



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.

COMPANION ANIMALS

Containment systems keep cats safe and well

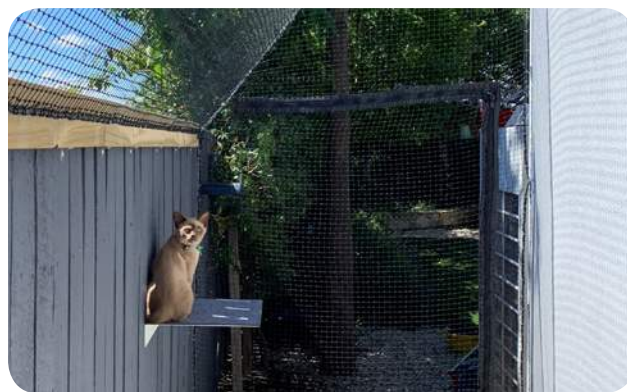
Allowing cats to roam has animal health and welfare consequences. Free-roaming cats are at risk of infectious disease, injury, theft and being hit by cars. Free-roaming cats also pose a threat to wild animals. Cat containment systems aim to keep cats confined to their owners' property, thus allowing outdoor access without the risks associated with roaming.

This study is the first to investigate how physical containment systems affect cat welfare. The authors surveyed cat owners in the United Kingdom (n=443) who purchased a ProtectaPet® cat containment system (e.g., cat fence, enclosure, catio). Survey questions covered cat and owner demographics, how cats were kept, and perceptions about the cats' health and behaviour. Prior to installing the containment system, 30.9% of the cats did not have outdoor access, 47.6% had restricted and/or supervised outdoor access, and 21.5% roamed freely.

After installing the cat containment system, 78.3% of owners reported that their cat had greater outdoor access. Cat containment systems allowed cats to spend significantly more time outdoors (before = median 1 to 2 hours, after = median 3 to 7 hours). Approximately a quarter of owners reported improvements in cat health

and behaviour (e.g., reduced soiling in the home, less anxious, fewer episodes of unexplained irritability, increased active relaxed behaviour). Owners, many of whom (56.4%) had previous cats hit by cars, were significantly less concerned about allowing their cats access to the outdoors. Overall, these findings support the use of cat containment systems to benefit cat welfare as well as owner peace of mind.

de Assis LS, Mills DS (2020) [Introducing a controlled outdoor environment impacts positively in cat welfare and owner concerns: The use of a new feline welfare assessment tool](#). *Frontiers in Veterinary Science* 7, 599284.



Monitoring daily weight gain aids management of kittens in foster care

Kittens who are orphaned, sick, injured and malnourished, are often presented to animal rescue organisations. They are vaccinated, wormed, fed and often transferred to foster care. Daily weight gain is a key metric to evaluate how kittens' respond to this care.

This study investigated daily weight gain in kittens less than nine weeks old presenting to a 'no-kill' shelter in the United States. The kittens (n=203) from 87 different litters were raised by 37 foster carers. Kitten weight was recorded daily. Factors that may influence weight gain were recorded, such as sex, age at admission, source of food (e.g., queen, formula, soft food), signs of disease (e.g., diarrhoea, upper respiratory tract infection, lethargy), neutering, and age at neutering. Mortalities were also recorded.

In kittens ≥ 35 days old at admission, the average rate of weight gain (19.2 g/day) was higher than previous studies (7 to 15 g/day). Factors affecting weight gain included sex, age at admission and

presence of lethargy. In kittens ≥ 35 days old at admission, females had a significantly lower rate of weight gain compared to males. Kittens ≥ 35 days old at admission had higher-than-average daily weight gain compared to kittens < 35 days old (13.2g/day). The presence of lethargy for more than a day was associated with lower-than-average weight gain. Neutering, age at neutering and source of nutrition did not affect weight gain. Five of the kittens died or were euthanased during the study. Four of the five deaths were associated with pneumonia. Three of the five deaths were associated with weight loss and the fourth showed minimal weight gain. While the animals and shelter in this study may not be representative of all kittens and shelters, the authors recommend monitoring daily weight gain to aid care provision and early intervention.

Berliner EA, Scarlett JM, Cowan AC et al (2022) A prospective study of growth rate, disease incidence, and mortality in kittens less than 9 weeks of age in shelter and foster care. *Journal of Applied Animal Welfare Science* doi: 10.1080/10888705.2021.2021409

Different people have different attitudes to dog welfare in kennel facilities

Dogs are often housed in kennel facilities (e.g., shelters, vet clinics, breeding establishments, racing and government service dogs). Kennel facilities commonly do not meet dogs' welfare needs. Improvements in kennel facilities require changes in people's perceptions about the welfare of kennelled dogs.

This study evaluated people's perceptions about the welfare of kennelled dogs. Participants (n =2036), mostly from Australia, the United Kingdom and United States, were recruited online. The majority of participants (76%) were dog owners. The majority of respondents (56%) had no experience working in kennels. Participants were asked questions to gauge their attitudes about dog health and welfare, enrichment, kennel design and management.

Attitudes to dog welfare in kennel facilities varied depending on experience, facility types, gender and age. Attitudes differed significantly between people

with experience versus people without experience working in kennels. For example, people who work in kennels were most supportive of statements about the general importance of dog welfare but least supportive of statements that suggested that kennelling compromises dog welfare. People with experience working in shelters were more likely to be supportive of enrichment compared to people who worked in commercial boarding, vet clinics or greyhound racing kennels. Female respondents and kennel employees under the age of 30 were more likely to support the importance of health and hygiene compared to male and older participants. The authors assert that these attitudes underlie care-giving behaviour and should to be considered in training, education, management and research relating to dogs in kennel facilities.

Cobb ML, Carter A, Lill A (2022) Perceived importance of specific kennel management practices for the provision of canine welfare. *Applied Animal Behaviour Science* 249, 105591.

More research needed to understand the effects of group size on cat welfare

Households often have more than one cat. Despite how commonly cats are kept in groups, few studies investigate the effects of group size on cat welfare.

This review analysed studies (n=15), conducted mainly in the United Kingdom, that compared welfare indicators (behavioural and/or physiological) between single and multiple-cat households. They included cross-sectional surveys (n=9), observational analytical cohort studies (n=4), and retrospective studies (n=2). Sample sizes varied from 74 to over 23,000 cats. Only four of the studies explicitly aimed to investigate the effects of group size on cat welfare. The majority of the studies considered group size as one of many categorical variables. Only one study specified the exact number of cats in each group.

The majority of papers analysed in this review indicated that group size affects cat welfare. However,

the results were mixed. Six of the 15 papers found evidence of poorer welfare outcomes with increasing numbers of cats in the home. Another six studies found the opposite. In some cases, findings indicated no significant link between group size and cat welfare. Differences in results likely reflect different methods, sample sizes, populations, and measures. The authors recommend large matched cohort studies to investigate the effects of group size on cat welfare. They recommend future studies account for confounders including space, resource distribution, sex, socialisation, relatedness and measures of how well the cats in the household get on with one another and with people.

Finka LR, Foreman-Worsley R (2022) [Are multi-cat homes more stressful? A critical review of the evidence associated with cat group size and wellbeing.](#) *Journal of Feline Medicine and Surgery* 24(2):65-76.



Do people realise that flat-faced dogs' breathing difficulties are a health and welfare problem?

Brachycephalic (flat-faced) dogs, such as pugs and bulldogs, suffer a range of health and welfare problems including breathing, birthing, skin and eye problems. Despite these problems, brachycephalic dogs are popular companion animals. To improve dog welfare, it is important that people are more aware of the health and welfare issues associated with how brachycephalic dogs are bred to look.

This study investigated whether an education intervention could improve people's understanding of brachycephalic breed-related health problems, particularly Brachycephalic Obstructive Airway Syndrome (BOAS). Respondents (n=587) were recruited on Facebook. The majority of respondents owned pedigree dogs (87.9%) and 18.2% of respondents owned brachycephalic dogs. The intervention consisted of an information sheet on BOAS and a video on the surgical management of BOAS. Before and after the intervention, respondents were asked a series of questions about brachycephalic breed-related health problems.

Almost all (99.7%) of the respondents thought the education intervention had improved their understanding of BOAS. After the intervention, fewer respondents perceived clinical signs of BOAS (e.g., loud-breathing, exercise intolerance, being easily overheated) as normal, and 77.5% of respondents would not recommend a brachycephalic dog to their friends and family. However, even after the education intervention, over 30% of respondents who had never owned a brachycephalic dog before would still consider owning one. Despite over a quarter (27.9%) of the brachycephalic dog owners perceiving their dogs to have breathing difficulties, the majority (70.7%) said that the intervention did not change their perception of brachycephalic breeds. Steadfast perceptions may reflect psychological conflict or cognitive dissonance. While this study demonstrated the potential of education to improve dog welfare, barriers remain to change people's behaviour and breed choices.

Kenny DD, Freemantle R, Jeffery A et al (2022) [Impact of an educational intervention on public perception of brachycephalic obstructive airway syndrome in brachycephalic dogs](#). Veterinary Record e1430.

French bulldogs have serious health and welfare issues associated with their extreme features

French bulldogs have grown in popularity over the past decade. Paradoxically, this growing popularity has occurred in parallel to increasing evidence of serious breed-related health and welfare problems

This cohort study compared the health of randomly selected French bulldogs (n = 2781) and non-French bulldogs (n= 21 850) presenting to veterinary clinics in the United Kingdom in 2016. The odds ratios of 43 specific common disorders and 32 grouped-level disorders (i.e., at a body system level) were calculated. As the French bulldog population was significantly younger than the non-French bulldog population, the analysis accounted for age as a confounder.

While French bulldogs had reduced adjusted odds of some problems such as undesirable behaviour and obesity, overall French bulldogs were found to be suffering severely compromised health. Analyses revealed that French bulldogs were predisposed to 20/43 specific common disorders and 12/32 of the grouped-level disorders. The predispositions to these health problems are associated with how French bulldogs are bred to look. For example, compared to non-French bulldogs, French bulldogs had 42.14

times the adjusted odds of narrowed nostrils, 30.89 times the adjusted odds of Brachycephalic Obstructive Airway Syndrome (BOAS), and 4.88 times the adjusted odds of upper respiratory tract infections. Other ultra-predispositions included: skin fold dermatitis (11.18 times the adjusted odds), difficulty giving birth (9.13 times the adjusted odds), and corneal ulceration (4.38 times the adjusted odds). Overall, the health of French bulldogs has diverged so dramatically from that of non-French bulldogs that the authors suggest that French bulldogs can no longer, in many respects, be considered as 'average' or 'typical' dogs. It is proposed that there must be a change in the way French bulldogs are bred so they have a more moderate phenotype to reduce the serious health and welfare issues in the breed.

O'Neill DG, Packer RM, Francis P et al (2021) [French Bulldogs differ to other dogs in the UK in propensity for many common disorders: A VetCompass study](#). Canine Medicine and Genetics 8, 13.

Challenging assumptions about shelter dogs' behaviour

It is often assumed that shelter dogs are more likely to have behavioural problems compared to owned dogs, and that these problems contributed to the dogs' relinquishment. However, such judgements about shelter dogs are not necessarily backed up by evidence.

This review challenges assumptions that dogs in shelters have relationship-breaking behavioural incompatibilities. The authors argue that negative judgements about shelter dogs' behaviour are not based on biological data but on social constructs. In their consideration of the literature on shelter dog returns, they found three studies that reported reasons for 'failed adoption'. Very few dogs were returned due to behavioural problems (6 to 9%). The authors also considered studies on behavioural incompatibilities in owned dogs (n=13). They conclude that people love the dogs they own irrespective of 'less than ideal' behaviour. They argue that the same regard should be extended to shelter dogs.

The authors acknowledge that behaviour plays a role in relinquishment of dogs to shelters. However, few studies compare the frequency of behaviours in a population of relinquished dogs compared to a control population of owned dogs. A case-control study by the National Council for Pet Population Study and Policy (NCPSP) (n= 2631 relinquished dogs, 3434 owned dogs) found an increased risk of relinquishment if dogs soiled in the home (at any frequency), or displayed fear, hyperactivity or destructive behaviour (always/ almost always or most of the time). However, these behaviours may not necessarily be dog-problems but rather, the product of owner and environment factors. Recommendations are made for community-based interventions to support owners and dogs, and prevent relinquishment.

Patronek GJ, Bradley J, Arps E (2022) [Saving normal: A new look at behavioural incompatibilities and dog relinquishment to shelters](#). Journal of Veterinary Behavior 49:36-45.

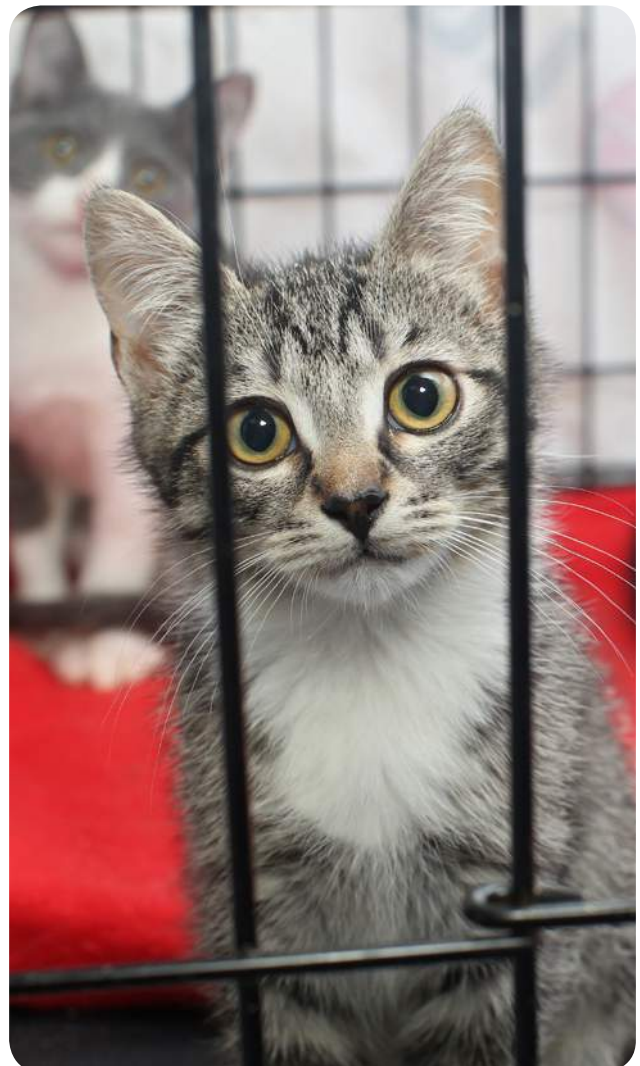
Sociability of cats can improve during their stay in a shelter

Sociability with people is a factor affecting the adoptability of shelter cats. For example, a cat who is fearful of people may be less likely to be adopted and may spend an extended period of time in a shelter.

This study monitored sociability in cats (n=158) at a shelter in the Czech Republic. After 14 days quarantine, cats were housed in a 53m² area as a group of 25. Every two weeks, a trained observer performed the five-point scale Human Approach Test to evaluate the cats' willingness to interact. Based on this test, cats were evaluated as 1 (very friendly), 2 (friendly), 3 (neutral), 4 (unfriendly) or 5 (very unfriendly/not possible to make contact).

At the initial evaluation, the majority of cats (81%) were rated 1 or 2. Only two cats were assessed as 5. At the final evaluation, the majority of cats (63.6%) had not changed their sociability score. Of the 32 cats whose scores changed, 26 improved. Improved scores were mainly seen in cats who were initially scored 3 to 5. The authors suggest that a longer time in the shelter may give some animals the opportunity to become accustomed to people. However, they acknowledge that cats may react differently to the shelter environment, and decisions about the future of animals should be made based on individual behaviour and history.

Vojtkovská V, Voslářová E, Večerek V et al (2022) Changes in sociability of shelter cats. Journal of Veterinary Behavior 49:20-27.



A one-week education intervention can improve young children's animal welfare attitudes

Rabbits are popular companion animals. Despite their popularity, there are gaps in people's understanding of their welfare needs, resulting in poor rabbit health and welfare. As attitudes towards animals are shaped during childhood, teaching children about rabbits is seen as a potential strategy to improve rabbit welfare.

This study aimed to evaluate the effectiveness of "Rabbit Rescuers", a rabbit welfare educational intervention developed by the Scottish Society for the Prevention of Cruelty to Animals (SPCA). Primary school children (n = 123) aged five to seven years old were given 5-30 minute sessions daily for five days. The sessions, delivered by their class teachers, involved activities about rabbits' needs (environment, diet, behaviour, companionship and health), sentience, attachment to pets, and neglect and cruelty. Classes were semi-randomly allocated a soft-toy rabbit, mechanical rabbit or no intervention. Pre- and post-

intervention interviews evaluated the children's knowledge, thoughts and feelings about rabbit welfare.

"Rabbit Rescuers" effectively increased children's knowledge of rabbit welfare and increased their attachment to pets. Following the intervention, children were more likely to find rabbit neglect and cruelty unacceptable. In terms of improving children's understanding of rabbit welfare needs, sentience, neglect and cruelty, the mechanical rabbit appeared to be more effective than the soft-toy rabbit. Further research is required to understand whether educational interventions such as "Rabbit Rescuers" generalises to other species or affects long-term behavioural change.

Williams JM, Cardoso MP, Zumaglini S et al (2022) ["Rabbit Rescuers": A school-based animal welfare education intervention for young children](#). *Anthrozoös* 35(1):55-73.

FARM ANIMALS

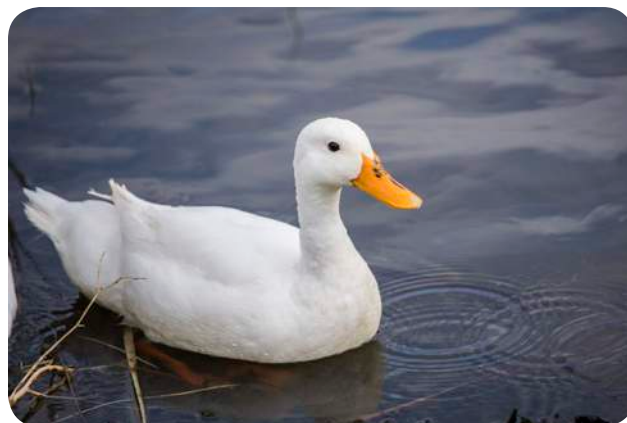
Open water access is important for farmed duck welfare

Ducks being semi-aquatic have unique behavioural needs for open water compared to other commonly farmed poultry species. In commercial production, there are no regulations stipulating open water provision and ducks are often deprived of open water access to fulfil natural and motivated water-related behaviours. As duck production continues to increase, more ducks are being kept in intensive indoor housing systems without open water access.

This review evaluates ducks' needs for water and how these needs could be met in commercial production. To maintain ducks' physical and behavioural health, open water access is important for performing essential maintenance behaviours including preening and bathing. Preening and bathing (including immersion of the head and body) are critical for maintaining feather integrity, waterproofing, regulating body temperature, pheromone and hormone production, and potentially also protecting ducks against infections. In addition, preening and bathing are important for ducks' social well-being and comfort. The importance of water depth, temperature, hygiene, space and location are discussed. While more research is required to understand ducks' motivation to access open water, there is evidence that they are motivated to access open water sources and use different open water sources for different water-related behaviours.

Depriving ducks of access to open water represents a significant animal health and welfare challenge for commercial duck production. There is evidence that ducks deprived of open water access have elevated stress hormones and an increased amount of feather pecking behaviour. Further research is needed, however, to fully understand the effects of open water deprivation, ducks' water access preferences and how these preferences may vary between breeds, strains and ages.

Babington S, Campbell DLM (2022) [Water for domestic ducks: The benefits and challenges in commercial production](#). *Frontiers in Animal Science* 3, 782507 [Author S Babington is from RSPCA Australia].



Further research needed to improve farmed salmonid welfare

The first Canadian Code of Practice for the Care and Handling of Farmed Salmonids was recently completed. During the development of the Code of Practice, the Canadian National Farm Animal Care Council conducted a survey of experts and other key stakeholders to identify outstanding issues not addressed in the current literature and a list of research needs.

This review outlines outstanding knowledge gaps relating to farmed salmonid welfare. Five key areas requiring further research were identified: (1) biodiversity (or stocking density), (2) health monitoring and management, (3) feed quality and management, (4) enclosure design and enrichment, and (5) slaughter and euthanasia.

Basic and applied research is needed to safeguard the health and welfare of farmed fish. More work is needed to characterise optimal biodiversity for different species and life stages. The authors were unable to find any studies which investigate salmonids' preferences for different biodiversities. Preference tests, such as motivation tests and judgement bias tests, have yet to be validated in salmonids. Further

research is also needed to understand the impact of chemical and non-chemical methods used to treat and prevent pathogens and parasites. Little is known about the welfare implications of feed composition and feed restriction. While there is some laboratory evidence for the benefits of environmental enrichment, there is almost no information available at a commercial scale. Other aspects of the aquaculture environment, such as continuous artificial lighting, can have welfare consequences but little is known about the welfare impact. There are also outstanding gaps in our knowledge about the welfare impact of slaughter methods on different species, life-stages and in commercial settings. Given the increasing number of salmonids farmed in aquaculture, there is a need to address these knowledge gaps, and improve management. The authors recommend a comprehensive review be undertaken to evaluate the full extent of research gaps.

Gaffney LP, Lavery JM (2022) [Research before policy: Identifying gaps in salmonid welfare research that require further study to inform evidence-based aquaculture guidelines in Canada](#). *Frontiers in Veterinary Science* 8, 768558.

Elevated platforms and straw bales improve meat chicken welfare

Meat chickens (broilers) in commercial production are at risk of suffering from painful foot and leg conditions including footpad dermatitis (FPD) and hock burns (HB). Factors contributing to these conditions include breeding for rapid growth and the barren housing conditions in which meat chickens may be kept. Improvements in meat chicken housing and management can help to address these health and welfare concerns.

This study, conducted in France, tested whether environmental enrichment (in the form of elevated platforms and straw bales) could improve meat chicken welfare. Walking ability, FPD, HB, weight, mortality and litter quality were assessed for 14,994 broilers at two different stocking densities (31 kg/m² and 41 kg/m²), with or without enrichment. In the straw bale test pens, one bale was placed on either side of the pen. The bale was not renewed if it disintegrated. In the platform test pens, one elevated platform made of perforated plastic slats was made available from the first to last day of life. The severity of FPD and HB were evaluated post-mortem.

FPD was less severe in meat chickens housed at lower stocking density and with enrichment. HB was less severe at lower stocking density but HB severity could not be compared between groups with and without enrichment. Meat chickens housed at lower stocking density and with enrichment also had better walking ability compared to the meat chickens housed at higher stocking density without enrichment. Overall, the authors conclude that housing meat chickens at lower stocking density and with enrichment could help improve hock and footpad health.

Mocz F, Michel V, Janvrot M et al (2022) [Positive effects of elevated platforms and straw bales on the welfare of fast-growing broiler chickens reared at two different stocking densities](#). *Animals* 12(5), 542.

Preventing the transport of young calves using umbilical stump healing as an indicator of age

Transport is stressful particularly for young animals who do not have fully developed coping mechanisms. To restrict the transport of very young dairy calves, the European Union (EU) has prohibited the transport of calves whose navel has not “completely healed”. However, it is unclear how a “completely healed” umbilical stump correlates with calf age.

To provide clarity around how a “completely healed” umbilical stump correlates with age, this study monitored navel healing in dairy calves from birth to 90 days of age. Holstein and crossbred dairy calves (n = 299) were reared across five farms in Italy. Three observers with experience in cattle medicine scored the umbilical stumps as: (1) red-pink, (2) crimson-purple, flattened, partially dry, (3) brown-black, completely dry, shrivelled, inflexible, (4) covered by scab or granulation tissue or (5) scarred over/completely healed.

Typically by 14 days of age, the umbilical wound is covered by a scab. In this study, the umbilical stump was covered by scab or granulation tissue in the majority (90%) of calves by 15 to 40 days of age. The wound fully heals no earlier than 3 to 4 weeks of age. The youngest calves with a completely healed umbilical stump were 19 to 20 days old. These results indicate that calves with a completely dry, shrivelled navel stump may still be too young to transport. The authors recommend that only calves with a scarred over/ completely healed umbilical stump (i.e., no younger than 3 to 4 weeks) be transported, particularly for longer journeys (>8 hours).

Roccaro M, Bolcato M, Masebo NT et al (2022) [Navel healing and calf fitness for transport](#). *Animals* 12, 358.

More information required to set safe freight rail noise thresholds for farm animals

Freight rail generates very loud noise (>100 decibels at 15m) and intense vibrations (up to 160Hz at 50m) that can be disruptive and harmful to animals. As freight rail networks expand across agricultural land, there is a growing need to understand the effects of associated noise and vibrations on farm animals.

This scoping review investigated associations between freight rail noise and farm animal welfare. A total of 28 relevant papers were found, 5 on the effects of vibration and 23 on noise. Studies originated from around the world including North America, the United Kingdom, Europe, Asia and the Pacific. Species covered included poultry, livestock, horses, camels and working dogs. Effects of rail noise and vibrations included fear, nausea, stress, distress, fatigue, and changes in behaviour (e.g., reduced feeding). For example, noise >100 dB can trigger a fight-or-flight response in horses and cause cattle to stampede. Birds are particularly sensitive to noise and vibrations. Vibration as low as 1 to 10 Hz can causing a stress response in birds. In some cases, animals exposed to noise and vibration suffer hearing loss. For example, Japanese quail lost all hearing after being exposed to noise at 70 dB. Although horses may habituate to loud high-speed rail noise (<90 dB) and cattle may habituate to noise from 90-120 dB, no studies were found addressing habituation of animals to freight rail vibration.

Overall, there is little research specifically examining the impact of freight rail noise and vibration on farm

animals. However, from existing studies, it is clear that noise and vibration can have harmful effects on farm animals, with effects varying depending on species and noise intensity. Further knowledge on habituation is needed as well as further research to establish thresholds and develop animal welfare guidelines relating to freight rail noise and vibration.

Trigg J, Naweed A, Kinnear S (2022) A scoping review of freight rail noise and vibration impacts on domestic animal health and welfare. *Animal Welfare* 31(1):69-77.



A new method for assessing the welfare of loose-housed laying hens

There are different methods available to assess the welfare of loose-housed laying hens. AssureWel involves assessing 50 randomly selected hens in the flock using seven animal welfare indicators: feather loss, dirtiness, beak trimming, antagonistic behaviour, flightiness, birds needing further care, and dead birds. The Norwegian farm advisors' NorWel method, involving eight indicators, is similar to AssureWel but also includes wound scoring. A new Aviary Transect method has been developed which focuses on severe welfare issues associated with layer hens. The new method involves screening the whole flock for twelve indicators including feather loss on various parts of the body, wounds, and the number of sick and dead birds. Before the new Aviary Transect method can be implemented on commercial farms, it needs to be evaluated for time efficiency, inter-observer reliability and sensitivity.

This study, conducted on six commercial farms in Norway, compared the time requirements, interobserver reliability and sensitivity of AssureWel, NorWel and the new Aviary Transect method. All flocks contained approximately 7,500 hens housed in

fully enclosed indoor multi-tiered aviary systems (385 to 1000 m²) with mechanical ventilation and artificial lighting. Two observers visited the six farms and collected data using the Aviary Transect, AssureWel and NorWel methods.

All three methods took a similar amount of time to perform (~20 minutes per flock). The three methods generally had good inter-observer reliability. On comparable animal welfare indicators, the new Aviary Transect method produced comparable results to the existing methods. However, all the methods varied in their sensitivity. For example, the new Aviary Transect method is more sensitive at detecting less common welfare issues such as wounds. Overall, the new Aviary Transect method was found to be a time efficient and sensitive method for assessing the welfare of layer hens in loose housing systems.

Vasdal G, Marchewka J, Newberry RC et al (2022) [Developing a novel welfare assessment tool for loose-housed laying hens – the Aviary Transect method](#). Poultry Science 101(1), 101533.



Dairy beef as an alternative to killing bobby calves

Viewed as a low value by-product of dairy production, non-replacement male dairy calves (bobby calves) are routinely separated from their mothers and killed before they reach 10 days of age. Every year in Australia, approximately 400,000 bobby calves are killed in abattoirs. One potential alternative is to raise bobby calves as “dairy beef”. However, there appear to be barriers to adoption of dairy beef.

This is the first study to investigate Australian dairy producers’ views on bobby calf management and dairy beef. In-depth interviews were carried out with individual producers (n= 15) in New South Wales and Victoria. The majority ran 200 to 400 milking cows.

All producers agreed that killing bobby calves should be the last resort. Twelve of the fifteen producers reported that they would never kill bobby calves even if it was more profitable to do so. One producer commented, “*no one likes putting down good healthy calves.*” The interviews raised concerns about the mental health costs associated with killing bobby calves. When discussing the alternative, three barriers to adoption of dairy beef were identified: market sustainability, drought and resourcing. While four producers felt that it was important to treat all calves equally, other farmers (particularly those affected by drought) prioritised limited resources (e.g., feed, shelter, vaccinations, medications) for other animals.

Only half the participants had access to consistent and economically viable dairy beef markets. If dairy beef is to be a viable alternative to killing bobby calves, producers must have access to consistent dairy beef markets.

Vicic V, Saliba AJ, Campbell MA et al (2022) [Barriers to utilizing non-replacement male calves in the Australian dairy industry: A qualitative study](#). *Frontiers in Veterinary Science* 8, 800388.



Loose housing gives sows more choice and control over nursing compared to farrowing crates

Sows are routinely confined to narrow farrowing crates for farrowing (giving birth) and immediately after while nursing their piglets. While farrowing crates are often argued to be necessary to prevent sows from crushing their piglets, the extreme confinement of sows in crates is associated with major animal welfare issues for both sows and piglets. An increasing number of jurisdictions are beginning to prohibit the use of farrowing crates and replacing them with alternatives such as farrowing pens. Different farrowing and housing systems have been previously shown to affect sow and piglet interactions and welfare outcomes.

This study, conducted at a research farm in Germany, compared nursing behaviour in sows (n = 60) kept in farrowing crates (FC) versus a loose-housing pen without a crate (LH). The FC measured 190 cm x 80 cm (1.52 m²). The LH pen provided approximately 4 m² of usable space. Sows and piglets in both housing systems were managed in the same way. Sow nursing

behaviour was monitored using video cameras. Video footage was used to evaluate nursing frequency, sow-terminated nursing, un-nursed piglets, and duration of nursing bouts.

Overall, when comparing sow nursing behaviour in LH versus FC, there was no significant difference in nursing frequency or the odds of un-nursed piglets. Differences in nursing behaviour included: average nursing bouts were longer in FC (7.01 ± 4.96 minutes) compared to LH (5.69 ± 4.56 minutes), and more nursing bouts were terminated by the sow in LH (65.3%) compared to FC (58.2%). Sow nursing behaviour in LH appears to reflect sow behaviour in semi-natural conditions, and a greater degree of sow choice and control in LH compared to FC.

Wiechers D-H, Herbrandt S, Kemper N et al (2022) [Does nursing behaviour of sows in loose-housing pens differ from that of sows in farrowing pens with crates?](#) *Animals* 12(2), 137.

ANIMALS IN SPORT, ENTERTAINMENT, PERFORMANCE RECREATION AND WORK

Aversive tack is associated with problem behaviours in horses

A variety of equipment and apparatus (tack) is used to control horses. Use of tack, particularly those that are designed to be aversive (e.g., whips, spurs, bits, reins, chain/lip straps, nosebands, martingales), can have consequences for horse welfare.

This study investigated the response of horses to aversive tack. In an online survey, respondents in Australia (n=1101) were asked about the tack used (e.g., bit style, thickness, material, type) and their horses' response when ridden with this tack (e.g., rears, bolts, bucks, shies, easy-to-steer, easy-to-stop).

Aversive tack was used commonly by the respondents. For example, over 78% reported using bits, almost 60% used nosebands, over 46% used whips, and over 32% used spurs. Almost all the respondents (n = 997/1101) reported that their horse displayed at least one problem behaviour when ridden with this tack. For example, 30.74% of respondents reported their horse would pull their head forward and down,

a potential indicator that the restriction of the mouth, head and neck is unwelcome. Use of aversive tack, in combination or separately, is associated with behaviours indicative of discomfort, conflict between rider and horse, hyper-reactivity, and hyper-vigilance. Use of aversive tack was also associated with the horse requiring stronger cues to perform behaviours desired by the rider. For example, horses ridden with smooth spurs were over 3 times more likely to require stronger canter cues than horses ridden without spurs. While they refrain from implying causality, the authors encourage ethical use of tack. They recommend that numerous factors, including application of stimuli, individual horse sensitivity and context, should be considered when evaluating horses' responses to tack.

Condon VM, McGreevy PD, McLean AN et al (2022) Associations between commonly used apparatus and conflict behaviors reported in the ridden horse in Australia. *Journal of Veterinary Behavior* 49:1-14.



Horses appear to gain some comfort from scratching up against automatic brushes

Physical contact has been shown to have some positive effects in social species. Fixed automatic brushes have been used to provide social species, such as horses and cattle, with physical contact.

This study investigated the response of horses to physical contact with fixed automatic brushes. Two brushes (1200cm x 72cm x 30cm) were installed in the middle of the stable. The brushes automatically started rotating at 25.5 rotations/minute when horses made contact. After a month-long familiarisation period, 40 female Welsh ponies were observed interacting with the brushes. Ponies were observed over four 7.5 hour observation periods. Video recordings were reviewed for types of behaviour, interactions between horses, and their facial expressions.

A large proportion of the horses (87.5%) were observed using the brushes. On average, they used

the brushes 3.97 times per day for short bouts of less than a minute. The head was the area of the body most often presented to the brush. Half of the horses observed using the brush exhibited a positive facial expression (neck moderately raised, eyes opened or half closed, upper lip extended, and ears backwards and immobile or twitching). When using the brushes, the horses exhibited more positive social behaviours (allogrooming) compared to aggressive behaviours, possibly indicating that they derived some comfort from using the automatic brushes.

Lansade L, Lemarchand J, Reigner F et al (2022) [Automatic brushes induce positive emotions and foster positive social interactions in group-housed horses](#). Applied Animal Behaviour Science 246, 105538.

Racing's social licence to operate shaky after exposé of horse killings

Deaths in the horse racing industry are usually concealed. However, in the run up to the 2019 Melbourne Cup, the Australian Broadcasting Corporation aired 'The Final Race', a documentary depicting unwanted Thoroughbred racehorses being abused and killed. Such exposés and animal welfare concerns more broadly, can challenge community acceptance of animal use industries, also known as Social Licence to Operate (SLO).

This paper examined the Australian Thoroughbred racing industry's SLO. The authors considered publicly available material (e.g., television programs, newspaper articles, websites, social media) to evaluate people's position on Thoroughbred racing. They also considered other information that may reflect levels of community support for racing (e.g., crowd size, gambling revenue, television ratings).

There was a strong negative reaction to 'The Final Race'. Celebrities, consumers, and sponsors expressed concerns about animal cruelty. Other possible indicators of decreasing support for racing included: falling gambling revenue, lower television ratings, and reduced attendance at the 2019 Melbourne Cup compared to previous years (the lowest since 1995). A growing number of people registered for 'Nup to the Cup' events and participated in protests. While the response from racing industry spokespeople varied, there was some pushback. The authors posit that withdrawal of SLO may be possible for the Thoroughbred racing industry in Australia.

McManus P (2022) Animal-based entertainment industries, animal death and Social Licence to Operate (SLO): An analysis of 'The Final Race' and the 2019 Melbourne Cup. Social & Cultural Geography doi:10.1080/14649365.2022.2053194.



ANIMALS IN RESEARCH AND TEACHING

Pet rats commonly engage in natural behaviours that are restricted in laboratory rats

There are ongoing concerns for the welfare of laboratory rats. To date, research on laboratory rat welfare has largely focused on housing and husbandry. Another potential untapped resource is to draw on information about pet rats.

Pet rat owners in the United Kingdom (n= 677) were surveyed about rat housing, enrichment, handling and behaviour. Respondents were recruited on social media. The online survey included seven parts: (1) You and your rat(s), (2) Your rat(s), (3) Your rat's cage, (4) Interacting with your rat, (5) Your rat's behaviour, (6) Your rat's health, and (7) Your experience as a rat owner.

The majority of survey respondents kept more than one pet rat (97.6%) and handled their rats daily (91.6%). They provided their pet rats with multiple types of enrichment including: bedding (e.g., sawdust), nesting material (e.g., shredded paper), suspended

areas, climbing structures, hideaways, tubes, foraging devices and activities. The survey found that a range of behaviours are common in pet rats including: climbing, food hoarding, bounding, nesting, digging, boggling (eyes "popping in and out") and bruxing (grinding teeth without moving the eyes). In contrast, laboratory rats are not routinely provided with enrichment, and are unable to engage in many natural behaviours due to the restrictive environments in which they are kept. The authors suggest that information about pet rats can be used to develop novel animal welfare indicators and improve laboratory rat welfare.

Neville V, Mounty J, Benato L et al (2022) [Thinking outside the lab: Can studies of pet rats inform pet and laboratory rat welfare?](#) Applied Animal Behaviour Science 246, 105507.



Environmental enrichment in rodents

Laboratory cages pose a risk to rodent welfare because they restrict natural behaviours. These restrictive environments can cause stress, frustration, weakened immune responses, and behaviour consistent with anxiety. Environmental enrichment aims to relieve some of these animal welfare concerns. However, there are inconsistencies in how environmental enrichment is viewed and applied.

This metareview aimed to clarify concepts and definitions relating to environmental enrichment for laboratory rodents. Review articles (n= 29) on environmental enrichment in laboratory rats and mice were analysed. The broad aim of environmental enrichment is generally understood to be improving animal welfare. Types of environmental enrichment for rodents include nesting material, shelters, foraging opportunities, bedding, novel objects, and auditory enrichment. Environmental enrichment can have a variety of goals including: providing opportunities

to perform natural behaviours, improving health, enhancing psychological well-being, improving ability to cope with stressors, providing choice or control, reducing boredom, reducing stereotypic behaviours, and offering cognitive opportunities.

The authors identified potential barriers to the application of enrichment including: finances, labour, and animal safety. While some review articles raised concerns that environmental enrichment may alter research outcomes, the authors of this paper highlight that conventional housing does not represent ideal experimental conditions. Indeed, conventional housing is associated with abnormal responses which may affect research outcomes. Recommendations are made for clear, specific and consistent definitions of environmental enrichment for laboratory rodents.

Ratuski AS, Weary DM (2022) [Environmental enrichment for rats and mice housed in laboratories: A metareview](#). *Animals* 12, 41.

WILD ANIMALS

Rat baits have severe to extreme animal welfare impacts

Many different methods are used to control Norway rats (*Rattus norvegicus*). Despite the widespread use of trapping and baiting, there is little information available on the relative animal welfare impacts of different control methods.

This study investigated the relative welfare impacts of six lethal rat control methods used in the United Kingdom. Data was collected during two workshops involving 15 stakeholders, including: wildlife managers, rodent managers, rodent biologists, animal welfare scientists and veterinarians. During the workshops, information was collected on rat control methods and operating procedures. Based on a standardised scoring matrix, different methods were scored for animal welfare impact. The scoring matrix took into account overall impact on rat welfare (1 = no impact, 2 = mild, 3 = moderate, 4 = severe, 5 = extreme impact), and duration of impact (immediate to seconds, minutes, hours, days, weeks).

Baiting, and glue traps with concussive killing were identified as having the greatest welfare impacts. Baiting with anticoagulants, cholecalciferol and cellulose baits were assessed as having severe to

extreme impact lasting days. Rats typically are conscious as they bleed to death (with anticoagulants), die of organ failure (with cholecalciferol), or succumb to starvation and dehydration (with cellulose baits). When rats are caught in glue traps, they experience extreme welfare impact for hours. When trapped rats are killed using concussive force to the head, the welfare impact is mild to moderate for seconds to minutes. Cage trapping with concussive killing was seen to have a lower welfare impact. Lethal snap traps may be relatively humane but need to be thoroughly tested and regulated. Rat control methods can also have welfare consequences for non-target animals. Overall, the authors conclude that there is no entirely humane way to control rats but the method with the lowest welfare impact should be selected.

Baker SE, Ayers M, Beausoleil NJ et al (2022) [An assessment of animal welfare impacts on wild Norway \(*Rattus norvegicus*\) management](#). *Animal Welfare* 31:51-68.

Powerful owls around Melbourne may be dying from secondary poisoning

Powerful owls (*Nonox strenua*) face a number of stressors in human dominated landscapes including exposure to harmful pesticides, heavy metals and rat poisons (rodenticides). However, the prevalence of potentially toxic residues in powerful owl populations is unknown.

This study aimed to investigate the prevalence of toxic residues in powerful owl populations mainly around Melbourne. Dead owls were collected between 2004 and 2019 (n=10) and 2020/2021 (n=8). The majority of owls (n=17) were found dead around Melbourne, Victoria and one was found in New South Wales. Liver samples from the dead owls were analysed for a range of toxic residues including: heavy metals (arsenic, cadmium, lead and mercury) and eight rodenticides (warfarin, coumatetralyl, bromadiolone, brodifacoum, flocoumafen, difenacoum, difethialone and pindone). Muscle samples were analysed for multiple agricultural contaminants including fungicides, herbicides, insecticides, pesticides, organophosphates, organochlorines, carbamates, acaricides, phenols and synthetic pyrethroids.

A range of toxic residues were found in tissue samples collected from dead owls. Organochlorine pesticides were detected in 10/14 owls. Heavy metals including cadmium (17/18), mercury (14/18), and lead (3/18) were also detected. Anticoagulant rodenticides were detected in 15/18 owls, the most frequent being brodifacoum. Though there are challenges inferring health and welfare impacts, potentially lethal levels of second-generation anticoagulant rodenticides were detected in 11/15 owls. Powerful owls are reported to prey mainly on common ringtail possums. The findings of this study suggest deliberate or accidental rodenticide poisoning of possums is leading to secondary poisoning of owls. Further monitoring of possums and owls is warranted to understand the animal health, welfare and conservation implications.

Cooke R, Whitely P, Jin Y et al (2022) Widespread exposure of powerful owls to second generation anticoagulant rodenticides in Australia spans an urban to agricultural and forest landscape. *Science of the Total Environment* 819, 153024.



Environmental enrichment can improve the welfare of sea turtles in rehabilitation

Sea turtles face a number of threats including entanglement in fishing gear, plastic pollution, ingestion of hooks and line, trauma, infectious disease and crude oil. These threats can lead to sea turtles being brought into captivity for rehabilitation. Rescued sea turtles may be kept in captivity for weeks, months or even years. Compared to their rich, stimulating, natural environment, captivity is typically barren and monotonous. Environmental enrichment (EE) is a potential strategy to improve the welfare of sea turtles in rehabilitation.

This review examines how EE can be used to improve the welfare of sea turtles in rehabilitation. EE aims to optimise physical, physiological and psychological wellbeing by catering for animals' needs, providing choice, reducing boredom, and increasing behavioral diversity. Different categories of EE include: nutritional (e.g., food puzzles), physical (e.g., shelter), sensory (e.g., scratchers), occupational (e.g., training) and social (e.g., seeing or touching other animals) enrichment.

To illustrate the application of EE in sea turtle rehabilitation, case studies are presented. Increased

exploratory behaviour was observed when turtles were provided with a waterfall, and food hidden in submerged jugs and pipes. Positive effects were also observed when a blind green turtle (*Chelonia mydas*) was provided with a lettuce feeder made from PVC pipe and a carapace scratching device. In another case study, *C. mydas* reduced repetitive pattern swimming and increased focused behaviour when provided with various novel objects and food dispensing devices. EE has also been used in the rearing of hatchlings and to prepare turtles for release. EE has some limitations such as cost, and limited benefits for long-standing issues. The authors also acknowledge that EE can only do so much if the underlying causes of stress and distress are not addressed. Nevertheless, EE can be used effectively to improve the welfare of sea turtles in rehabilitation.

Escobedo-Bonilla CM, Quiros-Rojas NM, Rudin-Salazar E (2022) [Rehabilitation of marine turtles and welfare improvement by application of environmental enrichment strategies](#). *Animals* 12, 282.



COVID-19 litter poses a threat to animal health and welfare

Disposable personal protective equipment (PPE), such as face-masks and gloves, are being widely used during the COVID-19 pandemic. When discarded in the environment, disposable PPE becomes COVID-19 litter. COVID-19 litter is now common across the globe. For example, the #glovechallenge saw 11,000 photos of COVID-19 litter posted from all around the world. While disposable PPE aids human health, COVID-19 litter poses a risk to animal health and welfare.

This paper presents an overview of animal interactions with COVID-19 litter. Reports in English and Dutch were collected from Google images and social media platforms. Where possible, observers were contacted for supporting information.

Reports of animals interacting with COVID-19 litter came from many different countries and environments. An octopus was pictured hiding under a face-mask. Fish were found dead, trapped in gloves. Crabs, bats and birds were reported entangled in face-masks. Birds were seen carrying face-masks in their beaks. A cat was reported to have ingested a face-mask. For the first time on record, birds were reported using COVID-19 litter as nesting material. The full scale of the impact of COVID-19 litter on animals is unknown. The authors recommend people use reusable PPE and encourage anyone who sees animals interacting with COVID-19 litter to lodge a report at www.covidlitter.com.

Hiemstra A-F, Rambonnet L, Gravendeel B et al (2021) [The effects of COVID-19 litter on animal life](#). *Animal Biology* 71:215-231.



MISCELLANEOUS

Octopuses, the first invertebrates to be extended welfare concern

Invertebrates are often neglected in animal welfare research, policy and legislation. Barriers to progress include lack of knowledge, lack of regard, and in some cases, disdain towards invertebrates. One type of invertebrate, octopuses, appear to be overcoming these barriers.

This piece examines progress in octopuses' welfare. While there are many gaps in our knowledge of the basic biology and behaviour of octopuses, there is a growing appreciation for their intelligence and sentience. The 'Cambridge Declaration on Consciousness' (acknowledging the potential for consciousness in octopuses), and the publication of 'The Welfare of Invertebrate Animals' (the only welfare book focused on invertebrates), were milestones in octopus welfare. Yet growing scientific knowledge has not necessarily translated into progress in policy

and legislation. Some jurisdictions, such as Canada, the European Union (EU), United Kingdom, Australia and NZ, have included octopuses in regulations on animal experimentation. However, octopuses receive no animal welfare protection in the United States. *CephsinAction*, established in the EU, aims to identify research needs, develop octopus welfare indicators, set animal welfare standards and offer training.

Octopuses appear to be the first invertebrates to be extended welfare concern. The authors believe that this may evolve into increasing concern for the welfare of invertebrates more broadly.

Mather J (2022) Why are octopuses going to be the 'poster child' for invertebrate welfare? *Journal of Applied Animal Welfare Science* 25(1):31-40.

ARTICLES OF INTEREST

COMPANION ANIMALS

Abusaada H, Elshater A (2021) Building sustainable habitats for free-roaming cats in public spaces: A systematic literature review. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2021.2014840.

Aeluro S, Buchanan JM, Boone JD et al (2021) "State of the mewnion": Practices of feral cat care and advocacy organizations in the United States. *Frontiers in Veterinary Science* 8, 1469.

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(5), 629.

Brincat BL, McGreevy PD, Bowell, VA et al (2022) Who's getting a head start? Mesocephalic dogs in still images are attributed more positively valenced emotions than dogs of other cephalic index groups. *Animals* 12, 49.

Burmeister AK, Drasch K, Rinder M et al (2022) The owner-bird relationship: Relevance for pet bird welfare. *Animal Welfare* 31(1):137-154.

Cardoso SD, Faraco CB, de Sousa L et al (2022) Empathy with humans and with non-human animals: Are there differences between individuals who have adopted and those who have relinquished a pet? *Journal of Veterinary Behavior* 49:46-52.

Couture M, Stellato AC, Moody CM et al (2022) Owner perspectives of cat handling techniques used in the veterinary clinic. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2022.2039144.

Enomoto M, Lascelles BDX, Robertson JB et al (2022) Refinement of the feline musculoskeletal pain index (FMPI) and development of the short-form FMPI. *Journal of Feline Medicine and Surgery* 24(2):142-151.

Eyre R, Trehou M, Marshall E et al (2022) Aging cats prefer warm food. *Journal of Veterinary Behavior* 47:86-92.

Finka LR (2022) Conspecific and human sociality in the domestic cat: Consideration of proximate mechanisms, human selection and implications for cat welfare. *Animals* 12(3), 298.

Girault C, Priymenko N, Helsly M et al (2022) Dog behaviours in veterinary consultations: Part 1. Effect of the owner's presence or absence. *The Veterinary Journal* 280, 105788.

González-Martínez Á, Castro S, Camino F et al (2022) Epidemiology of behavioural problems in pet rabbits: An owners' survey. *Journal of Veterinary Behavior* 4:65-70.

Griffin KE, Elizabeth J, Tom P et al (2022) What will happen to this dog? A qualitative analysis of rehoming organisations' pre-adoption dog behaviour screening policies and procedures. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.796596.

Harvey ND, Christley RM, Giragosian K et al (2022) Impact of changes in time left alone on separation-related behaviour in UK pet dogs. *Animals* 12(4), 482.

Hoffman CL, Spencer TG, Makolinski KV (2021) Assessing the impact of a virtual shelter medicine rotation on veterinary students' knowledge, skills, and attitudes regarding access to veterinary care. *Frontiers in Veterinary Science* 8, 1522.

Jahn K (2022) Management of stress during international air travel in 4 cats – a case series. *Journal of Veterinary Behavior* 48:83-84.

Jones M, Alexander ME, Snellgrove D et al (2022) How should we monitor welfare in the ornamental fish trade? *Reviews in Aquaculture* 14(2):770-790.

Karpiński M, Wojtaś J, Garbiec A (2022) Temperament assessment algorithm in dogs. *Animals* 12(5), 634.

King T, Flint HE, Hunt ABG et al (2022) Effect of music on stress parameters in dogs during a mock veterinary visit. *Animals* 12(2), 187.

Lee HS, Song JG, Lee JY (2022) Influences of dog attachment and dog walking on reducing loneliness during the COVID-19 pandemic in Korea. *Animals* 12(4), 483.

Martin AL, Walther CM, Pattillo MJ et al (2022) Impact of visual barrier removal on the behavior of shelter-housed dogs. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2021.2021407.

McDonald SE, Sweeney J, Niestat L et al (2022) Grooming-related concerns among companion animals: preliminary data on an overlooked topic and considerations for animals' access to health-related services. *Frontiers in Veterinary Science* doi:10.3389/fvets.2022.827348.

Mota-Rojas D, Marcet-Rius M, Ogi A et al (2021) Current advances in assessment of dog's emotions, facial expressions, and their use for clinical recognition of pain. *Animals* 11, 3334.

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* doi:10.1080/10888705.2022.2038168.

Notari L, Kirton R, Mills DS (2022) Psycho-behavioural changes in dogs treated with corticosteroids: A clinical behaviour perspective. *Animals* 2022, 12(5).

Nugent WR, Daugherty L (2022) A measurement equivalence study of the family bondedness scale: Measurement equivalence between cat and dog owners. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.812922.

O'Neill DG, Yin Y, Tetas Pont R, et al (2022) Breed and conformational predispositions for prolapsed nictitating membrane gland (PNMG) in dogs in the UK: A VetCompass study. *PLoS ONE* 17(1), e0260538.

Overall KL (2022) Are we sheltering assumptions in addition to dogs and cats? *Journal of Veterinary Behavior* 49, A1-A2.

Paz JE, da Costa FV, Nunes LN et al (2021) Evaluation of music therapy to reduce stress in hospitalized cats. *Journal of Feline Medicine and Surgery* doi:10.1177/1098612X211066484.

Stavisky J, White C (2022), Does spaying at a younger age reduce dogs' risk of developing mammary tumours? *Veterinary Record*, 190:123-125.

Steagall PV, Robertson S, Simon B et al (2022) 2022 ISFM consensus guidelines on the management of acute pain in cats. *Journal of Feline Medicine and Surgery* 24(1):4-30.

Sumner CL, Walker JK, Dale AR (2022) The implications of policies on the welfare of free-roaming cats in New Zealand. *Animals* 12(3), 237.

Thuesen IS, Agerholm JS, Mejer H et al (2022) How serious are health-related welfare problems in unowned unsocialised domestic cats? A study from Denmark based on 598 necropsies. *Animals* 12(5), 662.

Vitale KR (2022) The social lives of free-ranging cats. *Animals* 12(1), 126.

Windschnurer I, Häusler, A, Waiblinger S et al (2022). Relationships between owner and household characteristics and enrichment and cat behaviour. *Applied Animal Behaviour Science* 247, 105562.

Zurlinden S, Spano S, Griffith E et al (2022) Impact of classical counterconditioning (quiet kennel exercise) on barking in kenneled dogs—A pilot study. *Animals* 12(2), 171.

FARM ANIMALS

Aquaculture

Arechavala-Lopez P, Cabrera-Alvarez MJ, Maia CM et al (2022) Environmental enrichment in fish aquaculture: A review of fundamental and practical aspects. *Reviews in Aquaculture* 14(2):704-728.

Blaker E, Ellis T (2022) Assessment, causes and consequences of short opercula in laboratory reared Atlantic salmon (*Salmo salar*). *Animal Welfare* 31(1):79-89.

Droege P, Schwob N, Weiss DJ (2021) Fishnition: Developing models from cognition toward consciousness. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.785256.

Healy SD, Patton BW (2022) It began in ponds and rivers: charting the beginnings of the ecology of fish cognition. *Frontiers in Veterinary Science* doi:10.3389/fvets.2022.823143.

Heredia-Azuaje H, Niklitschek EJ, Sepulveda M (2022) Pinnipeds and salmon farming: Threats, conflicts and challenges to co-existence after 50 years of industrial growth and expansion. *Reviews in Aquaculture* 14(2):528-546.

Morro B, Davidson K, Adams TP et al (2022) Offshore aquaculture of finfish: Big expectations at sea. *Reviews in Aquaculture* 14(2):791-815.

Nielsen SS, Bicout DJ, Calistri P et al (2022) Assessment of animal diseases caused by bacteria resistant to antimicrobials: kept fish species. *EFSA Journal* 20(2), e07076.

Turnbull JF (2022) The complex influences on how we care for farmed fish. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.765797.

Zheng C, Zhao Q, Li E et al (2022) Role of hypoxia in the behaviour, physiology, immunity and response mechanisms of crustaceans: A review. *Reviews in Aquaculture* 14(2):676-687.

Cattle

Albornoz RI, Giri K, Hannah MC et al (2022) An improved approach to automated measurement of body condition score in dairy cows using a three-dimensional camera system. *Animals* 12(1), 72.

Browne N, Hudson CD, Crossley RE et al (2022) Cow- and herd-level risk factors for lameness in partly housed pasture-based dairy cows. *Journal of Dairy Science* 105(2):1418-143.

Burns JG, Glenk K, Eory V et al (2022) Preferences of European dairy stakeholders in breeding for resilient and efficient cattle: A best-worst scaling approach. *Journal of Dairy Science* 105(2):1265-1280.

Charlton G, Gauld C, Veronesi F et al (2022) Assessing the accuracy of leg mounted sensors for recording dairy cow behavioural activity at pasture, in cubicle housing and a straw yard. *Animals* 12(5), 638.

Chen M, Weary DM (2022) "Cattle welfare is basically human welfare": Workers' perceptions of 'animal welfare' on two dairies in China. *Frontier in Veterinary Science* doi:10.3389/fvets.2021.808767.

Conboy MH, Winder CB, Cantor MC et al (2022) Associations between feeding behaviors collected from an automated milk feeder and neonatal calf diarrhea in group housed dairy calves: A case-control study. *Animals* 12(2), 170.

Crociati M, Sylla L, De Vincenzi A et al (2022) How to predict parturition in cattle? A literature review of automatic devices and technologies for remote monitoring and calving prediction. *Animals* 12(3), 405.

Dallago GM, Cue RI, Wade KM et al (2022) Birth conditions affect the longevity of Holstein offspring. *Journal of Dairy Science* 105(2):1255-1264.

Denholm K, Haggerty A, Mason C et al (2022) Comparison of testing for failure of passive transfer in calf serum using four different testing methods. *The Veterinary Journal* 281, 105812.

Ebinghaus A, Matull K, Ute Knierim U et al (2022) Associations between dairy herds' qualitative behavior and aspects of herd health, stockperson and farm factors—A cross-sectional exploration. *Animals* 12(2), 182.

Falkenberg U, Krömker V, Konow M et al (2022) Management of calves in commercial dairy farms in Mecklenburg-Western Pomerania, Germany and its impact on calf mortality and prevalence of rotavirus and *Cryptosporidium parvum* infections in pre-weaned calves. *Veterinary and Animal Science* 16, 100243.

Foris B, Mangilli LG, Van Os JMC et al (2022) Individual and environmental factors associated with defecation while lying down in dairy cows. *Journal of Dairy Science* 105(1):726-733.

Gaab T, Wright M, Pierdon M (2022) Behavioral and physiological response to routine thermal disbudding in dairy calves treated with transdermal Flunixin Meglumine. *Animals* 12(5), 533.

Henchion MM, Regan Á, Beecher M et al (2022) Developing 'smart' dairy farming responsive to farmers and consumer-citizens: A review. *Animals* 12(3), 360.

Knauss M, Adams CL, Orsel K (2022) Producer perceptions toward prevention and control of lameness in dairy cows in Alberta Canada: A thematic analysis doi:10.3389/fvets.2022.812710.

Kovács L, Kézér FL, Ruff F et al (2022) Single-dose meloxicam treatment improves standing ability of low-vitality dairy calves. *Journal of Dairy Science* 105(2):1618-1624.

Kremer L, van Reenen CG, Engel B et al (2022) Developing a feasible and sensitive judgement bias task in dairy cows. *Animal Cognition* 25:425-445.

Langford FM, Bell DJ, Nevison IM et al (2021) What type of loafing areas do housed dairy cattle prefer? *Applied Animal Behaviour Science* 245, 105511.

Leliveld LMC, Riva E, Mattachini G et al (2022) Dairy cow behavior is affected by period, time of day and housing. *Animals* 12(4), 512.

Lopez AJ, Heinrichs AJ (2022) Invited review: The importance of colostrum in the newborn dairy calf. *Journal of Dairy Science* 105(4):2733-2749.

Lutz B, Zwygart S, Rufener C et al (2021) Data-based variables used as indicators of dairy cow welfare at farm level: A Review. *Animals* 2021, 11(12), 3458.

Magrin L, Cozzi G, Lora I et al (2022) Brief research report: How do claw disorders affect activity, body weight, and milk yield of multiparous Holstein dairy cows? *Frontiers in Veterinary Science* doi:10.3389/fvets.2022.824371.

Mahendran SA, Wathes DC, Booth RE et al (2022) A survey of calf management practices and farmer perceptions of calf housing in UK dairy herds. *Journal of Dairy Science* 105(1):409-423.

Maher JW, Clarke A, Byrne AW et al (2021) Exploring the opinions of Irish dairy farmers regarding male dairy calves. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.635565.

Maier GU, Breitenbuecher J, Gomez JP et al (2022) Vaccination for the prevention of neonatal calf diarrhea in cow-calf operations: A scoping review. *Veterinary and Animal Science* 15, 100238.

Mainau E, Llonch P, Temple D et al (2022) Alteration in activity patterns of cows as a result of pain due to health conditions. *Animals* 12(2), 176.

Martin MS, Kleinhenz MD, Viscardi AV et al (2022) Effect of bupivacaine liposome suspension administered as a local anesthetic block on indicators of pain and distress during and after surgical castration in dairy calves. *Journal of Animal Science* 100(1), skab378.

Maurer L, Schenkenfelder J, Winckler C (2021) Resource, collaborator, or individual cow? Applying Q methodology to investigate Austrian farmers' viewpoints on motivational aspects of improving animal welfare. *Frontiers in Veterinary Science* doi:10.3389/fvets.2020.607925.

McFarlane WJ, Renaud DL, Reedman CN et al (2022) A scoping review of the analytical literature concerning nonambulatory dairy cattle. *Journal of Dairy Science* 105(3):2544-2557.

McFarlane WJ, Winder CB, Duffield TF et al (2022) Factors influencing how Canadian dairy producers respond to a downer cow scenario. *Journal of Dairy Science* 105(1):684-694.

Neave HW, Sumner CL, Henwood RJT et al (2022) Dairy farmers' perspectives on providing cow-calf contact in the pasture-based systems of New Zealand. *Journal of Dairy Science* 105(1):453-467.

Nogues E, von Keyserlingk MAG, Weary DM (2022) Pain in the weeks following surgical and rubber ring castration in dairy calves. *Journal of Dairy Science* 104(12):12881-12886.

Pearson C, Filippi P, Lush L et al (2021) Automated behavioural monitoring allows assessment of the relationships between cow and calf behaviour and calves' survivability and performance. *Applied Animal Behaviour Science* 245, 105493.

Pisoni L, Devant M, Blanch M et al (2022) Simulation of feed restriction and fasting: Effects on animal recovery and gastrointestinal permeability in unweaned Angus-Holstein calves. *Journal of Dairy Science* 105(3):2572-2586.

Qiao Y, Xue T, Kong H et al (2022) One-shot learning with pseudo-labeling for cattle video segmentation in smart livestock farming. *Animals* 12(5), 558.

Rell J, Home R, Bähler C et al (2022) Motivations for Swiss veal farmers to adopt calf health management strategies that enable reduction in antibiotic use. *Animal Production Science* 62(5):490-500.

Röder M, Heuwieser W, Borchardt S et al (2022) The effect of transdermal flunixin meglumine on blood cortisol levels in dairy calves after cautery disbudding with local anesthesia. *Journal of Dairy Science* 105(4):3468-3476.

Russell ER, von Keyserlingk MAG, Weary DM (2022) Views of Western Canadian dairy producers on calf rearing: An interview-based study. *Journal of Dairy Science* 105(2):1480-1492.

Schnaider MA, Heidemann MS, Silva AHP et al (2022) Vocalization and other behaviors as indicators of emotional valence: The case of cow-calf separation and reunion in beef cattle. *Journal of Veterinary Behavior* 49:28-35.

Schnaider MA, Heidemann MS, Silva AHP et al (2022) Vocalization and other behaviors indicating pain in beef calves during the ear tagging procedure. *Journal of Veterinary Behavior* 47:93-98.

Shojaeipour A, Falzon G, Kwan P et al (2021) Automated muzzle detection and biometric identification via few-shot deep transfer learning of mixed breed cattle. *Agronomy* 11(11), 2365.

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.

Sun F, Zhao Q, Chen X et al (2022) Physiological Indicators and production performance of dairy cows with tongue rolling stereotyped behavior. *Frontier in Veterinary Science* doi:10.3389/fvets.2022.840726

Truman CM, Campler MR, Costa JHC (2022) Body condition score change throughout lactation utilizing an automated BCS System: A descriptive study. *Animals* 12(5), 601.

Tunstall J, Mueller K, Grove White D et al (2019) Lameness in beef cattle: UK farmers' perceptions, knowledge, barriers, and approaches to treatment and control. *Frontiers in Veterinary Science* doi:10.3389/fvets.2019.00094.

Werema CW, Laven L, Mueller K et al (2021) Evaluating alternatives to locomotion scoring for lameness detection in pasture-based dairy cows in New Zealand: Infra-red thermography. *Animals* 11(12), 3473.

Whalin L, Weary DM, von Keyserlingk MAG (2022) Prewaning dairy calves' preferences for outdoor access. *Journal of Dairy Science* 105(3):1817-2727.

Pigs

Albernaz-Gonçalves R, Antillón GO, Hötzel MJ (2022) Linking animal welfare and antibiotic use in pig farming—A review. *Animals* 12(2), 216.

Baert S, Aubé L, Haley DB et al (2022) To wallow or nurse: Sows housed outdoors have distinctive approaches to thermoregulation in gestation and lactation. *Applied Animal Behaviour Science* 248, 105575.

Boyle LA, Edwards SA, Bolhuis JE et al (2022) The evidence for a causal link between disease and damaging behavior in pigs. *Frontiers in Veterinary Science* 8, 771682.

Briefer EF, Sypherd CCR, Linhart P et al (2022) Classification of pig calls produced from birth to slaughter according to their emotional valence and context of production. *Scientific Reports* 12, 3409.

Bushby EV, Dye L, Collins LM (2021) Is magnesium supplementation an effective nutritional method to reduce stress in domestic pigs? A systematic review. *Frontiers in Veterinary Science* 7, 596205.

Camerlink I, Scheck K, Cadman T et al (2022) Lying in spatial proximity and active social behaviours capture different information when analysed at group level in indoor-housed pigs. *Applied Animal Behaviour Science* 246, 105540.

Camp Montoro J, Pessoa J, Solà-Oriol D et al (2022) Effect of phase feeding, space allowance and mixing on productive performance of grower-finisher pigs. *Animals* 12(3), 390.

Cerón JJ, Contreras-Aguilar M, Escribano D et al (2022) Basics for the potential use of saliva to evaluate stress, inflammation, immune system, and redox homeostasis in pigs. *BMC Veterinary Research* 18(1), 81.

Clouard C, Resmond R, Prunier A et al (2022) Exploration of early social behaviors and social styles in relation to individual characteristics in suckling piglets. *Scientific Reports* 12, 2318.

Eisermann J, Schomburg H, Knöll J et al (2022) Bite-o-Mat: A device to assess the individual manipulative behaviour of group housed pigs. *Computers and Electronics in Agriculture* 193, 106708.

Gaab T, Nogay E, Pierdon M (2022) Development and progression of shoulder lesions and their influence on sow behavior. *Animals* 12(3), 224.

Götz S, Raoult CMC, Reiter K et al (2022) Lying, feeding and activity preference of weaned piglets for led-illuminated vs. dark pen compartments. *Animals* 12(2), 202.

Heidinger B, Maschat K, Kuchling S et al (2022) Short confinement of sows after farrowing, but not pen type affects live-born piglet mortality. *Animal* 16(2), 100446.

Ipema AF, Gerrits WJJ, Bokkers EAM et al (2022) Assessing the effectiveness of providing live black soldier fly larvae (*Hermetia illucens*) to ease the weaning transition of piglets. *Frontiers in Veterinary Science* 9, 838018.

Ko HL, Temple D, Hales J et al (2022) Welfare and performance of sows and piglets in farrowing pens with temporary crating system on a Spanish commercial farm. *Applied Animal Behaviour Science* 246, 105527.

Kobek-Kjeldager C, Schönherz AA, Canibe N et al (2022) Diet and microbiota-gut-brain axis in relation to tail biting in pigs: A review. *Applied Animal Behaviour Science* 246, 105514.

Lin-Schilstra L, Fischer ARH (2022) Paradoxical consumers in four European countries: Meat-eating justification and willingness to pay for meat from animals treated by alternatives to surgical castration. *Meat Science* 188, 108777.

Liu M, Xu Q, Zhao J et al (2022) Pigs' skin lesions at weaning are primarily caused by standoff and being bullied instead of unilateral active attack at the individual level. *Applied Animal Behaviour Science* 247, 105556.

Ludwiczak A, Skrzypczak E, Składanowska-Baryza J et al (2021) How housing conditions determine the welfare of pigs. *Animals* 11(12), 3484.

Martinez A, Donoso E, Hernández RO et al (2022) Assessment of animal welfare in fattening pig farms certified in good livestock practices. *Journal of Applied Animal Welfare Science* 1-13.

Merlot E, Meunier-Salaün MC, Peuteman B et al (2022). Improving maternal welfare during gestation has positive outcomes on neonatal survival and modulates offspring immune response in pigs. *Physiology & Behavior* 249, 113751.

Nery da Silva A, Silva Araujo M, Pértile F et al (2022) How epigenetics can enhance pig welfare? *Animals* 12(1), 32.

Nielsen SS, Bicout DJ, Calistri P et al (2021) Assessment of animal diseases caused by bacteria resistant to antimicrobials: Swine. *EFSA Journal* 19(12), e07113.

O'Malley CI, Steibel JP, Bates RO et al (2022) The social life of pigs: Changes in affiliative and agonistic behaviors following mixing. *Animals* 12(2), 206.

Ocepek M, Žnidar A, Lavrič M et al (2022) DigiPig: First developments of an automated monitoring system for body, head and tail detection in intensive pig farming. *Agriculture* 12(1), 2.

Pan L, Nian H, Zhang R (2022). Stereotypic behaviors are associated with physiology and immunity differences in long-term confined sows. *Physiology & Behavior* 8(249), 113776.

Pandolfi F, Barber C, Edwards S (2022) The “real welfare” scheme: Changes in UK finishing pig welfare since the introduction of formal welfare outcome assessment. *Animals* 12(5), 607.

Pastorelli G, Serra V, Turin L et al (2022) Tranquillizing effect of passiflora incarnata extract: Outcome on behavioral and physiological indicators in weaning pigs with intact tails. *Animals* 12(2), 203.

Pérez-Ciria L, Miana-Mena FJ, López-Mendoza MC et al (2021) Influence of immunocastration and diet on meat and fat quality of heavy female and male pigs. *Animals* 11(12), 3355.

Romero MH, Sánchez JA, Hernandez RO (2022) Field trial of factors associated with the presence of dead and non-ambulatory pigs during transport across three Colombian slaughterhouses. *Frontiers in Veterinary Science* 9, 790570.

Sánchez-Salcedo JA, Yáñez-Pizaña A (2022) Effects of free farrowing system on the productive performance and welfare of sows and piglets. *Journal of Applied Animal Welfare Science* 7(1), 11.

Schodl K, Wiesauer L, Winckler C et al (2021) Reduced stocking density and provision of straw in a rack improve pig welfare on commercial fattening farms. *Frontiers in Veterinary Science* 8, 656211.

Stäbler R, Patzkéwitsch D, Reese S et al (2022) Behavior of domestic pigs under near-natural forest conditions with ad libitum supplementary feeding. *Journal of Veterinary Behavior* 48, 20-35.

Stukelj M, Hajdinjak, M, Pusnik I (2022) Stress-free measurement of body temperature of pigs by using thermal imaging – Useful fact or wishful thinking. *Computers and Electronics in Agriculture* 193, 106656.

Sundman ER, Gabler NK, Millman ST et al (2022) The use of attractants to stimulate neonatal piglet interest in rope enrichment. *Animals* 12(2), 211.

Tillmanns M, Scheepens K, Stolte M et al (2022) Implementation of a pig toilet in a nursery pen with a straw-littered lying area. *Animals* 12(1), 113.

Vandresen B, Hötzel MJ (2021) “Mothers should have freedom of movement”—Citizens’ attitudes regarding farrowing housing systems for sows and their piglets. *Animals* 11(12), 3439.

Vitali M, Sardi L, Martelli G et al (2021) Literature Review on the pre-slaughter welfare of Italian heavy pigs. *Animals* 11(12), 3352.

Wallgren T, Gunnarson S (2022) Implementation of straw racks in commercial pig housing—Impact on straw availability and pig behaviour. *Agriculture* 12(1), 5.

Poultry

Aldridge DJ, Owens CM, 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.

Attia YA, Rahman MT, Hossain MJ et al (2022) Poultry production and sustainability in developing countries under the COVID-19 crisis: Lessons learned. *Animals* 12(5), 644.

Badmus KA, Idrus Z, Meng GY et al (2021) Telomere length and regulatory genes as novel stress biomarkers and their diversities in broiler chickens (*Gallus gallus domesticus*) subjected to corticosterone feeding. *Animals* 11(10), 2759.

Bello KO, Irekhore OT, Adeitan OO et al (2022) Physiological response, haematology and stress condition of scavenging chickens in cement production areas. *Journal of Applied Animal Welfare Science* 1-12.

Campbell DLM, Belson S, Dyal TR et al (2022) Impacts of rearing enrichments on pullets’ and free-range hens’ positive behaviors across the flock cycle. *Animals* 12(3), 280.

Chew JA, Widowski T, Herwig E et al (2021) The Effect of light intensity, strain, and age on the behavior, jumping frequency and success, and welfare of egg-strain pullets reared in perchery systems. *Animals* 11(12), 3353.

Colapietro M, Ianni A, Bennato F et al (2022) Evaluation of commercial meat products of red chicken reared under LED lights. *Foods* 11(3), 370.

Derakhshani SM, Overduin M, van Niekerk TGCM et al (2022) Implementation of inertia sensor and machine learning technologies for analyzing the behavior of individual laying hens. *Animals* 12(5), 536.

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

El Sabry MI, Hassan SSA, Zaki MM et al (2022) Stocking density: A clue for improving social behavior, welfare, health indices along with productivity performances of quail (*Coturnix coturnix*)—A review. *Tropical Animal Health Production* 54, 83.

Ferreira VHB, Simoni A, Germain K et al (2022) Foraging behavior shows individual-consistency over time, and predicts range use in slow-growing free-range male broiler chickens. *Frontiers in Veterinary Science* 9, 814054.

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.

Gómez Y, Berezowski J, Jorge YA et al (2022) Similarity in temporal movement patterns in laying hens increases with time and social association. *Animals* 12(5), 555.

Göransson L, Yngvesson J, Gunnarsson S (2022) Bird health and welfare in slower-growing hybrids on Swedish commercial organic broiler chicken farms. *Journal of Veterinary Behavior* 48, 84.

Jeon JJ, Kim HJ, Kim HJ et al (2022). Effects of animal welfare-certified rearing systems on the blood parameters and meat quality characteristics of broilers at the farm level in Korea. *Food Science of Animal Resources* 42(1):128–141.

Jyotsnarani B, Kennady V, Bhattacharya TK et al (2021) Impact of heat stress on poultry production, *World's Poultry Science Journal* 78(1):179-196.

Kaewtapee C, Thepparak S, Rakangthong C et al (2021) Objective scoring of footpad dermatitis in broiler chickens using image segmentation and a deep learning approach: camera-based scoring system. *British Poultry Science* 1-7.

Karaarslan S, Tatli O, Kaya M et al (2021) Effects of barrier perch access and early dietary protein and energy dilution on some welfare parameters, tibiotarsus measurements, fear and mobility level in broiler chickens. *British Poultry Science* 63(2):99-107.

Krautwald-Junghanns ME, Sirovnik J (2022) The influence of stocking density on behaviour, health, and production in commercial fattening turkeys - A review. *British Poultry Science* doi:10.1080/00071668.2022.2050673.

Krunt O, Kraus A, Zita L et al (2022) The effect of housing system and gender on relative brain weight, body temperature, hematological traits, and bone quality in Muscovy ducks. *Animals* 12(3), 370.

Leishman EM, van Staaveren N, Osborne VR et al (2022) The prevalence of integument injuries and associated risk factors among Canadian turkeys. *Frontiers in Veterinary Science* 8, 757776.

Liu H, Qi J, Yang Q et al (2022) Effects of cage and floor rearing systems on the metabolic components of the uropygial gland in ducks. *Animals* 12(2), 214.

López-López P, Sarmiento-Franco LA, Santos-Ricalde R (2021). Effect of stocking density on performance, infection by *Eimeria* spp., intestinal lesions and foot pad injuries in broilers with outdoor access under tropical conditions. *British Poultry Science* 63(2):108-114.

Louton H, Bergmann S, Piller A et al (2022) Automatic Scoring system for monitoring foot pad dermatitis in broilers. *Agriculture* 12(2), 221.

Makinde TO, Adewole DI (2022) Can feed additives be used to promote positive behaviour in laying hens? A review, *World's Poultry Science Journal* 78(1):21-40.

Mens AJW, van Emous RA (2022) Broiler breeders roosted more on slats than on perches during the laying period. *Applied Animal Behaviour Science* 246, 105531.

Neethirajan S (2022) Automated tracking systems for the assessment of farmed poultry. *Animals* 12(3), 232.

Nielsen SS, Bicout DJ, Calistri P et al (2021) Assessment of animal diseases caused by bacteria resistant to antimicrobials: Poultry. *EFSA Journal* 19(12), e07114.

Onbasilar E (2022) Effect of alternative litter materials on the behaviour of male broilers. *Behavioural Processes* 195, 104566.

Oso OM, Metowogo K, Oke OE et al (2022) Evaluation of light emitting diode characteristics on growth performance of different poultry species: A review. *World's Poultry Science Journal* 1-15.

Pepper CM, Dunlop MW (2021) An industry survey on litter management and re-use practices of Australian meat chicken growers. *Animal Production Science* 62:401-408.

Pijpers N, van den Heuvel H, Duncan IH et al (2022) Understanding chicks' emotions: Are eye blinks & facial temperatures reliable indicators? *bioRxiv* doi:10.1101/2022.01.31.478468.

Rana MS, Lee C, Lea JM et al (2022) Commercial free-range laying hens' preferences for shelters with different sunlight filtering percentages. *Animals* 12(3), 344.

Sandøe P, Hansen HO, Forkman B et al (2022) Market driven initiatives can improve broiler welfare—A comparison across five European countries based on the Benchmark method. *Poultry Science* 101(5), 101806.

Sans ECO, Tuytens FAM, Taconeli CA et al (2021) From the point of view of the chickens: What difference does a window make? *Animals* 11(12), 3397.

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(4), 101768.

Sobotik EB, Nelson JR, Pavlidis HO et al (2022) Evaluating the effects of supplementing *Saccharomyces cerevisiae* in the feed or drinking water on stress susceptibility of broilers. *Journal of Applied Poultry Research* 31(1), 100220.

Sözcü A, İpek A, Oğuz Z et al (2022) Comparison of behavioral time budget and welfare indicators in two local laying hen genotypes (atak-s and atabey) in a free-range system. *Animals* 12(1), 46.

Sugiharto S (2022) Dietary strategies to alleviate high-stocking-density-induced stress in broiler chickens - A comprehensive review. *Archive Animal Breeding* 65(1):21-36.

Tahamtani FM, Kittelsen K, Vasdal G (2022) Environmental enrichment in commercial flocks of aviary housed laying hens: relationship with plumage condition and fearfulness. *Poultry Science* 101(4), 101754.

Tainika B, Bayraktar ÖH (2022) Lighted incubation: embryonic development, hatchability and hatching quality of broiler chicks. *World's Poultry Science Journal* 78(1):161-178.

Taylor PS, Hemsworth PH, Rault JL (2022) Environmental complexity: Additional human visual contact reduced meat chickens' fear of humans and physical items altered pecking behavior. *Animals* 12(3), 310.

Tetel V, Wyk, BV, Fraley GS (2022) Sex differences in glucocorticoid responses to shipping stress in Pekin ducks. *Poultry Science* 101(1):101534-101534.

Topal E, Petek M (2021) Effects of fully or partially slatted flooring designs on the performance, welfare and carcass characteristics of broiler chickens. *British Poultry Science* 62(6):804-809.

Vasdal G, Muri K, Stubbsjøen SM et al (2022) Qualitative behaviour assessment as part of a welfare assessment in flocks of laying hens. *Applied Animal Behaviour Science* 246, 105535.

Verlinden SMD, Larsen MLV, Debontridder P et al (2022) Effect of lower temperature stimuli during incubation on fear and social-related behaviours in broilers. *Applied Animal Behaviour Science* 248, 105572.

Vostrizansky A, Barce A, Gum Z et al (2022). Effect of pre-hatch incubator lights on the ontogeny of CNS opsins and photoreceptors in the Pekin duck. *Poultry Science* 101(4), 101699.

Wang Y, Zhang R, Wang L et al (2022) Effect of social order, perch, and dust-bath allocation on behavior in laying hens. *Animal Bioscience* 35(2):299-307.

Wei H, Feng Y, Ding S et al (2022) Keel bone damage affects behavioral and physiological responses related to stress and fear in two strains of laying hens. *Journal of Animal Science* doi:10.1093/jas/skac076.

Wood B, Rufener C, Makagon MM et al (2021) The utility of scatter feeding as enrichment: Do broiler chickens engage with scatter-fed items? *Animals* 11(12), 3478.

Yan C, Liu W, Xiao J et al (2022) Learning ability and hippocampal transcriptome responses to early and later life environmental complexities in dual-purpose chicks. *Animals* 12(5), 668.

Yoshida Y, Nishimura S, Tabata S et al (2021) Chicken taste receptors and perception: Recent advances in our understanding of poultry nutrient-sensing systems. *World's Poultry Science Journal* 78(1):5-20.

Zhang Y, Wang Z, Dong Y et al (2022) Blue light alters the composition of the jejunal microbiota and promotes the development of the small intestine by reducing oxidative stress. *Antioxidants* 11(2), 274.

Sheep/Goats

Colditz I, Vuocolo T, Denman S et al (2022) Fleece rot in sheep: A review of pathogenesis, aetiology, resistance and vaccines. *Animal Production Science* 62(3):201-215.

Clune T, Lockwood A, Hancock S et al (2022) Abortion and lamb mortality between pregnancy scanning and lamb marking for maiden ewes in southern Australia. *Animals* 12(1), 10.

Denman S, Tellam R, Vuocolo T et al (2022) Fleece rot and dermatophilosis (lumpy wool) in sheep: Opportunities and challenges for new vaccines. *Animal Production Science* 62(4):301-320.

Hydbring-Sandberg E, von Walter LW, Forkman B (2022) Cortisol is not enough: A complex stress reaction in tethered goats. *Animal Welfare* 31(1):91-98(8).

Kearton T, Marini D, Lee et al (2021) The influence of observing a maternal demonstrator on the ability of lambs to learn a virtual fence. *Animal Production Science* 62(5):470-481.

Kotze AC, James PJ (2022) Control of sheep flystrike: What's been tried in the past and where to from here. *Australian Veterinary Journal* 100(1-2):1-19.

Marcone G, Carnovale F, Arney D et al (2022) A simple method for on-farm evaluation of sheep welfare using animal-based indicators. *Small Ruminant Research* 208, 106636.

Schoiswohl J, Stanitznig A, Sigmund M et al (2021) Comparison of alternative disbudding methods with hot-iron dehorning of goat kids. *Journal of Veterinary Behavior* 46:31-39.

Stephenson E, Haskell MJ (2022) The use of a "go/go" cognitive bias task and response to a novel object to assess the effect of housing enrichment in sheep (*Ovis aries*). *Journal of Applied Animal Welfare Science* 25(1):62-74.

Ungerfeld R, Fernández-Werner A, Gökdağ Ö et al (2021) Lambs identify their mothers' bleats but not a picture of her face. *Journal of Veterinary Behavior* 46:69-73.

General (farm animals)

Acharya RY, Hemsworth PH, Coleman GJ et al (2022) The animal-human interface in farm animal production: Animal fear, stress, reproduction and welfare. *Animals* 12(4), 487.

Bozzo G, Corrente M, Testa G et al (2021) Animal welfare, health and the fight against climate change: One solution for global objectives. *Agriculture* 11(12), 1248.

Canozzi MEA, Borges JAR, Barcellos JOJ (2022) Which factors can influence the perception of pain by veterinarians and animal scientists from Brazil? *Journal of Veterinary Behavior* 47:59-69.

Chen S, Luo S, Yan C (2022) Gut microbiota implications for health and welfare in farm animals: A review. *Animals* 12(1), 93.

Chriki S, Ellies-Oury M-P, Hocquette J-F (2022) Is "cultured meat" a viable alternative to slaughtering animals and a good compromise between animal welfare and human expectations? *Animal Frontiers* 12(1):35-42.

Ciborowska P, Michalczuk M, Bień D (2021) The effect of music on livestock: Cattle, poultry and pigs. *Animals* 11(12), 3572.

Dieterle JM (2022) Agency and autonomy in food choice: Can we really vote with our forks? *Journal of Agricultural and Environmental Ethics* 35(5).

Hernandez E, Llonch P, Turner PV (2022) Communication: Applied animal ethics in industrial food animal production: Exploring the role of the veterinarian. *Animals* 12(6), 678.

Littlewood KE, Beausoleil NJ (2021) Two domains to five: Advancing veterinary duty of care to fulfil public expectations of animal welfare expertise. *Animals* 11(12), 3504.

Neethirajan S (2022) Affective state recognition in livestock—Artificial intelligence approaches. *Animals* 12(6), 759.

Paci P, Mancini C, Nuseibeh B (2022) The case for animal privacy in the design of technologically supported environments. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.784794.

Regan A, Sweeney S, McKernan C et al (2021) The Impact of the Covid-19 pandemic on food consumers' awareness of antimicrobial resistance, OneHealth, and animal welfare information on food labels. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.678509.

Rowe E, Mullan S (2022) Advancing a "good life" for farm animals: Development of resource tier frameworks for on-farm assessment of positive welfare for beef cattle, broiler chicken and pigs. *Animals* 12(5), 565.

Whitton C, Bogueva D, Marinova D et al (2021) Are we approaching peak meat consumption? Analysis of meat consumption from 2000 to 2019 in 35 countries and its relationship to gross domestic product. *Animals* 11(12), 3466.

ANIMALS IN SPORT, ENTERTAINMENT, PERFORMANCE, RECREATION AND WORK

Acebes F, Pellitero JL, Muñoz-Diez C et al (2022) Development of desirable behaviors in dog-assisted interventions. *Animals* 12(4), 477.

Dyson S, Pollard D et al (2022) Application of the ridden horse pain ethogram to horses competing in British eventing 90, 100 and novice one-day events and comparison with performance. *Animals* 12(5), 590.

Flash ML, Crabb HK, Hitchens PL et al (2021) Factors associated with racing performance and career duration for Victorian-born Thoroughbreds. *Australian Veterinary Journal* 100(1-2):48-55.

Flash ML, Crabb HK, Hitchens PL et al (2021) Participation of Victorian Thoroughbreds in the racing industry: A whole-of-population benchmark. *Australian Veterinary Journal* 100(1-2):40-47.

Furtado T, Preshaw L, Hockenhull J et al (2021) How happy are equine athletes? Stakeholder perceptions of equine welfare issues associated with equestrian sport. *Animals* 11, 3228.

Gandenberger J, Flynn E, Moratto E et al (2022) Molecular biomarkers of adult human and dog stress during canine-assisted interventions: A systematic scoping review. *Animals* 12(5), 651.

Lofgren EA, Rice BMG, Brady CM (2022) Exploring perceptions of equine welfare scenarios using a positive approach. *Applied Animal Welfare Science* 25(1):54-61.

Luke KL, Rawluk A, McAdie T (2022) A new approach to horse welfare based on systems thinking. *Animal Welfare* 31:37-49.

McDuffee L, Carr L, Montelpare W (2022) An observational evaluation of stress in horses during therapeutic riding sessions. *Journal of Veterinary Behavior* 49:53-64.

McManus B, Good G, Yeung P (2021) Interactions between the public and assistance dog handlers and trainers. *Animals* 11(12), 3359.

Mignot A, de Luca K, Servais V et al (2022) Handlers' representations on therapy dogs' welfare. *Animals* 2022, 12(5), 580.

Ortolani F, Scilimati N, Gialletti R et al (2021) Development and preliminary validation of a pain scale for ophthalmic pain in horses: The Equine Ophthalmic Pain Scale (EOPS) *Veterinary Journal* 278, 105774.

Pechette Markley A, Shoben AB, Kieves NR (2022) Internet survey of risk factors associated with training and competition in dogs competing in agility competitions. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.791617.

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:10.1080/10888705.2021.2012783.

Riley CB, Rogers CW, Thompson KR et al (2022) A survey-based analysis of injuries to horses associated with transport by road in New Zealand. *Animals* 12(3), 259

ANIMALS IN RESEARCH AND TEACHING

Kapusta J, Kriczek M, Pochron E et al (2022) Welfare of encaged rodents: Species specific behavioral reaction of voles to new enrichment items. *Applied Animal Behaviour Science* 246, 105522.

Kitchenham L, Nazal B, Adcock A et al (2022) Why does lifelong conventional housing reduce the sociability of female mice? *Applied Animal Behaviour Science* 246, 105532.

WILD ANIMALS

Brereton J, Rose P (2022) An evaluation of the role of 'biological evidence' in zoo and aquarium enrichment practices. *Animal Welfare* 31(1):13-26.

Goldsborough Z, Sterck EHM, de Waal FBM et al (2022) Individual variation in chimpanzee (*Pan troglodytes*) repertoires of abnormal behaviour. *Animal Welfare* 31(1):125-135.

Guest EE, Stamps BF, Durish ND et al (2022) An updated review of hypotheses regarding bat attraction to wind turbines. *Animals* 12, 343.

Shaw MN, McLeod EM, Borrie WT et al (2022) Human positioning in close-encounter photographs and the effect on public perceptions of zoo animals. *Animals* 12(1), 11.

Stephens T (2021) Kangaroo management and animal welfare. *Ecological Management & Restoration. Special Issue: Optimum management of overabundant macropods* 22(S1):71-74.

White P, Van Valkenburgh B (2022) Low-cost forensics reveal high rates of non-lethal snaring and shotgun injuries in Zambia's large carnivores. *Frontiers in Conservation Science* 3, 803381.

TRANSPORTATION OF ANIMALS

Bachelard N (2022) Animal transport as regulated in Europe: a work in progress as viewed by an NGO. *Animal Frontiers* 12(1):16-24.

Goetz HM, Winder CB, Costa JHC et al (2022) Characterizing the literature surrounding transportation of young dairy calves: A scoping review. *Journal of Dairy Science* 105(2):1555-1572.

Marcato F, van den Brand H, Kemp B et al (2022) Calf and dam characteristics and calf transport age affect immunoglobulin titers and hematological parameters of veal calves. *Journal of Dairy Science* 105(2):1432-1451.

Marcato F, van den Brand H, Kemp B et al (2022) Effects of transport age and calf and maternal characteristics on health and performance of veal calves. *Journal of Dairy Science* 105(2):1452-1468.

Menchetti L, Nanni Costa L, Zappaterra M et al (2021) Effects of reduced space allowance and heat stress on behavior and eye temperature in unweaned lambs: A pilot study. *Animals* 11(12), 3464.

HUMANE KILLING

Browning H, Veit W (2022) The importance of end-of-life welfare. *Animal Frontiers* 12(1):8-15.

Burgstaller J, Wittek T, Sudhaus-Jörn N et al (2022) Associations between animal welfare indicators and animal-related factors of slaughter cattle in Austria. *Animals* 12(5), 659.

Conficoni D, Zaghi M, Rossin T et al (2022) Meeting religious requirements and food safety during ritual slaughter: A case study on how Italian authorities handle the issue. *Animal Frontiers* 12(1):25-34.

Friedman A, Dalla Costa FA, Dalla Costa OA et al (2021) Time to loss of behavioral and brainstem responses of ducks following non-stunned slaughter. *Animals* 11(12), 3531.

Hultgren J, Schiffer KJ, Babol J et al (2022) Animal welfare and food safety when slaughtering cattle using the gunshot method. *Animals* 12(4), 492.

Leffert S (2021) Is ongoing ritual slaughter of livestock justifiable in modern America? *Journal of Applied Animal Research* 49(1):492-522.

Losada-Espinosa N, Estévez-Moreno LX, Bautista-Fernández M et al (2021) Cattle welfare assessment at the slaughterhouse level: Integrated risk profiles based on the animal's origin, pre-slaughter logistics, and iceberg indicators. *Preventive Veterinary Medicine* 197, 105513.

McDermott P, McKeivitt A, Hanlon A (2022) On farm emergency slaughter and emergency killing of acutely injured cattle: Analysis of guidelines from five jurisdictions. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.795227.

Merenda VR, de Oliveira EB, Fowler HN et al (2022) Dairy cattle euthanasia—Focus groups exploring the perspectives of Brazilians working in the dairy cattle industry. *Animals* 12(4), 409.

Terlouw EMC, Veissier I (2022) Animal welfare during transport and slaughter: An issue that remains to be solved. *Animal Frontiers* 12(1):3-5.

Quain A, Mullan S, Ward MP (2022) Low and no-contact euthanasia: Associated ethical challenges experienced by veterinary team members during the early months of the COVID-19 pandemic. *Animals* 12(5), 560.

Zappaterra M, Padalino B, Menchetti L et al (2022) Carcass lesion severity and pre-slaughter conditions in heavy pigs: A prospective study at a commercial abattoir in northern Italy. *Applied Sciences* 12(3), 1078.

Žurek J, Rudy M, Duma-Kocan P et al (2022) Impact of Kosher slaughter methods of heifers and young bulls on physical and chemical properties of their meat. *Foods* 11(4), 622.

MISCELLANEOUS

Anthony R, De Paula Vieira A (2022) One Health animal disaster management: An ethics of care approach. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2022.2040360.

Argent G (2022) Human-animal relationships and welfare in the anthropocene: Pandemics, climate change, and other disasters. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2022.2042299.

Boyle L, Conneely M, Kennedy E et al (2022) Animal welfare research – Progress to date and future prospects. *Irish Journal of Agricultural and Food Research* doi:10.15212/ijafr-2020-0151.

Chan MCH, Schonert-Reichl KA, Binfet JT (2022) Human–animal interactions and the promotion of social and emotional competencies: A scoping review. *Anthrozoös* doi:10.1080/08927936.2022.2042080.

Fernandez EJ (2022) Training as enrichment: A critical review. *Animal Welfare* 31(1):1-12.

Gandenberger J, Hawes SM, Wheattall E et al (2021) Development and initial validation of the Animal Welfare Cultural Competence Inventory (AWCCI) to assess cultural competence in animal welfare. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2021.2008934.

Garcia A, McGlone JJ (2022) Animal welfare and the acknowledgment of cultural differences. *Animals* 12(4), 474.

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

Ireland JL, Birch P, Lewis M et al (2022) Animal abuse proclivity among women: Exploring callousness, sadism, and psychopathy traits. *Anthrozoös* 35(1):37-53.

Jenkins JL Jr, Rudd ML (2022) Decolonizing animal welfare through a social justice framework. *Frontiers in Veterinary Science* 8, 787555.

Johnstone ECS, Frye MA, Lord LK et al (2019) Knowledge and opinions of third year veterinary students relevant to animal welfare before and after implementation of a core welfare course. *Frontiers in Veterinary Science* doi:10.3389/fvets.2019.00103.

Milburn J, Bobier C (2022) New omnivorism: A novel approach to food and animal ethics. *Food Ethics* 7, 5.

Overall KL (2022) Horses, dolphins, dogs and cats: Pursuing improved welfare through standardized assessment. *Journal*

of Veterinary Behavior 47, A1-A2.

Patrizia P, Clara M, Bashar N (2022) The case for animal privacy in the design of technologically supported environments. *Frontiers in Veterinary Science* doi:10.3389/fvets.2021.784794.

Persson K, Gerdts WR, Hartnack S et al (2022) Assessing moral judgements in veterinary students: An exploratory mixed-methods study from Germany. *Animals* 12(5), 586.

Pietrzykowski T, Smilowska K (2022) Kinds of harm: Animal law language from a scientific perspective. *Animals* 12(5), 557.

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:10.1080/10888705.2021.2012783.

Potocka A (2022) The moral foundations of care and authority and the perception of animal mind in relation to violence against animals. *Anthrozoös* 35(1):105-123.

Rault JL, Sandøe P, Sonntag Q et al (2022) Positive animal welfare: Bridging the gap or raising inequalities worldwide? *Frontiers in Animal Science* 3, 825379.

Roberts KC, Buckingham TL, Janke KJ et al (2021) Where are we on the animal welfare map? Using GIS to assess stakeholder diversity and inclusion. *Frontiers in Veterinary Science* 8, 1499.

Stephens T (ed) (2022) One welfare in practice: The role of the veterinarian. CRC Press, Florida, United States.

Veit W, Browning H (2021) Developmental programming, evolution, and animal welfare: A case for evolutionary veterinary science. *Journal of Applied Animal Welfare Science* doi:10.1080/10888705.2021.2014838.

