animal welfare science update

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.

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farm animals

Pain in prawns

While it is generally accepted that all animals can detect harmful stimuli and react accordingly to them, the question of whether invertebrates can experience the sensation of pain remains to be answered convincingly. Insects can learn to avoid electric shocks, and the injection of bee venom into a spider leg can cause that leg to be shed; such experiments give some indication that these animals might experience a sensation that they would prefer to avoid. Prompted by a question, by the British seafood chef Rick Stein, on the ability of crustaceans to feel pain, the authors of this paper carried out an experiment on the Irish glass prawn.

The prawns were divided into two groups: one received a coat of the anaesthetic Benzocaine on one of their antennae, and the other received no anaesthetic. Prawns from each of the groups were then subjected to one of the following treatments: the application of vinegar, caustic soda solution or a pinch from a pair of forceps to the treated antenna. The researchers found that the Benzocaine-treated animals showed less tail-flicking behaviour (an escape response) on application of the chemical or physical stimuli. More importantly, however, the animals that had not received any anaesthetic were seen to groom the affected antenna and rub it against the sides of the aquarium significantly more than the Benzocaine-treated animals. This is similar to the responses to harmful stimuli seen in a wide range of vertebrate animals, such as rats, fish and frogs, where rubbing and grooming can serve to reduce pain signals. The authors suggest that their experimental results are consistent with the idea that prawns can experience pain.

Barr, S. et al. (2007) Nociception or pain in a decapod crustacean? *Animal Behaviour* (epub).

Feather pecking and cannibalism in hens

Hens reared in large groups can develop behavioural problems such as feather pecking, which, in severe cases, can lead to the target animal being wounded and killed. This behaviour therefore has the potential to negatively impact not only animal welfare, but also productivity. This review article explores the possible triggers of feather pecking behaviour, and also discusses the research to date on the techniques that can be employed to minimize this behaviour.

Feather pecking is different from aggressive pecking, which is used to establish and maintain a dominance hierarchy among hens. Instead, feather pecking is thought to be a misdirected ground pecking behaviour, as rearing chicks on a sand, straw or grain substrate can reduce this behaviour later in life (as compared to chicks reared in pens with slatted floors). This behaviour seems to have a genetic basis, and is often associated with hens of certain colours or strains. The conventional practice among animal breeders is to select hens based on individual characteristics such as egg production and growth rates. The authors suggest that selecting entire groups of hens (for breeding) that display low rates of feather pecking might be more advantageous in the long run.

The conditions under which chicks are reared also seem to have a bearing on the later development of feather pecking. Chicks exposed to low levels of stress hormones are less fearful later in life, and exhibit reduced feather pecking behaviour. Chicks raised under dark brooders (i.e. without heating lamps), or in the presence of their mother, both showed lower levels of feather pecking. This last finding has wide-ranging implications for the industry, as poultry species are about the only domesticated animals in which mother and offspring are completely separated in practice, for the purposes of hygiene and efficiency.

Rodenburg, T. *et al.* (2007) Selection method and early-life history affect behavioural development, feather pecking and cannibalism in laying hens: A review. *Applied Animal Behaviour Science* (epub.).

Rooting pigs

Rooting is an important natural behaviour exhibited by pigs, and involves digging through soil or other artificial substrates with their snout or lower jaw. As domestic pigs living in a semi-natural environment can spend up to 52% of the daylight period foraging (rooting and grazing), this review article discusses possible motivations for rooting behaviour, and presents evidence supporting the appropriateness of certain materials that should be provided to pigs being reared in artificial housing.

Pigs will engage in exploratory behaviour, such as rooting, to satisfy their twin demands of hunger and curiosity. Often, even pigs reared with constant access to food might root out of hunger – this is because pigs prefer to feed with other pigs, and the resulting competition for food at certain times of the day might cause certain individuals to go hungry, and engage in rooting behaviour. Pigs will also root to gain more information about their environment. This is particularly true when they first encounter a new material or object, or when they are brought to a new location. The authors therefore suggest providing pigs with material that is changeable, as well as destructible, so as to maintain its novelty value. It is also helpful if the material contains edible parts, as this may stimulate foraging behaviour.

Failure to provide pigs with material in which they can root can lead to the development of abnormal behaviours directed at other pigs. The availability of an enrichment material such as straw might even be more important than the availability of more space in reducing abnormal behaviours. Many materials can be used to the same effect: in fact, peat, mushroom compost and sawdust seem to be received more favourably by pigs than straw or bark chips, while non-manipulable materials and objects such as rope, rubber items and food/straw dispensers fare less well.

Studnitz, M. *et al.* (2007) Why do pigs root and in what will they root? A review on the exploratory behaviour of pigs in relation to environmental enrichment. *Applied Animal Behaviour Science*, **107**: 183–197.

Beak trimming in chickens

Beak trimming of commercial poultry is carried out to prevent aggression, feather-pecking and cannibalism among birds. While it is generally regarded as an effective and necessary procedure, a range of welfare concerns have been raised, and involve functional loss, long- and short-term pain, scarring and tongue damage. The author of this review article first describes the anatomy of the chicken beak in some detail, before going on to describe elements of the nervous system associated with the beak and with feeding, in an attempt to address these welfare concerns.

The practice of beak trimming normally involves removal of 50% of the beak. Anatomical structures that would be removed in such an operation include blood vessels, and touch and pain receptors, while taste receptors, the tongue and salivary glands should remain intact. Food and water intake appears to decline temporarily after beak trimming, as does preening; however, this tends to return to normal levels, especially if the birds undergo the procedure at an early age. The same applies to short-term pain: the procedure itself is accompanied by a sensation of pain, but in younger birds (day-old chicks) the stress response appears to be negligible. Some nervous scar tissue does form at the site of injury, but this appears to be temporary; persistent scarring only seems to occur when excessive amounts of beak are removed, especially at a later age.

It has been suggested that beak-trimmed birds might feel sensations similar to phantom-limb pain in human amputees. After comparing the bird brain to the mammalian cortex, however, the author concludes that this is unlikely, as the structures in the bird brain are too dissimilar to those found in the mammalian cortex. The author concludes that beak trimming should be carried out preferably within the first week after hatching, and should involve the removal of no more than 50% of the beak, in order to minimize functional loss, discomfort, scar tissue and misshapen beaks, and to enhance recovery, and avoid long-term pain.

Kuenzel, W. (2007) Neurobiological Basis of Sensory Perception: Welfare Implications of Beak Trimming. *Poultry Science*, **86**(6): 1273-1282.

The transport of slaughter pigs

Like other farm animals, pigs are susceptible to the stress-inducing effects of transportation. Transportation can induce a range of symptoms, including increased blood cortisol and adrenaline, increased heart rate, higher concentrations of white blood cells, lameness, and death through general circulatory breakdown. The

last effect is known to be correlated with a genetic mutation, which causes a condition called malignant hyperthermia syndrome (MHS). From the economic point of view, animals surviving this condition can have poor quality meat, due to change in blood acid-base levels.

The authors of this article report the changes in the mortality of transported pigs over the years 1999-2003, using documentation obtained from a large German slaughter company. The results showed that mortality had decreased over the period under investigation, due to the tightening of European transport regulations (through e.g. improved vehicle design and improvements in the skills of animal handlers) and the eradication of the MHS strain from the population. Mortality was highest in the summer months, when the potential for heat stress was highest. Surprisingly, however, mortality was higher not only for very long periods of transportation (eight hours), but also for very short trips (of one hour). In fact, the percentages of pathological findings (e.g. circulatory problems, fractures) were higher after short journeys. The authors suggest that this may be due to the fact that pigs on short journeys have less time to recover from the stress of loading, before they face the additional stress of being unloaded.

Werner, C. *et al.* (2007) Short as well as long transport duration can affect the welfare of slaughter pigs. *Animal Welfare*, **16**: 385-389.

Effects of pre-haul management and transport duration on calves

The transportation of beef calves is a potentially stressful procedure for the animals, and can result in economic losses due to acute respiratory disease, injury and death. Preconditioning is a management technique that involves vaccination at least three weeks prior to sale or shipment (and at an age of four months or more), and castration, treatment for warbles and dehorning at least three weeks prior to sale. It is also necessary that calves be weaned for a minimum of 45 days, and that they be trained to eat from a feed bunk before being transported. This experimental study involved a total of 174 steer calves, half of which were subjected to a modified preconditioning regime. Equal numbers from each group were then transported in commercial tandem transport trailers for short-haul (2.7 hours) and long-haul (15 hours) trips.

The results indicate that non-conditioned calves appeared more unsettled than conditioned calves, and spent more time moving, standing, and displaying weaning-related stress behaviours such as bawling. Non-conditioned calves also had higher blood levels of the stress hormone cortisol at the pre-loading and off-loading stages, while conditioned calves subjected to the short-haul journey had the lowest heart rate of all four groups. These calves also displayed the lowest weight loss (as a result of transport) and the greatest intake of dry food and average daily weight gain. The authors conclude that conditioning calves prior to transport, coupled with short transport times, allows the animals to better cope with the stresses of transport and handling.

Schwartzkopf-Genswein, K. *et al.* (2007) Effects of pre-haul management and transport duration on beef calf performance and welfare. *Applied Animal Behaviour Science*, **108**: 12–30.

Gas-stunning of chickens

Chickens are typically stunned before slaughter by dipping them head-first into an electrified water bath. Although this should ideally cause immediate and prolonged unconsciousness, there are aspects of this technique that could negatively impact on animal welfare. For instance, birds are shackled live and held upside down, they might miss the water bath completely and be slaughtered fully conscious, or they may receive pre-stunning shocks through their wings as they dangle down. This research article therefore investigates three alternative means of stunning chickens – low oxygen, high carbon dioxide (CO_2) and a two-step procedure involving a stepped increase in CO_2 concentration.

The researchers exposed individual chickens to each treatment, and simultaneously recorded their behaviour, breathing movements, and electrical activity from the brain and heart. The researchers found that all the approaches tested had potentially negative aspects: low oxygen was associated with vigorous behavioural responses (such as wing flapping, which may cause injury) in a period when consciousness could not be excluded, while high CO_2 induced strong respiratory responses (such as gasping, with possible sensations of pain). The two-step procedure produced far fewer behavioural responses, but was associated with respiratory responses, and also took longer to take effect. The authors state that deciding between the relative importance of respiratory discomfort versus potentially negative behavioural responses is ultimately a value judgement as to which is deemed a more significant issue for the animal. Moreover, as one study has shown that chickens readily return to normal feeding behaviour after brief periods of respiratory discomfort, this might be a 'price worth paying' to eliminate the other side effects of stunning.

McKeegan, D. *et al*. (2007) Physiological and behavioural responses of broilers to controlled atmosphere stunning: implications for welfare. *Animal Welfare*, **16**: 409-426.

animals used for sport and entertainment

Racehorse fatalities in jump starts

Although less than 1% of all races in Australia are jump starts (i.e. steeplechase or hurdle), they are almost 19 times more likely than flat starts to cause serious injury and death (see "Racehorse fatalities in flat starts"). As the vast majority of jump starts in Australia take place in Victoria, the authors of this study investigated horses taking part in such races on all Victorian racecourses between 1989 and 2004.

The researchers found that several variables related to prior race participation were associated with the risk of fatality. For example, horses with longer racing careers were less likely to die from a jump start. However, the underlying reason might be the 'healthy horse effect': less healthy horses would have died early in their careers, leaving only fit horses to continue racing for a long time. On the other hand, a horse that had participated in more flat or jump starts previously, also had an increased risk of fatality. Putting these findings together, the authors conclude that the intensity of racing exercise (i.e. the number of races over a given career length) is an important risk factor. They also suggest that the Victorian racing industry set limits on the number of flat starts a horse may have before it commences jump racing, and increasing the interval between successive jump starts. Finally, the odds of fatality were increased for steeplechase starts relative to hurdle starts, possibly due to differences in race length, and the size of the obstacles the horses need to jump over.

Boden, L. *et al*. (2007) Risk factors for thoroughbred racehorse fatality in jump starts in Victoria, Australia (1989–2004). *Equine Veterinary Journal*, **39**(5): 422-428.

Racehorse fatalities in flat starts

The death of racehorses during or immediately after races is a cause of concern not only for the industry, but also for those interested in the animals' welfare. Only two studies have investigated racehorse fatalities in Australia, but research in other parts of the world has uncovered a range of factors that may be responsible for this phenomenon. As some studies have shown that the risk factors may differ among countries and among the regions within a single country, the authors of this paper examined the conditions that appear to be correlated with the death of racehorses among all racetracks in Victoria. The authors compared the records of horses that had died during or immediately after a race, or had been euthanised within 24 hours of completing a race.

The researchers found that male horses were more than twice as likely to die as females or geldings. It is suggested that sex hormones might play a role in the horses' responses to injury and high levels of exercise. The trend might also reflect the willingness of horse owners to withdraw females from races when they suffer minor injuries, and use them for breeding purposes. Geldings and males might have a greater chance of participating in races in spite of previous injuries. The recent racing history of horses was also an important risk factor: horses that had raced one to two months previously were more likely to die in a subsequent race, possibly as a consequence of accumulated stress and injury.

Prior experience in jump races tended to reduce the chances of death in a flat race, an observation that the authors were unable to explain. On the other hand, long races were far more likely to end in a fatality than were short races. Finally, track condition seems to also play a role in determining the risk of fatality. The authors suggest that the water content of tracks might alter the stress placed on the limb bones during the high-speed exercise of a race. The pattern is quite complicated, however: a low water content in well-turfed tracks and a high water content in dirt tracks both increase the risk of injury and fatality. The level of maintenance and turf coverage of country racecourses was also found to be an important factor.

Boden, L. *et al*. (2007) Risk factors for thoroughbred racehorse fatality in flat starts in Victoria, Australia (1989–2004). *Equine Veterinary Journal*, **39**(5): 430-437.

The advent of equitation science

The First International Equitation Science Symposium was held in Australia in 2005, attracting speakers from six countries, and attendees from many more. The new field of equitation science aims to develop scientific methods to study, measure and interpret interactions between horse and rider. The author of this review article first explores the current state of understanding of horse behaviour and the techniques used by trainers, and then suggests possible avenues for future research, aimed at a better appreciation of the horses' reactions during a given task.

The training of horses currently makes extensive use of the phenomenon of negative reinforcement, where an animal learns to perform a behaviour in order to avoid an unpleasant stimulus. Thus, a horse can be trained to move forward upon feeling the pressure of the rider's spurs; the horse can also learn to stop in order to escape the pressure of the bit. The author advocates the use of scientific methodology not to replace the art of equestrianism, but to objectively measure the amount of discomfort that the horse might feel during such practices, and thereby improve animal welfare. A scientific approach would also result in better-trained animals, as dangerous behaviour in horses (such as rearing to throw off a rider) is often the result of the inappropriate and excessive use of negative reinforcement. Other welfare concerns include the use of modified apparatus such as mule gag bits and training techniques such as rapping and neck hyperflexion (Rollkür) which may cause pain and distress to the animals.

A top priority in equitation science is therefore the development of instrumentation to measure the optimal level of contact between a horse and its rider. Techniques currently exist to measure the pressure placed in a horse's mouth during training, and to gauge the tension on the reins. However, there is an urgent need to develop a pressure-sensitive saddle cloth and half-chaps (to be worn by the rider) that permit assessment of the rider's movement in the saddle and engagement with the horse's sides.

McGreevy, P. (2007) The advent of equitation science. *The Veterinary Journal*, **174**: 492–500.

wildlife

Is 1080 a humane poison?

The chemical compound 1080 (sodium fluoroacetate) is a widely used poison in Australia and New Zealand aimed at the eradication of vertebrate pests such as foxes, possums and rabbits. Its low cost, potency, relative ease of use, and low risk of wider environmental contamination and persistence in the food chain make it a highly popular poison, and its supporters claim that it is not only efficient and target specific, but also humane. This review article by an RSPCA Australia staff member re-examines the literature on the use of 1080, placing particular emphasis on the scientific basis for claims of its humaneness.

The author reports that much of the previous work on the toxic effects on 1080 merely assumed that this poison was a more benign alternative to other compounds such as arsenic and strychnine, which produce visible signs of pain and discomfort. The evidence used to support such an assertion was often indirect or subjective – for example, the observation that poisoned animals did not travel far before dying was taken to mean that death must have been humane. In some experimental studies to investigate the effects of 1080, only the later stages of poisoning (when nervous system function would already have been seriously impaired) were examined in detail, or the poison was administered to animals that had already been anaesthetized in some way. Such studies therefore cannot provide conclusive evidence regarding the animal's consciousness or ability to feel pain under the effect of 1080.

The behavioural effects of 1080 poisoning in dogs include uncontrollable running or barking, convulsions, retching and vomiting and twitching of the eyes, tail and legs. Interestingly, humans who have survived 1080 poisoning have reported similar symptoms (verbosity or unusual vocalisation, agitation, and vomiting), and have also reported pain in association with muscular spasms. The use of 1080 in pest control is still plagued with uncertainty: the minimum lethal dose and time to death seem highly variable, not only between species, but also within the same species. Moreover, the long-term effects of ingesting a non-fatal dose of the poison are still not well understood. The risk that a bait intended for a particular species will be eaten by another animal can also never be completely eradicated. The author therefore suggests that 1080 does not unambiguously meet the criteria for humaneness, and strongly recommends further research into alternative control methods and/or improving the humaneness of 1080 baits.

Sherley, M. (2007) Is sodium fluoroacetate (1080) a humane poison? *Animal Welfare*, **16**: 449-458.

The effectiveness of fox baiting

As foxes kill not only native fauna, but also attack farm animals and have the potential to spread diseases, state government agencies have tried to promote the poison baiting of foxes among local landowners. Baiting using the poison 1080 remains a controversial issue (see “Is 1080 a humane poison?” and “Target specificity of 1080 baits”); ethical and welfare considerations aside, even the effectiveness of long-term baiting programs has been called into question. This paper investigated current strategies of fox baiting in the lands managed by the Molong Rural Lands Protection Board (RLPB) in central-western New South Wales, using the records of 1080 baiting held by the Board, previously published models of fox ecology and dispersal patterns and geographical information systems software.

The authors found a lack of consistency and coordination in the baiting program involving both landholders and government agencies. Not only did the number of landholders baiting in any given year fluctuate considerably, but the spatial coverage of baits was also patchy, with large, contiguous areas remaining unbaited each year and from year to year. Most (>80%) landholders baited only once a year, with less than 16% baiting twice and only 3.3% baiting three times or more in the same year, even though the ‘Outfox the Fox’ program promotes baiting at least twice a year and also the synchronizing of baiting with adjoining landholders. Most landholders deploying baits had only one other neighbour participating in the program. Finally, the fox dispersal data, when combined with the spatial data on baiting, showed that all baited areas were close enough to a non-baited area to allow recolonisation through the immigration of young foxes in subsequent years.

The authors conclude that the ‘Outfox’ programme appears not to have had sufficient impact to radically improve baiting practices, at least in the study area. They suggest the trialing of alternative strategies, such as undertaking seminars at field days and liaising with existing landholder or regional groups to increase landholder participation, to dispel myths about foxes and 1080, and to improve coordination between neighbouring landholders.

Gentle, M. *et al*. (2007) Poisoning for production: how effective is fox baiting in south-eastern Australia? *Mammal Review*, **37**(3): 177-190.

Target-specificity of 1080 baits

As mentioned in a previous article (see “Is 1080 a humane poison”), current methods for the delivery of the pesticide 1080 to vertebrate pests in Australia also leave open the possibility that the poisoned baits will be consumed by non-target species. This article reviews the scientific literature on the effectiveness of various techniques of 1080 delivery in Australia, and evaluates their effect on populations of non-target species, particularly native carnivores such as quolls and phascogales.

The authors argue that there is, at present, little evidence to support the contention that the use of 1080 to control exotic predators, such as foxes, has a negative impact on the native animals living in the same region. However, arguments can be made both in favour of, and against, the use of 1080 on a large scale. Many Australian plants contain a chemical similar to 1080, and native Australian animals tend to have some resistance to the poison through generations of exposure to it. On the other hand, quolls and phascogales are quite small, and by consuming a bait meant for a much larger fox, ingest a dose of poison that might prove lethal. Experimental trials in the wild, involving the use of non-poisoned baits, have shown that native animals will often be attracted to the baits, and even consume them. However, similar trials using poisoned baits have shown little or no decline in the native animal population; studies tracking radio-collared quolls in New South Wales and Queensland have found that the uptake of bait by quolls was very low, as was the resulting mortality from poisoning. At the same time, large decreases in the populations of exotic predators have been reported (often of the order of a 95-100% reduction in the population of feral cats and foxes).

The successful control of predators brought about by 1080 might outweigh the cost of a few deaths among non-target species, and in the long run might prove beneficial to native wildlife. A wide range of alternative baiting methods is available, and should be further investigated through rigorous field trials, in order to determine their true impact on the native fauna.

Glen, A. *et al*. (2007) Non-target impacts of poison baiting for predator control in Australia. *Mammal Review*, **37**(3): 191-205.

other articles of interest

DAO (2007). A DAO Special on aquatic animal welfare. *Diseases of Aquatic Organisms*, **75**(85).

Jensen, M. and Pederson, L. (2007) The value assigned to six different rooting materials by growing pigs. *Applied Animal Behaviour Science*, **108**(1-2): 31-44.

Pines, M. *et al*. (2007) Stakeholders' assessment of welfare indicators for sheep and cattle exported by sea from Australia. *Animal Welfare*, **16**(4): 489-498.

Velarde, A. *et al*. (2007) Aversion to carbon dioxide stunning in pigs: Effect of carbon dioxide concentration and halothan genotype. *Animal Welfare*, **16**(4): 513-522.

Wechsler, B. and Weber, R. (2007) Loose farrowing systems: challenges and solutions. *Animal Welfare*, **16**(3): 295-307.

Whay, H. *et al*. (2007) Assessment of the behaviour and welfare of laying hens on free-range units. *Veterinary Record*, **161**(4): 119-128.

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