



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

COMPANION ANIMALS

Mood-dependent learning in dogs

'Affective state' is a phenomenon that is receiving increasing attention in animal behaviour and welfare studies. It refers generally to the 'mood' that an animal might be experiencing. An animal's affective state can be positive or negative, and it is the latter that can be an important sign of poor welfare. However, positive affective states largely remain unstudied in animals, and researchers are still uncertain about how these states can be accurately measured.

Assuming that the consumption of a food reward will cause an animal, such as a dog, to be in a positive state, the authors of this paper decided to test whether the existence of such a state can be indicated by a more 'optimistic' attitude in dogs trained to search for food in an experimental maze. The experimental beagles were first given a food treat, and then trained to associate a dark grey card with the presence of food in a bowl. A light grey card indicated the absence of food. In a subsequent test, these dogs were shown cards coloured intermediate shades of grey, to see if they would still 'optimistically' expect a food reward. However, the results of the experiments showed that dogs that had already received a reward took longer to approach a bowl marked with an intermediate grey colour. This underscores the difficulties involved in studying animals' affective state, and the authors call for more detailed studies.

Burman, O., McGowan, R., Mendl, M. *et al.* (2011) Using judgement bias to measure positive affective state in dogs, *Applied Animal Behaviour Science*, **132**: 160-168.

Effect of training method on dog learning



Dogs are trained by their owners using a variety of techniques. Although the use of reward-oriented training protocols has increased in popularity in recent years, many owners still report using different kinds of punishment, especially for specific, unwanted behaviours, such as stealing an object. However, there have been few empirical studies on how an owner's training style

affects a dog's temperament and later ability to learn new tasks.

The authors of this paper surveyed around 50 dog owners in the UK, to ask them about the methods used when training common tasks such as toilet training, sitting on command and walking to heel. The owners were then interviewed in their own homes, and their interactions with their dog were video recorded, especially while training the dog to perform a novel task (touching an object with its nose). The researchers found that dogs owned by subjects who reported using a higher proportion of punishment were less likely to interact with a stranger, and those dogs whose owners favoured physical punishment tended to be less playful. Dogs whose owners reported using more rewards tended to perform better in the novel training task. Ability at this novel task was also higher in dogs belonging to owners who were seen to be more playful and who employed a patient approach to training. The authors conclude that, for dog owners, the use of reward-based training appears to be the most beneficial for the dog's welfare, since it is linked to enhanced learning and a balanced and healthy dog-owner relationship.

Rooney, N.J. & Cowan, S. (2011) Training methods and owner-dog interactions: Links with dog behaviour and learning ability, *Applied Animal Behaviour Science*, **132**: 169-177.

Bathing behaviour of captive orange-winged Amazon parrots

Parrots and their relatives are very popular pets, and it is estimated that around 16 million such birds are kept in captivity in the United States alone. Around 10% of captive parrots suffer from feather damage for a variety of reasons, and it is thought that behaviours such as preening and bathing help to clean and maintain the birds' skin and feathers. This is particularly true of Amazonian parrots, which in the wild would normally experience high amounts of daily rainfall. The authors of this paper investigated the preening and bathing behaviour of 12 captive-reared orange-winged Amazon parrots. The researchers also tried to determine whether spraying the parrots with water, to simulate rainfall, might have any beneficial welfare effects.



Spraying with water induced real bathing behaviour in the experimental parrots, but surprisingly, also stimulated other parrots in the room to display mock

bathing-like behaviour, even though the water had not touched them. This indicates that bathing might have an important social function. Parrots preferred to bathe in the morning for 10 minutes at a time, and the researchers determined that the best welfare results were obtained by spraying the parrots once every four days.

Murphy, S., Braun J.V. & Millam J.R. (2011) Bathing behavior of captive Orange-winged Amazon parrots (*Amazona amazonica*), *Applied Animal Behaviour Science*, **132**: 200-210.

Perceptions of stray and feral cat welfare



In countries such as New Zealand, the popularity of the cat as a companion animal exceeds that of the dog. Neglect of the companion cat population may result in the establishment of stray and feral cat populations. The transition from companion to stray (i.e. still receiving some human contact and support) or feral (completely independent of human support), status. This can happen as quickly

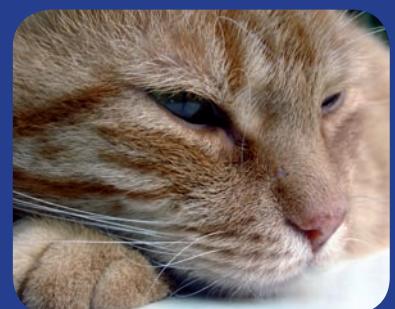
The current definition of a feral cat as having “none of its needs provided by humans” may allow feral cats to be viewed as ‘outsiders’...

as one generation after a cat is lost or abandoned. Such cats can present a risk to the survival of native species that may be potential prey particularly where native animals have evolved in the absence of native terrestrial predators. As a result of their potential impact on native species, cat populations may be subject to control. Management measures include lethal and non-lethal strategies including shooting, lethal trapping, poisoning, trap-neuter-release (TNR), contraception and trap-neuter-rehome (TNRh).

The authors of this paper investigated the perceptions of the New Zealand public towards these methods in the context of controlling stray or feral cat populations. They found that lethal control methods were consistently considered more acceptable for feral cats than for strays. The choice of control measure was dictated by concern over conservation issues and disease costs of the presence of free-roaming cat populations rather than concern for the welfare costs to the cats that are the target of the control measure. Preference for lethal measures depended on people's sex, age, profession and on whether they owned a cat. Cat owners also considered lethal methods of control for stray cats significantly less acceptable than non cat owners and they also found nonlethal methods significantly more acceptable for stray cats than non cat owners.

These significant findings did not extend to feral cats despite greater concern for feral cat welfare in the cat-owning respondents. This may suggest that the conservation imperative may outweigh welfare concerns for cat owners and that feral cats are possibly considered discrete from companion and stray cats. The current definition of a feral cat as having “none of its needs provided by humans” may allow feral cats to be viewed as ‘outsiders’ and their impacts on native animals accentuated as they may be perceived as “lone hunters outside human control”. The effect of increased empathy, resulting from positive exposure to companion animals is indicated in this study by a greater concern for conservation, biosecurity, and animal welfare among cat owners. The authors conclude that the use of the words ‘stray’ and ‘feral’ have significantly different impacts on people's attitudes.

Farnworth, M.J., Campbell, J. & Adams, N.J. (2011) What's in a name? Perceptions of stray and feral cat welfare and control in Aotearoa, New Zealand, *Journal of Applied Animal Welfare Science*, **14**: 59-74.



FARM ANIMALS

RSPCA-funded review of meat chicken welfare

Robins, A. & Phillips, C.J.C. (2011) International approaches to the welfare of meat chickens, *World's Poultry Science Journal*, 67(02): 351-369.

Abstract

Welfare issues and approaches are compared in the following review, for all major meat chicken producing countries. In certain countries, such as the United States and Australia, the industry comprises a small number of integrated, self-regulated companies, whereas in Europe the industry is more diverse, with greater competition, and more government regulation. There is much more meat chicken welfare research and regulation in Europe, and in particular the United Kingdom, than in countries with self-regulated industries, such as the United States, even taking into account the level of meat chicken production in the relevant areas. By contrast, welfare regulation in two of the world's major meat chicken producing countries; namely Brazil and China, is negligible. Some welfare issues are regional, such as high temperatures which are particularly problematic for free range birds, breeds selected for rapid growth and when birds are removed from fully-housed systems. However, similar welfare issues affect intensively-housed birds worldwide, which comprise the majority of animals produced. These include rapid growth rates, predisposing birds to heart and leg problems, especially ascites and sudden death syndrome, and high stocking densities, which inhibit locomotion and environmental exploration, predisposing birds to contact dermatitis. Welfare research in Europe has shown that highly stocked birds spend longer sleeping, congregate around feeders and are more fearful, as well as experiencing higher ammonia levels, which irritate their eyes and respiratory systems. The review concludes that intensive systems present similar welfare issues worldwide; however, European research is more directed to the behavioural and cognitive requirements of the birds, than in self-regulated countries. This will enable their industry to respond better to future welfare requirements from consumers.

Vaccination of Atlantic salmon

In Norway, commercially bred fish such as salmon and trout are administered a vaccine to avoid severe infections and reduce the use of antibiotics. The vaccine, designed to counteract a range of harmful pathogens, is injected into the body cavity of each fish. It is thought that the vaccine itself may induce an inflammatory condition called peritonitis, which has the potential to cause pain. Vaccinated fish may also develop spinal deformities, eye damage, or a condition that resembles an autoimmune disorder. In this paper, the researchers tried to experimentally determine whether salmon treated with a commercial vaccine developed any behavioural changes that could be associated with pain.

Six Atlantic salmon were vaccinated, and their behaviours video recorded, for over 90 minutes each day, on selected days, over a period of five weeks. Another group of six salmon were given a vaccine-free injection, and observed as a control group for the same period. The researchers found that vaccinated fish showed less interest in food than the controls, especially on the day of the injection. Social behaviours were reduced directly after injection, but the original dominance relationships did not seem to be changed by the treatment. Post mortems revealed that the vaccinated fish had developed peritonitis, and that degree of behavioural change following vaccination corresponded well with

the degree of inflammation. Vaccination can therefore cause peritonitis in salmon, which leads to behavioural changes that may indicate pain.

Bjørge, M.H., Nordgreen, J., Janczak, A.M. *et al.* (In press) Behavioural changes following intraperitoneal vaccination in Atlantic salmon (*Salmo salar*), *Applied Animal Behaviour Science*.

Wallowing in pigs

Wallowing is a common behaviour seen in pigs and their wild relatives, but it has received little attention in animal welfare research, and in commercial breeding systems. When wallowing, many animal species coat their entire body, or part of it, in mud or a mud-like



substance. The author of this review article argues that wallowing could provide many important and beneficial outcomes to pigs, and that the provision of a wallow (or a suitable substitute) should be seriously considered by pig producers who are interested in animal welfare.

Pigs, along with other species, such as wild boar, rhinos, hippos, water buffalo and elephants, are known to spend considerable amounts of time and energy digging around water bodies to create shallow depressions (wallow) that fill with mud. Most researchers agree that, in the case of pig species at least, wallowing serves to cool the animal, which lacks functional sweat glands, and is otherwise unable to efficiently lose heat in hot weather. Mud is effective in this respect, as it loses water gradually while on the animal's skin, and keeps the animal cool. In addition, wallowing may help remove parasites such as ticks, protect the animal's skin from sunlight, and also play an important social role, especially during mating. Finally, the author suggests that the behaviour may be hard-wired, and that animals may simply 'enjoy' the experience of wallowing. Depriving an animal of such an experience would, therefore, have negative welfare outcomes.

Bracke, M.B.M. (In press), Review of wallowing in pigs: Description of the behaviour and its motivational basis, *Applied Animal Behaviour Science*.



Effect of grazing on cow mortality

Grazing is generally considered to be a natural and beneficial part of cow behaviour, but in many countries, cows are being kept indoors year-round to reduce costs, and increase productivity. However, recent studies have indicated that cows that are not allowed to graze may suffer from health problems. In this study, therefore, the researchers sent questionnaires to randomly chosen Danish dairy farms with at least 100 cows, to determine if cattle that were allowed to graze acquired any health benefits.

Results were received from 131 farms that allowed summer grazing, and 260 farms that allowed no grazing.

The questionnaire responses showed that although grazing reduced cow mortality overall, there was also an interaction between the presence of grazing and the milking system used at the farms. In general, grazing reduced the risk of a cow dying by a much greater extent on farms where an automatic milking system was used compared to a traditional milking system. In addition, the more time the cows were allowed to spend on pasture, the lower was the mortality.

Burow, E., Thomsen, P.T., Sørensen, J.T. *et al.* (2011) The effect of grazing on cow mortality in Danish dairy herds, *Preventive Veterinary Medicine*, **100**: 237-241.

Effects of minor beak trimming in chickens

Beak trimming is a routine procedure that involves the removal of one third to half of the upper and lower beak of a chicken. This is carried out in the poultry industry to reduce feather pecking, and to increase productivity, but critics of the procedure have claimed that beak trimming causes both short- and long-term pain to the birds. In this experimental study, the researchers tested the effects of beak trimming on the ability of chickens to peck at a simulated food source, and to locate a food source using their magnetic sense.

The researchers found that beak trimmed birds pecked harder in the 24 hours after trimming than control birds...

Beak trimmed birds, half of which were treated with the anaesthetic lidocaine, were tested individually in an experimental arena, where they were able to peck at a pebble. The force of the birds' pecks was recorded by an instrument glued to the bottom of the pebble. The researchers found that beak trimmed birds pecked harder in the 24 hours after trimming than control birds, and concluded that beak trimming causes no pain to the birds. Next, birds that had been trained to associate a food source with a magnetic coil were tested following beak trimming. It was recently reported that chickens have iron particles in their beaks, and that this might allow them to detect the presence of magnetic fields. As expected, control birds were better at finding a hidden magnetic coil than beak-trimmed birds. Minor beak trimming thus appears to impair the bird's ability to detect magnetism and the physical force of pecking, but does not seem to cause them any pain.

Freire, R., Eastwood, M.A. & Joyce, M. (2011) Minor beak trimming in chickens leads to loss of mechanoreception and magnetoreception, *Journal of Animal Science*, **89**(4): 1201-1206.

Effects of housing conditions on meat rabbits

Wild rabbits live in large groups, but this is thought to be an adaptation that provides protection against predators. It may not be advisable to reproduce completely natural conditions in farming situations, because the welfare needs of animals in captivity can be very different from those of their wild relatives. In this review article, the authors summarise the current knowledge of the effects of various housing situations on the welfare of meat rabbits.

Although large groups provide rabbits the opportunity to engage in social behaviours, this advantage is often outweighed by the negative welfare outcomes, such as injuries and stress caused by aggression and a higher risk of disease from contamination. It seems that rabbits are best housed at 4-5 to a cage or pen, at a density not exceeding 15-17 rabbits per square metre. Housing rabbits at lower densities has no further welfare advantage. This review also concluded that wire net floors do not negatively affect rabbit behaviour, and experiments have shown that rabbits may actually prefer wire or plastic net floors to deep litter. Finally, gnawing sticks of soft wood with 3-cm diameter fixed on cage walls are one of the most efficient enrichments in reducing bodily injury caused by aggression.

Szendro, Z. & Zotte, A. (2011) Effect of housing conditions on production and behaviour of growing meat rabbits: A review, *Livestock Science*, **137**: 296-303.

Mandatory welfare labelling of eggs and pork

It is sometimes assumed that legislating the mandatory labelling of welfare information on farm animal products is a better alternative to banning undesirable farming practices. In theory, this gives the consumer more choice, and s/he is then able to bring about a change in production practices over time through his/her purchasing power. Banning questionable practices, on the other hand, could lead to detrimental economic impacts for producers. In this study, the researchers examined the attitudes of US residents to the question of mandatory welfare labelling indicating the use of laying cages for hens and gestation crates (or stalls) for sows.



Overall, consumers supported the concept of mandatory welfare labelling, and were even willing to pay up to 20% higher prices to help defray the additional cost of labelling. This was particularly true of female respondents and young consumers. Interestingly, frequent egg consumers were willing to pay more for mandatory labelling than frequent pork consumers. This may reflect the longer history of egg labelling in the retail market, or the lower price of eggs (compared to pork) in general. Finally, the authors warn that several other considerations also need to be taken into account – mandatory labelling may actually reduce consumer choice and consumer benefits, consumers may be faced with information overload, and frequent meat consumers may not have the same attitudes towards welfare as interest groups. The authors suggest that alternative schemes, such as voluntary labelling, should also be considered, and that a composite welfare label, such as that used for 'heart healthy' foods, should be developed, to take into account the very complex nature of animal welfare.

Overall, customers supported the concept of mandatory labelling, and were even willing to pay 20% higher prices...

Tonsor, G.T. & Wolf, C.A. (2011) On mandatory labeling of animal welfare attributes, *Food Policy*, **36**: 430-437.

Reducing cross-sucking in calves

Calves are often group housed, as this is thought to be beneficial for their welfare. When such calves are fed through an artificial rearing system, however, a behaviour known as cross-sucking can appear, where calves perform sucking actions on the ears, navels and udders of their pen-mates. This can lead to inflammation of the affected areas, digestive disorders, and also improper development of the udder. In this study, the researchers trialled the provision of certain enrichments to artificially-raised, group-housed calves, following a milk meal. After feeding, calves were automatically allowed into an adjacent enclosure, where they were allowed to suck on artificial rubber teats attached to a bucket at head height. A net filled with hay was also hung from a truss in this enclosure. These calves were also additionally supplied with an 11 m² exercise yard.

The researchers found that cross-sucking behaviour in the calves that received the enrichments was significantly lower (12-17%) than in control calves that received no enrichment (59-73%). Cross-sucking bouts were also of much longer duration in the latter group. The calves clearly found the enrichments to be attractive, as they also left the feeding station faster.

Ude, G., Georg, H. & Schwalm, A. (2011) Reducing milk induced cross-sucking of group housed calves by an environmentally enriched post feeding area, *Livestock Science*, **138**: 293-298.

Characteristics of tail-biting piglets and their victims

Tail-biting can be a serious problem in pig farms, and it is often difficult to detect until the first signs of tail damage start to appear on the victims. An understanding of the characteristics of the individuals that engage in tail-biting, and of their victims, could therefore help farmers to identify potential biters before the problem becomes hard to control. It has previously been suggested that biters are usually female, smaller, and more active and aggressive in the lead up to a biting outbreak, while the victims tend to be male and larger. This study aimed at verifying these claims, and quantify biting behaviour in the six days prior to an outbreak.

The researchers found that only some of the previous

claims were supported by the results of their study. In particular, biters were neither the smaller pigs in the group, nor were they more often female. Biters tended to receive more aggressive behaviour than victims or control piglets. Victims were the heavier pigs in the pen, and tended to be more restless preceding the tail-biting outbreak. Surprisingly, it was also the victims who performed more aggressive behaviour overall, leading the researchers to suggest that tail-biting might be a response to aggression from a dominant piglet.

Zonderland, J.J., Schepers, F., Bracke, B.M. *et al.* (2011) Characteristics of biter and victim piglets apparent before a tail-biting outbreak. *animal*, 5(5): 767-775.



ANIMALS USED FOR SPORT, ENTERTAINMENT, RECREATION AND WORK

Predictors of guide dog success



Guide dogs are a valuable resource for people with visual impairments, but the training of such animals is a highly labour intensive and costly process. It costs about A\$30,000 to train a single dog, and given that only 50-56% of dogs successfully complete their training, the costs of production are extremely high. Therefore, identifying methods for early detection of dogs that are suitable for guide work would help to reduce the cost of production. Although previous studies have identified some broad characteristics of dogs that can be successfully trained (e.g. reduced fearfulness, reduced excitability and reduced tendency to be distracted by other dogs), there is still plenty of room for fine-tuning these criteria and streamlining the training process.

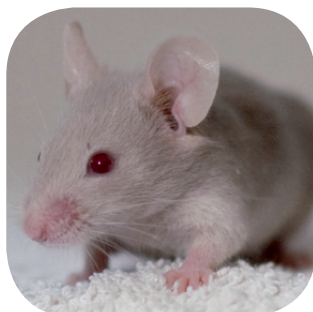
It costs about A\$30,000 to train a single dog...

Using a combination of temperament tests, behavioural observations in kennels and physiological measures, the authors of this paper assessed over 100 potential guide dogs in the Guide Dogs NSW/ACT Training Centre. Dogs were more likely to successfully complete training if they did not show anxiety (by panting or licking) when confronted with a strange dog, were less alarmed by sudden noises, or spent more time resting in the evening when in a kennel. By rehoming dogs that do not meet these criteria, the authors say, trainers can reduce the costs of guide dog training, and also direct more resources towards more suitable candidates.

Tomkins, L.M., Thomson, P.C. & McGreevy, P.D. (2011) Behavioral and physiological predictors of guide dog success, *Journal of Veterinary Behavior Clinical Applications and Research*, 6: 178-187.

RESEARCH ANIMALS

Placement of enrichments in female mouse cages



Mice housed in research facilities benefit from the provision of enrichment items in their cages, which would otherwise be bare. However, when the mice are housed in groups, the provision of a novel, high-value item may cause competition between individuals, and

lead to aggressive interactions. In this experimental study, the researchers provided enrichment items such as a running wheel, two types of nesting material, sticks coated in peanut butter, and folded pieces of paper to mice housed in pairs. In half the cages, the enrichment materials were all clustered in one part of the cage, while in the other cages, the materials were dispersed within the cage.

The researchers found that in the 'clustered' cages, there were higher levels of aggression and stereotypic behaviours observed in the mice, compared to the 'dispersed' cages. There was also a tendency in the clustered cages for one mouse to displace the other, while the latter was using an enrichment device. The authors conclude that clustering resources within an animal enclosure can cause welfare problems, and that enrichment materials should be spread out.

Akre, A.K., Bakken, M., Hovland, A.L. *et al.* (2011) Clustered environmental enrichments induce more aggression and stereotypic behaviour than do dispersed enrichments in female mice, *Applied Animal Behaviour Science*, **131**: 145-152.

The effect of housing on rhesus monkey stereotypes

Rhesus monkeys kept in zoos and laboratories often show abnormal behaviours that indicate poor welfare. Of these, motor stereotypes (MS), which include repeated movements such as pacing, flipping, twirling, swinging, bouncing, head twisting or rocking, are among the most common. Although such behaviours have been studied in the past, researchers have mostly focused on demographic risk factors such as age and sex, and early experiences of captivity. In this study, the researchers tried to identify whether such factors could interact with other variables such as housing conditions and the temperament of individual monkeys.

Upon examining the life-history data of over 200 monkeys, the researchers found that around 25%

exhibited MS, of which, pacing was the most common type. Factors such as being male, having a greater proportion of life lived indoors, having a greater proportion of life indoors singly housed, and having a greater number of anaesthesia and blood draws were risk factors for MS. In addition, the effects of single housing were most prominent in indoor-reared

...the researchers found that around 25% exhibited MS...

animals as opposed to outdoor-reared animals. Within the indoor-reared group, mother-reared individuals were more strongly affected than were nursery-reared animals. Finally, individuals with 'gentle' and 'nervous' temperaments were more likely to develop MS if they had been indoor-reared.

Vandeleest, J.J., McCowan, B. & Capitanio, J.P. (2011) Early rearing interacts with temperament and housing to influence the risk for motor stereotypy in rhesus monkeys (*Macaca mulatta*), *Applied Animal Behaviour Science*, **132**: 81-89.

Aggression training of rhesus macaques

Captive rhesus macaques kept in laboratory situations can experience high levels of stress and anxiety, and display aggressive tendencies towards humans. Such a situation not only indicates poor animal welfare, but also poses a safety risk to the humans who have to be near and handle the animals on a daily basis. In this study, therefore, the researchers trialled a training program, called contra-aggression training, to test whether macaques could be taught to reduce their aggressive behaviours towards humans

Contra-aggression training is based on the principle of positive reinforcement, where undesirable behaviours (such as aggression) are ignored by the trainer, and desirable behaviours (such as calm, cooperative behaviour) are rewarded. The researchers found that six weeks of training was able to significantly reduce, although not completely eliminate, aggressive behaviour, when the macaques were exposed to new humans, novel objects or routine husbandry procedures. The use of multiple trainers for each monkey did not speed up the training process, indicating that having a single, steady trainer might be advantageous.

Minier, D.E., Tatum, L., Gottlieb, D.H. *et al.* (2011) Human-directed contra-aggression training using positive reinforcement with single and multiple trainers for indoor-housed rhesus macaques, *Applied Animal Behaviour Science*, **132**: 178-186.

ARTICLES OF INTEREST

COMPANION ANIMALS

Søndergaard, E., Jensen, M. B. & Nicol, C.J. (2011) Motivation for social contact in horses measured by operant conditioning, *Applied Animal Behaviour Science*, **132** (2011) 131-137

FARM ANIMALS

Aquaculture

Adriaenssens, B. & Johnsson, J.I. (2011) Learning and context-specific exploration behaviour in hatchery and wild brown trout, *Applied Animal Behaviour Science*, **132**(1-2): 90-99.

Jones, H.A.C., Noble, C., Damsgård, B. *et al.* (In press) Social network analysis of the behavioural interactions that influence the development of fin damage in Atlantic salmon parr (*Salmo salar*) held at different stocking densities, *Applied Animal Behaviour Science*.

Laursen, D.C., Olsén, H.L., de Lourdes Ruiz-Gomez, M. *et al.* (2011) Behavioural responses to hypoxia provide a non-invasive method for distinguishing between stress coping styles in fish, *Applied Animal Behaviour Science*, **132**(3-4): 211-216.

Cattle

Ahola, J.K., Foster, H.A., VanOverbeke, D.L. *et al.* (2011) Survey of quality defects in market beef and dairy cows and bulls sold through livestock auction markets in the Western United States: I. Incidence rates, *Journal of Animal Science*, **89**(5): 1474-1483.

Aizaki, H., Sawada, M. & Sato, K. (In press) Consumers' attitudes toward consumption of cloned beef: the impact of exposure to technological information about animal cloning, *Appetite*.

Brcic, M., Heutinck, L.F., Wolthuis-Fillerup, M. *et al.* (2011) Prevalence of gastrointestinal disorders recorded at post-mortem inspection in white veal calves and associated risk factors, *Journal Dairy Science*, **94**(2): 853-863.

Cafe, L.M., Robinson, D.L., Ferguson, D.M. *et al.* (2011) Cattle temperament: Persistence of assessments and associations with productivity, efficiency, carcass and meat quality traits, *Journal of Animal Science*, **89**(5): 1452-1465.

Cullen, B.R. & Eckard R.J. (2011) Impacts of future climate scenarios on the balance between productivity and total greenhouse gas emissions from pasture based dairy systems in south-eastern Australia, *Animal Feed Science and Technology*, **166-167**: 721-735.

de Vries, M., Bokkers, E.A.M., Dijkstra, T. *et al.* (2011) Invited review: Associations between variables of routine herd data and dairy cattle welfare indicators, *Journal of Dairy Science*, **94**(7): 3213-3228.

Dechow, C.D., Smith, E.A. & Goodling, R.C. (2011) The effect of management system on mortality and other welfare indicators in Pennsylvania dairy herds, *Animal Welfare*, **20**: 145-158.

DeJarnette, J.M., Leach, M.A., Nebel, R.L. *et al.* (2011) Effects of sex-sorting and sperm dosage on conception rates of Holstein heifers: Is comparable fertility of sex-sorted and conventional semen plausible? *Journal of Dairy Science*, **94**(7): 3477-3483.

Dikmen, S., Ustuner, H. & Orman, A. (2011) The effect of body weight on some welfare indicators in feedlot cattle in a hot environment, *International Journal of Biometeorology*.

Dodzi, M.S. & Muchenje, V. (2011) Avoidance-related behavioural variables and their relationship to milk yield in pasture-based dairy cows, *Applied Animal Behaviour Science*, **133**(1-2): 11-17.

Earley, B., Murray, M., Prendiville, D.J. *et al.* (In press) The effect of transport by road and sea on physiology, immunity and behaviour of beef cattle, *Research in Veterinary Science*.

Forde, N., Beltman, M.E., Lonergan, P. *et al.* (2011) Oestrous cycles in *Bos taurus* cattle, *Animal Reproduction Science*, **124**(3-4): 163-169.

Graunke, K.L., Telezhenko, E., Hessle, A. *et al.* (2011) Does rubber flooring improve welfare and production in growing bulls in fully slatted floor pens? *Animal Welfare*, **20**: 173-183.

Houe, H., Sandøe, P. & Thomsen, P.T. (2011) Welfare assessments based on lifetime health and production data in Danish dairy cows, *Journal of Applied Animal Welfare Science*, **14**(3): 255 – 264.

Izzo, M.M., Kirkland, P.D., Mohler, V.L. *et al.* (2011) Prevalence of major enteric pathogens in Australian dairy calves with diarrhoea, *Australian Veterinary Journal*, **89**(5): 167-173.

Jago, J. & Kerrisk K. (2011) Training methods for introducing cows to a pasture-based automatic milking system, *Applied Animal Behaviour Science*, **131**(3-4): 79-85.

Klinlmair, K., Stevens, K.B. & Gregory, N.G. (2011) Luminance and glare in indoor cattle-handling facilities, *Animal Welfare*, **20**: 263-269.

Lawrence, K.E., Chesterton, R.N. & Laven R.A. (2011) Further investigation of lameness in cows at pasture: An analysis of the lesions found in, and some possible risk factors associated with, lame New Zealand dairy cattle requiring veterinary treatment, *Journal of Dairy Science*, **94**(6): 2794-2805.

Lievaart, J.J. & Noordhuizen, J.P.T.M. (2011) Ranking experts' preferences regarding measures and methods of assessment of welfare in dairy herds using Adaptive Conjoint Analysis, *Journal of Dairy Science*, **94**(7): 3420-3427.

McCarthy, B., Delaby, L., Pierce, K.M. *et al.* (2011) Meta-analysis of the impact of stocking rate on the productivity of pasture-based milk production systems, *animal*, **5**(05): 784-794.

O'Driscoll, K., Gleeson, D., O'Brien, B. *et al.* (2011) Does omission of a regular milking event affect cow comfort? *Livestock Science*, **138**(1-3): 132-143.

Petherick, J.C., McCosker, K., Mayer, D.G. *et al.* (2011)

Preliminary investigation of some physiological responses of *Bos indicus* heifers to surgical spaying, *Australian Veterinary Journal*, **89**(4): 131-137.

Robert, B.D., White, B.J., Renter, D.G. *et al.* (2011) Determination of lying behavior patterns in healthy beef cattle by use of wireless accelerometers, *American Journal of Veterinary Research*, **72**(4): 467-473.

Sartori, R. & Barros C.M. (2011) Reproductive cycles in *Bos indicus* cattle, *Animal Reproduction Science*, **124**(3-4): 244-250.

Siivonen, J., Taponen, S., Hovinen, M. *et al.* (2011) Impact of acute clinical mastitis on cow behaviour, *Applied Animal Behaviour Science*, **132**(3-4): 101-106.

Pigs

Barnett, J.L., Hemsworth, P.H., Butler, K.L. *et al.* (2011) Effects of stall dimensions on the welfare of pregnant sows, *Animal Production Science*, **51**(5): 471-480.

Brunberg, E., Wallenbeck, A. & Keeling, L.J. (2011) Tail biting in fattening pigs: Associations between frequency of tail biting and other abnormal behaviours, *Applied Animal Behaviour Science*, **133**(1-2): 18-25.

Bryer, P.J., Sutherland, M.A., Davis, B.L. *et al.* (2011) The effect transport and space allowance on the physiology of breeding age gilts, *Livestock Science*, **137**(1-3): 58-65.

Clouard, C., Meunier-Salaün, M.C. & Devillers, N. (2011) Development of approach and handling tests for the assessment of reactivity to humans of sows housed in stall or in group, *Applied Animal Behaviour Science*, **133**(1-2): 26-39.

de Greef, K.H., Vermeer, H.M., Houwers, H.W.J. *et al.* (In press) Proof of Principle of the Comfort Class concept in pigs: Experimenting in the midst of a stakeholder process on pig welfare, *Livestock Science*.

Donald, R.D., Healy, S.D., Lawrence, A.B. *et al.* (In press) Emotionality in growing pigs: Is the open field a valid test? *Physiology & Behavior*.

Hemsworth, P.H., Smith, K., Karlen, M.G. *et al.* (2011) The choice behaviour of pigs in a Y maze: Effects of deprivation of feed, social contact and bedding, *Behavioural Processes*, **87**(2): 210-217.

Herskin, M.S., Bonde, M.K., Jørgensen, E. *et al.* (2011) Decubital shoulder ulcers in sows: a review of classification, pain and welfare consequences, *animal*, **5**(05): 757 - 766.

Hoge, M.D. & Bates, R.O. (2011) Developmental factors that influence sow longevity, *Journal of Animal Science*, **89**(4): 1238-1245.

Horchner, P.M. & Pointon, A.M. (In press) HACCP-based program for on-farm food safety for pig production in Australia, *Food Control*.

Imfeld-Mueller, S., Van Wezemael, L., Stauffacher, M. *et al.* (2011) Do pigs distinguish between situations of different emotional valences during anticipation? *Applied Animal Behaviour Science*, **131**(3-4): 86-93.

Li, Y. & Wang, L. (2011) Effects of previous housing system on

agonistic behaviors of growing pigs at mixing, *Applied Animal Behaviour Science*, **132**(1-2): 20-26.

Patterson-Kane, E.G., Kirkden, R.D. & Pajor, E.A. (2011) Measuring motivation in swine: The food-metric scale, *Journal of Applied Animal Welfare Science*, **14**(3): 175-186.

Pedersen, L.J., Berg, P., Jørgensen, G. *et al.* (2011) Neonatal piglet traits of importance for survival in crates and indoor pens, *Journal of Animal Science*, **89**(4): 1207-1218.

Pittman Elmore, M.R., Garner, J.P., Johnson, A.K. *et al.* (In press) Getting around social status: Motivation and enrichment use of dominant and subordinate sows in a group setting, *Applied Animal Behaviour Science*.

Soede, N.M., Langendijk, P., Kemp B. (2011) Reproductive cycles in pigs, *Animal Reproduction Science*, **124**(3-4): 251-258.

Swaby, H. & Gregory, N.G. (In press) A note on the frequency of gastric ulcers detected during post-mortem examination at a pig abattoir, *Meat Science*.

Tori, M. (2011) Decreasing stress, aggression and injury in pigs housed in intensive production systems, Essay selected for The Veterinarian magazine Prize for Written Communication for Sydney University third-year veterinary science students, *The Veterinarian*, June 2011.

Trezona, M., Mullan, B.P., D'Souza, D.N. *et al.* (2011) Influence of housing type and age in female pigs. 1. Effects on growth performance and fat deposition and distribution in the carcasses of female Large White x Landrace pigs grown from 5.5 to 120 kg liveweight, *Animal Production Science*, **51**(5): 426-433.

Trezona, M., Mullan, B.P., D'Souza, D.N. *et al.* (2011) Influence of housing type and age in female pigs. 2. Effects on biochemical indicators of fat metabolism and the fatty acid profile of belly fat and back fat depots, *Animal Production Science*, **51**(5): 434-442.

Tuytens, F.A.M., Vanhonacker, F., Verhille, B. *et al.* (In press) Pig producer attitude towards surgical castration of piglets without anaesthesia versus alternative strategies, *Research in Veterinary Science*.

Van Beirendonck, S., Driessen, B., Verbeke, G., *et al.* (2011) Behavior of piglets after castration with and without CO₂-anesthesia, *Journal of Animal Science*.

Vasdal, G., Ostensen, I., Melisova, M. *et al.* (2011) Management routines at the time of farrowing-effects on teat success and postnatal piglet mortality from loose housed sows, *Livestock Science*, **136**(2-3): 225-231.

Vogel, K.D., Badtram, G., Claus, J.R. *et al.* (2011) Head-only followed by cardiac arrest electrical stunning is an effective alternative to head-only electrical stunning in pigs, *Journal of Animal Science*, **89**(5): 1412-1418.

Poultry

Abbas, R.Z., Iqbal, Z., Blake, D. *et al.* (2011) Anticoccidial drug resistance in fowl coccidia: the state of play revisited (2011), *World's Poultry Science Journal*, **67**(02): 337-350.

- Barker, K.J., Coufal, C.D., Purswell, J.L. *et al.* (2011) In-house windrowing of a commercial broiler farm during the summer months and its effect on litter composition, *Journal of Applied Poultry Research*, **20**(2): 168-180.
- Berrang, M.E., Smith, D.P. & Meinersmann, R.J. (2011) Variations on standard broiler processing in an effort to reduce *Campylobacter* numbers on postpick carcasses, *Journal of Applied Poultry Research*, **20**(2): 197-202.
- Brunberg, E., Jensen, P., Isaksson, A. *et al.* (2011) Feather pecking behavior in laying hens: Hypothalamic gene expression in birds performing and receiving pecks, *Poultry Science*, **90**(6): 1145-1152.
- Collins, S., Forkman, B., Kristensen, H.H. *et al.* (In press) Investigating the importance of vision in poultry: Comparing the behaviour of blind and sighted chickens, *Applied Animal Behaviour Science*.
- Dekker, S.E.M., de Boer, I.J.M., Vermeij, I. *et al.* (In press) Ecological and economic evaluation of Dutch egg production systems, *Livestock Science*.
- Harlander-Matauschek, A. & Bas Rodenburg, T. (In press) Applying chemical stimuli on feathers to reduce feather pecking in laying hens, *Applied Animal Behaviour Science*.
- Hepworth, P.J., Nefedov, A.V., Muchnik, I.B. *et al.* (2011) Hock burn: an indicator of broiler flock health, *Veterinary Record*, **168**(11): U14-U16.
- Huneau-Salaün, A., Guinebretière, M., Taktak, A. (2011) Furnished cages for laying hens: study of the effects of group size and litter provision on laying location, zootechnical performance and egg quality, *animal*, **5**(06): 911 – 917.
- Kaufmann, F., Daş, G., Sohnrey, B. *et al.* (In press) Helminth infections in laying hens kept in organic free range systems in Germany, *Livestock Science*.
- Kjaer, J.B., Glawatz, H., Scholz, B. *et al.* (2011) Reducing stress during welfare inspection: validation of a non-intrusive version of the LayWel plumage scoring system for laying hens, *British Poultry Science*, **52**(2): 149-154.
- Makagon, M.M. & Mench, J.A. (2011) Floor laying by Pekin ducks: Effects of nest box ratio and design, *Poultry Science*, **90**(6): 1179-1184.
- Mitterer-Istyagin, H., Ludewig, M., Bartels, T. *et al.* (2011) Examinations on the prevalence of footpad lesions and breast skin lesions in BUT Big 6 fattening turkeys in Germany. Part II: Prevalence of breast skin lesions (breast buttons and breast blisters), *Poultry Science*, **90**(4): 775-780.
- Nicol, C.J., Caplen, G., Edgar, J. *et al.* (2011) Relationships between multiple welfare indicators measured in individual chickens across different time periods and environments, *Animal Welfare*, **20**: 133-143.
- Nicol, C.J., Caplen, G., Statham, P. *et al.* (In press) Decisions about foraging and risk trade-offs in chickens are associated with individual somatic response profiles, *Animal Behaviour*.
- Nordquist, R.E., Heerkens, J.L.T., Bas Rodenburg, T. *et al.* (2011) Laying hens selected for low mortality: Behaviour in tests of fearfulness, anxiety and cognition, *Applied Animal Behaviour Science*, **131**(3-4): 110-122.
- Patwardhan, D. & King, A. (2011) Review: feed withdrawal and non feed withdrawal moult, *World's Poultry Science Journal*, **67**(02): 253 – 268.
- Pickel, T., Schrader, L. & Scholz, B. (2011) Pressure load on keel bone and foot pads in perching laying hens in relation to perch design, *Poultry Science*, **90**(4): 715-724.
- Racicot, M., Venne, D., Durivage, A. *et al.* (In press) Description of 44 biosecurity errors while entering and exiting poultry barns based on video surveillance in Quebec, Canada, *Preventive Veterinary Medicine*.
- Sandilands, V., Raj, A.B.M., Baker, L. *et al.* (2011) Aversion of chickens to various lethal gas mixtures, *Animal Welfare*, **20**: 253-262.
- Thiruvankadan, A.K., Prabakaran, R. & Panneerselvam, S. (2011) Broiler breeding strategies over the decades: an overview, *World's Poultry Science Journal*, **67**(02): 309-336.
- Toghyani, M., Toghyani, M., Gheisari, A. *et al.* (2011) Evaluation of cinnamon and garlic as antibiotic growth promoter substitutions on performance, immune responses, serum biochemical and haematological parameters in broiler chicks, *Livestock Science*, **138**(1-3): 167-173.
- Tuytens, F.A.M., Sonck, B., Staes, M. *et al.* (2011) Survey of egg producers on the introduction of alternative housing systems for laying hens in Flanders, Belgium, *Poultry Science*, **90**(4): 941-950.
- Villagra, A., Olivas, I., Benitez, V. *et al.* (2011) Evaluation of sludge from paper recycling as bedding material for broilers, *Poultry Science*, **90**(5): 953-957.
- Wu, K. & Hocking, P.M. (2011) Turkeys are equally susceptible to foot pad dermatitis from 1 to 10 weeks of age and foot pad scores were minimized when litter moisture was less than 30%, *Poultry Science*, **90**(6): 1170-1178.

Sheep/goats

- Bartlewski, P.M., Baby, T.E., Giffin, J.L. (2011) Reproductive cycles in sheep, *Animal Reproduction Science*, **124**(3-4): 259-268.
- Bickell, S., Nowak, R., Poindron, P. *et al.* (2011) Challenge by a novel object does not impair the capacity of ewes and lambs selected for a nervous temperament to display early preference for each other, *Animal Production Science*, **51**(6): 575-581.
- Coulon, M., Hild, S., Schroeder, A. *et al.* (In press) Gentle vs. aversive handling of pregnant ewes: II. Physiology & behavior of the lambs, *Physiology & Behavior*.
- Hild, S., Clark, C.C.A., Dwyer, C.M. *et al.* (2011) Ewes are more attentive to their offspring experiencing pain but not stress, *Applied Animal Behaviour Science*, **132**(3-4): 114-120.
- Napolitano, F., De Rosa, G., Girolami, A. *et al.* (In press) Avoidance distance in sheep: Test-retest reliability and relationship with stockmen attitude, *Small Ruminant Research*.
- Nordmann, E., Keil, N.M., Schmied-Wagner, C. *et al.* (2011) Feed barrier design affects behaviour and physiology in goats,

Applied Animal Behaviour Science, **133**(1-2): 40-53.

Phythian, C.J., Michalopoulou, E., Jones, P.H. *et al.* (2011) Validating indicators of sheep welfare through a consensus of expert opinion, *animal*, **5**(06): 943-952.

Rault, J.L., Boissy, A. & Boivin, X. (2011) Separation distress in artificially-reared lambs depends on human presence and the number of conspecifics, *Applied Animal Behaviour Science*, **132**(1-2): 42-50.

Sanger, M.E., Doyle, R.E., Hinch, G.H. *et al.* (2011) Sheep exhibit a positive judgement bias and stress-induced hyperthermia following shearing, *Applied Animal Behaviour Science*, **131**(3-4): 94-103.

Stubsjoen, S.M., Hektoen, L., Valle, P.S. *et al.* (2011) Assessment of sheep welfare using on-farm registrations and performance data, *Animal Welfare*, **20**: 239-251.

Verbeek, E., Waas, J.R., McLeay, L. *et al.* (2011) Measurement of feeding motivation in sheep and the effects of food restriction, *Applied Animal Behaviour Science*, **132**(3-4): 121-130.

General

Henneman, A., Peterson, A., Albrecht, J. *et al.* (2011) Creating a food web site that brings together gatekeepers from farm to factory to fork, *Journal of Nutrition Education and Behavior*, **43**(4), Supplement 1: S2.

Kues, W.A. & Niemann, H. (In press) Advances in farm animal transgenesis, *Preventive Veterinary Medicine*.

Marahrens, M., Kleinschmidt, N., Di Nardo, A. *et al.* (In press) Risk assessment in animal welfare – Especially referring to animal transport, *Preventive Veterinary Medicine*.

Rushen, J., Butterworth, A. & Swanson, J.C. (2011) Animal Behavior and Well-Being Symposium: Farm animal welfare assurance: Science and application, *Journal of Animal Science*, **89**(4): 1219-1228.

ANIMALS USED FOR SPORT, ENTERTAINMENT, RECREATION AND WORK

Shultz, A.D., Murchie, K.J., Griffith, C. (2011) Impacts of dissolved oxygen on the behavior and physiology of bonefish: Implications for live-release angling tournaments, *Journal of Experimental Marine Biology and Ecology*, **402**(1-2): 19-26

WILD ANIMALS

Cockram, M.S., Shaw, D.J., Milne, E. *et al.* (2011) Comparison of effects of different methods of culling red deer (*Cervus elaphus*) by shooting on behaviour and post mortem measurements of blood chemistry, muscle glycogen and carcase characteristics, *Animal Welfare*, **20**: 211-224.

Roberts, L.J., Taylor, J., Garcia de Leaniz, C. (In press) Environmental enrichment reduces maladaptive risk-taking behavior in salmon reared for conservation, *Biological Conservation*.

Sanders, D.L., Xie, F., Mauldin, R.E., *et al.* (2011) Efficacy of ERL-4221 as an ovotoxin for feral pigs (*Sus scrofa*), *Wildlife Research*, **38**(2).

MISCELLANEOUS

Mendl, M., Paul, E.S. & Chittka, L. (2011) Animal behaviour: Emotion in invertebrates? *Current Biology*, **21**(12): R463-R465.

O'Callaghan, T. (2011) Exploring animals' emotional experiences, *The New Scientist*, **210**(2811): 48.

Ohl, F. & van der Staay, F.J. (In press) Animal welfare: At the interface between science and society, *The Veterinary Journal*.

Email science@rspca.org.au to subscribe.