

animal welfare science update

The aim of the animal welfare science update is to keep you informed of developments in animal welfare science relating to the work of the RSPCA. The update provides summaries of the most relevant scientific papers and reports received by the RSPCA Australia office in the past quarter.

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If you have recently had an article or book published that would be of interest to other readers of the Science Update, please send us the reference so we can include it in the next issue. We like to encourage and promote animal welfare research whenever possible but don't always get to see every relevant paper.

companion animals

Short online survey about dog welfare and kennel facilities

Mia Cobb is currently undertaking a PhD (with the Animal Welfare Science Centre in Melbourne) researching the effects of social and environmental enrichment on the welfare of dogs housed in kennel facilities. Part of this exciting research involves a short online survey, currently being distributed worldwide, to learn more about the attitudes and perceptions of people towards kennel facilities and dog welfare. The results from this anonymous survey will be used by scientists to report on information that is currently only available as anecdotal comments and may show differences in attitudes between general public and people who have experience with kennel facilities. The survey only takes around 10 minutes to complete and has been approved by the appropriate ethics committee at Monash University.

Follow this link to read the participant information and to commence the survey:
<http://www.med.monash.edu.au/spppm/surveys2009/mcobb>

farm animals

Animal-based welfare monitoring

Animal-based indicators of animal welfare are the subject of current research efforts to assess animal well-being on-farm in a more direct manner. Behavioural, physiological, performance and health indicators are seen to be more reliable assessment measures than external parameters, such as cage size for example. This report covers a number of research initiatives, including the ongoing EU Welfare Quality project, and concludes that a standardised on-farm animal-based welfare assessment is technically feasible. The report goes on to look at the potential for automated measuring of welfare on-farm and the advantages compared to on-farm auditing - including real-time recording, more objective measuring, and avoiding biosecurity risks. A cost-effective tool for automated recording is yet to be found, however.

The second part of the report takes two major welfare issues in the dairy industry (mastitis and lameness) as a case study to analyse the socio-economic factors that need to be taken into account when introducing an animal-based welfare assessment system. The case study shows that the economic impact will depend on the extent to which farmers need to move from a level of 'low' welfare to a level of 'high' welfare. The report points out that expenditure on improving welfare is compensated by the financial benefits of, for example, sustained milk yield and reduced health care costs.

The liberalisation and globalisation of the food market will increase competition, putting financial pressure on farmers. However, the more animal welfare friendly production system may present an opportunity for product differentiation. The report suggests large-scale farms may be better able to

implement automated welfare monitoring systems. The report questions whether retailers will drive changes in animal welfare because consumer willingness to pay for animal-friendly products is lagging behind society's general concern for the treatment of farm animals.

Finally, the report offers three ways in which farmers (whom EU citizens see as being responsible for animal welfare) can be supported in the use of an animal-based monitoring system. The report ends with a reminder that public perceptions of animal welfare can differ from science/animal-based assessments and the question as to "what conditions should be met in order to foster public trust in farming practices" may remain unsolved.

European Parliament, Science and Technology Options Assessment (2009) Animal-based welfare monitoring: Final report, IP/A/STOA/FWC2005-28/SC28/40, Manuscript completed in March 2009.

Temperature preferences of newborn dairy calves

Low temperatures can be harmful to newborn calves, and can even lead to increased mortality. Traditionally, calves exposed to cold temperatures have been given extra food to allow the animals to compensate for the effort of keeping themselves warm. As the effectiveness of this procedure was challenged by a later study, the authors of this paper decided to test a different technique, namely electric heat lamps, on the ability of calves to cope with the cold. 27 newborn Holstein calves were divided into two groups, which were given high or low daily rations. Calves were then individually led into a pen that was heated at one end, thereby creating a temperature gradient over the length of the pen. The calves' behaviour was video recorded over a period of three days.

The researchers found that the calves spent most of their time in the heated end of the experimental pen, regardless of the amount of milk they were provided. Temperature gauges attached to the backs of the calves also showed that the animals were not regulating their temperature through changes in body posture. The researchers concluded that calves show a preference for warmer environments even when the outside temperature was mild, and that the use of heat lamps is a good management practice.

Borderas, F., de Passillé, A.M.B. & Rushen, J. (2009) Temperature preferences and feed level of the newborn dairy calf, *Applied Animal Behaviour Science*, 120: 56-61.

Assessment of emotion in sheep

In order to ensure the welfare of farm animals, it is important to recognise when animals are stressed, and when they are in a positive state of mind. This study investigated the physiological and behavioural changes that occur in sheep, when they are exposed to stressful and pleasing situations. A total of 19 Swiss White Alpine and Lacauae ewes were subjected to three situations of differing emotional value: separation from the flock (negative), standing in the feeding area of the home pen (neutral) and voluntary grooming by a known human handler (positive). Variables such as heart rate, body temperature and breathing rate, as well as behavioural measures such as ear position, posture changes and eye width were monitored during the experiment.

The researchers found that sheep in the positive situation moved their ears less, preferring to hold them pointing straight away from the body, did not open their eyes wide, and had a slower heartbeat. Sheep in the negative situation reacted in the opposite way, by moving their ears more and preferring to hold them pointing forwards, opening their eyes wider, sweating more, and having a faster heartbeat. The authors concluded that emotional states in sheep can be readily assessed by the measures used in the study, and that simple behavioural observations could also provide information regarding a sheep's stress levels.

Reefmann, N., Wechsler, B. & Gygax, L. (in press) Behavioural and physiological assessment of positive and negative emotion in sheep, *Animal Behaviour*, doi:10.1016/j.anbehav.2009.06.015.

Reducing mortality in lambs

Merino management guidelines in Australia state that mortality among lambs should be no higher than 4% in the year after weaning. However, field data suggest that actual mortality may range from 10% to as high as 39%, depending on the state in which the lambs are reared.

The authors of this study used field data collected between 1996 and 2003 to determine the main risk factors associated with mortality in weaned Merino lambs. Their analysis showed that mortality among nine groups of lambs weaned during these years was frequently well in excess of the industry target. Low weaning body weight was consistently associated with increased mortality risk, as was low growth rate. For example, weaners weighing 10 kg had 1.6-fold the mortality risk of weaners weighing 12 kg, while the mortality risk of weaners growing at an average of 0.25 kg/month during summer and autumn was 6.7-fold that of weaners growing at 0.5 kg/month. The authors suggest that farmers separate the lightweight portion of the flock without delay at weaning each year, for subsequent preferential management. An 85% decrease in mortality could be achieved through increasing the mean weaner growth rate in the first 5 months after weaning from 0.25 kg/month to 0.5 kg/month. In an average summer, this might be achieved by feeding 2.5 kg/head/month of supplementary oats and lupins at a cost of AUD\$0.40/head/month at average historical prices, making this a highly cost-effective strategy. It is also suggested that in southern Australia at least, not shearing spring-born Merino weaners between December and May might assist in reducing overall post-weaning mortality.

Campbell, A.J.D., Vizard, A.L. & Larsen, J.W.A. (2009) Risk factors for post-weaning mortality of Merino sheep in south-eastern Australia, *Australian Veterinary Journal*, 87(8): 305-312.

The use of a topical anaesthetic and/or NSAID in Merino lamb castration

Castration is an important routine procedure in the sheep industry, but one which causes significant short-term pain and distress to the animals. Although many studies have demonstrated the ability of injected painkillers in relieving the distress of castration, this method is not practical when considering the large numbers of animals that would need to be treated. The authors of this study tested the effectiveness of a topical anaesthetic spray (Tri-solfen) in combination with a non-steroidal anti-inflammatory drug (carprofen), on the pain and stress associated with ring and knife castration in Merino lambs.

The authors found that knife-castrated lambs had higher levels of the stress hormone cortisol in the blood for the first 6 h after treatment than ring-castrated lambs. On the other hand, ring-castrated lambs showed far more pain-related behaviour than knife-castrated animals. Tri-Solfen applied to the knife castration wound significantly reduced the peak cortisol concentration for the first 6 hours, and improved lying behaviour in the first 12 hours. Carprofen reduced the cortisol response to knife castration at 30 min. Carprofen nearly halved the number of acute pain behaviours associated with ring castration. Combining Tri-solfen and carprofen did not further reduce the pain experienced by the animals. The authors conclude that the use of a topical anaesthetic for knife castration or a single injection of carprofen for ring castration may provide modest amelioration of the pain and distress of the procedure.

Paull, D.R. et al. (2009) Effects of a topical anaesthetic formulation and systemic carprofen, given singly or in combination, on the cortisol and behavioural responses of Merino lambs to castration. *Australian Veterinary Journal*, 87(6): 230-237.

Moral attitudes to animal culling

During the outbreak of animal epidemics such as foot and mouth disease and avian influenza, tens of thousands of healthy animals may be culled, leading to public outcry. The authors of this paper argue that national governments use purely economic criteria in such situations to make policy decisions; such an approach is often at odds with public attitudes concerning the place of animals in modern human society. In the authors' model, people's fundamental moral attitude is shaped by four main elements. These are 1) beliefs about whether animals are inferior, equal or superior to humans in the natural hierarchy, 2) beliefs about the intrinsic value of animals, either as food or as companions, 3) beliefs about whether humans have an obligation to protect and care for animals, and 4) beliefs about whether animals have rights. These beliefs form the basis of a two-layered approach towards animal ethics: the first layer represents the most basic, deeply felt moral convictions about animals, while the second layer consists of the more practical convictions which are dependent on context (such as the type of animal in question), and are more likely to be used in debates on an animal issue. The authors suggest that such an understanding of the factors underlying people's attitudes towards animals may facilitate communication between opposing groups in an animal issues debate.

Cohen, N.E., Brom, F.W.A. & Stassen, E.N. (2009) Fundamental moral attitudes to animals and their role in judgment: an empirical model to describe fundamental moral attitudes to animals and their role in judgment on the culling of healthy animals during an animal disease epidemic, *Journal of Agricultural and Environmental Ethics*, 22: 341-359.

Using quinine to stop feather pecking in chickens

Severe feather pecking between chickens is a serious problem in the poultry industry. It is thought to be the result of misdirected feeding behaviour, and can cause pain, feather loss and bleeding to the recipient. The authors of this study investigated whether the bitter tasting chemical, quinine, could be sprayed onto the feathers of commercially reared chickens, in an attempt to prevent aggressive individuals from pecking.

Sixty birds each from two strains of chicken were observed over a period of four weeks. In week two, half the birds from each strain were sprayed with a quinine solution, and any changes in the rate of feather pecking were recorded. The researchers found that severe and gentle feather pecking decreased following the quinine spray, and in some cases remained low until week four, suggesting that the chickens had learnt to avoid the bad taste of the chemical by reducing their pecking behaviour. Importantly, the quinine treatment led to a reduction in aggressive behaviour between chickens, while normal self-preening behaviour remained the same. However, the effect of quinine was temporary in some cases, and the authors suggest that treating chickens at an early age might lead to longer-term effects.

Harlander-Matauschek, A., Beck, P. & Piepho, H.-P. (in press) Taste aversion learning to eliminate feather pecking in laying hens, *Gallus gallus domesticus*, *Animal Behaviour*, doi:10.1016/j.anbehav.2009.05.020.

The effect of stocking density on broiler welfare

The stocking density of farm animals is a critically important consideration when trying to maximise their welfare. Unfortunately, it is a complicated matter to determine an ideal stocking density, as a wide range of welfare-related variables need to be taken into account. The authors of this study attempted to take many of these variables into account while determining an ideal stocking density for broiler chickens. 1,300 chickens were divided into groups of 8, 19, 29, 40, 45, 51 and 61, and their fearfulness, stress hormone levels, leg health, bursa weight, body weight and mortality were measured.

The authors found that stress hormone levels, bursa weight, final body weight and mortality were not significantly affected by stocking density. However, leg strength decreased, and hock and footpad dermatitis and fearfulness (in males only) increased with increasing stock density. In spite of this overall trend, the detailed findings were quite complicated - not every increase in stocking density resulted in a similar or consistent reduction in these welfare aspects. Integrating all welfare aspects, the researchers found that the lowest two densities showed better scores than most middle densities, whereas the highest density fared the worst of all. However, no single critical stocking density could be determined, beyond which all welfare indicators became negative, as different indicators responded differently to increasing density.

Buijs, S. et al. (2009) Stocking density effects on broiler welfare: identifying sensitive ranges for different indicators. *Poultry Science*, 88(8): 1536-1543.

animals used for sport, entertainment, recreation and work

Horses' responses to bitless bridles

Bitted bridles are used almost universally in the equestrian world, but in recent years, there has been growing concern that such devices may cause great discomfort to horses. Bits apply pressure to various parts of a horse's highly sensitive mouth, and their improper use may lead to serious conflict behaviours such as bucking and rearing. Bitless bridles apply pressure mainly across the nasal plane, less along the cheeks, and least across the nuchal crest. The pressures employed with this bitless bridle are spread over a larger surface area than with a traditional bitted bridle and are essentially used to effectively and gently 'push' the horse in the desired direction.

The authors of this study compared the effects of bitted and bitless bridles on the behavioral and cardiac responses of six horses undergoing foundation training (bridling, long reining, and riding). The researchers

found that during long reining, the horses wearing the bitted bridle took more steps than those in the bitless bridle after the application of the halt stimulus before achieving the halt. This finding indicates that the horses in the bitless bridle were more likely than those in the bitted bridle to be able to perform the correct response to the halt command. In addition, the horses wearing the bitless bridle had the lowest heart rates and heart rate variability during long reining, implying that these horses were experiencing the least stress when first encountering the rein. The results of this study suggest that horses wearing bitless bridles performed at least as well as, if not better than, those in bitted bridles. The use of bitless bridles could be beneficial in animal welfare terms, but the authors advise caution in drawing any conclusions drawn from their results due to the low number of horses used.

Quick, J.S., & Warren-Smith, A.K. (2009) Preliminary investigations of horses' (*Equus caballus*) responses to different bridles during foundation training. *Journal of Veterinary Behavior*, 4: 169-176.

Hot iron branding and microchip injection in horses

Horses are routinely branded with hot irons to either identify their owner, or to allow owners to distinguish between individual horses. As microchip transponders are now available for horses, it is possible that this technology might be an improvement over branding, as it could potentially cause far less pain and suffering to horses. The authors of this study evaluated the behavioural and physiological responses of horses to both methods of identification, over a period of seven days.

The researchers found that, as expected, hot-iron branding on the left leg caused far more pain-related behaviour in horses, than did the microchip injection into the skin of the neck. The site of branding also exhibited significantly higher skin sensitivity, temperature and swelling than did the site of injection. Some of these effects were long term, and lasted well over 24 hours. The level of stress hormones in the blood was not affected by either treatment. The authors conclude that since hot iron branding causes more pain and discomfort to horses than does microchip injection, the latter method of identification should be preferred. Moreover, there is also evidence that microchip identification lasts longer, and is more accurate.

Lindegaard et al. (2009) Evaluation of pain and inflammation associated with hot iron branding and microchip transponder injection in horses. *American Journal of Veterinary Research*, 70(7): 840-847.

Grouping horses according to gender

Horses are group living animals, and without the social contact of other horses, may develop abnormal behaviours such as weaving or increased aggression. Horse owners, when putting horses together in groups, tend to do by gender, due to the belief that individuals in same-sex groups display less aggressive behaviour towards group-mates. The authors of this paper tested this idea, in order to determine if such a practice indeed led to better animal welfare.

A total of 66 horses from four different farms in Norway and Denmark were placed into three groups: mares only, geldings only and mixed gender. After about six weeks of acclimatisation, a trained observer recorded all social interactions in a group for two hours each day on three consecutive days. The researchers found that the gender composition of the groups had no effect on social interactions. In any case, the vast majority of all aggressive interactions across all groups were mere threats, and did not involve physical contact. Most importantly, horses with the smallest space in which to live showed the most aggression. The authors conclude that more attention must be paid to the space available to individual horses, than to group gender composition.

Jorgensen et al. (2009) Grouping horses according to gender—effects on aggression, spacing and injuries. *Applied Animal Behaviour Science*, 120: 94-99.

research animals

Attitudes towards the use of animals in scientific research

Attitudes towards the use of animals in research vary widely within the general population. It has been shown that a range of factors play a role in shaping such attitudes, such as an individual's political

orientation, his/her personality, and whether s/he owns a pet. However, research has also shown that people's attitudes towards scientific studies involving animals can also be affected by the characteristics of the study itself, such as the type of animal being used. The authors of this paper looked at three such study-specific characteristics, namely the type of animal used in the research, the potential benefit to humans resulting from the research (represented by the severity of the human disease being examined), and the level of harm suffered by the animal.

Over 570 participants were made to read fictitious medical scenarios describing research to be undertaken on animals; however, scenarios were systematically varied according to one of the three study-specific characteristics mentioned above. Participants then had to answer a short questionnaire that asked about their attitudes towards the research mentioned in the scenario they had just read. In general, women were more opposed to the use of animals in medical research than were men. Moreover, regardless of sex or general attitudes about animals, participants were: 1) more opposed to research using chimpanzees and dogs than research using mice; 2) more opposed to research resulting in death or injury for the animal than research resulting in no harm; and 3) more supportive of research seeking a cure for a fatal disease than research seeking a cure for a non-fatal one.

Henry, B. & Pulcino, R. (2009) Individual difference and study-specific characteristics influencing attitudes about the use of animals in medical research. *Society and Animals*, 17: 305-324.

Interactions of rats with different-sized objects

It has been suggested that captive animals should be given as much environmental enrichment as possible, in order to maximise their welfare. However, in laboratory situations, where hundreds of animals may be kept at once, this is often not possible, due to financial or procedural reasons. The authors of this paper therefore investigated the interaction of laboratory rats with single enrichment objects, that differed only in size.

Eight rats were exposed to either a large (5cm X 3cm X 7cm) or small (3cm X 1.5cm X 1cm) object made of Lego bricks, and allowed to interact with it over four days. The results showed that rats spent longer with large objects rather than small ones, and also spent longer climbing on top of the large objects. This behaviour continued even when the large objects were laid on their sides instead of placed upright in the arena, suggesting that the rats were not simply climbing on the objects to investigate the top of the arena and thus an escape route, but instead were genuinely motivated to climb. The researchers conclude that rat welfare could be enhanced by the addition to their cages of objects that are large enough to permit climbing.

Williams, C.M., Hanmer, L.A., Riddell, P.M. (2009) The effect of the functional attributes of objects within the caged environment on interaction time in laboratory rats. *Applied Animal Behaviour Science*, 120: 208-215.

wildlife

Animal-visitor interactions in zoos

Entertaining the public is one of the primary objectives of zoos, along with animal welfare, conservation, education and research. However, since zoos depend on attracting large numbers of visitors through displaying exotic animals seen at close proximity, the goal of entertainment can often come into conflict with the goal of ensuring animal welfare. The authors of this review article present research from the past two decades on the subject of animal-visitor interactions in zoos, and discuss the implications of the findings for animal welfare.

The authors found that there were two main directions of research on the above subject. Firstly, researchers have investigated the effect that certain animals, animal behaviours or exhibit types have on visitors to zoos. Not surprisingly, visitors prefer to see animals in naturalistic settings, and during periods of activity. Enriched environments and animal training sessions were found to have positive effects on visitor attitudes. Secondly, many studies have looked at the effects of visitors on captive zoo animals. For many animals, both primate and non-primate, intense exposure to large visitor numbers were found to produce stress-related behaviour in zoo animals, such as hiding, pacing or aggression. As a result, many animals tend to be more active on days when the zoo is closed. When large numbers of visitors are plainly visible to animals for long periods of time, or when visitors are noisy, animals welfare may also be

compromised. The authors suggest that simple steps can be taken by zoos to improve animal welfare without losing the revenue obtained from visitors. This includes better visitor education through signs, improved placement of popular exhibits to control crowd numbers, and the use of items such as camouflage netting to screen visitors from animals.

Fernandez et al. (2009) Animal-visitor interactions in the modern zoo: conflicts and interventions. *Applied Animal Behaviour Science*, 120: 1-8.

miscellaneous

Bones as enrichment for farmed blue foxes

European Convention regulations state that farmed blue foxes must be provided with an object with which they can interact. Traditionally, foxes have been provided with blocks of wood, as these are cheap and readily available. The advantage of such objects is that they provide the foxes with enrichment in their cages, prevent the appearance of stereotyped behaviours, and also keep the animals' teeth and gums healthy. Unfortunately, foxes can destroy a block of wood completely in a matter of weeks, and any splinters swallowed in the process can lead to serious health problems.

The authors of this study wondered whether animal bones might be a superior substitute for wooden blocks. Sixteen blue fox families were housed in special two-cage enclosures, and a cow leg bone was provided to half the families. Observations of the foxes' interactions with the bone were made over a period of four months. During the experimental period, the bone was removed for two 10-day periods. The foxes used the bones around 50 min a day, but were unable to consume the bones during the experiment. This rate of interaction was significantly higher than that reported with wooden blocks in previous studies. The availability of the bones stimulated play and prevented the development of oral stereotypic activity. The time the foxes spent in the bone cage and the interaction with the bones increased after both times that the bones were taken away. The researchers conclude that bones are long-lasting activity objects, which may enhance the welfare of blue foxes.

Koistinen et al. (2009) Bones as enrichment for farmed blue foxes (*Vulpes lagopus*): interaction with the bones and preference for a cage with the bones. *Applied Animal Behaviour Science*, 120: 108-116.

other articles and publications of interest

Boivin, X., Gilard, F., & Egal, D. (in press) The effect of early human contact and the separation method from the dam on responses of beef calves to humans, *Applied Animal Behaviour Science*.

Bracke, M.B.M. (2009) Rope test may indicate efficacy of tail-biting treatments in growing pigs, *Animal Welfare*, 18: 263-266.

Calamari, L., Calegari, F. & Stefanini, L. (2009) Effect of different free stall surfaces on behavioural, productive and metabolic parameters in dairy cows, *Applied Animal Behaviour Science*, 120(1-2): 9-17.

Ellis, K.A. et al. (2009) Public opinion on UK milk marketing and dairy cow welfare, *Animal Welfare*, 18: 267-282.

Gillman, C.E. et al. (in press) A cross-sectional study of the prevalence of foot lesions in post-weaning pigs and risks associated with floor type on commercial farms in England, *Preventative Veterinary Medicine*.

Guy, J.H. et al. (2009) Reducing post-mixing aggression and skin lesions in weaned pigs by application of a synthetic maternal hormone, *Animal Welfare*, 18: 249-255.

Hernandez, C.E. et al. (2009) Effects of sex, litter size and periconceptional ewe nutrition on the ewe-lamb bond, *Applied Animal Behaviour Science*, 120 (1-20): 76-83.

von Keyserlingk, M.A.G., et al. (2009) Invited review: The welfare of dairy cattle – Key concepts and the role of science, *J. Dairy Sci.*, 92: 4101-4111.

KilBride, A.L., Gillman, C.E. & Green, L.E. (2009) A cross-sectional study of the prevalence of lameness in finishing pigs, gilts and pregnant sows and associations with limb lesions and floor types on commercial farms in England, *Animal Welfare*, 18: 215-224.

- Krystallis, A. et al. (in press) Attitudes of European citizens towards pig production systems, *Livestock Science*.
- Legrand, A.L., von Keyserlingk, M.A.G. & Weary, D.M. (2009) Preference and usage of pasture versus free-stall housing by lactating dairy cattle, *J. Dairy Sci.*, 92: 3651-3658.
- Nicol, C.J. et al. (in press) Associations between welfare indicators and environmental choice in laying hens, *Animal Behaviour*.
- O'Driscoll, K.K.M., et al. (2009) The effect of floor surface on dairy cow immune function and locomotion score, *J. Dairy Sci.*, 92: 4249-4261.
- Petherick, J.C. et al. (2009) Quality of handling and holding yard environment, and beef cattle temperament: 1. Relationship with flight speed and fear of humans, *Applied Animal Behaviour Science*, 120(1-2): 18-27
- Petherick, J.C. et al. (2009) Quality of handling and holding yard environment, and beef cattle temperament: 2. Consequences for stress and productivity, *Applied Animal Behaviour Science*, 120(1-20): 28-38.
- RSPCA Australia Scientific Seminar 2008 Animals in transit: The journey ahead, *Journal of Veterinary Behavior: Clinical Applications and Research*, 4(4).
- Sutherland, M.A. et al. (in press) The effect of three space allowances on the physiology and behavior of weaned pigs during transportation, *Livestock Science*.
- Tonsor, G.T., Wolf, C. & Olynk, N. (in press) Consumer voting and demand behavior regarding swine gestation crates, *Food Policy*.
- Tucker, C.B. et al. (in press) Laterality of lying behaviour in dairy cattle, *Applied Animal Behaviour Science*.
- Vasdal, G., Andersen, I.L. & Pedersen, L.J. (2009) Piglet use of the creep area - Effects of breeding value and farrowing environment, *Applied Animal Behaviour Science*, 120 (1-2): 62-67.
- Wemelsfelder, F., Nevison, I. & Lawrence, A.B. (in press), The effect of perceived environmental background on qualitative assessments of pig behaviour, *Animal Behaviour*.
- Worthing, K. (2009) Stepping out: Recent advances in detecting lameness in dairy cattle, *The Veterinarian*, July 2009, Essay selected for the magazine Prize for Written Communication for Sydney University third-year veterinary science students.
- Zoric, M. et al. (2009) Incidence of lameness and abrasions in piglets in identical farrowing pens with four different types of floor, *Acta Vet Scand*, 51:23.

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