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ANIMALS USED FOR SPORT, ENTERTAINMENT, RECREATION AND WORK

Environmental factors associated with success in Australian stock herding dogs

It is estimated that 25% of Australian dogs that are recruited to work with livestock on farms fail to graduate to become successful working dogs, which has a cost for the farmer in rearing these dogs, and also ethical and welfare considerations of the unsuccessful dogs being culled. It is thought that behavioural issues are the leading cause of dogs failing to perform adequately, and recent research has increasingly indicated that the learning and memory of dogs is influenced both by training techniques but also by other husbandry and management practices. This study was designed to investigate current practices used for working dogs on-farm in Australia and the characteristics of the farmers who handle and breed these dogs.

An online survey was made available and farmers using working dogs were invited to complete the survey. The survey consisted of 10 different sections examining different aspects of working dog handling, breeding and training as well as the farmer's personality and demographical information such as the size, location of the property and the number of livestock held. 812 herding dog owners responded to the survey providing information on about 4,027 working dogs. It was found that there were seven significant associations between the success rate that farmers had with their dogs and the variables assessed. The variables that were related to the dog were: the breed of dog (cattle dogs had a lower success rate), the method

used for housing the dog (dogs housed in groups or pens had a higher success rate than those that were chained), whether the dog had been involved in dog trials (increased success in dogs that had been used in trials), and the age that the dog was first owned by the farmer (those first obtained under 6 months of age had a better chance of success). The variables related to the owner were: the use of an electric shock collar during training (lower success rate if used), the amount of money the farmer was prepared to spend if the dog was injured or ill (higher chance of success if the farmer was prepared to spend more) and the owner personality (a high level of conscientiousness of the farmer was associated with an increased success rate).

The study shows that many different factors can influence the chances of a dog graduating successfully as a working dog and emphasises the impact that handling skills and management of the dog during training, as well as the farmers personality and the way they interact with their dog to create a positive human-canine bond, can have on its eventual success as a working dog on-farm.

Arnott ER, Early JB, Wade CM *et al* (2014) Environmental factors associated with success rates of Australian stock herding dogs. *Plos One* 9(8):e104457.



Canine performance science: Offering a sustainable future for working dogs

Working and sporting dogs provide major contributions worldwide. The process of producing working dogs generally involves breeding (including genetic selection), puppy rearing, recruitment and assessment, training, housing and handling, handler education, health and working life end-point management. At present, inefficiencies throughout the process result in a high failure rate of dogs attaining operational status. Although limited, available data suggests that success rates generally average 50% across working dog industry sectors. This level of wastage would be condemned in other animal production industries for economic reasons and has significant implications for dog welfare, as well as public perceptions of these industries.

Standards of acceptable animal use are changing and some historically common uses of animals are no longer publicly acceptable, especially where harm is caused for purposes deemed trivial, or where

alternatives exist. Growing awareness has led to rising public expectations and lower levels of tolerance for conditions perceived as inadequate. Public scrutiny of animal use appears likely to increase and extend to all roles of animals, including working and sporting dogs. Transparency, traceability and ethically acceptable processes are critical as are evidence-based approaches which already inform best practice in fields as diverse as agriculture and human athletic performance.

This article introduces the discipline of canine performance science and discusses how this model can improve dog welfare and working dog efficiencies, such as learning and performance outcomes.

Cobb M, Branson N, McGreevy P *et al* (2014) The advent of canine performance science: Offering a sustainable future for working dogs. *Behavioural Processes* 110:96–104.

Effect of season and track condition on injury rate in racing greyhounds

Injuries sustained by greyhounds during racing are a welfare concern and are thought to be, at least in part, due to the design and management of the racetrack. Changes to the racetrack therefore may be effective in reducing injury rate to greyhounds and so research investigating which factors are likely to have the most effect on the welfare of the dogs are important.

This study examined the effect of the track on greyhounds at two different racecourses in the United Kingdom by collecting data over a number of years. Data from Track A were collected from 2002–2006 and the number of injuries the greyhounds sustained was recorded. Data obtained from Track B were collected between 2003–2006 and the injury rate of these dogs was calculated. In addition, at this track, the month of the year that the track was used for racing, the environmental temperature during the races and the track condition (the 'going', which is a partially objective indication of track condition expressed as how fast or slow the track is due to its condition on the day) was also recorded and the data analysed. It was found that the number of injuries at Track A, when compared with previous studies, was lower on this sanded track than on the grass tracks. The month of year that the races were run, or the environmental temperature had no effect on injury rate at Track B, however, it was found that injury rate of the dogs increased as the 'going' became faster.

The results of this study suggest that changes in track maintenance, such as using sand instead of grass and keeping the track condition slower, may reduce injury rate in these dogs with the consequential increase in their welfare.

Iddon J, Lockyer RH, Freen SP (2014) The effect of season and track condition on injury rate in racing greyhounds. *Journal of Small Animal Practice* 55:399–404.



COMPANION ANIMALS

People's perceptions of shelter cats and how it affects adoption time

In many areas of the United States, the number of cats entering an animal shelter is greater than those leaving, meaning that a large number are euthanased. The behaviour of the cat in the shelter and its adoption time have a significant effect on its welfare, as an increase in time in the stressful environment of the shelter makes cats more susceptible to developing disease or being euthanased, and decreases the chances that the animals will be adopted to new homes.

This study looked at the factors that might influence adoption times for cats in shelters, and if differences exist between those cats surrendered by owners and those cats found as strays. In a first study, data of 1,089 cats (422 owner surrendered, 667 stray) that were under 12 months of age that entered a shelter in Nebraska in the United States was analysed to determine time to adoption. A second study was then performed on 56 cats entering the shelter (25 owner surrendered, 31 stray) examining the amount of time that each cat took to approach a mock adopter within an enclosure in the shelter. A third study using a survey then obtained information from 150 university students about their demographics as well as their experience with pets and opinions on images of stray and owner-surrendered cats. The first study showed that owner-surrendered cats were adopted in significantly less time than stray cats. The second study showed that stray cats took longer to approach a mock adopter than owner-surrendered cats, which influenced the number of days for the cat to be adopted (longer approach time, the longer time to adoption). The third study showed that the reason that the university students were most likely to adopt a cat is if 'it behaved friendly towards them'.



The three studies indicate that owner-surrendered cats have an advantage over stray cats in being considered as most suitable for adoption and being adopted more quickly. The cat's behaviour towards humans is important in affecting its potential for adoption from the shelter, as measured by approach time, and the results indicate that people may have negative associations with 'stray' cats that influence their decisions when adopting a cat from a shelter. The authors suggest that adding toys to shelter enclosures to encourage social interactions or renaming stray cats as 'lost' may give a number of cats a better opportunity for adoption.

Dybdall K, Strasser R (2014) Is there a bias against stray cats in shelters? People's perception of shelter cats and how it influences adoption time. *Anthrozoös* 27(4):603–614.

What factors do people consider when acquiring a dog?

Nearly half (47%) of households in the United States own at least one dog, but only 20% of these dogs were obtained at animal welfare organisations. Approximately 31% of the 3.9 million dogs that enter shelters each year are euthanased, and only 1.2 million adopted out. Previous studies have shown that more than half of people who are considering acquiring a dog report that they would obtain the animal from a shelter, but only around 20% actually do.

This study used an online survey to obtain information about 1,009 people in the United States who had recently acquired a dog, or were considering acquiring one in the next year and explored factors that influence the choices that people make in that decision. It was found that almost half of respondents (48%) stated that the availability of the animal at an animal shelter was extremely or very important, and only 15% stated that availability was not very or

at all important. 40% of people reported that they would drive more than 60 miles to get to dogs of their preference. The survey also indicated that people had a complex set of requirements when looking for a new dog, and the particular features that are important to each person, varied widely between different people. People therefore sought variety when visiting a shelter searching for the dog that was right for them.

This study has positive implications for dog relocation programs, in which dogs are moved between shelters with the hope of providing more variety for people visiting the shelters. If a greater variety of dogs are available at different shelters, it is more likely that a potential owner visiting a shelter will find a dog that

fits his or her requirements. The use of strategies such as relocation programs has the potential to increase the number of dogs adopted in shelters in providing potential adopters with a 'variety' of dogs, rather than simply those dogs typically thought of as 'in demand' and could significantly increase the number of lives saved.

Garrison L, Weiss E (2015) What do people want? Factors people consider when acquiring dogs, the complexity of the choices they make, and implications for nonhuman animal relocation programs. *Journal of Applied Animal Welfare Science* **18**:57–73.

Animal hoarding in NSW

Hoarding of animals is an animal welfare and public health issue that is reported to occur throughout Australia. The Hoarding of Animals Research Consortium (HARC) defines animal hoarding using a number of criteria including: 1) having more than the typical number of companion animals, 2) failing to provide appropriate standards of nutrition, sanitation, shelter, and veterinary care, often resulting in animal illness and death from starvation, spread of infectious disease and untreated injury or medical condition, 3) denial of the inability to provide appropriate care and the effect of that failure on the animals, the household and human occupants of the dwelling and 4) persistence, despite this failure, in accumulating animals. This paper highlights the characteristics of persons convicted for offences related to animal hoarding in New South Wales (NSW), documents the outcomes of cases and compares them with overseas studies.

Records of finalised prosecutions for offences relating to animal hoarding between 2005 and 2011 were examined involving 29 persons. Data recorded included: the age of each subject at the first offence, sex, postcode, occupation, living conditions, number of charges and prosecutions, number and species of live animals, whether animals needed veterinary attention, the medical conditions that the animals suffered, whether dead animals were

on the property, how animals were obtained, veterinary and legal costs accrued and case outcomes. The majority of hoarders were female (72.4%) and 23 were 40–64 years of age at their first offence. Almost one-third identified themselves as breeders, eight as pensioners and four as unemployed. Most resided in inner regional Australia (45%), 28% lived in major cities and 28% lived in outer regional Australia. Dogs were the species hoarded in 80% of cases. Animals requiring veterinary attention were identified in all cases. Dead animals were found on premises in 41.4% of cases.

Persons prosecuted for charges relating to animal hoarding in NSW have similar characteristics to those of previous studies, although the outcomes may be different. More farm animals and horses were hoarded in NSW and hoarders in NSW were more likely to live in inner regional and outer regional areas (rural areas) than animal hoarders in the USA. Further studies are needed to permit further insights into animal hoarders to enable earlier detection of animal hoarding and therefore earlier, more effective and potentially less costly intervention.

Joffe M, O'Shannessy D, Dhand NK *et al* (2014) Characteristics of persons convicted for offences relating to animal hoarding in New South Wales. *Australian Veterinary Journal* **92**(10):369–375.

The factors that affect the length of life of cats attending veterinary practices in England

There are between 8.5–10.3 million cats kept as pets in the United Kingdom (UK), with between 19–26% of households owning at least one cat. A greater understanding of what affects the lifespan of cats and the reason that cats die would therefore have a significant effect on breeding, husbandry and clinical strategies that will help improve the health and welfare of these cats. This study aimed to assess this by accessing the VetCompass database, a database used by veterinary practices in the UK, which holds detailed records of the clinical health of companion animals in the UK.

The records of 4,009 cats that had been confirmed as dead by veterinary practices were obtained from the VetCompass database for further analysis. It was found that, in cats dying at an age of less than 5 years, almost half (47%) was as a result of trauma, with the majority of these being as a result of a road traffic accident. In cats over 5 years of age, the percentage of cats dying as a result of trauma decreased to 5%. The most common causes for death in cats over 5 years of age were renal (kidney) disorders (13.6%), non-specific illness (12.6%) and mass lesion disorder (11.6%). The average age that a cat lived was 14 years, and crossbred cats lived longer than purebred cats but individual breeds of cat varied in the length of life. In cats that died age 5 years or older, those cats that were a crossbreed, had a lower bodyweight and were neutered lived longer lives.

The results of this study can be used to help guide breeding and research strategies. An increased understanding of the causes of death in cats can help to direct improved management strategies and clinical techniques to improve the welfare of pet cats.

O'Neill DG, Church DB, McGreevy PD *et al* (2014) Longevity and mortality of cats attending primary care veterinary practices in England. *Journal of Feline Medicine and Surgery*. DOI:10.1177/1098612X14536176

Behaviour of adopted shelter kittens after desexing at a traditional or early age

Surgical gonadectomy (surgical desexing) is the most reliable method of contraception for cats. Traditionally, it is performed around 6 months of age or later, however, at this age, some cats will already be capable of producing litters. To prevent cats that are adopted from shelters having litters, surgical desexing before 6 months of age, or prepubertal gonadectomy (PPG), is encouraged in most shelters. PPG is usually performed between 6 and 16 weeks of age. Some concerns have been voiced in the past about the potential effects that PPG may have on kittens such as risks associated with anaesthesia and surgery, and the possible development of certain medical conditions such as obesity and urinary tract diseases, etc. Several studies have now established safe anaesthetic and surgical techniques for PPG and investigated physical development after early-age desexing without significant differences found between cats desexed at 7 weeks or 7 months. This study aimed to investigate the effect of age at desexing on the occurrence of undesirable behaviours during 24 months after adoption from a shelter.

800 healthy kittens recruited from animal shelters in Flanders, Belgium, were randomly assigned to a PPG group (desexed prepubertally) and a TAG group

(desexed between 6–8 months of age). A record of the cat's behaviour was then kept for 30 days following desexing and, if the cat had been adopted out, owners were asked to contribute to surveys at 2, 6, 12, 18 and 24 months after adoption that were designed to obtain information about the behaviour of the cat following gonadectomy. No difference was found in the occurrence of potentially undesirable behaviours or the occurrence of commonly reported undesirable behaviours such as non-play-related aggression, inappropriate elimination, fearfulness and destruction. Associations between undesirable behaviours and other social and environmental factors such as the use of punishment by the owner and the cat's relationship with the owner were identified.

This prospective study indicates that PPG has no detrimental effect on the behaviour of the cat either in the short or long term and hence PPG is recommended as a method of desexing for shelter cats.

Porters N, de Rooster H, Verschueren K *et al* (2014) Development of behaviour in adopted shelter kittens after gonadectomy performed at an early age or at a traditional age. *Journal of Veterinary Behavior* 9:196–206.

FARM ANIMALS

Physiological, behavioural and vocal indicators of emotions in goats

Emotions are important for an animal as they allow an individual to make appropriate behavioural decisions depending on what is happening around them. Techniques for understanding and assessing emotions in animals, in particular those examining positive emotions, are still being developed. Emotions can be said to have two dimensions: their arousal (bodily excitation) and their valence (negative or positive), and these two dimensions affect emotions in different ways.



This study examined the reactions of 22 goats (between 3 and 17 years of age) kept at a goat sanctuary in the United Kingdom to various stimuli lasting less than 5 minutes which were: 1) a control stimulus (no stimulus), 2) anticipation of a food reward (positive), 3) food-related frustration (negative) and 4) isolation from the herd (negative). Behavioural data was collected and the goat's heart rate was monitored using a heart rate monitor that was attached around its chest. It was found that, when goats are aroused, they had higher respiration rates and lower heart rate variability and displayed more head movements, moved around more, had their ears pointed forward more often and on the side (horizontal) less often, and made more calls. In positive situations, goats had their ears pointed backwards less often and spent more time with their tail up than in negative situations. Therefore, physiological and behavioural as well as vocal indicators of arousal can be observed in goats.

Arousal indicators (how excited the goat was) could be used to help identify and therefore minimise stress during negative situations and valence (whether the emotion was positive or negative) could be used to help differentiate between negative and positive situations. The authors suggest that research such as this can be used to increase knowledge and understanding of animal emotions including through cross-species comparisons.

Briefer EF, Tettamanti F, McElligott AG (2015) Emotions in goats: mapping physiological, behavioural and vocal profiles. *Animal Behaviour* **99**:131–143.

Effectiveness of a non-penetrating captive bolt for euthanasia of small pigs

The transition for piglets from suckling from the sow to weaning is a stressful time and during this time, the weaker, injured or diseased pigs are at a higher risk of mortality. Euthanasia of the weaker weaner pigs is often performed to improve group welfare and improve profits for the farmer. Physical methods of euthanasia, such as blunt force trauma, are most practical, but piglet weights reach around

13kg by 7 weeks of age, making euthanasia during the weaning period using this method, difficult and not recommended due to the potential to be inhumane. Captive bolt guns provide a mechanical approach to euthanasia, and so do not depend solely on stockperson strength. Recently a non-penetrating captive bolt Zephyr-E gun was found to be highly effective for the euthanasia of very small neonatal pigs.

This study aimed to assess the effectiveness of this gun for the slightly larger suckling and weaner pigs.

150 low-viability pigs between 3–9kgs in weight from four commercial piggery units and two research stations in Canada were used in this study. Fifteen different stockpersons were responsible for using the Zephyr-E gun for euthanasia of the pigs. Brainstem reflexes, convulsions and heartbeat were measured and used to assess insensibility, time of brain death and cardiac arrest following the use of the captive bolt gun.



It was found that the Zephyr-E gun consistently provided a humane death for pigs between 3–9kgs, causing immediate insensibility in 98.6% of pigs from which they did not recover. Two piglets did show signs of recovery and required a repeat application of the gun. It is thought that the partial recovery of these two piglets may be attributed to operator error, and emphasises the importance of correct training. Following the use of the Zephyr-E on pigs, convulsions ceased in 82 seconds, brain death was achieved in 145 seconds and cardiac arrest occurred in 227 seconds.

The results of the study indicate that the Zephyr-E can be used as a reliable and humane single-step euthanasia for pigs of 3–9kgs.

Casey-Trott TM, Millman ST, Turner PV *et al* (2014) Effectiveness of a nonpenetrating captive bolt for euthanasia of 3kg to 9kg pigs. *Journal of Animal Science* 92:5166–5174.

The effects of environmental enrichment on feather picking in commercially housed Pekin ducks

Feathers obtained from ducks are used to provide down for such items as pillows, blankets and clothing. Considerable losses in production occur each year due to feather picking of ducks together with a reduction in their health and an increase in mortality. Ducks tend to preen their feathers throughout their lives, but increase this behaviour between days 17–22, when the feathers change from down to adult plumage. Injurious feather picking is sometimes performed by commercially held ducks and is a self-mutilation behaviour. This differs from feather pecking in the layer hen industry as the duck directs this behaviour at itself, instead of at others. Self picking can draw blood which can then lead to surrounding birds pecking at the wound, causing feather damage and increasing the potential for disease. It is unknown what causes feather picking to occur, although it is thought that a lack of environmental enrichment may have an effect.

This study was performed in the United States and firstly aimed to determine if the addition of environmental enrichment in the form of a perforated, light-weight ball threaded with 4 zip ties: 1) would have a positive effect on the behaviour of the birds, 2) would affect the body scores of the ducks either provided with enrichment or not and to determine 3) if the colour of the enrichment would affect the interaction that the birds had with it. Five sheds of commercially raised Pekin ducks were divided into two pens each holding approximately 4,500 ducks (one control pen and one with enrichment added) and both pens were videotaped for 2h per day and the physical characteristics of the birds scored at age 7, 21, 28 and 35 days of age.

It was found that the addition of the enrichment caused a decrease in both self-picking and picking at others and by day 21 of the study, those ducks provided with enrichment had cleaner feathers of a better quality than the control ducks. The ducks were also found to interact more enthusiastically with the ball if it was of a blue/green colour then if it was red or white. The study suggests that the addition of this type of enrichment into commercial duck barns may lead to improved welfare and production in the duck industry.

Colton S, Fraley GS (2014) The effects of environmental enrichment devices on feather picking in commercially housed Pekin ducks. *Poultry Science* 93:2143–2150.



Could animal production become a profession?

During the mid-1900s, economically developed countries underwent a change from smaller outdoor farms to widespread intensification of animal production. There was a shift towards fewer but larger farms, the use of confinement for species such as pigs, poultry and grain-fed cattle, and the use of automation to replace labour for routine tasks. In industrialised countries, these changes were perceived to be similar to the instance of industrialisation. As occurred during the industrial revolution, when a program of legislation on standards for workers in factories were introduced, intensive animal production has led, in a similar way, to a structure of legislation being devised around the confinement of animals to maintain their welfare in intensive settings. The author of this paper argues that, in fact, important differences are apparent between industrialisation and intensification. Basic welfare outcomes, such as lameness, injuries and survival rates differ between farms, even though the farmers are meeting the same legislative standards.

This variation is suggested to occur because animal welfare is influenced by many aspects of animal management including hygiene, nutrition and handling, all of which are dependent on the skill and competence of the stockpersons. Hence valuing and encouraging these qualities in people is an important avenue for improving animal welfare.



The author suggests that the new role of the producer may be described as 'professional' as it encompasses three required elements: 1) provision of a service that people need, 2) competence in a specialised area of skill and knowledge and 3) the creation of public trust by respecting the interests and ethical expectations of society, normally through self regulation. The author suggests that making a professional model of animal production is more feasible than in the past, and the growing need for food is likely to emphasise animal production as an important service. Certification of farms, if self regulated by industry, could provide a means of ensuring competence and adherence to standards, and could provide an alternate means for animal producers to establish public trust.

Fraser D (2014) Could animal production become a profession? *Livestock Science* **169**:155–162.

Do shoulder ulcers in sows affect their behaviour?

Shoulder ulcers are pressure sores that are commonly found on the shoulder of sows kept in farrowing crates and have been shown to be present in 10–34% of lactating sows. Pressure sores in humans are known to cause pain and discomfort and patients mention that one way to relieve the pain is to make postural changes. At the present time, there is only limited data available examining how these ulcers affect the behaviour of sows.

This Danish study performed on-farm compared the behaviour of sows having shoulder ulcers (n=19) with healthy sows (n=19) over a 24-hour period approximately 2 weeks after the sows had given birth to their litters. Upon examination of the video recordings, it was found that the sows that had ulcers had a higher level of activity and spent more time making postural changes, with less time resting than the healthy sows. The sows with the ulcers also showed increased rubbing of the shoulder regions against the farrowing crates. These behaviours are thought to indicate restlessness in the sows and motivational conflict, which is an indicator of persistent pain in mammals. Changes in the maternal behaviour of the sows with the ulcers were also found, and although sows are extremely motivated to perform maternal behaviour, the nursing frequency was found to be lower in the sows with ulcers than those without, suggesting that the presence of ulcers prevents the sow from performing nursing behaviour at the frequency that she would like. The study also showed that ulcers were still present on the sows two weeks following farrowing.

This research suggests that lactating sows may be experiencing motivational conflict between wishing to perform nursing behaviour and their motivation to relieve the pain caused by the ulcers, indicating that the presence of shoulder ulcers may be a welfare issue for both lactating sows and their piglets.

Larsen T, Kaiser M, Herskin MS (2015) Does the presence of shoulder ulcers affect the behaviour of sows? *Research in Veterinary Science* **98**:19–24.

The effect of post-weaning handling strategies on lamb welfare and productivity

Weaning can be very stressful for lambs as it involves a change in both the young animal's nutrition, where milk is replaced by solid food, and changes in the relationship that the lamb has with its mother. In the natural environment, weaning generally occurs gradually, but weaning is a more sudden practice in the commercial environment, where the lamb is abruptly separated from the mother. Management practices that can make this process less stressful for the lamb can improve its health and increase weight gain, and a number of approaches have been attempted to reduce stress in lambs during weaning. As sheep are a herd animal by nature, when lambs are removed from the dam prematurely, they may try to compensate by interacting with other social stimuli such as other animals or people. This study examined the use of different social stimuli for lambs at weaning and the effect that it had on stress and weight gain.

The study was performed in Zaragoza in Spain using 36 lambs (18 male and 18 female). Following the completion of the milking period for these lambs (at day 30 of life), they were separated from their mothers for the subsequent fattening period (another 30 days) and were placed in one of three experimental groups: 1) control group where the lambs had minimal contact with stockpeople or other adult animals during fattening, 2) fattening with gentle human contact including stroking and talking to the lambs for an hour each day and 3) fattening in the presence of two adult dry ewes, but minimal contact with the stockpeople. Blood samples were also taken and infrared thermography was also used to estimate stress in the lambs in each group.



It was found that the group of lambs that were provided with daily gentle human contact grew faster than those in the other two experimental groups, suggesting that this form of contact during the post-weaning phase may reduce stress. Those lambs housed with the ewes showed better growth than those in the control group. Those lambs in the control group also showed significantly different results in terms of the measured physiological parameters used to indicate stress levels, suggesting that this method of fattening with limited social contact increased stress levels in the lambs. The study indicates that providing social enrichment at weaning, especially that using a positive human-animal bond, is beneficial for reducing stress in lambs and also has positive effects on productivity.

Pascual-Alonso M, Miranda-de la Lama GC, Aguayo-Ulloa L *et al* (2014) Effect of postweaning handling strategies on welfare and productive traits in lambs. *Journal of Applied Animal Welfare Science* 18(1):42–56.

The ethics of using a co-regulatory model for farm animal welfare research

Farm animal welfare is governed around the world using three major models, the regulatory model (typically used in the European Union), consumer-driven model (typically used in the USA) or a model using co-regulation between the livestock industries and the government (used in Australia). This paper investigates the validity of research performed in Australia (i.e. under the co-regulatory model) that has been sponsored, at least partially, with funding from industry. The paper outlines two examples involving the transport of livestock where the conclusions of research could be questioned. Transport is a contentious animal welfare issue in Australia because animals are transported over long distances within the country and overseas.

The first example that the authors present describes research performed to determine adequate stocking density for livestock on long distance ship journeys. The authors argue that, as a result of industry being involved in the research program, unjustified conclusions may have been drawn from the performance of the research, and the conclusions used to defend the current regulatory requirements for stocking density for livestock on-board ships. The second example examines research performed to determine the maximum time off feed for bobby calves over 5 days of age. In this case, the results of the research concluded that 30h with good practice in other aspects of calf management and transport was defensible as a legal limit for the time off feed for these young calves.

The authors of this paper argue that in this second case, the results of the performed research were represented in a manner that was misleading, so as to reach a desired result from the research which was subsequently incorporated into legislation.

The authors of this paper state that the co-regulatory model for the management of animal welfare research appears to have limitations, and researchers may be under pressure to draw invalid conclusions as they may be reliant on continued funding to pursue their work, or, alternatively, they may wish to support the interests of the producers, rather than the animals. Industry can also influence experimental design and reporting through staff who are involved with the research. In addition, management of the co-regulatory model is usually situated within agricultural departments nationally, whose role it is to support agriculture. The authors state that particular risks occur if scientists are dependent on industry funding to evaluate industry-led standards.

Phillips CJC, Petherick JC (2014) The ethics of a co-regulatory model for farm animal welfare research. *Journal of Agricultural and Environmental Ethics* DOI:10.1007/s10806-014-9524-9

The landing behaviour of laying hens on different perch designs

Within the European Union, the installation of perches into all types of hen houses is now compulsory. While perches allow birds to express more of their natural behaviours, they are also associated with a higher incidence of fractures and deformities to the keel bone (an extension of the breast bone). Incidences of keel bone damage have been reported in 73% of hens in aviaries and another study found deformities in 33% of hens in furnished cages, 97% in aviary systems and 55% of aviary and floor pen systems, therefore indicating a significant welfare concern. It is thought that the damage to the keel bone occurs when the bird collides with perches, or with other solid objects or by extended perching periods. The design of the perch has a significant effect on the injuries sustained and this study aims to determine keel injuries in three strains of birds (Lohmann Selected Leghorn (LSL), Lohmann Traditional (LT) and Lohmann Brown (LB)). The three different strains were examined as there is a difference in body weight between the light white shell layers (LSL) and medium heavy brown shell layers (LT and LB).



20 laying hens of each of the three strain types were used in this study conducted in Germany. Each of the different strains of birds were placed in separate experimental rooms and during the six weeks prior to the performance of the experiment, the birds were trained to jump from a start perch onto another destination perch for a food reward. During the experimental phase, the birds were asked to jump between the perches from heights of 25cm, 50cm and 60cm where the horizontal distance between perches was 75cm. The destination perch in each case was either one of three steel perches of varying diameters, a commercially available mushroom shaped plastic perch or a newly developed prototype perch with a soft surface material

It was found that the optimum height for jumps to the destination perch in order to minimise risk of unsafe or failed landings was 50cm (with a slope of 34° between jumps) and above this height, the number of safe landings decreased. The largest number of safe landings occurred when the birds jumped onto the prototype perch with soft surface material, and the least safe landings occurred onto the steel perches. The commercially available mushroom shaped plastic perch was intermediate between these two. The heavier strains of birds (LT and LB) had a lower proportion of safe landings than the lighter strain (LSL) indicating that the heavier birds may have had more difficulty negotiating the jumps than the lighter ones. With the common use of steel perches in commercial laying systems today, there is clear room for improvement in perch design for the welfare of laying hens.

Scholz B, Kjaer JB, Schrader L (2014) Analysis of landing behaviour of three layer lines on different perch designs. *British Poultry Science* 55(4):419–426.

Effectiveness of meloxicam for reducing pain in lambs

The castration and tail docking of lambs are two commonly performed management procedures which are known to inflict pain that may last more than 24 hours following the procedure. For this reason, the potential use of non-steroidal anti-inflammatory drugs to reduce pain has been recognised, but for these to be of use in the commercial environment, they need to be easy to apply, non-expensive, effective upon application, and practical to use in a setting holding a large number of lambs.

This study, which was performed in Armidale in Australia used 60 lambs, aged 7–10 weeks which were allocated to receive either a placebo or 1 mg/kg meloxicam at 10mg/mL (a non-steroidal anti-inflammatory drug) which was administered into the mouth of the lambs immediately before knife castration followed by tail docking. Lambs were then released into a grassy paddock and observed for the next 8 hours and then for another 45 minutes at 24 hours following the procedures. Lambs were weighed and their wounds observed on days 4 and 7 following the procedure.

It was found that the administration of meloxicam led to a 7-fold reduction in behaviours indicative of pain (hunched or stretched posture or walking stiffly) and this group also spent more time grazing, suckling and lying in normal postures than did the control groups. Some behavioural evidence that the group that had received meloxicam were experiencing less pain was still evident 24 hours later. Meloxicam had no effect on the willingness of the lambs to follow their mothers into the paddock and there was no effect of meloxicam on weight change.

The study suggests that, at least under these conditions, the oral administration of meloxicam can be successfully used to reduce pain in lambs following castration and tail docking and the analgesic effects can still be seen 24 hours following the procedure.

Small AH, Belson S, Holm M *et al* (2014) Efficacy of a buccal meloxicam formulation for pain relief in Merino lambs undergoing knife castration and tail docking in a randomised field trial. *Australian Veterinary Journal* **92**(10): 81–388.

Methods for killing poultry on-farm

Small numbers of poultry may need to be killed on-farm to euthanase sick or injured birds, for disease control or for sale of animals from the farm. Poultry are usually killed on-farm using the method of cervical dislocation, a technique that should sever the vertebral column and rupture essential blood vessels that supply the brain, killing the bird quickly. This technique is commonly used as it requires no equipment, and is easy to learn. However, some government and non-government organisations have voiced reservations about the humaneness of this technique. This paper therefore reviews other techniques that are currently available to kill poultry on-farm (without prior stunning) and discusses the advantages and disadvantages of each technique.

Techniques discussed are manual and mechanical cervical dislocation, crushing methods (such as burdizzos or pliers), percussive devices, blunt force trauma and a brain-stem piercing device. The authors review each technique in detail and provide available evidence of the humaneness of each technique. They then present a table which lists the techniques discussed in the paper and provides scores for ease of use of each technique, effort required to use the

technique (e.g. the strength or skill of the operator), the accuracy that can be expected to be obtained by each individual technique, a score depicting the expected effect on the welfare of the animal based on rapid loss of brain function and death and an overall score for each technique.

The authors suggest that, from the available evidence, there may be some concern that cervical dislocation, despite being the simplest method, may be inhumane due to the time taken to reach insensibility. However data on this is lacking and the authors suggest that more research should be performed examining this technique to ensure that it is actually within acceptable standards that ensure animal welfare.

Sparrey J, Sandercock DA, Sparks NHC *et al* (2014) Current and novel methods for killing poultry individually on-farm. *World's Poultry Science Journal* **70**:737–758.

The effects of growth-promoting technology on feedlot cattle behaviour

Growth promoting technologies in the beef cattle industry include the use of antibiotics (to prevent and treat illness), ionophores (to reduce sub-acute ruminal acidosis), steroid implants (to increase daily gain and feed efficiency) and β_2 -adrenergic agonists (fed in the latter stages of the finishing period to increase weight gain and maximise lean muscle growth). Decisions about the use of growth promoting technologies are additive and feedlots usually start with the most common, such as ionophores and steroid implants and then make decisions about adding β_2 -adrenergic agonists later on. Growth promoting technologies however, can affect other aspects of biological function some of which may affect the welfare of the animal. Feedlot managers have anecdotally reported an increase in lateral lying behaviour of cattle when β_2 -adrenergic agonists have been fed in the month before slaughter. This study aimed to examine this in greater detail and to quantify the effects that β_2 -adrenergic agonists have on the cattle.

This study was performed in California in the United States and involved 160 Angus crossbred steers which were allocated to 1 of 16 pens, with 10 animals per pen. All cattle were assigned to either: 1) a control treatment with no feed additive or hormones, 2) monensin (an antibiotic), 3) monensin, together with trenbolone acetate and estradiol (or IMP — steroids used for growth) or 4) IMP and a β_2 -adrenergic agonist (which was fed according to the commercial requirements to be fed for the last 20 days before slaughter, allowing for a 3-day withholding period).

It was found that the β_2 -adrenergic agonist affected the lying behaviour in cattle when fed as part of a suite of growth promoting technologies and increased the amount of lateral lying behaviour that these cattle performed by 31%. In addition, the β_2 -adrenergic agonist was also found to increase the amount of aggressive behaviour that the cattle showed in the days before slaughter when compared to the control group or those treated only with monensin. The study indicated that the use of IMP and β_2 -adrenergic agonists affected both aggressive and lying behaviour, which may be undesirable behaviours both from an animal welfare and animal management perspective.

Stackhouse-Lawson KR, Tucker CB, Calvo-Lorenzo MS *et al* (2015) Effects of growth-promoting technology on feedlot cattle behaviour in the 21 days before slaughter. *Applied Animal Behaviour Science* **162**:1–8.

The effect of adding jute sacks to the enclosures of intensively reared gilts

Tail biting is a common problem in intensively reared pigs, and can cause detrimental effects to the welfare of the pigs and a decrease in productivity. The reasons that tail biting occurs is complex and cannot be attributed to a single cause. Materials such as straw and compost have been shown to be effective in reducing this type of behaviour, but due to the requirements for additional labour, increased difficulties in maintaining hygiene and the cost involved, the majority of pig producers do not use these materials. Other items such as metal chains may be used to meet requirements for enrichment for pigs, however, they may not be effective on a long-term basis.

This study performed in The Netherlands assessed the effectiveness of using jute sacks to reduce tail biting behaviours in gilts and its relation to production. Jute sacks were chosen as they are chewable, easy to handle and inexpensive. Piglets raised from 72 litters were firstly kept in farrowing pens with or without a vertically hung jute sack, and then, following weaning, the female piglets, or gilts (n=346) were observed for the rest of the study and remained in the same treatment group, with or without a jute sack.

The behaviours of the gilts, as well as the tail, ear, and sow damage was recorded along with production characteristics.

It was found that addition of jute sacks significantly reduced (up to 50%) all types of biting behaviours (ear, tail and sow) directed at the pen mates of gilts, and at all times, damage from tail biting was lower in the gilts housed with the jute bags. The jute bags remained attractive to the gilts throughout the experiment. The study also showed that those pigs that had litters that were heavier and larger displayed more biting behaviour towards pen mates, suggesting some effects of litter size and pig weight on damaging biting behaviour. However, the study does suggest that the use of jute bags may, at least partly, meet the behavioural needs of pigs for rooting and chewing and can dramatically reduce the occurrence of damaging behaviours in rearing gilts.

Ursinus WW, Wijnen HJ, Bartels AC *et al* (2014) Damaging biting behaviours in intensively kept rearing gilts: The effect of jute sacks and relations with production characteristics. *Journal of Animal Science* **92**:5193–5202.

WILD ANIMALS

The conflict over the European rabbit in the Iberian Peninsula

Biodiversity conflicts arise when the interests of two or more parties compete over a resource, and when at least one of the parties is perceived to push to obtain what it wants, at the expense of another party and at the detriment of biodiversity. Typically, the more parties that are involved in these conflicts, the more complex they become. Solving these conflicts can be a big challenge for biodiversity conservation as the conflicts typically integrate ecological, social and economic aspects, and in many cases, one or many of these components remain poorly understood.

This paper outlines a case study in which a biodiversity conflict is occurring in the Iberian Peninsula between conservationists, hunters and farmers over the management of the European rabbit (*Oryctolagus cuniculus*). The authors discuss the reasons that have motivated the conflict, the various stakeholders involved and their roles in the conflict. They then review the ecological, economic and social factors that have generated the conflict and aim to determine those areas with knowledge gaps. They also provide suggestions for short-term management solutions that may reduce or result the conflict and suggest some directions for long-term solutions.

The authors suggest that a better understanding of the people involved in conflicts and the views that the different stakeholders hold, can help in the design of an appropriate management model to solve biodiversity conflicts, such as this presently occurring in the Iberian Peninsula.

Delibes-Mateos M, Ferreira C, Rouco C *et al* (2014) Conservationists, hunters and farmers: the European rabbit *Oryctolagus cuniculus* management conflict in the Iberian Peninsula. *Mammal Review* **44**:190–203.

Learning lessons from controlling the red fox on Phillip Island

Red foxes were introduced into Australia in the mid 1800s, but due to the negative impact they have on native animals, they have been the target of repeated attempts to reduce their numbers since the 1880s. However, foxes breed at a high rate and can travel long distances, making attempts to control population growth difficult. This paper outlines the attempts to control the red fox population on Phillip Island, an island off the coast of Victoria, Australia. Foxes have been living on Phillip Island since 1907 and have had a detrimental effect on the population of little penguins. The authors evaluate the fox control strategies that have been used over a period of 58 years on the island, and in light of the lessons learned along the way, describe those techniques that were successful, and those that were less successful. They also discuss the factors that can improve the success of pest-animal control campaigns.

The major lessons learned are: 1) the need to evaluate the effectiveness of the different methods available independently of personal and public bias, 2) the potential use of more than one control method to improve effectiveness, 3) the importance of targeting all individuals in a population, 4) a requirement for dedicated teams of people who are responsible for implementing the control program, 5) inclusion of



monitoring the effectiveness of the control program, 6) monitoring the success rate over time as this can change as the target species adapts, 7) developing effective methodologies to determine when an area is completely free of the target species and 8) ensuring that, once the species is eradicated, programs remain to ensure that the area is not again invaded by the target species.

Kirkwood R, Sunderland DR, Murphy S *et al* (2014) Lessons from long-term predator control: a case study with the red fox. *Wildlife Research* **41**:222–232.

The effects of a contraceptive vaccine on the movement and activity of free-living wild boar

In the United Kingdom, feral wild boar populations have become established after individual animals escaped from farms and, although populations are small at present, they have the potential to cause agricultural damage and transmission of disease to livestock and are a risk to public safety. Management strategies to control these boar have been considered, with one of these strategies being a non-lethal method of fertility control. The vaccine Gonacon™ inhibits reproductive activity by reducing the levels of gonadotrophin-releasing hormone (GnRH) in the female boar, thereby reducing reproduction. Contraceptive methods such as these also need to have no significant effects on physiology and behaviour (such as an increase in boar aggression) in order to be acceptable for use in a wild population.

This study evaluated the use of this contraceptive vaccine on a boar population in Hertfordshire, UK. Female boars were trapped over a 4-year period from 2006–2010, every 2 weeks between January and August each year. The boars were fitted with identification and half were injected intramuscularly with Gonacon™ (n=10), and the other half with saline solution (n=11). The boars were then fitted with units to monitor their movements and activities and released. Anti-GnRH levels were measured in six recaptured boars over the experimental period to assess the effectiveness of the vaccine.

It was found that the vaccine levels in those recaptured individuals varied, but four of the five boars that were resampled had antibodies high enough to block reproduction, and there was no evidence that the vaccine had adversely affected those females that were pregnant when receiving the vaccine. In addition, no difference was seen in movement and activity between the boars that had received the vaccine and those that hadn't. The study suggests that the use of a contraceptive vaccine could be effective in providing non-lethal population control, however, the authors suggest a larger number of animals are studied before drawing robust conclusions.

Quy RJ, Massei G, Lambert MS *et al* (2014) Effects of a GnRH vaccine on the movement and activity of free-living wild boar (*Sus scrofa*). *Wildlife Research* 41:185–193.

Long-term and large-scale control of the red fox in Australian forests

Introduced mammalian predators can have a negative effect on native animals, which may result in their reduced population growth and even extinction. Native animals may not possess the co-evolved adaptations needed to escape introduced predators and predators may also have a negative effect on population growth by causing stress in the prey animals. Management agencies commonly attempt to control introduced predators, however there is some uncertainty about the effectiveness of different techniques. Few long-term and large-scale programs have performed comparisons between the effectiveness of control techniques in an area in which control of predators has been implemented and similar areas in which control strategies have not been undertaken. This study aimed to do just that using the red fox as the predator species. The red fox was introduced into Australia in the mid 1800s and has been implicated as a primary cause of the extinction of a range of native mammal species in this country.

This study evaluates the effects of a 9-year control program, using baiting, on the abundance of the red fox and three of the prey species that were, at the start of the control program, initially in low abundance as a result of being killed and eaten by the fox. These were: 1) the southern brown bandicoot, 2) the long-

nosed potaroo and 3) the common brushtail possum. The study compared treatment with non-treatment areas in south-west Victoria, Australia, to determine if fox abundances have been affected by baiting and if the population control undertaken has resulted in an increase in the population of the three prey species.

It was found that the baiting of the red foxes had proved successful as there was a lower level of fox abundance in the treatment areas compared to the non-treatment areas. In addition, there was a higher abundance of all three prey species. The average occupancy rates in treatment areas compared to non-treatment areas were 15% greater for brushtail possums, 52% greater for southern brown bandicoots and 65% greater for long-nosed potaroos. This study showed that this control program had proved successful, but the authors suggest that caution is taken when planning a control program for the red fox as other factors such as prey food availability, habitat quality and other predators such as feral cats, may influence the effectiveness of the program.

Robley A, Gormley AM, Forsyth DM *et al* (2014) Long-term and large-scale control of the introduced red fox increases native mammal occupancy in Australian forests. *Biological Conservation* 180:262–269.

TRANSPORTATION OF ANIMALS

Wronging nonhuman animals in the Australian live export industry

Australia is the world's largest exporter of live animals and the export market is still growing. In 2012, approximately 620,000 cattle were exported for slaughter to Indonesia and over 2 million sheep were sent to the Middle East. Australia has stronger animal protection laws than many other countries in the world, however mistreatment of animals during export still occurs. The mistreatment of animals during live export was exposed to the world in 2011 as a result of footage taken by Animals Australia which showed Australian cattle being seriously mistreated in an Indonesian slaughter plant. This footage caused shock and outrage throughout the country and the Government was forced to reassess the treatment of animals during export for slaughter.

This paper provides a background to the use of animals in this trade, the development of animal welfare standards around the process and the potential problems that can occur with the animals at sea, when reaching the destination country, and at the foreign slaughter plant. The author examines the treatment of sheep and cattle during live export from a number of different established moralistic and ethical frameworks, and argues the continuation of this trade in light of the fact that Australia's neighbouring country New Zealand has not exported animals for slaughter for a number of years. The author argues that Australian regulations for animal protection are insufficient to safeguard the welfare of animals involved in live export and since the airing of the footage in 2011 showing severe animal mistreatment, the increased public concern for this practice suggests that societal values would now not approve of the continuation of exporting live animals for slaughter.

Coghlan S (2014) Australia and live animal export: Wronging nonhuman animals. *Journal of Animal Ethics* 4(2):45–60.

MISCELLANEOUS

How should the welfare of foetal and neurologically immature postnatal animals be protected?

The death of antenatal (prior to birth) animals is common in today's society. For example, the life of foetuses that are destined for use in scientific experiments will be terminated prior to birth, foetal animals may be killed when their mothers are sent to the meatworks for slaughter or foetuses may die during transport or when their mothers are subjected to other stressful circumstances. At the present time, many countries provide no legal protection for prenatal animals, and those that do, usually limit the protection to only covering the welfare of the animal after a certain stage of development.

This paper reviews the available evidence around how foetal and newborn animals can experience pain and perceive the world at different stages of development and whether current laws adequately provide for the protection of these animals. The authors discuss the evidence surrounding the ability of these young animals to suffer, and the likelihood that different animals which develop at different rates in the womb and hence have neurological levels of maturity, are conscious at different stages prior to birth. The authors

then approach the question of whether there are reasons unrelated to the suffering of the young animal prior to birth, which may affect the need to place restrictions around the treatment of foetuses, such as inflicting effects on the foetal animal which may not kill it, but which may affect the health or the welfare of the animal after its birth.

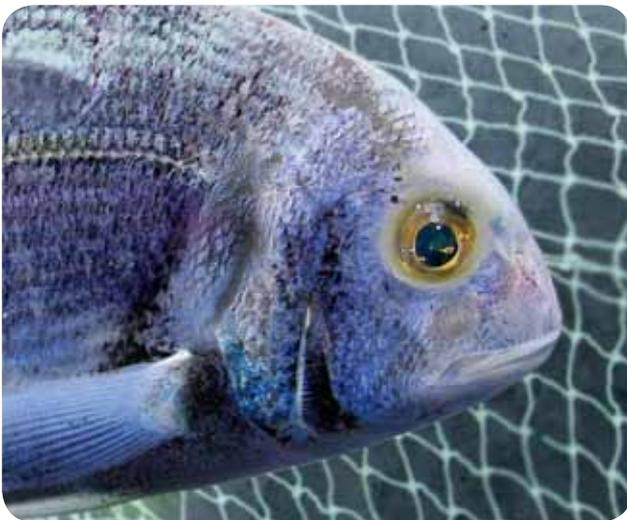
The authors conclude that the current legal protection of animal foetuses and immature young does not fully reflect what we understand about neurological pathways in these animals and their ability to suffer. There is some evidence that negative treatment of these animals may, in some circumstances, cause deleterious effects on their welfare. In order for the animal welfare legislation of different countries worldwide to be effective overall, it needs to at least contain information around the treatment of animals in their prenatal forms.

Campbell MLH, Mellor DJ, Sandøe P (2014) How should the welfare of fetal and neurologically immature postnatal animals be protected. *Animal Welfare* 23:369–379.

The fish pain debate

It has long been argued that fish do not feel pain in the same manner as we, as a society, now accept that mammals do. Certainly, compared to the other species of animals that are farmed and used for human consumption, they are not of a great concern in the public eye. Fish have certain characteristics that make it hard for us to empathise with them such as the inability to make facial expressions or to vocalise in a manner that we are able to hear. However, there has been a growing amount of recent literature adding strength to the concept that fish do feel pain.

This paper aims to add to this literature by discussing a number of aspects that point to the existence of fish being able to feel pain. The author explores and describes the presence of nociceptors in fish (receptors that respond to pain) and the evidence suggesting that fish are likely to possess consciousness, which would enable them to respond to noxious stimuli and pain. The objections that have been raised regarding fish being able to feel pain are described and scientific arguments made against these beliefs. The author then suggests reasons for why we, as a society, hold these beliefs which include the fact that the use of fish and fishing is culturally acceptable in our society, and the fact that fish lack neotenous characteristics (which mean that humans don't instinctively respond to them in the same way as they do other animals, as they are not perceived by humans to be 'cute').



Current research suggests that fish, as they possess consciousness and are able to perceive pain, will have the ability to suffer. The implications of this are vast in terms of the harm that we cause by choosing a diet containing fish. Recreational fishing needs to be seen as an unnecessary cause of suffering and management techniques used in commercial fisheries need to be scrutinised. As the majority of recent evidence is pointing towards fish as animals with the ability to feel pain and with complex mental and social lives, the author suggests it is time to review the human-fish relationship of the past with a view to developing better welfare strategies for fish in the future.

Elder MP (2014) The fish pain debate: Broadening humanity's moral horizon. *Journal of Animal Ethics* 4(2): 16–29.

Why animal welfare matters

RSPCA Australia
Animal Welfare
Seminar 2015

Date: Friday 1 May 2015
Venue: BAE Systems Theatre,
Australian War Memorial,
Canberra

Animal welfare is, and always has been, core business for the RSPCA. But how much does ensuring the welfare of animals actually matter in today's society and our human-centred day-to-day lives?

You don't need to be an 'activist' or a 'radical' to regard animal welfare as a priority issue, nor does this have to mean that animal use should be abandoned altogether.

This year's **RSPCA Australia Animal Welfare Seminar**, titled *Why Animal Welfare Matters*, brings together leaders in business, science, education, government and the not-for-profit sectors to share their stories of how and why animal welfare matters to them, their organisations and the people they connect and work with.

Join us at this year's seminar to find out more about why animal welfare matters.

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ARTICLES OF INTEREST

Due to a computer glitch, the 'articles of interest' section of this issue of the Science Update is far from comprehensive. Apologies!

ANIMALS USED FOR SPORT, ENTERTAINMENT, RECREATION AND WORK

Early JB, Arnott ER, Wade CM, McGreevy PD (2014) Manual muster: A critical analysis of the use of common terms in Australian working dog manuals. *Journal of Veterinary Behavior* **9**(6):370–374.

COMPANION ANIMALS

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Vinke CM, Van der Leij WJR. (2014) Will a hiding box result into stress reduction for shelter cats? *Journal of Veterinary Behavior* **9**(6):e4.

FARM ANIMALS

Cattle

de Vries M, Bokkers EAM, van Reenen CG *et al* (2015) Housing and management factors associated with indicators of dairy cattle welfare. *Preventive Veterinary Medicine* **118**(1):80–92.

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Isensee A, Leiber F, Bieber A *et al* (2014) Comparison of a classical with a highly formularized body condition scoring system for dairy cattle. *animal* **8**(12):1971–1977.

Lobeck-Luchterhand KM, Silva PRB, Chebel RC *et al* (in press) Effect of stocking density on social, feeding, and lying behavior of prepartum dairy animals. *Journal of Dairy Science*.

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Pigs

Peralta JM, Rizzo V (2015) The use of ice to enrich the environment of pigs housed indoors. *Journal of Applied Animal Welfare Science* **18**(1):32–41.

Schembri N, Hernandez-Jover M, Toribio J-A *et al* (2015) On-farm characteristics and biosecurity protocols for small-scale swine producers in Eastern Australia. *Preventive Veterinary Medicine* **118**(1):104–116.

Poultry

Banerjee D, Daigle CL, Dong B *et al* (2014) Detection of jumping and landing force in laying hens using wireless wearable sensors. *Poultry Science* **93**(11):2724–2733.

Carbajal A, Tallo-Parra O, Sabes-Alsina M *et al* (2014) Feather corticosterone evaluated by ELISA in broilers: A potential tool to evaluate broiler welfare. *Poultry Science* **93**(11):2884–2886.

Elkhoraihi C, Blatchford RA, Pitesky ME *et al* (2014) Backyard chickens in the United States: A survey of flock owners. *Poultry Science* **93**(11):2920–2931.

Hernández-Jover M, Schemann K, East IJ *et al* (2015) Evaluating the risk of avian influenza introduction and spread among poultry exhibition flocks in Australia. *Preventive Veterinary Medicine* **118**(1):128–141.

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Levot GW, Langfield BJ, Aiken DJ (2014) Survival advantage of cyromazine-resistant sheep blowfly larvae on dicyclanil- and cyromazine-treated Merinos. *Australian Veterinary Journal* **92**(11):421–426.

WILD ANIMALS

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TRANSPORTATION OF ANIMALS

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HUMANE KILLING

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