that sow stalls may be got rid of altogether as a result of his research. See <<http://www.abc.net.au/rural/content/2010/s2965415.htm>>

68 Letter dated 19 May 2010 from Professor Rob White, the Chairman of the Tasmanian Animal Welfare Advisory Committee, to Minister Bryan Green, obtained by Voiceless from the Tasmanian Department of Primary Industries, Parks, Water and Environment.

69 The pig industry was unhappy with this. In an “Issues Alert” dated 10 June 2010, APL referred to the AWAC decision saying (clearly referring to Professor Hemsworth’s presentation) “[t]his was despite... animal welfare scientist’s advice” and “[w]e also believe research and scientific evidence was provided which was contrary to this decision” (sic) see <[http://www.australianpork.com.au/pages/images/Sowstalls\\_Issues%20Alert\\_100610.pdf](http://www.australianpork.com.au/pages/images/Sowstalls_Issues%20Alert_100610.pdf)>

70 Letter dated 19 May 2010 from Professor Rob White, the Chairman of the Tasmanian Animal Welfare Advisory Committee, to Minister Bryan Green, obtained by Voiceless from the Tasmanian Department of Primary Industries, Parks, Water and Environment.



## The incorrect use of statistics

Measures of biological parameters, such as cortisol levels, or numbers of piglets born to a sow, are not the same for all animals, even where those animals have received exactly the same treatments. If these measures were identical for all animals, it would only be necessary to make one measurement in one animal for each particular treatment (for example sow stall housing is one treatment; group housing is another).

The variability in the measures of these parameters means that they have to be made in many animals. The number needed will depend on how great the variability is. The group of animals studied will virtually always be just a representative sample of the total population. Usually, one is interested in taking from the many measurements some representative measure of the parameter in the group, and the usual measure is the average, or mean value.

When comparing the effect of two (or more) treatments, the means of the data (e.g. cortisol) for the two treatments will rarely be the same. This is because the two groups of animals are samples from the larger group (for example, one might study groups of 10 pregnant sows, which could be said to represent samples from the population of all pregnant sows in production). The question the scientist wants to answer is whether, on the basis of comparison of the means from the two samples (with two different treatments, such as stall versus group housing) the means of the entire population of animals in those treatments are different.

To answer this question, one uses statistical analysis. This is very important, because it offers an objective way of answering the question (and science is all about objectivity).<sup>71</sup>

The statistics look at this question by first of all making an assumption (called the “null hypothesis”) that the means of the two populations of animals (with the two different treatments) are the same. If the means of the two samples are different (and of course there will be variability in the responses of individual animals), the question to be answered by the statistical analysis is “if the null hypothesis is true (i.e. the means of the populations are in fact equal), what would be the probability of observing results as extreme or even more extreme, as the results observed in

this particular experiment?” This question is answered by calculating a “p” value, which is a measure of the probability referred to in the question just posed.

When the “p” value is less than 5%, there is a less than 5% chance that the observed difference between the mean values in the two samples has occurred purely by chance and the difference is said to be “statistically significant”. The cut-off point of 5% has no special meaning. It is just a statistical convention. What it means is if one rejects the null hypothesis (the means are as different as they are because of chance), there is less than a one in twenty chance of making that decision wrongly.

The decision to reject or not reject the null hypothesis is an all or nothing decision. If the “p” value is less than 5% (or 0.05, as it is normally written), then the scientist decides the observed difference between the two experimental group sample means is statistically significant.

Some authors fall into the trap of saying that a “p” value which is close to being less than 5%, but is still larger than 5%, indicates there is a “trend” towards the difference between sample means being statistically significantly different. Squires has said:

“...readers should be... wary of authors who describe ‘trends’ – an observed difference or effect (the authors would like to see) that simply does not meet statistical standards of significance. Too often I read manuscripts in which the authors have reported a ‘trend that was not significantly significant’ in the results section and then used the observed trend to justify a particular conclusion in the discussion and the abstract. This sort of ploy borders, I believe, on fraud.”<sup>72</sup>

Other authors have said in this context “results do not ‘trend toward significance’ ... [t]hey either are or are not significant, depending on ... the p value”<sup>73</sup> and “a ‘trend that is not quite statistically significant’ is a trend that might as well be zero.”<sup>74</sup>

Thus, Karlen et al (2007) report in the abstract of their paper a “trend for higher salivary cortisol concentrations” in sows housed in groups; the authors in their Discussion state that while the differences between stall and group housing for cortisol were not significant, “sows in the [group] treatment had higher salivary cortisol concentrations...” and proceed to discuss the import of this alleged difference. This is unjustifiable.

71 For a very readable account of the tests used and what they can say, see Motulsky, H., *Intuitive Biostatistics*, (2010) Oxford, New York: Oxford University Press.

72 Squires (1990) p 213-214.

73 Lang (2006) p 422.

74 Norman and Steiner (2008).



## 1.6 THE COMMONWEALTH GOVERNMENT'S CURRENT POSITION

As noted above, the Commonwealth's current formal position on sow stalls is embodied in the Pig Code, which says (at paragraph 4.1.5) "from 10 years after endorsement of the Code a sow must not be confined in a stall for more than six weeks of any gestation period..." The Code was endorsed by the Primary Industries Ministerial Council on 20 April 2007.

Consistent with the suspicion that the pork industry is unlikely to achieve a voluntary ban industry-wide, APL appears to be putting the view to Ministers, including the Commonwealth Minister for Agriculture, Senator Joe Ludwig - who is responsible for the Pig Code - that sow stall use during the first six weeks of pregnancy is advocated by the science.<sup>75</sup>

Senator Ludwig has written to Voiceless saying that he sees no need to revise the Pig Code to ban sow stalls (thereby reflecting the industry's apparent unwillingness to ban them), as the Australian Veterinary Association (AVA) has a policy (made in 2005) based on the view that sow stalls are beneficial in the first six weeks of a sow's pregnancy.<sup>76</sup>

Clearly, if Coles changes its decision to ban products sourced from those who use sow stalls, the industry has left itself free to renege on its pursuit of the use of alternatives to sow stalls. The only way to ensure that the industry is kept to its word is to legislate against the use of sow stalls.

## 1.7 INDUSTRY FUNDED PRO-SOW-STALL CAMPAIGN BY VETS

There has been one other curious response of a large (35) group of scientists and vets to the initial announcement by Coles that it would ban products sourced from users of sow stalls.

In March 2011 these persons signed an advertisement placed prominently in several national newspapers.<sup>77</sup> This advertisement referred to the Coles policy on sow stalls, saying it "may harm...animals". The signatories said they supported methods of production that favoured animal well-being and considered that sow stalls met those criteria. They also said that decisions about such matters should be made by "farmers and their scientific advisors".

Professor Ian Lean, an adjunct professor of veterinary science at the University of Sydney and managing director of a livestock consultancy, who coordinated the advertisement, has said that the ad was funded by the Animal Health Alliance. This organisation represents companies that produce (amongst other things) veterinary pharmaceuticals.<sup>78</sup>

On its face, a reader might think these comments are made by scientists who have experience of the area of pregnant sow housing and are qualified to comment on it. However, a search of the scientific literature shows that of the 35 signatories, only 5 have published original scientific research on pigs in the last 10 years;<sup>79</sup> most of those papers concern pig nutrition, and none of them relate to pregnant sow housing.

Brian Sherman and Annemarie Jonson of Voiceless responded to the advertisement in an opinion piece published in *The Australian* on 14 March 2011, summarising the reasons why sow stalls are bad for pregnant pigs. Professor Lean responded in turn by saying that he and the group he represents "support an orderly move to phase out gestation crates".<sup>80</sup>

75 On 17 November 2010 APL issued a media release saying it would "start a round of meetings with state and federal Agriculture Ministers to brief them on the voluntary phase out and what this step means for Australian pork farmers" <<http://www.australianpork.com.au/pages/images/World%20First%20for%20Australian%20Pork%20Producers.pdf>> It does not seem unreasonable to assume that APL has expressed its view on the relevant science to the Ministers.

76 See the AVA policy "9.2 Sow housing" <<http://www.ava.com.au/policy/92-sow-housing>> It says "based on the available evidence, the AVA supports the use of sow stalls for the first 6 weeks of gestation." It goes on to say that "individual housing of sows in gestation stalls for the 4-6 weeks of pregnancy has demonstrated advantages for the health, nutrition, welfare and survival rate of sows and unborn piglets." The policy says that sow stalls eliminate competition for food and attendant fighting, stress and injury to sows during the critical period of embryo implantation and hormone fluctuation. It refers to advantages in feeding sows and says sow stalls maximize the proportion of successful pregnancies by reducing stress-induced abortions. This policy was ratified by the AVA Board in May 2005.

77 'Ensuring Environmentally Sustainable and Ethical Food Production for the World's Growing Population' published in *The Australian*, 11 March 2011. The full text of the advertisement can be found online at *Open letter from concerned Australian scientists* (14 March 2011) Kondinin Group <<http://www.kondinigroup.com.au/storyview.asp?storyid=2389736&sectionsourc=s588049>>

78 See the Coles website <<http://www.coles.com.au/Portals/0/content/pdf/News/ABC%207%2030%20Report%20confirms%20AHA%20is%20behind%20scientists.pdf>>

79 Professor I.J. Lean, Professor W.L. Bryden, Professor F.R. Dunshea, Dr B.J. Leury and Dr R. van Barneveld. Note that Professor Lean himself is the author of a book on keeping pigs.

80 See columnist Ruth Ostrow's blog at <<http://ruthostrow.com/professor-ian-lean-to-respond>>

## 1. Background

In that case, one might ask, why were they so adamant that the decision by Coles to get rid of sow stall-sourced products would “harm animals”, and that sow stalls “favour the well-being” of pigs? If anything, this illustrates the need to question those who purport to be speaking on this subject with scientific authority.

It is claimed by APL, the AVA, the Commonwealth and some researchers that science indicates the necessity of sow stalls. These claims are readily testable and this report seeks to do just that. It will review the up-to-date science relating to sow welfare in stalls, compared to other housing systems, and will focus particularly on the effect of different housing systems during the first six weeks of pregnancy.

## 2. Science of Sow Housing



## 2. SCIENCE OF SOW HOUSING<sup>81</sup>

### 2.1 BACKGROUND

The role of science in the assessment of the benefits and disadvantages of sow stalls and alternative forms of housing has become increasingly important. Both consumers and politicians rely on scientists to provide objective advice on the basis of their findings. Objectivity is particularly questionable where the industry concerned funds a significant part of the scientific research. It is also incumbent on industry, where it is seeking to influence lawmakers and consumers, to refer to relevant science in an objective manner, even where the path indicated by the science may not be to the commercial advantage of those in the industry.

The question to be considered from an Australian perspective is “does housing sows in stalls for the first six weeks of pregnancy reduce welfare, compared to housing in groups throughout pregnancy?”

There is, however, one comment which can be made about sow stalls without reference to any complex scientific appraisal. That is, that the size of sow stalls (that is about 2 metres by 0.6 metres) has been set by reference to the static space requirement of the sow; in other words, the amount of space occupied by a sow's body.<sup>82</sup> Indeed, some measures indicate that the current sow stall size (width in particular) is too small to accommodate a sow lying on its side, even after only six weeks gestation, particularly for sows of increasing parity<sup>83</sup> (although even that assumes a sow will poke its legs through to an adjacent stall).<sup>84</sup> Moreover, the space required to allow a sow to get up and lie down is substantially greater than the static space<sup>85</sup> and inadequate stall size makes it more difficult to move from standing to lying (or *vice versa*).<sup>86</sup>

The important consequence of this is that the sow stall dimensions currently allowed (2.2 metres by 0.6 metres) will themselves breach Standard 4.1.3 of the Pig Code which says that “sows...accommodated individually in stalls must be able to stand, get up and lie down...and to be able to freely undertake such movements.”<sup>87</sup> Note that this Standard of the Pig Code did not appear in the versions of the Pig Code standards which have been incorporated into legislation, except in the case of Victoria.<sup>88</sup>

Finally, a factor which greatly complicates any analysis of the scientific data is the great variety of configurations of housing systems which have been used, particularly so far as group housing is concerned. Parameters which have been varied and which may be important in affecting welfare include numbers of sows in groups, space allowance, shape of pen, flooring, provision of bedding material such as straw or rice hulls and inclusion of partitions.<sup>89</sup>

81 There have been several major recent reviews of this subject: see Box 5.

82 Marchant-Forde (2009b) p 124; Baxter and Schwaller (1983) p 182 and Curtis et al (1989) p 1247.

83 See the Glossary for definition of 'parity'.

84 McGlone et al (2004a) p 2421; O'Connell et al (2007) p 1336.

85 Marchant-Forde (2009b) p 124.

86 Anil et al (2002).

87 *Model Code of Practice for the Welfare of Animals- Pigs Third Edition* <<http://www.publish.csiro.au/Books/download.cfm?ID=5698>>

88 *Prevention of Cruelty to Animals (General) Regulation 2006* (NSW) reg 19; Schedule 2 (incorporating the *Animal Welfare Code of Practice – Commercial Pig Production 2009*) <[http://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0003/313158/animal-welfare-code-of-practice-commercial-pig-production.pdf](http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/313158/animal-welfare-code-of-practice-commercial-pig-production.pdf)> ; *Animal Welfare Regulations 2000* (SA) reg 28; *Animal Welfare (Pig Industry) Regulations 2010* (WA) regs 2(d) and 13(4); *Livestock Management Regulations 2011* (Vic) reg 5; Department of Primary Industries (2008), *Code of Accepted Farming Practice for the Welfare of Pigs* (Revision 2), section 4.1.3

89 Marchant-Forde (2009b) p 99.

## Modern reviews of sow housing science

- Marchant-Forde JN (2009) Welfare of dry sows in *The Welfare of Pigs*. Springer Science+Business Media, Dordrecht.

*A well-balanced and (comparatively) up to date review. Conclusions include that no matter what the system, management is crucial; different systems have different welfare advantages and disadvantages.*

- Algers B, Sanaa M, Nunes T, Wechsler B, Spoolder H, Meunier-Salaun M-C, Pedersen LJ. Scientific report on animal health and welfare aspects of different housing and husbandry systems for adult breeding boars, pregnant, farrowing sows and unweaned piglets. *EFSA Journal* 2007; 572:1-107.

*This follow-up report of the Scientific Panel for Animal Health and Welfare of the European Food Safety Authority was adopted in 2007. It says "several circumstances indicate that crating from weaning and the following four weeks impair welfare...group housing from weaning seems to imply a number of welfare advantages..."*

- Rhodes RT, Appleby MC, Chinn K, Douglas L, Firkins LD, Houpt KA, Irwin C, McGlone JJ, Sundberg P, Tokach L, Wills RW. A comprehensive review of housing for pregnant sows. *Journal of the American Veterinary Medical Association* 2005; 227:1580-1590.

*A high-quality review. Conclusions include that sows kept in stalls have equivalent production performance to sows kept in groups, that stalls may adversely affect welfare, and that aggression is most often worse in group housing. The review quotes extensively from an unpublished study.*

- McGlone JJ, von Borell EH, Deen J, Johnson K, Levis DG, Meunier Salaun M, Morrow J, Reeves J, Salak-Johnson JL, Sundberg PL. Review: compilation of the scientific literature comparing housing systems for gestating sows and gilts using measures of physiology, behavior, performance and health. *The Professional Animal Scientist* 2004b; 20:105-117.

*This is a detailed meta-analysis of relevant publications. These authors concluded that, overall, there was no clear scientific evidence from comparative studies that stalls or group housing caused consistent and significant signs of stress.*

- Barnett JL, Hemsworth PH, Cronin GM, Jongman EC, Hutson GJ. A review of the welfare issues for sows and piglets in relation to housing. *Australian Journal of Agricultural Research* 2001; 52:1-28.

*Whilst this review provides a good summary of the literature, there are several potential issues with it. The authors seem to take the view that "current knowledge may not allow detection of some of the more subtle or less serious risks to welfare" and that less serious challenges should be reflected in biological changes. This is not the view taken by other authors. The authors suggest that "because stall housing is a controversial issue from the view of public perception, housing in stalls for a defined period that is considerably less than the period of gestation may be a reasonable compromise." This suggestion seems to be based on consideration of an unpublished study by a commercial company. The review states that it was 'supported' by funds from the Pig Research and Development Corporation (the predecessor of Australian Pork Limited).*

- The Welfare of intensively kept pigs – report of the Scientific Veterinary Committee (1997) to the European Commission. Its members were Professors P Jensen, E Von Borell, DM Broom, D Csermely, AA Dikhuizen and Drs SA Edwards, F Madec and C Stamataris.

*This is a most extensive and valuable review of 190 pages, citing over 800 references. It concluded "since overall welfare appears to be better when sows are not confined throughout gestation, sows should preferably be kept in groups." <sup>90</sup>*

90 *The Welfare of Intensively Kept Pigs*, European Commission Scientific Veterinary Committee, (30 September 1997) Paragraph 73, p 99  
<[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf)>



### 2.2 THE 'AUSTRALIAN PERSPECTIVE'

The Australian approach to a review of the science of sow stall housing, as part of the development of the Pig Code, was to use a firm of economic consultants (not scientists) to carry out the review. This approach ignored the recommendation of the Neuman Report on animal welfare Codes (commissioned by the Commonwealth Department of Agriculture, Fisheries and Forestry). That report recommended Code reviews (including the review of the Pig Code) should be based on an independent review of the relevant science.<sup>91</sup>

Whether or not there is actual bias, where a scientist is reliant to a significant extent on pork industry funding for his or her research, a reasonable person could possibly take the view that the scientist may not be able to be an objective reviewer of sow stall housing science.<sup>92</sup> Part of the problem is that the funding for this sort of science is controlled to a significant extent by the pig industry. Any Australian scientist wanting to make a mark in pregnant sow housing research is obliged to seek industry funding and collaboration in order to support their research. The necessarily large scale of the trials, time consuming nature of behaviour and physiological measurements and significant housing and animal requirements make it extremely unlikely that this work will be undertaken without industry support, under the current government funding arrangements. Importantly, the number and amount of grants awarded to an academic researcher will be a major determinant of their advancement.<sup>93</sup> Furthermore, the more funding a researcher has, the more scientific papers he or she can publish in scientific journals – another factor which works in their favour when seeking advancement or promotion.

The pork producer body, Australian Pork Limited, was established in the early 1990's as a Research and Development Company under the *Primary Industries and Energy Research and Development Act 1989*. APL's expenditure on research (its funding comes from a levy on producers) is matched dollar for dollar by the Commonwealth, that is, it is subsidised by the taxpayer.<sup>94</sup>

Even though the Australian taxpayer contributes a substantial amount of money to research and development determined by APL, there has been little evidence that APL-directed research is routinely published in peer-reviewed journals.<sup>95</sup> Whilst it is difficult to be sure about this, it appears that of the six projects listed on the APL website which directly concern pregnant sow housing, only the project of the Hemsworth group has been published in a peer-reviewed journal.<sup>96</sup> The Hemsworth group appears to be far and away the most prominent Australian research group working in this area, with a total of about 43 papers (peer-reviewed and otherwise) published in the past 30 years or so.

Another 'Australian perspective' is the adoption by the 2007 Hemsworth group review<sup>97</sup> of perhaps a condescending view that the public has misconceptions about farm animal welfare, which could have terrible consequences – including "affecting the sustainability of the livestock industries". They contend that consumers and governments may "react to these issues, perhaps emotively and without factual information" and this could have "implications for other livestock industries as a result of generalisation of the public's views."<sup>98</sup> Surely the job of these scientists is to do the science, not comment on possible outcomes for industry?

91 Neumann G., (2005) *Review of the Australian Model Codes of Practice for the welfare of animals* <[http://www.daff.gov.au/\\_data/assets/pdf\\_file/0006/146751/Neumann\\_report.pdf](http://www.daff.gov.au/_data/assets/pdf_file/0006/146751/Neumann_report.pdf)> p 31.

92 Professor Peter Singer, eminent philosopher and ethicist, currently of Princeton University, advised the Senate Select Committee inquiry into intensive livestock production that the interests of parties such as university scientists receiving research money from producers should be discounted <[http://www.aph.gov.au/Parliamentary\\_Business/Committees/Senate/Committees?url=history/animalwelfare\\_ctte/intensive\\_livestock\\_production/report.pdf](http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Committees?url=history/animalwelfare_ctte/intensive_livestock_production/report.pdf)> p 39. See also Professor Bernard Rollins' comment regarding the Pew Commission's negative views on industry funding of research in this area: Box 2.

93 See for example, the promotion criteria on the University of Queensland website <<https://ppl.app.uq.edu.au/content/5.70.17-criteria-academic-performance>> section 6.

94 Core P (2009) *A retrospective on rural R&D in Australia*, <[http://www.daff.gov.au/\\_data/assets/pdf\\_file/0020/1435331/rd-retrospective-report.pdf](http://www.daff.gov.au/_data/assets/pdf_file/0020/1435331/rd-retrospective-report.pdf)> p 10. See also *Australian Pigmeat Industry* (2005) Productivity Commission Inquiry Report No 35 which notes that in 2004 the R&D component of the pig slaughter levy raised \$4 million, and the government matching funding provided a further \$4.6 million (p 90). That report also noted "there is little information on the impact and effectiveness of APL's R&D activities" (p 91). A Cooperative Research Centre, proposed by entities including APL, has been funded by a \$25.75 million grant; there is also significant research funding from State governments (p 94).

95 As an example, one significant APL-funded study on litter systems for grouped sows, by Morrison and Smits, was never published in a peer-reviewed journal. This contains significant data, which would contribute to the debate, were it published in a peer-reviewed journal. For example, in a study of nearly 500 sows in group housing, the authors found the farrowing rate (i.e. birth rate per sow mated) was between 75% and 79%. This counters data from the study of Karlen et al (2007) p 96, which reported a farrowing rate of only 66% in group-housed sows.

96 Karlen et al (2007).

97 Karlen et al (2007).

98 Barnett et al (2001) p 1.

There is another aspect of the 'Australian perspective' which emerges from consideration of some influential Australian research publications. First, the review of sow housing by the Hemsworth group said the European Scientific Veterinary Committee review<sup>99</sup> was done "from the European perspective".<sup>100</sup> This is a misrepresentation, given that the reference list of that review includes reference to over 50 relevant publications by Australian scientists. It defies logic to thereby imply that the European Scientific Veterinary Committee review (and possibly other international research) is not relevant to the issue of sow housing in Australia.

### 2.3 GIVING THE ANIMAL THE BENEFIT OF THE DOUBT IN THE ABSENCE OF SCIENTIFIC PROOF

Perhaps more importantly, there is a strong view expressed by Australian scientists that legislated changes to housing practices must be "underpinned by sound science".<sup>101</sup> This clearly resonates with politicians, who undoubtedly would like to say that their legislative decisions are based on science.<sup>102</sup>

The grave danger of this approach is that the absence of "science" provides an excuse for doing nothing. Clearly, there is a possibility that confining a pregnant sow in a stall little bigger than her body for six weeks of every pregnancy could have negative psychological effects. But if the science cannot measure a change providing evidence for such an effect, does that mean it is reasonable to conclude that such an effect does not occur, with the conclusion that welfare is not decreased by the confinement?

This issue was addressed by the UK's Brambell Committee, which in 1965 said "it is morally incumbent upon us to give the animal the benefit of doubt and to protect it so far as is possible from conditions that may be reasonably supposed to cause it suffering, though this cannot be proved."<sup>103</sup>

It is that last phrase which is the most important, particularly when the issue relates to the psychological state of a sentient animal, such as a sow. This is particularly important where the initial justification for putting sows into stalls (which occurred in the 1960s in Australia) was to maximise economic returns to the pig farmer. There was no scientific justification for confining sows in stalls, simply because there were no relevant published scientific studies at that time.<sup>104</sup>

As Radford has said, it will often be necessary and appropriate to develop policy on the basis of incomplete evidence.<sup>105</sup> He points out that a House of Commons report in 1981 on pig housing (amongst other things) was critical of the view of the relevant Ministry that decisions should

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<sup>101</sup> See, for example, Barnett (2007) p 4.

<sup>102</sup> In a letter dated 14 February 2011 to Brian Sherman, Voiceless director, the Commonwealth Agriculture Minister, Joe Ludwig, referred to "evidence-based" animal welfare codes of practice and said that the use of sow stalls for the first six weeks of pregnancy was "based on the available evidence." See also the helpful commentary by Radford in *Animal Welfare Law In Britain* 2001. Oxford: Oxford University Press, at p 190.

<sup>103</sup> *Report of the Technical Committee to enquire into the welfare of animals kept under intensive livestock husbandry systems*. HMSO 1965, quoted in Woods (2012) p 20. This view is reflected in the comments of Rushen and de Passile (1992), who noted that "concern about animal suffering is closely related to concern about the ethics of our treatment of animals."

<sup>104</sup> See Rhodes et al (2005).

<sup>105</sup> Radford (2001) p 191.

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<sup>99</sup> von Borell et al (1997).  
<sup>100</sup> Barnett et al (2001) p 3.

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be based on established experience or sound scientific evidence. This approach put the onus of proof in the wrong place, and could be used to justify tolerating practices which were clearly undesirable, even though that could not be scientifically proved.<sup>106</sup>

This point about the reversal of the onus of proof has also been made in the context of the Pig Code Regulatory Impact Statement process.<sup>107</sup> From an Australian perspective, politicians would do well to revisit the comments of the Senate inquiry in 1990<sup>108</sup>, which concluded that an animal's subjective feelings, including whether it was suffering mentally, were not directly accessible to scientific investigation.

### 2.4 WHAT IS WELFARE?

A useful definition of animal welfare, when that term is used as an objectively-determined scientific measure, is the state of the animal as regards its attempts to cope with its environment,<sup>109</sup> or for a sentient animal "a state of body and mind [as it] attempts to cope with its environment".<sup>110</sup> Elaborating on the technical definition of sentience given above, a sentient animal can be said to be one that has "feelings that matter".<sup>111</sup>

#### 2.4.1 The needs of an animal

Assessment of welfare in this context must consider the needs of animals. These needs include requirements to carry out actions to keep each aspect of its state within a tolerable range. A need can include the need to perform a certain behaviour;<sup>112</sup> for example pigs have a need to root in soil.<sup>113</sup> Where there are unsatisfied needs (or "wants"), an animal can experience negative feelings, and awareness of that state is an important part of welfare assessment,<sup>114</sup> although of course this may not be measurable.

The failure to satisfy needs may be reflected in physiological changes, including changes in metabolites such as glucose (when an animal does not have adequate food, for example), hormones such as adrenaline or cortisol, or physiological parameters such as blood pressure or heart rate.

#### 2.4.2 The Five Freedoms

A regard for animal needs and acknowledgment of the advantages of good animal husbandry has led to the development of the 'Five Freedoms' which form the underlying philosophy of the UK Farm Animal Welfare Council.<sup>115</sup> These are:

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106 Caulfield and Cambridge (2008) p 446.

107 Ibid.

108 Senate Select Committee on Animal Welfare (1990) *Intensive Livestock Production*, p 43 .

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109 Broom (1986) p 524.

110 Fraser and Broom (1990).

111 Webster (2005) p 52.

112 Note that what an animal "wants" can be as important to it in the welfare context (if the urge to satisfy the "want" is frustrated) as what an animal "needs" (in the context of what is required for survival and reproduction): see Duncan and Petherick (1991) p 5018.

113 Broom (1996b).

114 Dawkins (1990) p 2; Duncan (1996); Broom (1996a); Webster (2005) p 10 – the latter has said "the welfare of an animal is determined by its capacity to avoid suffering and sustain fitness". See also Farm Animal Welfare Council (2009) *Farm animal welfare in Great Britain: past, present and future* <<http://www.fawc.org.uk/pdf/ppf-report091012.pdf>> and Duncan and Petherick (1991) p 5017.

115 Webster (2001) p 233. The Farm Animal Welfare Council was replaced by the Farm Animal Welfare Committee on 1 April 2011. Regarding the "Five Freedoms" see <<http://www.defra.gov.uk/fawc/about/five-freedoms/>>

- Freedom from thirst, hunger and malnutrition;
- Freedom from discomfort;
- Freedom from pain, injury and disease;
- Freedom to express normal behaviour; and
- Freedom from fear and distress.

### 2.4.3 Indicators of welfare

Poor welfare can also be indicated by poor health (including injury and disease), growth, or reproductive ability. Indications of compromised health may include reduced immune function.<sup>116</sup> It is important to note that while reduced 'performance' (i.e. growth and reproductive performance), which is a parameter important to animal farmers, may result from poor animal welfare, the converse is not true: good growth and reproductive performance, taken in isolation, do not mean the animal is in good state of welfare. However, a minority of scientists maintain that an animal's 'state of being' can be assessed by its 'performance'.<sup>117</sup>

Behavioural measures have developed as an important tool in the assessment of animal welfare. Assessment of behaviour in the welfare context requires knowledge of the animal's normal behaviour. To some extent this may be revealed by knowledge of how animals behave in natural environments,<sup>118</sup> although this may be too simplistic a view.<sup>119</sup> It also requires an appraisal of which behaviours occur in response to changes in an animal's environment which may reduce its welfare. However, it is obvious that no amount of behavioural data will enable direct assessment of a pig's feelings; this will make it impossible to quantify welfare where a pig suffers mental abnormality without any associated physical signs.<sup>120</sup>

It is clear that any attempt to assess welfare scientifically must employ a wide range of measures, including behavioural, pathological, physiological, productivity and health measures.<sup>121</sup> However, any assessment of welfare must be arbitrary, as it is impossible to weigh the results of different measures appropriately.<sup>122</sup>

#### 2.4.3.1 Behavioural measures

Knowledge of the natural behaviours of sows is a good place to start in assessing the effects of housing systems on behaviour, as frustration of natural behavioural urges by housing conditions may reduce a sow's welfare.<sup>123</sup> Several studies have addressed this issue by examining the behaviour of domestic pigs in free-range conditions. This acknowledges that the behaviour of pigs has (albeit to some extent) in all probability been influenced by domestication.<sup>124</sup>

In these conditions, pigs are for most of the time social animals, interacting with other group members,<sup>125</sup> in a friendly, rather than aggressive way.<sup>126</sup> Thus, on this basis, individual confinement in stalls is unnatural for sows,<sup>127</sup> a view which is reinforced by observations that pigs will leave the group nest area (used when resting) to defaecate and urinate.<sup>128</sup> Sows housed in groups will often use one area of a pen for dunging, thereby allowing expression of this (arguably) natural behaviour pattern.<sup>129</sup>

##### 2.4.3.1.1 Aggression

Pigs will spend a great deal of their time foraging, primarily using their snout. Providing concentrated food in a single location (as occurs in any form of intensive housing) will probably not satisfy the motivation of pigs to explore and forage.<sup>130</sup>

In group housing, allowing sows simultaneous access to one source of food may lead to undesirable interactions with group mates, including tail-biting and ear-chewing. However, these behaviours may be mitigated by providing manipulable substrates such as straw,<sup>131</sup> or other modifications which enrich an otherwise barren environment.<sup>132</sup>

Sows in a free-ranging group establish a stable, linear dominance hierarchy.<sup>133</sup> Aggressive interactions between pregnant sows rarely occur in a free-ranging situation, because dominance relationships form early and different groups avoid one another.<sup>134</sup> However, pregnant sows

116 Broom (1996a).

117 See Curtis (2007) p 574.

118 Rollin (1993).

119 It cannot be assumed that just because an animal cannot perform a natural behaviour in a housing system, its welfare is compromised, as some behaviours may only be performed in natural environments: see Marchant-Forde (2009a) p 3.

120 Marchant-Forde (2009b). Dawkins (1985) p 33-34.

121 Dawkins (1985) p 29; Broom (1996a); (1996b); von Borell et al (1997) p 1; Webster (1998); Marchant-Forde (2009a) p 4.

122 Marchant-Forde (2009a) p 5; Rushen and dePassile (1992) p 735.

123 This was the view of the Brambell Committee. See also Rushen and dePassile (1992) p 728 and Jensen and Pedersen (2008) p 341.

124 D'Eath and Turner (2009) p 14.

125 A group usually consists of between 2 and 4 adult females: Marchant-Forde (2009b) p 101.

126 Wood-Gush et al (1990).

127 D'Eath and Turner (2009) p 36.

128 Stolba and Wood-Gush (1984) p 292.

129 D'Eath and Turner (2009) p 36.

130 D'Eath and Turner (2009) p 36.

131 Jensen et al (2000) p 542.

132 Durrell et al (1997) p 304.

133 Jensen and Wood-Gush (1984) p 328.

134 D'Eath and Turner (2009) p 37.

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unfamiliar with each other will often fight when housed intensively in groups in a confined space<sup>135</sup> (although this is not universally the case).<sup>136</sup>

Hoy and Bauer compared the number of aggressive interactions between sows reunited in groups after being housed in individual stalls for 7 and 28 days respectively.<sup>137</sup> They found a remarkable difference, with the sows housed for the shorter period showing a much lower number of agonistic interactions. This suggests that re-establishment of existing hierarchies takes longer after extended times of separation.

Inter-sow aggression is particularly likely at feeding times where all sows in a group have simultaneous access to food, as with floor feeding or trough feeding.<sup>138</sup> Individual feeding stalls can be effective in reducing aggression.<sup>139</sup> Although electronic sow feeding systems can control the amount of food obtained by sows and obviate direct competition at the feeding point, there may be significant aggressive interactions at the entrance to the feeder.<sup>140</sup> Feeders which regulate the rate of feed provided to sows at individual feeding points can reduce fighting.<sup>141</sup>

In dynamic group arrangements used in a commercial setting, it is possible that sows may be subjected to between 3 and 12 mixings per gestation cycle.<sup>142</sup> This may give rise to significant aggressive interactions between unfamiliar sows, although this is usually only intense immediately after mixing.<sup>143</sup>

The incidence of aggression can be reduced by various strategies, such as providing a solid barrier or sub-divisions within a pen.<sup>144</sup> Another promising approach is to pre-mix sows in small groups in a pen within a larger pen, prior to

mixing with the large group.<sup>145</sup> Altering the food composition of group-housed sows fed ad libitum by increasing the content of dietary fibre may reduce aggressive behaviour by increasing the amount of time spent eating.<sup>146</sup>

Stall housing is commonly assumed to prevent inter-sow aggression. However, this is not so.<sup>147</sup> Unlike in group-housed sows, many of the aggressive interactions between stall-housed sows seem to be unresolved, and this may constitute a considerable imposition of stress.<sup>148</sup>

Another important factor for group housing is the amount of space allowed per sow. Studies of long-term sow housing with varying space allocations (with small stable sow groups) showed that decreasing space allowance increased the number of aggressive interactions.<sup>149</sup> Some scientists have not been able to replicate this finding, although their results may have been confounded by varying group sizes.<sup>150</sup> It is not clear whether there is an optimum group size to minimise aggressive encounters.<sup>151</sup>

Several reviewers have concluded that while aggression in group housing cannot be eliminated altogether, it can be minimised by careful management and manipulation of environmental factors.<sup>152</sup>

### 2.4.3.1.2 Effect on normal behaviour

It is apparent that keeping a sow in a stall will compromise the animal's ability to express normal behaviour more than group housing.<sup>153</sup> The sow's normal 'time budget' involves a lot of time spent foraging, with little time (about 6% of time during daylight hours) spent resting.<sup>154</sup> Sows in stalls spend a large proportion of their time (of the order of 70-80%) lying inactive.<sup>155</sup>

With small group sizes, converting stall systems to group housing by opening them up to a group area showed that time spent in various activities was comparable to full stall-housing; around 70% of the time the sows were inactive.<sup>156</sup> However, sows in one study using a large dynamic group with electronic feeding, and a solid-floored kennel arrangement

135 Arey and Edwards (1998) p 61; Estienne et al (2005) p 243, observed higher lesion scores early after grouping; Karlen et al (2007) p 95, observed higher rates of aggression 1 week after mixing in a large group than 9 weeks after mixing.

136 Strawford et al (2008) p 562.

137 Hoy and Bauer (2005) p 25.

138 Csermely and Wood Gush (1986); Arey and Edwards (1998); Gonyou (2005) p 1336.

139 Barnett et al (1992) p 213.

140 Marchant et al (1995); Anil et al (2003) p 1337.

141 von Borell et al (1997) p 25.

142 This is a consequence of the fact that, in a commercial setting, the timing of sow pregnancies are staggered across the total sow herd, so that the group is 'dynamic' (as opposed to static), in that sows are put into the group as they become pregnant, or are taken out of the group as they are about to give birth. This maximises the use of farrowing facilities (where the sows give birth and feed piglets).

143 Arey and Edwards (1998) p 63; Marchant-Forde (2009b) p 113; Krauss and Hoy (2011) p 23.

144 Edwards et al (1993); Bunger and Kallweit (1994); von Borell et al (1997) p 105; Marchant-Forde (2009b) p 113.

145 Kennedy and Broom (1996).

146 See Marchant-Forde (2009b) p 117.

147 Barnett et al (1987a); Broom et al (1985).

148 Jensen (1984) p 99; Marchant-Forde (2009b) p 118.

149 Weng et al (1998) p 310.

150 Seguin et al (2005) p 94.

151 Arey and Edwards (1998) p 63.

152 Marchant-Forde (2009b); Spoolder et al (2009) p 11.

153 Marchant-Forde (2009b) p 121.

154 Stolba and Wood-Gush (1989).

155 Broom et al (1995) p 374; Holt et al (2006) p 949.

156 Harris et al (2006) p 176.



were much more active (about 70% of the time);<sup>157</sup> this is not the case for all such studies.<sup>158</sup>

Marchant-Forde notes that while it may appear that time spent active is equivalent in stall housing and group housing, detailed analysis of time budgets in group housing systems versus stall housing shows that, as parity increases, so stall-housed sows spend much more of their time engaged in stereotyped behaviour (see section 2.4.3.1.3 below for more detail on stereotypes, which are indicators of poor welfare).<sup>159</sup>

It may be possible to get some insight into the importance of a particular natural behaviour by assessing the amount of work a sow is prepared to do to allow it to perform the behaviour.<sup>160</sup> In one study, dominant sows had to perform a panel-pressing task to get access to a group pen containing 2 familiar subordinate sows, as opposed to staying in a sow stall to obtain one sixteenth of their food ration (which they would lose if they chose to join the group). It was found that the sows overall attached no more importance to group access than to getting their residual food ration.<sup>161</sup>

However, the authors noted, importantly, that motivation to join the group may be higher if access was denied for a sufficient time. Access was denied only for one day in the study. Likewise, as the authors noted, motivation to join the group may be increased if the quality of the group space was improved.

#### 2.4.3.1.3 Aberrant behaviours

Abnormalities of behaviour may provide the best indication of long-term problems with housing.<sup>162</sup> They may include stereotypies, reduced responsiveness to stimuli which would normally elicit a response, and redirected behaviour.<sup>163</sup>

Stereotypies are repetitive, unvarying and apparently functionless behaviour patterns typically observed in animals under some conditions of confinement.<sup>164</sup> They develop when an animal is severely or chronically frustrated, and their presence indicates poor welfare (although this has been questioned<sup>165</sup>).<sup>166</sup> Typical stereotypies in sows include

sham chewing and bar-biting.

Some scientists have suggested that stereotypies may be responses which help animals cope with their environment.<sup>167</sup> There may be parallels between some stereotyped behaviour and redirection of feeding motivation.<sup>168</sup> It has been said that non-feeding 'oral-nasal-facial behaviours'<sup>169</sup> show a similar frequency in outdoor housed sows compared to stall housed sows, suggesting that sows are highly motivated to perform these behaviours.<sup>170</sup> However, just because there is a correlation between the frequency of these behaviours in outdoor sows compared to stall housed sows does not mean that performance of the behaviour in a stall-housed sow satisfies a natural behavioural drive.

Regardless, stereotypies are believed to result from the frustration of motivations, and are associated with restrictive confinement.<sup>171</sup> The strong consensus is that stereotypies are indicative of poor welfare, as they are indicators that an animal is having difficulty coping with its environment.<sup>172</sup>

Stereotypies are rare in sows kept in groups, particularly where the environment is enriched. By contrast, many studies have reported a high incidence of stereotypies in stall-housed sows.<sup>173</sup> Stall-housed sows (4<sup>th</sup> parity) showed greatly increased stereotypies compared to group housed animals when observed 10-11 weeks after entering the housing system.<sup>174</sup>

In another study, the incidence of stereotypies (bar, trough biting, licking, nosing, champing) was found to be higher 1 week after housing in stalls, compared to housing in large groups on deep litter. There was no difference in these behaviours after 9 weeks of housing.<sup>175</sup> There is evidence that supplementing the feed of sows with fibrous feed ingredients (sugar beet pulp) reduces bar-biting and sham chewing.<sup>176</sup>

157 Durrell et al (2002).

158 Broom et al (1995); Karlen et al (2007).

159 Marchant-Forde (2009b) p 123; Broom et al (1995) p 374-377.

160 Kirkden et al (2003). See also the comments by Dawkins (1985) p 35 regarding animals' preferences.

161 Kirkden and Pajor (2006) p 127.

162 Broom (1996b).

163 Broom (1996b); von Borell et al (1997) p 6; Broom and Kirkden (2004) p 363; Marchant-Forde (2009a).

164 Lawrence and Terlouw (1993) p 2815.

165 Mason (1991) p 109; Rushen and de Passile (1992) p 730.

166 von Borell et al (1997) p 6.

167 Mason (1991).

168 "Redirection of feeding motivation" is hypothesized to occur when the psychological arousal caused by feeding, but frustrated by restricted feeding, "overshoots" when feeding finishes, so that the drive for food is redirected to other available stimuli, such as fittings of the housing system. This could result, for example, in bar chewing: Lawrence and Terlouw (1993) p 2816-2817.

169 "Oral-nasal-facial behaviours" or "ONF behaviours" is a term coined by John McGlone and co-workers to describe actions by pigs which include chewing or biting of grass, chewing or biting of bars, chewing rocks or soil and rooting behaviour: see, for example, Dailey and McGlone (1997).

170 McGlone et al (2004b) p 110.

171 Broom and Kirkden (2004) p 341.

172 Broom and Johnson (1993); Rhodes et al (2005) p 1584.

173 von Borell et al (1997) p 89.

174 Broom et al (1995) p 377.

175 Karlen et al (2007) p 95.

176 Brouns et al (1995) p 302.

## Cortisol – an indicator of stress?

Stimuli causing arousal (in animals such as pigs and humans) are processed in the brain and ultimately result in several responses, including release of various hormones. One of the key hormones is the steroid hormone cortisol, which is released from the cortex of the adrenal glands. These are small bodies sitting on top of the kidneys. Another, perhaps better known adrenal hormone is adrenaline, released as part of the “fight and flight” response to threatening stimuli.

The part of the brain responsible for triggering cortisol release is the hypothalamus, and it produces that response by releasing a stimulator hormone (corticotropin-releasing hormone – a peptide), which in turn triggers the pituitary gland (which sits just below the hypothalamus) to release yet another peptide hormone, adrenocorticotrophic hormone, or ACTH. ACTH enters the blood circulation and travels to the adrenal glands, where it stimulates cortisol release. About 90% of blood cortisol is bound to proteins. It is thought only unbound cortisol is able to exert biological effects, so measurements of “free” cortisol have often been said to be more useful than measures of total cortisol, although even this is arguable.<sup>177</sup>

This is the hypothalamic-pituitary-adrenal (HPA) system.

The function of cortisol, elevated by arousing stimuli (including stressful stimuli), is to provide extra energy for forthcoming activity undertaken in response to the stimulus.<sup>178</sup> Clearly then, cortisol may not only be increased in situations which may indicate decreased welfare, such as stress, but also may be increased in situations where there is no threat to welfare (i.e. arousal without stress).<sup>179</sup> So, at the simplest level, an increase in cortisol may reflect arousal, but that does not necessarily reflect the presence of a stressful stimulus. The situation is further complicated as it has often been demonstrated that there is no direct or consistent correlation between apparent stressors and increased cortisol levels. For example, aggressive interactions between sows grouped after weaning, which can be assumed to be stressors, were not correlated with cortisol levels.<sup>180</sup>

The link between cortisol elevation and stress was originally made by Hans Selye on the basis of relatively crude interventions (wrapping rats in a towel for 48 hours or tying their legs<sup>181</sup>) which would be expected to be very stressful. However, observations in humans have shown that increases in cortisol are seen when there “appears to be a rather undifferentiated state of arousal, alerting or involvement – perhaps in anticipation of activity or coping.”<sup>182</sup>

Cortisol production is circadian, with a peak in late morning corresponding to the circadian rhythm of behaviour.<sup>183</sup> This natural fluctuation makes it difficult to assess whether a change in cortisol reflects a decrease in welfare in a chronic situation, as is the case with stall or group housing of sows.<sup>184</sup>

Typically cortisol is elevated in response to an acute stimulus. Even where the stimulus is maintained, levels of the hormone return to baseline pre-stimulus levels.<sup>185</sup> Cortisol production following disturbance takes about 2 minutes to be measurable as a change in blood levels, reaches a peak in 5 to 20 minutes and declines after 15 to 40 minutes.<sup>186</sup> Hence, cortisol responses to housing conditions may be missed unless there is regular sampling.

To be of any value, cortisol measures should be repeated at different time points. Regardless, changes in cortisol levels are unlikely to be indicative of behavioural or mental changes when stress is chronic (as is the case with sow housing); there are many instances of impositions of chronic stressors where cortisol levels remain unchanged.<sup>187</sup>

177 Mormede et al (2007); Einarsson et al (2008) for reviews. In blood the majority of cortisol is bound to a specific protein. See also Kerlik et al (2010), Gatti et al (2009) and Levine et al (2007) for further references and commentary regarding free versus bound cortisol measures.

178 von Borell et al (1997) p 7; Mormede et al (2007) p 319.

179 Mormede et al (2007) p 319.

180 Pedersen et al (1993) p 35.

181 Selye (1936).

182 Mason (1968) p 592.

183 Marchant-Forde (2009b) p 124.

184 Broom (1996b); McGlone et al (2004a) p 109.

185 Mormede et al (2007) p 319.

186 von Borell et al (1997) p 7.

187 Mormede et al (2007).

Geverink and peers observed stall and group housed (non-pregnant) gilts housed for 30 days and found that stereotypic behaviours (chain biting, bar biting, sham chewing) developed to a high frequency (about 50% of the time spent chain-biting during a 2 hour period following afternoon feeding) in stall-housed gilts after 1.5 weeks housing, reaching a peak at about 5 weeks.<sup>188</sup> Although the results of different studies are not consistent,<sup>189</sup> it is at least arguable that a six week period of stall housing is sufficient to cause a significant incidence of stereotypies.

### 2.4.3.2 Physiology

#### *Cortisol*

Cortisol<sup>190</sup> is a hormone often said to be released in response to stress.<sup>191</sup> Many workers have regarded increases in cortisol levels in pregnant sows as indicative of stress and therefore of poor welfare. Webster's trenchant criticism of that assumption is worth repeating: *"this line of thought has largely been recognised as simplistic, non-specific and usually founded on prejudice."*<sup>192</sup>

The consensus is that when assessing the impact of housing conditions on pregnant sow welfare over several weeks (that is, in a situation where any stress resulting from the housing will be chronic), cortisol measures cannot be relied on as indicators of the levels of stress and therefore cannot be relied on as a measure of welfare.<sup>193</sup>

Despite this, the scientific literature on sow housing is replete with cortisol measures representing them as indicative of welfare status. To some extent this is probably to do with the availability of simple radioimmunoassay kits which allow easy measurement of cortisol from samples.<sup>194</sup> An elevation of cortisol cannot be taken as proof of poor welfare.<sup>195</sup> The only way in which an increase of cortisol (presuming it is of sufficient magnitude to truly reflect a response to a stimulus) can be taken to indicate poor welfare is if it occurs together with other measures of welfare such as behavioural changes which provide data supporting that interpretation.<sup>196</sup>

There has been considerable interest in the effects of stress on pig reproduction; the results of some studies have indicated that pregnant sows suffering high levels of stress during early pregnancy may produce fewer piglets than unstressed sows and there have been suggestions that this may result from elevation of cortisol levels in response to stress.<sup>197</sup>

A number of Australian studies which have been reported as relevant to the effect of housing on cortisol levels<sup>198</sup> have been excluded from this report, either because study animals were not pregnant, animals were not put in the experimental housing until 3-5 weeks after mating, or stall housing was not included in the experiment.<sup>199</sup> Another study has also not been considered, as animals were said to have been mated over a 6 week period before entering experimental housing, so it is not clear how long after mating each animal was in the relevant housing.<sup>200</sup> These studies are therefore not relevant to a consideration of whether housing pregnant sows in stalls for the first 6 weeks of pregnancy is necessary in order to reduce stress and thereby avoid reduced productivity.

A study of small groups of pigs (4 animals per group) observed that free plasma cortisol was higher (3.5nM) in pens with restricted space allowance (just under 1 square metre per pig) compared to pens with about twice the space

188 Geverink et al (2003).

189 For example, a study of housing in stalls versus groups for 30 days found that the incidence of a range of behaviours which may indicate stereotypies occurred with the same frequencies in stall-housed and group-housed sows: Estienne et al (2006) p 243.

190 See Box 6.

191 Care must be taken in the use of the word "stress". It cannot be used to mean "any stimulus which causes cortisol elevation": see Rushen and de Passile (1992) p 733; Broom and Kirkden (2004) p 339. A sensible meaning for the word in the context of animal welfare measures is a stimulus which has a deleterious effect on an individual: Broom and Johnson (1993).

192 Webster (1998) p 264. As Dawkins (1985) p 32 said, "there is no justification for concluding that [an animal] suffers every time there is a bit more hormone in its blood..."

193 Changes in cortisol levels may be useful in indicating a change in welfare status where the stressor under consideration is applied in the short- to medium-term. For example, in calves undergoing surgical castration, plasma cortisol levels increase about 6-fold, reaching a peak in about 30 minutes post-surgery, then declining to pre-operative levels in the following 3 hours: Boesch et al (2008) p 340.

194 Although note that cortisol levels estimated on the basis of radioimmunoassays may be over-estimated because of interactions of the antibody used in the assay with other substances: see for example Murphy (2002).

195 Dawkins (1985) p 32; Rushen and de Passile (1992) p 733; Webster (1998) p 264; Dawkins (2008) p 940.

196 Dawkins (1985); Broom (1996); von Borell et al (1997) p 7; Webster (1998) p 265; Marchant-Forde (2009b).

197 Tsuma et al (1996) p 274-276; Razdan et al (2002); Turner et al (2005) p 408; Einarsson et al (2008).

198 Marchant-Forde (2009b) p 124.

199 Barnett et al (1984); Barnett et al (1985); Barnett et al (1987a); Barnett et al (1987b).

200 Barnett et al (1991).

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allowance (2.4nM). In the same study, plasma cortisol was also low (2.5nM) in sows fed in stalls.<sup>201</sup>

Measures of salivary cortisol have been proposed as reflecting free (unbound) plasma cortisol and have been said to have the advantage of requiring less physical restraint during sample collection than that needed for obtaining plasma samples.<sup>202</sup> One study reported that salivary cortisol was not well correlated with free plasma cortisol,<sup>203</sup> although others have noted a good correlation (albeit in very small sample numbers).<sup>204</sup> It seems likely that several aspects of the measurement of salivary cortisol may lead to artefacts. The use of Salivette cotton swabs to collect saliva has been shown to introduce errors in this respect.<sup>205</sup>

Salivary cortisol was reported as lower after 56 days in stalls (about 1.5nM), compared to housing in large groups (about 6nM) with electronic feeding. Total injury scores were also significantly higher in the group-housed sows compared to those in stalls.<sup>206</sup>

Another study, comparing sows housed in large groups on deep litter with stall-housed sows, did not find a statistically significant difference in salivary cortisol for the two housing treatments when measures were made at 1 week and 9 weeks of housing. The authors of this study reported salivary cortisol levels of about 4-5nM at both these time points.<sup>207</sup>

An interesting point emerges when these latter salivary cortisol measures are compared with those of Strawford and colleagues, who studied sows kept in stalls for 37-46 days post-breeding. These workers found average salivary cortisol of about 24 nM.<sup>208</sup> This variation between the findings of the two groups illustrates the unreliability of this measure. If pregnant sow cortisol measures are to be of any use, then they should be within the same range, regardless of where they are measured.

In another relevant study, Estienne and colleagues found serum cortisol (total) was not significantly different after 30 days housing of sows in stalls compared to groups.<sup>209</sup>

The study by Strawford and co-workers illustrates the application of reversed logic when using cortisol measures to assess welfare. These workers found that on one measure of aggression (aggression at the feeder, measured as number of instances per animal per 15 hours), sows housed in stalls then grouped pre-embryo implantation had higher (0.97) aggressions received than sows grouped post-embryo implantation (0.60). These authors said "sows that were mixed post-implantation were less aggressive than sows that were introduced pre-implantation." But the post-implant sows were found to have higher salivary cortisol concentrations than pre-implant sows. In other words, the less aggressive sows had higher salivary cortisol. This finding was rationalised by saying that this was "not indicative of higher stress" as "cortisol levels increase throughout gestation" and "higher cortisol levels... may be due to their physiological state and not due to stress."

This again reinforces the view that cortisol measures are most certainly not good measures of stress or welfare when used in isolation. Further, it illustrates how many workers in this field plough on regardless assuming that cortisol is the only useful measure in welfare studies. Parenthetically, it is worth noting that this study showed no difference in the two housing treatments for total durations of aggressive encounters, numbers of aggressive encounters or injury scores. The authors' conclusion that mixing post-implantation reduces aggression must therefore be treated with caution.

The hypothesis that stress elevates cortisol and cortisol reduces embryo number was directly tested by stressing pregnant gilts to increase cortisol and measuring the effect on embryos.<sup>210</sup> Starvation increased plasma cortisol from about 20nM to about 90nM; the increase was maintained from about day 8 of pregnancy to day 12 of pregnancy. There was no effect on embryo survival (measured at day 17 of pregnancy).

A useful insight into the significance of any observed rises in salivary cortisol comes from work recording increases in response to ACTH<sup>211</sup> (albeit recorded at 10-11 weeks after entering experimental housing, in 4<sup>th</sup> parity sows). Here, basal levels were about 5-11nM, and increased to between about 25nM and 50nM after ACTH, in other words, up to a 10-fold increase.<sup>212</sup> Thus, the small differences reported as being recorded (where those effects were significant)

201 Barnett et al (1992) p 215.

202 Blackshaw and Blackshaw (1989) p 268.

203 Blackshaw and Blackshaw (1989) p 268.

204 Brandt et al (2009) p 78-179.

205 Strazdins et al (2005) p 170; Hansen et al (2008) p 828; Kozaki et al (2009); Kidd et al (2009).

206 Anil et al (2005).

207 Karlen et al (2007) p 95-97.

208 Strawford et al (2008).

209 Estienne et al (2005).

210 Tsuma et al (1996) p 271.

211 See Box 6.

212 Broom et al (1995) p 379.



between sows in stalls compared to sows in groups represent a fraction of the maximal cortisol elevation which is seen in response to ACTH. In fact it may be that the small alterations seen in cortisol in studies of housing that induce long-term chronic stress may be of no significance as the cortisol response is probably only evident in response to shorter term stressors.

Regardless of what is measured, claims about animal welfare based on data measuring pituitary-adrenocortical activity reflected in cortisol levels should be viewed with scepticism.<sup>213</sup>

### 2.4.3.3 Health

#### 2.4.3.3.1 Leg strength and lameness

Continuous housing in sow stalls for 8 or 9 pregnancies (compared to large group housing) reduces bone strength and muscle weight,<sup>214</sup> although this effect may possibly be less significant in sows housed for only six weeks of each pregnancy.

Locomotion scores in sows housed in stalls measured after 9 weeks confinement showed significantly impaired locomotion compared to sows in a large group on deep litter. It should be noted that the stall housed sows were allowed to walk freely before the measurement 'to avoid confusion between stiffness as a product of lack of exercise and a low degree of lameness.'<sup>215</sup> It is reasonable to assume the locomotion scores would have been worse had the sows been studied immediately after removal from the stall. Clearly stiffness as a consequence of being kept in stalls is a welfare issue. To deliberately avoid measuring this is unacceptable. This study also found a higher percentage of animals with high lameness scores in stall-housed sows and increased rates of culling due to lameness in stall-housed sows.

#### 2.4.3.3.2 Immune changes

There is a view that stress decreases the competence of the immune system to combat infectious agents, making a stressed animal more prone to disease.<sup>216</sup> This effect is said to be the result of increased cortisol, although this will

require substantial adrenal cortex responses.<sup>217</sup> However, immunosuppression can also result from changes which do not involve cortisol.<sup>218</sup>

A meta-analysis of reports up to 2004 found that different housing systems had no effect on immune system parameters.<sup>219</sup> Disease incidence data is rarely reported, although there are suggestions that stall-housed sows may be more prone to some disease conditions.<sup>220</sup> There are few peer-reviewed reports that provide useful comparative information about the effect of housing systems on health.<sup>221</sup> Again, it seems unlikely that six-week housing of sows would have any significant impact on disease susceptibility, compared to housing for the entire gestation period. Indeed, application of modern pig management practices on any good facility is very unlikely to show substantial levels of infectious disease, regardless of housing system.<sup>222</sup>

#### 2.4.3.3.3 Injuries

Many scientists have reported a greater incidence of injuries such as scratches in group-housed than stall-housed sows.<sup>223</sup> These include studies of large groups fed with electronic feeding systems.<sup>224</sup> In a study of large groups in deep litter with individual feeding stalls, scratches were common but cuts were almost absent.<sup>225</sup> In any case, it is certainly the case that skin lesions themselves are not causative of poor welfare, although of course they may indicate poor welfare – that is, the stress of aggressive interactions.<sup>226</sup> Fighting and consequent injuries may be reduced by good management.<sup>227</sup>

Stall-housed sows are not injury-free. Sows can suffer injuries (abrasions) to the back area by pressing against the bars at the stall sides because of the inadequate stall width.<sup>228</sup>

213 Rushen (1991) p 384.

214 Marchant and Broom (1996) p 109. Hughes et al (2010) p 302 have noted, based on APL figures, that the average sow replacement rate for Australian herds is 61% each year, while sows are culled after 4.1 parities (that is, at just under 2 years of age), on average. These authors also remark that reproductive failure is the largest single cause for culling sows. The situation appears similar in the US, where a sow's average lifespan is about 3.5 pregnancies: Marchant-Forde (2009b) p 130.

215 Karlen et al (2007) p 90.

216 Marchant-Forde (2009b) p 129.

217 von Borell et al (1997) p 94; Broom and Johnson (1993).

218 Broom (1996b); von Borell et al (1997).

219 McGlone et al (2004b) p 109.

220 Marchant-Forde (2009a).

221 Rhodes et al (2005) p 1585.

222 von Borell et al (1997) p 94.

223 Karlen et al (2007) p 93.

224 Anil et al (2003) p 1337.

225 Karlen et al (2007) p 93.

226 Marchant-Forde (2009a).

227 This point is elaborated on in Section 3.

228 Anil et al (2003) p 1337; Karlen et al (2007) p 93.



### 2.4.3.4 Productivity

Reproductive performance of sows is relatively easily measured. It is, of course, a parameter that is very important to pig farmers. Some have asserted that it is the best measure of welfare,<sup>229</sup> although the scientific consensus is it is but one measure which should be used to assess welfare.<sup>230</sup>

#### 2.4.3.4.1 Scientific studies

Measures of productivity include returns to service (i.e. the sows which fail to become pregnant and have to be inseminated again), litter size and piglet weight. Weaning to oestrus interval is a significant measure from a production point of view; in one study weaning to mating interval was decreased in sows housed in groups, compared to stall-housed sows; farrowing rate was equivalent in the two housing conditions.<sup>231</sup> In another study there was a very small difference in weaning to oestrus interval in the two housing conditions.<sup>232</sup> Another important figure is the number of piglets weaned per sow mated. Productivity data recorded from scientific studies does not measure reproductive performance over the life of a sow, which limits the value of such data.<sup>233</sup>

Several short-term studies of housing effects on productivity indicate that group housing (compared to stall housing) is associated with larger litters,<sup>234</sup> and heavier piglets.<sup>235</sup> Sows kept in the Hurnik-Morris variant of group housing showed better lifetime productivity than sows kept in stalls.<sup>236</sup> One recent meta-analysis of the literature concluded that sows kept in stalls had greater or equal reproductive performance compared to sows in group housing.<sup>237</sup>

In a review of studies up to 2007, Marchant-Forde cites six studies where the authors found better productivity in group housing compared to stall housing systems<sup>238</sup> and eight mostly older studies where there was no difference.<sup>239</sup> In three reports, stall-housed sows had better productivity.<sup>240</sup> However, one of those studies – the Karlen et al report relied on by the pig industry - reports (in the paper's abstract and discussion, with no reference to statistical significance) a decrease in piglets per sow mated for stall-housed compared to group-housed sows. This conclusion is not supported by the reported data, which shows there was not a statistically significant difference between group housing (large group; hoop barns) and stall housing for piglets weaned per sow mated.<sup>241</sup> The authors reported a higher average piglet weight at weaning in groups (8.7kg) compared to stalls (8.0kg). A recent Taiwanese study found better production statistics in sows housed in group housing compared to stall housing, although this data is probably best related to pig facilities in a sub-tropical environment.<sup>242</sup>

Schmidt and co-workers studied various productivity measures in sows housed for 30-35 days after breeding in either stalls or groups (which were outside).<sup>243</sup> They saw a lower farrowing rate (i.e. number of sows which gave birth) in sows kept in stalls, attributable to early loss of pregnancy. Estienne and colleagues specifically examined the effect of housing in stalls or groups for 30 days on various reproductive parameters.<sup>244</sup> They found decreased pregnancy rate in groups (86%) compared to stalls (100%). Other parameters, including viable embryos, were not different in the two housing treatments. A more recent study found no difference in live piglets per litter for stall-housed compared to (large) group housed sows.<sup>245</sup> In that study, there was early disruption of pregnancy (measured at about 28 days gestation by ultrasound coupled with measures of elevated progesterone) in 8.5% of animals in group housing, but in only 1.8% of animals in stalls. By contrast, gilts housed either in stalls or in groups examined

229 Curtis (2007) p 579.

230 von Borell et al (1997) p 140; Marchant-Forde (2009b) p 130.

231 Hemsworth et al (1982).

232 Schmidt et al (1985) p 576.

233 Marchant-Forde (2009b) p 130.

234 Bates et al (2003) p 32 (ESF system); Lammers et al (2007) p 1314 (hoop barns); Salak-Johnson et al (2007) p 1761-1762 (small groups); Seguin et al (2006) (groups of 11-31 sows).

235 Seguin et al (2006) p 93.

236 Morris et al (1998) p 2760.

237 McGlone et al (2004b) p 114.

238 Marchant-Forde (2009b) p 131; see Bates et al (2003); Lammers et al (2007); Salak-Johnson et al (2007); Cronin et al (1996); Morris et al (1998); Seguin et al (2006).

239 von Borell et al (1992) (Hurnik-Morris system); Stamer and Ernsset (1992); Gjein and Larssen (1995); Backus et al (1997) (unreported); Hoy and Rathel (2002); Boyle et al (2001); Harris et al (2006) and Hulbert and McGlone (2006).

240 McGlone et al (1989); Backus et al (1991) (unreported); Karlen et al (2007).

241 Karlen et al (2007): see the commentary on use of statistics in Box 6.

242 Weng et al (2009).

243 Schmidt et al (1985) p 756.

244 Estienne et al (2005) p 246.

245 Munsterhjelm et al (2008).

about 26 days after mating had statistically indistinguishable ovulation rates, embryo numbers or embryo survival rates. This study also found no effect on reproductive parameters of remixing previously group-housed gilts to form stable groups on about three or eight days of gestation.<sup>246</sup>

Soede and colleagues devised a protocol where they sought to stress pregnant gilts by repeated mixing with unfamiliar gilts, both before and after insemination.<sup>247</sup> Measures at around the time of regrouping showed an increase in fighting and skin scratches and increased time spent standing. None of the reproductive parameters measured at day 35 (including embryo survival) were affected by the imposition of the mixing treatment. In another experiment,<sup>248</sup> the same workers imposed physical stress (nose-sling – stress was confirmed by elevation of heart rate) and other stressors (variable feeding routines) on gilts at varying times. Pregnancy rates were high regardless of whether animals were stressed or not; reproductive parameters were unaffected by imposition of the stress regime. Elevation of cortisol in early pregnancy by starvation of pregnant gilts had no effect on embryo survival.<sup>249</sup>

To conclude, there is no clear evidence from a range of scientific studies that productivity is increased by housing pregnant sows in stalls.

#### 2.4.3.4.1 Commercial productivity in countries with and without sow stalls

Arey and Edwards have pointed out that seeming detrimental effects of aggression in group housing on production would be expected to be reflected in higher productivity figures for farms using stall housing, compared to those using group housing. However, examination of UK data for 1990-1995 revealed that not to be the case. One set of data (from 238 herds) obtained in that period showed an average of 0.17 more piglets per litter and 2% greater farrowing rate for herds using stalls compared to group housing in yards. However, another data set (from 225 herds) showed 0.05 fewer piglets per litter for stall-housed sows.<sup>250</sup>

Likewise, production data from Danish herds in the period 1997-2007 do not provide support for the suggestion that group housing from weaning to mating causes reduced reproduction.<sup>251</sup>

This is also the situation when comparisons are made between Australian pig productivity (i.e. where sow stalls are still widely used) and UK and Swedish productivity (where sow stalls are not used). If APL is correct, and use of sow stalls in the first six weeks of gestation is essential to prevent abortions of foetuses, and hence reduced production, then systems which do not use sow stalls should have reduced productivity compared to systems which use sow stalls.

In one sense, there has been an experiment to test this on a grand scale, involving many hundreds of thousands of sows, as sow stalls have been banned in the UK since 1999 and in Sweden since 1988.<sup>252</sup> Consequently, productivity per sow, if APL is right, should be lower in Sweden and the UK (where sow stalls are not used at all) than in Australia (where sow stalls are still used widely).<sup>253</sup> APL's own publications<sup>254</sup> show that in 2008, the number of piglets weaned per sow per year was 21.1 for Australia, 22.09 for the UK and 23.17 for Sweden.<sup>255</sup> In 2008 there were 263,000 breeding sows in Australia.<sup>256</sup> European Union figures show that in 2008 there were 487,000 breeding sows in the UK and 168,000 sows in Sweden.<sup>257</sup>

The conclusion is that removing sow stalls did not impair the ability of UK pig producers to match the productivity of Australian pig producers, who use sow stalls. Swedish pig producers appear to be able to do better without sow stalls than Australian pig producers in productivity terms.

246 van Wettere et al (2008) p 386.

247 Soede et al (2006) p 139-141.

248 Soede et al (2007) p 138.

249 Tsuma et al (1996) p 276.

250 Arey and Edwards (1998) p 67.

251 Algers et al (2007) p 30.

252 Compassion in World Farming (2000) *The welfare of Europe's sows in close confinement stalls* <[http://www.ciwf.org.uk/includes/documents/cm\\_docs/2008/w/welfare\\_of\\_europes\\_sows\\_in\\_close\\_confinement\\_stalls.pdf](http://www.ciwf.org.uk/includes/documents/cm_docs/2008/w/welfare_of_europes_sows_in_close_confinement_stalls.pdf)>

253 Figures provided by APL to the authors of the Regulatory Impact Statement associated with the Pig Code show that in 2004 about 76% of pregnant sows spent some of their time in stalls.

254 Australian Pig Annual 2009-2010 <<http://www.australianpork.com.au/pages/images/Australian%20Pig%20Annual%202009-10%20Amended%2006052011%20LR.pdf>>

255 Australian Pig Annual 2009-2010 <<http://www.australianpork.com.au/pages/images/Australian%20Pig%20Annual%202009-10%20Amended%2006052011%20LR.pdf>> p 66.

256 Australian Pig Annual Supplement Issue 1 June 2009, p 7 <<http://www.australianpork.com.au/pages/images/APA%20Supplement%201%20June%20098.pdf>>

257 EU statistics on the pig population – slaughtering and pigmeat production: see the Eurostat database <[http://epp.eurostat.ec.europa.eu/portal/page/portal/product\\_details/dataset?p\\_product\\_code=APRO\\_MT\\_LSPIG](http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/dataset?p_product_code=APRO_MT_LSPIG)>

# 3. Housing Sows in Groups



### 3. HOUSING SOWS IN GROUPS

Group housing provides an alternative housing system for pregnant sows where pigs are farmed intensively. There are many variants of group housing, involving changes in parameters such as the size of the group, whether the group is static or dynamic (and if the latter how sows are rotated in and out of the group),<sup>258</sup> the amount of space allowed for each sow, the type of flooring, the type of bedding and feeding arrangements.<sup>259</sup> While a detailed consideration of all the variants of group housing is beyond the scope of this review, it is nevertheless useful to note some major considerations.

The 1997 review of sow housing by the European Scientific Veterinary Committee (ESVC) identified the need to consider physical characteristics of the flooring and bedding aspects of sow housing in groups, as well as the amount of space provided to sows,<sup>260</sup> as important considerations in optimising sow welfare.<sup>261</sup> The report considered that flooring for group housing should include a solid floor area, as sows prefer that sort of surface, but part of the flooring should have sufficient perforation or slot structure to allow proper removal of faeces and cleaning. This arrangement also allows for the preference of pigs to separate dunging and activity areas from lying areas. The ESVC report also noted that pigs provided with manipulable bedding material, such as straw, exhibited more activity and exploratory behaviour compared to pigs housed on bare floors. Straw can also help from the dietary point of view, as it compensates for lack of bulk in the diet. Straw also provides pigs with a medium allowing “recreation”, particularly as an outlet for chewing and rooting behaviour. Provision of “toys”, such as chains or ropes increases the frequency of exploratory or play behaviour.

Given that aggression between pregnant sows is particularly likely at and around feeding times, the ESVC report also emphasised the need to carefully consider feeding arrangements in group housing to minimise inter-sow aggression. This can be achieved by means such as providing individual feeding stalls, or feeding stations with partial barriers between sows. More sophisticated systems involved automated identification of each animal and rationing.

The changes in European Union legislation relating to sow housing which followed the two major scientific reports<sup>262</sup> included provisions that floors must include a solid area, and sows must be provided with access to manipulable material.<sup>263</sup> As of 2010, all EU member states except Hungary and Romania had implemented the Directive. Several countries had imposed requirements beyond those imposed by the Directive.<sup>264</sup>

The consensus on group housing is that there is considerable evidence to show that aggression can be kept at a low level by judicious selection of environmental and management factors. This includes using a non-competitive feeding system, attempting to establish stable groups of sows and providing sufficient space with access to manipulable material, such as straw.<sup>265</sup>

258 Marchant-Forde (2009b) p 102-104.

259 See von Borell et al (1997) and Marchant-Forde (2009b) p 100-112, for a description of different group housing systems.

260 There is still considerable debate about the minimum space allowance necessary for a sow in group housing: see Algers et al (2007) p 28.

261 von Borell et al (1997) p 34 and 58.

262 von Borell et al (1997); Algers et al (2007).

263 Council of the European Union Directive 2008/120/EC (Article 3, Section 2a and Section 5). The material which can be used includes straw, hay, wood, sawdust, mushroom compost, peat or any mixture of these materials.

264 Mul et al (2010) p 3.

265 Marchant-Forde (2009b) p 120; Spoolder et al (2009) p 11.

# 4. Conclusions



#### 4. CONCLUSIONS

Where there are chronic stressors, measures of welfare based on blood or salivary cortisol measures must be treated with extreme caution.

Behavioural measures are more reliable. They have indicated that sow stalls not only prevent most normal behaviours of sows, but are simply too small to even allow unimpaired changes in position from standing to lying. Keeping sows in stalls even for six weeks impairs welfare, as evidenced by aberrant behaviours, including stereotypies.<sup>266</sup>

It is clear that inter-sow aggression can be a problem in group housing; however, it can be greatly reduced by adopting appropriate pen designs and management strategies.

Aggression can result in group-housed sows suffering skin lesions. However, it is likely that stall-housed sows suffer lameness and other leg problems.

There is no evidence of significant impairment of immune function by either stall or group housing of sows.

Production measures, both from scientific studies and from consideration of large-scale production data from countries and facilities with and without sow stalls, strongly indicate that putting sows in stalls (compared to group housing) does not result in greater production.

There is no support for the claim that group housing increases stress (or cortisol levels) sufficiently to impair reproduction. The evidence indicates that well managed group housing does not impact negatively on the health of pregnant sows to the same extent as sow stalls.

The overall conclusion is that the science and productivity figures do not support the Australian pig industry's claim, repeated many times, that pregnant sows must be housed in stalls for the first six weeks of pregnancy in order to avoid a decrease in welfare.

While APL has voted to phase out the use of sow stalls from 2017, it has also stated that it believes sow stalls have significant welfare benefits compared to group housing. For that reason, APL's commitment cannot be relied on.<sup>267</sup>

As the science strongly indicates that housing sows in stalls for the first six weeks of pregnancy decreases welfare, compared to group housing, it is apparent the Commonwealth government ought to revise the Pig Code accordingly to ban sow stall use. State governments must likewise introduce or amend legislation to follow the lead given by Tasmania, and prohibit the use of sow stalls.

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<sup>266</sup> Algers et al (2007).

<sup>267</sup> These statements are supported by material contained in the body of this report.

## Glossary of Terms

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| <b>ACTH</b>  | Adrenocorticotrophic hormone – the hormone released from the pituitary gland which then causes cortisol secretion (see Box 4).   |
| <b>Circadian</b>                                     | A rhythm of a biological process occurring with a 24 hour cycle.   |
| <b>Cortisol</b>                                      | A hormone secreted by the adrenal glands in response to stimuli causing arousal (see Box 6).   |
| <b>Farrowing</b>                                     | When a sow gives birth.  |
| <b>Gilt</b>  | Pregnant sow about to have her first litter.   |
| <b>Lymphocyte</b>                                    | A type of white blood cell, a subset of which produces antibodies. Seriously reduced lymphocyte levels will impair the ability of an animal to resist infection.   |
| <b>Meta-analysis</b>                                 | Where data from a number of different studies are subjected to a statistical analysis to allow a conclusion to be drawn on the basis (in effect) from a combination of all the data in the different studies.  |
| <b>Oestrus</b>                                       | When a sow is sexually receptive and able to become pregnant.  |
| <b>Oral-nasal-facial behaviours (ONF behaviours)</b> | A term coined by McGlone and co-workers to describe actions by pigs which include chewing or biting of grass, chewing or biting of bars, chewing rocks or soil and rooting behaviour (see for example Dailey and McGlone (1997)).  |
| <b>Parity</b>  | A term used in relation to breeding sows indicating the number of times a breeding sow has had a litter of piglets. For example, a sow of parity 4 has had 4 litters of piglets.   |
| <b>Progesterone</b>                                  | A sex hormone, which is elevated during pregnancy.   |
| <b>Radioimmunoassay</b>                              | An assay for a substance, such as cortisol, which uses specific antibodies raised to the substance. For example, cortisol molecules (say in a sample of blood or saliva) will bind to the anti-cortisol antibodies, and the amount of cortisol bound can be measured indirectly by use of a radioactively-labeled version of cortisol. |
| <b>Stereotypies</b>                                  | Stereotypies are repetitive, unvarying and apparently functionless behaviour patterns typically observed in animals under some conditions of confinement. They are indicative of poor welfare.   |

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