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ANIMAL WELFARE SCIENCE UPDATE

ISSUE 56 – APRIL 2017

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. **Email science@rspca.org.au to subscribe.**

ANIMALS USED FOR SPORT, ENTERTAINMENT, RECREATION AND WORK

Noseband use in equestrian sports - An international study

It is commonly recommended that the noseband on a bridle should be loose enough to fit two fingers between the horse's face and the noseband. However, tightening the noseband has been associated with improved responsiveness to the bit and preventing the horse from opening its mouth, both of which are desirable outcomes for the rider during equestrian events. Welfare concerns arise because a tight noseband may be uncomfortable for the horse, with preliminary research indicating that they elicit a stress response and may reduce blood flow to the muzzle. In response to increasing concerns about tight nosebands, a taper gauge was recently developed specifically for measuring tightness. However, the use of this device, and indeed any regulation of noseband tightness during equestrian events, has been limited. The aim of this study was to quantify current noseband usage during equestrian events.

Data on noseband design, position and tightness were collected from 737 horses at equestrian competitions in Ireland, England and Belgium. The riders were approached either directly before or after an event, and the bridle measured using calipers and the taper gauge described above. The equestrian events included dressage, eventing and hunter performance competitions.

Almost half (44%) of the horses in this sample had nosebands tightened to the point that the taper gauge could not be inserted between the bridle and the horse's face. This is extremely tight, and raises concerns for the welfare of these horses. The majority of these horses were from eventing competitions, and the tightness of the noseband may be a method used by riders to keep the horse's mouth shut. Opening the mouth during an event is penalised by the judges, as it is seen as resistance to the rider's commands. While there are currently no welfare assessments available for the impact of tight nosebands, potential impacts relate to behavioural restriction, pain, and excessive pressure on facial muscles, nerves and vasculature.

Doherty O, Casey V, McGreevy P (2017) Noseband use in equestrian sports - an international study. PLOS One 12 doi:10.1371/journal.pone.0169060

Whip rule breaches in a major Australian racing jurisdiction

The use of whips in the horse racing industry is a contentious issue, and the Australian racing industry imposes rules relating to whip use during races. Whips must be padded, and jockeys are restricted in the number and technique of whip strikes, with the exception of the last 100m before the finish line. It is not known specifically whether whipping is painful for horses, but in the absence of evidence to the contrary, the authors assume that whipping is painful. Compliance with the whip rules is self-regulated by the racing industry, with race Stewards responsible for identifying breaches and imposing penalties.

This study examined Steward Reports and Race Diaries for all races that occurred in NSW and the ACT during 2013 to determine the number and type of whip rule breaches, what penalties were imposed, and other details of the race (e.g. length, prize pool, jockey information). There are 24 different types of breaches including whip use where horses are clearly winning, not responding or are out of contention and after the race finishes.

During 2013, there were 5,604 horse races, with 56,456 starters. A whip rule breach was reported for 348 starts, with 37 of these reporting two whip rule breaches. The most common breaches related to the frequency of whip use, and for raising the whip arm above shoulder height. Penalties received for breaches were relatively low, with approximately two thirds receiving reprimands only, and one third receiving fines of around $200. Because around half of the offenders were repeat offenders, it would appear that these penalties are not sufficient deterrents to offset the gains achieved by winning, as whip breaches were more frequently seen in winning or placing horses. It was also determined that more breaches were recorded at metropolitan locations than country or provincial locations. The authors recommend examination of the surveillance techniques used by Stewards to ensure that they are accurately monitoring all whip use during races. The authors also recommend that racing compliance data be reviewed annually to further inform whip-use policy and regulation.

Hood J, McDonald C, Wilson B et al (2017) Whip rule breaches in a major Australian racing jurisdiction: Welfare and regulatory implications. Animals 7(1),4.

Factors associated with dust dispersed in the air of indoor riding arenas

Exposure to dust is a risk factor for respiratory disease in humans and horses. In indoor riding arenas, dust is stirred up by horse movement. The increased respiration of the horses while exercising in this dusty environment may place them at greater risk of respiratory disease; however the air quality inside riding arenas has not been previously assessed. The aim of this study was to evaluate airborne dust concentrations in indoor riding arenas.

Four indoor riding arenas in Germany were selected for study, and the air quality in these arenas was assessed every month for one year. A hand-held dust monitor was used to measure dust concentration in the morning prior to any riding occurring that day. The air was also sampled at two different heights to approximate the height of the horse's nose (1.5m) and the rider's nose (2.5m). Once the initial samples were collected, a single horse and rider entered the arena and performed a standardised riding routine for 20 minutes. Once completed, the air was re-sampled for 3 mins after the horse had left the arena. Samples of the flooring were also collected monthly, with all arenas using sand flooring except for one, which used a mixture of sand and sawdust.

The airborne dust concentrations within the study arenas were found to be greater after the horse riding routine, when the arena had direct access to the stables, at 1.5m height from the ground, and during the colder months when the floors were not watered to reduce dust levels. While the observed dust concentrations were below the recommended limits set for horse stables, the authors state that the current study was only conducted with one horse. Airborne dust concentrations are likely to increase with more riders or longer riding periods. With approximately 35% of riding instructors experiencing chronic bronchitis, further investigations into the pathogenicity of airborne dust in riding arenas should be investigated.

Lühe T, Mielenz N, Schulz J et al (2017) Factors associated with dust dispersed in the air of indoor riding arenas. Equine Veterinary Journal 49:73-78.

Developing a horse welfare assessment protocol

Traditionally, the protocols used for assessing horse welfare have focused on whether the horse has access to the appropriate resources or not (e.g. space allowance, water availability, etc.), rather than the actual physical state of the horse or how those resources are used. Incorporating animal-based measures of welfare, as well as management-based measures, allows for a more comprehensive assessment to be performed. A standardised welfare protocol that incorporates resource, animal and management-based measures will provide horse owners with a reliable and accurate method of assessing their horse's welfare, leading to early detection and remediation of welfare issues. The current study developed a horse welfare assessment protocol based on the Welfare Quality® protocol used for farm animals in the EU, and examined the feasibility and repeatability of this protocol for use by horse owners and managers.

The welfare assessment protocol was developed through a literature review and consultation with horse welfare experts, and considered the following principles: good feeding, good housing, good health, and appropriate behaviour. The welfare assessment protocol was then tested *in situ* at two riding schools in Sweden, where the horses were housed in paddocks during the day and indoors at night (in individual boxes or tie-up stalls). The welfare assessments were conducted on each horse twice, with a gap of 16–25 days between each assessment, to assess repeatability of the protocol. All assessments were performed by the same person with a total of 37 horses being assessed.

Only about two-thirds of the variables had good repeatability (+85%) between the two assessments. This was considered to be due to actual changes in the many variables being measured, rather than unreliability of the assessor. For example, a number of horses experienced an increase in exercise sessions between the first and second assessments, resulting in a decrease in body condition score and thus reducing the repeatability of this measure. To improve the accuracy of the protocol, the authors suggest including measures of indoor climate regulation, the human-animal relationships, feeding methods and managerial routines.

Viksten SM, Visser EK, Nyman S et al (2017) Developing a horse welfare assessment protocol. Animal Welfare 26:59-65.

COMPANION ANIMALS

Free-roaming cat populations and Trap-Neuter-Return programs

Free-roaming cat populations in urban areas are increasing in size, and these populations must be managed for public health and ecological reasons, as well as for the welfare of the cats themselves. Trap-Neuter-Return (TNR) programs are a method of non-lethal population management that involves trapping free-roaming cats, surgically sterilising them and then releasing them at their capture site. This approach can reduce the number of kittens born, as well as reducing the incidence of unwanted behaviours in the cats, such as aggression. The aim of this study was to estimate the size of free-roaming cat populations in a highly urban area (New York City) in North America, and to monitor the impact of a year-long TNR program on those populations.

Free-roaming cat populations were estimated using a sight-resight method. Four transect lines in urban areas (each approximately 12km long) were walked weekly for one month at the beginning and end of the study. Two observers photographed every cat that they saw to allow identification using coat characteristics and age. Neutered cats were identified visually by missing 'ear tips', as the tip of the left ear is removed following sterilisation for this purpose. Cat populations were estimated from this data and the impact of the TNR program calculated.

Cat populations were estimated at 2.6–4.1 cats/km between different transect sites, with 129 individuals sighted in the first year and 155 sighted in the second year. There was high turnover of cats in the population, with only 2-12% of cats re-sighted during the second observation period. In total, 185 cats were trapped, sterilised and released, and sightings of neutered cats in the study areas increased to 50%. This was substantial, but is still lower than the 75-80% needed to reduce the size of the population. The authors did not find a significant reduction in the population of adults or juveniles following the year-long TNR program, and discussed the methodological issues associated with trapping sufficient numbers of cats for sterilisation. Reducing the cat population in highly urban areas using TNR would require a substantial effort over a longer time period.

Kilgour RJ, Magle SB, Slater M et al (2017) Estimating free-roaming cat populations and the effects of one year Trap-Neuter-Return management effort in a highly urban area. Urban Ecosystems 20(1):207-216.

Assessing stress in dogs during a visit to the veterinary clinic

Dogs may experience stress during visits to the vet. Because some animals mask their pain as a protective mechanism, and because pain and stress elicit similar responses in animals, assessing stress during veterinary visits can be difficult and it is not clear who would be best at making this assessment. The owner is more familiar with the dog's normal behaviour, but the veterinarian is more familiar with the indicators of stress. The aim of this study was to determine whether owners, veterinarians, vet nurses and researchers made similar assessments of dog stress in veterinary clinics, and whether these assessments could be correlated with standardised measures of stress in dogs.

233 dog owners attending a Swedish animal hospital completed a questionnaire scoring their dog's levels of stress and pain on a scale of 1–10. These dogs were also scored for stress and pain by the veterinarian, the vet nurse, and the researcher. Of the 233 dogs that had questionnaires completed, 105 participated in three behavioural tests that assessed their response to the researcher (social contact test), their willingness to play (play test), and their willingness to eat a treat (treat test). The play test and treat test were both performed twice, once inside the clinic and once outdoors.

Pain assessments were in agreement, however the vets and vet nurses assessed stress as being higher than the owners and researcher did. This may have been due to the vets and vet nurses assessing the dogs during the consult, which may have been a more stressful situation for the dogs than the waiting room, where the owners and researcher made their assessments. The dogs were more likely to play and eat the treat when outside the clinic, indicating that the clinic was perceived negatively. Dogs that scored higher for stress spent less time with the researcher in the social contact test, and the authors conclude that the way a dog greets an unfamiliar person, combined with owner, vet nurse and veterinarian ratings of stress may provide a practical method of assessing stress in dogs during veterinary visits.

Lind AK, Hydbring-Sandberg E, Forkman B et al (2017) Assessing stress in dogs during a visit to the veterinary clinic: Correlations between dog behavior in standardized tests and assessments by veterinary staff and owners. Journal of Veterinary Behavior 17:24-31.

Assessing upper airway obstruction in three brachycephalic breeds of dogs

Brachycephalic breeds of dogs, such as pugs and bulldogs, have been artificially selected for short muzzles. This can result in brachycephalic obstructive airway syndrome (BOAS), with associated respiratory distress, loss of respiratory function, gastrointestinal disorders, and intolerance of exercise. Current methods of diagnosing BOAS involve subjective and invasive assessments (such as during anaesthesia), however a new, non-invasive method of assessing respiratory function in dogs has been developed. Whole-Body Barometric Plethysmography (WBBP) involves placing a dog in a sealed barometric chamber and recording the changes in pressure caused by the dogs breathing. Variables that can be measured include respiration rate, respiration volume, and respiration duration. This allows respiratory function to be recorded and analysed in an objective manner, leading to an accurate diagnosis.

The respiratory function of 100 French Bulldogs, 100 Pugs, 66 Bulldogs and 28 non-brachycephalic control dogs were examined using two methods: the standard assessment procedures of scoring respiratory effort before and after exercise on a grade of 0–3; and the new assessment that involved placing the dogs in a barometric chamber for WBBP and calculating an index score of 1–100. In addition, data was collected on body weight, body condition score and nostril width for each dog.

Using the standard assessment procedure, 60% of Pugs, 46% of French Bulldogs and 40% of Bulldogs were diagnosed with moderate to severe BOAS (Grade 2/3). Obesity and stenotic nares (narrow nostrils) were highly associated with BOAS. The WBBP was able to discriminate between Grade 0/1 dogs and Grade 2/3 with excellent accuracy, and the authors conclude that WBBP can be used to accurately diagnose BOAS. It should be noted that 40–50% of the dogs assessed in this study were found to be moderately to severely affected by BOAS, but had not received treatment. This is a welfare concern considering the increasing popularity of brachycephalic dog breeds as pets in the UK.

Liu NC, Adams VJ, Kalmar L et al (2016) Whole-body barometric plethysmography characterizes upper airway obstruction in 3 brachycephalic breeds of dogs. Journal of Veterinary Internal Medicine 30:853-865.

Guardians' perceptions of dogs' welfare and behaviours related to visiting the veterinary clinic

Veterinary visits can be stressful for dogs, and most dogs display fearful and anxious behaviours in the clinic prior to seeing the vet. This negative subjective experience is a welfare concern for dogs, particularly as a dog may become sensitised to the clinic and experience increased fear with subsequent visits. This in turn may discourage owners from seeking veterinary attention to avoid stressing their dog. A further concern is that a fearful animal that is unable to escape may resort to aggression, which increases the risk of injury to the veterinarian. This study investigated owner perceptions of their dog's behaviour to assess stress in dogs during different stages of their veterinary visit.

A questionnaire was administered to 906 dog owners while in the waiting room of 35 veterinary clinics in Italy. Two sections of the questionnaire collected information on the characteristics and history of the dog, and the owner's previous behaviour in relation to the dog's health care. The third section assessed the behaviour of both the veterinarian and dog during different stages of the clinical visit (in the waiting room, entering the examination room, and in the examination room).

According to the owner reports, a high proportion of dogs experienced poor welfare during all three phases of the veterinary visit. A dog was more likely to show undesirable behaviour at the clinic if it had not been to the vet since puppyhood, if it did not accept medical treatments from the owner, and if the owner scolded the dog when it refused treatments. Scolding for refusing treatments was also associated with increased aggression toward the owner and the vet, and 6% of owners were bitten during the examination. Dogs were calmer during examination when the vet took the time to interact with the dog and offer a treat prior to examination. The authors conclude that it is important for veterinarians to both approach dogs in an appropriate manner before examining them, and to educate owners in ways to reduce and prevent their dogs becoming fearful of veterinary visits, such as through habituation and a reduction in scolding.

Mariti C, Pierantoni L, Sighieri C et al (2017) Guardians' perceptions of dogs' welfare and behaviors related to visiting the veterinary clinic. Journal of Applied Animal Welfare Science 20:24-33.

Adoption and relinquishment interventions at the animal shelter

There are approximately 78 million pet dogs in the United States, and nearly 4 million of these dogs enter animal shelters every year. Dogs may enter animal shelters due to owner relinquishment, being stray, being returned after adoption, or due to confiscation for animal cruelty. Over 30% of the dogs entering a shelter are euthanased, and shelter euthanasia is the leading cause of canine death in the US. This paper reviews the efficacy of current interventions used by animal shelters to increase adoption rates and reduce relinquishments.

The physical appearance of a dog is the largest factor determining whether a potential adopter will ask to remove the dog from their kennel for further interaction. In general, dogs that are lighter in colour, longer haired, younger and smaller were more likely to be adopted. The behaviour of the dogs during the out-of-kennel inspection was also an important determinant of adoption rates. Dogs that lay down next to the adopter and were playful had higher rates of adoption. Encouraging the dogs to perform these behaviours during interactions with adopters led to a 2.5 fold increase in adoption rates. Obedience training has also been shown to improve adoption rates, and positive interactions with people improve the welfare of shelter dogs.

Approximately 7–15% of adopted dogs are returned to the shelter, with many of these being returned during the first month. Reasons for both relinquishment and return are similar, and have been related to behavioural problems, lack of housing that accommodates dogs, and age, with dogs under two years of age much more likely to be relinquished. There are no interventions that systematically reduce the number of dogs entering shelters, however it appears that taking the time to match dogs with owners, such as through trial adoptions, combined with behavioural assessments and educating owners about how to deal with common behavioural problems, may reduce the number of dogs returned to shelters.

Protopopova A, Gunter LM (2017) Adoption and relinquishment interventions at the animal shelter: A review. Animal Welfare 26:35-48.

Prevalence of vertebral malformations in French bulldogs, Pugs and English bulldogs with and without associated neurological deficits

Small brachycephalic breeds of dog often have congenital defects of the spinal vertebrae, such as fused vertebrae (block vertebrae) or wedge-shaped vertebrae (hemivertebrae), in the thoracic region. It is the wedge-shaped vertebrae that give these breeds their characteristic screw-tail. While these malformations are common, the majority are not associated with spinal disease. It was the aim of this study to determine the prevalence of vertebral spinal malformations in screw-tail breeds of brachycephalic dog.

The digital records of 181 dogs that received a CT or MRI at the Royal Veterinary College, UK, were reviewed retrospectively for thoracic vertebral malformations. This group was comprised of 63 French bulldogs, 77 Pugs and 41 English bulldogs. The type of spinal malformation, as well as its location, was compared to the breed of dog and the clinical symptoms that it presented with at the clinic.

This research found that vertebral malformations in neurologically normal dogs are highly prevalent. Ten dogs had clinically relevant malformations that resulted in neurological symptoms, such as weak hind legs. Of the neurologically normal dogs (no neurological symptoms present), 19% had no malformations at all, 81% had at least one vertebral malformation and 60% had multiple malformations. Hemivertebrae were more frequently diagnosed in French bulldogs and English bulldogs, however this malformation was more likely to be associated with neurological symptoms when it occurred in Pugs. This may be due to Pugs developing a different subtype of hemivertebrae than the other two breeds, however the vertebral subtypes were unable to be identified accurately with the images used. Further research may elucidate these differences.

Ryan R, Gutierrez-Quintana R, ter Haar G et al (2017) Prevalence of thoracic vertebral malformations in French bulldogs, Pugs and English bulldogs with and without associated neurological deficits. The Veterinary Journal 221:25-29.

Influence of chemical signals on the social lives of domestic cats

Chemical signalling is a vital aspect of communication in cats that contributes to both species-typical behaviours and problem behaviours, yet little is understood on how it could be used to improve cat welfare. Chemical signalling in cats uses pheromones to elicit a behavioural response in the receiver, and "chemical signatures", which are used to identify individuals. This review examines chemical signalling in cats and its potential applications for improving cat welfare.

Cats produce scent from scent glands located around the body, including the head, paws and anal region. The cat rubs these glands on surfaces to deposit its scent, and this can be used to mark objects and other individuals as a sign of affiliation. Of the five facial pheromones secreted from the cheek glands, two have been synthesised and are available commercially to reduce anxiety (Feliway™) and increase friendliness (Felifriend™). Cats also use scratching, saliva, urine and faeces to communicate, and as inappropriate scratching and elimination behaviours are common reasons for relinquishment to shelters, it is important to understand these methods of signalling. In addition to the chemical stimuli produced by conspecifics, cats also respond to other chemical stimuli, such as catnip, and the use of these odours has been suggested for use in enrichment programs.

Being able to smell the nest calms kittens, presumably by confirming that they are in a safe location, and the authors suggest that adult cats may rely on familiar scent-marks in the home to feel safe. Removing these scents with cleaning products may increase anxiety, and is not recommended by the authors. Observations on marking behaviour suggest that cats mark their home territories to establish them as a familiar spatial reference point, rather than as a deterrent to other cats. Cats are also able to discriminate many different characteristics of conspecifics through smell, and introducing cats through scent before physically meeting may reduce stress. In conclusion, there are many ways in which scent contributes to the social lives of cats, and a better understanding of cat chemical signals could improve the welfare of domestic cats.

Vitale Shreve KR, Udell MAR (2017) Stress, security, and scent: The influence of chemical signals on the social lives of domestic cats and implications for applied settings. Applied Animal Behaviour Science 187:69-76.

Welfare of dairy cows in continuously housed and pasture-based production systems

There is an increasing global trend toward the continuous indoor housing of dairy cows due to the improvements in efficiency this system provides over pasture-based systems. The two systems differ mainly in terms of nutrition and housing, with indoor-housed cows receiving concentrates rather than grazing. The intensive nature of indoor systems is generally perceived by the public to result in poor animal welfare, and the aim of this review is to scientifically compare the welfare of cows housed in both systems.

In terms of health, indoor housing systems are generally associated with a greater prevalence of lameness, hock lesions, mastitis, dystocia, uterine disease and mortality due to higher pathogen concentrations, harder surfaces, and reduced opportunities for lying and exercise than the pasture-based systems. In comparison, the cows on pasture-based systems have an increased risk of endoparasites and disease due to contact with neighbouring herds and wildlife.

In terms of behaviour, indoor housing resulted in less time spent feeding and lying than in pasture-based systems. This is presumably due to the cows being fed concentrates rather than grazing, and the reduced space allowances prevent cows from the synchronous lying behaviour they perform on pasture. Competition for feed also resulted in increased aggression for indoor-housed cows. Despite spending more time feeding, the pasture-based cows showed evidence of a negative energy balance, and were exposed to weather extremes that compromise welfare and elicit a stress response. When given a choice, cows will generally spend about half of the day in indoor housing, but show a strong preference for pasture at night time. To summarise, pasture-based systems have been shown to benefit cows in terms of improved health and normal behaviour, but may not be meeting their nutritional and shelter requirements. The authors conclude that there are considerable welfare benefits to providing pasture access to dairy cows, and research should be directed toward incorporating these benefits into the indoor housing environment.

Arnott G, Ferris CP, O'Connell NE (2017) Review: welfare of dairy cows in continuously housed and pasture-based production systems. Animal 11:261-273.

Hair cortisol as a physiological measure of stress response

Measuring stress is an important component of animal welfare assessment, and this is usually done by assessing the concentration of cortisol (a stress hormone) in the blood. However, blood sampling can be stressful, and it may not be clear if the measured cortisol concentrations are due to the blood sampling procedure or due to other stressors. Measuring cortisol in hair rather than blood avoids this issue by providing a non-invasive record of average cortisol concentrations over long periods. While unable to measure acute changes in blood cortisol concentrations, this method may provide a measure of chronic stress.

There are several difficulties with measuring hair cortisol. Hair growth rates can vary, making it difficult to quantify the period of time taken to grow the hair sample. Secondly, the amount of cortisol within a hair fibre can vary due to hair growth rate, density of hair follicles, sampling location on the body, gender, age, adiposity (fatness), hair colour, and position along the hair fibre. In fact, very high concentrations of cortisol in the blood will cause hair to stop growing. These factors should be taken into account when measuring hair cortisol. And finally, the specific mechanism by which cortisol enters the hair fibre is not yet fully understood.

Despite these limitations, hair cortisol can provide an approximate indicator of chronic stress in animals and humans. Significant correlations have been found between cortisol in hair and other sampling mediums, such as saliva and faeces, when repeated sampling over time is used. The relationships were strongest for the faecal comparisons, presumably due to the longer timeframe involved in forming faeces compared to saliva, which is thus more similar to hair formation. Hair cortisol has also been elevated following repeated administration of ACTH (to artificially elevate blood cortisol concentrations), and is higher for both humans and animals exposed to chronic stressors such as chronic pain, mental and physical illness, reproductive status, fearfulness and low socioeconomic status. Hair cortisol has potential as a measure of chronic stress, but a great deal of further research is required before it can be used accurately.

Burnard C, Ralph C, Hynd P et al (2017) Hair cortisol and its potential value as a physiological measure of stress response in human and non-human animals. Animal Production Science 57:401-414.

In-ovo sexing of 14-day-old chicken embryos

Hatcheries for the egg industry produce both male and female chicks, but only the female chicks are required for egg production. The male chicks are culled at one day of age, and approximately 42 million male chicks are culled each year in Germany, where this study was conducted. It would be preferable to cull these male chicks while they are still embryonic within the egg, however there are currently no commercially feasible methods of identifying male embryos prior to hatch. Because some strains of laying hens show sexual dimorphism in the colour of chicks at hatch (females are brown, males are yellow), the current study investigated the use of a hyperspectral camera to assess feather colour in unhatched chicks as a method of determining gender prior to hatch.

"Spectral fingerprints" were collected from over 4300 eggs at a commercial hatchery by shining a bright halogen light through them (known as candling), and recording an image with the hyperspectral camera. Candling duration was kept to a minimum duration (500 milliseconds) to avoid causing heat damage to the embryos. Hyperspectral classification of chick gender was conducted on days 11–14 of incubation, as the embryos do not start to develop feathers until day 11. The 'spectral fingerprint' was then used to determine whether the unhatched chick had brown or yellow feathers.

At day 11, the accuracy of the gender classification was low (58–66%) and this was attributed to the embryos only just starting to develop feathers at this age. By the time the embryos reached day 14 the gender classification was highly accurate at 97%. The authors conclude that hyperspectral imaging of fertilised eggs at day 14 may be a commercially feasible method of sexing chicken embryos prior to hatch in sexually dimorphic lines of laying hen. The authors also note that while culling unhatched embryos is preferable to day-old chicks, the embryos are capable of perceiving pain from Day 10 of incubation and thus culling at Day 14 is not an optimal solution.

Göhler D, Fischer B, Meissner S (2017) In-ovo sexing of 14-day-old chicken embryos by pattern analysis in hyperspectral images (VIS/NIR spectra): A non-destructive method for layer lines with gender-specific down feather color. Poultry Science 96:1-4.

Effect of shade on animal welfare in feedlots

In the USA, it is common practice to finish beef cattle in feedlots on concentrates prior to slaughter. Only 17% of feedlots provide shade for the cattle, and thus during the summer months large numbers of cattle are exposed to heat stress. Further exacerbating this issue is the routine administration of β-adrenergic agonists to improve growth and feed efficiency. Cattle fed beta agonists have a reduced capacity to cope with heat stress, and experience higher mortality rates in feedlots during the summer months. This study investigated the effects of shade provision on panting, growth, and carcass characteristics of feedlot cattle fed beta agonists.

Shade structures were erected in 7 pens of cattle, with each pen containing approximately 100 cattle. Shade was provided along one side of the pen at a rate of 1.5m^2 per animal, and cattle could access the water troughs while shaded. Directly opposite the shaded pens were 7 unshaded control pens. During a 5-week period in mid-summer, the pen floor temperature and incidence of open-mouthed breathing in the cattle was recorded on 29 days. Weather data was collected from a nearby station, and productivity measures were obtained from the farm and abattoir records.

The provision of shade reduced the incidence of panting and increased the amount of feed consumed, indicating a reduction in heat stress experienced by the cattle. Despite this effect, shade did not provide consistent improvements in growth and carcass characteristics when compared to non-shaded animals. The authors speculate that this may be due to the relatively mild summer conditions experienced that year, and that the experiment may have yielded different results if conducted in previous years with more substantial heat loads. Other research in this area has also provided inconsistent results, and this makes it difficult for feedlot managers to estimate the financial benefits of providing shade. In conclusion, the provision of shade resulted in reduced visual signs of heat stress (panting) and improved feed intake, indicating improved welfare for shaded cattle and the potential for improved productivity under more challenging weather conditions.

Hagenmaier JA, Reinhardt CD, Bartle SJ et al (2016) Effect of shade on animal welfare, growth performance, and carcass characteristics in large pens of beef cattle fed a beta agonist in a commercial feedlot. Journal of Animal Science 94:5064–5076.

A review of cognition, emotion, and behaviour in the domestic chicken

Chickens are the most common of all domesticated animals, with the UN estimating their global population at 19 billion. Due to the common perception of chickens as a source of cheap meat and eggs, chickens are often considered to be less intelligent or complex than other animals. This means that their cognitive abilities are often not investigated or recognised. The purpose of this review is to better understand chicken cognition, emotion, personality and sociality by summarising the available scientific literature, and identify areas requiring further non-invasive research.

Chickens have been domesticated for at least 8000 years, but because their selection has focused on physical characteristics related to productivity, there is no evidence that their cognitive or perceptual abilities have been altered from that of their wild predecessors. Chickens show evidence of a range of complex cognitive abilities, such as object permanence (understanding that an object still exists, even when out of sight), discrimination between different quantities, simple arithmetic, perception and estimation of time passing, episodic memory (recalling specific events from the past), self-control (choosing a larger delayed reward over a smaller immediate reward), transitive inference (using deductive reasoning to predict social interactions based on observing other individuals interact), complex communication (such as varying their calls in relation to the audience or risk involved). Chickens can discriminate and recognise individuals within their own group, use deception and counter-strategies against deception, and learn by observing others. Chickens also experience a range of positive and negative emotions, emotional contagion, some evidence of empathy, and personality differences.

The author concludes that chickens are just as cognitively, emotionally and socially complex as most other birds and mammals in many areas, and that there is a need for further research in this area.

Marino L (2016) Thinking chickens: A review of cognition, emotion, and behaviour in the domestic chicken. Animal Cognition 20(2):127-147.

Piglets recognise and remember a previous aversive handler

It is well known that aversive handling can cause animals to become fearful of humans. The amount of fear experienced can be assessed by measuring the avoidance behaviour of the animals in response to a human, with greater avoidance indicative of greater fear. Previous research has indicated that piglets can distinguish between different people, and may be able to recognise a person that has previously handled them aversively. This study aimed to determine whether piglets can remember an aversive handler after three weeks with no contact from that handler.

This research was conducted with 48 piglets on an experimental farm in Brazil. Sixteen piglets received aversive contact with one handler from birth until 70 days of age. The aversive handler wore orange overalls, was noisy, moved "harshly" and shouted frequently during routine feeding and cleaning procedures. After day 70, the piglets did not have any further contact with the aversive handler and a new neutral treatment was introduced and applied between days 70-91. The neutral handler wore blue overalls, and used a soft tone of voice and was careful. At 35 and 91 days of age a Human Approach Test was performed to measure the piglets' avoidance response to the aversive handler, to the neutral handler and to an unknown handler in white overalls (control).

The piglets showed avoidance of the aversive handler at both day 35 and day 91 compared with the other handlers, despite not having had any contact with the aversive handler for three weeks prior to the last test. Their responses indicate that they were able to remember the quality of their interactions and identify the aversive handler after at least three weeks with no contact.

Sommavilla R, Titto EAL, Titto CG et al (2016) Ninety one-days-old piglets recognize and remember a previous aversive handler. Livestock Science 194:7-9.

Farm size and animal welfare

In recent years, an inverse relationship has emerged between the number of farms and the size of those farms in many countries around the world. The cause of this is multifactorial, but largely relates to more people leaving the agricultural industries, and the increased financial incentives associated with larger farm sizes. The majority of the public consider these increases in farm size to be deleterious to animal welfare, and it was the purpose of this review to critically assess the literature regarding farm size and farm animal welfare.

The majority of this review focused on dairy farms, but other species were considered where possible. There were no consistent relationships found between farm size, health and overall welfare scores. Large farms were more likely to have increased rates of Salmonella infection, diarrhoea, and mortality in cows (but not in calves). Large farms were also less likely to provide outdoor access and behavioural enrichment than smaller farms, and had fewer positive interactions between the animals and the farmer. Large farms did euthanase lame cows more rapidly than smaller farms, and performed painful procedures (such as dehorning) at a younger age, which is preferable from an animal welfare perspective. In addition, farm staff on larger farms were more likely to be better paid, better trained and more satisfied, which is likely to improve the quality of animal care they provide. There was no relationship between farm size and violations of animal care regulations.

In conclusion, there was no consistent relationship between farm size and animal welfare. Where differences did exist between large and small farms, the effects are likely to be due to factors associated with size (such as economic viability, professional management, etc.) rather than size itself. Small farms often still use the same controversial husbandry practices that large farms use, and are less likely to adopt new technology or accept professional advice. The view that welfare is better on small farms is an oversimplification, and is more likely to be related to concern about the intensification of farming systems. Resolving the specific welfare challenges on farms of all sizes should be the focus.

Robbins JA, von Keyserlingk MAG, Fraser D et al (2016) Farm size and animal welfare. Journal of Animal Science 94: 5439–5455.

Evaluation of kosher slaughter inspection procedures

Kosher slaughter (or shechitàh) is a method of slaughtering animals for consumption by the Jewish community. During kosher slaughter, ruminant animals are restrained and slaughtered without stunning, and the carcasses inspected for lesions or defects. Any non-compliance with the strict slaughter procedure, involving a throat cut using a very sharp blade, or the presence of sufficient carcass defects are grounds for rejection and the meat classified as unsuitable (non-kosher or taref). The meat considered unsuitable for Jewish consumption is then sold to non-Jewish consumers without labelling to indicate that it is meat from animals that were not stunned prior to slaughter. To determine the amount of non-kosher meat entering the commercial supply, this study investigated the carcass rejection rate during kosher slaughter in Italy.

During shechitàh, the suitability of animals for Jewish consumption is assessed in three stages: pre-slaughter (e.g. the presence of injuries), during slaughter (e.g. adherence to the strict throat cutting procedure), and post-mortem (e.g. the presence of lesions or pathologies in the lungs). This study observed shechitàh slaughter for 727 calves (8–12 months) and recorded the percentage of rejection rates during the three stages of slaughter (pre-slaughter, slaughter, post-mortem), and for the origin of the Rabbis (Rome or Milan).

The rate of carcass rejection was found to be high, with 52% of carcasses classified as non-kosher. The majority of carcass rejections occurred during the post-mortem examination (49%), with a small number (3%) occurring during the pre-slaughter handling and slaughter procedure. The rejection rate varied between religious communities, with Rabbis from Milan rejecting significantly more carcasses than Rabbis from Rome (72% vs 44% respectively). The authors conclude by questioning the ethics of selling unlabelled non-kosher meat to non-Jewish consumers.

Bozzo G, Di Pinto A, Bonerba E et al (2017) Kosher slaughter paradigms: Evaluation of slaughterhouse inspection procedures. Meat Science 128:30-33.

Euthanasia of piglets

Piglet euthanasia may be performed on farm due to poor health, ill thrift, or commercial concerns, and is generally carried out by manual blunt force trauma to the head. This can involve swinging the piglet by the hind legs so that the head hits a hard surface, or using a hard object such as a hammer to hit the head. Manual blunt force trauma has several issues, including heavy reliance on the ability of the stockperson performing the procedure. The use of a non-penetrating captive-bolt device has advantages including less reliance on the operator, and improved reproducibility. This study investigated the effectiveness of a non-penetrating captive-bolt gun (the Zephyr EXL) for euthanasing piglets as an alternative to manual euthanasia in the UK.

The effectiveness of the Zephyr EXL in producing an immediate kill was assessed using electroencephalogram (EEG) responses to a flashing light, known as Visual Evoked Potentials (VEPs). VEPs will occur even when the piglet is under anaesthesia, and brain death is considered to occur when VEPs cease. Sixty piglets from different weight categories (between 3 and 11kgs) were anaesthetised, electrodes inserted and their VEPs recorded to determine their pre-shot VEP averages. Once the pre-shot data were established, each piglet was shot once in the head with the Zephyr EXL. VEP recording continued for 3 minutes post-shot to verify the piglet's death. The heads of the piglets were then subjected to post-mortem examination.

The Zephyr EXL elicited immediate and irreversible loss of VEPs following the shot, indicative of death, but only when the head was held against a hard surface and appropriately restrained. Post-mortem examination revealed substantial fractures across the skull, haemorrhaging within the skull and damage to the brain itself. In conclusion, the Zephyr EXL, when using the appropriate technique, provides an effective method of immediately killing piglets up to 10.9kgs in weight, and provides a suitable alternative to manual blunt force trauma.

Grist A, Murrell JC, McKinstry JL et al (2017) Humane euthanasia of neonates I: Validation of the effectiveness of the Zephyr EXL non-penetrating captive-bolt euthanasia system on neonate piglets up to 10.9 kg live-weight. Animal Welfare 26:111-120.

MISCELLANEOUS

Addressing the problem of intimate partner violence

Intimate partner violence (IPV) is an issue that can affect people from all genders, backgrounds and sexual orientations, but is most commonly experienced by young women (18–24yrs). For a number of reasons, people experiencing IPV may have difficulties seeking help, and this paper discusses the opportunities for veterinarians to be able to assist in this matter.

Many people experiencing IPV own pets, and these pets often provide a source of emotional support to the victims. It is through these pets that veterinarians may interact with victims of IPV, as abuse of animals is closely linked to human violence, and these pets may also experience abuse. Veterinary clinics assist by providing a supportive environment and disseminating information about IPV and opportunities for help, such as through brochures. Information may include the link between human and animal abuse, lists of local family violence shelters that accommodate pets, and how to make an emergency plan of action that includes the pet. As victims of IPV may delay seeking help in order to stay and protect their pet, it is vital that victims are aware of pet-friendly options available.

Training veterinarians to respond appropriately to any victims that reach out for help is vital, and partnering with local violence protection agencies may aid veterinarians in identifying and responding appropriately to cases of suspected IPV. Veterinary clinics may also wish to consider offering low-cost or free veterinary care or housing for the pets of victims seeking help from the local protection agencies. Veterinarians have a responsibility to protect animals from abuse by providing a supportive environment and a caring response to victims, by disseminating educational information, and by partnering with local authorities. In this way, veterinarians may help to save the lives of victims and their pets by encouraging victims of IPV to seek help.

Allison M, Satterwhite C, Ramaswamy M et al (2017) Strategies veterinary practices can use to address the problem of intimate partner violence. Journal of the American Veterinary Association 250:42–45.

Improving upper elementary students' humane attitudes

Humane education programs are delivered to primary school children to foster feelings of kindness, compassion, and concern for non-human animals, people and the environment. Such programs were originally developed in the late 1800s with basic concepts and principles still being taught today. Previous research investigating the effectiveness of these programs has found that they improve students' self-reported humane attitudes and empathy, but to date no studies have investigated their effects on student behaviour. This study investigated the effects of a humane education program on the attitudes and behaviour of fourth grade students in the USA.

Twelve classes of students (9–11years) received either the humane education program (8 classes) or chess club (4 classes) every week for 11 weeks. Prior to this period, student humane attitudes were assessed using a questionnaire and student behaviour was assessed by teacher observations during class time. The student behaviours of interest were prosocial behaviours (such as being friendly or empathetic) and disruptive behaviours (such as breaking rules or property). These measures were assessed at the end of the program to determine whether the program led to any improvements in attitudes or behaviour.

Students who had received the humane education program showed an improvement in humane attitudes and prosocial behaviours compared to the students who had attended chess club. It is likely that the observed changes in prosocial behaviour were extended to situations outside of the classroom. The authors had hypothesised that a greater respect and empathy for others (due to the program) would lead to less disruption of others during class, but this was not the case and no effect on the program was seen for disruptive behaviour. This may have been due to the program not specifically teaching students to learn how to curtail their disruptive behaviour. This is the first study confirming that humane education programs can improve both attitudes and social behaviour in students.

Samuels WE, Meers LL, Normando S (2017) Improving upper elementary students' humane attitudes and prosocial behaviors through an in-class humane education program. Anthrozoös 29:597-610.

WILD ANIMALS

Evaluating and ranking the relative animal welfare impacts of wildlife control methods

The Five Domains Model is a method of animal welfare assessment that considers how four physical domains (nutrition, environment, health and behaviour) affect the mental state of the animal (the fifth domain). The mental state of the animal is then used to assess welfare status. The Five Domains Model has been adapted for use with lethal and non-lethal pest control measures, and assesses welfare in two stages: impact on the animal prior to death, and actual mode of death. The aim of this study was to demonstrate the use of this new assessment framework by comparing the welfare impacts of seven different poisons used in the lethal control of brushtail possums in New Zealand.

The seven poisons that were assessed were: cyanide, sodium fluroacetate (1080), cholecalciferol, phosphorous, zinc phosphide, broadifacoum and pindone. A thorough literature review was conducted for each poison to determine the mode of action, the symptoms, and the time from ingestion until irreversible loss of consciousness and death. A panel of six scientists then independently reviewed this information using the new assessment framework to create a score for each of the five domains, for each type of poison. The panel then met and discussed the results, with the median score for each poison used to rank welfare impact.

The rankings given to the poisons agree with previous research using more traditional methods of assessing welfare, with cyanide considered to have the lowest welfare impact (ranked as moderate) and the anticoagulants broadifacoum and pindone having the greatest impact (ranked as severe to extreme). The authors discuss the advantages and disadvantages of using the new assessment framework for determining welfare impacts, including the difficulties of weighting different effects. For example, is extreme breathlessness for a short period preferable to a much longer period of mild pain? In conclusion, the new assessment framework was successfully used to rank the welfare impacts of a range of poisons on possums, and provides a transparent process for stakeholders to see how these rankings were derived.

Beausoleil NJ, Fisher P, Littin KE et al (2016) A systematic approach to evaluating and ranking the relative animal welfare impacts of wildlife control methods: Poisons used for lethal control of brushtail possums (*Trichosurus vulpecula*) in New Zealand. Wildlife Research 43:553–565.

International consensus principles for ethical wildlife control

Due to expanding human populations and their associated infrastructure, human-wildlife conflicts are becoming more common. These conflicts are addressed using lethal and non-lethal methods of wildlife control, and many of these methods receive opposition on ethical and welfare grounds. Consequently, there is an increasing need for ethical and evidence-based approaches to wildlife control. In aid of this, 20 experts in wildlife management met for a 2-day workshop in Canada to develop the first international principles for ethical decision making in wildlife control.

The first principle is 'Modifying human practices', and proposes altering human practices where possible and fostering a culture of co-existence between humans and wildlife. This should be followed by Principle 2, which is 'Justification for control' and requires objective evidence that substantial harm is being caused by wildlife before remedial action is taken. Principle 3 is 'Clear and achievable outcome-based objectives'. This ensures that wildlife management has clear goals, is able to predict the likelihood of success, and emphasises the need for monitoring to determine success. Principle 4 is 'Animal welfare', and proposes using methods that cause the least harm to the least number of animals. This includes the target animals, and non-target animals such as dependent young and other ecological effects. Principle 5 is 'Social acceptability' and proposes that the values of the affected community be included when making management decisions. This could involve an ethical review board that assesses the acceptability of wildlife management options, similar to the role of the animal ethics committees that approve scientific research. Principle 6 is 'Systematic planning', and proposes that wildlife management should be systematically managed using long-term planning, and that ad-hoc or hasty decisions may lead to ineffective methods that result in senseless harm. Principle 7 is the final principle, and advocates that wildlife management should be based on the specifics of the situation, rather than labels that are applied to the target species, such as 'pest' or 'overabundant'.

It is envisaged that these 7 principles could be incorporated into international standards as a framework that can be used to make rational, ethical, evidence-based decisions about wildlife management.

Dubois S, Fenwick N, Ryan EA et al (2017) International consensus principles for ethical wildlife control. Conservation Biology 00:1–10.

Aversive behaviour by koalas during the course of a music festival

Anthropogenic sources of noise pose a potential threat to the welfare of wildlife by acting as a stressor or interfering with communication and reproduction. For this reason, part of the approval process for a five-day music festival in Australia was to investigate the effects of the festival on the surrounding wildlife. A population of koalas was known to inhabit the festival site, and as koalas are considered a species that does not react well to disturbance they were the focus of the present study.

Koalas typically live in overlapping home ranges, with core areas within these ranges known to be where they spend the majority of their time. Seven koalas were captured in their home ranges and fitted with radio-tracking collars to allow their movements to be tracked for three months prior to, during, and for three months following the five-day music festival.

Six of the seven koalas moved away from the music festival during the musical phase. The three koalas whose home ranges were closest to the centre of the festival (350–480m) showed an 'evacuation like response'. These animals moved directly away from the festival to an area outside of their home range and stayed there until the festival had ceased, after which they returned to their home ranges. Three other koalas whose home ranges were further from the festival (550–700m) also moved away from the festival, but only to the furthest point of their home range, and returned once the festival had finished. The seventh koala showed signs of illness during the festival and was found dead shortly afterward. The effects of the festival on the behaviour of the koalas was relatively short-term (several days), although the impacts on koala health should be further investigated. The author recommends a minimum distance of 725m as an exclusion zone for music festivals around habitat known to contain koalas, and that amplified music should be directed away from known populations. Other less feasible suggestions involve re-creating koala habitat elsewhere, and restricting the timing of festivals to avoid the breeding season of koalas.

Phillips S (2016) Aversive behaviour by koalas (*Phascolarctos cinereus*) during the course of a music festival in northern New South Wales, Australia. Australian Mammology 38:158–163.

Olfactory enrichment in captive California sea lions

Animals in the wild encounter a wide range of sensory stimuli that is both variable and biologically relevant. These stimuli cannot be fully replicated under captive conditions, and animals in captivity can develop abnormal behaviours and stereotypies, often due to a lack of stimulation (among other reasons). Providing environmental enrichment for animals encourages them to display species-typical behaviour and reduce abnormal behaviours. For example, providing a novel object (a ball) has been shown to reduce stereotypic swimming in seals. One opportunity for enrichment that has not been investigated is olfactory enrichment. This study investigated the use of scent enrichments on the behaviour of captive California sea lions.

Eight different scents were presented to four sea lions in a standardised manner at the Institute for Marine Mammal Studies in the USA. These scents consisted of four natural odours (soil, sand, kelp and sardine oil) and four non-natural odours (orange, banana, vanilla, cinnamon), and one scent was applied to the walls of the sea lion enclosures each day. Scents were cleaned off the walls at the end of each session to eliminate odours for the next day. Sea lion behaviour was video recorded during scent exposure, and changes in habitat usage, behavioural states and stereotypic behaviours were analysed.

Scent enrichment was successful in increasing habitat utilisation, in terms of more time spent out of the water, and reducing stereotypic swimming behaviours. The effect of scents on individualised stereotypical behaviours (e.g. floor sucking) was less clear, as the two sea lions involved showed a variable response. There was no difference in the behavioural response to the natural and non-natural scents, indicating that there is an infinite variety of scents that can be successfully used in this scenario, reducing the risk of habituation. Other benefits of using scent enrichment include its low cost, ease of application, and ability to be used in sterile environments, such as seal rehabilitation centres. In conclusion, scent can be used as a novel enrichment for captive sea lions.

Samuelson MM, Lauderdale LK, Pulis K et al (2017) Olfactory enrichment in California sea lions (*Zalophus californianus*): An effective tool for captive welfare? Journal of Applied Animal Welfare Science 20:75-85.

The visitor effect in captive felids

The visitor effect is described as the change in behaviour and/or physiological responses of animals in the presence of zoo visitors, and has been associated with a number of welfare challenges in zoo species. While some species find the presence of zoo visitors enriching, the most common effects are increases in agonistic behaviour, hiding, vigilance, and abnormal behaviour. This indicates that the visitor effect can be stressful for many species, which may potentially interfere with their health and breeding success. Because the majority of research into the visitor effect has focused on primates, little research has been conducted with captive felid species. This study aimed to determine whether visitor presence influenced the behavioural patterns and space use of five felid species in the zoo environment.

Observations of felid behaviour were conducted at two zoos in Spain, and the species included in this study were Eurasian lynx, Asiatic lion, bobcat, jaguar and ocelot. Animal behaviour and visitor density were recorded between 10am–2pm for at least 14 days for each species. Because the zoos were closed to the public on Mondays, the researchers were able to compare the behaviour of the felids in the presence and absence of zoo visitors.

Changes in behaviour were recorded for all five species on zoo open days compared to closed days, with all species except the jaguar showing a reduction in complex behaviours and activity levels when visitors were present. The lynxes, lions and ocelots also displayed agnostic behaviour, but only when visitors were present. These behavioural changes indicate that these species may experience stress and poor welfare in the presence of zoo visitors. These visitor effects did not vary with the density of visitors at the enclosure, indicating that it was the presence of humans rather than the number of humans that was driving these effects. In comparison, the jaguar became more active in the presence of visitors, and may have found them enriching. The authors discuss possible methods of reducing the visitor effect on sensitive species at zoos.

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ISSUE 56 – APRIL 2017