



ANIMAL WELFARE SCIENCE UPDATE

Issue 80 | January 2023

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 viewed by the RSPCA Australia office in the past quarter.

[Click here
to subscribe](#)





QUIT HORISING AROUND

ADVANCING HORSE WELFARE IN AUSTRALIA

22-23
FEBRUARY
ONLINE

**ANIMAL WELFARE
SEMINAR 2023**



INCLUDED IN THIS UPDATE

Companion animals 3

Farm animals 8

Animals in sport, entertainment, performance,
recreation and work 12

Animals in research and teaching 14

Wild animals 15

Miscellaneous..... 17

Articles of interest 19



COMPANION ANIMALS

Free-roaming cats face potentially fatal risks

Cats are commonly fitted with collars. However, few studies examine the animal welfare risks and benefits of cat collars.

This study, targeting German speakers in central Europe, surveyed cat owners (n=5,247) about the risks and benefits of cat collars. Respondents answered an online questionnaire about collar use, and incidents affecting present (n=10,923) and past cats (n=20,476). The majority of respondents allowed their present and past cats to roam outdoors (62.2%). Most cat owners never used a collar (67.1%), suggesting that collars are less commonly used in central Europe compared to Australia and New Zealand.

While owners reported problems with collars, other incidents were more common than collar-related problems. Collar-related problems included fur or skin issues (16.7%) and entrapment (15.4%), and rarely, entrapment with injury (2.7%). Severe incidents were more likely to involve intact male cats, possibly because they roam further and engage in riskier behaviours. A total of 19 past cats (0.6%), all free-roaming, were reported to have died in collar-related incidents (most over 10 years ago), mainly associated with entanglement. Altercations with other animals were more common with over a third (33.6%) of present free-roaming cats injured in altercations such as cat fights and dog attacks. The deadliest

risk to free-roaming cats was being hit by a car. The researchers extrapolated that ~22.7% of past and present cats had been hit by cars. Respondents reported that 21.6% of present cats had gone missing for a period. Over 12% of past cats had gone missing and never returned home. Cats were more likely to be reunited with their owners if they were identified (e.g. collar and microchip) and registered. Overall, this study found that free-roaming cats face potentially fatal animal welfare risks which are more serious than any risks associated with collars.

Arhant C, Lesch R, Heizmann V et al (2022) [Risks associated with free-roaming and collar use in cats—An online survey.](#) *Journal of Veterinary Behaviour* 58:23-36.



Trap-Assess-Resolve (TAR) is an effective strategy to manage stray cats

Free-roaming unowned stray cats, living as individuals or in colonies after being lost or abandoned, pose several animal welfare concerns. For example, stray cats face potentially fatal risks such as road accident trauma, and cats prey on wildlife.

With an overall vision of “no more strays”, the Lonely Miaow (LM), a New Zealand charity, has used Trap-Assess-Resolve (TAR) to rehome unowned stray cats. In response to calls from members of the public, LM volunteers trap stray cats who then receive vet checks, desexing, vaccination, microchipping, anti-parasitic treatment, and foster care before being put up for adoption. This study examined 25 years of LM’s records to evaluate

the demographics of unowned cat populations in Auckland, their health status, and costs associated with their care.

Over 25 years, LM volunteers trapped 14,611 unowned cats from 3,737 colonies. Over a fifth (22%) of cats needed veterinary treatment for problems such as respiratory infections, trauma (e.g. fight wounds, fractures), dental problems and ringworm. LM’s intensive TAR program cost over NZD 2 million (not including volunteer hours and pro-bono veterinary contributions). There were roughly equal numbers of male and female kittens but there were more adult females compared to adult males, and more older males compared to older females.

These age-sex ratios suggest that males die earlier possibly due to roaming and fighting, and older females might be exhausted by non-stop breeding. These findings highlight the animal welfare issues associated with stray cat populations. Of all the cats trapped by LM, 64.2% were adopted and 22.2% were euthanased (e.g. due to irreconcilable health problems). Annual adoption rates increased over time, with over 80.0% of cats being adopted in 2018 and 2019. Overall, the authors recommend that TAR should be implemented as part of a wider municipal strategy to manage cats, and prevent unwanted breeding, loss and abandonment.

Calver MC, Crawford HM, Scarff FR et al (2022) [Intensive adoption as a management strategy for unowned, urban cats: A case study of 25 years of Trap-Assess-Resolve \(TAR\) in Auckland, New Zealand](#). *Animals* 12, 2301.

Measures are needed to reduce stress for cats visiting the veterinarian

Veterinary visits can be stressful for cats. To improve cat health and welfare, it is important to minimise the stress of vet visits.

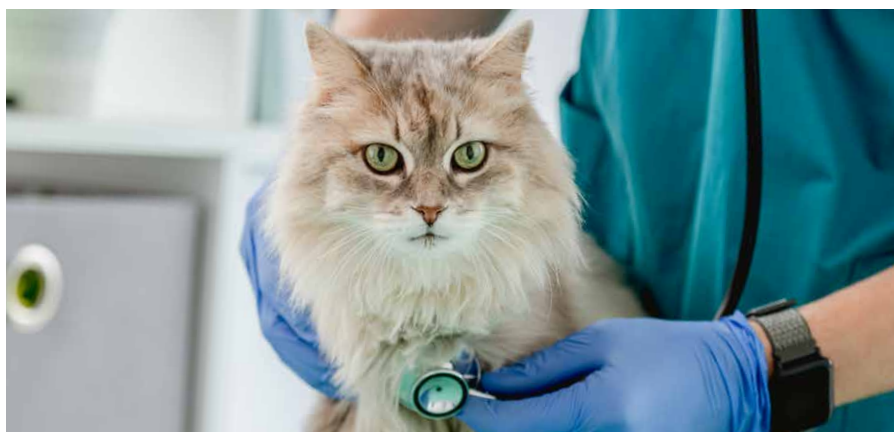
This study used an online survey of cat owners (n= 263), mainly from the United Kingdom, to investigate factors associated with veterinary visits that may cause cats stress (e.g. travelling, other animals in the waiting room, examination), and characterise measures being used to reduce stress. Owners were asked to assign cat stress scores (1=least stressful, 10=most stressful).

The majority of cat owners (94.7%) reported that their cat was stressed

during vet visits. Factors associated with the highest cat stress scores (median score 6/10), as assigned by owners, included putting the cat in a cat carrier, travelling to the clinic, the presence of other animals in the waiting room, and the consultation. Many owners (31.3%) were so concerned about their cat’s stress that it put them off visiting the veterinarian. Clinics took a variety of steps to address stress including providing advice on transport, quiet

cat only waiting rooms, and Feliway diffusers. The Cat Friendly Clinic program, developed by International Cat Care (iCatCare), provides guidelines and an accreditation scheme for veterinary clinics to reduce stress for cats.

Caney SM, Robinson NJ, Gunn-Moore DA et al (2022). [Happy cats: Stress in cats and their carers associated with outpatient visits to the clinic](#). *Journal of Feline Medicine and Surgery* 24(12):e551-e557.





Enrichment is associated with fewer reports of cats scratching furniture

Cats naturally perform scratching behaviours for a variety of reasons including to maintain their claws and mark territory. While these scratching behaviours are essential for cats to perform, they can pose problems to owners when cats damage furniture.

This study, conducted in the United States and Canada, surveyed cat owners (n= 2,465) about unwanted scratching. The survey included questions about the cats (e.g. age, desexing status), owners (e.g. age, gender, experience) and management factors (e.g. enrichment).

Over half of respondents (57.5%) reported that their cat damaged

furniture with their scratching behaviour. Owner factors did not significantly affect the likelihood of unwanted scratching. Older cats (>7 years) were less likely to engage in unwanted scratching behaviour possibly due to their developmental stage and activity levels. Management factors associated with fewer reports of unwanted scratching included: providing enrichment (e.g. flat scratching surfaces, scratching rope and additional scratching posts), applying attractants to scratching objects, and restricting access to things the owners did not want scratched. Punishing the cat using verbal (e.g. shouting “No!”) or physical (e.g. hitting) means were associated with higher reports of unwanted scratching.

*Cisneros A, Litwin D, Niel L et al (2022) [Unwanted scratching behaviour in cats: influence of management strategies and cat and owner characteristics](#). *Animals* 12, 2551.*

Developing a reliable standardised animal welfare assessment tool for cats

Reliable standardised assessment tools are needed to evaluate cat welfare, and cats’ response to interventions such as enrichment and behaviour modification.

This study, conducted in Canada, aimed to develop a reliable standardised animal welfare assessment tool for cats. The tool had four components: (1) Fear, Anxiety, and Stress (FAS), (2) Response to Petting (RTP), (3) Participation in Play (PIP), and (4) Food Intake Summary (FIS). A total of 16 participants, divided into three cohorts, received a one-hour training session per rating system (four hours total). Participants viewed

30 video clips of cat behaviour (up to 30 seconds each) to score FAS, RTP, and PIP. Based on standardised descriptors, FAS was scored zero (no high stress behaviours e.g. body tense, ears flattened, rapid breathing, and many low stress behaviours e.g. relaxed posture, ears forward, approaches eagerly) to five (pronounced high stress behaviours and aggression, and likely absent low stress behaviours). RTP was scored zero (approach and actively interact) to five (flee or lunge). PIP was scored zero (enthusiastically playing) to five (no interest or retreats). To score FIS, participants were shown

30 photographs of food intake information. FIS was scored zero (ate $\frac{3}{4}$ of either wet or dry food at both meals) to five (ate nothing).

The cat welfare assessment tool showed consistent results across different participants. The authors concluded that it may be an effective means to evaluate cat welfare in shelters, research settings and in the home environment.

*Ellis JJ (2022) [Beyond “doing better”: Ordinal rating scales to monitor behavioural indicators of well-being in cats](#). *Animals* 12, 2897.*

More research needed to understand ideal play programs for cats

Many animals engage in play behaviour. Different types of play, including object play, locomotor play, and social play, are important for animals' development. While play is broadly seen as beneficial, there is limited research on the links between animal welfare and play behaviour, particularly in companion animals such as cats.

This review synthesises the current literature on cat welfare and play behaviour. Cats play with people, other cats, by themselves, and sometimes with other animals. However, at

present, little is known about how play affects cats' affective state or overall welfare. Play can be an indicator or promoter of good animal welfare; an indicator because it occurs most frequently when essential needs are met and in the absence of threats, and a promoter because it is rewarding, strengthens bonds, and may lead to improved welfare outcomes. There is evidence that play may also benefit cats by minimising problem behaviours and negative welfare outcomes.

The authors recommend further studies on links between play and cat welfare, particularly what types and amount of play are optimal.

Henning J, Fernandez E J, Nielsen T et al (2022) Play and welfare in domestic cats: Current knowledge and future directions. Animal Welfare 31(4):407-421.



Minimum animal welfare requirements for frogs and turtles are not being met

Many frogs and turtles are being kept in Australian households. However, little is known about how these animals are being cared for, and their welfare status is not well understood.

This study investigated how frogs and turtles are being kept by people in Victoria. Frog (n= 128) and turtle (n= 60) keepers, recruited from the state license database, completed an online survey including questions about their animals' diet, exercise, and environment. These questions were designed to evaluate whether the animals' minimum needs were being met based on the Victorian Codes of Practice for the Private Keeping of Reptiles and the Welfare of Amphibians in Captivity.

The majority of respondents described their animals as members of the family, and demonstrated

some knowledge of the species' needs. However, less than a fifth of frog keepers kept their animals in enclosures that met minimum size standards, and only ten turtle keepers provided their animals with the minimum enclosure attributes as outlined in the Code of

Practice. The large percentage of frog and turtle keepers failing to meet minimum standards is concerning.

Howell TJ, Warwick C, Bennett P (2022) Pet management practices of frog and turtle owners in Victoria, Australia. Veterinary Record 191(12), e2180.



Foster care can reduce rescue dogs' risk of being returned to shelters

Every year, thousands of dogs end up in rescue shelters across Australia, and they need homes. Some dogs are adopted from shelters but are subsequently returned. This upheaval can be traumatic for dogs, adopters, and shelter staff. Information is needed on how to minimise return rates.

To understand factors associated with return rates, this study examined data on dogs adopted

from RSPCA Queensland from 2019 to 2020. During this period, a total of 6,212 dogs were adopted, and 865 of these dogs were readmitted, including 119 on the same day they were adopted, and 552 within 14 days of adoption. The majority of dogs re-admitted were returned by the adopters (89%), with the remaining dogs mainly found as strays.

Factors associated with re-admission included dog size, age, coat colour, and breed. Larger dogs ($\geq 10\text{kg}$), older dogs (≥ 6 months), working breeds, and brindle or white dogs were at higher risk of being returned to the shelter. Dogs who had spent time in foster care before adoption were less likely to be returned, likely

because they received training and behavioural support in a home environment, which helped them adapt to their new life. The authors recommend that risk of readmission could be reduced with improved adopter counselling and post-adoption engagement, enhanced foster care capabilities, a more rigorous adopter-dog matching processes, and targeted support for higher risk dogs, such as larger older dogs.

*Thumpkin E, Paterson MBA, Morton JM et al (2022) **Adoption can be a risky business: Risk factors predictive of dogs adopted from RSPCA Queensland being returned.** Animals 12, 2568. [Author MBA Paterson is from RSPCA Queensland].*



FARM ANIMALS

A road map for the transition away from extreme confinement of sows

Sows are commonly subjected to extreme confinement in farrowing crates. However, due to serious animal welfare concerns, these systems have been prohibited in some countries, and are banned by some market-driven initiatives.

This review examines over 40 years of research into alternative farrowing systems and the views of different stakeholders, and provides a roadmap for the transition away from farrowing

crates. Alternatives to conventional farrowing crates include temporary crating, also referred to as loose lactation, free lactation or temporary confinement. Some of these systems use crates that fit within the footprint of a conventional farrowing crate's pen (3.6 to 4.6m²) while others have a larger footprint (5.5-7.4m²) but all allow temporary confinement of the sow, meaning she cannot turn around. In contrast, free farrowing or loose housing systems do not have a crate in which the sow can be confined.

Designing a new farrowing system requires some key considerations to be made and several layers of decision-making, including those influenced by externalities (e.g. animal welfare

regulations, market drivers, finances), those relating to pen design and their management, and those relating to other factors (e.g. sow genotype). The amount of space required for a system to work successfully is determined by the animals' needs (e.g. pen shape, layout, flooring, partitions, piglet protections), while also needing to consider the needs of people working within those systems (e.g. feeding, daily routines, handling), as well as environmental impact and societal acceptance of the production system.

*Baxter EM, Moustsen VA, Goumon S et al (2022) [Transitioning from crates to free farrowing: A roadmap to navigate key decisions](#). *Frontiers in Veterinary Science* 9, 998192.*





Overhead sprinklers as a water source for commercially raised ducks

Ducks are highly motivated to access and use water for a variety of water-related behaviours, such as bathing and preening. However, ducks in commercial production systems are routinely deprived of access to open water. It has been suggested that using misting via overhead sprinklers in commercial production systems may allow ducks to perform some water-related behaviours.

This study, conducted in Victoria, tested misting systems on seven flocks (4 misted, 3 non-misted) of Pekin ducks (total $n = 27,780$ to $29,220$ ducklings). Ducks in the misted flocks received one hour of misting from 26 to 33 days of age. Health (e.g. body weight) and behavioural indicators (e.g. preening, tail wagging, walking) were assessed at the beginning and end of this period via video recordings.

On day 33, the misted ducks had better feather quality on the back and wings compared to non-misted ducks, and misted ducks were

drinking, tail wagging and walking more frequently than they had been on day 26. While there were some subtle differences in behavioural patterns between misted and non-misted ducks, misting did not appear to have significant positive or negative effects on duck welfare overall. The authors recommend further studies on duck water provision to investigate the effects of heat load index and larger water droplets.

Campbell DLM, Belson S, Erasmus MA et al (2022) [Behaviour and welfare impacts of water provisions via misting in commercial Pekin ducks](#). Journal of Animal Science 100(12), skac341.

Concerns about farm animal welfare can help drive sustainable food choices

Food choices have consequences for human health, climate change, biodiversity conservation, and animal health and welfare. Recommendations have been made for more sustainable food choices to benefit people, animals and the planet.

This discussion paper examines how concerns about farm animal welfare could inform more sustainable food choices. Though the majority of consumers have no direct contact with farm animals, and meat industries 'de-animalise' products to conceal their origins, contemporary consumers

are increasingly concerned about farm animal welfare. Consumers are concerned about the pain and suffering inflicted on farm animals, the act of killing, how removed industrialised livestock production is from animals' natural life, and inequalities in how different animals are treated. However, food choices are often paradoxical with many people simultaneously condemning harm to animals whilst still eating meat.

The authors adapt the 3Rs (replacement, reduction, refinement), originally developed for laboratory

animal ethics, to develop three sustainable food choice goals (1) eat less animal products, (2) eat less and better animal products, (3) eat 'less worrisome' animal products. While there are differences in how consumers in different markets behave, the authors propose these 3Rs as a guide towards choosing sustainable diets that are animal friendly and address human health, climate change, biodiversity and food security challenges.

de Boer J, Aiking H (2022) [Considering how farm animal welfare concerns may contribute to more sustainable diets](#). Appetite 168, 105786.

Experimental investigation of Low Atmospheric Pressure Stunning (LAPS) in pigs

Worldwide in 2020, 1.4 billion pigs were slaughtered for human consumption. Pigs are most commonly stunned using carbon dioxide (CO₂) which causes pain, fear and distress. Low Atmospheric Pressure Stunning (LAPS), developed for the stunning of poultry, has been suggested as an alternative to CO₂. In LAPS, oxygen is displaced by an inert gas (e.g. argon or nitrogen) causing decompression and lack of adequate oxygen necessary for life (hypobaric hypoxia).

This experimental study, conducted in the United Kingdom, investigated the effects of LAPS on pigs (n=60). Anaesthetised pigs were exposed to decompression rates of 40, 60, 80 and 100 ms⁻¹, at two cycle durations of 480 and 720 seconds. Indicators of cardiac arrest and death were measured including electro-cardiograms, respiratory rate and body movements (e.g. convulsions).

At faster decompression rates, pigs went into cardiac arrest and stopped breathing in a shorter time (e.g. 178.0 ± 22.2 seconds at 40 ms⁻¹ compared to 120.0 ± 14.2 seconds at 100 ms⁻¹). It took longer for male pigs and pigs with higher baseline heart rates to go into cardiac arrest. At slower decompression rates (40

ms⁻¹), a greater percentage of pigs were observed convulsing. Visible abdominal swelling was observed in all pigs with over half of pigs swelling prior to cardiac arrest. Approximately a minute after cardiac arrest, pigs went into respiratory arrest. 100% of pigs died within the proposed time restraints. Overall, the authors highlight the need for further research on LAPS in pigs to evaluate the response of conscious pigs to decompression at intermediate rates compared to CO₂ stunning.

Martin JE, Baxter EM, Clarkson JM et al (2022) [Characterising candidate decompression rates for hypobaric hypoxic stunning of pigs. Part 1: Reflexive behaviour and physiological responses](#). Frontiers in Veterinary Science 9, 1027878.

Cooperation between stakeholders is needed to improve management of surplus calves

In the dairy industry, surplus calves, mainly males (also known as bobby calves), are routinely killed within the first weeks of life. This raises a range of ethical and animal welfare concerns. Raising male dairy calves for meat (dairy beef) has been suggested as an alternative.

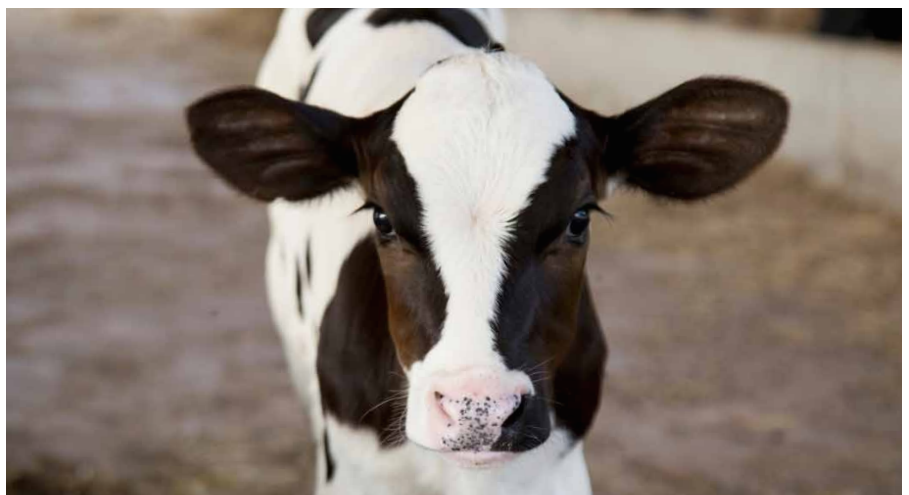
This study, conducted in Canada, aimed to investigate what dairy farmers think about dairy beef as an alternative to the slaughter of surplus calves. Dairy farmers (n=7) participated in five group discussions about the feasibility of creating a dairy beef system. Participants asked for genetics companies and beef processors to join the discussion, as well as dairy farmers from other countries who were pursuing dairy beef.

Farmers discussed surplus calf rearing practices, feeding, breeding and marketing, leadership in the dairy industry, vertical integration,

localising production, and economic and social viability. While the findings are not necessarily generalisable across the dairy industry, four themes emerged from the group discussions: (1) Challenges, (2) The role of leadership and partnerships, (3) Catering for local markets, and (4) Viability. The authors recommend that greater engagement

and cooperation between different stakeholders can help resolve challenges and improve surplus calf management.

Proudfoot KL, Hendricks J, Higgins A et al (2022) [The entrepreneurs: Dairy farmer perspectives on findings an industry solution for the surplus calf issue – a participatory study](#). Frontiers in Sustainable Food Systems 6, 961068.



Slower growing meat chicken breeds have better welfare than fast-growing breeds

The rapid growth and housing of meat chickens at high stocking densities has led to a number of animal welfare issues in commercial production systems. Using slower growing breeds and reducing stocking density have been proposed as means to improve the welfare of meat chickens. However, little is known about how these factors interact.

This study, conducted in The Netherlands, aimed to compare the behavioural responses of fast (64g/day average weight gain) and slower growing (50g/day) meat chickens housed at different stocking densities (24, 30, 36 and 42 kg/m²). A total of 11,360 fast-growing and 11,360 slower growing meat chickens were randomly allocated to two replicates of each of the four stocking densities. Behavioural tests included enrichment (e.g. hay bale), reaction to a novel object, and human approach

and free-space tests (observer walks around the pen making sounds and waving arms to drive birds away). Behavioural observations were taken for locomotion (e.g. walking, running), comfort behaviours (e.g. preening, dust bathing) and foraging behaviours (e.g. ground pecking, ground scratching).

Slower growing meat chickens moved around more and performed more comfort and foraging behaviours, and less fear-related behaviours. For example, slower growing meat chickens were more likely to approach a human and novel object compared to fast-growing meat chickens. Slower growing meat chickens also made better use of enrichment, with a greater percentage of slower growing meat chickens seen sitting on hay bales. Although few interactions between breed and the stocking densities were seen, all meat chickens at lower stocking densities displayed more comfort and foraging

behaviours. These results suggest that slower growing meat chickens had better overall welfare than fast-growing meat chickens, and lower stocking densities can encourage bird behaviour.

Van der Eijk JAJ, Gunnink H, Melis S et al (2022) [Reducing stocking density benefits behaviour of fast and slower-growing broilers](#). *Applied Animal Behaviour Science* 257, 105754.



Reducing severe feather pecking requires consideration of management and housing factors

Severe feather pecking (SFP) is a serious animal welfare challenge that occurs commonly in hens farmed for commercial egg production. SFP involves the compulsive pecking, pulling and removal of feathers, which is a serious animal welfare problem because it reflects birds struggling to cope with stress, and causes pain, fear, injuries, and deaths by cannibalism.

This study, conducted across 16 commercial aviary-based and free-range farms in Germany, investigated the effects of management and housing on SFP. Thirty non-beak-trimmed flocks were visited during the rearing and

laying period. Individual birds were given a plumage and skin lesion score. A total of 1,755 pullets and 3,390 laying hens were scored. Management and housing factors were also recorded including number of animals per caregiver, stocking density, litter quality, number of birds per drinking nipple and perch length per bird.

During the rearing period, plumage condition was significantly worse with high stocking density and poor litter quality. The percentage of birds affected by severe plumage damage increased during the laying period. By the end of the laying period, 18 of

the 30 flocks had severe plumage damage. During the laying period, a lack of free range, poor litter quality, insufficient enrichment, and plumage damage during rearing were significant risk factors for poor plumage condition. For example, flocks with access to free range had less plumage damage compared to birds kept in aviaries. Overall, the authors recommend that a variety of management and housing factors must be used to reduce SFP including litter quality, stocking density, provision of free-range areas, and enrichment.

Schwarzer A, Rauch E, Bergmann S et al (2022) [Risk factors for the occurrence of feather pecking in non-beak-trimmed pullets and laying hens on commercial farms](#). *Applied Sciences* 12, 9699.

ANIMALS IN SPORT, ENTERTAINMENT, PERFORMANCE, RECREATION AND WORK

Equines should be given the opportunity to engage in rolling behaviour

Rolling on the ground is a normal equine behaviour. However, many equines kept by people do not have the opportunity to engage in rolling behaviour.

This study, conducted in Brazil, investigated rolling behaviour in horses (n=8) and mules (n=8). For twenty consecutive days, after a standardised exercise regime, animals were given up to 15 minutes to choose whether to roll in sand, grass or manure. Body

temperature was then measured across five body regions using an infrared thermometer to assess whether rolling behaviour affected animals' ability to regulate their body temperature (thermoregulation).

Horses preferred to roll on grass. Mules preferred to roll on sand. The temperature of horses and mules was significantly reduced after rolling suggesting that this behaviour plays a role in thermoregulation, similarly

to sand and mud bathing in other species. The authors recommend that equines be provided with adequate space and choices of substrate to facilitate rolling behaviour.

Ferreira Da Luz MP, Maia CM, Filho JN (2022) Equine rolling behaviour: Thermoregulation mechanism after exercise and substrate preference. Journal of Applied Animal Welfare Science doi:10.1080/10888705.2022.2132825.



Equine behaviourists face challenges explaining fear and anxiety to horse owners

Horses display a range of subtle and overt signs of fear and anxiety. However, horse owners may not be familiar with these signs. Failure to recognise these signs and respond appropriately can compromise animal welfare.

Using semi-structured interviews, this study explored the experiences of Animal Behaviour and Training Council registered equine behaviourists (n=9) in the United Kingdom. Behaviourists were asked to share their experience working with clients. Questions included “how well do people recognise fear and/or anxiety in horses?” and “how do caregivers tend to respond when told their horses are fearful and/or anxious?”.

Three themes emerged from the interviews: (1) Clients are extremely poor at recognising fear and anxiety in horses, (2) Some clients may recognise overt signs of fear and/or anxiety (e.g. rearing) but miss subtle signs (e.g. tension in face, hesitant gait), (3) Fear and/or anxiety behaviours are often misinterpreted or mislabelled. For example, one behaviourist described how behaviour consistent with fear and/or anxiety is often “misinterpreted to be naughty, cheeky, excited, being a pain”. When a horse is fearful or anxious, some clients “find it really annoying when they can’t go out and do what they want to do with their expensive animal.” When trying

to explain the steps necessary to manage their horse’s fear/anxiety, the behaviourists used approaches such as: likening the horses’ fear/anxiety to human fear/anxiety (constructive anthropomorphism), talking the client through real-time observations of the horse, discussing the evolution of behaviours under natural conditions (ethology), and sharing other anonymised cases so owners feel better about their situation.

Rogers S, Bell C (2022) [Perceptions of fear and anxiety in horses as reported in interviews with equine behaviourists](#). *Animals* 12, 2904.

Assistance dogs need assistance too

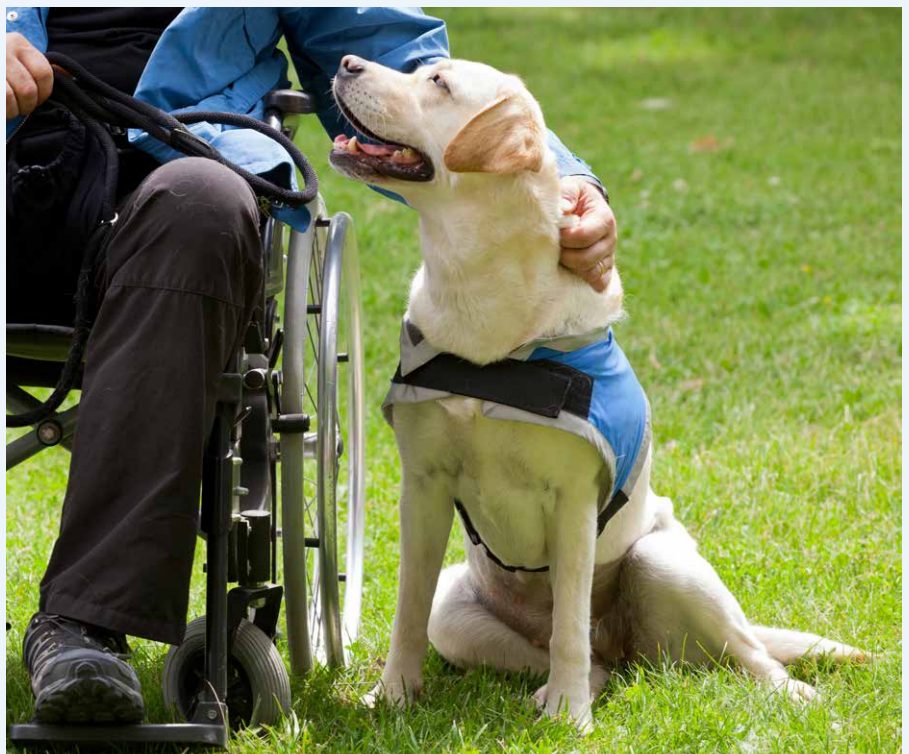
Assistance dogs, trained to assist people with a disability, fulfil a number of important roles. There is growing recognition of the importance of safeguarding the welfare of assistance animals.

This review synthesises information about the welfare of assistance dogs in Australia. Several aspects of assistance dogs’ lives may pose animal welfare concerns including intensive training, the physical and mental demands of their work, stress, the lack of down time, issues later in life and relinquishment. For example, few aged care facilities in Australia permit assistance dogs likely resulting in relinquishment which is distressing for people and dogs.

Regulatory mechanisms may be used to safeguard the welfare of assistance dogs. For example, in Queensland, animal-handler teams must be certified by an approved trainer, and it is implicit that the dog is treated in a manner that ensures they can perform the duties for which they are certified. The authors

also recommend that greater support needs to be provided to animal-handler teams so animals’ needs can be met throughout their lives.

Salmon A, Driscoll C, Paterson M et al (2022) [Issues regarding the welfare of assistance dogs](#). *Animals* 12(23), 3250. [Author M Paterson is from RSPCA Queensland].





ANIMALS IN RESEARCH AND TEACHING

Pain assessment in laboratory rodents needs further refinement

Methods to accurately measure pain in laboratory rodents are essential for severity assessments, pain management and humane endpoints. There is a growing body of evidence supporting the use of pain indicators such as facial expression patterns (grimace scale), burrowing and nest building.

This review examined 74 papers on pain indicators in laboratory rodents in the context of surgical interventions. The majority of papers focused on pain associated with abdominal surgery (laparotomy). All studies used anaesthesia, most commonly inhalational agents. Animals in the majority of studies received pain relief (analgesia) but almost all studies used only one type of analgesic, either an opioid or non-steroidal anti-inflammatory. Grimace scales were frequently used to assess pain.

The authors identify several knowledge gaps including lack of information about post-surgical pain in different strains and ages of rodents, and with different types of procedures. They recommend the wider use of multi-modal pain relief, and more research to validate different pain scoring systems.

*Aulehner K, Leenaars C, Buchecker V et al (2022) **Grimace scale, burrowing, and nest building for the assessment of post-surgical pain in mice and rats - A systematic review.** Frontiers in Veterinary Science 9, 930005.*

Questioning the ethics of breeding animals who cannot experience pain

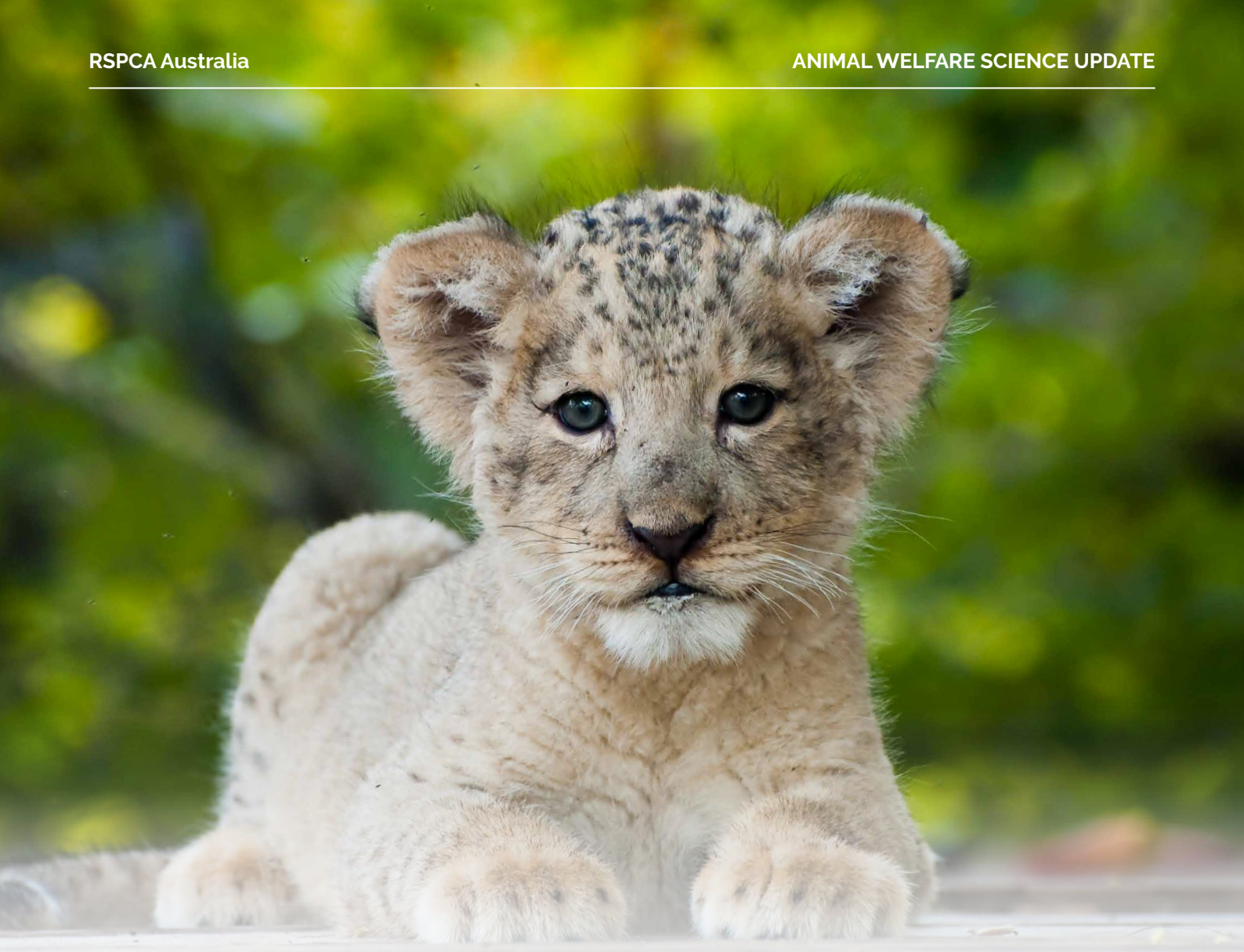
Pain and suffering are inflicted on millions of animals every year for research purposes. The 3Rs (replacement, reduction, refinement), developed in the 1950s, well before the burgeoning of animal welfare science and animal ethics, form the basis of policies and regulations on the use of animals in research. As new animal welfare and ethics challenges arise, there is a need to evaluate them using the 3Rs. For example, it has been proposed that laboratory animals could be selectively bred to limit their ability to feel pain (genetic pain disenchantment).

This review paper evaluated whether genetic pain disenchantment (GPD) complies with the 3Rs. Using emerging gene editing technologies, GPD proposes to reduce or eliminate animals' capacity to experience negative emotional states.

In terms of replacement, GPD cannot be seen to address the moral issue of animal distress because the animals used are still sentient. In terms of reduction, GPD would not necessarily result in fewer animals used. In terms of refinement, it is unclear whether GPD would lead to a decrease in the incidence or severity of inhumane

procedures, or whether GPD animals would suffer less than unaltered animals. For example, animals with pain insensitivity disorders have increased vulnerability to physical injuries, and have higher morbidity and mortality rates. The authors conclude that GPD highlights deficiencies in the 3Rs. The 3Rs give limited moral significance to animals, they fail to recognise that animals have value in themselves. Interfering with animals' capacities in order to continue to use and kill them, poses significant ethical issues.

Camenzind S, Eggel M (2022) The 3Rs principles and genetic pain disenchantment. Animal Welfare 31:495-503.



WILD ANIMALS

Lion cubs subjected to poor welfare by the canned hunting industry

In South Africa, the “canned-hunting” industry commercially farms thousands of lions to be sedated and released into fenced areas for trophy hunters to kill. This industry also generates revenue from ‘lion cub petting’, where tourists pay to interact with lion cubs. The canned hunting industry, including lion cub petting, raises several animal welfare concerns.

This study aimed to evaluate the welfare of lion cubs used in cub-petting activities in South Africa. Videos (n=49) uploaded to YouTube by tourists participating in lion cub petting activities, were evaluated for cub age, husbandry concerns and stress behaviours.

All but two videos showed people interacting with unweaned cubs under seven months. In almost all videos (48/49), these young cubs were separated from their mothers, socially isolated and forced to be active during the day. Normally, lion cubs would only leave the den at night and not venture away from their mother. Half the videos depicted cubs being kept in barren enclosures devoid of any environmental enrichment. The majority of videos (38/49, 77%) showed at least one stress behaviour including avoidance (26/49), aggression (24/49), abnormal behaviour (10/49) and hiding (1/49). A total of 41% (20/49) of videos showed white lions,

a mutation popular among trophy hunters. The prevalence of white lion cubs indicates severe inbreeding which leads to genetic defects and increased susceptibility to disease. Overall, cub-petting activities have a negative impact on animal welfare. In 2021, the South African government announced plans to ban these activities and canned hunting more broadly.

Chorney S, DeFalco A, Jacquet J et al (2022) Poor welfare indicators and husbandry practices at Lion (Panthera leo) “Cub Petting”: facilities: Evidence from public YouTube videos. Animals 12(20), 2767.

Fertility control can reduce population growth rates of wild horses

Wild horses raise environmental and animal welfare concerns, but managing their populations is operationally and ethically challenging. Fertility control has been explored as a management method but few studies critically evaluate the effects of contraceptives on wild horse population growth.

This study, conducted in the United States, evaluated the effects of a contraceptive vaccine (PZP-22) on populations of wild horses in large herd management areas. PZP-22 was administered by dart or by hand in 2008 and 2012. Animals were also removed from the populations, and this was taken into account in the analyses. Population size, reproductive rates and population growth rates were assessed.

This study is the first to demonstrate that contraceptives can help reduce the population growth rates of wild horses in large herd management

areas. While overall population sizes increased over the study period, the reproductive rate (pooled proportion of mares foaling) and population growth rate decreased. In one area, PZP-22 reduced population growth rates by 74%. The authors emphasise that a large majority of mares must be treated over multiple years for fertility control to be effective.

Grams K, Rutberg A, Turner Jr JW (2022) Reduction in growth rates of wild horse populations treated with the controlled release immunocontraceptive PZP-22 in the western United States. Wildlife Research 49(8):738-748.

Observations of dolphin behaviour may provide clues about their welfare

Behavioural observations may be used to evaluate the welfare of captive animals. However, validation studies are required to establish whether such observations can be relied upon as robust animal welfare indicators.

This study aimed to investigate whether behavioural observations could be used as animal welfare indicators in captive dolphins. It focused on Yangtze finless porpoises (n=5), East Asian finless porpoises (EAFP) (n=4) and bottlenose dolphins (n=5) kept in captivity at two facilities in Wuhan, China. Keepers working with the dolphins completed questionnaires rating dolphins' behaviours towards humans, other dolphins, their enclosure and unusual events (e.g. transport, social separation, high visitor density, birth and death of a calf). In conjunction with keepers' ratings, 15-minute videos of the dolphins' behaviour was recorded daily (morning, noon and afternoon) and evaluated by experienced observers to estimate the time spent engaged in different behaviours (time budgets).

Consistencies were found between keepers' ratings and evaluations by

the experienced observers, including in the scoring of individual dolphins' behaviour during training and free time, interactions with people and other dolphins, and fast synchronous swimming. For example, fast synchronous swimming was observed in all three groups of captive dolphins, which may be a sign of stress. Dolphin behaviours towards humans, other dolphins and their environment were seen to change significantly with transport, social separation, and high visitor density. For example, when visitor density was high, EAFPs had nowhere to withdraw from crowds and were seen to be reluctant to

interact with people at the viewing windows. The authors conclude that observations by keepers may be used to detect subtle indicators of animals' emotional state.

*Serres A, Wang C, Hao Y et al (2022) Reliability of caretakers' ratings of captive bottlenose dolphins (*Tursiops truncatus*) and finless porpoises (*Neophocaena asiaeorientalis* sp.) behavioural style for welfare monitoring. Journal of Applied Animal Welfare Science doi:10.1080/10888705.2022.2141575.*



MISCELLANEOUS

Busy bees work hard and play hard

Play is enjoyable and has an important role in animals' development. Many animals engage in play behaviours by interacting and manipulating objects 'just for fun' (object play).

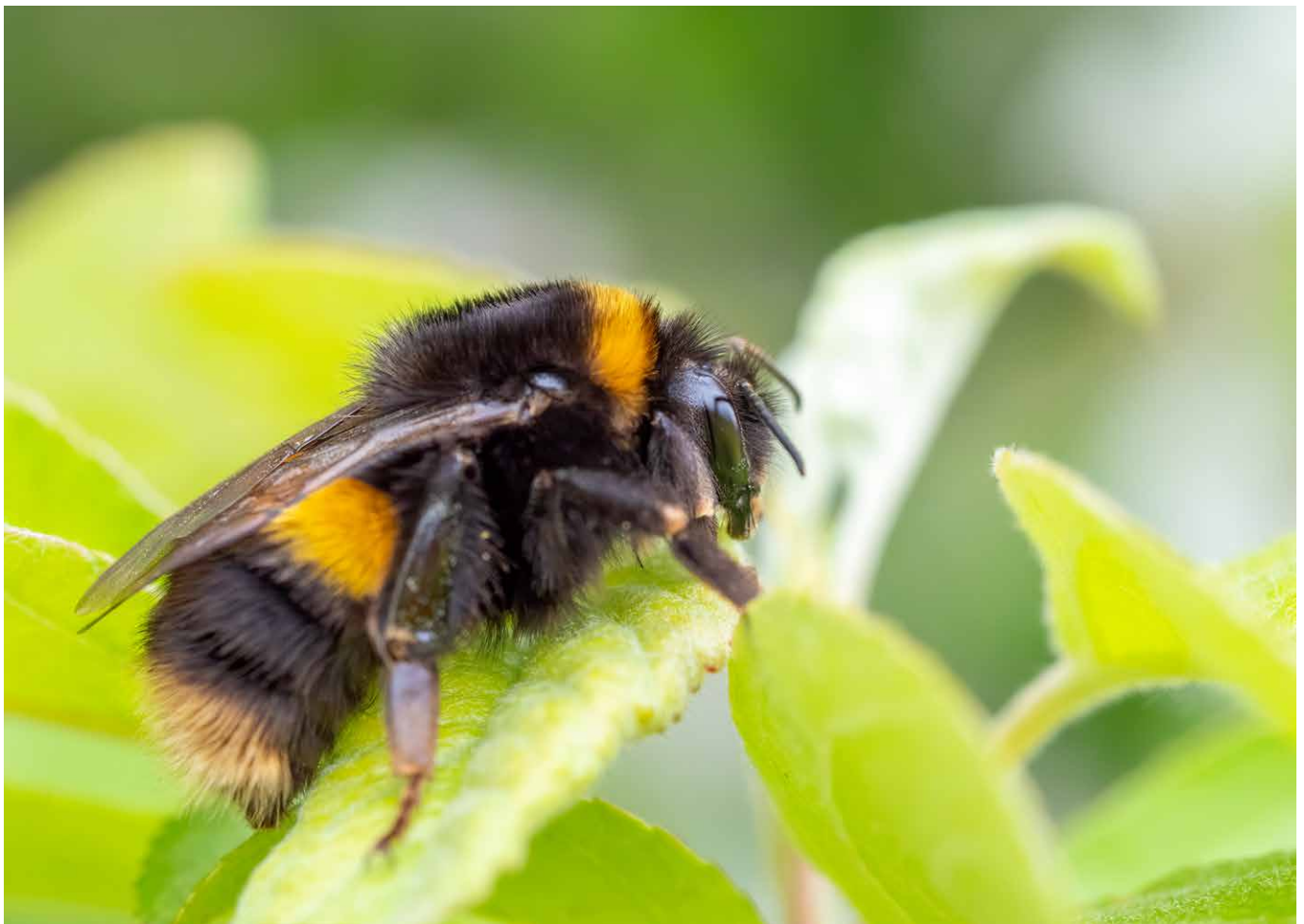
This study investigated play behaviour in insects. A colony of individually identified and sexed bumble bees (*Bombus terrestris audax*) (n=45) were kept in a laboratory hive. For three hours a day, bees were given access to an arena containing nine wooden balls (15mm diameter), including 3 yellow, 3 purple and 3 plain wood balls. When the bees entered the arena, they could choose to walk an unobstructed path to feeders or deviate to interact with the balls. Bees were then given access

to two coloured chambers, one with balls and one without, then these were swapped. The bees' behaviour was observed for 18 days.

Bumble bees were observed rolling wooden balls 'just for fun'. They rolled the balls for 0.4 to 31 seconds between once and 44 times per day. They showed no preferences for particular ball colours. Younger bees (aged 3 to 7 days) rolled balls more often than older bees. When the coloured chambers were swapped, bees showed a preference for the colour where they'd previously played with the balls, suggesting that they found the activity rewarding and wanted to play again. Despite having a continuous supply of

nectar and pollen in a separate area, bees continued to seek out the ball areas. The authors argue that these behaviours meet the criteria for play as they are not immediately functional, they are voluntary, spontaneous and rewarding, they did not contribute to survival strategies (e.g. search for food, clearing clutter, or mating), they occur when bees are not under stress, and they are repeated but not stereotyped. These findings suggest that bumble bees experience positive affective states and add to growing evidence in support of sentience in insects.

Dona HSG, Solvi C, Kowalewska A et al (2022) [Do bumble bees play](#). Animal Behaviour 194:239-251.





Evidence indicates that some insects, including cockroaches and flies, can feel pain

To date, insects have not been given moral consideration because it has been thought that they cannot feel pain. However, evidence is growing that insects can feel pain.

This review synthesises the evidence for pain in six orders of insects: Blattodea (cockroaches and termites), Coleoptera (beetles), Diptera (flies and mosquitoes), Hymenoptera (bees, wasps, ants), Lepidoptera (butterflies and moths) and Orthoptera (crickets, grasshoppers, locusts). The authors use the eight criteria for animal sentience as outlined by Birch et al. (2021) in a report for the United Kingdom government: (1) Nociceptors (receptors for noxious stimuli), (2) Integrative brain regions capable of processing information from different sensory sources,

(3) Integrative nociception (neural pathways connecting nociceptors and integrative brain regions), (4) Response to endogenous (internal) or exogenous (external) pain relief, (5) Motivational trade-offs between noxious stimuli and rewards, (6) Flexible self-protective behaviour, (7) Associative learning to avoid noxious stimuli, (8) Preference for pain-relief when injured (learn to self-administer pain relief, seek out a place where pain relief can be accessed, or prioritise accessing pain relief over other needs).

Appraising available literature, the authors found strong evidence that adult Diptera and Blattodea feel pain as they satisfy six of the eight criteria of the Birch et al. (2021) framework. There is substantial evidence (satisfying

3 to 4 criteria) for pain in adults of Hymenoptera, Lepidoptera and Orthoptera, juvenile Blattodea and Diptera, and last instar Lepidoptera. While there remain many significant knowledge gaps, particularly for earlier life stages, the authors argue that there is sufficient evidence to indicate many insects deserve moral consideration, with implications for their use, breeding, management and slaughter.

Gibbons M, Crump A, Barrett M et al (2022) Chapter 3 - Can insects feel pain? A review of the neural and behavioural evidence. Advances in Insect Physiology 63:155-229.

Birch J, Burn C, Schnell A et al (2021) [Review of the evidence of sentience in cephalopod molluscs and decapod crustaceans](#). LSE Consulting, London, UK.

ARTICLES OF INTEREST

COMPANION ANIMALS

- Azevedo A, Guimarães L, Ferraz J et al (2022) Understanding the human–reptile bond: An exploratory mixed Methods Study. *Anthrozoös* 35(6):755-772.
- Benka VA, Boone JD, Miller PS et al (2022) Guidance for management of free-roaming community cats: a bioeconomic analysis. *Journal of Feline Medicine and Surgery* 24(10):975-985.
- Bennetts SK, Crawford SB, Howell T et al (2022) Companionship and worries in uncertain times: Australian parents' experiences of children and pets during COVID-19. *Anthrozoös* 35(6):833-846.
- Booth AL, Otter K (2022) The law and the pussycat: Public perceptions of the use of municipal bylaws to control free-roaming domestic cats in Canada. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2142059.
- Brubaker L, Udell MAR (2022) Does pet parenting style predict the social and problem-solving behavior of pet dogs (*Canis lupus familiaris*)? *Animal Cognition* doi:10.1007/s10071-022-01694-6.
- Busch G, Schütz A, Hölker S et al (2022) Is pet ownership associated with values and attitudes towards animals? *Animal Welfare* 31(4):447-454.
- Buttner AP, Strasser R (2022) Extreme life histories are associated with altered social behavior and cortisol levels in shelter dogs. *Applied Animal Behaviour Science* 256, 105693.
- Cameron K, Holder H, Connor R et al (2022) Cross-sectional survey of husbandry for pet guinea pigs (*Cavia porcellus*) in New Zealand. *New Zealand Veterinary Journal* 71(1):27-32.
- Carroll GA, Torjussen A, Reeve C (2022) Companion animal adoption and relinquishment during the covid-19 pandemic: Peri-pandemic pets at greatest risk of relinquishment. *Frontiers in Veterinary Science* doi:10.3389/fvets.1017954.
- Dinwoodie IR, Zottola V, Dodman NH (2022) An investigation into the effectiveness of various professionals and behavior modification programs, with or without medication, for the treatment of canine fears. *Journal of Veterinary Behavior* 55–56:1-6.
- Dinwoodie IR, Zottola V, Kubitz K et al (2022) Selection factors influencing eventual owner satisfaction about pet dog adoption. *Animals* 12(17), 2264.
- Estevam MV, Beretta S, Smargiassi NF et al (2022) Congenital malformations in brachycephalic dogs: A retrospective study. *Frontiers in Veterinary Science* 9, 981923.
- Kinsman RH, Owczarczak-Garstecka SC, Casey RA et al (2022) Introducing a puppy to existing household. *Animals* 12(18), 2389.

- Minnis LE, Davis DB, Loftis KE (2022) Decision factors considered by potential dog adopters during shelter visitation. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2141574.
- Morrow L, Belshaw Z (2022) Is cannabidiol an effective supplementary treatment for reducing pain in dogs with osteoarthritis? *Veterinary Record* 191:420-421.
- Naughton V, Grzelak T, Mulhern MS et al (2022) Association between socio-demographic factors and owners' beliefs and attitudes to pet cats fundamental dietary and physical exercise needs, in City of Belfast *Animals* 12(19), 2645.
- Romaniuk AC, Barnard S, Weller JE et al (2022) Welfare throughout the peri-parturient period in commercial breeding kennels. *Animals* 12, 2820.
- Stephens-Lewis D, Johnson A, Turley N et al (2022) Understanding canine 'reactivity': Species-specific behaviour or human inconvenience? *Journal of Applied Animal Welfare Science* doi: 10.1080/10888705.2147007.
- Stolzlechner L, Bonorand A, Riemer S (2022) Optimising puppy socialisation – Short- and long-term effects of a training programme during the early socialisation period. *Animals* 12(22), 3067.
- 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* 191(10), 1627.

FARM ANIMALS

Aquaculture

- Madaro A, Kjølglum S, Hansen T et al (2022) A comparison of triploid and diploid Atlantic salmon (*Salmo salar*) performance and welfare under commercial farming conditions in Norway. *Journal of Applied Aquaculture* doi:10.1080/10888705.2152689.
- Moltumyr L, Stien LH, Madaro A et al (2022) Increasing dip net mesh size results in more fin splits in post-smolt Atlantic salmon. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2152689.
- Torgerson-White L, Sánchez-Suárez W (2022) Looking beyond the shoal: Fish welfare as an individual attribute. *Animals* 12(19), 2592.
- Zitti M, Guttormsen AG (2022) Climate risk and financial disclosure in salmon aquaculture. *Aquaculture Economics & Management* doi:10.1080/13657305.2143934.

Cattle

- Adler F, Campe A (2022) Large-scale assessment of German dairy farmers' personality and resulting ideas for improving veterinary consultancy. *PLoS One* 17(11), 0277219.

- Anzai H, Sakurai H (2022) Preliminary study on the application of robotic herding to manipulation of grazing distribution: Behavioral response of cattle to herding by an unmanned vehicle and its manipulation performance. *Applied Animal Behaviour Science* 256, 105751.
- Bisschop PIH, Santman-Berends IMGA, Nijhoving GH et al (2022) Longevity and the association with cattle health in Dutch dairy farms. *Preventive Veterinary Medicine* 210, 105797.
- Burkhardt FK, Hayer JJ, Heinemann C et al (2022) Drinking behavior of dairy cows under commercial farm conditions differs depending on water trough design and cleanliness. *Applied Animal Behaviour Science* 256, 105752.
- Canozzi ME, Clariget J, Roig, G et al (2022) Shade effect on behaviour, physiology, performance, and carcass weight of heat-stressed feedlot steers in humid subtropical area. *Animal Production Science* 62(17):1692-1705.
- Carmickle AT, Larson CC, Hernandez FS et al (2022) Physiological responses of Holstein calves and heifers carrying the SLICK1 allele to heat stress in California and Florida dairy farms. *Journal of Dairy Science* 105(11):9216-9225.
- Carter HSM, Steele MA, Costa JHC et al (2022) Evaluating the effectiveness of colostrum as a therapy for diarrhea in preweaned calves. *Journal of Dairy Science* 105(12):9982-9994.
- Dachrodt L, Bartel A, Arndt H et al (2022) Benchmarking calf health: Assessment tools for dairy herd health consultancy based on reference values from 730 German dairies with respect to seasonal, farm type, and herd size effects. *Frontiers in Veterinary Science* doi:10.3389/fvets.990798.
- Frondelius L, Van Weyenberg S, Lindeberg H et al (2022) Spatial behaviour of dairy cows is affected by lameness. *Applied Animal Behaviour Science* 256, 105763.
- Grinter LN, Mazon G, Costa JHC (2023) Voluntary heat stress abatement system for dairy cows: Does it mitigate the effects of heat stress on physiology and behavior? *Journal of Dairy Science* 106(1):519-533.
- Gündel S, Looft C, Foldager L et al (2022) Effect of lameness on feeding behavior of zero grazed Jersey dairy cows. *Frontiers in Veterinary Science* 9,980238.
- Hernandez A, Trindade PHE, Da Costa MJRP et al (2022) Limited effects of pain control treatments on behaviour and weight gain of pure and crossbred Nellore heifer calves when subjected to hot-iron branding. *Animals* 12(22), 3143.
- Iqbal MW, Draganova I, Morel PCH et al (2022) Factors affecting grazing and rumination behaviours of dairy cows in a pasture-based system in New Zealand. *Animals* 12(23), 3323.

- Keeling LJ, Winckler C, Hintze et al (2022) Towards a positive welfare protocol for cattle: A critical review of indicators and suggestion of how we might proceed. *Frontiers in Animal Science* doi:10.3389/fanim.753080.
- Lardy R, Mialon M-M, Wagner N et al (2022) Understanding anomalies in animal behaviour: Data on cow activity in relation to health and welfare. *Animal - Open Space* 1(1), 100004.
- Lean IJ, Golder HN, LeBlanc SJ et al (2023) Increased parity is negatively associated with survival and reproduction in different production systems. *Journal of Dairy Science* 106(1):476-499.
- Lean IJ, LeBlanc SJ, Sheedy DB et al (2023) Associations of parity with health disorders and blood metabolite concentrations in Holstein cows in different production systems. *Journal of Dairy Science* 106(1):500-518.
- Lecorps B, Woodroffe RE, Von Keyserlingk MAG et al (2022) Assessing cognitive performance in dairy calves using a modified hole-board test. *Animal Cognition* 25:1365-1370.
- Lindena T, Hess S (2022) Is animal welfare better on smaller dairy farms? Evidence from 3,085 dairy farms in Germany. *Journal of Dairy Science* 105(11):8924-8945.
- Martin M, Kleinhenz MD, Schwartzkopf-Genswein KS et al (2022) Characterizing the diagnostic sensitivity and specificity of pain biomarkers in cattle using receiver operating characteristic curves. *Journal of Dairy Science* 105(12):9853-9868.
- Mason WA, Cuttance EL, Müller KR et al (2022) Graduate Student Literature Review: A systematic review on the associations between nonsteroidal anti-inflammatory drug use at the time of diagnosis and treatment of claw horn lameness in dairy cattle and lameness scores, algometer readings, and lying times. *Journal of Dairy Science* 105(11):9021-9037.
- Nawroth C, Rørvangb MV (2022) Opportunities (and challenges) in dairy cattle cognition research: A key area needed to design future high welfare housing systems. *Applied Animal Behaviour Science* 255,105727.
- Pardodi A, Valencia-Salazar S, Loboguerrero et al (2022) The sustainable transformation of the Colombian cattle sector: Assessing its circularity. *PLOS Climate* doi:10.1371/journal.0000074.
- Pinedo PJ, Manríquez D, Ciarletta C, Azocar J et al (2022) Association between body condition score fluctuations and pregnancy loss in Holstein cows. *Journal of Animal Science* doi:10.1093/jas/skac266.
- Sadiq MB, Ramanoon SZ, Mossadeq WMS et al (2022) Treatment protocols for claw horn lesions and their impact on lameness recovery, pain sensitivity, and lesion severity in moderately lame primiparous dairy cows. *Frontiers in Veterinary Science* doi:10.3389/fvets.1060520
- Schanza L, Hintze S, Hübner S et al (2022) Single- and multi-species groups: A descriptive study of cattle and broiler behaviour on pasture. *Applied Animal Behaviour Science* 257, 105779.
- Shi R, Shu H, Yu R et al (2022) Current attitudes of Chinese dairy practitioners to pain and its management in intensively raised dairy cattle. *Animals* 12(22), 3140.
- Sonne C, Alstrup AKO, Pertoldi C, et al (2022) Cortisol in manure from cattle enclosed with Nofence virtual fencing. *Animals* 12(21), 3017.
- Stokes JE, Rowe E, Mullan S et al (2022) A "good life" for dairy cattle: Developing and piloting a framework for assessing positive welfare opportunities based on scientific evidence and farmer expertise. *Animals* 12(19), 2540.
- Van Knegsel ATM, Burgers EEA, Ma J et al (2022) Extending lactation length: Consequences for cow, calf, and farmer. *Journal of Animal Science* doi:10.1093/skac220.
- Vicic V, Saliba AJ, Campbell MS et al (2022) Producer practices and attitudes: Non-replacement male calf management in the Australian dairy industry. *Frontiers in Animal Science* 9, 979035.
- Wilson DJ, Pempek JA, Cheng T-Y et al (2023) A survey of male and female dairy calf care practices and opportunities for change. *Journal of Dairy Science* 106(1):703-717.
- Zablotski Y, Knubben-Schweizer G, Hoedemaker M et al (2022) Non-linear change in body condition score over lifetime is associated with breed in dairy cows in Germany. *Veterinary and Animal Science* 18, 100275.
- ### Pigs
- Alghamdi S, Zhao Z, Ha DS et al (2022) Improved pig behavior analysis by optimizing window sizes for individual behaviors on acceleration and angular velocity data. *Journal of Animal Science* doi:10.1093/jas/skac293.
- Archer C, Garcia A, Henderson M et al (2022) Olfactory enrichment using a maternal pheromone improved post-weaning pig performance and behavior. *Frontiers in Veterinary Science* doi:10.3389/fvets.965370.
- Bagaria M, Kuiper L, Meijer E et al (2022) Individual behavioral correlates of tail biting in pre-finishing piglets. *Frontiers in Veterinary Science* doi:10.3389/fvets.1033463.
- Baude BM, Krugmann K, Diers S et al (2022) Short-term fixation of sows in farrowing pens using different opening procedures. *Livestock Science* 264, 105051.
- Baxter EM, McKeegan DEF, Farish M et al (2022) Characterizing candidate decompression rates for hypobaric hypoxic stunning of pigs. Part 2: Pathological consequences. *Frontiers in Veterinary Science* doi:10.3389/fvets.1027883.
- Chidgey KL, Udomteerasawat N, Morel PCH et al (2022) Animal welfare compromises associated with causes of death in neonatal piglets. *Animals* 12(21), 2933.
- Chou JY, Marchant JN, Nalon E et al (2022) Investigating risk factors behind piglet facial and sow teat lesions through a literature review and a survey on teeth reduction. *Frontiers in Veterinary Science* doi:10.3389/fvets.909401.
- Coutant M, Malmkvist J, Kaiser M et al (2022) Piglets' acute responses to local anesthetic injection and surgical castration: Effects of the injection method and interval between injection and castration. *Frontiers in Veterinary Science* doi:3389/fvets.1009858.
- Gómez-Prado J, Pereira AMF, Wang D et al (2022) Thermoregulation mechanisms and perspectives for validating thermal windows in pigs with hypothermia and hyperthermia: An overview. *Frontiers in Veterinary Science* doi:10.3389/fvets.1023294.
- Lanthony M, Danglot M, Špinká M et al (2022) Dominance hierarchy in groups of pregnant sows: Characteristics and identification of related indicators. *Applied Animal Behaviour Science* 254, 105683.
- Larsen MLV, Pedersen LJ (2022) Use of drinkers by finisher pigs depend on drinker location, pig age, time of day, stocking density and tail damage. *Frontiers in Veterinary Science* doi:10.3389/fvets.1029803.
- Liang Y, Cheng Y, Xu Y et al (2022) Consumer preferences for animal welfare in China: Optimization of pork production-marketing chains. *Animals* 12(21), 3051.
- Liu T, Ning K, Liu Z et al (2022) New insights into factors affecting piglet crushing and anti-crushing techniques. *Livestock Science* 265, 105080.
- Makridis G, Heyrman E, Kotiosc D et al (2022) Evaluating machine learning techniques to define the factors related to boar taint. *Livestock Science* 264, 105045.
- Manteuffela C, Puppeab B, Hartwigc T et al (2022) Learning, health, and productivity of group-housed sows conditioned to signal-feeding under realistic husbandry conditions. *Livestock Science* 266, 105111.
- McAuley M, Buijs S, Muns R et al (2022) Effect of reduced dietary protein level on finishing pigs' harmful social behaviour before and after an abrupt dietary change. *Applied Animal Behaviour Science* 256, 105762.
- Nastasijevic I, Glisic M, Milijasevic M et al (2022) Biosecurity and lairage time versus pork meat quality traits in a farm-abattoir continuum. *Animals* 12(23), 3382.
- Schale P, Schmitt AO, Dänicke S et al (2022) Does the implementation of an animal welfare programme on a farm yield a demonstrable improvement in fattening pig welfare? *Animals* 12(23), 3337.
- Söbbeler FJ, Wendt S, Briesa A et al (2022) Comparative study of pain-related responses of male piglets up to seven days of age to the application of different local anaesthetics and subsequent castration. *Animals* 12(20), 2833
- Staveley LM, Zemitis JE, Plush KJ et al (2022) Infrared thermography for early identification and treatment of shoulder sores to improve sow and piglet welfare. *Animals* 12(22), 3136.
- Tu S, Zeng Q, Liang Y et al (2022) Automated behavior recognition and tracking of group-housed pigs with an improved deepsort method. *Agriculture* 12(11), 1907.
- Vargovic L, Athorn RZ, Hermesesch S et al (2022) Improving sow welfare and outcomes in the farrowing house by identifying early indicators from pre-farrowing assessment. *Journal of Animal Science* doi:10.1093/jas/skac294.
- Walls A, Hatze B, Lomax S et al (2022) Defining "normal" in pig parturition. *Animals* 12(20), 2754.

Poultry

Brink M, Janssens GPJ, Delezie E (2022) Does feeding more phases reduce ammonia concentrations from broiler litter? *Animal Nutrition* 11:152–159.

Brink M, Janssens GPJ, Delezie E (2022). How do moisture content, friability, and crust development of litter influence ammonia concentrations in broiler production? *Livestock Science* 265, 105109.

Brink M, Janssens GPJ, Demeyer P et al (2022) Ammonia concentrations, litter quality, performance and some welfare parameters of broilers kept on different bedding materials. *British Poultry Science* doi:10.1080/00071668.2106775.

Brunet H, Creach P, Concorde D (2023) Optimal estimation of broiler movement for commercial tracking. *Smart Agricultural Technology* 3, 100113.

Caravaca FP, Camacho-Pinto T, González-Redondo P (2022) The quail game farming sector in Spain. *Animals* 12(22), 3118.

Carney V L, Anthony NB, Robinson F E et al (2022) Evolution of maternal feed restriction practices over 60 years of selection for broiler productivity. *Poultry Science* 101(10), 101957.

Castro FLS, Chai L, Arango J et al (2023) Poultry industry paradigms: Connecting the dots. *Journal of Applied Poultry Research* doi:10.1016/j.japr.100310.

De Luna MCT, Yang Q, Agus A et al (2022) Cage egg producers' perspectives on the adoption of cage-free systems in China, Japan, Indonesia, Malaysia, Philippines, and Thailand. *Frontiers in Veterinary Science* 9, 1038362.

Dumontier L, Janczak AM, Smulders TV et al (2022) Early life environment and adult enrichment: Effects on fearfulness in laying hens. *Applied Animal Behaviour Science* 256, 105750.

Greening S, Gates M (2022) Cross-sectional survey of barriers and opportunities for engaging backyard poultry producers and veterinarians in addressing poultry health. *New Zealand Veterinary Journal* 71(1):18-26.

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* 35(6):773-788.

Iyaseri OS, Olajumoke OP, Durosaro SO et al (2022) Nigerian indigenous hens show more discomfort-related behavior with visual separation than physical separation from their chicks: An exploratory study. *Frontiers in Veterinary Science* 9, 978848.

Jacobs L, Blatchford RA, De Jong IC et al (2023) Enhancing their quality of life: Environmental enrichment for poultry. *Poultry Science* 102(1), 102233.

Jarrett RA, Erasmus MA, Murillo AC et al (2022) Laying hen production and welfare in a cage-free setting is impacted by the northern fowl mite. *Journal of Applied Poultry Research* 31(4), 100290.

Leishman EM, Wood BJ, Baes CF et al (2022) The usual suspects: Co-occurrence of integument injuries in turkey flocks. *Poultry Science* 101(11), 102137.

Li DL, Wang JS, Liu LJ et al (2022) Effects of early post-hatch feeding on the growth performance, hormone secretion, intestinal morphology, and intestinal microbiota structure in broilers. *Poultry Science* 101(11), 102133.

Lima HJD, Morais MVM, Pereira IDB (2022) Updates in research on quail nutrition and feeding: A review. *World's Poultry Science Journal* doi:10.1080/00439339.2150926.

Lopez R, Weimer SL, Balderama ES et al (2022) Evaluation of platform enrichments in a commercial broiler house. *Journal of Applied Poultry Research* 31(4), 100294.

Mace JL, Knight A (2022) The impacts of colony cages on the welfare of chickens farmed for meat. *Animals* 12(21), 2988.

Malchow J, Eusemann BK, Petow S et al (2022) Productive performance, perching behavior, keel bone and other health aspects in dual-purpose compared to conventional laying hens. *Poultry Science* 101(11), 102095.

Mostert PF, Bos AP, Van Harn J et al (2022) The impact of changing toward higher welfare broiler production systems on greenhouse gas emissions: A Dutch case study using life cycle assessment. *Poultry Science* 101(12), 102151.

Oladokun S, Adewole DI (2022) Biomarkers of heat stress and mechanism of heat stress response in avian species: Current insights and future perspectives from poultry science. *Journal of Thermal Biology* 110, 103332.

Olanrewaju HA, Purswell JL, Collier SD et al (2022) Age-related effects of feeder space availability on welfare of broilers reared to 56 days of age. Part 1: Biochemical, enzymatical, and electrolyte variables. *Journal of Applied Poultry Research* 31(3), 100281.

Özkan S, Yalçın S, Bayraktar Ö et al (2022) Effects of incubation lighting with green or white light on brown layers: Hatching performance, feather pecking and hypothalamic expressions of genes related with photoreception, serotonin, and stress systems. *Poultry Science* 101(11), 102114.

Özlü S, Erkuş T, Kamanlı S et al (2022) Influence of the replacement holding time and feeding hydration supplementation before placement on yolk sac utilization, the crop filling rate, feeding behavior and first-week broiler performance. *Poultry Science* 101(10), 102056.

Remonato Franco BM, Shynkaruk T, Crowe T et al (2022) Light wavelength and its impact on broiler health. *Poultry Science* 101(12), 102178.

Rutkauskaitė A, Jensen P (2022) Domestication effects on social information transfer in chickens. *Animal Cognition* 25:1473–1478.

Rutt RL, Jakobsen J (2022) The “brother layer problem”: Routine killing, biotechnology and the pursuit of “ethical sustainability” in industrial poultry. *Environment and Planning E: Nature and Space* doi:10.1177/25148486221131195.

Schomburg H, Malchow J, Sanders O et al (2023) Elevated platforms with integrated weighing beams allow automatic monitoring of usage and activity in broiler chickens. *Smart Agricultural Technology* 3, 100095.

Schwarzer A, Erhard M, Schmidt P et al (2022) Effects of stocking rate and environmental enrichment on the ontogeny of pecking behavior of laying hen pullets confined in aviary compartments during the first 4 weeks of life. *Animals* 12(19), 2639.

Stratmann A, Ringgenberg N (2022) Use of different elevated structures by commercial fattening turkeys in Switzerland. *Journal of Applied Poultry Research* 32(1), 100304.

Struthers S, Buchynski K, Chew J et al (2022) Specialized beak blunting feeders and their potential as an alternative to current beak treatment methods in leghorn pullets. *Journal of Applied Poultry Research* 31(4), 100285.

Tonissen S, Tetel V, Fraley GS (2022) Transportation stress increases fos immunoreactivity in the paraventricular nucleus, but not in the nucleus of the hippocampal commissure in the Pekin duck, *Anas platyrhynchos domesticus*. *Animals* 12(22), 3213.

Van der Eijk JA, Guzha O, Voss A et al (2022) Seeing is caring – Automated assessment of resource use of broilers with computer vision techniques. *Frontiers in Veterinary Science* doi:10.3389/fanim.945534

Van der Sluis M, Asher L, Bas Rodenburg T et al (2022) Early locomotor activity in broilers and the relationship with body weight gain. *Poultry Science* 101(10), 102086.

Wegner M, Kokoszynski D, Biegowska M (2022) Effect of litter system and nest box type on egg production and performance of Ross 308 broiler breeders. *Animal Production Science* 62, 1600.

Wilson PW, Dunn IC, McCormack HA (2022) Development of an in vivo radiographic method with potential for use in improving bone quality and the welfare of laying hens through genetic selection. *British Poultry Science* doi:10.1080/00071668.2119835.

Witjes VL, Bruckmaier RM, Gebhardt-Henrich SG et al (2022) Effects of on-farm hatching on short term stress indicators, weight gain, and cognitive ability in layer chicks. *Applied Animal Behaviour Science* 254, 105692.

Wurtz KE, Thodberg K, Berenjian A et al (2022) Commercial layer hybrids kept under organic conditions: a comparison of range use, welfare, and egg production in two layer strains. *Poultry Science* 101(9), 102005.

Xu D, Shu G, Liu Y et al (2022) Farm environmental enrichments improve the welfare of layer chicks and pullets: A comprehensive review. *Animals* 12(19), 2610.

Rabbits

Bozzo G, Dimuccio MM, Casalino G et al (2022) Preliminary evidence regarding the detection of cortisol and IL-6 to assess animal welfare in various rabbit housing systems. *Agriculture* 12(10), 1622.

Sheep/Goats

Berthel R, Simmler M, Dohme-Meier F et al (2022) Dairy sheep and goats prefer the single components over the mixed ration. *Frontiers in Veterinary Science* doi:10.3389/fvets.1017669.

Cellier M, Nielsen BL, Duvaux-Ponter C et al (2022) Browse or browsing: Investigating goat preferences for feeding posture, feeding height and feed type. *Frontiers in Veterinary Science* doi:10.3389/fvets.1032631.

Chesterton RN, Chesterton SJ, Laven RA (2022) Lesions found at foot trimming of dairy goats: Baseline data for comparing lesions and locomotion scoring. *The Veterinary Journal* 290, 105927.

Duffrene J, Petit O, Thierry B et al (2022) Both sheep and goats can solve inferential by exclusion tasks. *Animal Cognition* 25:1631–1644.

Eftang S, Vas J, Holand O et al (2022) Goats are able to adapt to virtual fencing: A field study in commercial goat herds on Norwegian farms. *Applied Animal Behaviour Science* 256, 105755.

Kampherbeek EW, Webb LE, Reynolds BJ et al (2022) A preliminary investigation of the effect of solar panels and rotation frequency on the grazing behavior of sheep (*Ovis aries*) grazing dormant pasture. *Applied Animal Behaviour Science* 258, 105799.

Kleanthous N, Hussain A, Sneddon J et al (2022) Towards a virtual fencing system: Training domestic sheep using audio stimuli. *Animals* 12(21), 2920.

Kongara K, Corner-Thomas R, Bruere S et al (2022) Practices and opinions of New Zealand sheep farmers towards pain management in lambs during castration and/or tail docking. *New Zealand Veterinary Journal* 71(1):8-17.

Marcone G, Carnovale F, Arney D et al (2022) Relevance of animal-based indicators for the evaluation of sheep welfare as perceived by different stakeholders. *Small Ruminant Research* 217, 106827.

Mayes BT, Tait LA, Cowley FC et al (2022) Stocking density, restricted trough space, and implications for sheep behaviour and biological functioning. *Frontiers in Veterinary Science* doi:10.3389/fvets.965635.

Mersmann D, Schmied-Wagner C, Waiblinger S (2022) The relationships between attitudes, personal characteristics and behaviour of stockpeople on dairy goat farms. *Animal Welfare* 31(4):529-544.

Muhammad M, Stokes JE, Manning L (2022) Positive aspects of welfare in sheep: Current debates and future opportunities. *Animals* 12(23), 3265.

Turini L, Bonelli F, Lanatà A et al (2022) Validation of a new smart textiles biotechnology for heart rate variability monitoring in sheep. *Frontiers in Veterinary Science* doi:10.3389/fvets.1018213.

General (farm animals)

Durosaro SO, Iyasere OS, Ilori BM et al (2023) Molecular regulation, breed differences and genes involved in stress control in farm animals. *Domestic Animal Endocrinology* 82, 106769.

Fischer-Tenhagen C, Meier J, Pohl A (2022) “Do not look at me like that”: Is the facial expression score reliable and accurate to evaluate pain in large domestic animals? A systematic review. *Frontiers in Veterinary Science* doi:10.3389/fvets.1002681.

Gliessman S (2022) Smaller farms or factory farms? An agroecological perspective. *Agroecology and Sustainable Food Systems* 46(10):1443-1444.

Grandin T (2022) Practical application of the Five Domains animal welfare framework for supply food animal chain managers. *Animals* 12(20), 2831.

Lee K, Pereira RV, Martínez-López B et al (2022) Assessment of the knowledge and behavior of backyard and small-scale producers in California regarding disease prevention, biosecurity practices and antibiotics use. *PLOS ONE* doi:10.1371/journal.pone.0277897.

Mata F, Araujo J, Soares L et al (2022) Local people standings on existing farm animal welfare legislation in the BRIC countries and the USA. Comparison with Western European legislation. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2141577.

Mata F, Jaeger B, Domingues I (2022) Perceptions of farm animal sentience and suffering: Evidence from the BRIC countries and the United States. *Animals* 12(23), 3416.

Michaelis S, Schubbert A, Gieseke D et al (2022) A comparison of online and live training of livestock farmers for an on-farm self-assessment of animal welfare. *Frontiers in Animal Science* 3, 915708.

Rivero MJ, Lee MRF (2022) A perspective on animal welfare of grazing ruminants and its relationship with sustainability. *Animal Production Science* 62(18):1739–1748.

Schanz L, Hintze S, Hübner S et al (2022) Single- and multi-species groups: A descriptive study of cattle and broiler behaviour on pasture. *Applied Animal Behaviour Science* 257, 105779.

Spitzer H, Meagher RK, Proudfoot KL (2022) The impact of providing hiding spaces to farmed animals: A scoping review. *PLOS ONE* doi:10.1371/journal.pone.0277665.

Wijerathna-Yapa A, Pathirana R (2022) Sustainable agro-food systems for addressing climate change and food security. *Agriculture* 12(10), 1554.

ANIMALS IN SPORT, ENTERTAINMENT, PERFORMANCE, RECREATION AND WORK

Furtado T, Perkins E, Pinchbeck G et al (2022) Exploring human behavior change in equine welfare: Insights from a COM-B analysis of the UK's equine obesity epidemic. *Frontiers in Veterinary Science* doi:10.3389/fvets.961537.

Hodgson S, Bennet-Skinner P, Lancaster B et al (2022) Posture and pull pressure by horses when eating hay or haylage from a hay net hung at various positions. *Animals* 12 (21), 2999.

Legg KA, Bolwell CF, Gee EK et al (2022) Risk factors for horse falls in New Zealand Thoroughbred jumps racing. *The Veterinary Journal* 289, 105915.

Lo Feudo CH, Sutccchi L, Conturba B et al (2022) Equine Gastric Ulcer Syndrome affects fitness parameters in poorly performing Standardbred racehorses. *Frontiers in Veterinary Science* doi:10.3389/fvets.1014619.

Mota-Rojas D, Mariti C, Marcet-Rius M et al (2022) The welfare of fighting dogs: Wounds, neurobiology of pain, legal aspects and the potential role of the veterinary profession. *Animals* 12, 2257.

Rowland M, Hudson N, Connor M et al (2022) The welfare of traveller and gypsy owned horses in the UK and Ireland. *Animals* 12(18), 2402.

Ruet A, Arnould C, Lemarchand J et al (2022) A joint assessment of four categories of behavioural indicators using the AWIN protocol, scan sampling and surveys. *Animal Welfare* 31(4):455-466.

ANIMALS IN RESEARCH AND TEACHING

Dalix E, Maalouf M, Linossier M-T et al (2022) Improvement of pain management by Nefopam in a rat adjuvant-induced arthritis model. *Frontiers in Veterinary Science* 9, 809980.

De Franca SM, De Menezes GAC, Silva FS et al (2022) Welfare improvement by enrichment programs in Common Marmoset females under social isolation. *Journal of Applied Animal Welfare Science* 25(3):297-309.

Del Pace L, Viviani L, Straccia M (2022) Researchers and their experimental models: A pilot survey in the context of the European Union health and life science research. *Animals* 12(20), 2778.

Mauri D, Bonelli S, Ozella L (2022) The “Second Life” of laboratory rats (*Rattus norvegicus*): Assessment of social behavior of a colony of rats based on social network analysis. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2132826.

Sanders K, Fernandez EJ (2022) Behavioral implications of enrichment for Golden Lion Tamarins: A tool for Ex Situ conservation. *Journal of Applied Animal Welfare Science* 25(3):214-223.

Truelove MA, Smith PO, Martin AL et al (2022) Predictors of long-term social compatibility in Rhesus Macaques (*Macaca mulatta*) housed in research settings. *Journal of Applied Animal Welfare Science* 25(4):418-426.

WILD ANIMALS

Bigiani S, Pilenga C (2022) A fast technique to induce and measure anticipatory behavior in bottlenose dolphins (*Tursiops truncatus*). *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2063019.

Bruck JN, Pack AA (2022) Understanding across the senses: Cross modal studies of cognition in cetaceans. *Animal Cognition* 25:1059-1075.

Ghavamian Y, Minier DE, Jaffe K (2022) Effects of complex feeding enrichment on the behavior of captive Malayan sun bears (*Helarctos malayanus*). *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2023874.

Hanke FD, Biolsi K, Harley HE (2022) Cognition in marine mammals: The strength of flexibility in adapting to marine life. *Animal Cognition* 25:1015-1018.

Kamaluddin SN, Matsuda I, Md-Zain BM (2022) Activity budget and postural behaviors in orangutans on Bukit Merah Orang Utan Island for assessing captive great ape welfare. *Journal of Applied Animal Welfare Science* 25(3):244-255.

Mátrai E, Gendron SM, Boos M (2022) Cognitive group testing promotes affiliative behaviors in dolphins. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2149267.

Ramis F, Mohr M, Kohn G et al (2022) Spatial design of guest feeding programs and their effects on giraffe participation and social interactions. *Journal of Applied Animal Welfare Science* 25(3):224-243.

Riedman K, Cunningham G, DiVicenti L (2022) Does accreditation by the Association of Zoos and Aquariums correlate with animal welfare act compliance? *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2028150.

Smith LE, Rowe C, Mackay F et al (2022) Aquarium tank design is integral to the elimination of mantle abrasion in the captive curled octopus (*Eledone cirrhosa*): A case study at Macduff Marine Aquarium. *Journal of Applied Animal Welfare Science* 25(4):355-361.

Spirit M, Melchiori F, Diekes P et al (2022) Development of a tool for assessing the reputation of zoos: The Zoo Ethical Reputation Survey (ZERS). *Animals* 12(20), 2802.

Wood LD (2022) Managing long term wellness in captive sea turtles. *Animal Welfare* 831:423-432.

TRANSPORTATION OF ANIMALS

EFSA Panel on Biological Hazards (2022) Scientific opinion on the transmission of antimicrobial resistance (AMR) during animal transport. *EFSA Journal* 20(10), 7586.

Golightly HR, Brown J, Bergeron R et al (2022) Impact of two commercial weaning and transport strategies on piglet behaviour, body weight change, lesions and lameness following transport. *Applied Animal Behaviour Science* 257, 105775.

Hultgren J, Segerkvista KA, Berg C et al (2022) Preslaughter stress and beef quality in relation to slaughter transport of cattle. *Livestock Science* 264, 105073.

Marti E, Nannoni E, Visentin G et al (2022) Mortality during transport of pigs subjected to long journeys: A study in a large European abattoir. *Veterinary Science* 9(11), 590.

Meléndez DM, Marti S, Haley DB et al (2022) Effect of rest, post-rest transport duration, and conditioning on performance, behaviour, and physiological welfare indicators of beef calves. *PLOS ONE* doi:10.1371/journal.pone.0278768.

Nielsen SS, Alvarez J, Bicoût DJ et al (2022) Welfare of domestic birds and rabbits transported in containers. *EFSA Journal* 20(9), e07441.

Nordquist RE, Vernooij JCM, Dull CL et al (2022) The effects of transport of 18-day old hatching eggs on physiology and behaviour of slow growing broiler chicken. *Applied Animal Behaviour Science* 257, 105789.

Phillips CJC (2022) Zoonotic disease risks of live export of cattle and sheep, with a focus on Australian shipments to Asia and the Middle East. *Animals* 12(23), 3425.

Viola OS, Obertino I, Manenti M et al (2022) Using sensors to detect individual responses of lambs during transport and pre-slaughter handling and their relationship with meat quality. *Animal Welfare* 31(4):505-516.

HUMANE KILLING

Albalat A, Gornik SG, Muangnapoh C et al (2022) Effectiveness and quality evaluation of electrical stunning versus chilling in Norway lobsters (*Nephrops norvegicus*). *Food Control* 138, 108930.

Baxter EM, McKeegan DEF, Farish M et al (2022) Characterizing candidate decompression rates for hypobaric hypoxic stunning of pigs. Part 2: Pathological consequences. *Frontiers in Veterinary Science* 9, 1027883.

Bouwsema JA, Ellis MA, Lines JA et al (2022) In-water electric stunning as a humane commercial method for culling juvenile salmonids. *Aquacultural Engineering* 99, 102286.

Bussolari C, Packman W, Currin-McCulloch J et al (2022) Mass depopulation of swine during COVID-19: An exploration of swine veterinarians' perspectives. *Veterinary Science* 9(10), 563.

Fuseini A (2022) Isolation a slaughter stressor in sheep. *Veterinary Record* 191(5), 220.

Gascho D, Stephan R, Bauer C et al (2022) Assessment of a newly designed double-barreled bullet-shooting stunner for adequate stunning of water buffaloes. *Meat Science* 193, 108933.

Hamad B, Hadeif L, Aggad H et al (2022) Stress responses in camels subjected to different rest periods (0 and 12 h) at slaughterhouse. *Acta Tropica* 234, 106612.

Isbrandt R, Wiegard M, Meemken D et al (2022) Impact of procedures and human-animal interactions during transport and slaughter on animal welfare of pigs: A systematic literature review. *Animals* 12(23), 3391.

Junghans A, Deseniß L, Louton H (2022) Data evaluation of broiler chicken rearing and slaughter—An exploratory study. *Frontiers in Veterinary Science* 9, 957786.

Kumar P, Abubakar AA, Ahmed MA et al (2023) Pre-slaughter stress mitigation in goats: Prospects and challenges. *Meat Science* 195, 109010.

Kumar P, Abubakar AA, Sazili AO et al (2022) Application of electroencephalography in preslaughter management: A review. *Animals* 12(20), 2857.

Li W, Yan C, Descovich K et al (2022) The effects of preslaughter electrical stunning on serum cortisol and meat quality parameters of a slow-growing Chinese chicken breed. *Animals* 12(20), 2866.

McDermott P, McKeivitt A, Santos FH et al (2022) Management of acutely injured cattle by on farm emergency slaughter: Survey of veterinarian views. *Frontiers in Veterinary Science* doi:10.3389/fvets.976595.

Pastrana-Camacho AP, Estévez-Moreno L X, Miranda-de la Lama GC (2023) What slaughterhouse workers' attitudes and knowledge reveal about human-pig relationships during pre-slaughter operations: A profile-based approach. *Meat Science* 195, 109017.

Skúladóttir G, Hunter-Holmøy I, Phythian CJ et al (2022) Occurrence and reasons for on-farm emergency slaughter of cattle in Norway. *Frontiers in Veterinary Science* doi:10.3389/fvets.1067489.

Sundermann T, Bibbal D, Holleville N et al (2023) Moving from routine to risk-based official controls in slaughterhouses: Development of a scoring tool for the risk of non-compliance with animal welfare regulations. *Food Control* 143, 109321.

Tetlow SAJ, Brennan ML, Garcia-Ara A (2022) Welfare indicators for stunning versus non-stunning slaughter in sheep and cattle: A scoping review. *Veterinary Record* doi:10.1002/vetr.1739.

MISCELLANEOUS

Chan MCH, Schonert-Reichl KA, Binfet JT (2022) Human-animal interactions and the promotion of social and emotional competencies: A scoping review. *Anthrozoös* 35(5):647-692.

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. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2047681.

Erasmus M, Rollins J (2022) Visitors' self-reported knowledge and attitudes about an animal-free exhibit on animal welfare. *Journal of Applied Animal Welfare Science* 25(4):382-395

Franceschini MM (2022) Traditional conceptions of the legal person and nonhuman animals. *Animals* 12(19), 2590.

Gallo C, Vêjar L, Galindo F et al (2022) Animal welfare in Latin America: Trends and characteristics of scientific publications. *Frontiers in Veterinary Science* 9, 1030454.

Langbein J, Nawroth C (2022) Editorial: Captive animal behavior: Individual differences in learning and cognition, and implications on animal welfare. *Frontiers in Veterinary Science* 9, 1102122.

Lemma M, Doyle R, Alemayehu G et al (2022) Using Community Conversations to explore animal welfare perceptions and practices of rural households in Ethiopia. *Frontiers in Veterinary Science* 9, 980192.

Morton R, Hebart ML, Ankeny RA et al (2022) Portraying animal cruelty: A thematic analysis of Australian news media reports on penalties for animal cruelty. *Animals* 12(21), 2918.

Nejad JG, Ghaffari MH, Ataollahi M et al (2022) Stress concepts and applications in various matrices with a focus on hair cortisol and analytical methods. *Animals* 12(22), 3096.

Podturkin AA, Krebs BL, Watters JV (2022) A quantitative approach for using anticipatory behavior as a graded welfare assessment. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2012783.

Racciatti DS, Feld A, Rial LA et al (2022) Ackonc-AWA: A multi-species animal welfare assessment protocol for wild animals under human care to overcome the use of generic welfare checklists. *Frontiers in Veterinary Science* 9, 1033821.

Tatemoto P, Broom DM, Zanella AJ (2022) Changes in stereotypies: Effects over time and over generations. *Animals* 12(19), 2504.

Wahlteiz SJ, Stacy NI, Hadfield CA et al (2022) Perspective: Opportunities for advancing aquatic invertebrate welfare. *Frontiers in Veterinary Science* doi:10.3389/fvets.973376.

Zidenberg AM, Sparks B, Olver M (2022) A survey of veterinary medical professionals' knowledge, attitudes, and experiences with animal sexual abuse. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2131430.