

animal welfare science update

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

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companion animals

Journal of Veterinary Behavior: Clinical Applications and Research Volume 5 Issue 1

A number of abstracts from the 7th International Veterinary Behavior Meeting (IVBM) which are relevant to shelters can be found in this edition. The IVBM took place in Scotland in October 2009.

Stereotypic licking in dogs

Dogs sometimes develop a skin condition known as acral lick dermatitis. This is a result of prolonged and abnormal licking of the limbs, particularly of the paw region, which can lead to hair loss, skin irritation, ulceration and infection. The cause of this behaviour is often difficult to determine, and can range from allergies to psychological disturbances.

In this study, the owners of 20 dogs with long-term acral lick dermatitis caused by psychological problems were asked about the dogs' physical and social environment, temperament, and 'triggers' that might have brought about the stereotypic behaviour. The researchers found that the vast majority of the dogs in the study were large breeds, most of which lived in small spaces, and were not allowed to stay inside the house. All owners considered their dogs to have an "anxious" character, and in the case of 13 dogs, at least one supposed 'triggering' non-medical component (e.g. death of a canine companion) was identified. Previous skin conditions played little role in triggering the stereotypic behaviour. The authors conclude that as with other stereotypic behaviours, environmental restrictions, as well as a lack of appropriate social interactions, play an important role in the development of acral lick dermatitis.

Pereira, J.T., Larsson, C.E., & Ramos, D. (2010) Environmental, individual and triggering aspects of dogs presenting with psychogenic acral lick dermatitis, *Journal of Veterinary Behavior: Clinical Applications and Research*, 5(3): 165.

The effects of human interaction on stress in shelter dogs

Dogs brought to animal shelters may experience high levels of stress, due to isolation and the newness of their surroundings. This may make them appear aggressive or afraid, and thus reduce their chances of being adopted by a new family. In this study, the researchers investigated the effects of human contact sessions on the stress levels and behaviour of a group of 10 dogs (compared to a similarly-sized group of controls) housed at the Municipal Dog Shelter in Turin, Italy. Only dogs that were free from any pre-existing medical conditions were used in this study; in addition, highly aggressive and highly anxious dogs were excluded from the investigations. The sample of dogs used in the study therefore appeared to be quite representative of the population of dogs that might be considered for adoption at many public shelters.

A range of physiological measures were recorded from both groups of dogs at four time points, once every four weeks - this included salivary cortisol levels and various measures of heart rate variability (stress indicators). Behavioural tests were also carried out to gauge the dogs' aggressiveness and sociability. The researchers found that their human interaction program, which included playing with the dog outside, walking on leash, grooming activities, playing inside with toys, obedience commands, treat rewards, and verbal and tactile contact, had a positive effect on the behaviour of shelter dogs. Some of the measured physiological indicators, such as salivary cortisol levels, were also positively affected by human contact.

Bergamasco, L., Osella, M.C., Savarino, P., *et al.* (2010) Heart rate variability and saliva cortisol assessment in shelter dog: human-animal interaction effects, *Applied Animal Behaviour Science*, 125: 56-68.

Food pellets for Amazon parrots

Parrots are becoming more popular as companion animals, with the result that many specialised high-energy foods have now been developed to meet the dietary requirements of these birds. However, birds kept in captivity have a very different lifestyle compared to their wild conspecifics, which have to spend the greater part of their waking life foraging at multiple locations just to obtain enough food energy to survive.

In this study, the researchers first monitored six orange-winged Amazon parrots over a period of several days, to determine how much of their time was devoted to activities such as perching, feeding, preening, etc. A surprising finding was the extent of inactivity observed in the parrots in this study and the limited amount of time spent feeding. The parrots left their perches for only about 30 min/day (6% of their activity budget); most of this time was accounted for by trips to the feeder and water fountain. Next, the researchers compared the parrot's preferences for normal-sized food pellets versus pellets that were 20-30 times larger. Parrots strongly preferred the oversized pellets to regular pellets, retrieving over-sized pellets approximately seven times more often, and also spent far more time manipulating the larger pellets. Finally, parrots given only regular pellets seemed far more interested in interacting with a wooden cube provided as enrichment, than parrots that had access to oversized pellets. These results suggest that parrots offered only regular-size pellets are deprived of an opportunity to engage in foraging behaviour. Offering parrots over-sized pellets or enrichment devices that provide foraging-like opportunities can dramatically reduce periods of inactivity and encourage a more naturalistic activity budget, thereby enhancing welfare.

Rozek, J.C., Danner, L.M., Stucky, P.A. *et al.* (2010) Over-sized pellets naturalize foraging time of captive Orange-winged Amazon parrots (*Amazona amazonica*), *Applied Animal Behaviour Science*, 125: 80-87.

Optimal group sizes for aquarium fishes

Freshwater ornamental fishes are a very popular group of companion animals, and it has been estimated that they comprise 80-90% of the 350 million aquarium fishes traded around the world annually. While much has been written on the topic of water quality in home aquaria, very little research has been carried out on the best stocking densities at which to keep different fish species to best ensure their welfare.

The authors of this study investigated the effects of group size in four popular aquarium fish (neon tetras, white cloud mountain minnows, tiger barbs and angelfish), by measuring four variables that indicated fish welfare - darting, shoaling, aggression and willingness to start feeding. The researchers found that the neon tetras and minnows showed less aggression and darting, and spent more time shoaling in larger groups - this indicated better welfare. The results were less clear for the angelfish and the generally more aggressive tiger barbs, although larger group sizes did lead to more shoaling. Overall, however, there was improved welfare in larger groups of neon tetras, white cloud mountain minnows and tiger barbs, but no clear link between welfare and group size in angelfish. The authors conclude that the effect of group size on the behaviour of ornamental fish species is a species-specific combination of behavioural parameters.

Saxby, A. Adams, L., Snellgrove, D. *et al.* (2010) The effect of group size on the behaviour and welfare of four fish species commonly kept in home aquaria, *Applied Animal Behaviour Science*, 125: 195-205.

farm animals

Pig farmers' attitudes to welfare outcome assessments

Animal husbandry in the United Kingdom has, for over a decade, involved a system of farm assurance where farmers are required to meet certain criteria relating to food safety, animal welfare and environmental concerns. Although the vast majority of pork in the UK comes from assured farms, critics of such schemes have complained that too little emphasis is placed on animal welfare. According to them, current assurance standards focus mainly on the existence of certain resources on pig farms, while ignoring welfare outcomes (Shortly before the publication of this article however, one assurance scheme, Assured British Pigs, released an updated set of standards, valid from April 2010).

The authors of this article surveyed 56 British pig farmers, asking them about their attitudes towards their industry in general, and towards the possible inclusion of welfare outcomes into assurance schemes in particular. Farmers were most commonly proud of the productivity and welfare of the pigs on their farm, and of the welfare of pigs in the UK industry as a whole. The most common thing that farmers wanted to

tell consumers about was the welfare of the pigs, followed by their stockmanship qualities, the quality of their pig meat and the safety of their pig meat. Finally, two-thirds of farmers said that they would be willing to perform welfare self-assessments as part of farm assurance, while an equal number said that they would be happy to participate in an anonymous benchmarking scheme on the welfare of their pigs, where they could measure their farm's performance against others.

Mullan, S., Butterworth, A., Whay, H.R. *et al.* (2010) Consultation of pig farmers on the inclusion of some welfare outcome assessments within UK farm assurance, *Veterinary Record*, **166**: 678-680.

An assurance scheme for broiler welfare

Broiler chicken strains have traditionally been selected to produce maximum growth in the shortest possible time. In the mid 1950s, it took a broiler on average 84 days to reach a marketable weight of 1.8 kg, whereas by 2007, certain strains could achieve this in a mere 31 days. This represents an increase in daily weight gain from 21 g to 63 g. This high growth rate has been shown to cause a large number of serious metabolic and physical disorders in chickens, including sudden death syndrome and lameness. A 2008 study of 51,000 birds from the United Kingdom's top five broiler producers revealed a shocking result: almost 98% of those birds had some detectable leg problem, with almost one in three suffering from moderate to extreme lameness. Moreover, the parents of these broilers, the so-called broiler breeders, are kept on severely feed-restricted diets, as they have to be kept alive for over a year, and this is the popular means by which producers attempt to control and limit their growth rate. At the typical slaughter weight, therefore, the average breeder's weight is only one-quarter that of her offspring. As a result of this practice, many studies have concluded that feed-restricted broilers are chronically hungry, frustrated and stressed.

This article, authored by members of the United Kingdom RSPCA Science Group, presents a case study of an RSPCA farm assurance scheme, 'Freedom Food', and its effect on the commercial practices of the British broiler industry. In consultation with leading broiler breeding companies, the RSPCA in 2006 proposed a restriction requiring producers certified under the Freedom Food label to exclusively select strains which grew no faster than 45 g per day on average. In spite of this restriction, around 25 million chickens, or 2.9% of all UK-reared broilers were reared under the Freedom Food scheme in the first year. By 2008, this number had grown to around 55 million, or 6.6% of market share. The authors conclude that while such a scheme does not represent a total solution to all welfare issues, successful assurance schemes that are supported by the public can play a pivotal role in tackling genetic welfare problems in farm animals.

Cooper, M. & Wrathall, J. (2010) Assurance schemes as a tool to tackle genetic welfare problems in farm animals: broilers, *Animal Welfare*, **19**(S): 51-56.

Relationships between feather pecking and foraging behaviour in hens

Feather pecking is commonly seen in commercial flocks of laying hens and, if severe, may result in severe pain, fear and stress for the victim. It has been suggested that feather pecking behaviour results when normal foraging behaviours are prevented due to, e.g. the constraints imposed by artificial housing. It has also been suggested that high feather pecking (HFP) hens are more likely to cope with novel situations in a proactive style (fight/flee), whereas low feather pecking (LFP) hens are more likely to be reactive (freeze).

In this study, the researchers individually tested HFP and LFP hens in a maze, in which were placed worms, food pellets, grass and feathers. HFP hens explored the maze more, and vocalised earlier, thus demonstrating less fear than LFP hens. Both strains preferred to peck at the worms, although the HFP hens pecked at them more often. HFP hens also did not show any preference for pecking the feathers in the maze. The authors conclude that HFP birds respond actively to fear-eliciting situations, which may originate from a proactive coping style. Also, instead of a clear preference for eating feathers, this study supports earlier findings that HFP birds have a stronger pecking motivation than LFP birds.

De Haas, E., Nielsen, B.L., Buitenhuis, A.J. *et al.* (2010) Selection on feather pecking affects response to novelty and foraging behaviour in laying hens, *Applied Animal Behaviour Science*, **124**: 90-96.

Breeding farm animals for behavioural change

Farm animals are traditionally bred to improve production (and therefore economic) outcomes - this involves selecting for traits such as faster growth, greater milk yields, or higher offspring numbers. In a departure from this standard idea of 'breeding for physical traits', the authors of this article argue that it might be beneficial, both in terms of profitability as well as animal welfare, for breeders to select for desirable behaviours in farm animals. Many behaviours are now known to have a genetic basis, although the degree to which genes affect different behaviours varies greatly. These include aggression, stereotypy, fearfulness, ease of handling and maternal behaviour.

While discussing the potential for behaviour-based animal breeding, the authors also acknowledge the many practical hurdles to implementing such practices. The genetics of behaviour is complex, and it is often difficult, time consuming and labour intensive to identify desirable or unwanted behavioural traits in an animal. There are also important ethical issues to be considered: in attempting to breed out fearfulness or aggression, breeders may inadvertently develop strains of farm animals that are unreactive to an abnormal degree (which the authors label 'zombies'), or those that do not show signs of poor welfare even though they might be suffering (the 'stoics'). In either case, there would be a loss of 'naturalness' and/or animal integrity, which would be a highly undesirable outcome. Initially, however, breeders would need to develop well-validated, convenient methods of reliably recording and measuring behavioural traits.

D'Eath, R.B., Conington, J., Lawrence, A.B. *et al.* (2010) Breeding for behavioural change in farm animals: practical, economic and ethical considerations, *Animal Welfare*, 19(S): 17-27.

Stress and microbes in cattle

Commercially farmed cattle may be routinely exposed to a range of different experiences that cause psychological and physiological stress. These include changes in environmental temperatures, particularly chronic exposure to extremes of heat or cold, restraint such as tethering, isolation from herd members, negative social experiences (with other animals, or with humans during handling procedures), and physical stress resulting from poor diet, dehydration, injury and illness such as infection.

Recent research has shown that stress can directly influence the amount of bacteria that can be found in cattle guts and faeces. Laboratory studies have shown that many different strains of bacteria grow faster in the presence of cattle stress hormones. This may be due to an impairment of the animal's immune system during times of stress, and also because the gut bacteria themselves are able to sense and respond to increased stress hormone levels. The authors of this review article conclude that happy, less stressed ruminants may therefore be better-nourished animals and safer sources of meat.

Freestone, P. & Lyte, M. (2010) Stress and microbial endocrinology: prospects for ruminant nutrition, *animal*, 4(7): 1248-1257.

Auditing animal welfare at slaughter plants

A number of national governments, private companies and animal health and welfare organisations around the world have developed and adopted minimum standards for the transport and slaughter of farm animals, with the aim of ensuring animal welfare. The author of this paper has herself been highly influential in developing a numerical scoring framework that was recently adopted by the Food Safety and Inspection Service of the United States Department of Agriculture, and was also used by companies such as McDonald's Corporation, Wendy's International, and Burger King to implement animal welfare auditing programs at their slaughter plants.

The numerical scoring system measures five variables: 1) percentage of animals effectively stunned on the first attempt, 2) percentage rendered insensible, 3) percentage that vocalise (bellow, moo, squeal) during handling and stunning, 4) percentage that fall during handling, and 5) percentage moved with an electric goad. These measures can be easily obtained by a trained auditor, and have the added advantage of being good indicators for a wide range of potential welfare issues that might arise at the abattoir. In addition, the author recommends a complete ban on bad practices such as dragging, dropping, throwing, puntilla, and hoisting live animals before ritual slaughter. Other variables that could be measured on farm and during transport include: 1) percentage of lame animals, 2) percentage of thin animals, 3) percentage of dirty animals, 4) percentage with sores, bruises or lesions, 5) death and morbidity, and 6) percentage of birds with broken wings and legs.

Grandin, T. (2010) Auditing animal welfare at slaughter plants, *Meat Science*, doi: 10.1016/j.meatsci.2010.04.022

A chemical alternative to mulesing

The mulesing of lambs to prevent blowfly strike is a highly controversial issue both in Australia and overseas, due to the highly painful nature of the procedure. This is evident in the behaviour and posture of recently mulesed lambs, and although behaviour generally returns to normal by 72 h after mulesing, lambs can develop an aversion to their human handlers for up to 114 days after the operation.

As a possible alternative, the authors of this paper tested the chemical sodium lauryl sulfate (SLS), which is thought to painlessly cause localised cell damage and scar formation when injected into healthy tissue. Six Merino sheep were injected in their flank with small amounts of SLS, and tissue biopsies were taken from the treated areas over a period of several days. There was a rapid visible reaction at the site of injection, and in three weeks, the treated area was covered by a scab, which had sloughed off completely by day 28. As far as the researchers could tell, this process was painless, as they could detect no changes in the sheep's behaviour, weight gain or appetite. They conclude that if SLS were applied around the breech of sheep, the resulting scar formation and skin contraction would increase the perineal bare area and minimise the faecal and urine staining that leads to flystrike.

Lee, E. & Rothwell, J. (2010) Histological changes to the skin of Merino sheep following deep dermal and subcutaneous injections of sodium lauryl sulfate, *Australian Veterinary Journal*, **88**(4): 146-150.

Physical activity and light levels in broiler chickens

Lameness in fast-growing commercial broiler chickens is a serious welfare issue, and can be the direct outcome of a range of conditions, including abnormal joint development due to the abnormally large muscle mass, low bone density, or dermatitis as a result of prolonged contact with litter. In the worst cases of lameness, broilers at slaughter weight may only spend 1.5-3.3% of their time walking.

In this study, the researchers trialed a way to make broiler chickens engage in more physical activity in semi-commercial conditions. It was hoped that by alternating light levels between normal and high in the chicken's enclosures, the chickens could be induced to walk more in the high-light condition, and thus improve their bone density and leg health. However, the lighting regime tested here had no effect on physical activity or any of the leg health measures. According to the authors, one plausible explanation is that modern, fast-growing strains of broiler chickens do not take sufficient exercise to produce a difference in bone quality even when given the choice.

Sherlock, L., Demmers, T.G.M., Goodship, A.E., McCarthy, I.D. *et al.* (2010) The relationship between physical activity and leg health in the broiler chicken, *British Poultry Science*, **51**(1): 22-30.

research animals

Euthanasia of laboratory amphibians

Amphibians such as the African clawed frog *Xenopus laevis* are routinely used in scientific laboratories, but the official guidelines for their humane euthanasia are often vague, compared to other laboratory organisms such as rats and mice. Prior to euthanasia as well, the inappropriate housing and handling of laboratory animals can cause elevated stress levels, which can lead to disease outbreaks, and compromise welfare.

In this study, the researchers compared the different methods of euthanasia recommended by the UK's Code of Practice for the Humane Killing of Animals, which include an overdose of anaesthetic and stunning by a blow to the head. Anaesthetic overdoses may be preferred by animal workers because they may be easier to carry out and may be perceived as less stressful to the workers themselves. Differences in the stress experienced by amphibians culled under the different methods have not been investigated. Six different methods of euthanasia were used in this study. The researchers tested four different treatments of the anaesthetic tricaine methanesulphonate (MS-222), on adult female *Xenopus* (3 g L⁻¹ solution buffered to a neutral pH; 3 g L⁻¹ unbuffered; 1 g L⁻¹ buffered; 1 g L⁻¹ unbuffered). Two control treatments were used: the first involved instant stunning by a blow to the head and the second, placing the animal in a container of water for 11 minutes prior to stunning, to examine the effect of housing the animal in a small container. The researchers then measured and compared blood corticosterone levels for the different treatments, which is a reliable indicator of stress in vertebrates.

The corticosterone values for animals in the 3 g L⁻¹ buffered (neutral pH) MS-222 treatment were

significantly lower than those in the other chemical treatments and those in the control treatment where animals were stunned after being held in water. Corticosterone values did not differ significantly between the 3 g L⁻¹ buffered treatment and the instant stunning control treatment. Time to unconsciousness was reduced with a higher concentration of MS-222, ranging from a median of 6.5 min (1 g L⁻¹ buffered) to 3.0 min (3 g L⁻¹ buffered).

The researchers concluded that if we can assume that lower corticosterone levels do indicate lower stress, then a buffered 3 g L⁻¹ solution is the best of the MS-222 solutions tested in this study to euthanase *X. laevis*. The level of disturbance that animals experienced also affected corticosterone levels. Animals that were taken from the tank later in the sequence of removal for euthanasia had significantly higher corticosterone levels than those taken first. The study also has implications for the use of MS-222 as an anaesthetic agent as it indicated that its use at lower concentrations may increase stress and thus negatively affect welfare in some circumstances.

Archard, G. & Goldsmith, A. (2010) Euthanasia methods, corticosterone and haematocrit levels in *Xenopus laevis*: evidence for differences in stress? *Animal Welfare*, 19: 85-92.

Rat cage design and placement

Laboratory rats are housed either in clear-walled or opaque cages, which are placed on multi-tier racks. Research on other species of animals has shown that stress levels in captive animals may vary with the amount of visual exposure that the animal's housing allows - when given a choice, many animals prefer to remain in places where they cannot be seen by humans or other animals. This study investigated the effects of parameters such as the visual characteristics of different cages (clear walls, walls with opaque stripes and opaque walls) on rat stress levels, as measured by faecal corticosteroid levels. Rats were observed over two four-week periods while kept in different cage conditions, and subjected to behavioural tests before and after the treatment.

The results showed that there was an interaction between the visibility of a cage and the height at which it was kept on a standard three-tier rack: rats housed in clear cages on lower tiers tended to have higher stress levels than rats housed in partial-cover cages on upper tiers. When given a choice between all three cage types, rats preferred the opaque-walled cages to rest in during daylight hours. Overall, the study showed that the degree to which individually housed rats could see humans and other rats from their home cage affected physiological and behavioural indicators of stress. In particular, visual exposure without the possibility of hiding was found to increase stress levels. As this conclusion conflicts with laboratory animal care guidelines, which recommend the uninterrupted observation of captive animals, the authors suggest that cages with opaque walls at one end and walls with partial cover (vertical stripes) at the other end might provide a better alternative for rat welfare and husbandry than cages with fully clear or opaque walls.

Cloutier, S. & Newberry, R. (2010) Physiological and behavioural responses of laboratory rats housed at different tier levels and levels of visual contact with conspecifics and humans, *Applied Animal Behaviour Science*, 125: 69-79.

Treating stereotypic behaviour in rhesus macaques

Rhesus macaques kept in captivity may develop stereotypic behaviours due to poor housing conditions or lack of appropriate social contact. These behaviours, which are an indicator of poor welfare, include 'bouncing' (repetitive hopping or bouncing in place), 'circling' (repetitive twirling or walking in a tight circle in place, typically holding the roof of the cage while doing so), 'pacing' (repetitive walking in the same path in the cage) and 'somersaulting' (doing a series of backflips). In this study, the researchers investigated whether training macaques to perform a novel task, while using positive reinforcement, can reduce stereotypic behaviours in this species.

Six adult female macaques showing stereotypic behaviour were trained over a period of four months to first touch a PVC pipe on command, and then offer an arm for the taking of a blood sample by a researcher, in return for food rewards. Another group of macaques was not trained, and served as a control. Behavioural observations were made once a month for each animal. The researchers found that stereotypic behaviours were greatly reduced in the trained group during the first month, but in subsequent months, this effect of training disappeared. In three of the six trained macaques, however, this reduction in stereotypies persisted for three months. The authors conclude that positive reinforcement training may be a useful treatment for some captive macaques.

Coleman, K. & Maier, A. (2010) The use of positive reinforcement training to reduce stereotypic behavior in rhesus macaques, *Applied Animal Behaviour Science*, 124: 142-148.

Conservation and Animal Welfare, *Animal Welfare* Volume 19, Issue 2 (special issue)

The following list of papers feature in a special issue of *Animal Welfare* which focuses on a workshop held in Vancouver in 2007 titled “Interdisciplinary approaches to managing human-wildlife interactions”. The workshop brought together people from different application areas: forestry, agriculture, aquaculture, management of invasive species, wild animals in captivity, human-wildlife conflict, and the recreational use of animals. Workshop participants developed a ‘consensus statement’ on how scientists need to recognise both areas of concern in their work. This consensus statement as well as six of the workshop papers are included in this special issue.

Fraser, D. Toward a synthesis of conservation and animal welfare science p121-124.
Swaisgood, R.R. The conservation-welfare nexus in reintroduction programmes: a role for sensory ecology p125-137.
Braithwaite, V.A. & Salvanes, A.G.V. Aquaculture and restocking: implications for conservation and welfare p139-149.
Blumstein, D.T. Conservation and animal welfare issues arising from forestry practices p151-157.
Mathews, F. Wild animal conservation and welfare in agricultural systems p159-170.
Littin, K.E. Animal welfare and pest control: meeting both conservation and animal welfare goals p171-176.
Paquet, P.C. & Darimont, C.T. Wildlife conservation and animal welfare: two sides of the same coin? p177-190.
Conservation and animal welfare: consensus statement and guiding principles p191-192.

Immunocontraception in feral horses

Controlling fertility and reproductive rate is thought to be one of the most humane ways of carrying out the long-term control of feral animal populations. In the United States, the immunocontraceptive porcine zona pellucida (PZP) is regularly used to manage the populations of feral horses and deer; PZP works by inducing the target (female) animal’s immune system to create antibodies against its own eggs, thereby reducing their chances of being fertilized. However, there is some uncertainty regarding the side effects of this treatment. The reproductive physiology of horses can be adversely affected by PZP, leading to abnormal reproductive behaviours in both males and females. This has the potential to disrupt the social structure of family groups, and affect the welfare of the treated animals.

The authors of this study investigated the influences of PZP immunocontraception on the behavior of feral horses in three discrete free-roaming populations in the western United States over a 4-year period. They found that treated females received significantly more reproductive behaviours from stallions than did control females. This may result in greater harassment of the females, and may contribute to a decline in their body condition and/or a reduction in the cohesiveness of the family group. Other behaviours such as feeding, herding and harem tending were dependent on variables such as body condition and the presence or absence of foals, and could not be attributed to the PZP treatment. However, since the presence or absence of foals is directly related to the effectiveness of the treatment, the authors suggest that these behaviours should also be considered when making management decisions.

Ransom, J.I., Cade, B.S. & Thompson Hobbs, N. (2010) Influences of immunocontraception on time budgets, social behavior, and body condition in feral horses. *Applied Animal Behaviour Science*, 124: 51-60.

other articles and publications of interest

- Aggrey, S.E. (2010) Modification of animals versus modification of the production environment to meet welfare needs, *Poultry Science*, **89**(4): 852-854.
- Ask, B. (2010) Genetic variation of contact dermatitis in broilers, *Poultry Science*, **89**(5): 866-875.
- Banchero, G., Vazquez, A., Montossi, F. et al. (2010) Pre-partum shearing of ewes under pastoral conditions improves the early vigour of both single and twin lambs, *Animal Production Science*, **50**(4): 309-314.
- Blackwell, E.J., Bradshaw J.W.S., Casey R.A. (2010) Preventing separation problems in re-homed dogs: Improving owner compliance, *Journal of Veterinary Behavior: Clinical Applications and Research*, **5**(1): 23-24.
- Bourgueta, C., Deissa, V., Goberta, M. et al. (2010) Characterising the emotional reactivity of cows to understand and predict their stress reactions to the slaughter procedure, *Applied Animal Behaviour Science*, **125**(1-2): 9-21.
- Braem, M.D. & Mills, D.S. (2010) Factors affecting response of dogs to obedience instruction: A field and experimental study, *Applied Animal Behaviour Science*, **125**(1): 47-55.
- Buijs, S., Keeling, L.J., Vangestel, C. et al. (2010) Resting or hiding? Why broiler chickens stay near walls and how density affects this, *Applied Animal Behaviour Science*, **124**(3-4): 97-103 .
- Cao, D., Sharman, K. & White, S. (2010) Animal law in Australia & New Zealand, Thomson Reuters (Professional) Australia Ltd, Pyrmont, NSW.
- Chapinal, N., Ruiz-De-La-Torre, J.L., Cerisuelo, A. et al. (2010) Aggressive behavior in two different group-housing systems for pregnant sows, *Journal of Applied Animal Welfare Science*, **13**(2): 137-153.
- Christie, L.A., Oprii, W.O., Head, E. et al. (2010) Effects of acetyl-L-carnitine and lipoic acid supplementation on cognition in aged beagles, *Journal of Veterinary Behavior: Clinical Applications and Research*, **5**(3): 160.
- Conington, J., Collins, J. & Dwyer, C. (2010) Selection for easier managed sheep, *Animal Welfare*, **19**(5): 83-92.
- Corridan, C.L., Mills D. S., & Pfeffer K. (2010) Comparison of factors limiting acquisition versus retention of companion dogs, *Journal of Veterinary Behavior: Clinical Applications and Research*, **5**(1): 22.
- Dalmou, A., Geverink, N.A., Van Nuffel, A. et al. (2010) Repeatability of lameness, fear and slipping scores to assess animal welfare upon arrival in pig slaughterhouses, *animal*, **4**(5): 804 - 809.
- De Rivera, C., Araujo, J.A. & Milgram, N.W. (2010) Modeling anxiety in beagle dogs, *Journal of Veterinary Behavior: Clinical Applications and Research*, **5**(3): 158-159.
- Dreschel, N. A. (2010) The effects of fear and anxiety on health and lifespan in pet dogs, *Applied Animal Behaviour Science*, **125**(3): 157-162.
- Elliott, R., Toribio, J.L.M.L. & Wigney D. (2010) The Greyhound Adoption Program (GAP) in Australia and New Zealand: A survey of owners' experiences with their greyhounds one month after adoption, *Applied Animal Behaviour Science*, **124**(3-4): 121-135.
- Enriquez, D.H., Ungerfeld, R., Quintans, G. et al. (2010) The effects of alternative weaning methods on behaviour in beef calves, *Livestock Science*, **128**(1-3): 20-27.
- Fisher, A.D., Niemeyer, D.O., Lea, J.M. et al. (2010) The effects of 12, 30 or 48 hours of road transport on the physiological and behavioural responses of sheep, *J Anim Sci*, doi:10.2527/jas.2008-1674.
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- Gourdine, J.L., de Greef, K.H. & Rydhmer, L. (In Press) Breeding for welfare in outdoor pig production: A simulation study, *Livestock Science*.
- Hampson, B.A., Morton, J.M., Mills, P.C. et al. (2010) Monitoring distances travelled by horses using GPS tracking collars, *Australian Veterinary Journal*, **88**(5):176-181.
- Hild, S., Andersen, I.L. & Zanella, A.J. (2010) The relationship between thermal nociceptive threshold in lambs and ewe-lamb interactions, *Small Ruminant Research*, **90**(1-3): 142-145.
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