



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.

COMPANION ANIMALS

Breeding companion dogs with suitable behaviours

The vast majority of dogs in Australia are kept as companion pets and only about 4,200 of the 3.4 million are estimated to perform working roles. In the past, dogs were bred to perform specific utilitarian roles, whereas nowadays, the dog's most common role is that of human companion. While the world has changed significantly since the first dog breeds were developed, many of these existing breeds remain popular as companion pets. Pet dogs often provide a range of significant benefits to humans, however, some dogs may exhibit behaviours that their owners consider undesirable and as a consequence, they may be relinquished to shelters. The authors propose that some unsuitable behaviour may be the result of inappropriate dog-owner matching, made more likely by the general change in the role of dogs, coupled with a strong tendency for modern owners and breeders to select dogs primarily on the basis of physical appearance, rather than behavioural and health characteristics. Behavioural traits may be overlooked, in spite of the fact that modern-day pet owners rate behavioural traits such as calmness and sociability highly.

The paper highlights the importance of taking physical health and behaviour (as well as perceived beauty) into consideration when breeding and selecting dogs as companions. The authors point out that many behavioural traits are heritable, and that given sufficient access to accurate information and tools, breeders could select for desirable behaviours in their animals. Importantly, some behaviours may be genetically (and unpredictably) linked to certain anatomical traits – thus, even though breeders have tried to exclusively select appearance-related features, they may have



inadvertently also selected for undesirable behavioural traits. The authors suggest that breeders need to be aware that most modern day dogs are companions; that pet owners usually rank behaviour more highly than appearance; that behaviour is highly heritable and that the correct rearing of puppies in the early critical stages of life can greatly improve socialisation as an adult. The authors suggest that scientists need to work with breeders and develop accurate behavioural assessments, able to identify desirable canine behavioural traits which would provide invaluable tools for breeders and other dog-related organisations.

King T., Marston L.C. & Bennett P.C. (2012) Breeding dogs for beauty and behaviour: Why scientists need to do more to develop valid and reliable behaviour assessments for dogs kept as companions, *Applied Animal Behaviour Science*, **137**: 1– 12.

Domestic violence and animal welfare

It is estimated that one in three Australian women has, at some time, faced violence from a male partner. In households where the woman owns a companion animal, that animal may also become the target of violence from the abusive partner. Where a woman owner has a strong emotional bond with an animal, violence towards that animal may be used as a tool to enforce coercive control over the woman. Children in violent households may show higher levels of cruelty to animals than those not living with domestic violence.

In this study, members of the Australian public were invited to telephone a researcher for a semi-structured interview on the topic of domestic violence and animal welfare. In total, 26 Australian women reported one or more companion animals in the household being verbally and/or physically abused by their male partner, usually with prolonged effects on animal behaviour; 92% indicated that they had been unwilling to discuss the animal abuse with a veterinarian. Many were unaware of animal accommodation services for people fleeing violence and those who did know about these were unwilling to use them, citing their bond with the animals as the main reason. Animals targeted for abuse were most likely to be dogs, and owned by women rather than men, children or both partners. One of the recommendations made on the basis of these findings is that women fleeing domestic violence should be housed together with their companion animals, in order to reduce stress to both parties.

The authors also suggest that training in the area of interpersonal violence and animal abuse be included in veterinary school curricula, just as many medical schools include instruction in dealing with family violence.

Tiplady, C.M., Walsh D.B., & Phillips, C.J.C. (2012) Intimate partner violence and companion animal welfare. *Australian Veterinary Journal*, **90**: 48-53.

FARM ANIMALS

Mastitis in dairy heifers

Although mastitis is a common problem in older cows, its prevalence among heifers is a puzzling phenomenon, because heifers have never been milked, whereas it is the milking process that is thought to be a major cause of the condition. The authors of this review article point out that certain bacteria have been implicated in causing the disease, the main culprit being coagulase-negative staphylococci (CNS). Mastitis affects both heifers and cows in the late stages of gestation, and there seems to be a peak in infection one day after calving. In fact, incidence rates of mastitis are higher in heifers after first calving than in cows. This may result in discarded milk, lower milk yields and the culling of chronically infected individuals, which in turn leads to monetary losses for farmers.

The factors that predispose heifers to udder infection by bacteria are poorly understood, but there is some evidence that inappropriate housing, dirty udders, and abnormal conditions such as twin births, retained placenta and open teat canals up to 10 days before calving may facilitate the development of mastitis.



General hygiene is also important, as farms with effective fly control, as well as those that prevent calves from suckling on other heifers, seem to have fewer cases of mastitis.

De Vliegheer, S., Fox, L.K., Piepers, S. *et al.*, (2012) Mastitis in dairy heifers: Nature of the disease, potential impact, prevention, and control, *Journal of Dairy Science*, **95**: 1025-1040.

Measuring empathy in animals

In humans, 'empathy' is described as the ability of a person to observe the emotional state (such as distress) of another human, and to develop an appropriate emotion in one's own mind. In practice, it is quite hard to determine experimentally whether an emotional response generated in an observer is really due to that observer feeling what another human might be feeling, or if it is merely a result of the observer having seen something pleasant or unpleasant (i.e. the observer's personal response to a stimulus). Naturally, the difficulties in determining whether a behaviour is empathic or not are compounded when non-human animals are the subject of investigation.

The authors of this review article argue that many experimental studies that claim to show empathy in animals are actually inconclusive, because of inappropriate experimental design (such as the absence of crucial controls) or the neglect of variables that are likely to be involved in any potential empathic response. In one study, for example, chimpanzees, who were the victims of aggression, appeared to be 'comforted' or 'consoled' by other bystander animals. This study neglected to document any physiological parameters indicating changes in stress levels in the victim chimps, and so the claim that these individuals were 'comforted' by the bystanders remained untested. In another study, ewes who were the mothers of lambs being castrated and tail-docked seemed to produce a certain kind of empathic vocalisation during the procedure. However, a control experiment, where the lambs were merely handled by humans, but not operated on, was not carried out. The authors of the review article warn against the making of policy decisions on the basis of incomplete evidence – they cite as a worrying example, a recent Farm Animal Welfare Council statement that the welfare of pigs and sheep is not compromised when they are made to view other animals being slaughtered. The authors stress the need for well-designed studies that make use of both behavioural and physiological observations.

Edgar, J., Nicol, C.J., Clark, C.C.A. *et al.*, (In press) Measuring empathic responses in animals. *Applied Animal Behaviour Science*.

Clips as an alternative to mulesing

Mulesing is a significant and well-known welfare issue in Merino lambs, as it is a painful procedure that reduces the chances of lambs developing the even more distressing condition known as flystrike. As a result, there has been much interest in recent years in developing more humane alternatives to ordinary mulesing, such as the use of spray-on anaesthetics, and chemicals that produce scar tissue. This experimental study reports on the use of another technique - plastic clips attached to the skin of the breech, which causes the skin to dry and fall off in 2-4 weeks. Earlier trials of this method have shown that clipped lambs have a faster growth rate than mulesed lambs, which is significant as low body weight is associated with post-weaning mortality.



Between 170 and 550 two to 12-week-old lambs were involved in this experiment on five different farms. Lambs were either 1) mulesed, 2) clipped, or 3) tail-docked but not mulesed or clipped. The clip treatment increased the size of the breech and tail bare areas compared with the unclipped, unmulesed control lambs, although the increases were less than in mulesed lambs. The clips reduced breech wrinkle, dag and urine stain to levels partway between those recorded in the unclipped, unmulesed controls and the mulesed lambs. Clipped lambs weighed more than mulesed lambs after treatment and had higher cumulative percentage survival up to 90 days after treatment.

Evans, I.B., Lawton, P.W. & Lloyd, J.B. (2012) Effect of plastic occlusive clips used as an alternative to mulesing on breech conformation, body weight and survival of Merino lambs, *Australian Veterinary Journal*, **90**(3): 88-96.

The behaviour of cattle at pasture

The notion of the "Five Freedoms" is central to modern conceptions of animal welfare. One of these is the freedom to express normal behaviour – this may include actions such as dust bathing in chickens, or rooting behaviour in pigs. Animal welfare scientists commonly look to the wild relatives of domesticated animals for information on what might constitute 'normal' behaviour for a particular species, with the aim of trying to provide the conditions, in farm settings for example, that would facilitate the performance of that behaviour.



Unfortunately, the wild ancestors of modern cattle went extinct a long time ago, with the result that scientists have a limited understanding of the components of 'normal' cattle behaviour.

This review paper is intended to provide a summary of the known behavioural research carried out on cattle at pasture, i.e. under conditions with minimal human interference. Earlier studies have identified up to 40 different behaviours spontaneously carried out by cattle, including licking other animals, scratching oneself with a limb, or hitting vegetation with the horns. However, several studies have shown that up to 95% of the time budget of cattle is invested in just three behaviours – grazing, ruminating and resting. Most grazing is performed during the hours of daylight, with very little grazing observed at night, although there were exceptions where considerable grazing was observed in the dark. The greater part of rumination occurred while animals were lying rather than standing and, although the information was scant, ruminating and resting tended to occur at night rather than during the day. Finally, cattle generally follow a diurnal rhythm characterised by peaks of grazing activity associated with sunrise and sunset.

Kilgour, R. (In press) In pursuit of "normal": A review of the behaviour of cattle at pasture, *Applied Animal Behaviour Science*.

Reproduction in small ruminants

This paper appeared in a special issue of the journal *Animal Reproduction Science*, entitled 'Reproductive Health Management of Sheep and Goats'. Here, the author suggests that although sheep and goats tend to have a high welfare, 'green' image in the public view, recent advances in reproductive technology have the potential to cause serious negative impacts on the well-being of these small ruminants. The current notion of the 'Five Freedoms' is intended to safeguard domestic animals against unnecessary suffering, but the author points out that there is as yet little legislation that outlaws unacceptable violation of the 'integrity' of an animal (as a species), or that generates individuals whose sentience has been reduced to an unacceptable degree. This last point was made in response to a hypothetical scenario where it might be possible to artificially breed animals that were less self aware, and would therefore be as 'happy' in low-welfare situations as their more sentient predecessors might have been under more favourable conditions.

Some new technologies that are already available to vets also raise clear ethical questions, and pose welfare concerns. An example is juvenile in vitro embryo transfer (JIVET), a technique developed in Australia, with which reproductive cycles can be stimulated in juvenile animals (ewe-lambs or doe-kids, 6–8 weeks old), offering the potential to substantially reduce generation intervals and produce multiple progeny. On the other hand, an example of good practice is said to be research on sheep breeding programs at the Scottish Agriculture College, which has incorporated traits that are important for being a 'good' ewe alongside those important for being a 'good' lamb, in addition to key sustainability traits, such as lamb survival and ewe longevity. The author concludes that we need to provide more opportunity for sheep and goats to indicate prime strategies directed at moving welfare status from 'a life worth living' to 'a good life'.

Roger, P. (2012) Welfare issues in the reproductive management of small ruminants, *Animal Reproduction Science*, **130**: 141–146.

Effects of daylength on commercial broilers

Commercial broiler chickens are sometimes raised in almost full-light conditions (i.e. with no dark phase), because of the belief that being able to visually find food 24 hours a day will lead to faster growth rates. Farmers also sometimes say that constant light makes it easier to catch the chickens at market time. In order to investigate the welfare implications of this practice, the authors of this paper subjected two age-groups of chickens (27-day-old and 42-day-old) to four different light conditions (ranging from 14–23 hours of light per day). The behaviour of the birds was recorded every 10 minutes with an infrared camera for 24 hours.

The researchers found that increasing daylight led to a reduction in a range of behaviours, including time spent standing, walking, feeding, dustbathing, stretching, preening, and litter pecking. High light levels completely eliminated running behaviour in the younger birds, while the same was true for dustbathing in the older birds.



At 23 hours of light a day, birds were also quieter than in the other conditions. Birds in longer days also spent less time at the feeder. The authors conclude that the ease of catching birds kept in constant light may actually be the result of poor welfare, and that such conditions would also adversely impact the productivity of the farm. They suggest that optimal welfare for broiler chickens can be achieved under 16 to 17 hours of light per day.

Schwean-Lardner, K., Fancher, B.I. & Classen, H.L. (2012) Impact of daylength on behavioural output in commercial broilers, *Applied Animal Behaviour Science*, **137**: 43–52.



ANIMALS USED FOR SPORT, ENTERTAINMENT, RECREATION AND WORK

Whip use by jockeys

The use of whips by jockeys in Australian thoroughbred racing is an important issue. The authors of this study viewed high-speed footage taken from the left side of the track, analysing the way in which jockeys used their whips in the last 200 metres of races from two meetings at Gosford Racecourse in NSW. A total of 109 fully visible whip strikes behind the saddle were recorded. The outcomes noted included the area struck by the whip; the percentage of the unpadded section of the whip making contact; whether the seam made contact and whether a visible indentation was evident on impact. These findings were examined in the light of the current Australian Rules of Racing.

The study found evidence of at least 28 examples, in 9 horses, of breaches of the whip rules (one seam contact, 13 contacts with the head, and 14 arm actions that rose above the height of the shoulder). The unpadded section of the whip made contact on 64% of impacts, an extremely important finding given the racing industry's description of the padded whip as a pain-free whip. More than 75% of the time the whip struck the horse in the abdomen (or flank) suggesting that the abdomen rather than the hindquarters were being targeted. This is a concern as there is evidence that the inguinal and abdominal regions are particularly sensitive to tactile stimulation.



The study also found that the whip caused a visible indentation on 83% of impacts with visible indentation likely indicating a painful strike. The majority of jockeys observed used a backhand whip action, possibly to avoid being penalised as the current Australian whip rules maintain a focus solely on forehand action.

Given that the Stewards did not notice any of the breaches recorded by the researchers, and that the former use retrospective head-on footage with lower speed HD video than that used in this study, the researchers call into question the ability of race officials to adequately identify violations of the whipping rules.

McGreevy, P.D., Corken R.A., Salvin H. *et al.* (2012) Whip use by jockeys in a sample of Australian thoroughbred races - an observational study, *PLOS One*, 7(3).

Genetic disorders in horses

The breeding of horses shows many parallels with the breeding of dogs, in that practices such as inbreeding, using small numbers of founding individuals and closed-stud systems are employed for both species. In spite of these similarities, it has been claimed that the horse has a low incidence of inherited disorders compared to other domestic species, such as the dog. There are, of course, a number of genetic diseases that are known to occur in horses, some of which may be fatal or highly debilitating – these include severe combined immunodeficiency disorder (SCID), lethal white foal syndrome and hyperkalaemic periodic paralysis. However, the full extent to which inherited disorders occur in different breeds of domestic horse (*Equus caballus*) has not been previously investigated. A two-part search was conducted by the authors: (i) electronic bibliographic databases for published studies; and (ii) existing online databases of inherited disorders in animals.

The researchers were able to identify 102 potentially inherited disorders in the horse; they are listed at <http://www.ufaw.org.uk/supplementarymaterial.php>, along with the names of the breeds they occur in. 47 breeds of domestic horse were reportedly predisposed to one or more inherited disorders. However, the authors caution that horse breed predisposition data should be used with caution, as the working environment that the horses are exposed to may be just as responsible for a particular condition as the horses' genes. The authors discuss the animal welfare implications of inherited disorders noting that animal welfare can be compromised in animals suffering from inherited disorders, and that many of the inherited disorders reviewed cause pain and distress, which in some cases is severe. The authors suggest that further research is required in this area.

Bettley C.D., Cardwell J.M., Collins L.M. *et al.* (2012) A review of scientific literature on inherited disorders in domestic horse breeds, *Animal Welfare*, 21: 59-64.

Risk factors associated with ridden behaviour problems in horses

Ridden behaviour problems are prevalent in the UK leisure horse population and may have implications for horse welfare and rider safety. Behavioural problems in horses, especially those exhibited during riding, are likely to be the result of a variety of factors, ranging from poorly-fitting equipment (saddles or bits) to a lack of timely foot and dental care and the type of training approaches (draw reins, running martingales, etc.). These factors can cause the horse to experience pain or become anxious, and react unpredictably during a riding session. In this study, the researchers surveyed the owners of close to 800 horses in the UK, asking them for information on the type of work undertaken with the horses, the types of equipment and training methods used on them and the regularity that professional services (farriers, saddlers and dentistry professionals) were employed. Respondents were also asked to rate the frequency that their horse performed fifteen different behaviour problems over the last week it was ridden.

The researchers were able to identify three major influences on ridden behaviour including i) the design and fit of the saddle ii) foot care and shoeing, where an extended interval (seven weeks or more) between farrier visits was associated with an increased risk of discomfort behaviour and iii) taking an outcome-centred approach to training (e.g. through the use of artificial training aids) which was associated with an increased risk of behavioural problems, while spending more time with the horse outside of training situations, a more horse-centred approach, was associated with a reduced risk of problems. The authors suggest that further research is required to understand the causal relationships behind these associations, with the aim of improving the welfare of the horse and the safety of the rider.

Hockenull, J. & Creighton, E. (2012) Equipment and training risk factors associated with ridden behaviour problems in UK leisure horses, *Applied Animal Behaviour Science*, **137**: 36-42.

Keeping horses in groups

Wild horses are social animals, mostly living in large groups, and rarely being observed alone. In contrast, domesticated horses may be routinely housed singly in stables, and offered little opportunity to socialise with other horses. This is surprising given that keeping horses in groups is recognised as the best way to fulfil their behavioural and physical needs, particularly their need for social contact with conspecifics, and to have a beneficial effect on horse-human interactions during training. Isolated horses often develop stereotypic behaviours such as crib-biting, which is an indicator of poor welfare. Some horse owners state that individual stalling is done to prevent potential injuries that may result from social interactions and competition over food and mates. There may also be concerns about introducing new horses into established groups. As a result, some horse owners may be reluctant to group house, in spite of the documented advantages of group housing, particularly for juveniles. Horses that have been group housed early on are less aggressive and seem to have more refined social skills towards familiar and unfamiliar horses when compared to horses deprived of social contact early in life.

The authors of this article carried out a review of the scientific literature on the topic of keeping horses in groups. They conclude that the domestic environment should, whenever possible, offer horses the opportunity to socialise with other horses and that this can be best achieved by keeping horses in groups. Group housing has clear advantages, especially for younger horses. Socialisation is enhanced if it follows a pre-exposure phase where horses are kept in neighbouring stalls, and

allowed limited contact at first. Practical questions that remain include whether to introduce a new horse to the entire group at once, or to do it in instalments, and whether training a horse in the presence of other horses improves learning. The authors indicate there may not be one best method in practice because factors such as available space, feeding regime or individual horse characteristics must be taken into account. Further scientific data on horse group housing is needed to optimise management and improve and safeguard horse welfare and human safety.

Hartmann, E., Søndergaard E. & Keeling L.J. (2012) Keeping horses in groups: a review, *Applied Animal Behaviour Science*, **136**: 77-87.



WILD ANIMALS

Releasing rescued bats

The release of injured or orphaned animals back into the wild is one of the primary goals of wildlife rehabilitation. Wild animals, such as bats, are usually received at wildlife rescue centres as juveniles, and are released into their natural habitat once they are deemed fit enough to fend for themselves. However, there is a serious lack of longitudinal studies that document the survival of released wild animals. The death of such animals soon after release due to insufficient rehabilitation and/or unfavourable environmental conditions would represent not only an unfavourable welfare outcome, but also a waste of the resources invested in a wildlife rescue program. Two studies are presented below which report on the survivorship and behaviour of rehabilitated pipistrelles (a variety of small bat species) in Italy and in the United Kingdom. In both studies, radio transmitters were attached to the released animals' backs, and their activity tracked for as long as the transmitters' batteries would allow (usually 2 weeks).

The Italian study involved 21 Kuhl's pipistrelles (*Pipistrellus kuhlii*), of which 19 were confirmed to be alive at the end of the two week study period. During rehabilitation, the bats were allowed to build up their strength by flying in a large room for 12 nights. Those that were able to fly for at least 10 minutes at a time were selected for release. The bats were tagged with transmitters, and released in an open area beside a national park; this area contained two nest boxes that the bats were already familiar with, and were allowed to use freely. The researchers found that the bats flew around freely upon being released, and that the vast majority returned to their nest box at the end of their first night outdoors. Twelve bats eventually moved to new roost sites (mostly in buildings), and of these, six joined local bat colonies. Bats travelled less than 5 km in total each night, and preferred to hunt for insects near street lamps in human-occupied areas. Farmland and woodland were less attractive places to hunt, and the least amount of hunting took place next to rivers. A bat's home range (the area within which it moved) typically included equal amounts of urban areas, farmland and river vegetation, but less woodland. The authors conclude that this bat species is able to adapt to its release conditions quite well, and shows a high level of (at least) short-term survival.

The UK study investigated the post-release survivorship of common (*Pipistrellus pipistrellus*) and soprano (*Pipistrellus pygmaeus*) pipistrelles. A total of ten bats were radio-tracked for up to ten days, while another 39 bats were tagged with aluminium rings on their forelimbs, and observed after release.

The researchers calculated that 60% of the radio-tracked bats survived for at least six days, while three individuals had to be retrieved soon after release, as they became stuck in buildings. Confirmed long-term survival was evident in six of the ringed individuals, and one was observed alive even after close to four years. The researchers conclude that the inability of released bats to escape from man-made confined spaces such as roofs and chimneys represents a major hurdle to the successful rehabilitation of bats. They have since modified their bat flight cage to include an enclosed area resembling a roof space with various sizes of entrances/exits for bats to learn to negotiate.

Serangeli M.T., Cistrone., Ancillotto L. *et al.* (2012) The post-release fate of hand-reared orphaned bats: survival and habitat selection, *Animal Welfare*, 21: 9-18.

Kelly A., Goodwin S., Grogan A. *et al.* (2012) Further evidence for the post-release survival of hand-reared, orphaned bats based on radio-tracking and ring-return data, *Animal Welfare*, 21: 27-31.



HUMANE KILLING

Restraint and stunning in veal calf slaughter

European Union regulations regarding animal slaughter state that animals should be restrained during the slaughter process, and stunned before slaughter. When slaughter is to be carried out by neck cutting, the animals are usually rotated in the restraining apparatus, so that they lie on their backs, and their necks are easily accessible to the human operator. This, however, may cause considerable stress and discomfort to the animal, as not only is it an unnatural position, but it can also cause the animal's stomach and intestines to press upon the heart and lungs. In addition, certain forms of religious slaughter require that the animal be unharmed prior to slaughter, with the result that stunning is carried out after the throat cut.

In this experimental study, the researchers investigated the effects of rotation and electric and captive-bolt stunning before and after throat cut, on stress and consciousness-related parameters such as brain EEG signals and the blink reflex. The results suggested that there was a slow induction of unconsciousness

after neck cutting (80 seconds) and a rapid induction of unconsciousness after post-cut captive bolt (4 seconds) and pre-cut electrical stunning (immediate). Marked changes in heart rate and some blood chemical values indicated that the animals found rotation in the restrainer to be stressful.

Lambooij, E., van der Werf, J.T.N., Reimert, H.G.M. *et al.* (2012) Restraining and neck cutting or stunning and neck cutting of veal calves, *Meat Science*, **91**: 22-28.



ARTICLES OF INTEREST

FARM ANIMALS

Aquaculture

Jones, H.A.C., Noble, C., Damsgård, B. *et al.* (In press) Investigating the influence of predictable and unpredictable feed delivery schedules upon the behaviour and welfare of Atlantic salmon parr (*Salmo salar*) using social network analysis and fin damage, *Applied Animal Behaviour Science*.

Cattle

Barrier, A.C. Ruelle, E., Haskell, M.J. *et al.* (2012) Effect of a difficult calving on the vigour of the calf, the onset of maternal behaviour, and some behavioural indicators of pain in the dam, *Preventive Veterinary Medicine*, **103**(4): 247-304.

Boichard, D. & Brochard, M. (2012) New phenotypes for new breeding goals in dairy cattle, *animal*, **6**(4): 544-550.

Burton, R.J.F., Peoples, S. & Cooper, M.H. (In press) Building 'cowshed cultures': A cultural perspective on the promotion of stockmanship and animal welfare on dairy farms, *Journal of Rural Studies*.

Elbakidze, L. & Nayga, R.M. (2012) The effects of information on willingness to pay for animal welfare in dairy production: Application of nonhypothetical valuation mechanisms, *Journal of Dairy Science*, **95**(3): 1099-1107.

Fogsgaard, K.K., Røntved, C.M., Sørensen, P. *et al.* (2012) Sickness behaviour in dairy cows during *Escherichia coli* mastitis, *Journal of Dairy Science*, **95**(2): 630-638.

Johnston, D.J., Tier B. & Graser H.-U. (2012) Beef cattle breeding in Australia with genomics: opportunities and needs, *Animal Production Science*, **52**(3): 100-106.

Kilgour, R.J., Uetake, K., Ishiwata, T. *et al.* (In press) The behaviour of beef cattle at pasture, *Applied Animal Behaviour Science*.

Parola, F., Hillmann, E., Schütz, K.E. *et al.* (2012) Preferences for overhead sprinklers by naïve beef steers: Test of two nozzle types, *Applied Animal Behaviour Science*, **137**(1-2): 13-22.

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Schütz, K.E., Hawke, M., Waas, J.R. *et al.* (2012) Effects of human handling during early rearing on the behaviour of dairy calves, *Animal Welfare*, **21**: 19-26.

Swan, A.A., Johnston, D.J., Brown, D.J. *et al.* (2011) Integration of genomic information into beef cattle and sheep genetic evaluations in Australia, *Animal Production Science*, **52**(3): 126-132.

Vasseur, E., Pellerin, D., de Passille, A.M. *et al.* (2012) Assessing the welfare of dairy calves: outcome-based measures of calf health versus input-based measures of the use of risky management practices, *Animal Welfare*, **21**: 77-86.

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Pigs

Andersson, K., Brunius, C., Zamaratskaia, G. *et al.* (2012) Early vaccination with Improvac®: effects on performance and behaviour of male pigs, *animal*, **6**(1): 87-95.

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

Fitzgerald, R.F., Stalder, K.J., Karriker, L.A. *et al.* (2012) The effect of hoof abnormalities on sow behavior and performance, *Livestock Science*, **145**(1-3): 230-238.

Imfeld-Mueller, S. & Hillmann, E. (2012) Anticipation of a food ball increases short-term activity levels in growing pigs, *Applied Animal Behaviour Science*, **137**(1-2): 23-29.

Kauppinen, T., Vesala, K.M. & Valros, A. (2012) Farmer attitude toward improvement of animal welfare is correlated with piglet production parameters, *Livestock Science*, **143**(2-3): 142-150.

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Poultry

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