



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

Recognising pain in horses

There is evidence that over 47% of horses used for sport may be lame, but the lameness is not recognised by owners or trainers. Horses that resist commands are often labelled as problem horses and may receive more intense and sometimes punitive training practices. These practices may exacerbate existing musculoskeletal problems and compromise horse welfare. Behavioural indicators of pain in horses include overt behaviours, such as bucking and rearing, and more subtle behaviours such as changes in facial expression. This UK study developed an ethogram that could be used to recognise pain-related behaviours in horses under saddle.

A preliminary ethogram of pain-related behaviours in horses was constructed from the scientific literature, resulting in a list of 117 behaviours. These behaviours were classified as facial markers, body markers and gait markers. This ethogram was tested for reliability and refined down to 70 behavioural markers of pain. Using video footage, the refined ethogram was then used to score the behaviour of 24 lame and 14 non-lame horses being ridden around an arena and in small (10m) circles. Each behaviour was scored as 1 (present) or 0 (not present) and converted to an occurrence score, with a

maximum possible score of 14. Horses received a higher score if they showed more pain-related behaviours.

There was a strong correlation between 20 behavioural markers and the presence of lameness. For lame horses, the following behaviours occurred significantly more often: ears back, mouth opening, tongue out, changes in eye posture and expression, holding the head high, tossing or tilting the head, unwillingness to go forward and spontaneous stopping, crookedness, hurrying, changing gait spontaneously, poor quality canter, stumbling and toe dragging. These results allowed the authors to simplify the ethogram to a list of 24 behaviours that were indicative of pain in horses. Using this ethogram, any horse that received an occurrence score of eight or above was highly likely to be experiencing musculoskeletal pain. Recognition of these behaviours as potential indicators of musculoskeletal pain may enable earlier recognition of lameness and avoidance of punishment-based training.

Dyson S, Berger J, Ellis AD et al (2018). Development of an ethogram for a pain scoring system in ridden horses and its application to determine the presence of musculoskeletal pain. *Journal of Veterinary Behavior* 23:47-57.

The effects of animal-assisted interventions on therapy dogs

Animal-assisted interventions (AAIs) are becoming increasingly popular in clinical settings. AAIs are defined as the 'purposeful incorporation of specially trained animals in services to improve human health', and dogs are commonly used for these interventions. These therapy dogs interact with a variety of patients in a clinical setting, and it is possible that the dogs find these interactions stressful. There is currently a lack of agreement regarding if and how AAIs affect animal welfare, and further research is needed to ensure the welfare needs of therapy dogs are being met. This study measured the physiological and behavioural effects of regular AAI sessions on therapy dogs.

The AAIs monitored in this study occurred between therapy dogs and children between the ages of 3-17 years who had recently been diagnosed with cancer in the USA. The children were enrolled in the study for a four-month period, during which they received weekly visits from the same therapy dog and handler. A total of 26 therapy dogs were used to visit 60 children, and each visit lasted for approximately 20 minutes. The dog handlers completed a questionnaire relating to how their dog typically responds to common events and stimuli in the environment, and collected saliva samples

at home and immediately after an AAI to determine changes in stress physiology (cortisol). The behaviour of the dogs was video recorded during each AAI and the total frequency of stress-related behaviours and affiliative behaviours were recorded for each session.

The results of this study indicate that therapy dogs show minimal signs of distress during AAI sessions. The therapy dogs did not have a significantly increased physiological stress response following the session, nor did they exhibit significantly more stress-related behaviours than affiliative-related behaviours. There were significant relationships found between salivary cortisol and behaviour, with a higher cortisol concentration associated with more stress behaviours, and lower cortisol concentration associated with more affiliative behaviours. This study provides valuable and rigorous evidence that AAI participation in paediatric hospitals does not appear to place therapy dogs at significant risk of stress.

McCullough A, Jenkins MA, Ruehrdanz A (2018) Physiological and behavioural effects of animal-assisted interventions on therapy dogs in pediatric oncology settings. *Applied Animal Behaviour Science* 200:86-95.

The impact of hay bags and slow feeders on horse behaviour and welfare

Many domestic horses are managed under conditions that are far removed from their natural environment. This includes housing in stables and consuming a low roughage diet instead of grazing. Horses would normally spend 18 hours/day grazing, and an inadequate supply of hay has been associated with stereotypic behaviour and gastric discomfort in stabled horses. Owners therefore seek solutions that improve horse welfare through appropriate feeding strategies. Providing *ad libitum* hay on the stable floor may result in the horse rapidly consuming it or spoiling it. Providing hay in hay bags or slow feeders increases the amount of time horses spend feeding. A slow feeder is similar to a feed trough with a piece of wide mesh sitting on top of the hay. This study investigated the impact of hay bags and slow feeders on horse welfare and feeding behaviour.

This experiment was conducted at a riding school in France using 38 adult geldings and mares. Each horse was housed individually in a 3 x 3 m stable, and only let out for a 1 hour riding session on weekdays. All horses were submitted in a random order to three feeding treatments for three weeks per treatment. The treatments consisted of the daily hay ration being

placed on the floor, in a hay bag hanging from the wall, or from a slow feeding device in the corner. Horse behaviour was monitored daily, and at the beginning of each treatment the behavioural response of the horses to a human at their stable door was recorded.

Horses increased the amount of time spent feeding with both the hay bag and slow feeder treatments, but appeared to find the hay bags frustrating to use. The hay bags moved around, and were hung from the wall which may have led to neck and back problems if used for long periods. Horses showed a reduction in stereotypic behaviours and increased 'friendliness' toward humans when using the slow feeders, indicative of a more positive affective state and better welfare. These results emphasize the importance of identifying feeding strategies and / or devices that improve feeding distribution and improve horse welfare.

Rochais C, Henry S, Hausberger M (2018) "Hay-bags" and "slow feeders": Testing their impact on horse behaviour and welfare. *Applied Animal Behaviour Science* 198:52-59.



Horses prefer to approach humans displaying submissive rather than dominant postures

In species with dominance hierarchies, the effective communication of rank and ability are crucial for maintaining social relationships and access to resources. Dominance-related body postures tend to be similar across different species, with an inflated body size communicating dominance and a smaller body size communicating submissiveness. Horses are a highly social species with a strict dominance hierarchy, and may be able to discriminate between dominant and submissive body postures in humans. Previous research has not been able to demonstrate this ability in horses, but did not provide the horses with an incentive (i.e. food reward) for approaching the humans. This study explores whether horses can discriminate between dominant and submissive body postures in humans that have previously presented the horse with a food reward.

This study was conducted at a riding school in the UK, using 30 domestic horses. The horses were first trained to approach two adult female demonstrators to receive a food reward while they were both standing in a neutral position. The horse was then led away, and each demonstrator adopted either a dominant posture (upright posture, legs apart) or a submissive

posture (hands in pockets, legs together, crouching slightly). The horse was released and allowed to move freely toward the demonstrators. The horse was considered to have chosen a demonstrator when its head approached within 50cm of that person. This procedure was repeated three more times so that each demonstrator displayed both postures, and on both sides of the test area to avoid side biases.

The horses showed a significant preference for approaching the submissive posture, although there was no difference in the latency taken to approach each posture. Future research should include a neutral posture to determine if the horses are approaching the submissive posture, or avoiding the dominant posture. These results raise interesting questions about possible universality and flexibility of dominance signalling across species, and may help inform horse handlers and trainers about how horses perceive our communicative signals.

Smith AV, Wilson C, McComb K et al (2018). Domestic horses (*Equus caballus*) prefer to approach humans displaying a submissive body posture rather than a dominant body posture. *Animal Cognition* 21:307-312.

A welfare assessment tool used on working equids in low and middle-income countries

Of the 112 million equids in the world, nearly 100 million are located in Low-Middle Income Countries (LMICs). These equids help support approximately 600 million people worldwide by directly generating income through agricultural, construction and tourism industries, or by providing transport options for households. Brooke is a charity organisation that works to improve the welfare of working equids in LMICs by educating communities, providing emergency treatment, and advocating for the legislative protection of equids. Brooke has developed a specific tool for assessing the welfare of equids in LMICs using minimal resources. This paper outlines the development of this tool, its practical application, and how it has been used by Brooke to improve the welfare of working equids worldwide.

For animal welfare to be improved, it must first be monitored. The Standardised Equine Based Welfare Assessment Tool (SEBWAT) allows equid welfare to be monitored, and is comprised of 40 animal-based measures and four descriptive identifiers. The animal-based measures that the SEBWAT uses are: descriptors (work type, species, etc), general health, behaviour (fear, pain response, etc), practice-induced conditions

(mutilations, lesions, etc), and hoof and limb condition. This welfare assessment can be performed in less than 10 minutes using two assessors, and requires minimal equipment (halter, hoof pick, data sheet). The rapid assessment process is an important component of this tool, as horse owners in LMICs are unlikely to participate in an assessment that takes them away from their work for long. Two assessors can assess up to 60 animals per day.

SEBWAT records have been generated for almost 72000 equids in 11 countries between December 2010 – December 2016. These data have allowed Brooke to make evidence based decisions about where to provide funding, and to monitor changes in equid welfare over time to assess the effectiveness of their welfare programs. This tool has been the most widely applied standardised welfare assessment for equine animals in LMICs, and would be useful for anyone working in LMICs who wishes to identify key welfare issues, track changes over time, or reveal associations between different aspects of equid welfare.

Somerville R, Brown AF, Upjohn M (2018) A standardised equine-based assessment tool used for six years in low and middle income countries. *PLOS One* 13:e0192354.

The effect of aggressive riding behaviour on horse behaviour during barrel races

Anecdotally, there is concern that the degree to which riders use aggressive riding techniques may be related to their horses becoming stressed and agitated during gymkhana events, such as barrel racing. Previous research has shown that racing Thoroughbreds reach top velocity when no whip is used, and that whip use is not associated with finishing position. This suggests that aggressive riding techniques during barrel races may be unnecessary. This study quantified the incidence of aggressive riding behaviours and horse conflict behaviours seen during youth barrel racing, and related these to the final time of the run.

All behavioural observations were conducted at a single horse show in the USA. 69 horse and rider teams were video recorded during their individual participation in a cloverleaf barrel race. The riders were observed for aggressive riding behaviours, including jerking the reins, excessive spurring, excessive kicking and whipping. The horses were observed for behavioural indicators of stress or conflict, including behaviours such as head tossing, ears back, tail swishing, and rearing. The total number of each behaviour was counted for each horse and rider. In addition, a gate score (1-3) was assigned to each horse

as it approached the starting gate to assess the degree of agitation the horse was experiencing prior to the race. The relationships between rider behaviour, horse behaviour and final run time were then compared.

Aggressive riding did not enhance the final run time, refuting the commonly held belief that striking or kicking a horse will improve race performance. There was wide variability between riders in the number of strikes administered to their horse, indicating that not all riders engaged in aggressive riding styles. In addition, there were some small but significant relationships between some rider and horse behaviours. Horses that were whipped more during the race were more likely to react poorly to entering the arena. Horses were more likely to rear when they received more kicks and spurs during the race. The authors conclude that rider behaviour does influence horse behaviour in cloverleaf barrel racing, and this provides support for future youth education programs.

Waite K, Heleski C, Ewing M (2018) Quantifying aggressive riding behaviour of youth barrel racers and conflict behaviours of their horses. *Journal of Veterinary Behavior* 24:36-41.



COMPANION ANIMALS

Early weaning increases aggression and stereotypic behaviour in cats

Early weaning is defined as permanent separation from the mother before the time that it would occur in nature. Feral cats wean their kittens between 4-8 weeks of age, but the kittens usually stay with the mother until 4 months of age. Domestic kittens are routinely weaned and separated from their mother at 8 weeks of age, and this may be too early for the kittens to have learned the full repertoire of social and exploratory behaviours. Very early weaning (2 weeks of age) has been associated with anxiety and aggression in cats, and with stereotypic wool sucking in a separate study. This study investigated the effects of early weaning on the behaviour of domestic cats.

This study was conducted in Finland, using an online questionnaire survey to collect data on the health, living conditions and behaviour of Finnish domestic cats. Data were collected on cat demographics, weaning age, problem behaviours, oral behaviours, activity levels, the tendency to seek human contact, aggression and shyness. The questionnaire was advertised on Facebook and via cat breed organisations, and received responses for 5726 home living domestic cats in 40 breeds. Cats weaned before

12 weeks of age were considered to be early weaned, and the behaviour of early weaned cats was compared to late weaned cats using logistic regression.

This study revealed that behavioural problems are common in cats, and that early weaning can have detrimental effects on cat behaviour. Early weaned cats were more likely to behave aggressively, and late weaned cats were less likely to behave aggressively or display stereotypic wool sucking. Owners were more likely to report a behavioural problem if their cat had been weaned before 8 weeks of age. The cats weaned in adulthood (16 weeks +) had the lowest probability for aggression, shyness and abnormal behaviour. Because cats displaying high levels of aggression, shyness or stereotypy may be experiencing poor welfare, the authors suggest that increasing the weaning age of kittens may be a simple and inexpensive way of improving cat welfare.

Ahola MK, Vapalahti K, Lohi H (2017) Early weaning increases aggression and stereotypic behaviour in cats. *Scientific Reports* 7(10412).



Using free adoptions to reduce crowding and euthanasia at cat shelters

Many healthy adult cats are euthanased annually in shelters, with shelter cats experiencing up to three times the euthanasia rate of shelter dogs. Many of these cats are euthanased due to illness, disease or behavioural issues, but some are euthanased due to shelter crowding or financial strain. Animal shelters may employ a variety of tactics to avoid euthanasia of older but otherwise adoptable cats, such as waiving adoption fees during periods of overcrowding. This practice is controversial as it is perceived to attract less responsible pet owners who may not ensure the welfare of their new cat. This study investigated whether free cat adopters differed from normal-fee cat adopters in terms of demographics and responsible cat care.

A large cat shelter in Australia experienced an extremely busy 'kitten season' in 2015, and conducted a 3-day free-adoption drive to relieve crowding pressure. A survey was developed by the authors to collect information on the husbandry and fate of adopted cats, the gender of the adopters, their history with cat shelters, and how they heard about the adoption drive. Demographic data for adopter suburbs were

obtained from the Australian Bureau of Statistics. Using the contact details provided at the time of adoption, cat adopters were approached 3-18 months after adoption and asked to complete the questionnaire. The questionnaire achieved a response rate of 69 free cat adopters, and 72 normal-fee adopters.

The free-adoption drive attracted more first-time cat owners than normal-fee adoptions, but cat care and retention was almost identical between the two groups. This study found no differences between free and normal-fee adopter demographics, cat demographics, cat fate post-adoption, incidence of medical and behavioural issues, and adherence to husbandry legislation. In conclusion, this study found no evidence for adverse outcomes associated with free adoptions, and animal shelters should not be dissuaded from occasional free-adoption drives during overflow periods.

Crawford HM, Fontaine JB, Calver MC (2017) Using free adoptions to reduce crowding and euthanasia at cat shelters: An Australian case study. *Animals* 7(12), 92, doi:10.3390/ani7120092.

Online relinquishments of dogs and cats in Australia

Pet owners may relinquish their pets for a number of reasons, and traditionally these pets would be relinquished to an animal shelter. The internet provides an alternate method of relinquishing pets through the use of online advertisements, but little is known about why pet owners choose to relinquish their pets online rather than at an animal shelter. This study examined online advertisements to estimate the number of pets being relinquished and owner motivations for using online methods.

This study used webscraping techniques to extract data from Australia's largest online trading site, Gumtree. Online advertisements relinquishing dogs and cats were collected for a 3 week period during 2016, with relinquishment defined as the 'voluntarily cease to keep or claim; give up'. This excluded breeders selling puppies or kittens online, and shelters rehoming animals. Data relating to the breed, crossbreed status, owner status, age, price and State/Territory were collected from each advertisement. Advertisers were contacted by email to ask if they would participate in a questionnaire. This questionnaire collected information about the animal being relinquished, the reasons for relinquishing

online, and other details about the owners attempts to rehome their pet. The questionnaire had a very low response rate (2.5%), with only 8/324 dog owners and 7/299 cat owners completing the survey.

During the 3 week data collection period, there were 2640 advertisements for relinquished dogs and 2093 for relinquished cats. It was estimated that >31,000 puppies/dogs and >24,000 kittens/cats are relinquished on Gumtree every year. 23% of the dogs and 62% of the cats were being given away for free. Queensland had a higher proportion of relinquishments and Victoria had fewer. The people who completed the questionnaire stated that they had chosen Gumtree to relinquish their pet because they believed that the animal shelters were full, they wanted to see/interview the new owner, or because they originally got the animal on Gumtree and they know that it works. A number of owners reported that relinquishing their pet was distressing. These results will be valuable for implementing policy and interventions to protect the welfare of unwanted cats and dogs.

Hazel SJ, Jenvey CJ, Tuke J (2018) Online relinquishments of dogs and cats in Australia. *Animals* 8(2), 25, doi:10.3390/ani8020025.

Attitudes of veterinary teaching staff and students to early-age desexing

A substantial proportion of cats and a smaller proportion of dogs entering animal shelters are juveniles. Cats are prolific breeders, and most owners are unaware that their cats can become pregnant at 4 months of age. The traditional age that cats are desexed is at 6 months, however desexing cats at an earlier age will help reduce the number of unwanted litters being produced. Only a small proportion vets perform early-age desexing (EAD), and it appears that vets are not being taught about EAD during their training as students. This study investigated the attitudes of veterinary teaching staff toward EAD and the amount of exposure to EAD that vet students received during training.

In 2008 and 2015, the heads and deans of all veterinary schools in Australia were asked to provide the contact details for all veterinary staff that were teaching practical, theoretical or anaesthetic procedures for desexing to veterinary students. These staff were contacted via email and asked to complete a questionnaire that assessed their beliefs and attitudes toward EAD, as well as their teaching practices. In 2008, 15/19 eligible staff participated, and in 2015, 25/37 eligible staff participated.

The majority (64%) of teaching staff did not advocate EAD, and the number advocating EAD had decreased from 2008 to 2015. Staff that did not advocate EAD viewed this procedure as risky in relation to anaesthetic risk, orthopaedic problems, hypoglycaemia, and urinary incontinence. These concerns are not supported by the scientific literature, particularly anaesthetic risk and orthopaedic problems. Those that did advocate EAD cited the benefits of this procedure as population control, ease of surgery and behavioural benefits. Most veterinary students were not exposed to EAD procedures or allowed to perform EAD prior to graduation. This failure to advocate EAD or provide students with skills in EAD may be contributing to the large number of kittens being surrendered to shelters and euthanased. The authors recommend that school policy be reviewed in this regard, and that veterinary schools partner with animal shelters to provide students with EAD experience.

Jupe A, Rand J, Morton J et al (2018) Attitudes of veterinary teaching staff and exposure of veterinary students to early-age desexing, with review of current early-age desexing literature. *Animals* 8(1), E3, doi:10.3390/ani8010003.



The effect of providing additional space to budgerigars in aviaries

Budgerigars have been kept as pets for over 150 years, and are typically housed in a variety of cage sizes. Budgerigars kept in small cages develop stereotypic behaviours such as screaming, pecking and abnormal oral behaviours. Housing budgerigars in larger cages and with other conspecifics has been shown to decrease stereotypies and increase flying behaviour. This study investigated the space requirements of budgerigars by comparing their behaviour under three different space allowances.

Twelve adult male budgerigars were housed at a veterinary hospital in Australia in three groups of four. Each group was housed in one of three adjacent aviaries measuring 1.5m x 1.5m x 1.8m. After a week of habituation, two of the aviaries were decreased in size so that one represented the current recommended space allowance (Small treatment, 0.65m³/bird), one represented a 28% increase (Medium treatment, 0.83m³/bird) and one remained at a 56% increase (High treatment, 1.01m³/bird). The three bird groups experienced all three treatments during three 21-day experimental periods in a balanced changeover design. Bird behaviour was recorded using video cameras, and the frequency of all flight related, oral, self-maintenance, and locomotory behaviours were recorded for 5 minutes on Days 1, 7 and 21 of each experimental period. On the final day of each treatment, the distance flown during three separate flights was calculated for each bird.

The budgerigars made more flights on Day 1 in the High treatment, and more wing shakes on Day 1 in the Low treatment. This suggests that the smallest

cage size was not satisfying the behavioural flying requirements of the birds, and that their flying behaviour was thwarted at low space allowances. The budgerigars also flew faster in the High treatment, with calculated speeds of 266, 286 and 375 cm/s in the Small, Medium and High treatments respectively. Budgerigars can reach speeds of 500-1000 cm/s, and it appears that the optimal flight speed of the birds may be thwarted at low space allowances. It is concluded that there are benefits to budgerigar welfare from providing increased space in aviaries above that specified in the standards.

Phillips CJ, Farrugia C, Lin C et al (2018) The effect providing space in excess of standards on the behaviour of budgerigars in aviaries. *Applied Animal Behaviour Science* 199:89-93.



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The high prevalence of gait abnormalities in pugs

The pug is a breed of dog that is predisposed to specific orthopaedic conditions and neurological problems. These conditions can manifest as gait abnormalities, including lameness, partial paralysis (paresis) and uncoordinated movement (ataxia). The severity and prevalence of these conditions is high in pugs, with a Swedish report suggesting a seven-fold increase in mortality due to ataxia, paresis and collapse for pugs compared to other breeds. This study examined the prevalence of gait abnormalities in a cohort of Swedish pugs.

The Swedish Kennel Club was used to contact all owners of pugs that had dogs aged one, five or eight years of age. These ages were chosen to clearly differentiate age-related gait abnormalities. Pug owners were invited to participate in the study, resulting in 550 questionnaires being completed. Pug owners were asked to classify their pug as having a normal gait or an abnormal gait. If classified as abnormal, owners were then asked to provide details of the abnormality (e.g. lameness, ataxia, weakness, inability to jump, uneven wearing of the nails). Pug owners were also asked to submit video footage of

their pug walking, and this footage was assessed for signs of gait abnormality by two veterinary neurologists.

The prevalence of gait abnormalities in the pug breed was high (31%), and this prevalence increased with age. The high prevalence of certain symptoms (e.g. uneven nail wear) suggest that the majority of gait abnormalities in pugs are related to neurological rather than orthopaedic disorders. Uneven wearing of the nails was present in one year old dogs, suggesting a congenital or early onset pathology. In addition, abnormal gait was associated with other health problems, such as difficulty breathing (dyspnoea) and incontinence. The single most common cause of death or euthanasia was an abnormal gait, suggesting that gait abnormalities are a more significant health problem than previously thought. Future studies on the mechanisms of these gait abnormalities are warranted.

Rohdin C, Jäderlund KH, Ljungvall I et al (2018) High prevalence of gait abnormalities in pugs. *Veterinary Record* 182(6), 167.

Common features of dog bites in France during 2009-2010

In 1999, France developed legislation relating to dangerous dogs following a well-publicized incident involving severe dog bites. This legislation referred specifically to certain breeds as being more dangerous than others, but epidemiological studies of dog bites in France have never identified breed as a risk factor for biting. This paper examined the distribution and determinants of severe dog bites in France.

Medical information was collected from eight emergency services following admission of a dog bite victim to the emergency unit. Data were collected immediately about the victim (e.g. demographics, location of the wound), the biting dog (age, breed, relationship to the victim etc), and the medical treatment provided. An interview was conducted with the bite victim within 2 weeks of the bite to discuss the characteristics of the biting dog and the circumstances of the bite. One month after the emergency care visit, the victim completed another questionnaire regarding any long-term effects (sequelae) of the bite that they experienced, such as pain, scarring or trauma.

Previous research has shown that only 10% of people who are bitten by a dog will attend a hospital

visit. Because this study only collected data on dog bites that resulted in a hospital visit, the number of dog bites reported will be an underrepresentation. In adults, the most common bite cause was the separation of two fighting dogs. Children were often bitten when they interacted with a familiar dog around the sleeping place of the dog or during the dog's mealtime. In children, dog bites were more frequent on the head and neck, but the wounds were less severe than those received by adults. This is likely due to children receiving warning aggression in the home, compared to adults receiving full aggression while separating a fight. The breeds cited for biting in this study overlapped with the most common breeds to live in France. No links were found between the severity of the bite and the breed of the dog. The authors conclude that simple prevention measures against dog bites can be put in place using the results of this research.

Sarcey G, Ricard C, Thelot B et al (2017) Descriptive study of dog bites in France – Severity factors, factors of onset of sequelae, and circumstances. Results of a survey conducted by InVS and Zoopsy in 2009-2010. *Journal of Veterinary Behavior* 22:66-74.

FARM ANIMALS

Spatial cognition and range use in free-range laying hens

Free-range laying hens vary markedly in their use of the outdoor range, with some hens venturing outside every day while others never leave the laying shed. The outdoor environment contains additional complexity and large spaces that require navigational skills to successfully return to shelter, food and nest boxes. Hens that transition between indoor and outdoor areas may have improved spatial cognition compared to birds that remain indoors. This experiment investigated whether differences in spatial cognition contributed to the variability in range use, and whether enrichment during rearing modified cognitive performance in laying hens.

Two experiments were conducted at a research facility in Australia. Experiment 1 examined the spatial learning capabilities of hens that went outdoors on 100% of available days (outdoor-preferring), those that went out on 2-10% of available days (indoor-preferring hens), and those that never went outside (exclusively indoor hens). The range use of each hen had been determined in a previous experiment using RFID tags. Spatial cognition was assessed by measuring how long it took each hen to learn to navigate a T-shaped maze to receive a food reward. Experiment 2 assessed the spatial cognition of young hens that had

been reared with or without environmental enrichment (a variety of stimulation including patterned wallpaper, cinder blocks, large sealed plastic tubs, novel objects, coloured flashing lights, and auditory playbacks), but had not yet been allowed outside. The subsequent range use of these hens was recorded using RFID tags.

These experiments suggest that spatial cognition is related to outdoor range use. Hens that preferred to range outdoors learned to find the food reward faster than hens that preferred to stay inside and those that never left the shed. The second experiment found that these differences in spatial cognition exist before the hens have experience with the outdoor range, and that faster learning in the maze was associated with more outdoor range use, but only for the enriched birds that were tested before the onset of lay. This suggests that early environmental enrichment enhances pre-existing differences in spatial cognition, and may help to reduce fear and increase exploration when provided in the housing environment. Further research is needed to fully understand the interplay between fear, spatial cognition and range use in hens.

Campbell DL, Talk AC, Loh ZA, et al (2018) Spatial cognition and range use in free-range laying hens. *Animals* 8(26).



Similarities between post-partum disorders in humans and preweaning piglet mortality in sows

Pregnancy and parturition in all mammals is accompanied by physical, psychological, social and hormonal shifts that impact the mother. In humans, these changes can be associated with postpartum disorders (PPD) such as depression and psychosis. Some of the risk factors associated with PPD are poor mental welfare, inexperience, poor social support, and sensitivity to hormonal fluctuations. In this review, the author suggests that piglet crushing and savaging by sows may parallel postpartum depression and psychosis in humans, and that the commercial housing conditions that sows experience may expose them to the same risk factors that predispose humans to PPD. This article reviews the similarities between PPD in humans and piglet crushing by sows.

There are several similarities between humans and pigs. Humans and pigs are both highly-cognitive species that have evolved social structures and the ability to communicate and transfer social information through experience and observation. Humans that are at most risk of PPD are those with poor social networks and social isolation, inexperienced mothers giving birth for the first time, those that are sensitive to hormonal fluctuations, and those exposed to stress during pregnancy. These risk factors for humans are replicated for sows under commercial farming conditions. Poor social networks are experienced by sows when they are isolated following parturition

when they would normally return to the herd and spend time with piglets and other sows.

High or low hormone levels also impact sow maternal behaviour, and there is a genetic component that may allow sows to be selected for less extreme hormonal variation, better maternal behaviour and lower piglet mortality. The final risk factor for sows is stress. Sows that experience stress while *in utero*, as well as sows that experience stress during gestation, display increased aggression and decreased maternal care toward their piglets. Further, sows may be kept in stalls or pens during gestation and are therefore unable to perform nest building behaviour which they are highly motivated to perform. Sows which are kept in loose-housing systems experience stress after transfer into a farrowing crate due to the drastic restriction in space and mobility.

In conclusion, understanding what strategies are effective in preventing PPD in humans may have welfare and production benefits for sows. Current housing and management practices may need revision to reduce the impact on sow behaviour and piglet mortality, and sows may need to be provided with a different social environment for farrowing and nursing.

Daigle C (2018) Parallels between postpartum disorders in humans and preweaning piglet mortality in sows. *Animals* 8(2), 22.



Access to water alleviates heat stress in Muscovy ducks

Current methods of intensively farming ducks can utilise a dry system, in which ducks are housed without access to free water for swimming. Restricting access to water improves the hygiene of the environment, but presents problems for duck welfare. Ducks require water for preening and thermoregulation, and show marked reductions in productivity when they are exposed to heat stress without access to swimming water. This study investigated the effects of providing ducks with 2 hours of access to water at different times of the day on welfare and productivity measures.

This experiment was conducted at a Research Farm in Egypt using 180 Muscovy ducks at 4 weeks old. The ducks were allocated into four treatment groups. The control group was housed in an open-sided shed without access to water for swimming. The first treatment group was housed in the same shed but was given access to a swimming pool from 10am–12pm daily until 16 weeks of age. The second treatment group was given access to the pool from 12–2pm, and the third treatment group was given access

to the pool from 2–4pm. Body weight and feed intake were measured every 4 weeks until the conclusion of the experiment at 16 weeks of age. The ducks were then assessed for plumage condition and general health indicators, after which they were killed to allow assessment of the carcass traits and immune function.

Providing the ducks with access to a swimming pool during the hottest part of the day (12–2pm) improved growth performance, dressed carcass weight, meat tenderness, immune function, body temperature and mortality rates. This was attributed to the ability of the ducks to thermoregulate in the water during periods of heat stress. There were no significant effects of the treatments on plumage condition or bone strength. The authors recommend that ducks in hot conditions should be given access to a swimming pool to improve the productivity and health of the birds.

Farghly MFA, Mahrose KM, Ullah Z (2017) Influence of swimming time in alleviating the deleterious effects of hot summer on growing Muscovy duck performance. *Poultry Science* 96:3912–3919.

Selection for improved breech traits had little impact on production traits in Merino sheep

The wrinkly skin of Merino sheep predisposes them to flystrike, particularly the amount of wrinkle and wool cover in the breech (perineal) area. Within Australian flocks there is variation in the degree of wrinkling and wool cover seen in the breech area, and this provides farmers with the opportunity to artificially select for sheep that have reduced wrinkle and wool cover. However, previous research has found that these breech traits are related to other key production traits. Some studies have shown that selecting for reduced breech cover can also reduce the productivity of the flock, but these results are not always consistent, and have used older breeds of Merino that had more body wrinkling. This study used a modern breed of Merino to investigate the relationships between breech traits, skin wrinkle and production traits.

The Australian Sheep Cooperative Research Centre maintains eight 'Information Nucleus' flocks of Merino sheep at different sites around Australia. These sheep are monitored for a wide variety of production traits, including breech cover, wrinkling, wool quality and liveweight. These comprehensive production data were analysed for all sheep born from these flocks between 2007–2011 and the phenotypic correlations between breech traits and production traits were determined.

The relationships found between breech traits and production traits were favourable for farmers to select against flystrike susceptibility with little to no detrimental impact on production. Selecting sheep for a larger bare area around the perineum (breech cover) will increase liveweight with no significant impact on wool production. Selecting sheep for less wrinkling will increase liveweight but will decrease the average wool production of the flock by a small amount. This loss may be recouped by the increased reproduction and fertility seen in less wrinkly sheep, and by the reduction in treatment costs associated with flystrike.

Hatcher S, Preston JWV (2017) Phenotypic relationships of breech cover, wrinkle and wool coverage scores with key production traits and their implications for Australian Merino sheep management to reduce flystrike. *Small Ruminant Research* 157:47–53.

Physiological and behavioural responses of rainbow trout to commonly used anaesthetics

Fish are commonly used in research, farmed as a food source, and kept as a companion animal. Globally, large numbers are kept in captivity, and anaesthetics are used to minimise the stress of handling, transportation and veterinary procedures. Anaesthesia is induced by immersing the fish in water containing an anaesthetic agent, and previous research has shown that zebrafish show avoidance and strong behavioural responses to water containing common anaesthetics. This raises concerns for the welfare of fish being anaesthetised. This study investigated the effects of five commonly used anaesthetics on the behaviour and physiology of rainbow trout.

This study was performed in the UK, and consisted of three experiments. Experiment 1 compared the aversiveness of euthanasia for fish using five different anaesthetics. The fish were immersed individually in buckets containing the recommended concentrations of anaesthetic until they died of an overdose. Their heart rate, response to regular tail pinches and cortisol concentrations were compared to that of fish killed by concussion. Experiment 2 compared the aversiveness of fish anaesthesia using five different anaesthetics. These fish were anaesthetised by immersion and their heart rate, response to tail pinches, and the strength of the behavioural response to the anaesthetic was

recorded. Their recovery rates were measured after being returned to the home tank, and these fish were killed 1 hour later to obtain a blood sample for cortisol analysis. Experiment 3 involved a conditioned place avoidance model, in which the latency of the fish to return to an area where they had been anaesthetised was measured.

The results of all three experiments suggest that the commonly used anaesthetic MS-222 may be relatively stressful for rainbow trout. This conclusion was based on the longer induction time needed for deep anaesthesia and increased cortisol concentrations of fish exposed to this drug. The anaesthetic 2-phenoxyethanol was considered the best anaesthetic for fish welfare due to a shorter induction time, reduced behavioural response and lower cortisol concentrations in fish exposed to this drug. However the analgesic properties of 2-phenoxyethanol may not be sufficient for invasive procedures or surgery, and further research in this area is required.

Pounder KC, Mitchell JL, Thomson JS et al (2018) Physiological and behavioural evaluation of common anaesthesia practices in rainbow trout. *Applied Animal Behaviour Science* 199:94-102.



A review of environmental enrichment for broiler chickens

Broiler chickens are fast-growing birds that are commonly housed in barren environments at high stocking densities. This can result in a wide range of welfare problems such as lameness, contact dermatitis, heat stress and limited opportunities to express behaviour. Providing broilers with environmental enrichment can improve welfare by encouraging physical activity, increasing the behavioural repertoire, and improving biological function. This article reviews the types of environmental enrichment that are provided to broilers, and how enrichment affects the behaviour and welfare of these birds.

Environmental enrichment was categorised as either 'point source objects', such as perches or straw bales, or more complex enriched environments, such as an outdoor range. Elevated resting areas increase the behavioural repertoire and are practical to apply. Platforms appear to be a better solution than perches for fast-growing genotypes that are less mobile. Structures such as panels provide shelter and generally improve welfare, but may present movement barriers for weaker birds.

Bales of substrate such as straw may stimulate foraging and dustbathing behaviour and improve litter quality, but there is limited research available on substances other than straw (such as wood shavings, miscanthus, or silage). Regularly introducing items to the broiler house can increase the risk of disease transmission. Providing novel objects may decrease neophobia in the

birds, with subsequent benefits to welfare, but can be impractical to apply. The economic benefits of providing enrichments is not well-studied. In general, the success of providing point source enrichments depends on the location and number of enrichments provided. An inadequate number of objects can lead to localised crowding and competition.

Complex enriched environments, such as outdoor ranges and covered verandas, may stimulate species-specific behaviours and thus be successful broiler enrichment. However, their success is dependent on several factors. Poor weather conditions and fearfulness inhibit use of the range, while good quality shelter and nutritious vegetation can increase use of the range. Covered verandas may be a good alternative to outdoor ranges during poor weather and for reducing disease transmission, although their benefits have not been well-studied. Many of the ideas for environmental enrichment need to be further developed, including the practical and economic aspects of these enrichments. However, there is a large amount of scientific literature and knowledge on environmental enrichment that can be applied, and further research should focus on the interaction of enrichment with factors such as natural light, genotype, stocking density and flock size.

Riber AB, van de Weerd HA, de Jong IC et al (2018) Review of environmental enrichment for broiler chickens. *Poultry Science* 97:378-396.

How benchmarking motivates farmers to improve dairy calf management

The amount of colostrum and milk that dairy calves receive after being separated from their mother is determined by the farmer. Dairy calf welfare is often challenged by insufficient quantities of milk and colostrum, but little is known about what motivates farmers to improve calf management around these concerns. Lack of information for farmers can be a barrier, and one method of providing information is through benchmarking. Benchmarking is a process of measuring performance using specific indicators and then comparing performance with that of peers to improve on these indicators. This qualitative study investigated how benchmarking calf performance motivated dairy farmers to make changes in calf management.

Data were collected on calf immune function and growth rates at 18 dairy farms in Canada. The dairy farmers were interviewed on their calf management practices, and how they felt about comparing their farm's performance to other farms. The farmers then received a report describing the performance of their own calves in comparison to those of their peers. Ten weeks later

they received a second report comparing their calves' performance against that of other farms, and the farmers were again interviewed about their calf management practices and their attitudes toward benchmarking.

The attitudes of the dairy farmers to the benchmarking process were largely positive. The motivation of the farmers to improve their calf management was associated with access to information, peer comparisons, and the value that the farmers placed on their calves. Benchmarking encouraged farmers to make changes to their calf management practices by identifying areas needing attention and promoting discussion about best practices. The authors conclude that some management problems can be addressed by providing farmers better access to data that they can use to judge their success and inform changes. Future research in this area could combine qualitative and quantitative methods to better assess farmer experiences.

Sumner CL, von Keyserlingk MAG, Weary DM (2018) How benchmarking motivates farmers to improve dairy calf management. *Journal of Dairy Science* 101:1-11.

Fish welfare during commercial harvesting

Fish welfare is acknowledged as an important societal issue, and while research in this area has been increasing in recent years, there is still limited information available on the welfare of fish during commercial harvesting of wild stock. This may be due to the wide variety of fishing methods used, a lack of welfare-friendly alternatives, and a poor perception of the capacity of fish to suffer. This article reviews the effects of the capture process in capture fisheries on fish welfare.

A literature review was conducted using 85 articles that addressed injuries and/or mortality incurred during the capture process on wild-caught fish species. Injuries and mortality rates were used as measures of fish welfare as these are easily measured in the field. Injuries were categorised as scale damage, skin damage, fin damage, hooking injuries, and injuries due to changes in water pressure. The types of capture methods assessed were trawls, hooks, purse seines, seines, gillnets and traps.

Fish were more likely to sustain scale, skin and fin injuries in all fishing methods except for hooks, which

resulted in hooking injuries. These injuries were mainly caused by contact with the net and other animals in the net. Pressure-related injuries occurred with all capture methods that caught fish from depths greater than 30m. Longer fishing duration was associated with more injuries, probably by exacerbating other variables. Larger fish sustained more injuries, but smaller fish experienced higher mortality rates. Mortality rates were higher in trawls, purse seines and seines than gillnets, hooks or traps. Mortality rates were also higher when the fish experienced large changes in water temperature and pressure, such as when lifted from the depths to the surface, and with a longer fishing duration. Longer duration of air exposure and high density in the net was also associated with higher mortality, probably due to asphyxiation. These relationships provide opportunities to reduce injuries and mortality during commercial fish capture, though implementation of these opportunities may have economic consequences.

Veldhuizen LJJ, Berentsen PBM, de Boer IJM et al (2018) Fish welfare during commercial harvesting. *Fisheries Research* 204:41-48.

Moderate lameness leads to marked behavioural changes in dairy cows

Lameness is one of the most prevalent diseases affecting the welfare of dairy cows. It is one of the main reasons for early culling, and results in poor productivity and welfare. Almost all lameness results from claw disorders, and early detection allows these disorders to be treated before they increase in severity. Early detection is reliant on farmers being able to identify cows with mild and moderate levels of lameness, however research has shown that this is a difficult task to perform reliably. For this reason, other indicators of moderate lameness are sought to facilitate early detection. This study investigated the changes in behaviour associated with moderate lameness to identify potential indicators for automated early lameness detection.

Dairy cattle at 17 dairy farms in Switzerland were scored for lameness using a 5-point gait scoring system. Cows that were scored as not lame (Score 1), and as moderately lame (Score 3) were fitted with electronic collars and leg tags that monitored physical activity, rumination, position in the milking order and the number of visits to the feeder and rotating brush. Cow activity was monitored continuously for 48 hours and the behaviours compared between the moderately

lame and non-lame cows to identify potential indicators of moderate lameness.

In comparison to the non-lame cows, the moderately lame cows spent more time lying and less time moving and eating. The moderately lame cows made less visits to the feeder and rotating brush, and were located further back in the milking order than the non-lame cows. These behavioural changes are likely due to the lame cows minimising the amount of time spent bearing weight on their feet, and walking more slowly. There was no change in rumination behaviour, largely because rumination often occurs while lying down. These results show that the behaviour of moderately lame dairy cows differs from that of non-lame dairy cows in ways that cause disadvantages to energy supply, health and welfare. While there was high variability between cows in these behaviours, they still show promise as early indicators of lameness in dairy cattle.

Weigle HC, Gygax L, Steiner A et al (2017). Moderate lameness leads to marked behavioral changes in dairy cows. *Journal of Dairy Science* 101:2370-2382.

MISCELLANEOUS

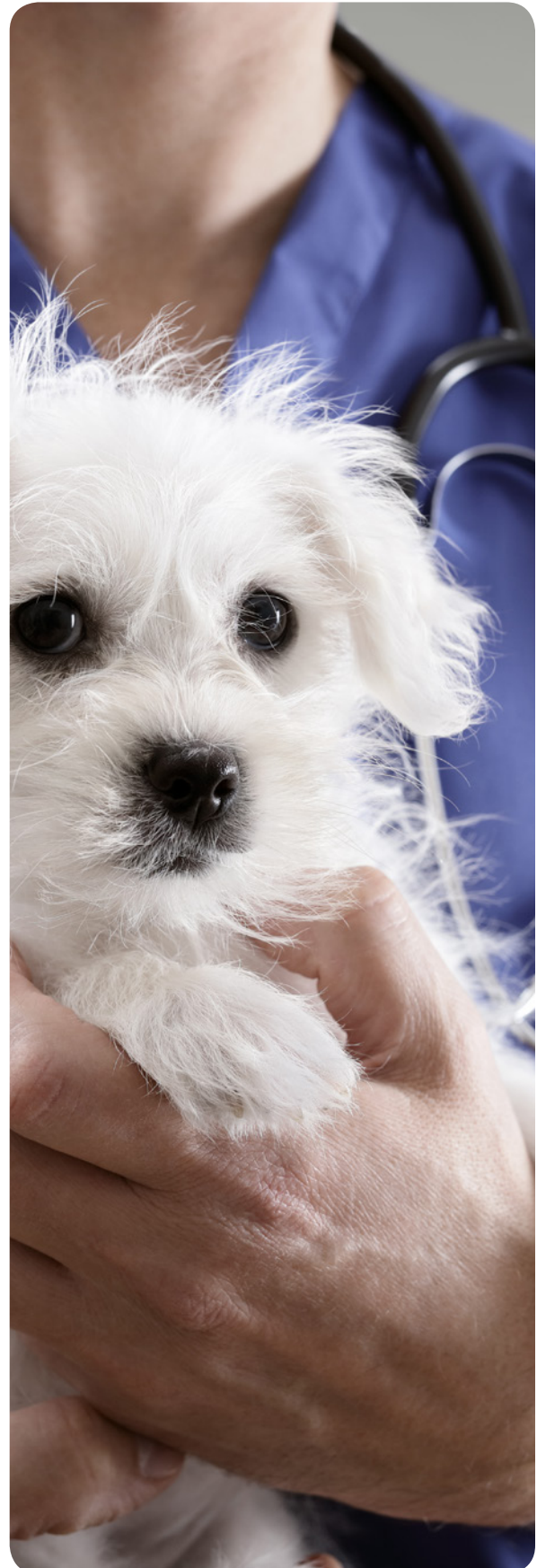
The ethical responsibility of veterinarians to speak up regarding animal welfare issues

Veterinarians have an ethical obligation to provide good care for the animals that they see in practice. However, at times, there may be conflicts between the interests of animal caregivers or owners, the interests of veterinarians and the interests of animals. For example, deep attachment between an owner and a beloved pet may prevent end of life decisions being made, despite continued suffering for the animal. This article outlines the ethical responsibilities of vets to 'speak up' in the face of animal suffering, and discusses how ethical decision-making can be taught and practiced for veterinarians.

This article provides a comparison of the strengths and weaknesses of the five main ethical frameworks (utilitarianism, deontology, contractarianism, virtue ethics and ethics of care), with an interpretation of how each framework relates to the veterinarian's responsibility to 'speak up'. Veterinary ethics is often included in the curriculum at veterinary schools, however the amount of time devoted to teaching ethics is variable. In addition, there are limited opportunities for students to practice and apply ethical frameworks in their decision making. Lack of ethical literacy may impact the ability of vets to articulate or justify their concerns. There are a variety of online resources available for ethical education, although it is unclear how much use veterinary schools make of these resources.

Case-studies are provided to demonstrate situations where complex and challenging cases have led to poor ethical-decision making and prolonged animal suffering. These case-studies relate to transporting lame animals, not recognising animal neglect, providing suboptimal treatment to reduce costs, not advocating for euthanasia when the animal's quality of life is severely compromised, and not providing adequate follow-up treatment. To truly and positively impact improve animal welfare in the long run term and meet societal expectations for the profession, the veterinarian must combine their knowledge of animal care with their ethical obligations to animals, and actively speak up and ask questions when they observe or suspect that animal well-being is compromised.

Hernandez E, Fawcett A, Brouwer E et al (2018) Speaking up: Veterinary ethical responsibilities and animal welfare issues in everyday practice. *Animals* 8(1), E15, doi: 10.3390/ani8010015.



Pigeons know when they will need hints

Metacognition relates to the ability of a human or animal to adaptively control their behaviour through awareness of their own knowledge levels. For example, a student who is aware that their knowledge of chemistry is lacking may focus their studies on this subject rather than others that they already excel in. A variety of mammal species will choose to avoid a difficult task during behavioural testing if possible, and will request help from humans more often during difficult tasks than easy ones. Birds have shown little evidence of metacognitive abilities, however the authors argue that the previous testing paradigms may have been too cognitively demanding to allow metacognitive processing in birds. This Japanese study tested pigeons for evidence of metacognition using a sequence learning task that required fewer working memory resources than previous tests.

Four pigeons were trained individually using operant chambers (Skinner boxes) that contained a small colour touch screen and a feed hopper. The touch screen displayed a series of three coloured squares, and the pigeons were trained to peck the squares in a specific sequence to receive a food reward. This sequence was termed the 'familiar' list, and did not

change throughout the experiment. The pigeons were then trained to recognise a symbol indicating whether they were going to be presented with the familiar list, or a more difficult novel list. After being notified of the upcoming familiar or novel list, the pigeons could choose to receive a hint (a flashing square) that would help them successfully complete the sequence. This task required pigeons to judge their knowledge states before attempting to solve the task.

In test sessions, pigeons could choose between a trial with a hint, or no hint. Pigeons chose the trial with a hint more often before receiving the novel test than the familiar test. The results demonstrated that three of the four test pigeons showed metacognitive-like behaviour, and one pigeon showed robust evidence of metacognition for long-term knowledge. The results suggest that pigeons monitor their long-term knowledge and control their environment before solving a task.

Iwasaki S, Watanabe S, Fujita K (2018) Pigeons (*Columba livia*) know when they will need hints: prospective metacognition for reference memory? *Animal Cognition* 21:207-217.



Identifying signals that may indicate distress

This Editorial briefly summarises 14 recent papers that relate to the detection of distress in animals, including dogs, horses, sheep and cattle. Four of these papers related to dogs. The first paper compared the behaviour of pet dogs with animal-assisted activity dogs that are used to facilitate social interactions and improve social skills. The animal-assisted activity dogs were found to be less impulsive than pet dogs, and spent longer gazing at an unknown experimenter. It was not known why these dogs were calmer than the pet dogs. The second paper examined how well owner surveys reflected separation anxiety behaviours in their dogs. Owners were much better at detecting overt signs of separation anxiety, such as destruction, and missed more subtle signs, such as freezing. The remaining two papers used online surveys to collect data. One paper assessed contributing factors to dog biting behaviour, while the second surveyed public knowledge of correct clicker training procedures.

There were five articles about horses presented; One paper described the development of an ethogram for assessing pain in horses (see Dyson et al, 2018 in this issue of the Science Update). One paper reported that crib-biting behaviour was associated

with low concentrations of selenium, while another demonstrated that weaning was stressful for both colts and fillies, but the sexes displayed different distress patterns. One paper reported that exercise had a greater impact on hormonal concentrations than dietary fibre. The final paper reported that stud stallions find travel stressful, but this is not related to the number of mares covered.

There were five articles about sheep and cattle. The first reported on the attitudes of truck drivers that transported sheep, whereby drivers were allocated to one of three profiles regarding the presence or absence two attributes - efficiency and concern for sheep. One paper reported the negative implications of poor hoof trimming in sheep, while another reported that the provision of concentrates improved lamb survival but did not alter maternal behaviour in sheep. Pica in cattle was associated with phosphorous deficiency. The final paper compared the locomotor activity of sheep, goats, horses and cattle between indoor and outdoor housing.

Overall KL (2018) Identifying signals that may indicate distress. *Journal of Veterinary Behavior* 23:iv-vi.

WILD ANIMALS

Predicting koala road crossing behaviour in south-east Queensland

Linear infrastructure, such as roads, railway lines and easements, can have significant negative effects on local wildlife. Roads may present a barrier to dispersal, prevent individuals from accessing resources or mates, or result in vehicle-related mortalities. One method of mitigating these effects is to build structures that either prevent wildlife from accessing roads (e.g. fencing), or facilitate safe passage across roads (e.g. wildlife crossing structures). Koala populations in south-east Queensland have declined by up to 80%, leading to their classification as a threatened species. Road-associated mortality is a primary threat to koala persistence. This study examined predictor variables for road crossing activity in koalas.

Koala road crossing data were collected from six sites in south-eastern Queensland, Australia. Koala movements were monitored using tracking collars, camera traps and RFID tags. The data for 51 koalas was used for analysis, with a median observation period of 232 days for each koala (range = 46 - 634 days). Additional data were collected on each individual, including sex, age, size, location, types of road crossing behaviour, presence of young and proximity to roads. These variables

were compared to the amount of road crossing behaviour shown by each individual to determine if any relationships existed between the two.

The results of this study found that less than half of the koalas studied (18 of 51) ever crossed a road during the observation period. Within this group the amount of road crossing behaviour was variable, with some koalas crossing often and others crossing infrequently. Koalas were more likely to cross a road if they were less than five years old, male, or were originally located within 100 m of a road. Females were much less likely to cross a road if they had a joey. The high number of young males found in the habitat next to roads suggests that these areas may facilitate dispersion by young males. Alternately, these young males may be filling the territories of individuals lost to vehicle strikes. The authors conclude that successful wildlife road mitigation can be improved by a better understanding of road-crossing behaviour.

Dexter CE, Appleby RG, Scott J et al (2018) Individuals matter: predicting koala road crossing behaviour in south-east Queensland. *Australian Mammalogy* 40:67-75.

Enrichment using food and space for African elephants

Environmental enrichment is used to improve the welfare of captive animals, and knowledge of how these enrichments impact elephant welfare is crucial for continued improvement of their husbandry and care. In the wild, elephants cover vast distances daily and spend a large proportion of their time foraging. In captive elephants, a lack of exercise has been associated with ailments such as foot issues, arthritis and obesity. Previous research has found that the amount of walking that captive elephants perform is influenced more by feeding enrichments than a larger amount of space. This study examined the effects of space availability and food distribution on the behaviour of zoo-housed African elephants.

This experiment was conducted at the San Diego Zoo Safari Park in the USA. This zoo was home to 13 African elephants that were housed in an enclosure consisting of two equally sized yards, separated by a gate. Each of the three space and food treatments were imposed three times, with each treatment lasting for 22 hours: access to one yard only, with food (Half); access to both yards but with food in one yard only (Both/Half), and access to both yards with food in both yards (Both). The amount and types of food presented

in each treatment was the same, but the location of the food varied. The distance walked by each elephant was measured using a GPS anklet, and elephant behaviour was observed for 6.5 hours per treatment. The dominance order of the herd was determined using keeper knowledge.

Walking varied significantly across treatments indicating that space and food did impact elephant movement, however no significant differences were found between any two pairs of treatments, possibly due to the small sample size. Differences in behavioural diversity between treatments 'Half' and 'Both' were significantly correlated with dominance, suggesting that subordinate animals may benefit from the combination of increased physical space without an increase in food distribution. The present study showed that a larger exhibit space and a wider distribution of food delivered some benefits to zoo-housed elephants.

Hacker CE, Miller LJ, Schulte BA (2018) Examination of enrichment using space and food for African elephants (*Loxodonta africana*) at the San Diego Zoo Safari Park. *Animal Welfare* 27:55-65.



ARTICLES OF INTEREST

ANIMALS USED FOR SPORT, ENTERTAINMENT, RECREATION AND WORK

Corrales-Hernández A, Mota-Rojas D, Guerrero-Legarreta I et al (in press) Physiological responses to horses, donkeys and mules sold at livestock markets. *International Journal of Veterinary Science and Medicine*.

DuBois C, DeVries T, Haley DB et al (2018) Putting an on-farm welfare assessment tool into practice in the Canadian equine industry – a pilot study. *Journal of Equine Veterinary Science* 63:34-40.

Heitman K, Rabquer B, Heitman E et al (2018) The use of lavender aromatherapy to relieve stress in trailered horses. *Journal of Equine Veterinary Science* 63:8-12.

Jongman EC, Butler KB, Hemsworth PH (2018) The effects of kennel size and exercise on the behaviour and stress physiology of individually-housed greyhounds. *Applied Animal Behaviour Science* 199:29-34.

Lanas R, Luna D, Tadich T (2018) The relationship between working horse welfare and their owners' socio-economic status. *Animal Welfare* 27(1):47-54.

Majecka K, Klawe A (2018) Influence of paddock size on social relationships in domestic horses. *Journal of Applied Animal Welfare Science* 21(1): 8-16.

Norton T, Piette D, Exadaktylos V et al (2018) Automated real-time stress monitoring of police horses using wearable technology. *Applied Animal Behaviour Science* 198:67-74.

Squibb K, Griffin K, Favier R et al (in press) Poker face: discrepancies in behaviour and affective states in horses during stressful handling procedures. *Applied Animal Behaviour Science*.

Thompson KR, Haigh L, Smith BP (2018) Planned and ultimate actions of horse owners facing a bushfire threat: implications for natural disaster preparedness and survivability. *International Journal of Disaster Risk Reduction* 27:490-498.

Thompson KR, Clarkson L, Riley CB et al (2018) Horse husbandry and preventative health practices in Australia. *Journal of Applied Animal Welfare Science*, doi:10.1080/10888705.2018.1428099

COMPANION ANIMALS

Farnworth MJ, Packer RMA, Sordo L et al (2018) In the eye of the beholder: owner preferences for variations in cats' appearances with a specific focus on skull morphology. *Animals* 8(2), doi: 10.3390/ani8020030.

Huang L, Coradini M, Rand J et al (2018) Search methods used to locate missing cats and locations where missing cats are found. *Animals* 8(1), 5, doi:10.3390/ani8010005

Isgate S, Couchman JJ (2018) What makes a dog adoptable? An eye-tracking investigation. *Journal of Applied Animal Welfare Science* 21(1):69-81

Mohan-Gibbons H, Dolan ED, Reid P et al (2018) The impact of excluding food guarding from a standardized behavioural canine assessment in animal shelters. *Animals* 8(2), 27, doi:10.3390/ani8020027.

Suchak M, Lamica J (2018) A comparison of cats (*Felis silvestrus catus*) housed in groups and single cages at a shelter: A retrospective matched cohort study. *Animals* 8(2), 29, doi:10.3390/ani8020029.

Tatlock S, Gober M, Williamson N et al (2017) Development and preliminary psychometric evaluation of an owner-completed measure of feline quality of life. *The Veterinary Journal* 228:22-32. **FARM ANIMALS**

Aquaculture

Alfnes F, Chen X, Rickertsen K (2018) Labeling farmed seafood: A review. *Aquaculture Economics & Management* 22(1):1-26.

Cattle

Bertocchi L, Fusi F, Angelucci A et al (2018) Characterization of hazards, welfare promoters and animal-based measures for the welfare assessment of dairy cows: Elicitation of expert opinion. *Preventive Veterinary Medicine* 150:8-18.

Boccardo A, Biffani S, Belloli A et al (2017) Risk factors associated with case fatality in 225 diarrhoeic calves: A retrospective study. *Veterinary Journal* 228:38-40.

Bruno K, Vanzant E, Vanzant K et al (2018) Relationship between quantitative measures of temperament and other observed behaviors in growing cattle. *Applied Animal Behaviour Science* 199:59-66.

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Ceballos MC, Gois KCR, Sant'Anna AC et al (2018) Frequent handling of grazing beef cattle maintained under the rotational stocking method improves temperament over time. *Animal Production Science* 58(2):307-313.

Costa JHC, Burnett TA, von Keyserlingk MAG et al (2018) Prevalence of lameness and leg lesions of lactating dairy cows housed in southern Brazil: Effects of housing systems. *Journal of Dairy Science* 101(3):2395-2405.

Cramer G, Winders T, Solano L et al (2018) Evaluation of agreement among digital dermatitis scoring methods in the milking parlor, pen, and hoof trimming chute. *Journal of Dairy Science* 101(3):2406-2414

Daigle CL, Jackson B, Gill R et al (2017) Impact of exercise on productivity, behavior, and immune functioning of weaned Bos indicus-cross calves housed in drylots. *Journal of Animal Science* 95(12):5230-5239.

Fischer AJ, Song Y, He Z et al (2018) Effect of delaying colostrum feeding on passive transfer and intestinal bacterial colonization in neonatal male Holstein calves. *Journal of Dairy Science* 101(4):3099-3109.

Fischer-Tenhagen C, Ladwig-Wiegand M, Heuwieser W et al (in press) Short communication: Is hair cortisol a potential indicator for stress caused by chronic lameness in dairy cows? *Journal of Dairy Science*.

Giammarco M, Fusaro I, Vignola G et al (2018) Effects of a single injection of Flunixin meglumine or Carprofen postpartum on haematological parameters, productive performance and fertility of dairy cattle. *Animal Production Science* 58(2):322-331.

Johnsen JF, Mejdell CM, Beaver A et al (2018) Behavioural responses to cow-calf separation: The effect of nutritional dependence. *Applied Animal Behaviour Science* 201:1-6.

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Losada-Espinosa N, Villarroel M, María GA et al (2018) Pre-slaughter cattle welfare indicators for use in commercial abattoirs with voluntary monitoring systems: A systematic review. *Meat Science* 138:34-48.

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Renaud DL, Duffield TF, LeBlanc SJ et al (2018) Risk factors associated with mortality at a milk-fed veal calf facility: A prospective cohort study. *Journal of Dairy Science* 101(3):2659-2668.

Ring SC, McCarthy J, Kelleher MM et al (2018) Risk factors associated with animal mortality in pasture-based, seasonal-

calving dairy and beef herds. *Journal of Animal Science* 96(1):35-55.

Roberts SL, Powell JG, Hughes HD et al (2018) Effect of castration method and analgesia on inflammation, behavior, growth performance, and carcass traits in feedlot cattle. *Journal of Animal Science* 96(1):66-75.

Robichaud MV, Rushen J, de Passillé A.M et al (2018) Is the profitability of Canadian freestall farms associated with their performance on an animal welfare assessment? *Journal of Dairy Science* 101(3):2350-2358.

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Winder CB, Miltenburg CL, Sargeant JM et al (in press) Effects of local anesthetic or systemic analgesia on pain associated with cautery disbudding in calves: A systematic review and meta-analysis. *Journal of Dairy Science*.

Pigs

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