



## An HSUS Report: Welfare Issues with Gestation Crates for Pregnant Sows

### Abstract

Throughout nearly the entirety of their 112-115 day pregnancies, an estimated 60-70% of breeding sows in the United States are confined in gestation crates (also known as sow stalls)—individual metal enclosures so restrictive that the pigs cannot turn around. Crated sows suffer a number of significant welfare problems, including elevated risk of urinary tract infections, weakened bones, overgrown hooves, lameness, behavioral restriction, and stereotypies. Due to concerns for the welfare of intensively confined sows, legislative, industry, and corporate policies are increasingly phasing out the use of gestation crates.

### Introduction

More than 5.8 million pigs are used for breeding in the U.S. pork industry.<sup>1</sup> The majority (an estimated 60-70%) of breeding sows are confined in gestation crates<sup>2</sup> for nearly the entirety of their approximately four-month (112-115 day)<sup>3</sup> pregnancies. Gestation crates are individual, concrete-floored metal stalls measuring 0.6-0.7 m (2.0-2.3 ft) by 2.0-2.1 m (6.6-6.9 ft), only slightly larger than the animal and so severely restrictive that the sows are unable to turn around.<sup>4</sup> In typical pig production facilities, gestation crates are placed side by side in rows, often with more than 20 sows per row and 100 or more sows per shed.<sup>5,6</sup> The crate floors are customarily constructed with slats to allow manure to fall into a lower pit to separate the sow from her excrement.<sup>7</sup>



Economic pressure, rather than science or animal welfare, is the driving force behind the use of gestation crate housing in the U.S. pork industry according to John J. McGlone, professor of Animal and Food Science and Cell Biology and Anatomy at Texas Tech University and a director of the Pork Industry Institute: “[I]t is the economic forces that drive pork producers to do things that hurt or stress their pigs.”<sup>8</sup> Although gestation crates are already banned in Sweden and the United Kingdom and, for welfare reasons, are being phased out in the European Union (with a total ban on use after the fourth week of pregnancy effective in 2013),<sup>9</sup> Tasmania,<sup>10</sup> and New Zealand,<sup>11</sup> they remain at present a common animal agribusiness practice in the United States.

Recent policy changes in the United States have indicated a clear move away from gestation crate practices, however. In 2002, Florida voters legislated against the use of gestation crates, with the ban going into effect in November 2008.<sup>12</sup> In 2006, Arizonans passed the Humane Treatment of Farm Animals Act, a voter proposition that disallows both gestation crates for pregnant sows and crates for calves raised for veal beginning January 1, 2013.<sup>13</sup> In 2007, Oregon became the first state to ban the use of gestation crates through the state legislature, a ban effective on January 1, 2012.<sup>14</sup> Colorado followed suit in 2008, banning crates for both calves raised for veal and pregnant pigs with a ten year phase-out period.<sup>15,16</sup> A November 2008 ballot measure in California, which passed with 63.5% of the vote, bans gestation crates, veal crates, and battery cages for egg-laying hens, effective January 1, 2015.<sup>17,18,19</sup> In May 2009, the Maine legislature passed a law banning gestation stalls for sows and veal crates for calves throughout the state, effective January 1, 2011.<sup>20</sup> Michigan followed in October 2009, with passage of state legislation that will phase out veal crates and gestation crates within ten years.<sup>21</sup> In 2010, an

agreement in Ohio led to a comprehensive set of rules banning the use of gestation crates for pregnant sows after 2025, among other animal welfare improvements.<sup>22,23</sup>

Industry shifts within North America have also pronounced movement away from the use of gestation crates. In 2007, Smithfield Foods, the world's and United States' largest pig producer,<sup>24,25</sup> and Maple Leaf, Canada's largest pig producer,<sup>26</sup> made corporate commitments to phase-out their use of gestation crates,<sup>27,28</sup> and the Colorado Pork Producers Council announced a ten-year phase-out for the state's pig producers.<sup>29</sup> Said Smithfield Foods CEO Larry Pope, "Our own research has demonstrated that group pens are as good as individual gestation stalls in caring for pregnant sows."<sup>30</sup> Celebrity chef Wolfgang Puck has committed to purchasing pork from crate-free sources for all of his restaurants,<sup>31</sup> and Burger King has begun purchasing crate-free pork in increasing quantities as supply becomes more consistent.<sup>32</sup> McDonald's 2008 Corporate Responsibility Report states it "has long supported suppliers that choose to move away from sow gestation crates and tethers,"<sup>33</sup> but has not yet made concrete purchasing policies mandating specific quantities of pork from crate-free operations.

## Crating Pregnant Sows

Within U.S. animal agriculture, breeding sows produce an average of 2.1-2.5 litters each year<sup>34</sup> and are typically first impregnated around seven months of age,<sup>35</sup> often through artificial insemination.<sup>36,37</sup> A week before birthing, sows are customarily moved into farrowing crates to nurse their piglets. The piglets are weaned at 17-21 days old,<sup>38</sup> and the sows are re-impregnated a few days later.<sup>39</sup> Breeding sows are typically culled after an average of 3.5 parities.<sup>40</sup> Although in decreasing percentages given legislative and industry shifts away from individually confining pregnant sows, at present, the majority spend nearly their entire approximately four-month pregnancies in gestation crates, which prevent the animals from satisfying basic psychological needs and engaging in most of their social and natural behavior,<sup>41</sup> including rooting, foraging, nest-building, grazing, and wallowing.<sup>42,43</sup>

As a result of the intensive confinement, crated sows suffer a number of welfare problems, including poor hygiene, risk of urinary infections, weakened bones, overgrown hooves, poor social interaction, lameness, behavioral restriction, and stereotypies. The European Union Scientific Veterinary Committee (SVC) criticized gestation crates in its 1997 report, "The Welfare of Intensively Kept Pigs," and concluded: "No individual pen should be used which does not allow the sow to turn around easily."<sup>44</sup>

Crated gestating sows have difficulty moving due to the spatial restriction, lack of exercise, and flooring type,<sup>45</sup> whereas group-housed sows have a greater range of movement and show fewer abnormalities of bone and muscle development.<sup>46</sup> As well, several factors relating to the construction of gestation crates and the unsanitary conditions prevalent in pig production facilities may predispose crated sows to disease and/or injury, including: confinement, slatted floors with sharp corners, rough concrete flooring, lack of bedding, and endemic infections.<sup>47,48</sup>

## Physical Health Concerns

Virtually immobilized in barren, restrictive gestation crates, the welfare of breeding sows is severely compromised. Jeremy Marchant-Forde, now a research animal scientist with the U.S. Department of Agriculture (USDA), and Donald Broom, professor of Animal Welfare at the University of Cambridge, have posited that difficulty performing the simple movements of standing and lying is indicative of poor sow welfare.<sup>49</sup> They describe that commercial stalls were not designed with the understanding of these movements and note: "With these dynamic space requirements taken into account, the vast majority of gestation stalls and farrowing crates are too small in width and length, to allow standing and lying to be carried out without spatial restriction."<sup>50</sup> Other animal scientists have made similar determinations and also suggest that crated sows experience increasingly severe discomfort as pregnancy advances.<sup>51</sup>

Indeed, welfare concerns were not the primary consideration in the design of many current housing systems.<sup>52</sup> A survey of manufacturers revealed that engineers never used sow measurements during the design of the first gestation crates.<sup>53</sup>

Discomfort can be compounded by problems associated with barren crates. Without any bedding materials, sows have no thermal protection, which can cause systemic and local cold stress, and may contribute to or exacerbate injuries to skin and limbs.<sup>54</sup> Since gestation crates are barely larger than the sow's body, the animals must urinate and defecate where they stand. As such, the concrete floors of the crates are often partially or fully slatted to allow waste to fall into a pit below. Housing the sows directly above their own excrement has been shown to expose the animals to aversively high levels of ammonia,<sup>55</sup> and respiratory disease has been found to be a significant health issue for pigs kept in confinement.<sup>56</sup> Foot and leg disorders, urinary tract infections, and cardiovascular problems are also of concern for crated sows, who additionally suffer traumatic injuries and body sores often caused by being forced to stand and lie on unnatural flooring or in residual feces and urine. Research led by Broom found 33% of crated sows required removal from production as a result of health problems, compared with less than 4% of group-housed sows.<sup>57</sup>

### Injury Due to Gestation Crate Design

Space restriction in gestation crates is a significant cause of injuries to pregnant sows. Intensively confined, crated sows experience soreness and injuries from rubbing against the bars of their enclosures and from standing or lying on barren flooring.<sup>58</sup> As gestation crates are narrow and typically placed side by side within pig production facilities, when lying down, sows must extend their limbs into adjacent stalls where they may be stepped on.<sup>59</sup> The slatted floors often have sharp corners that can injure exposed limbs and sows who slip in the crates.<sup>60</sup> Food-deprived sows can also suffer head and snout injuries from attempting to access an adjacent stall's feeder.<sup>61</sup> Research has shown that rates of injury increase with time spent in the gestation stall.<sup>62</sup> Despite concerns regarding injuries and research showing that providing extra stall space can considerably reduce injuries and improve breeding sow welfare,<sup>63</sup> industry observers believe the trend may be towards even narrower stalls.<sup>64</sup> Though stalls have not yet become physically smaller, over time, they have become effectively smaller compared to the size of the sow. Industry journal *National Hog Farmer* reported that in 1989, the sow stall was of adequate size to hold the average gestating sow,<sup>65</sup> but research from 2004 found that more than 60% of sows could not fit in conventional stalls without being compressed against the crate's sides.<sup>66</sup>

### Foot and Leg Problems

In their natural habitat, pigs evolved to walk in woodlands and scrub. Putting sows in gestation crates with unnatural flooring changes the stresses on sows' feet<sup>67</sup> and is considered to significantly contribute to toe lesions,<sup>68</sup> with some reports finding up to 80% of stall-housed sows suffering from this condition.<sup>69</sup> Gestation-crate confinement has also been found to excessively<sup>70</sup> cause damage to joints<sup>71</sup> and lameness.<sup>72,73</sup> Erosion of the cement floor from water and feed may leave rocks and sharp edges that can contribute to foot, leg, and shoulder sores,<sup>74</sup> and bolts which fix the crates in place can also contribute to similar injuries.<sup>75</sup>

### Reduced Muscle Mass and Bone Strength

The health and welfare of breeding sows housed in gestation crates has been determined to be negatively affected by their inability to turn around or exercise.<sup>76</sup> The restriction of movement can lead to a "reduction of muscle weight and considerable reduction of bone strength,"<sup>77</sup> making the most basic movements difficult<sup>78</sup> and leading to a "greater chance of the sow slipping during lying and standing and incurring physical damage."<sup>79</sup> Successive pregnancies exacerbate the problems of diminished muscle mass and bone strength.<sup>80</sup>

### Urinary Tract Infections

Gestation-crated sows suffer from a higher rate of urinary tract infections (UTIs) than uncrated sows,<sup>81</sup> due to their inactivity, decreased water consumption, infrequency of urination,<sup>82</sup> and possible contact with their own

waste.<sup>83</sup> These infections can result in a high mortality rate, with one study estimating that half of breeding sow mortalities were caused by UTIs.<sup>84</sup> In comparison, group-housed sows suffer a lower incidence of UTIs associated with inactivity.<sup>85</sup> Increasing water intake at one commercial operation using group pens rather than gestation crates nearly eliminated UTIs.<sup>86</sup>

## Mortality

Sows confined in gestation crates have been found to suffer from dramatic weight loss after successive pregnancies and a high incidence of health problems requiring the animals to be “removed from the [production] system.”<sup>87</sup> Research on crate-free production has found that both outdoor,<sup>88</sup> and loose-housing<sup>89</sup> systems offer benefits to sow health and longevity. Compared with typical U.S. crate production methods, deep-bedded, loose housing systems studied in Sweden result in lower cull rates and greater sow longevity.<sup>90</sup> Commercial operations have also recorded better reproductive performance and lower mortality rates for sows housed in pens rather than confined in crates.<sup>91</sup>

Compared to group-housed sows, gestation-crated sows show increased resting heart rates, likely due to decreased muscle fitness from chronic lack of exercise,<sup>92</sup> and are more likely to suffer decreased cardiovascular fitness.<sup>93</sup> The deaths of many pigs during transport can be traced to cardiovascular problems.<sup>94</sup>

## Mental Health and Behavioral Concerns

When pigs are not confined, they are active and curious animals. Pigs are intelligent, social, inquisitive, and capable of learning complex tasks,<sup>95,96,97</sup> perceiving time, and anticipating future events.<sup>98</sup> Near-immobilization in gestation crates without environmental enrichment or mental stimulation impairs their welfare.

## Inability to Express Natural Behavior

In natural environments, sows spend approximately 31% of their time grazing, 21% rooting, 14% walking, and 6% lying down.<sup>99</sup> Pigs also perform thermoregulatory behavior such as wallowing and shade-seeking.<sup>100</sup> When given space, sows elect separate areas for nesting, feeding, and eliminating.<sup>101,102</sup>

Highly social animals, pigs learn to perform simple tasks for the reward of contact with familiar individuals.<sup>103,104</sup> They develop behavioral and acoustic signals important to the organization of their social structure. Researchers have described more than 20 different sounds emitted by pigs while performing various social activities including feeding, play, maternal behavior, and sexual interactions.<sup>105</sup> For wild boars and feral pigs, their home range, for which they show a high degree of site fidelity, can vary from less than 1 km<sup>2</sup> (0.39 mi<sup>2</sup>) to more than 25 km<sup>2</sup> (9.65 mi<sup>2</sup>).<sup>106</sup> When released from confinement to semi-natural enclosures, sows quickly revert to natural behavior including rooting, nest-building, and traveling long distances, and spend considerable time performing such behavior when given the opportunity.<sup>107</sup>

Intensive confinement, however, thwarts nearly all this behavior, reducing daily activity to approximately ten minutes—the time it takes sows to eat their concentrated diet. According to one veterinarian, confinement in gestation crates is “so foreign to what I perceive to be the natural habits of swine that it is unjustified by the economic benefits perceived to result.”<sup>108</sup> Compared to group-housed sows, crated sows have been found to be more often frustrated, indicated by the amount of time spent performing stereotypic behavior,<sup>109</sup> likely due to their inability to express natural behavior such as foraging. Confinement in gestation crates, according to Marchant-Forde and Broom, “has resulted in alteration or prevention of many of the sow’s normal behaviours, increases in abnormal behaviour and in various other indicators of poor welfare.”<sup>110</sup>

## Stereotypies

Stereotypies are characterized as movement or behavior that is abnormal, repetitive, and seemingly with no function or goal.<sup>111</sup> Researchers attribute this behavior to boredom and frustration resulting from an

impoverished environment, confinement, restraint, and unfulfilled needs.<sup>112,113</sup> Stereotypies are commonly described in animals in zoos and laboratories, indicating the animal has difficulty coping with the conditions or is in an environment deleterious to welfare.<sup>114</sup>

Stereotypic behavior is common among gestation-crated sows and includes repetitive bar-biting, head-weaving, pressing their drinkers without drinking, and making chewing motions with an empty mouth, called sham- or vacuum-chewing.<sup>115,116,117</sup> Stereotypic behavior can lead to physical injury, such as sores from excessive rubbing against the crate's bars or damage in the mouth from bar-biting and sham-chewing.<sup>118</sup>

Confined sows are typically fed half the amount they would eat *ad libitum* to prevent excessive weight gain and fat deposition,<sup>119</sup> which can result in poor reproductive performance. It is believed that this restrictive diet, combined with the inability to forage, contribute to the development of stereotypic behavior and stress.<sup>120,121</sup>

Crated sows spend considerably more time performing oral stereotypic behavior than those housed in small groups. In one study by Broom *et al.*, sows in crates exhibited abnormal behavior approximately ten times more often than group-housed sows. One crated sow spent more than 40% of her time performing stereotypies. The authors commented: "Using a wide range of welfare indicators, it was clear that stall-housed sows had more problems than group-housed sows and that these problems were worse in the fourth than in the first pregnancy." The amount of time sows engaged in stereotypies in the study increased with the time spent in crates.<sup>122</sup> By comparison, in situations where sows have greater freedom in more complex environments, the amount of stereotyped behavior is virtually zero.<sup>123</sup>

"That stereotypies are an indication of welfare problems was a strong consensus among nearly all authors whose work was reviewed,"<sup>124</sup> concluded the American Veterinary Medical Association's (AVMA's) Task Force on the Housing of Pregnant Sows. The SVC agreed: "The extent of stereotypy gives an indication of how poor the welfare is."<sup>125</sup>

## Unresponsiveness

Unresponsiveness in sows is another behavioral disorder indicative of poor welfare. Over time, crated sows respond less to external stimuli, including water poured on their backs, sow grunts, an electronic buzzer, and even squeals from piglets<sup>126,127</sup> The SVC commented that inactivity and unresponsiveness are abnormal and it is likely that crated sows become clinically depressed.<sup>128</sup>

## Aggression

Limiting aggression is often given as justification for confining sows in gestation crates, yet antagonistic interactions remain a problem in stall housing systems. Studies have shown that confinement in individual stalls may lead to "unsettled dominance relationships" and "high aggression levels."<sup>129</sup> These unresolved agonistic interactions are likely to cause stress and worsen with successive pregnancies.<sup>130,131</sup> Crated sows have been found to experience agonistic interactions up to three times more often than group-housed sows and cannot readily practice avoidance.<sup>132</sup> This same study found that stall-housed sows were more aggressive than group-housed sows by their fourth pregnancy.<sup>133</sup> Although aggression can be a welfare problem in group housing, it can be curtailed with responsible management and good practices.<sup>134</sup>

## Stress

Changes in hormone levels are often used as a gauge of stress in animals.<sup>135</sup> Cortisol levels in restricted sows have been found to be significantly increased compared to group-housed sows, indicating a chronic stress response to confinement.<sup>136</sup> The simple act of turning around—in special stalls designed to allow this freedom<sup>137</sup>—measurably reduces stress hormone levels in sows<sup>138</sup> almost to the level of their group-housed counterparts.<sup>139</sup>

Additionally, stress associated with confinement has been implicated in diminishing immune function. Recent research has shown a redistribution of white blood cells occurs in sows who are crated during gestation, “suggesting immune dysfunction perhaps as a consequence of increased stress.”<sup>140</sup>

## Alternative Housing Systems

Alternatives to gestation-crate production methods include “turn-around” stalls, free-range and pasture-based systems, and, most commonly, indoor group housing. Turn-around stalls can be slightly larger than customary gestation crates or have a moving wall that allows the sow to turn around inside the crate. In free-range systems, sows are afforded access to the outdoors and, optimally, given the freedom and materials to express natural behavior such as nest-building and rooting. Sows are raised outdoors in pasture-based production and typically provided portable housing or shelters to allow for sustainable rotational practice. With the main alternative to gestation-crate systems, groups of up to several dozen sows are housed together in indoor pens, sometimes with deep litter allowing for access to bedding materials, and given freedom to move and the opportunity to socialize.

Feeding practices in group-housing systems vary. Often, group-housed sows are fed through automated or manual on-ground distribution of enough food for the entire group. This practice can result in aggression among sows during feeding, due to competition. Various types of feeding stalls have been introduced to reduce this aggression. Free-access stalls allow sows to enter an individual stall to feed, but do not resolve all welfare issues, particularly when sows who eat at different speeds are housed together; those who finish eating quickly may exit their stalls and bite at slower-feeding sows in other stalls. Some free-access stalls are fitted with a back gate or an automated, controlled rate feeder, so faster-eating sows are forced to eat more slowly, to eliminate this aggression. The most effective alternative to date is likely the electronic sow feeder (ESF) system, which allows entry of one sow at a time, identifies her through an electronic tag or collar, and distributes the appropriate ration. When the sow finishes eating, she leaves through a separate exit. In the ESF system, feeding aggression is eliminated because sows do not have to compete for food. In several countries, ESF systems are being widely adopted and their welfare advantages are well-documented in scientific reviews.<sup>141,142</sup>

Higher sow productivity is possible in group housing than in individual crates, resulting from reduced rates of confinement injuries and urinary tract infections,<sup>143</sup> earlier first estrus,<sup>144,145</sup> larger litter size, and lower stillbirth incidence.<sup>146</sup> Commenting on the increased litter size in group versus crated housing systems, Iowa State University animal science professor Mark Honeyman was quoted as saying it is “a large difference....It’s significant from an economic value and productivity value viewpoint.”<sup>147</sup>

In its review, the SVC reported that sows in groups “have more exercise, more control over their environment, more opportunity for normal social interactions and better potential for the provision of opportunities to root or manipulate materials....As a consequence, group-housed sows show less abnormality of bone and muscle development, much less abnormal behaviour, less likelihood of extreme physiological responses, less of the urinary tract infections associated with inactivity, and better cardiovascular fitness.”<sup>148</sup> Currently more than 4 million sows are raised in group housing in Europe.<sup>149</sup>

## Conclusion

Although the American Veterinary Medical Association’s Task Force on the Housing of Pregnant Sows concluded that “no one system is clearly better than others under all conditions,” the Task Force did identify a number of problems inherent to gestation crates: “Gestation stalls, particularly when used in conjunction with feed restriction, may adversely affect welfare by restricting behavior, including foraging, movement, and postural changes.”<sup>150</sup> Other contributing factors to poor welfare noted were “lack of exercise, lack of environmental complexity, lack of rooting/chewing materials, and an inability for the sow to exert control over her environment.”<sup>151</sup>

After a comprehensive two-year study, the independent Pew Commission on Industrial Farm Animal Production, a project of The Pew Charitable Trusts and the Johns Hopkins Bloomberg School of Public Health

chaired by former Kansas Governor John Carlin and including former U.S. Agriculture Secretary Dan Glickman, concluded that gestation crates should be phased out:

After reviewing the literature, visiting production facilities, and listening to producers themselves, the Commission believes that the most intensive confinement systems, such as restrictive veal crates, hog gestation pens, restrictive farrowing crates, and battery cages for poultry, all prevent the animal from a normal range of movement and constitute inhumane treatment.<sup>152</sup>

Scientific evidence supports improved health and welfare for sows not confined in gestation crates. In “The Welfare of Intensively Kept Pigs,” the European Union’s Scientific Veterinary Committee concluded: “Since overall welfare appears to be better when the sows are not confined throughout gestation, sows should preferably be kept in groups.”<sup>153</sup>

---

<sup>1</sup> U.S. Department of Agriculture, National Agricultural Statistics Service. 2011. Quarterly hogs and pigs, September 28. <http://usda01.library.cornell.edu/usda/current/HogsPigs/HogsPigs-09-28-2011.pdf>. Accessed November 10, 2011.

<sup>2</sup> Barnett JL, Hemsworth PH, Cronin GM, Jongman EC, and Hutson GD. 2001. A review of the welfare issues for sows and piglets in relation to housing. *Australian Journal of Agricultural Research* 52:1-28.

<sup>3</sup> U.S. Department of Agriculture, National Agricultural Statistics Service. 2006. U.S. hog breeding herd structure. <http://usda.mannlib.cornell.edu/usda/current/hog-herd/hog-herd-09-22-2006.pdf>. Accessed November 11, 2011.

<sup>4</sup> Commission of the European Communities. 2001. COM(2001) 20 final 2001/0021 (CNS) Communication from the Commission to the Council and the European Parliament on the welfare of intensively kept pigs in particularly taking into account the welfare of sows reared in varying degrees of confinement and in groups. Proposal for a Council Directive amending Directive 91/630/EEC laying down minimum standards for the protection of pigs.

<sup>5</sup> den Hartog LA, Backus GBC, and Vermeer HM. 1993. Evaluation of housing systems for sows. *Journal of Animal Science* 71:1339-44.

<sup>6</sup> Reun PD, Dial GD, Polson DD, and Marsh WE. 1992. Breeding and gestation facilities for swine: matching biology to facility design. *The Veterinary Clinics of North America: Food Animal Practice* 8(3):475-502

<sup>7</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 22. [http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.

<sup>8</sup> McGlone JJ. 2001. Alternative sow housing systems: driven by legislation, regulation, free trade and free market systems (but not science). Annual Meeting of the Manitoba Pork Producers, Winnipeg, Manitoba, Canada, January. [www.depts.ttu.edu/porkindustryinstitute/SowHousing\\_files/Sow\\_housing\\_Manitoba.pdf](http://www.depts.ttu.edu/porkindustryinstitute/SowHousing_files/Sow_housing_Manitoba.pdf). Accessed November 11, 2011.

<sup>9</sup> Commission of the European Communities. 2001. Council Directive 2001/88/EC of 23 October 2001 amending Directive 91/630/EEC laying down minimum standards for the protection of pigs. *Official Journal of the European Communities* L316:1-4.

<sup>10</sup> Australian Broadcasting Corporation. 2010. Govt to ban sow stalls. ABC News, June 10. [www.abc.net.au/news/2010-06-10/govt-to-ban-sow-stalls/861924](http://www.abc.net.au/news/2010-06-10/govt-to-ban-sow-stalls/861924). Accessed November 10, 2011.

<sup>11</sup> Australian Broadcasting Corporation. 2010. New Zealand bans sow stalls. ABC Rural news, March 12. [www.abc.net.au/rural/news/content/201012/s3083937.htm](http://www.abc.net.au/rural/news/content/201012/s3083937.htm). Accessed November 10, 2011.

<sup>12</sup> The Florida Constitution. 2002. Limiting cruel and inhumane confinement of pigs during pregnancy. Article X. Section 21. [www.leg.state.fl.us/Statutes/index.cfm?Mode=Constitution&Submenu=3&Tab=statutes#A10S21](http://www.leg.state.fl.us/Statutes/index.cfm?Mode=Constitution&Submenu=3&Tab=statutes#A10S21). Accessed November 11, 2011.

<sup>13</sup> Arizona Revised Statutes. 2006. Cruel and inhumane confinement of a pig during pregnancy or of a calf raised for veal. Title 13. Chapter 29. [www.azleg.gov/FormatDocument.asp?inDoc=/ars/13/02910-07.htm&Title=13&DocType=ARS](http://www.azleg.gov/FormatDocument.asp?inDoc=/ars/13/02910-07.htm&Title=13&DocType=ARS). Accessed November 11, 2011.

- 
- <sup>14</sup> 74th Oregon Legislative Assembly. 2007. Relating to confinement of animals. Senate Bill 694. <http://landru.leg.state.or.us/07reg/measures/sb0600.dir/sb0694.en.html>. Accessed November 11, 2011.
- <sup>15</sup> USAgNet. 2008. Colorado governor signs gestation and veal crate ban. May 22. [www.wisconsinagconnection.com/story-national.php?Id=1221&yr=2008](http://www.wisconsinagconnection.com/story-national.php?Id=1221&yr=2008). Accessed November 11, 2011.
- <sup>16</sup> General Assembly of the State of Colorado. 2008. Senate Bill 08-201. [www.leg.state.co.us/CLICS/CLICS2008A/csl.nsf/fsbillcont3/15738AC63DFF2DB1872573E600643253?Open&file=201\\_enr.pdf](http://www.leg.state.co.us/CLICS/CLICS2008A/csl.nsf/fsbillcont3/15738AC63DFF2DB1872573E600643253?Open&file=201_enr.pdf). Accessed November 14, 2011.
- <sup>17</sup> California Health and Safety Code, Division 20, Chapter 13.8, Farm Animal Cruelty, Section 25990-25994. <http://codes.lp.findlaw.com/cacode/HSC/1/d20/13.8/s25990>. Accessed November 11, 2011.
- <sup>18</sup> California Secretary of State Debra Bowen. 2008. Statement of Vote, November 4, 2008, General Election. [www.sos.ca.gov/elections/sov/2008\\_general/sov\\_complete.pdf](http://www.sos.ca.gov/elections/sov/2008_general/sov_complete.pdf). Accessed November 11, 2011.
- <sup>19</sup> Hall C. 2008. Measure to provide better treatment of farm animals passes. Los Angeles Times, Nov. 5.
- <sup>20</sup> Maine Public Law. 2009. Chapter 127, An act to prohibit cruel confinement of calves raised for veal and sows during gestation. [www.mainelegislature.org/legis/bills/bills\\_124th/chapters/PUBLIC127.asp](http://www.mainelegislature.org/legis/bills/bills_124th/chapters/PUBLIC127.asp). Accessed November 11, 2011.
- <sup>21</sup> Michigan Enrolled House Bill 5127 .2009. [www.legislature.mi.gov/documents/2009-2010/billenrolled/House/pdf/2009-hNB-5127.pdf](http://www.legislature.mi.gov/documents/2009-2010/billenrolled/House/pdf/2009-hNB-5127.pdf). Accessed November 10, 2011.
- <sup>22</sup> Gebert E. 2010. Both sides claim victory in livestock standards deal. Times Bulletin, July 2. [www.timesbulletin.com/main.asp?SectionID=2&SubSectionID=4&ArticleID=160158](http://www.timesbulletin.com/main.asp?SectionID=2&SubSectionID=4&ArticleID=160158). Accessed November 10, 2011.
- <sup>23</sup> Ohio Department of Agriculture. Livestock care standards, p. 33. [www.agri.ohio.gov/LivestockCareStandards/docs/Livestock%20Care%20Standards%20\(EFFECTIVE\).pdf](http://www.agri.ohio.gov/LivestockCareStandards/docs/Livestock%20Care%20Standards%20(EFFECTIVE).pdf). Accessed November 10, 2011.
- <sup>24</sup> Smithfield Foods. Understanding Smithfield: who we are. [www.r-calfusa.com/industry\\_info/2008\\_JBS\\_merger/080409-Exhibit18\\_HistoryofSmithfieldFoods.pdf](http://www.r-calfusa.com/industry_info/2008_JBS_merger/080409-Exhibit18_HistoryofSmithfieldFoods.pdf). Accessed November 11, 2011.
- <sup>25</sup> Successful Farming. 2007. Pork powerhouses 2007. <http://images.meredith.com/ag/pdf/2007SFPorkPowerhouses07.pdf>. Accessed November 11, 2011.
- <sup>26</sup> Successful Farming. 2007. Pork powerhouses 2007. <http://images.meredith.com/ag/pdf/2007SFPorkPowerhouses07.pdf>. Accessed November 11, 2011.
- <sup>27</sup> Smithfield Foods. 2007. Smithfield Foods makes landmark decision regarding animal management. Press release issued January 25. [www.prnewswire.com/news-releases/smithfield-foods-makes-landmark-decision-regarding-animal-management-53754097.html](http://www.prnewswire.com/news-releases/smithfield-foods-makes-landmark-decision-regarding-animal-management-53754097.html). Accessed November 11, 2011.
- <sup>28</sup> Maple Leaf Foods. 2007. Maple Leaf endorses U.S. industry direction on sow stalls. Press release issued January 31. <http://investor.mapleleaf.ca/phoenix.zhtml?c=88490&p=irol-newsArticle&ID=956262&highlight>. Accessed November 11, 2011.
- <sup>29</sup> Colorado Livestock Association. 2007. Colorado pork producers announce new animal management procedures. Press release issued December 20. [www.aasv.org/news/story.php?id=2728](http://www.aasv.org/news/story.php?id=2728). Accessed November 11, 2011.
- <sup>30</sup> McDonald's Corporation. 2008. Worldwide Corporate Responsibility Report: Responsible Food for a Sustainable Future, p.23. [www.aboutmcdonalds.com/etc/medialib/csr/report.Par.5257.File.tmp/mcd048\\_2008report\\_v5.pdf](http://www.aboutmcdonalds.com/etc/medialib/csr/report.Par.5257.File.tmp/mcd048_2008report_v5.pdf). Accessed November 18, 2011.
- <sup>31</sup> The Wolfgang Puck Companies. 2007. Chef Wolfgang Puck takes eating well to new level benefiting farm animals and customers. Press release issued March 22. [www.tribeofheart.org/pdf/puckhumanepdf.pdf](http://www.tribeofheart.org/pdf/puckhumanepdf.pdf). Accessed November 18, 2009.
- <sup>32</sup> Martin A. 2007. Burger King shifts policy on animals. The New York Times, March 28. [www.nytimes.com/2007/03/28/business/28burger.html?ei=5124&en=7104231631119310&ex=1332734400&pagewanted=print](http://www.nytimes.com/2007/03/28/business/28burger.html?ei=5124&en=7104231631119310&ex=1332734400&pagewanted=print). Accessed January 1, 2010.
- <sup>33</sup> McDonald's Corporation. 2008. Worldwide Corporate Responsibility Report: Responsible Food for a Sustainable Future, p.24.



---

[www.aboutmcdonalds.com/etc/medialib/csr/report.Par.5257.File.tmp/mcd048\\_2008report\\_v5.pdf](http://www.aboutmcdonalds.com/etc/medialib/csr/report.Par.5257.File.tmp/mcd048_2008report_v5.pdf). Accessed November 11, 2011.

<sup>34</sup> See MT. 2006. Obtaining optimal reproductive efficiency. North Carolina State Cooperative Extension Service, Swine News 29(1):1-4. [www.thepigsite.com/articles/?AREA=FeaturedArticle&Display=1554](http://www.thepigsite.com/articles/?AREA=FeaturedArticle&Display=1554). Accessed November 11, 2011.

<sup>35</sup> Webster J. 1994. *Animal Welfare: A Cool Eye Towards Eden* (Oxford, U.K.: Blackwell Science Ltd., pp. 146-7).

<sup>36</sup> National Pork Board. 2002. *Swine Care Handbook*.

<sup>37</sup> Rath D. 2002. Low dose insemination in the sow: a review. *Reproduction in Domestic Animals* 37:201-5.

<sup>38</sup> McGlone JJ. 2006. Comparison of sow welfare in the Swedish deep-bedded system and the US crated-sow system. *Journal of the American Veterinary Medical Association* 229(9):1377-80.

<sup>39</sup> Lammers PJ, Honeyman MS, Mabry JW, and Harmon JD. 2007. Performance of gestating sows in bedded hoop barns and confinement stalls. *Journal of Animal Science* 85(5):1311-7.

<sup>40</sup> See MT. 2006. Obtaining optimal reproductive efficiency. North Carolina State Cooperative Extension Service, Swine News 29(1):1-4. [www.thepigsite.com/articles/?AREA=FeaturedArticle&Display=1554](http://www.thepigsite.com/articles/?AREA=FeaturedArticle&Display=1554). Accessed November 11, 2011.

<sup>41</sup> Comis D. 2005. Settling doubts about livestock stress. *Agricultural Research* 53(3):4-7. [www.ars.usda.gov/is/AR/archive/mar05/stress0305.htm](http://www.ars.usda.gov/is/AR/archive/mar05/stress0305.htm). Accessed November 11, 2011.

<sup>42</sup> Stolba A and Wood-Gush DGM. 1989. The behaviour of pigs in a semi-natural environment. *Animal Production* 48:419-25.

<sup>43</sup> Fraser AF and Broom DM. 1990. *Farm Animal Behaviour and Welfare*, 3rd Edition (London, U.K.: Bailliere Tindall, p. 107).

<sup>44</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 100. [http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.

<sup>45</sup> Marchant JN and Broom DM. 1996. Factors affecting posture-changing in loose-housed and confined gestating sows. *Animal Science* 63:477-85.

<sup>46</sup> Commission of the European Communities. 2001. COM(2001) 20 final 2001/0021 (CNS) Communication from the Commission to the Council and the European Parliament on the welfare of intensively kept pigs in particularly taking into account the welfare of sows reared in varying degrees of confinement and in groups. Proposal for a Council Directive amending Directive 91/630/EEC laying down minimum standards for the protection of pigs.

<sup>47</sup> Anil L, Anil SS, and Deen J. 2002. Evaluation of the relationship between injuries and size of gestation stalls relative to size of sows. *Journal of the American Veterinary Medical Association* 221(6):834-6.

<sup>48</sup> Ekesbo I. 1981. Some aspects of sow health and housing. In: Sybesma W (ed.), *The Welfare of Pigs* (The Hague, The Netherlands: Marunns Nuijhoff).

<sup>49</sup> Marchant JN and Broom DM. 1996. Factors affecting posture-changing in loose-housed and confined gestating sows. *Animal Science* 63:477-85.

<sup>50</sup> Marchant JN and Broom DM. 1996. Factors affecting posture-changing in loose-housed and confined gestating sows. *Animal Science* 63:477-85.

<sup>51</sup> Anil L, Anil SS, and Deen J. 2002. Evaluation of the relationship between injuries and size of gestation stalls relative to size of sows. *Journal of the American Veterinary Medical Association* 221(6):834-6.

<sup>52</sup> Morris JR, Hurnik JF, Friendship RM, Buhr MM, and Allen OB. 1993. The behavior of gestating swine housed in the Hurnik-Morris system. *Journal of Animal Science* 71:3280-4.

<sup>53</sup> Baxter MR and Schwaller CE. 1983. Space requirements for sows in confinement. In: Baxter SH, Baxter MR, and MacCormack JAC (eds.), *Farm Animal Housing and Welfare* (Boston, MA: Artinus Nijhoff).

<sup>54</sup> Webster J. 1994. *Animal Welfare: A Cool Eye Towards Eden* (Oxford, U.K.: Blackwell Science Ltd., pp. 148-9).

<sup>55</sup> Smith JH, Wathes CM, and Baldwin BA. 1996. The preference of pigs for fresh air over ammoniated air. *Applied Animal Behaviour Science* 49:417-24.

<sup>56</sup> Tillon JP and Madec F. 1984. Diseases affecting confined sows: data from epidemiological observations. *Annales de Recherches Vétérinaires (Annals of Veterinary Research)* 15(2):195-9.

- 
- <sup>57</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>58</sup> Anil L, Anil SS, and Deen J. 2002. Evaluation of the relationship between injuries and size of gestation stalls relative to size of sows. *Journal of the American Veterinary Medical Association* 221(6):834-6.
- <sup>59</sup> Anil L, Anil SS, and Deen J. 2002. Evaluation of the relationship between injuries and size of gestation stalls relative to size of sows. *Journal of the American Veterinary Medical Association* 221(6):834-6.
- <sup>60</sup> Anil L, Anil SS, and Deen J. 2002. Evaluation of the relationship between injuries and size of gestation stalls relative to size of sows. *Journal of the American Veterinary Medical Association* 221(6):834-6.
- <sup>61</sup> Anil L, Anil SS, and Deen J. 2002. Evaluation of the relationship between injuries and size of gestation stalls relative to size of sows. *Journal of the American Veterinary Medical Association* 221(6):834-6.
- <sup>62</sup> Anil L, Bhend KMG, Baidoo SK, Morrison R, and Deen J. 2003. Comparison of injuries in sows housed in gestation stalls versus group pens with electronic sow feeders. *Journal of the American Veterinary Medical Association* 223(9):1334-8.
- <sup>63</sup> Anil L, Anil SS, and Deen J. 2002. Evaluation of the relationship between injuries and size of gestation stalls relative to size of sows. *Journal of the American Veterinary Medical Association* 221(6):834-6.
- <sup>64</sup> Kaufman M. 2001. In pig farming, growing concern: raising sows in crates is questioned. *The Washington Post*, June 18.
- <sup>65</sup> Vansickle J. 2007. Sow housing debated. *National Hog Farmer*, August 15.  
[http://nationalhogfarmer.com/mag/farming\\_sow\\_housing\\_debated/](http://nationalhogfarmer.com/mag/farming_sow_housing_debated/). Accessed November 11, 2011.
- <sup>66</sup> McGlone JJ, Vines B, Rudine AC, and DuBois P. 2004. The physical size of gestating sows. *Journal of Animal Science* 84:2421-7.
- <sup>67</sup> Mouttotou N, Hatchell FM, and Green LE. 1999. Foot lesions in finishing pigs and their associations with the type of floor. *Veterinary Record* 144(23):629-32.
- <sup>68</sup> Kornegay ET, Bryant KL, and Notter DR. 1990. Toe lesion development in gilts and sows housed in confinement as influenced by toe size and toe location. *Applied Agricultural Research* 5(4):327-34.
- <sup>69</sup> Tillon JP and Madec F. 1984. Diseases affecting confined sows: data from epidemiological observations. *Annales de Recherches Vétérinaires (Annals of Veterinary Research)* 15(2):195-9, citing: Le Denmat M, Saulnier J, and Le Meur D. 1982. Lesions des pieds et boiteries chez le porc. *Pointe Elev.* Novembre 19-22.
- <sup>70</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 98.  
[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011, citing: Bäckström L. 1973. Environment and animal health in piglet production: a field study of incidences and correlations. *Acta Veterinaria Scandinavica (Supplementum)* 41:1-240.
- <sup>71</sup> Fredeen HT and Sather AP. 1978. Joint damage in pigs reared under confinement. *Canadian Journal of Animal Science* 58:759-73.
- <sup>72</sup> Marchant JN and Broom DM. 1996. Effects of dry sow housing conditions on muscle weight and bone strength. *Animal Science* 62:105-13.
- <sup>73</sup> Sather AP and Fredeen HT. 1982. The effect of confinement housing upon the incidence of leg weakness in swine. *Canadian Journal of Animal Science* 62:1119-28.
- <sup>74</sup> Miller D. 2004. Sows flourish in pen gestation. *National Hog Farmer*, March 15.
- <sup>75</sup> Stalder K and Baas T. 2005. Screen gilts for feet and leg disorders. *National Hog Farmer*, February 15.
- <sup>76</sup> Marchant JN and Broom DM. 1996. Effects of dry sow housing conditions on muscle weight and bone strength. *Animal Science* 62:105-13.
- <sup>77</sup> Marchant JN and Broom DM. 1996. Effects of dry sow housing conditions on muscle weight and bone strength. *Animal Science* 62:105-13.
- <sup>78</sup> Marchant JN and Broom DM. 1996. Effects of dry sow housing conditions on muscle weight and bone strength. *Animal Science* 62:105-13.
- <sup>79</sup> Marchant JN and Broom DM. 1996. Effects of dry sow housing conditions on muscle weight and bone strength. *Animal Science* 62:105-13.
- <sup>80</sup> Marchant JN and Broom DM. 1996. Effects of dry sow housing conditions on muscle weight and bone strength. *Animal Science* 62:105-13.

- 
- <sup>81</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 96.  
[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.
- <sup>82</sup> Tillon JP and Madec F. 1984. Diseases affecting confined sows: data from epidemiological observations. *Annales de Recherches Vétérinaires (Annals of Veterinary Research)* 15(2):195-9.
- <sup>83</sup> Sather AP and Fredeen HT. 1982. The effect of confinement housing upon the incidence of leg weakness in swine. *Canadian Journal of Animal Science* 62:1119-28.
- <sup>84</sup> Tillon JP and Madec F. 1984. Diseases affecting confined sows: data from epidemiological observations. *Annales de Recherches Vétérinaires (Annals of Veterinary Research)* 15(2):195-9.
- <sup>85</sup> Commission of the European Communities. 2001. COM(2001) 20 final 2001/0021 (CNS) Communication from the Commission to the Council and the European Parliament on the welfare of intensively kept pigs in particularly taking into account the welfare of sows reared in varying degrees of confinement and in groups. Proposal for a Council Directive amending Directive 91/630/EEC laying down minimum standards for the protection of pigs.
- <sup>86</sup> Miller D. 2004. Sows flourish in pen gestation. *National Hog Farmer*, March 15.
- <sup>87</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>88</sup> Honeyman M. 1996. Swine System Options for Iowa. Iowa State University.  
[www.agmrc.org/media/cms/SA9\\_4209BA751CCB6.pdf](http://www.agmrc.org/media/cms/SA9_4209BA751CCB6.pdf). Accessed November 11, 2011.
- <sup>89</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>90</sup> Honeyman MS. 1995. Västgötmodellen: Sweden's sustainable alternative for swine production. *American Journal of Alternative Agriculture* 10(3):129-32.
- <sup>91</sup> Miller D. 2004. Sows flourish in pen gestation. *National Hog Farmer*, March 15.
- <sup>92</sup> Marchant JN, Rudd AR, and Broom DM. 1997. The effects of housing on heart rate of gestating sows during specific behaviours. *Applied Animal Behaviour Science* 55:67-78.
- <sup>93</sup> Commission of the European Communities. 2001. COM(2001) 20 final 2001/0021 (CNS) Communication from the Commission to the Council and the European Parliament on the welfare of intensively kept pigs in particularly taking into account the welfare of sows reared in varying degrees of confinement and in groups. Proposal for a Council Directive amending Directive 91/630/EEC laying down minimum standards for the protection of pigs.
- <sup>94</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 98.  
[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.
- <sup>95</sup> Dawkins MS. 1998. *Through Our Eyes Only? The Search for Consciousness* (Oxford, U.K.: Oxford University Press, pp. 156-7).
- <sup>96</sup> Signoret JP, Baldwin BA, Fraser D, and Hafez ESE. 1975. The behaviour of swine. In: Hafez ESE (ed.), *The Behaviour of Domestic Animals*, 3rd Edition (London, U.K.: Baillibre Tindall, p. 300).
- <sup>97</sup> Wright D. 2005. Was your meat smarter than your pet? Research suggests farm animals are surprisingly intelligent. *ABC News*, May 22.
- <sup>98</sup> Špinko M, Duncan IJH, and Widowski TM. 1998. Do domestic pigs prefer short-term to medium-term confinement? *Applied Animal Behaviour Science* 58:221-32.
- <sup>99</sup> Stolba A and Wood-Gush DGM. 1989. The behaviour of pigs in a semi-natural environment. *Animal Production* 48:419-25.
- <sup>100</sup> Fraser AF and Broom DM. 1990. *Farm Animal Behaviour and Welfare*, 3rd Edition (London, U.K.: Bailliere Tindall, p. 107).
- <sup>101</sup> Stolba A and Wood-Gush DGM. 1989. The behaviour of pigs in a semi-natural environment. *Animal Production* 48:419-25.
- <sup>102</sup> Signoret JP, Baldwin BA, Fraser D, and Hafez ESE. 1975. The behaviour of swine. In: Hafez ESE (ed.), *The Behaviour of Domestic Animals*, 3rd Edition (London, U.K.: Baillibre Tindall, p. 298).
- <sup>103</sup> Dawkins MS. 1998. *Through Our Eyes Only? The Search for Consciousness* (Oxford, U.K.: Oxford University Press, pp. 156-7).

- 
- <sup>104</sup> Matthews L and Ladewig J. 1987. Stimulus requirements of housed pigs assessed by behavioural demand functions. *Applied Animal Behaviour Science* 17:369L.
- <sup>105</sup> Signoret JP, Baldwin BA, Fraser D, and Hafez ESE. 1975. The behaviour of swine. In: Hafez ESE (ed.), *The Behaviour of Domestic Animals*, 3rd Edition (London, U.K.: Baillibre Tindall, p. 299), citing: Grauvogel A. 1958. *Über das Verhalten der Hausschweinen mit besonderer Berücksichtigung der Fortpflanzungsverhaltens*. Vet.-Med. Diss., Berlin.
- <sup>106</sup> Halverson MK. 2001. Farm animal health and well-being. [www.eqb.state.mn.us/geis/TWP\\_AnimalHealth.pdf](http://www.eqb.state.mn.us/geis/TWP_AnimalHealth.pdf). Accessed November 11, 2011, citing: Graves HB. 1984. Behaviour and ecology of wild and feral swine (*Sus Scrofa*). *Journal of Animal Science* 58:482-92 and Scientific Veterinary Committee, Animal Welfare Section.
- <sup>107</sup> Stolba A and Wood-Gush DGM. 1989. The behaviour of pigs in a semi-natural environment. *Animal Production* 48:419-25.
- <sup>108</sup> Kornheiser KM. 2004. Doesn't believe government regulations on gestation stalls helpful. *Journal of the American Veterinary Medical Association* 224(5):661-2.
- <sup>109</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>110</sup> Marchant JN and Broom DM. 1996. Effects of dry sow housing conditions on muscle weight and bone strength. *Animal Science* 62:105-13.
- <sup>111</sup> Mendl MT. 1991. The effects of alternative forms of intensive pig husbandry on measures of pig welfare. In: Bradley A and Skofield WL (eds.), *Proceedings of the First Association of Veterinary Students Animal Welfare Symposium* (Cambridge, U.K.: Association of Veterinary Students).
- <sup>112</sup> Mendl MT. 1991. The effects of alternative forms of intensive pig husbandry on measures of pig welfare. In: Bradley A and Skofield WL (eds.), *Proceedings of the First Association of Veterinary Students Animal Welfare Symposium* (Cambridge, U.K.: Association of Veterinary Students).
- <sup>113</sup> Broom DM and Johnson KG. 1993. *Stress and Animal Welfare* (London, U.K.: Chapman & Hall, p. 77).
- <sup>114</sup> Broom DM and Johnson KG. 1993. *Stress and Animal Welfare* (London, U.K.: Chapman & Hall, p. 77).
- <sup>115</sup> Morris JR, Hurnik JF, Friendship RM, Buhr MM, and Allen OB. 1993. The behavior of gestating swine housed in the Hurnik-Morris system. *Journal of Animal Science* 71:3280-4.
- <sup>116</sup> Mendl MT. 1991. The effects of alternative forms of intensive pig husbandry on measures of pig welfare. In: Bradley A and Skofield WL (eds.), *Proceedings of the First Association of Veterinary Students Animal Welfare Symposium* (Cambridge, U.K.: Association of Veterinary Students).
- <sup>117</sup> Vieuille-Thomas C, Le Pape G, and Signoret JP. 1995. Stereotypies in pregnant sows: indications of influence of the housing system on the patterns expressed by the animals. *Applied Animal Behaviour Science* 44:19-27.
- <sup>118</sup> Mendl MT. 1991. The effects of alternative forms of intensive pig husbandry on measures of pig welfare. In: Bradley A and Skofield WL (eds.), *Proceedings of the First Association of Veterinary Students Animal Welfare Symposium* (Cambridge, U.K.: Association of Veterinary Students).
- <sup>119</sup> Ramonet Y, Meunier-Salaun MC, and Dourmad JY. 1999. High-fiber diets in pregnant sows: digestive utilization and effects on the behavior of the animals. *Journal of Animal Science* 77(3):591-9.
- <sup>120</sup> Appleby MC and Lawrence AB. 1987. Food restriction as a cause of stereotypic behaviour in tethered gilts. *Animal Production* 45:103-11.
- <sup>121</sup> Lawrence AB, Appleby MC, and Macleod HA. 1988. Measuring hunger in the pig using operant conditioning: the effect of food restriction. *Animal Production* 47:131-7.
- <sup>122</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>123</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 91. [http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.
- <sup>124</sup> Task Force on the Housing of Pregnant Sows. 2005. A comprehensive review of housing for pregnant sows. *Journal of the American Veterinary Medical Association* 227(10):1580-90.

- 
- <sup>125</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 91.  
[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.
- <sup>126</sup> Broom DM. 1986. Stereotypies and responsiveness as welfare indicators in stall-housed sows. *Animal Production* 42:438-9.
- <sup>127</sup> Barnett JL, Hemsworth PH, Cronin GM, Jongman EC, and Hutson GD. 2001. A review of the welfare issues for sows and piglets in relation to housing. *Australian Journal of Agricultural Research* 52:1-28, citing: Barnett JL. 1995. The welfare of sows: housing options for dry sows. Report to the Pig Research and Development Corporation. Canberra.
- <sup>128</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 93.  
[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.
- <sup>129</sup> Jensen P. 1984. Effects of confinement on social interaction patterns in dry sows. *Applied Animal Behaviour Science* 12:93-101.
- <sup>130</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>131</sup> Barnett JL, Hemsworth PH, Winfield CG, and Fahy VA. 1987. The effects of pregnancy and parity number on behavioural and physiological responses related to the welfare status of individual and group housed pigs. *Applied Animal Behaviour Science* 17:229.
- <sup>132</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>133</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>134</sup> Appleby MC. 2005. Welfare challenges in sow housing. *Journal of the American Veterinary Medical Association* 226(8):1334-6.
- <sup>135</sup> Broom DM and Johnson KG. 1993. *Stress and Animal Welfare* (London, U.K.: Chapman & Hall, pp. 95-101).
- <sup>136</sup> Barnett JL, Hemsworth PH, Cronin GM, Jongman EC, and Hutson GD. 2001. A review of the welfare issues for sows and piglets in relation to housing. *Australian Journal of Agricultural Research* 52:1-28, citing: Barnett JL and Taylor IA. 1995. Turn-around stalls and the welfare of pigs. In: Hennessy DP and Cranwell PD (eds.), *Manipulating Pig Production V* (Werribee, Victoria, Australia: Australasian Pig Science Association, p. 22).
- <sup>137</sup> McFarlane JM, Boe KE, and Curtis SE. 1988. Turning and walking by gilts in modified gestation crates. *Journal of Animal Science* 66(2):326-33.
- <sup>138</sup> Bergeron R, Gonyou HW, and Eurell TE. 1996. Behavioral and physiological responses of Meishan, Yorkshire and crossbred gilts to conventional and turn-around gestation stalls. *Canadian Journal of Animal Science* 76:289-97.
- <sup>139</sup> Barnett JL, Hemsworth PH, Cronin GM, Jongman EC, and Hutson GD. 2001. A review of the welfare issues for sows and piglets in relation to housing. *Australian Journal of Agricultural Research* 52:1-28, citing: Barnett JL and Taylor IA. 1995. Turn-around stalls and the welfare of pigs. In: Hennessy DP and Cranwell PD (eds.), *Manipulating Pig Production V* (Werribee, Victoria, Australia: Australasian Pig Science Association, p. 22).
- <sup>140</sup> Karlen GAM, Hemsworth PH, Gonyou HW, Fabrega E, Strom AD, and Smits RJ. 2007. The welfare of gestating sows in conventional stalls and large groups on deep litter. *Applied Animal Behaviour Science* 105(1-3):87-101.
- <sup>141</sup> Broom DM, Mendl MT, and Zanella AJ. 1995. A comparison of the welfare of sows in different housing conditions. *Animal Science* 61:369-85.
- <sup>142</sup> Hodgkiss NJ, Eddison JC, Brooks PH, and Bugg P. 1998. Assessment of the injuries sustained by pregnant sows housed in groups using electronic feeders. *Veterinary Record* 143(22):604-7.
- <sup>143</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 96.  
[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.
- <sup>144</sup> Mavrogenis AP and Robison OW. 1976. Factors affecting puberty in swine. *Journal of Animal Science* 42(5):1251-5.

- 
- <sup>145</sup> Jensen AH, Yen JT, Gehring MM, Baker DH, Becker DE, and Harmon BG. 1970. Effects of space restriction and management on pre- and post-pubertal response of female swine. *Journal of Animal Science* 31:745-50.
- <sup>146</sup> Lammers PJ, Honeyman MS, Mabry JW, and Harmon JD. 2007. Performance of gestating sows in bedded hoop barns and confinement stalls. *Journal of Animal Science* 85(5):1311-7.
- <sup>147</sup> Arnot C and Gauldin C. 2007. Hoop barn study yields ‘surprise.’ *Feedstuffs*, May 7.
- <sup>148</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 100.  
[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.
- <sup>149</sup> Turner J. 2000. The welfare of Europe’s sows in close confinement stalls (Hampshire, U.K.: Compassion in World Farming Trust, p. 33).  
[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). Accessed November 11, 2011.
- <sup>150</sup> Task Force on the Housing of Pregnant Sows. 2005. A comprehensive review of housing for pregnant sows. *Journal of the American Veterinary Medical Association* 227(10):1580-90.
- <sup>151</sup> Task Force on the Housing of Pregnant Sows. 2005. A comprehensive review of housing for pregnant sows. *Journal of the American Veterinary Medical Association* 227(10):1580-90.
- <sup>152</sup> Pew Commission on Industrial Farm Animal Production. 2008. Putting meat on the table: industrial farm animal production in America. [www.ncifap.org/images/PCIFAPFin.pdf](http://www.ncifap.org/images/PCIFAPFin.pdf). Accessed November 11, 2011.
- <sup>153</sup> Scientific Veterinary Committee, Animal Welfare Section. 1997. The welfare of intensively kept pigs. For the European Commission; Report nr Doc XXIV/B3/ScVC/0005/1997, p. 100.  
[http://ec.europa.eu/food/fs/sc/oldcomm4/out17\\_en.pdf](http://ec.europa.eu/food/fs/sc/oldcomm4/out17_en.pdf). Accessed November 11, 2011.

The Humane Society of the United States is the nation’s largest animal protection organization—backed by 11 million Americans, or one of every 28. For more than a half-century, The HSUS has been fighting for the protection of all animals through advocacy, education, and hands-on programs. Celebrating animals and confronting cruelty. On the Web at [humanesociety.org](http://humanesociety.org).