RSPCA
for all creatures great & small

ANIMAL WELFARE SCIENCE UPDATE

Issue 78 | July 2022

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.

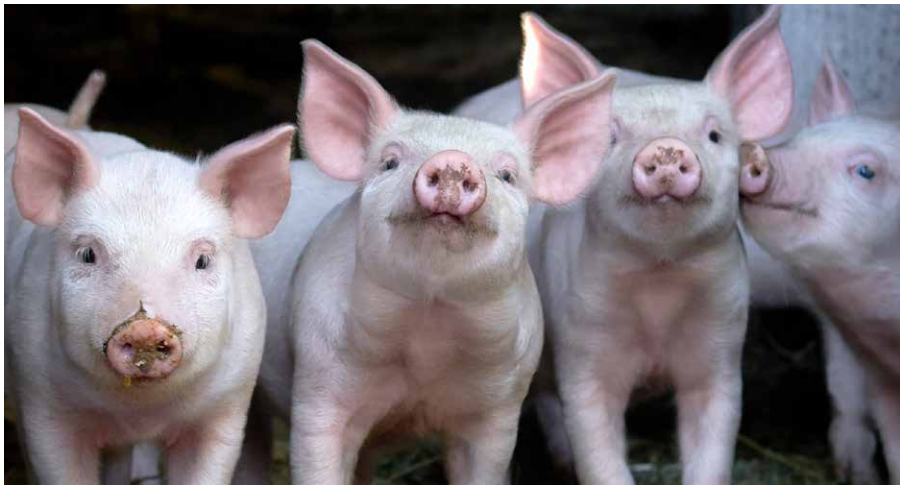
Click here to subscribe

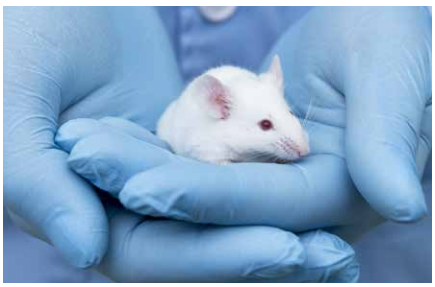
RSPCA AUSTRALIA SCHOLARSHIPS 2022

RSPCA Australia invites applications for the 2022 RSPCA Australia Scholarships. The scholarships seek to encourage students to take an active interest in animal welfare issues, to support animal welfare research that might not otherwise attract funding, and to promote the objectives of the RSPCA within the research community. The three RSPCA Australia scholarships are the Alan White Scholarship, the Hugh Wirth Humane Animal Production Scholarship, and the Sybil Emslie Animal Law Scholarship.

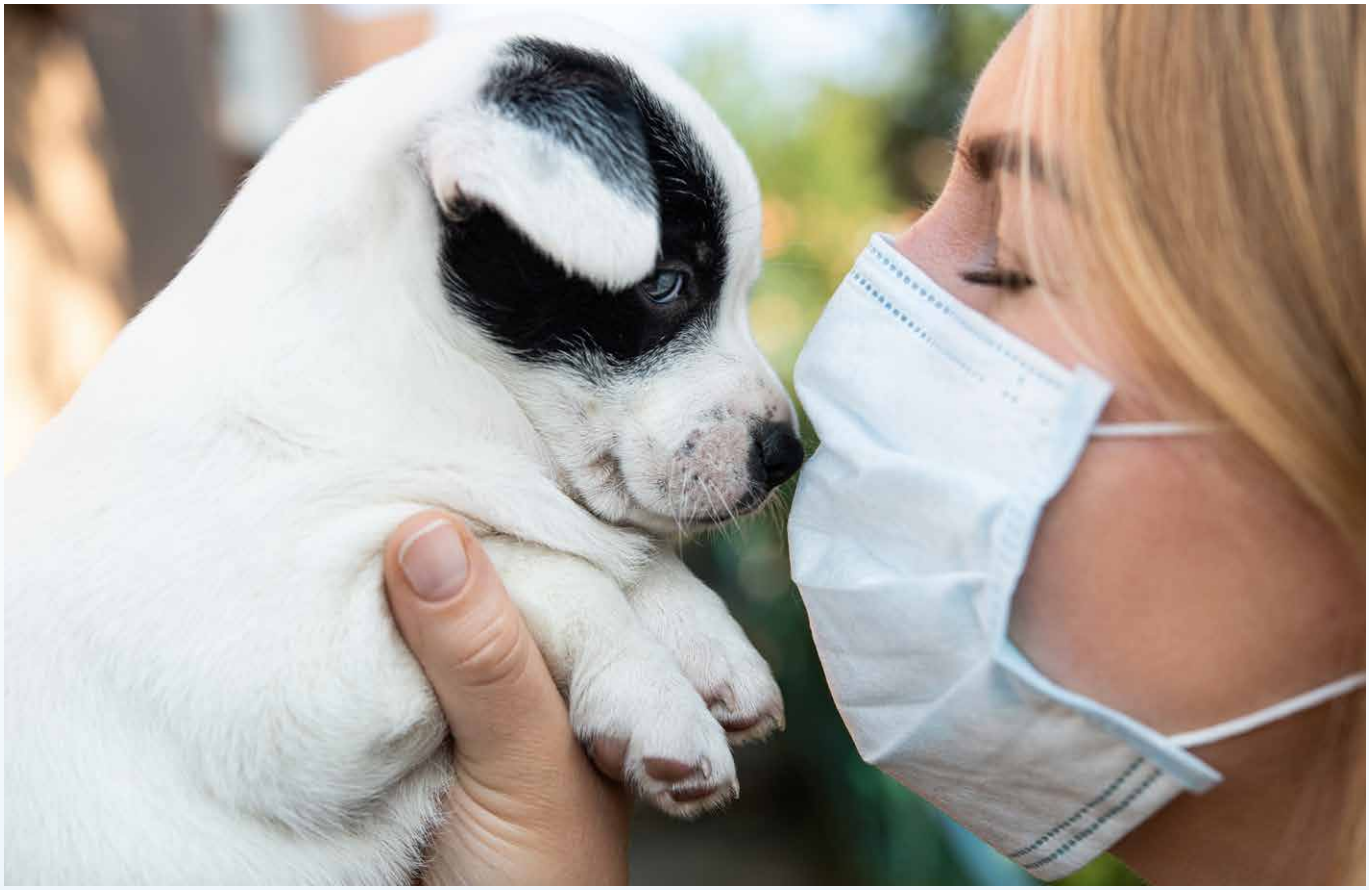
More information, including deadlines and application forms, can be found here: **rspca.org.au/our-role-in-animal-welfare-science/scholarships**

INCLUDED IN THIS UPDATE





COMPANION ANIMALS



Pandemic puppies may have been smuggled into the UK illegally

In early 2020, as the global COVID-19 pandemic unfolded, many people bought puppies (often referred to as pandemic puppies). This uptick in puppy buying raised animal welfare concerns relating to unscrupulous dog breeding, indiscriminate puppy buying, and behavioural problems arising from lack of socialisation.

This study aimed to characterise the health and behaviour of pandemic puppies purchased in 2020 during COVID-19 lockdowns in the United Kingdom. Via an online survey, respondents were asked questions about vet visits, and puppy health, training, socialisation and behaviour. Respondents included people who bought pandemic puppies (n = 4369) and people who acquired their puppies in 2019 before the pandemic (n= 1148).

Compared to puppies acquired in 2019, pandemic puppies were significantly less likely to have attended a puppy class or met visitors at home. The authors recommend that pandemic puppies attend reward-based adult training classes to help catch up on socialisation with people and other dogs. The three most commonly reported undesirable behaviours in pandemic puppies and 2019 puppies, were pulling on the lead, jumping up at people and lack of recall. These behaviours may just be age related. The authors were more concerned that one in six puppies in both the 2019 and 2020 cohorts were never left alone, which may predispose them to developing separation anxiety later in life. While pandemic puppies were less likely than 2019 puppies to have had a veterinary health check before 16 weeks of age, there were no significant differences in reported health problems. Compared to 2019 puppies (4.1%), significantly more pandemic puppies (7.1%) were sold with 'pet passports', and of these 87.4% were younger than 13 weeks. These findings raise suspicions that these pandemic puppies may have been smuggled into the UK illegally. Ongoing buyer education is needed to stop people inadvertently supporting the illegal puppy trade.

Brand CL, O'Neill DG, Belshaw Z et al (2022). ***Pandemic puppies: Demographic characteristics, health and early life experiences of puppies acquired during the 2020 phase of the COVID-19 pandemic in the UK.*** *Animals 12, 629.*

Poodle crosses are very popular but in reality "doodles" may not meet the motivating expectations of owners

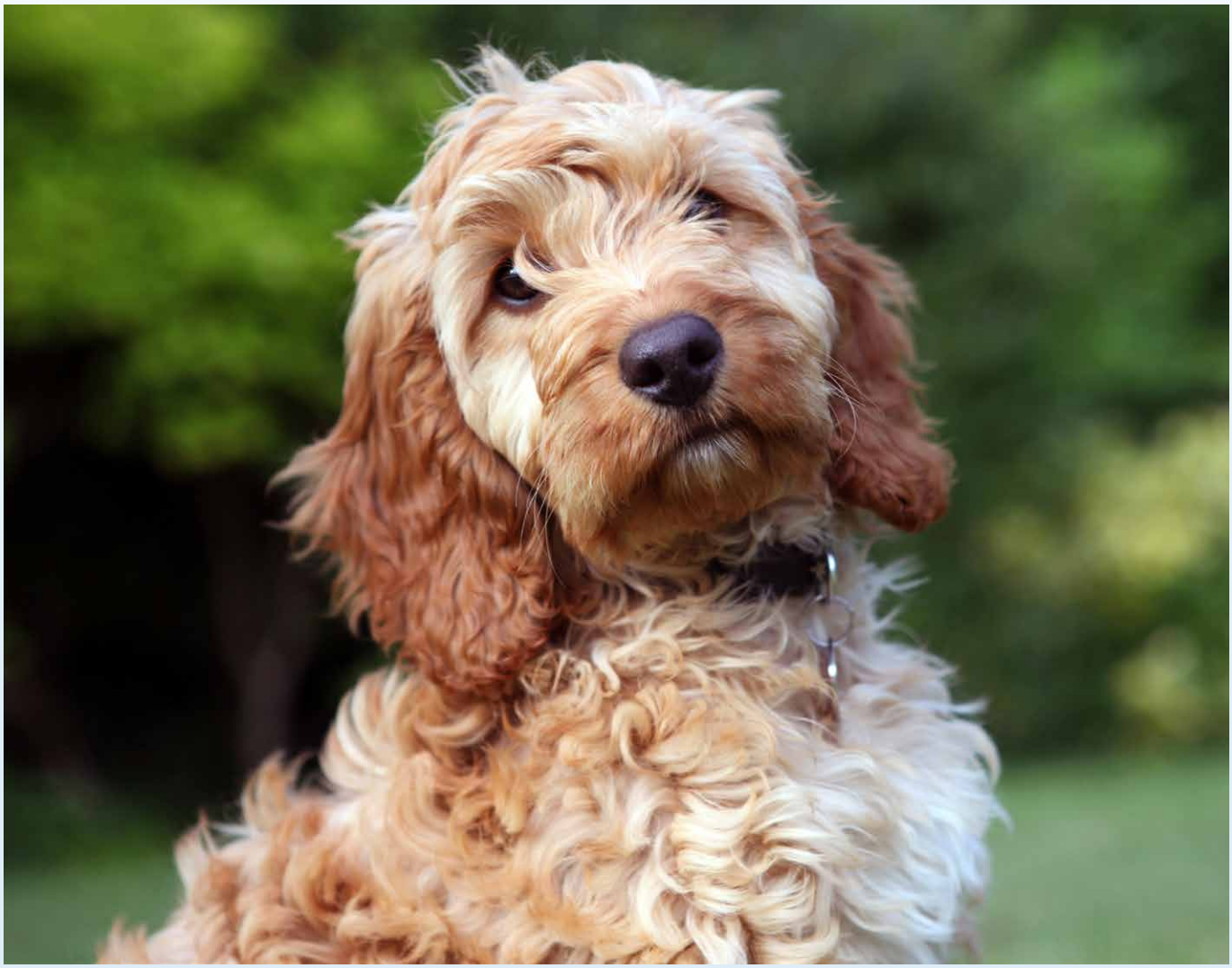
Poodle crosses like labradoodles (Labrador x poodle), cockapoos (cocker spaniel x poodle), and cavapoos (Cavalier King Charles spaniel x poodle), also known as 'designer crossbreeds', are increasingly popular.

This study, conducted in the United Kingdom, aimed to understand the motivations driving the popularity of 'designer crossbreeds'. People who purchased 'designer crossbreed' (n= 1575) and purebred (n= 4718) puppies in 2020 were surveyed. Respondents answered questions about their purchasing experience, and the reasons they chose that breed or crossbreed.

A total of 47.1% of people who purchased 'designer crossbreed' puppies said they were motivated by the perception that they are 'hypoallergenic' and, consequently, good for people with allergies. However, there is no scientific evidence that poodle-crosses are 'hypoallergenic'. 'Designer crossbreed' puppies cost significantly more than purebred puppies and were more likely to be a 'convenience purchase' via online classifieds like Gumtree (13.8%).

While all puppy purchasers said they had tried to find dog breeders they felt were trustworthy, this study raised concerns about irresponsible dog breeding and selling practices that may put dog welfare at risk. For example, people who purchased 'designer crossbreeds' were less likely to have seen the puppy, littermates or mother dog face-to-face, or to have received the results of health testing. While in some instances, crossbreeding has been used to improve the health of purebred dogs, the authors recommend further investigation into the health and behaviour of 'designer crossbreeds'.

Burnett E, Brand CL, O'Neill DG et al (2022) ***How much is that doodle in the window? Exploring motivations and behaviours of UK owners acquiring designer crossbreed dogs (2019-2020).*** *Canine Medicine and Genetics doi:10.1186/s40575-022-00120-x.*



Survey shows snakes need better care

Snakes are often kept in captivity by private owners but there is little information available about the conditions in which they are kept and how these conditions affect their welfare.

This study surveyed 744 snake owners, the majority from the United Kingdom, about housing, husbandry and environmental enrichment for captive snakes. Respondents were asked to describe how they take care of their snakes, including questions about the enclosure set up, feeding routine, temperature, humidity, and snake health, behaviour and lifespan.

Snakes in the UK are commonly bought from exotic pet shops (24.9%) and private breeders (24.5%). They are often kept on their own (93%) in an enclosure shorter than their body length (54.7%), which limits their ability to stretch out. Snakes are most commonly fed dead mice (59.8%) or rats (53.8%). The most common types of environmental enrichment provided include a hide (95.7%), water pool (91.7%) and climbing apparatus (87.8%). Most owners monitor the temperature of their snake's environment (92.3%) and some (51.9%) monitor humidity. However, many people are not keeping snakes within the recommended temperature and humidity range for the species. Snake health problems include respiratory problems, issues shedding skin, and parasites, scrapes and cuts.

Behaviours potentially indicative of poor welfare include interacting with transparent boundaries (52.8%), withdrawing when touched (52.4%), unusually high activity (51.1%), and attempting to escape (45.9%). Of those respondents who provided information about the lifespan of previous snake(s) (n= 237), over half (52.1%) of those snakes died by the age of two years (even though many snakes can live for decades). These results raise concerns about the welfare of snakes kept in captivity by private owners. The authors recommend that accurate information about snake care be made more available.

Cargill BM, Benato L, Rooney NJ (2022) ***A survey exploring the impact of housing and husbandry on pet snake welfare.*** *Animal Welfare 31(2):193-208.*

Tunnels, digging and exploring, these are a few of ferrets' favourite things

Environmental enrichment (EE) aims to enhance the lives of animals kept by people. Ferrets are commonly kept by people, for example as pets and in research laboratories, but there has been little research investigating how EE could improve their welfare.

This international study used an online questionnaire to investigate ferret housing, husbandry, and EE. Respondents (n= 831) from 17 countries completed the questionnaire, including ferret owners, and people who work with ferrets in labs, zoos, rescue centres and pest control. Questions included, "how much time do the ferrets usually spend outside a cage/enclosure?" and "what do you think is the ferret's favourite type of EE and why?"

Respondents most commonly cared for three to six ferrets and housed them socially (two or more ferrets together). Cages were the most common housing type, but all sectors allowed ferrets out of their cages to some degree. The most common types of EE included hammocks, tunnels, climbing frames, nesting material, toys and human interaction. Respondents believed ferrets most enjoyed tunnels, digging, human interaction and exploration. They interpreted ferrets' enjoyment via behaviours such as vocalisation, bouncing, and 'joy jumps'. Ferrets were also reported to enjoy scent trails using treats, plants/herbs, perfume, spices, oils, and the scents of other animals, although these forms of EE were rarely provided. Some potential risks of EE included ferrets getting claws stuck in certain fabrics, chewing and swallowing rubber toys, and becoming trapped in tunnels that were too narrow. Overall, the authors recommend improvements in EE for ferrets, including more time out of cages, and a greater variety of EE, particularly more of the activities they seem to enjoy the most.

Dancer AMM, Díez-León M, Bizley JK et al (2022). ***Housing and environmental enrichment of the domestic ferret: A multi-sector survey.*** *Animals 12, 1065.*

Cat owners are more likely to listen to less complicated advice

Problem behaviours often occur in cats when owners do not meet their physical and mental needs. In these instances, advisors (e.g., veterinarians) may recommend environmental enrichment to better meet the cat's physical and mental needs. However, application of enrichment depends on cat owners' willingness to listen to advisors and comply with advice. Human psychology can shed light on factors that influence cat owner's willingness to comply with advice.

This study used the psychological Theory of Planned Behaviour to investigate how owner intentions and attitudes, and subjective norms, influence their willingness to comply with advice on environmental enrichment. Dutch-speaking cat owners (n=703), recruited via social media, were presented with hypothetical scenarios where they received advice about environmental enrichment for cats. Advice was either 'mild' or 'severe' and came from either a highly credible professional advisor or a less credible advisor (an unqualified neighbour). 'Mild' advice involved recommendations for minor modifications, including adding a scratching post and cleaning litter trays once daily. 'Severe' advice involved more detailed and onerous recommendations relating to multiple scratching posts, litter trays, food and water, elevated areas, and play.

Cat owners were more likely to comply with 'mild' advice and advice from highly credible advisors. However, if the advice was contrary to the cat owner's existing beliefs, they were more likely to oppose it when it came from a highly credible advisor, perhaps because they felt challenged. Cat owners who self-identified as 'cat guardians' were more likely to comply with advice about environmental enrichment. The authors recommend that advisors receive sound animal behaviour training, improve communication skills, ensure advice is not too onerous, and help create pro-environmental enrichment social norms. This study used hypothetical scenarios. To understand how to improve compliance, the authors recommend that future research should apply the Theory of Planned Behaviour to owners seeking real-world advice for their cat's problem behaviours.

van Leeuwen E, ter Mors E, Stolting M (2022) ***How cat behavior advisors can improve clients' willingness to adopt their advice: An investigation of advice severity, advisor credibility, and clients' self-identity.*** *Journal of Applied Animal Welfare Science do i:10.1080/10888705.2022.2070845.*

Pugs are at extreme risk of life-altering health problems

Brachycephalic (flat-faced) dogs, such as pugs, remain very popular despite increasing concerns about the health and welfare issues associated with how they are bred to look.

This cross-sectional study, conducted in the United Kingdom, aimed to estimate how common different health problems are in pugs compared to other dogs (non-pugs). Data on a randomly selected subset of pugs (n= 4308) and non-pugs (n= 21,835) presenting to UK veterinary clinics in 2016 was collected from VetCompass clinical records. Risk factor modelling was used to calculate the odds of 40 common health problems in pugs compared to non-pugs.

Pugs were found to have significantly higher odds of being diagnosed with a range of health problems compared to non-pugs. Pugs had higher odds for 30/40 (75%) of common health problems compared to non-pugs. At a general body system level, pugs were ultra-predisposed (odds over 4 times higher than non-pugs) to disorders of the lower respiratory tract (7.5 times), oral cavity (6.28 times), upper respiratory tract (5.96 times), and abdomen (5.48 times). At a specific-condition level, pugs were ultra-predisposed to health problems including brachycephalic obstructive airway syndrome (BOAS) (53.92 times the odds), narrowed nostrils (51.25 times), corneal ulcers (13.01 times), skin fold infections (10.98 times), and ear discharge (9.61 times). It is possible that these were under-estimations as many pug owners view these issues as 'normal' so may not seek veterinary advice. While pugs had significantly lower odds of some problems such as heart murmurs, there were many more predispositions than protections. These results confirm that there are serious health and welfare problems in pugs. The authors conclude that these problems are so extreme that from a health perspective, pugs can no longer be considered a typical dog.

O'Neill DG, Sahota J, Brodbelt DC et al (2022) ***Health of Pug dogs in the UK: disorder predispositions and protections.*** *Canine Medicine and Genetics doi:10.1186/s40575-022-00117-6.*

Adopters who return dogs to shelters may have unrealistically high expectations

In the United States, around 15% of dogs adopted from rescue shelters are returned. This is an animal welfare problem as it causes stress to dogs and may increase the risk of euthanasia if a dog is returned for behavioural or medical reasons.

This study aimed to understand why some people return dogs to shelters after adoption. People (n=132) who adopted dogs from a US rescue shelter between June and September 2021, were asked questions about their expectations of dog ownership; for example, "how well has your dog adapted to their new home?", "to what extent have your expectations of dog ownership been matched?", and "have you experienced problems with your dog's behaviour?".

The majority of adopters were very happy with their new dog. However, 29/132 (22%) returned a dog to the shelter within three months of adoption, ten of those within the first two days. Fifty-eight percent of adopters who returned dogs cited reasons relating to animal behaviour. The study did not establish whether these were behavioural disorders or just behaviours people didn't like. Owner-related reasons for returns included not having enough time, and changes in their housing situation. Comparing adopters who returned dogs with those who kept their dogs, there were no significant differences in age, gender, previous dog ownership, or understanding of the effort required to care for a dog. The main differences were that owners who returned a dog had higher expectations of dog ownership (e.g., a dog should be an emotional support), and higher expectations for the dog to be healthy and behave well (e.g., friendly with children, respond well to training, not destructive, not fearful in new situations). The authors conclude that adopters who returned dogs had unrealistically high expectations. Improved adoption counselling is needed to ensure adopters have more realistic expectations.

Powell L, Lee B, Reinhard CL et al (2022) ***Returning a shelter dog: The role of owner expectations and dog behavior.*** *Animals 12, 1053.*

Shorter faces, shorter lives, brachycephalic dogs have the shortest life expectancy

Life tables are a way to estimate life expectancy at different ages. National life tables are often used to evaluate life expectancy in human populations, but they are rarely used for companion animals.

Using data from the veterinary record system VetCompass, this study compiled the first national life tables for dogs in the United Kingdom. The dataset included all dogs in the VetCompass system who died from January 2016 to July 2020 (n= 30, 563). Dogs' average life expectancy at age 0 was 11.23 years. Life expectancy varied significantly with sex, neutering status and breed. At age 0, females (average 11.41 years) were expected to live longer than males (average 11.07 years). Though the authors urged caution in interpreting the possible reasons, neutering was associated with a longer life expectancy for both sexes, especially females. Four brachycephalic (flat-faced) breeds, the French bulldog, English bulldog, pug and American Bulldog, had the shortest life expectancy of all 18 breeds included in the study, likely due to breed-related health problems that cut their lives short. French bulldogs had the shortest life expectancy at age 0 (average 4.53 years). Practical uses for life tables include calculating probability of death at specific ages, making treatment plans, understanding the effects of health problems on longevity, designing interventions to improve health and welfare, and informing end of life decisions.

Teng KT, Brodbelt DC, Pegram C et al (2022) ***Life tables of annual life expectancy and mortality for companion dogs in the United Kingdom.*** *Scientific Reports 12, 6415.*

FARM ANIMALS

Sows and piglets can stay safe and warm in loose outdoor farrowing systems

There is increasing interest in loose outdoor systems for sows to give birth to (farrow) their piglets. Compared to conventional indoor farrowing crates, loose outdoor systems offer animal welfare advantages such as more freedom of movement and more opportunities to engage in natural behaviours. However, concerns about loose outdoor farrowing systems include exposure to heat and cold, and sows accidentally crushing piglets.

This study, conducted in Canada, investigated sow behaviour (n = 42) in three different outdoor farrowing systems: wood modified A-frame huts (wood huts), plastic round calf hutches (plastic huts), and English-style metal arks (metal huts). Sows chose a hut on a first come first serve basis and were housed in groups of three. Temperature and humidity were recorded via loggers on the hut walls, and harnesses fitted to the piglets. Sow and piglet behaviour, including their position, posture, nursing behaviour, and crushing events, were recorded for 14 days post-farrowing.

The three different outdoor farrowing systems varied in temperature and humidity. Metal huts appeared to be well insulated, staying warm when it was cold outside, and cool when it was hot outside. However, during the day, all hut types sometimes reached temperatures above sows' upper temperature limit of 23°C. Lactating sows spent most of their time lying on their side nursing their piglets. When they weren't nursing, newborn piglets spent most of their time huddling with other piglets. A total of 181 crushing events, including two fatalities, were recorded, suggesting that sows were attentive to their piglets. The percentage of live born piglets who died from crushing or trauma did not differ significantly between hut types. The authors recommend further investigations into the benefits and risks of different hut sizes, shapes and materials as well as designs that reduce crushing events.

Conrad L, Aubé L, Heuchan E et al (2022) Effects of farrowing hut design on maternal and thermoregulatory behaviour in outdoor housed sows and piglets. Applied Animal Behaviour Science 251, 105616.

Pregnant sows face many concurrent, cumulative and chronic stressors

Pigs face a number of stressors including confinement, handling, restricted feed, and lack of opportunity to perform natural behaviours. Most pig welfare research focuses on acute (short-term) stress in weaners (recently weaned pigs) and finishers (pigs being fed to reach market weight). Less is known about chronic stress in pregnant sows (female breeding pigs).

This review synthesises the literature on chronic stress in pregnant sows. During pregnancy, sows experience many concurrent, cumulative and chronic stressors, including extreme confinement, unstable group dynamics, restricted feeding and chronic hunger, painful lameness, rough handling, lack of enrichment, uncomfortable flooring, heat stress, and few opportunities to perform natural behaviours like foraging and rooting around in substrate.

Chronic stress is mediated by long-term activation of the hypothalamic-pituitary-adrenocortical (HPA) axis, and involves the release of hormones including cortisol, which can be used as an indicator of compromised animal welfare. Prolonged HPA axis activation is a concern as it can lead to reduced immune function, higher incidence of disease and reduced reproductive performance (e.g., increased embryo mortality and higher number of stillbirths). In addition, stress to pregnant sows (pre-natal stress) may affect the health and welfare of piglets and subsequent generations. For example, when they grow up, the female offspring of stressed mothers develop behaviours consistent with anxiety, potentially resulting from the effects of pre-natal stress on their brain development. To benefit the health and welfare of current and future generations of pigs, the authors recommend improvements in sow housing, diet, husbandry, housing and enrichment.

Lagoda ME, Marchewka J, O'Driscoll K et al (2022) ***Risk factors for chronic stress in sows housed in groups, and associated risks of prenatal stress in their offspring.*** *Frontiers in Veterinary Science 9, 883154.*

Straw on the floor helps reduce feather pecking in pullets reared in aviaries

Egg-laying hens often peck one another (feather pecking). Feather pecking is an animal welfare issue because it is painful, can cause fear and stress, and may lead to infections, cannibalism and increased mortality.

This study, conducted in Austria, investigated animal, human and environment-based risk factors for feather pecking. Indicators of feather pecking included feather condition, extent of bloody lesions, and presence/absence of down feathers on the ground. Observers looked for these indicators in 100 flocks of Lohmann hybrid pullets on 28 farms. No birds were beak trimmed as this practice is prohibited in Austria. Over half the flocks (n = 53) were raised in aviary systems with no litter (aviary reared). In contrast, one organic flock and the remaining flocks (n = 46) were reared on the floor with straw litter (floor reared).

Data was also collected on quantity and quality of litter (in this case, straw), light intensity, husbandry, stocking density, and bird reactivity score and avoidance distance (as indicators of fear). In addition, farmers (n = 39) completed a questionnaire to gauge their beliefs and attitudes towards poultry.

Floor rearing with straw litter appeared to reduce feather pecking. There was less plumage damage and fewer bloody lesions in floor-reared compared to aviary-reared birds. These results confirm that access to litter from the first day of life is important to reduce feather pecking by directing pecking behaviour at the ground rather than towards other birds thereby promoting natural foraging and pecking behaviour. In addition, farmers' attitudes were also significant predictors of feather pecking. There was less plumage damage when farmers had a more positive general attitude towards the birds, which may influence husbandry.

Mels C, Niebuhr K, Futschik A et al (2022) ***Predictors for plumage damage and bloody lesions indicative of feather pecking in pullets reared in aviaries.*** *Applied Animal Behaviour Science 250, 105607.*

Improving animal welfare can help address antimicrobial resistance

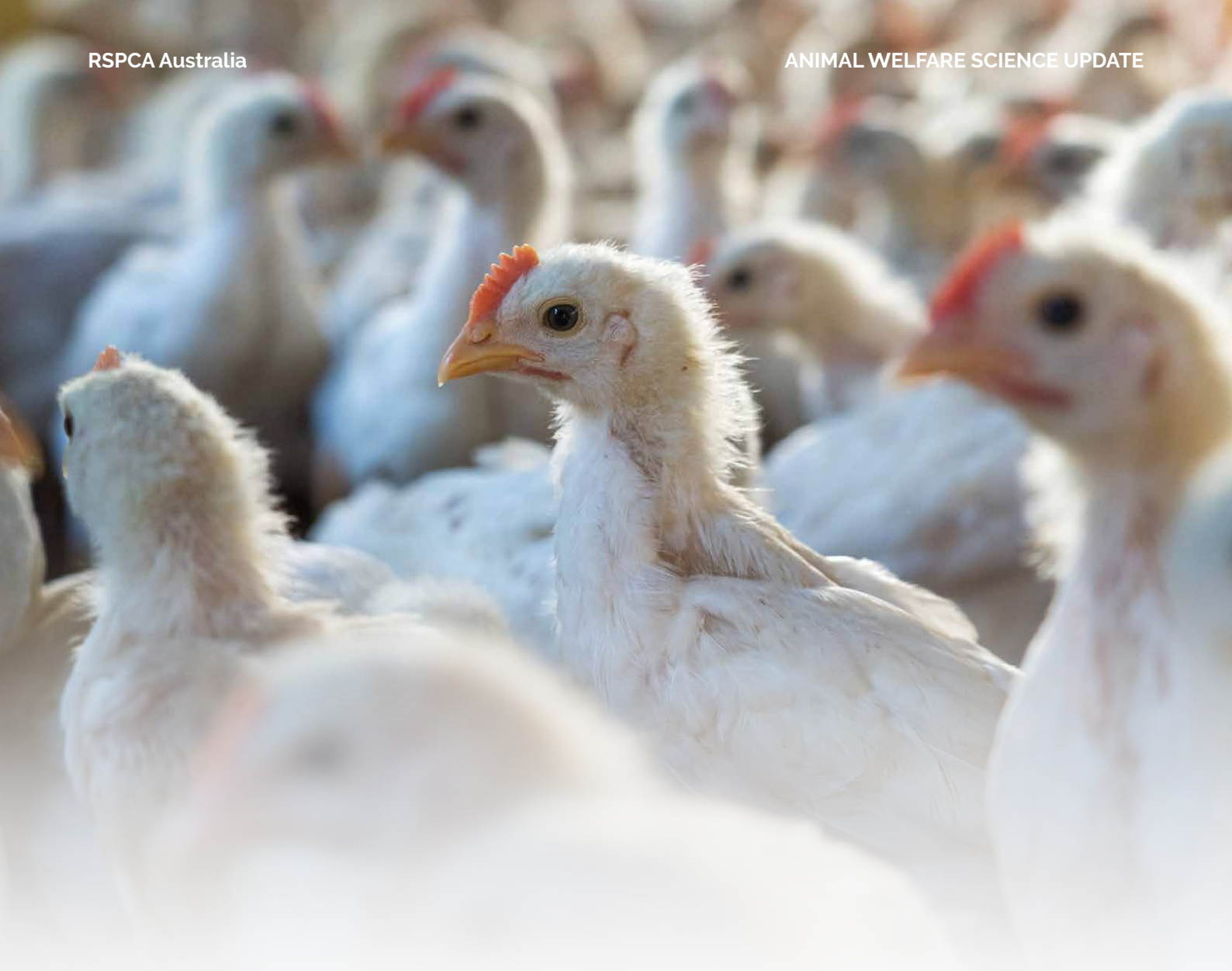
Imprudent antimicrobial use (AMU) can lead to antimicrobial resistance (AMR), that is, the rise of bacterial infections that are resistant to treatment. Globally, AMR is a threat to human and animal health.

This review aimed to summarise the literature on the links between AMU and animal welfare in captive animals including farm, zoo, companion and laboratory animals. The authors found 17 relevant studies. Almost all the studies (16/17) were on farm animals including pigs (n=7), dairy cattle (n=5), beef cattle (n=3) and poultry (n=1).

There is little research available on the links between AMU and animal welfare. This represents a significant knowledge gap. The authors found no publications on AMU and animal welfare in zoo or companion animals. The animal welfare indicators used in the existing literature are crude (e.g., mortality rates) and are not sensitive enough to detect poor welfare. The majority of the literature to date focuses on the effect of animal welfare on AMU (14/17) rather than vice versa.

From the existing literature, it appears that improved farm animal welfare is associated with lower AMU, and poor farm animal welfare is associated with higher AMU. For example, piggeries with poorer equipment, insufficient enrichment, extreme confinement, and poor pen conditions, have higher AMU. Poor conditions, painful husbandry procedures, and stress can contribute to infections and lead to administration of more antimicrobials. This is consistent with the Food and Agriculture Organisation of the United Nations (FAO) statement that improved animal health and welfare make animals less susceptible to infections thus reducing AMU.

Rodrigues de Costa M, Diana A (2022) ***A systematic review on the link between animal welfare and antimicrobial use in captive animals.*** *Animals 12, 1025.*



Mobility issues occur when conventional meat chickens grow too fast

Meat chickens (broilers) are being bred to grow faster and faster. Today's conventional meat chickens reach market weight of ~2.5kg in just 40 days. Rapid growth raises many animal welfare concerns including painful bone and joint problems, and difficulties standing and walking. These issues are compounded by common infections of the legs and footpads (e.g., footpad dermatitis, hock burn).

This study, conducted in Canada, investigated the relationship between growth rate, litter quality, mobility, footpad dermatitis and hock burn. Meat chickens (n = 7216) were allocated to 164 pens at a stocking density of 44 birds/pen (~30kg/m2). The test population included 14 strains of broiler with different growth rates: 2 conventional fast-growing strains (>60g/day) (CONV), and 16 slower growing strains, including 4 categorised as fast growing (53-55g/day) (FAST), 4 moderate growing (50-51g/day) (MOD) and 4 slow growing strains (<50g/day) (SLOW). Mobility was assessed using the latency-to-lie test (to see how long the birds could stand up) and group obstacle test (to see how long it took birds to step up and over an obstacle). Half the birds in each pen were examined to score the severity of footpad dermatitis and hock burn. The moisture content of litter was also estimated.

At target weight, there was a higher incidence of footpad dermatitis in CONV birds. CONV and FAST birds also had a higher incidence of hock burn compared to MOD and SLOW birds. CONV and FAST birds had shorter latency-to-lie (i.e., were unable to stand up for as long) compared to SLOW birds. CONV birds had the lowest total frequency of obstacle crossings. The authors suggest that these differences in mobility may be associated with differences in body weight, body shape and leg strength. The results of this study also emphasise the importance of good litter quality to reduce the risk of footpad dermatitis and hock burn.

Santos MN, Widowski TM, Kiarie EG et al (2022) ***In pursuit of a better broiler: walking ability and incidence of contact dermatitis in conventional and slower growing strains of broiler chickens.*** *Poultry Science 101, 101768.*

Consumers prefer dairy production that doesn't separate calves from their mothers

Dairy calves are routinely separated from their mothers within hours of birth. Cow-calf separation causes distress, prevents cows and calves from engaging in natural behaviours, and can damage calf development, behaviour and health.

This study investigated public attitudes towards cow-calf separation. Respondents (n = 307 Canadians, 1487 Americans) completed an online survey to gauge their attitudes towards four different cow-calf management systems: (1) no separation, (2) separation with individual calf housing, (3) separation with group housing of calves, and (4) separation with transfer of calves to foster cows. Respondents were asked to rate how unacceptable/acceptable they considered the system (1 = totally unacceptable to 7 = totally acceptable), perceived quality of life of the cow and calf (1 = very bad to 7 = very good), and reasons for their ratings. The survey also included questions about willingness to pay (WTP) for milk produced in the different systems.

Some respondents accepted cow-calf separation (e.g., "A dairy is a business, and in order to run the business, the farmer must separate cows and calves to get milk"). However, many respondents voiced concerns (e.g., "It is inhumane to separate them and not allow natural bonding"). Consumers did not appear to accept group housing or fostering as adequate replacements for mother-calf contact. Regardless of how familiar they were with the dairy industry, respondents had more positive attitudes towards the system where calves were not separated from their mothers. Cow-calf management system also affected WTP for milk.

Respondents were more likely to be WTP the same or more for milk when cows and calves were not separated. These results indicate that cow-calf separation risks the dairy industry's social license, and alternatives are needed to satisfy consumers.

Sirovica LV, Ritter C, Hendricks J et al (2022) ***Public attitude toward and perceptions of dairy cattle welfare in cow-calf management systems differing in type of social and maternal contact.*** *Journal of Dairy Science 105(4):3248-3268.*

The animal welfare risks of Precision Livestock Farming require independent investigation

There is growing interest in advanced technological sensor systems in animal agriculture. These systems, collectively referred to as Precision Livestock Farming (PLF), employ sensors on, around or inside animals to monitor factors such as movement, weight, reproductive status and temperature. Artificial intelligence can be used to analyse sensor data and make decisions about livestock management. While scientific evidence is currently lacking, broad optimistic claims are made about the potential animal welfare benefits of PLF. Less widely discussed are the potential animal welfare risks of PLF.

This article discusses the potential animal welfare risks of PLF. PLF may cause direct harm to animals via: (1) technical failures, (2) negative effects of hardware components on animal behaviour, health and comfort, (3) inaccurate predictions based on flawed algorithms, and (4) lack of uptake of meaningful animal welfare indicators. For example, PLF may prioritise readily quantifiable factors but may be less adept at monitoring animals' emotional states. PLF may cause indirect harm via: (5) under/over-reliance by the end user, (6) less quality time spent monitoring animals, (7) loss of husbandry skills, (8) changes in housing and management to suit PLF instead of animals, and (9) over-industrialisation where animals pay the price for the quest to produce cheaper animal products. For example, optimal operation of PLF favours barren, sterile housing systems but these result in poor animal welfare. PLF may also affect the status of farm animals by increasing: (10) speciesism, (11) instrumentalisation where animals are viewed as inanimate commodities, and (12) animal consumption and harm.

To date, few PLF systems are in commercial use so it remains to be seen how PLF will affect animal welfare. As PLF technologies continue to be developed, the authors recommend that the animal welfare risks be thoroughly and independently investigated under a range of commercial conditions.

Tuyttens FAM, Molento CFM, Benaissa S (2022) ***Twelve threats of precision livestock farming (PLF) for animal welfare.*** *Frontiers in Veterinary Science 9, 889623.*

ANIMALS IN SPORT, ENTERTAINMENT, PERFORMANCE, RECREATION AND WORK

New processes are needed to improve the lives of horses in equine sports

Many horses are used in equestrian sports such as racing, jumping, cross-country, dressage, and polo. Animal welfare concerns exist at every stage of sporting equids' lives from breeding to housing, feeding, handling, training, transport and competition.

This review summarises the scientific evidence for animal welfare concerns in equine sports. Brood mare welfare has received relatively little attention, but concerns include the pain and distress of covering (mating), multiple pregnancies, birthing, and mare-foal-separation at weaning. Concerns associated with training include punishment-based methods, extreme physical and mental demands from an early age, use of illegal drugs for masking or to enhance performance, and use of aversive tack (equipment) (e.g., spurs, whips, tongue ties). Sporting equids are routinely transported, which can cause stress and distress. Racehorses commonly suffer from tendon and ligament injuries, respiratory conditions, and bone injuries. In Britain, between 2000 and 2013 there were 628 racehorse fatalities, 683 between 2014 and 2017, and 202 in 2018. The slaughter of horses, particularly Thoroughbreds, who do not perform, who suffer injuries or develop lameness, is also a major animal welfare concern. Ethical concerns about the use of animals in sport include lack of agency, choice and consent. Some people consider that sport and financial reward do not ethically justify the use of animals. Other people accept the use of equids in sport, develop emotional relationships with horses, and strive for improved animal welfare by aiming to meet the animals' needs.

The authors conclude that there is ample scientific evidence that equids are suffering for sport. They argue that this scientific evidence cannot and should not be ignored. New processes, combining animal welfare science and human behaviour change strategies, are needed to improve equine welfare. Processes should involve different stakeholder groups, and incorporate animal welfare evaluations, transparent reporting, and independent oversight.

Holmes TQ, Brown AF (2022) ***Champing at the bit for improvements: A review of equine welfare in equestrian sports in the United Kingdom.*** *Animals 12, 1186.*

Happier horses are less likely to pose a risk to riders

In Australia, horses injure and kill more people than any other animal. A 2020 study suggested that 2500 horse riders are hospitalised in Australia every year, almost a quarter suffering from life-threatening injuries. It has been suggested that hyperreactive or conflict behaviours in horses (e.g., bucking, bolting, rearing, spooking) may contribute to rider injuries. These behaviours are also likely indicators of poor horse welfare.

This study applied the Five Domains Model to assess the welfare of ridden horses, and how it relates to hyperreactive behaviours and rider safety. Riders (n = 427) were asked to assess a suite of animal-based animal welfare indicators relating to health (e.g., back pain, lameness), general behaviour (e.g., ear carriage during transitions, aggression) and hyperreactive behaviours. This information was used to calculate a relative horse welfare score. Respondents were also asked to report if they sustained any accidents or injuries while riding (e.g., falling from the horse).

The majority of respondents (59%) reported that their horse displayed one or more hyper reactive behaviours while ridden. Of these, the most common hyperreactive behaviours were spooking (50.8%) and bucking (22.5%). Over the previous year, 281/427 (67%) of riders reported at least one fall or near miss, and 42% sustained an injury while riding. Riders mainly attributed the falls to horse behaviour (75%), and most of these (84%) were reported to be due to hyperreactive behaviour. As horse welfare score increased, the frequency of hyperreactive behaviours decreased, and rider accidents and injuries decreased. Overall, the results support the notion that horses with better welfare are less likely to perform hyperreactive behaviours, thus reducing the risk to riders. This represents an important link between human and animal welfare.

Luke KL, McAdie T, Smith BP et al (2022) ***New insights into ridden horse behaviour, horse welfare and horse-related safety.*** *Applied Animal Behaviour Science 246, 105539.*

Legal loopholes allow calf roping in most Australian jurisdictions despite evidence of poor welfare

Calf roping is a rodeo event where calves (as young as four months of age) are chased on horseback, lassoed, lifted up, forced to the ground and tied up. Calf roping raises numerous animal welfare concerns including fear, distress and pain. In New Zealand and Canada, legal challenges have been launched on the grounds that calf roping violates animal welfare legislation. Calf roping events continue to be held in some parts of Australia.

This article discusses research relating to the animal welfare consequences of calf roping. There is evidence that calves are frightened, agitated and stressed while being chased and roped. Calves' stress hormones are elevated following repeat roping, and they show behaviours consistent with fear (e.g., showing the whites of their eyes, trying to run away). Calf roping appears inconsistent with the Australian Animal Welfare Standards for Cattle which emphasise the importance of low stress stock handling. Where calf roping is permitted, except for Tasmania, there are no legal requirements for veterinarians to attend rodeo events and in no jurisdictions are animal injuries required to be reported, so injury rates in calves is unknown. However, calves may sustain injuries from being roped around the neck and thrown to the ground (e.g., bruising, damage to the throat, fractures).

Rodeos are prohibited in the Australian Capital Territory. Victoria and South Australia have effectively banned calf roping because animals less than 200kg cannot be used. However, calf roping continues in New South Wales, Tasmania, Western Australia, Queensland and the Northern Territory because codes of practice exempt rodeo operators from key animal welfare legislation. Calves are sentient animals with the capacity to suffer pain and experience fear, yet rodeo operators are exempted from legislation that prohibits causing unreasonable harm to animals. The authors recommend that there is sufficient scientific evidence to support the regulation of calf roping to protect calves from unreasonable harm.

Stonebridge M, Evans D, Kotzmann J (2022) ***Sentience matters: Analysing the regulation of calf-roping in Australian rodeos.*** *Animals 12, 1071. [Author D Evans is from RSPCA Australia].*

ANIMALS IN RESEARCH AND TEACHING

Transformative changes needed in biomedical research to phase out animal use

Despite a 2010 European Union (EU) Directive mandating that Member States must reduce the number of animals used in research, 5.46 million mice were used for biomedical research and regulatory testing across the EU (and Norway) in 2018. In 2021, the EU Parliament voted to phase out animal use in research, education and testing. Implementation of the EU phase out will require an accelerated move away from animal use, and faster adoption of non-animal models (NAMs) for the benefit of animal welfare and human health.

This article discusses how the EU plan can be implemented in biomedical research. The authors recommend three pillars of activity: (1) Use of advanced human-based NAMs, (2) Regulations to support the use of NAMs, and (3) Education and (re) training. Under Pillar 1, the European Commission and Member States are urged to formally recognise that human-based tools and methods are the best models for human health research. Under Pillar 2, standards and regulations need to be harmonised across Member States to increase the use of NAMs. The EU already supports training and education in NAMs but under Pillar 3, more continuing education would be provided to all stakeholders at every career stage.

The authors recommend clear metrics to track progress towards the phase out of animal use. In their worst-case scenario, there is an annual reduction of 100,000 animals used, approaching near zero by 2081. The mid-case scenario would see an annual reduction of 150,000 animals used, reaching near zero by 2060. The more ambitious best-case scenario would be an annual reduction of 200,000 animals, getting to zero by 2040. Some pharmaceutical companies have already achieved substantial reductions in animal use. However, the phasing out of animal use in research requires NAMs to be accepted as the 'new normal'.

Marshall LJ, Constantino H, Seidle T (2022) ***Phase-in to phase-out—Targeted, inclusive strategies are needed to enable full replacement of animal use in the European Union.*** *Animals 12, 863.*

WILD ANIMALS

Improving welfare assessment of wildlife trapping using the Five Domains

Wild animals are often trapped as part of management and research programs. Robust methods are needed to assess the animal welfare impact of trapping.

This paper discusses how best to apply the Sharp and Saunders framework to assess the animal welfare impact of wildlife trapping. Sharp and Saunders devised a framework to assess the relative humaneness of invasive animal control methods, including trapping. The Sharp and Saunders framework is based on the Five Domains model of animal welfare: (1) Nutrition/hydration, (2) Physical environment, (3) Health/function, (4) Behavioural interaction/agency, and (5) Affective state. This assessment takes into account animals' physical as well as mental experiences. Part A of the framework assesses the non-lethal components of the trapping process. An impact score of 1 to 8 is given for each Domain, based on duration (seconds, minutes, hours, days) and severity (no impact, mild, moderate, severe, extreme). Where the animal is killed, Part B assesses the impact of the killing method based on duration and severity of suffering.

Several recommendations are made to improve the application of the Sharp and Saunders framework. Recommendations include the incorporation of robust evidence, appropriate animal welfare indicators and confidence scores (0 = no data to 3 = high confidence). Assessment panels should include a diverse group of experts in the species' biology, veterinary physiology, veterinary pathology, and animal welfare science.

Beausoleil NJ, Baker SE, Sharp T (2022) ***Scientific assessment of the welfare of trapped mammals—key considerations for the use of the Sharp and Saunders humaneness assessment model.*** *Animals 12, 402.*

Keeping parrots in captivity causes extreme suffering

Millions of parrots are kept in captivity in the United States alone. Animal welfare concerns about captive parrots include lack of environmental complexity, and few opportunities to engage in natural behaviours like foraging, flying and flocking.

This article explores the ethics of keeping parrots in captivity. The review included peer-reviewed literature, conference presentations, and lectures relating to parrots, and bird intelligence more broadly. Brain and behaviour research on parrots indicates they are incredibly intelligent, with complex needs for mental and social stimulation. For example, hyacinth macaws have the biggest brain-to-body mass of any bird, palm cockatoos create tools, and African Grey parrots can learn complex tasks and human language. Parrots are not domesticated. They still need to fulfil natural instincts. When their needs are not met in captivity, parrots commonly develop problems such as self-mutilation, abnormal repetitive behaviours, constant screaming, and destructive and aggressive tendencies. These behaviours are signs of stress and distress. Factors contributing to stress and distress in captive parrots include early weaning and hand-rearing, inappropriate diet, lack of choice, boredom, confinement, lack of exercise, insufficient opportunity to fly, social isolation and not being able to live with other parrots in a flock. Some parrots live so long that they outlive their owners, experiencing the grief of loss and the stress of multiple rehomings.

Captivity can be harmful to parrots' quality of life. Recommendations are made for parrots to be raised by their parents, and have more opportunities to exercise, fly, interact with other parrots, forage for a variety of whole foods, and engage in stimulating enrichment activities. There are serious ethical questions surrounding the keeping of parrots in captivity. In light of ethical concerns, the authors recommend that minimum animal welfare standards and laws about the keeping of parrots in captivity need updating.

Starenchak Baukhagen HS, Engell MD (2022) Avian cognition and the implications for captive parrot welfare. Animal Welfare 31(2):257-267.

More clarity required to manage and monitor enrichment for zoo animals

Enrichment, the provision of novel and varied objects and activities, aims to improve animal welfare by meeting animals' behavioural needs, and encouraging natural behaviours. However, enrichment does not always achieve these aims.

This study investigated factors that affect zookeepers' capacity to implement effective enrichment for big cats (e.g., lions, tigers, leopards). The researchers interviewed big cat keepers (n= 23) across multiple zoos (n= 12) in Australia, New Zealand, Europe, South-east Asia, South Africa and the United States. Keepers were asked about what they believed to be the purpose of enrichment, how enrichment programs were developed, and how they should be evaluated.

Barriers to effective enrichment included real or perceived human and animal health and safety risks, conflicting priorities, uncertainty about enrichment practices, and concerns about visitors' perceptions of artificial enrichment items. Enrichment that targets mental stimulation without physical benefits was less likely to be encouraged, perhaps because the mental health of animals is not always prioritised in the same way as physical health. Consequently, many enrichment practices that would enhance the lives of zoo animals were viewed as optional because "they would still survive without". The survey revealed that evaluating enrichment outcomes was difficult due to confusion about the goals of enrichment and lack of standardised monitoring. The authors make recommendations to improve enrichment goals, guidelines, procedures and practices.

Tuite EK, Moss SA, Phillips CJ et al (2022) ***Why are enrichment practices in zoos difficult to implement effectively?*** *Animals 12, 554.*

HUMANE KILLING

More trained personnel needed to euthanase stranded cetaceans humanely

Euthanasia, painless killing to relieve suffering, is particularly challenging for stranded cetaceans due to the animals' size, physiology and anatomy, as well as resource limitations and field conditions. In 2013, the International Whaling Commission (IWC) held a workshop 'Euthanasia Protocols to Optimise Welfare Concerns for Stranded Cetaceans' which produced a number of recommendations.

This study aimed to investigate whether recommendations from the IWC workshop have been put into practice. A survey was sent to 344 experts involved in stranding response. The survey asked whether the IWC recommendations were being applied and why/why not. A total of 44 respondents completed the survey, including people from Europe (n= 13), the United Kingdom (6), United States (5), Argentina (5) and New Zealand (3). Respondents included researchers, veterinarians and stranding coordinators.

In half of the reported strandings, cetaceans were not euthanased. Where euthanasia was performed, the most common methods were ballistics and barbiturates. Sedation was under-utilised, possibly due to concerns about eco-toxicity, occupational health and safety and controlled drug restrictions. However, remote darting using accessible veterinary sedatives could help improve use of sedation. 'Time to insensibility' and 'time to death' were considered important animal welfare outcomes. However, indicators to measure these outcomes need to be refined. The majority of respondents (83.7%) were aware of the IWC recommendations on cetacean euthanasia. Some respondents said the recommendations were being applied, while others said they were not. Barriers to application included lack of government support, limited resources, and a shortage of experienced and trained personnel. The authors recommend that the IWC create a training program so more personnel are available to carry out humane euthanasia of stranded cetaceans.

Stringfellow H, Butterworth A, Simmonds MP (2022) A review of the approaches taken around the world to whale euthanasia. Animal Welfare 31:113-123.

MISCELLANEOUS

Disasters like floods and fires affect people, animals and the environment

One Health considers links between the health of humans, other animals and the environment. While One Health originated as a concept in infectious disease related fields, it can also be applied in the context of disasters such as fires, floods and pandemics.

This article explores a One Health animal disaster management (OHADM) framework. Disasters, such as the COVID-19 pandemic, bushfires and prolonged droughts, are not only human-centred problems. A OHADM framework considers 'relational solidarity' or interspecies connectedness, and the relationships between the health and welfare of humans, other animals and the environment. It focuses on our responsibilities to care for animals during disasters, a relatively new concept in the field of disaster management. OHADM incorporates animal health and welfare into all phases of disaster management including prevention, mitigation, preparedness, planning, response and recovery. For example, under a OHADM framework, preparedness for a zoonotic disease outbreak would consider how transmission could be minimised by maximising animal health and welfare, and "saving all who can be saved" including animals. The effects of the COVID-19 pandemic on global food supplies highlighted the need for greater alignment between the management of human health and animal welfare in disasters. For example, as COVID-19 spread throughout the workforce, abattoirs shut, resulting in compromised animal care, overcrowding and emergency culling.

OHADM frameworks have been adopted by international organisations including the World Health Organisation (WHO), World Organisation for Animal Health (OIE), and the United Nations' Food and Agriculture Organization (FAO). Further development of OHADM training, policies, practices, and decision-making tools are needed to improve animal management in disasters.

Anthony R, De Paula Vieira A (2022) One Health animal disaster management: an ethics of care approach. Journal of Applied Animal Welfare Science 25(2):180-194.

Overwhelming scientific evidence says the suffering of fish can no longer be ignored

Globally, trillions of fish are farmed, caught, traded, used in research and killed every year. Their capacity to experience suffering is largely ignored.

This review synthesises the literature on fish sentience (the capacity to have feelings). The authors found 349 articles relating to sentience in 142 different species of fishes. This body of literature recognises that fish are capable of experiencing stress, anxiety, fear, and pain. For example, many experimental studies have concluded that fish (including commonly kept and farmed species e.g., goldfish, carp and rainbow trout) experience pain. Common husbandry issues such as poor water quality and noise, have been shown to cause fish stress.

While more research is needed on the welfare needs of many fish species, there is abundant scientific evidence for fish sentience. The authors argue that policy, practices and legislation relating to the keeping, farming, and killing of fish must incorporate this evidence to protect animal welfare. Pet fish should not be viewed as disposable. Industries, such as aquaculture and commercial fisheries, need to address the welfare impact of common practices including handling, stocking densities and slaughter. For example, fish caught in commercial fisheries are commonly left to die by asphyxiation and this is inhumane. The authors also argue that future research should focus on how to improve public attitudes to and perceptions of fish. Furthermore, consistent with contemporary animal welfare science, more work is needed to understand how kept and farmed fish can be provided with positive experiences.

Lambert H, Cornish A, Elwin A et al (2022) ***A kettle of fish: A review of the scientific literature for evidence of fish sentience.*** *Animals 12, 1182.*

ARTICLES OF INTEREST

COMPANION ANIMALS

Burnett E, Brand CL, O'Neill DG et al (2022) How much is that doodle in the window? Exploring motivations and behaviours of UK owners acquiring designer crossbreed dogs (2019-2020). Canine Medicine and Genetics 9, 8.

Cameron A, Pollock K, Wilson E et al (2022) Scoping review of end-of-life decision-making models used in dogs, cats and equids. Veterinary Record doi:10.1002/vetr.1730.

Cameron KE, Holder HE, Connor RL (2022) Cross-sectional survey of housing for pet guinea pigs (Cavia porcellus) in New Zealand. New Zealand Veterinary Journal 70(4):228-232.

Daigle L, Delesalle L, Ravel A et al (2022) Occurrence and risk factors of dog bites in northern indigenous communities: A scoping review. Frontiers in Veterinary Science 9, doi:10.3389/fvets.2022.777640.

Eagan BH, Gordon E, Protopopova A (2022) Reasons for guardian-relinquishment of dogs to shelters: Animal and regional predictors in British Columbia, Canada. Frontiers in Veterinary Science doi:10.3389/fvets.2022.857634.

Edwards PT, Smith BP, McArthur ML et al (2022) At the heart of a dog's veterinary experience: Heart rate responses in dogs vary across a standard physical examination. Journal of Veterinary Behavior Clinical Applications and Research 51(4):23-34.

Fossati P (2022) Spay/neuter laws as a debated approach to stabilizing the populations of dogs and cats: An overview of the European legal framework and remarks. Journal of Applied Animal Welfare Science doi:10.1080/10888705.2022.2081807.

Frayne J, Edwards M, Templeman JR et al (2022) The behavioural impact on cats during a transition from a clay-based litter to a plant-based litter. Animals 12(8), 946.

Gunter LM, Gilchrist RJ, Blade EM et al (2022) Emergency fostering of dogs from animal shelters during the COVID-19 pandemic: Shelter practices, foster caregiver engagement, and dog outcomes. Frontiers in Veterinary Science 9, doi:10.3389/fvets.2022.862590.

Gurney M, Gower L (2022) Randomised clinical trial evaluating the effect of a single preappointment dose of gabapentin on signs of stress in hyperthyroid cats. Journal of Feline Medicine and Surgery doi:10.1177/1098612X221091736.

Haddad Pinho R, Luna SPL, Esteves Trindade PH et al (2022) Validation of the rabbit pain behaviour scale (RPBS) to assess acute postoperative pain in rabbits (Oryctolagus cuniculus). PLoS ONE 17(5), e0268973.

Holland KE, Mead R, Casey RA et al (2022) Why do people want dogs? A mixed-methods study of motivations for dog acquisition in the UK. Frontiers in Veterinary Science 9, doi:10.3389/fvets.2022.877950.

Houser B, Vitale KR (2022) Increasing shelter cat welfare through enrichment: A review. Applied Animal Behaviour Science 248,105585.

Hurley KF, Levy JK (2022) Rethinking the animal shelter's role in free-foaming cat management. Frontiers in Veterinary Science doi:10.3389/ fvets.2022.847081.

Kaur J, Seshadri S, Golla KH et al (2022) Efficacy and safety of standardized Ashwagandha *(Withania somnifera)* root extract on reducing stress and anxiety in domestic dogs: A randomized controlled trial. Journal of Veterinary Behavior Clinical Applications and Research 51(4):8-15.

Kilgour RJ, Flockhart DTT (2022) Direct and indirect factors influencing cat outcomes at an animal shelter. Frontiers in Veterinary Science 9, doi:10.3389/fvets.2022.766312.

Kogan LR, Wallace JE, Hellyer PW et al (2022) Canine caregivers: Paradoxical challenges and rewards. Animals 12(9), 1074.

Kuhl CA, Lea RG, Quarmby C et al (2022) Scoping review to assess online information available to new dog owners. Veterinary Record doi:10.1002/vetr.1487.

Lepczyk CA, Calver MC (2022) Cat got your tongue? The misnomer of 'community cats' and its relevance to conservation. Biological Invasions doi:10.1007/s10530-022-02788-5.

Matheson K, Pranschke M (2022) Predicting support for social actions and policies that enable pet ownership among people living in poverty. Anthrozoös doi:10.1080/08927936.2022.2051933.

McDonald SE, Miller GS, Fried TR et al (2022) Increasing engagement in kitten fostering programs: Lessons learned from high kitten intake zip codes in Los Angeles County. Frontiers in Veterinary Science 9, doi:10.3389/fvets.2022.897687.

Mee G, Tipton E, Oxley JA et al (2022). Owner demographic factors are associated with suitable pet rabbit housing provision in the United Kingdom. Veterinary Record e1736–e1736.

Meyer I, Forkman B, Fredholm M et al (2022) Pampered pets or poor bastards? The welfare of dogs kept as companion animals. Applied Animal Behaviour Science 251, 105640.

Mota-Rojas D, Monsalve S, Lezama-García K et al (2022) Review: Animal abuse as an indicator of domestic violence: One health, one welfare approach. Animals 12(8), 977.

Muzzatti SL, Grieve KL (2022) Covid cats and pandemic puppies: The altered realm of veterinary care for companion animals during a global pandemic. Journal of Applied Animal Welfare Science 25(2):293-312.

Reese LA (2022) Community factors and animal shelter outcomes. Applied Animal Welfare Science 12:1-19.

Reese LA, Jacobs J, Gembarski J et al (2022) The COVID-19 animal fostering boom: Ephemera or chimera? Animals 2022, 12(10), 1325.

Scanlon L, Hobson-West P, Cobb K et al (2022) Assessment of health and welfare in a small sample of dogs owned by people who are homeless. Veterinary Record doi:10.1002/vetr.776.

Smith SM, George Z, Duncan CG et al (2022) Opportunities for expanding access to veterinary care: Lessons from COVID-19. Frontiers in Veterinary Science 9, doi:10.3389/fvets.2022.804794.

Townsend, L, Dixon, L, Buckley, L (2022) Lead pulling as a welfare concern in pet dogs: What can veterinary professionals learn from current research? Veterinary Record doi:10.1002/vr.1627.

Rodriguez JR, Davis J, Hill S et al (2022) Trends in intake and outcome data from U.S. animal shelters from 2016 to 2020. Frontiers in Veterinary Science doi:10.3389/fvets.2022.863990.

Shaw N, Wemelsfelder F, Riley LM (2022) Bark to the future: The welfare of domestic dogs during interaction with a positively reinforcing artificial agent. Applied Animal Behaviour Science 249, 105595.

FARM ANIMALS

Aquaculture

Albalat A, Zacarias S, Coates CJ et al (2022) Welfare in farmed decapod crustaceans, with particular reference to *Penaeus vannamei.* Frontiers in Marine Science doi:10.3389/fmars.2022.886024.

Aragão C, Gonçalves AT, Costas B et al (2022) Alternative proteins for fish diets: Implications beyond growth. Animals 12(9), 1211.

Hubená P, Horký, P, Slavík O (2022) Fish self-awareness: Limits of current knowledge and theoretical expectations. Animal Cognition 25(2):447–461.

Zhang Z, Gao L, Zhang X (2022) Environmental enrichment increases aquatic animal welfare: A systematic review and meta-analysis. Reviews in Aquaculture doi:10.1111/raq.12641.

Cattle

Adcock SJJ, Tucker CB (2022) Buffering lidocaine heightens aversion to cornual nerve injections in dairy calves. Journal of Dairy Science 105(5):4490-4497.

Aleri, JW, Fisher AD, Gogoi-Tiwari J (2022) A survey of calf rearing practices in the south-west region of Western Australia. New Zealand Veterinary Journal 70(4):211-217.

Asder MF, Staahtoft SK, Korsgaard AH et al (2022) Is virtual fencing an effective way of enclosing cattle? Personality, herd behaviour and welfare. Animals 12(7), 842.

Bieber A, Walkenhorst M, Eppenstein R et al (2022) Effects of twice a day teat bucket feeding compared to twice a day mother suckling on behaviour, health traits and blood immune parameters in dairy calves and immune parameters in cow's milk. Applied Animal Behaviour Science 252, 105644.

Carslake C, Occhiuto F, Vázquez-Diosdado et al (2022) Repeatability and predictability of calf feeding behaviors—quantifying between- and within-individual variation for precision livestock farming. Frontiers in Veterinary Science doi:10.3389/fvets.2022.827124.

Carter LS, Haskell MJ, Ball D et al (2022) Dairy cows value an open area for lying down. PLOS ONE doi:10.1371/journal.pone.0268238.

Crump A, Jenkins K, Bethell EL et al (2022) Pasture access and eye temperature in dairy cows. Journal of Applied Animal Science doi:10.1080/10888705.2022.2063020.

Cull CA, Rezac DJ, DeDonder KD et al (2022) Behavioral and performance response associated with administration of intravenous flunixin meglumine or oral meloxicam immediately prior to surgical castration in bull calves. Journal of Animal Science 100(5), skac049.

Deil F, Rauch E, Palme R, et al (2022) Exploring the evacuation of dairy cattle at night in collaboration with the fire brigade: How to prepare openings for swift rescue in case of barn fire. Animals 12(11), 1344.

Downey BC, Jensen MB, Tucker CB (2022) Hay provision affects 24-h performance of normal and abnormal oral behaviors in individually housed dairy calves. Journal of Dairy Science 105:4434-4448.

Erjavec K, Klopčič M (2022) Views of consumers, farmers and stakeholders on alternative dairy cattle housing systems. Animals 12(10), 1231.

Holdsworth SE, Kells NJ, Vallée E et al (2022) Evaluating the behavioural responses of healthy newborn calves to a thoracic squeeze. Animals 12(7), 840.

Ivemeyer S, Preußera J, Haager D et al (2022) Impact of enhanced compared to restricted milk feeding on the behaviour and health of organic dairy calves. Applied Animal Behaviour Science 252, 105655.

Leach KA, Charlton GL, Green MJ et al (2022) Bedding system influences lying behaviour in dairy cows. Veterinary Record doi:10.1002/vetr.1066.

Leskovec J, Voljč M, Zgur S (2022) Effect of a high welfare floor and a concrete slatted floor on the growth performance, behavior and cleanliness of Charolais and Limousin heifers: A case study. Animals 12(7), 859.

Li G, Erickson GE, Xiong Y (2022) Individual beef cattle identification using muzzle images and deep learning techniques. Animals 12(11), 1453.

Linder EE, Gingerich KN, Burke KC et al (2022) Effects of social housing on dairy calf social bonding. Animals 12(7), 821.

Lovarelli D, Leliveld L, Finzi A et al (2022) Development of a new wearable 3D sensor node and innovative open classification system for dairy cows' behaviour. Animals 12(11), 1447.

Lowe GL, Sutherland MA, Stewart M et al (2022) Effects of provision of drinking water on the behavior and growth rate of group-housed calves with different milk allowances. Journal of Dairy Science 105(5):4449-4460.

Marumo JL, Fisher DN, Lusseau D et al (2022) Social associations in lactating dairy cows housed in a robotic milking system. Applied Animal Behaviour Science 249, 105589.

Mastellone V, Musco N, Infascelli F et al (2022) Higher forage:concentrate ratio and space availability may favor positive behaviors in dairy cows. Journal of Veterinary Behavior 51:16-22.

Moono P, Fruean SN, Hampson DJ et al (2022) The frequency of tail damage amongst cows from a sample of New Zealand dairy farms participating in an animal welfare programme. New Zealand Veterinary Journal doi:10.1080/00480169.2022.2069174.

Petrovski KR, Cusack P, Malmo J ett al (2022) The value of 'cow signs' in the assessment of the quality of nutrition on dairy farms. Animals 12(11), 1352.

Richardson CM, Amer PR, Quinton C et al (2022) Reducing greenhouse gas emissions through genetic selection in the Australian dairy industry. Journal of Dairy Science 105(5):4272-4288

Roadknight N, Wales W, Jongman E et al (2022) Does the duration of repeated temporary separation affect welfare in dairy cow-calf contact systems? Applied Animal Behaviour Science 249, 105592.

Schinwald M, Creutzinger K, Keunen A et al (2022) Predictors of diarrhea, mortality, and weight gain in male dairy calves. Journal of Dairy Science 105(6):5296-5309.

Schoiswohl J, Stanitznig A, Smetanig C et al (2022) Comparison of alternative methods for thermal disbudding in calves. Journal of Veterinary Behavior 51:35-42.

Smid AMC, De Jong S, Inberg PHJ et al (2022) Western Canadian dairy farmers' perspectives on the provision of outdoor access for dairy cows and on the perceptions of other stakeholders. Journal of Dairy Science 105(5):4461-4473.

Valente TS, Ruiz LRB et al (2022) Nose-flap devices used for two-stage weaning produce wounds in the nostrils of beef calves: Case report. Animals 12(11), 1452.

Wenker ML, Verwer CM, Bokkers EAM et al (2022) Effect of type of cow-calf contact on health, blood parameters, and performance of dairy cows and calves. Frontiers in Veterinary Science doi:10.3389/fvets.2022.855086.

Zhanga C, Junipera DT, Meagherab RK (2022) Effects of physical enrichment and pair housing before weaning on growth, behaviour and cognitive ability of calves after weaning and regrouping. Applied Animal Behaviour Science 249, 105606.

Pigs

Bernaerdt E, Maes D, Van Limbergen T et al (2022) Determining the characteristics of farms that raise pigs without antibiotics. Animals 12(10), 1224.

Bernardino T, Teodoro-Carvalho CP, Carvalho-Celeghini EC et al (2022) Poor welfare compromises testicle physiology in breeding boars. PLOS ONE 17(5), e0268944.

Bushby EV, Cotter SC, Wilkinson A et al (2022) Judgment bias during gestation in domestic pigs. Frontiers in Veterinary Science 9, 881101.

Byrd CJ, Young JM, Sommer DM (2022) Cross-fostering alters the post-weaning pig behavioral stress response in a sex-specific manner. Applied Animal Behaviour Science 249, 105593.

Collins LM, Smith LM (2022) Review: Smart agri-systems for the pig industry. Animal 16, 100518.

Costa A, Salvagnini C, Buoio E et al (2022) The effect of lift crates on piglet survival rate and sow stress level during farrowing. Animals 12(6), 745.

Drexl V, Dittrich I, Haase A et al (2022) Tail posture as an early indicator of tail biting a comparison of animal and pen level in weaner pigs. Applied Animal Behaviour Science 252, 105654.

Fornós M, Sanz-Fernández S, Jiménez-Moreno E et al (2022) The feeding behaviour habits of growing-finishing pigs and its effects on growth performance and carcass quality: A review. Animals 12(9), 1128.

Gomes A, Romeo C, Ghidini S, et al (2022) The relationship between carcass condemnations and tail lesion in swine considering different production systems and tail lengths. Animals 12(8), 949.

Hanh HQ, Phuong Giang NT, Viet Dung VT et al (2022) Comparison of the welfare of gestation sows raised in different production systems in North Vietnam. Journal of Applied Animal Welfare Science doi:10.1080/10888705.2022.2070846.

Johnson AK, Rault J-L, Marchant JN et al (2022) Improving young pig welfare on-farm: The Five Domains model. Journal of Animal Science 100(6), skac164.

Ko H-L, Temple D, Hales J et al (2022) Welfare and performance of post-weaning sows and piglets previously housed in farrowing pens with temporary crating on a Spanish commercial farm: A pilot study. Animals 12(6), 724.

Kranz V, Horback K, Parsons TD et al (2022) Sow behavior during introduction to a large dynamic group is influenced by familiarity and method. Applied Animal Behaviour 250, 105624.

Li S, Hu H, Huang J et al (2022) Effect of enrichment items on the physiology and behavior of sows in the third trimester of pregnancy. Animals 12(11), 1355.

Luo L, Van Der Zande LE, Van Marwijk MA et al (2022) Impact of enrichment and repeated mixing on resilience in pigs. Frontiers in Veterinary Science 9, 829060.

Parois SP, Van Der Zande LE, Knol EF et al (2022) Effects of a multi-suckling system combined with enriched housing post-weaning on response and cognitive resilience to isolation. Frontiers in Veterinary Science 9, 868149.

Pritchett RK, Gaskill BN, Erasmus MA et al 2022) Scratch that itch: Farrowing crate scratching enrichment for sows. Animal Welfare 31(2):243-255.

Werner J, Saller AM, Reiser J et al (2022) Evaluation of two injection techniques in combination with the local anesthetics lidocaine and mepivacaine for piglets undergoing surgical castration. Animals 12(8), 1028.

Zeng Y, Wang H, Ruan R et al (2022) Effect of stocking density on behavior and pen cleanliness of grouped growing pigs. Agriculture 12(3), 418.

Zhang J, Yu L, Yin G (2022) Evaluation of behavior and affective state of different-parity sows with strong/weak pupil light reflex. Animals 12(9), 1184.

Zira S, Röös E, Ivarsson E, et al (2022) An assessment of scenarios for future pig production using a One Health approach. Livestock Science 260, 104929.

Poultry

Afrouziyeh M, Zuidhof MJ (2022) Impact of broiler breeder growth trajectory on plasma corticosterone concentration: A comparison of analytical methods. Poultry Science 101(5), 101792.

Akter S, Liu Y, Cheng B et al (2022) Impacts of air velocity treatments under summer conditions: Part ii—Heavy broiler's behavioral response. Animals 12(9), 1050.

Aldridge DJ, Owens C, Maynard C et al (2022) Impact of light intensity or choice of intensity on broiler performance and behavior. Journal of Applied Poultry Research 31(1), 100216.

Arrazola A, Widowski TM, Torrey S (2022) In pursuit of a better broiler: Welfare and productivity of slower-growing broiler breeders during lay. Poultry Science 101(8), 101917.

Averós X, Nazar FN, Estevez I (2022). Animal welfare assessment: Quantifying differences among commercial medium and fast growth broiler flocks. Frontiers in Animal Science 3, 868851.

Baker PE, Nicol CJ, Weeks CA (2022) The effect of hard pecking enrichment during rear on feather cover, feather pecking behaviour and beak length in beak-trimmed and intact-beak laying hen pullets. Animals 12(6), 674.

De Jong IC, Bos B, Van Harn J et al (2022) Differences and variation in welfare performance of broiler flocks in three production systems. Poultry Science 101(7), 101933.

Dişa R, Özlü S Elibol O (2022) Research note: Interaction between hatching time and chick pull time affects broiler live performance. Poultry Science 101(6), 101845.

Dixon LM, Dunn IC, Brocklehurst S et al (2022) The effects of feed restriction, time of day, and time since feeding on behavioral and physiological indicators of hunger in broiler breeder hens. Poultry Science 101(5), 101838.

Downing JA (2022) Effect of light and stocking density on performance, breast muscle yield and potential damage caused by feather pecking in two strains of commercial Pekin ducks. Animal Production Science 62:870-879.

Du X, Qin P, Liu Y et al (2022) Effects of key farm management practices on pullets welfare—A review. Animals 12(6), 729.

Durosaro SO, Iyasere OS, Ilori BM et al (2022) Fear behaviour in turkey poults of fast and slow growing breeds. Applied Animal Behaviour Science 248, 105573.

Engel JM, Hemsworth PH, Butler KL et al (2022) Measurement of corticosterone in the plasma, eggs and faeces of laying hens. Animal Production Science 62:828-835.

Garnham LC, Clarke C, Løvlie H (2022) How inhibitory control relates to positive and negative affective states in red junglefowl. Frontiers in Veterinary Science 9, 872487.

Gernand E, Ahlers C, Huchler M et al (2022) Plumage damage and back skin lesions in laying hens with untrimmed beak depend on rearing of pullets and genetics. Poultry Science 63(3):274-282.

Guarino AM, Castellini C (2022) Adaptability challenges for organic broiler chickens: A commentary. Animals 12(11), 1354.

Hertamawati RT, Prasetyo B, Suryadi U (2022) Early production performance of crossing chickens raised on indoor or with outdoor access. IOP Conference Series: Earth and Environmental Science 980(1), 012018.

Jhetam S, Buchynski K, Shynkaruk T et al (2022) Evaluating the effects of stocking density on the behavior, health, and welfare of turkey hens to 11 weeks of age. Poultry Science 101(7), 101956.

Jiang DL, Zhou X, Xu Y et al (2022) Effects of stocking density on ovarian development and maturation during the rearing period in Shan-ma ducks. Poultry Science 101(5), 101809.

Loeb J (2022) DEFRA backs Better Chicken Commitment. Veterinary Record 190(5), 176.

Massari JM, De Moura DJ, De Alencar Nääs I et al (2022) Computer-vision-based indexes for analyzing broiler response to rearing environment: A proof of concept. Animals 12(7), 846.

May F, Stracke J, Heitmann S et al (2022) Structuring broiler barns: How a perforated flooring system affects animal behavior. Animals 12(6), 735.

Michel V, Berk J, Bozakova N et al (2022) The relationships between damaging behaviours and health in laying hens. Animals 12(8), 986.

Oso OM, Metowogo K, Oke OE et al (2022) Influence of LED bulb on reproductive and production performance of different poultry species: A review. World's Poultry Science Journal 78(2):515-529.

Paixão J, Mendes AS, Possenti S et al (2022) Broiler behavior differs from males to females when under different light wavelengths. Tropical Animal Health and Production 54(3), 189.

Patt A, Halle I, Dudde A et al (2022) Influence of different dietary fibre contents in the diet on feather pecking, locomotor activity and performance of laying hens. British Poultry Science doi:10.1080/00071668.2022.2076212.

Paul ES, Browne W, Mendl MT et al (2022) Assessing animal welfare: A triangulation of preference, judgement bias and other candidate welfare indicators. Animal Behaviour 186:151-177.

Prišenk J, Brus M (2022) Economic viability of alternative bedding material in broiler chicken farming. Agriculture 12(3), 375.

Pu F, Xiong X, Li Y et al (2022) Transcriptome analysis of oviduct in laying ducks under different stocking densities. British Poultry Science 63(3):283-290.

Rana MS, Lee C, Lea JM et al (2022) Relationship between sunlight and range use of commercial free-range hens in Australia. PLOS ONE 17(5), e0268854.

Rodenburg TB, Giersberg MF, Petersan P et al (2022) Freeing the hens: Workshop outcomes for applying ethology to the development of cage-free housing systems in the commercial egg industry. Applied Animal Behaviour Science 251, 105629.

Rose P, Roper A, Banks S et al (2022) Evaluation of the time-activity budgets of captive ducks *(Anatidae)* compared to wild counterparts. Applied Animal Behaviour Science 251,105626.

Rudkin C (2022. Feather pecking and foraging uncorrelated - The redirection hypothesis revisited. British Poultry Science 63(3):265–273.

Sandilands V, Baker L, Donbavand J et al (2022) Do hens use enrichments provided in free-range systems? Animals 12(8), 995.

Santos MN, Widowski TM, Kiarie EG et al (2022 In pursuit of a better broiler: Tibial morphology, breaking strength, and ash content in conventional and slower-growing strains of broiler chickens. Poultry Science 101(4), 101755.

Sirovnik J, Riber AB (2022) Why-oh-why? Dark brooders reduce injurious pecking, though are still not widely used in commercial rearing of layer pullets. Animals 12(10), 1276.

Sohel Rana MD, Lee C, Lea JM et al (2022) Relationship between sunlight and range use of commercial free-range hens in Australia. PLOS ONE 17(5), e0268854.

Son J, Lee W-D, Kim H-J et al (2022) Effect of providing environmental enrichment into aviary house on the welfare of laying hens. Animals 12(9), 1165.

Stracke J, Andersson R, Volkmann N et al (2022) Footpad monitoring: Reliability of an automated system to assess footpad dermatitis in turkeys *(Meleagris gallopavo)* during slaughter. Frontiers in Veterinary Science 9, 888503.

Struthers S, Fiss T, Classen H et al (2022) The effect of infrared beak treatment on the welfare of turkeys reared to 12 weeks of age. Poultry Science 101(4), 101728.

Sung JY, Adeola O (2022) Research Note: Estimation of individual feed intake of broiler chickens in group-housing systems. Poultry Science 101(4), 101752.

Taylor J, Walk C, Misiura M et al (2022) Quantifying the effect of coccidiosis on broiler performance and infection outcomes in the presence and absence of control methods. Poultry Science 101(4), 101746.

Törmä K, Kaukonen E, Lundén J et al (2022) A comparative analysis of meat inspection data as an information source of the health and welfare of broiler chickens based on Finnish data. Food Control 138, 109017.

Van Den Brand H, Molenaar R, Klaasen, M (2022). Research Note: Comparing methods to assess Valgus-Varus deformity in broiler chickens. Poultry Science 101(7), 101907.

Vasdal G, Gebhardt-Henrich SG, Kittelsen KE, et al (2022) Commercial broiler breeder pullet hens use perches but show no preference for perch type or height. Applied Animal Behaviour Science 249, 105608.

Wu Y, Huang J, Quan S et al (2022) Light regimen on health and growth of broilers: An update review. Poultry Science 101(1), 101545.

Zahoor MS, Ahmad S, Usman M et al (2022) Effects of mirror and coloured balls as environmental enrichment tools on performance, welfare and meat quality traits of commercial broiler. Tropical Animal Health and Production 54, 151.

Rabbits

Van Damme LGW, Deleziea E, Ampea B et al (2022) Timing of part-time group housing for farm rabbits: Effects on reproductive performance, skin injuries and behaviour. Applied Animal Behaviour Science 252, 105656.

Sheep/Goats

Arfuso F, Fazio F, Chikhi L et al (2022) Acute stress response of sheep to shearing procedures: Dynamic change of cortisol concentration and protein electrophoretic pattern. Animals 12(7), 862.

Browne N, Conneely M, Hudson C (2022) Use of non-steroidal anti-inflammatory drugs and attitudes to pain in pasture-based dairy cows: A comparative study of farmers and veterinarians Frontiers in Veterinary Science doi:10.3389/fvets.2022.912564.

Celozzi S, Battini M, Prato-Previde E et al (2022) Review: Humans and goats: Improving knowledge for a better relationship. Animals 12(6), 774.

Flay KJ, Ridler AL, Corner-Thomas RA et al (2022) Ewe wastage in commercial sheep flocks: A review of current knowledge. New Zealand Veterinary Journal 70(4), doi:10.1080/00480169.2022.2032446.

Freitas De Melo A, Garcia M, Rodriguez K et al (2022) Social stress during the estrus or luteal phase in sheep. Journal of Applied Animal Welfare Science doi:10.1080/10888705.2021.2021408.

Kannan G, Batchu P, Naldurtiker A et al (2022) Influence of excitability rate on physiological responses to stress in goats. Animals 12(8), 1023.

Plaza J, Palacios C, Abecia JA et al (2022) GPS monitoring reveals circadian rhythmicity in free-grazing sheep. Applied Animal Behaviour Science 251, 105643.

Silva SR, Sacarrão-Birrento L, Almeida M et al (2022) Extensive sheep and goat production: The role of novel technologies towards sustainability and animal welfare. Animals 12(7), 885.

General (farm animals)

Boaitey A, Eden M, Jette-Nantel S (2022) Too close to eat? Solidarity with animals, animal welfare and antibiotic use. Journal of Applied Animal Welfare Science doi:10.1080/10888705.2021.1986713.

Cooke AS, Mullan SM, Morten C et al (2022) V-QBA vs. QBA—How do video and live analysis compare for qualitative behaviour assessment? Frontiers in Veterinary Science 9, 832239.

Düpjan S, Dawkins MS (2022) Animal welfare and resistance to disease: Interaction of affective states and the immune system. Frontiers in Veterinary Science 9, 929805.

Giersberg MF, Meijboom FL (2022) Caught on camera: On the need of responsible use of video observation for animal behavior and welfare research. Frontiers in Veterinary Science 9, 864677.

Harris J, Ladak A, Mathur MB (2022) The effects of exposure to information about animal welfare reforms on animal farming opposition: A randomized experiment. Anthrozoös doi:10.1080/08927936.2022.2062868.

Jardat P, Lansade L (2022) Cognition and the human–animal relationship: A review of the sociocognitive skills of domestic mammals toward humans. Animal Cognition 25:369–384.

Liang Y, Hua G, Cai W et al (2022) Knowledge of animal welfare and consumers' behavioral intentions in China: A moderated mediation model of product cognition and empathy. Animals 12(8), 1043.

Machado Filho LCP, Gregorini P (2022) Editorial: Grazing behavior and welfare of ruminants. Frontiers in Veterinary Science doi:10.3389/fvets.2022.890289.

Pickering J, Moore S, Wray D (2022) Changing human behaviour to improve animal welfare outcomes. Animal Production Science doi:10.1071/AN21558.

Vicino GA, Sheftel JJ, Radosevich LM (2022) Enrichment is simple, that's the problem: Using outcome-based husbandry to shift from enrichment to experience. Animals 12(10), 1293.

ANIMALS IN SPORT, ENTERTAINMENT, PERFORMANCE, RECREATION AND WORK

Hedman FL, Ewerlof IR, Frossling J et L (2022) Swedish trotting horse trainers' perceptions of animal welfare inspections from public and private actors. Animals 12(11), 1441.

Martinez A, Campera M, Nekaris KAI (2022) The use of live action, animation, and computer-generated imagery of non-human primates in film. Animals 12(12), 1576.

Nath L, Stent A, Elliott A et al (2022) Risk factors for exercise-associated sudden cardiac death in Thoroughbred racehorses. Animals 12(10), 1297.

Riva MG, Dai F, Huhtinen M et al (2022) The impact of noise anxiety on behaviour and welfare of horses from UK and US owner's perspective. Animals 12(10), 1319.

ANIMALS IN RESEARCH AND TEACHING

Braid H (2022) The use of simulators for teaching practical clinical skills to veterinary students – A review. Alternatives to Laboratory Animals 50(3):184-194.

Lozada-Gallegos AR, Campero-Ruiz Velasco I, Perez-Rivero (2022) Evaluation of a low-cost renal simulator for diagnostic ultrasound training of veterinary medicine students. Alternatives to Laboratory Animals 50(3):201-207.

Matos PS, dos Santos Rodrigues B, de Oliveira Fernandes T et al (2022) The perceptions of students and lecturers on the use of animals in biomedical science undergraduate education in Brazil. Alternatives to Laboratory Animals 50(3):221-234.

Osenkowski P, Karaliunas I, Diorio M (2022) Educators' view on the use of dissection and dissection alternatives in American biology classrooms. Alternatives to Laboratory Animals 50(3):235-243.

WILD ANIMALS

Jiang AZ, Tribe A, Phillips CJC et al (2022) Insights from koala–cattle interaction experiments: Koalas and cattle may see each other as a disturbance. Animals 12(7), 872.

Kennedy BPA, Boyle N, Fleming PJS et al (2022) Ethical treatment of invasive and native fauna in Australia: Perspectives through the One Welfare lens. Animals 12(11), 1405.

Miraglia N, Di Brita A (2022) Behavior of wildlife species in urban areas to changing conditions during COVID-19 lockdowns: A review. Applied Animal Welfare Science 25(2):119-125.

Szydlowski M (2022) Elephants in Nepal: Correlating disease, tourism, and welfare. Applied Animal Welfare Science 25(2):126-138.

Vicino GA, Sheftel JJ, M. Radosevich LM (2022) Enrichment is simple, that's the problem: Using outcome-based husbandry to shift from enrichment to experience. Animals 12(10), 1293.

TRANSPORTATION OF ANIMALS

Dahl-Pedersen K (2022) Danish cattle farmers' experience with fitness for transport – A questionnaire survey. Frontiers in Veterinary Science doi:10.3389/fvets.2022.797149.

Dahl-Pedersen K, Herskin MS (2022) Transportation of cattle and pigs between EU member states 2014–2018 – Can data from traces be used to create overview and inform about potential welfare consequences? Journal of Applied Animal Welfare Science doi:10.1080/10888705.2021.1923491.

Frerichs C, Beaulac K, Crowe, T et al (2022) The influence on behavior and physiology of white-feathered end-of-cycle hens during simulated transport. Poultry Science 101(2), 101599.

HUMANE KILLING

Coelho MEG, Pedrazzani AS, Quintiliano MH et al (2022) Fish slaughter practices in Brazilian aquaculture and their consequences for animal welfare. Animal Welfare 31(2):187-192.

Fuseini A, Teye M, Lever L (2022) An update on halal slaughter: Current methods and ongoing research on halal meat production techniques and their implications for animal welfare. Animal Welfare 31(2):269-276.

Kieffer JD, Campler MR, Cheng T-Y et al (2022) Evaluation of a water-based medium-expansion foam depopulation method in suckling and finisher pigs. Animals 12(8), 1041.

May K, Hartmann L, von Wenzlawowicz M et al (2022) Key parameters of head-heart electrical stunning need to be adapted to improve stunning effectiveness and meat quality in pigs of different genetic lines. Meat Science 190, 108829.

Mota-Rojas D, Napolitano F, Strappini A et al (2022) Welfare of buffaloes at slaughter: Signs of the return of sensibility. In: Chauhan MS, Selokar N (ed) Biotechnological Applications in Buffalo Research. Springer, Singapore. pp145-164.

Pagamici C, Stephan R (2022) Pregnancy in slaughtered lambs and sheep—A cross-sectional study in three abattoirs in Switzerland. Animals 12(10), 1328.

Skúladóttir G, Phythian CJ, Holmøy IH et al (2022) Overview of the practices of on-farm emergency slaughter of cattle in the Nordic countries. Acta Veterinaria Scandinavica 64, 9.

MISCELLANEOUS

Broom DM (2022) Concepts and Interrelationships of awareness, consciousness, sentience, and welfare. Consciousness Studies 29(3-4):129-149.

Browning H (2022) The measurability of subjective animal welfare. Consciousness Studies 29(3-4):150-179.

Coria-Avila GA, Pfaus JG, Orihuela A et al (2022) The neurobiology of behavior and its applicability for animal welfare: A review. Animals 12(7), 928.

de Souza Valente C (2022) Anaesthesia of decapod crustaceans. Veterinary and Animal Science 16, 100252.

Endenburg N, Ryan S, van Lith HA (2022) A global survey of companion animal veterinary practitioners on animal welfare teaching – Focus on undergraduate and continuing education, and clients' sources of information. Applied Animal Welfare Science doi:10.1080/10888705.2022.2047681.

Hooper J (2022) Contamination: The case of civets, companionship, COVID, and SARS. Applied Animal Welfare Science Volume 25(2):167-179.

Kriengwatana BP, Mott R, Cate CT (2022) Music for animal welfare: A critical review & conceptual framework. Applied Animal Behaviour Science 251, 105641.

Mason GJ, Lavery JM (2022) What is it like to be a bass? Red herrings, fish pain and the study of animal sentience. Frontiers in Veterinary Science doi:10.3389/fvets.2022.788289.

Nawroth C, Krause ET (2022) The academic, societal and animal welfare benefits of open science for animal science. Frontiers in Veterinary Science doi:10.3389/fvets.2022.810989.

Rodriguez Ferrere MB (2022) Animal welfare underenforcement as a rule of law problem. Animals 12(11), 1411.

Ruge L, Mancini C (2022) An ethics toolkit to support animal-centered research and design. Frontiers in Veterinary Science 9, 891493.

Sommerville R (ed) (2022) Changing human behaviour to enhance animal welfare. CABI, UK.

Stevenson R, Morales C (2022) Trauma in animal protection and welfare work: The potential of trauma-informed practice. Animals 12(7), 852.

Taylor D, Clay Z, Dahl CD et al (2022) Vocal functional flexibility: What it is and why it matters. Animal Behaviour 186:93-100.

Varela M, Correia I (2022) Empathy and burnout in veterinarians and veterinary nurses: Identifying burnout protectors. Anthrozoös doi: 10.1080/08927936.2022.2074189.