2010 CCSAW Research Symposium

Oral Presentations

9:00 Welcome
Georgia Mason, Department of Animal & Poultry Science, University of Guelph

Session I: Housing conditions and animal welfare

9:05 Is all environmental enrichment meaningful? Effects of long term of housing and enrichment on behaviour, physiology and immune system reactivity in C57BL/6 and BALB/C mice
Pat Turner*, Jennifer Ovari, Dorothee Bienzlee, Amy Clipperton, John Armstrong and Elena Choleris

9:25 Too old to care? Environmental enrichment has reduced reward value for middle-aged mice with enrichment-resistant stereotypic behaviour
Georgia J. Mason*, Jamie Dallaire and Sarah-Lee C. Tilly

9:45 Two types of behavioural perseveration predict stereotypic behaviour and its elimination by environmental enrichment in American mink, Mustela vison
Jamie Dallaire* and Georgia J Mason

10:05 Lions and Tigers in Zoos, Oh My! An Exploration of Thermal Comfort and Its Implications for Zoo Exhibit Design
Tory Young*, Robert Brown and Esther Finnegan

10:25 GUEST LECTURE I
Loose housing of sows in the lactation period and piglet survival
Knut Egil Boe*, Guro Vasdal and Inger Lise Andersen

11:05 COFFEE and POSTERS

Session II: Handling, invasive procedures and animal welfare

11:35 The interaction of group size and alley width on the movement of near-market pigs
Lynn Kavanagh* and Harold W. Gonyou

11:55 The effect of birth weight and age on the behavioural and physiological responses of piglets to tail docking and ear notching
Kristi Bovey*, Nicolas Devillers, Martin Lessard, Chantal Farmer, Cate Dewey, Tina Widowski and Stephanie Torrey

12:15 Effect of pain relief at castration on performance of piglets
Glen Cassar*, Rocio Amezcuca and Robert M. Friendship
12:35  On elephants in the 19th-century circus and animal welfare science research for historians
Susan Nance*

1:15  LUNCH and POSTERS

Session III: Health, physiology and animal welfare

2:15  Effects of free-access feeding and milk replacer acidification on calf performance and development of digestive anatomy
Cindy Todd*, Trevor DeVries, Ken Leslie, Jan Sargeant, Neil Anderson and Suzanne Millman

2:35  Evaluation of the impact of health status on the behaviour of dairy heifer calves
Amy Stanton*, Ken Leslie, Tina Widowski, Steve Leblanc, Dave Kelton and Suzanne Millman

2:55  Behavioural changes of dairy cows during drying-off using abrupt cessation of milking
Kimberley Painter*, Elise Tatone and Ken Leslie

3:15  COFFEE AND POSTERS

3:30  GUEST LECTURE II
An update on horse welfare, contrasting the issues between developed countries and developing countries
Camie R. Heleski*

4:10  End and student prizes

Poster Presentations

A modified design of the Zephyr is effective for euthanasia of neonatal piglets
Teresa M. Casey*, Suzanne T. Millman, Penny Lawlis, and Tina M. Widowski

Transforming research into action: How can we best maintain institutional animal care practices current with the most recent scientific literature?
Julia Henkel*, Tina Widowski and Derek Haley

Early detection of lameness through pedometric activity and lying behaviour of dairy cattle
Janet Higginson*, Suzanne Millman, Gerard Cramer, Ken Leslie, Anne Marie de Passille, Todd Duffield and Dave Kelton

Why wild-caught striped mice seldom stereotype
Megan Anne Jones*, Georgia Mason and Neville Pillay

Assessing the effect of alternative diets and feeding strategies on behaviour, productivity, preference and welfare of broiler breeder hens.
Krysta Morrissey*, Tina Widowski, Steve Leeson and Stephanie Torrey

Relationships between eye white percentage, hair whorl position, feeding behaviour and temperament in beef cattle
Dayna Sills*, Steve Miller, Tina Widowski and Derek Haley
The development of feather pecking in a commercial turkey facility: The effect of growing environment
Stephanie Torrey, Graham Duggan*, Ashleigh Arnone, Tina Widowski, and Lloyd Weber

Abstracts

Guest Lectures

Speaker: Professor Knut E. Bøe

Loose housing of sows in the lactation period and piglet survival

Knut E. Bøe*, Guro Vasdal and Inger Lise Andersen

Norweigan University of Life Sciences, Department of Animal- and Aquacultural Sciences

In intensive pig production sows are often kept in crates during the whole lactation period, but in Switzerland, Sweden and Norway regulations put restrictions on the use of crates. The main arguments against keeping sows loose in pens during lactation are, first of all, increased piglet losses, as well as also an increased space allowance. However, data from Norwegian commercial pig farms show that some farmers achieve very good production results and have low piglet mortality even when keeping the sows loose. The aim of this paper is to summarize some of the research on physical and management factors important for achieving low piglet mortality in herds with loose housed sows.

Experiments with newborn piglets indicate that they have a preference for high infrared temperatures and saw dust flooring, but their use of the creep area is still very limited in the first three days after farrowing because they want to stay by the sow. Time spent in the creep area is apparently not correlated to the piglet mortality either. Hence, trying to optimize the creep area in order to lower piglet mortality seems to be a battle against biology. Farrowing rails, however, have been shown to be important for reducing piglet mortality. Supervision during farrowing, including with drying and warming the piglets and helping them to obtain colostrum, have also been shown to reduce piglet mortality. Cross-fostering and tooth grinding are important measures too. Overall improved management practices are the key to reducing piglet mortality in loose-housed systems, thus enhancing the welfare of both sow and piglet.
Speaker: Dr. Camie R. Heleski

An update on horse welfare, contrasting the issues between developed countries and developing countries

Dr. Camie R. Heleski*

Michigan State University, Department of Animal Science, Michigan, USA

Worldwide there are approximately 55 million horses; over 80 percent perform working tasks in developing parts of the world. Over 75 percent of horse-related resources, though, go toward the minority of equids who live in the developed world and perform tasks related to competition and/or recreation. The welfare issues affecting these dichotomous populations vary dramatically. In developing parts of the world, providing sufficient amounts of nutrients to maintain something approaching a moderate body condition score is challenging; providing sufficient drinking water to avoid dehydration can not be taken for granted; parasite management programs are rare; salt provision is minimal; and health care especially in the case of injuries – can appear barbaric and often provides no actual benefit. In contrast, horses in developed regions of the world appear at first to have an idyllic situation. In most cases, they have sufficient nutritional resources to maintain a moderate body condition score; in fact, one welfare problem in the developed world is obesity and associated problems. Water is almost never an issue, nor is salt provision, nor, in most cases, is parasite management. Equine veterinary care has reached an unprecedented level and exceeds the health care of humans in much of the world. But what if we look at horse welfare through the horse’s eyes? How many horses in the developed world lack sufficient social interaction? Or lack the opportunity for turnout at liberty? Or lack the opportunity to forage the majority of the day as they would in a feral situation? Fortunately for human owners, the horse is a highly adaptable domesticated animal, but the horse industry in the developed world still needs to ask itself if they are treating their horses fairly. Some of the practices that are done in the name of aesthetic modifications are truly questionable in terms of ethical appropriateness. Some of the training practices that are imposed are also unlikely to pass ethical scrutiny. A horse’s welfare should not be judged solely on meeting its physiological needs but also striving to meet behavioral needs.
Oral Presentations

The effect of birth weight and age on the behavioural and physiological responses of piglets to tail docking and ear notching

Kristi Bovey*1,2, Nicolas Devillers3, Martin Lessard3, Chantal Farmer3, Cate Dewey4, Tina Widowski2 and Stephanie Torrey1,2

1Agriculture and Agri-Food Canada, Guelph, Ontario, Canada
2Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada
3Agriculture and Agri-Food Canada, Sherbrooke, Quebec, Canada
4Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada

Selection for sows with high reproductive output has resulted in larger litters, comprised of a greater number of low-birth-weight (LBW) piglets of 1 kg or less. Given their presence in over three-quarters of litters and increased mortality rate, it is clear that a greater understanding of LBW piglet management is required for both animal welfare and productivity. The objective of this experiment was to compare the effects of ear-notching and tail-docking (two of the routine procedures involved in ‘processing’ young piglets) on LBW piglets during the first 24 h versus at 3 d of age on pain-related behaviour and growth. Six piglets per litter from 20 litters (n=120 piglets) were used in a 2 x 2 complete block design and analyzed using mixed model procedure in SAS with sow as random effect. Piglets were weighed at birth and designated as low-birth-weight (0.6 –1.0 kg; LBW) or average-birth-weight (≥1.2 kg; ABW), and tail docked and ear notched (without anesthetic, following standard practice) at either 1- or 3-days of age. Vocalizations were recorded during the procedures and analyzed using Raven Pro 1.3. Average daily gains (ADG) were determined through 21 days of age. During the procedures, LBW piglets produced fewer calls/second (0.95±0.08 vs. 1.16±0.06 Hz, P=0.0147), and their high frequency calls tended to have a lower mean frequency (2504 ±268 vs. 2685 ±190 Hz, P=0.06). Though ADG differed between LBW and ABW treatments (175.8±0.008 vs. 235.3±0.006 g/d, P<0.0001), the ADG between birth and d 5 was not affected by day of processing (200.7 ±7.0 vs. 210.4±7.0 g/d, P=0.11). Similar results were seen for the ADG from birth to d21 (99.6±7.0 vs. 153.6±6.0 g/d, P<0.0001; 119.6±6.7 vs. 133.6±6.9 g/d, P=0.84), showing that LBW piglets grow at a consistent, albeit lower, rate than ABW conspecifics whether processed at d 1 or 3. Because of the lack of treatment by day interactions, it is most likely that the vocalization differences were a reflection of decreased LBW piglet vitality rather than decreased welfare in response to pain and distress.
Effect of pain relief at castration on performance of piglets

Glen Cassar* DVM, PhD; Rocio Amezcua, DVM, PhD; and Robert M. Friendship DVM, MSc, Dip. ABVP.

Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada

All male pigs must be castrated to make them acceptable for the current market and there are no alternatives to commercial pork producers. The procedure is generally performed without analgesia, but castration of even very young pigs is a painful procedure and as such, raises a concern regarding animal welfare. General and local anesthesia have been examined and do not appear to be good solutions, and possibly make the welfare situation worse. Analgesics are not readily available for use in food producing animals. At the time this project was started ketoprofen (which provides pain relief for about 24 hours) was the only injectable product licensed for use in swine. The use of analgesia in pork production will have poor compliance unless farmers can be shown a production advantage or be rewarded in some other way because they are constantly faced with financial constraints. The objective of the study was to determine if analgesia at the time of castration produced a positive benefit such as faster growth or reduced mortality. A total of 1491 seven-day-old piglets from 301 litters were randomly assigned to a control and a treatment group. Control piglets were given saline by IM injection 30 minutes before castration (n=736), while treatment piglets received an IM injection of ketoprofen (0.15 ml per 5 kg bodyweight) 30 minutes before castration (n=755). All piglets were ear notched for identification and weighed at the time of castration and at 21 days of age to determine average daily weight gain (ADG). Mortality between castration and day 21 was recorded. Piglets were observed approximately 15 minutes after castration for behavioural signs of discomfort which included restlessness or isolation. There was no significant difference in ADG and mortality between the control (avg 272 g/d, 3.5%) and treatment (279 g/d, 2.9%) groups (P>0.05). Visual evaluation 15 minutes after castration did not reveal a difference between the two groups. This work indicates that there is no economic motivation for a producer to begin using analgesia routinely at the time of castration. In addition, the lack of a difference in behaviour between the two groups makes it difficult to encourage producers to use analgesia based on the argument that it will relieve suffering. The take home message from this study is that a recommendation to use analgesia when piglets are castrated is likely to result in poor compliance, and the solution to this problem is not obvious. This study was supported by Ontario Pork.
Environmental enrichment should reduce abnormal “stereotypic behaviours”, SBs (e.g. repetitive pacing). However, its effectiveness can vary greatly between individuals. Using mink (Mustela vison) as a model, we aimed to identify cognitive/behavioural control mechanisms that make some individuals resistant to enrichment. We assessed two different types of “perseveration” – the tendency to inappropriately repeat actions – to test the hypothesis that they cause enrichment-resistant SB. Recurrent perseveration represents a failure to inhibit the inappropriate repetition of already completed behaviours. It correlates with SB in autistic and schizophrenic humans, and in several other captive species. Affective perseveration, also called ‘impulsivity’, indicates a failure to inhibit responses to reward cues. It is hypothesized to cause SB when external stimuli repeatedly elicit the same behaviours (e.g. attempts to escape the cage or to reach expected food). 17 adult females, pre-selected as stereotypic, were tested for recurrent perseveration in a two-choice guessing task. Here, opening one of two doors yielded a food reward, the other a punishment (‘time-out’). The “correct” door was randomly determined for each trial. Highly stereotypic mink showed the most recurrent perseveration, spontaneously producing more patterned response sequences (GLM: F=7.07, p=0.020) containing more repetitions (F=6.49, p=0.024). The mink were also tested in a ‘detour task’ modified from a ‘reaching task’ used to assess impulsivity in primates. Here, subjects had to travel around a transparent, odour-permeable barrier to retrieve food on the other side. Impulsive individuals fail to inhibit movement directly toward the reward (and thus into the barrier). This form of perseveration did not, however, correlate with SB. The mink were then transferred to large enriched cages for several weeks, which successfully reduced SB (F=8.27, p=0.012), and increased normal activity (F=7.79, p=0.014). Mink were re-tested for recurrent perseveration. Despite the reduced SB, recurrent perseveration was unaffected; nor did this trait predict the change in SB. Pre-enrichment affective perseveration, however, did predict enrichment-resistant SB: impulsive mink showed the smallest reductions in stereotypic behaviour (F=4.88, p=0.047) and smallest increases in normal activity (F=4.79, p=0.048). Ongoing work is assessing whether the perceived reward value of enrichment (cf. Mason, Tilly and Dallaire abstract) also plays a role.
The Interaction of Group Size and Alley Width on the Movement of Near-Market Pigs

Lynn Kavanagh*1 and Harold W. Gonyou2

1University of Guelph, Guelph, Ontario, Canada
2Prairie Swine Centre, Saskatoon, Saskatchewan, Canada

Current recommendations advise that pigs be moved on farm in small groups of five or six. If farms had wider alley widths, larger groups of pigs may be moved efficiently and with low stress. The objective of this study was to examine the interaction between the group size and the alley width on the ease and speed of movement of near-market pigs. Forty-four finishing pigs were used each day in a randomized block design with treatments in a 4 x 4 factorial arrangement: 1) alley width (0.6, 0.9, 1.2 or 2.4 meters), and 2) group size (4, 8, 12 or 20 pigs). Pigs were moved through a three-sided simulated handling course from start pen to end pen. One handler was utilized, moving the pigs with paddle and board only, when necessary. Data were collected on heart rate, time to complete the course, handling ease and behavioural measures. Data was analyzed using the PROC MIXED procedure in SAS. Groups of 12 and 20 pigs took significantly more time to complete the course (116 and 162 seconds respectively) than groups four (77 seconds) and eight (93 seconds) (P<0.01). Handling became more challenging as group size increased as (P<0.01). Average heart rate increased relative to group size during the pre (P=0.01) and post (P<0.01) waiting period, which is likely a result of mixing in the start and end pens. No alley width effect was found for heart rate, time or handling. There were significant effects found for both alley width and group size on the behavioural measures of vocalizations and turn backs. An interaction effect was found for turn backs (P<0.01) and handling (P<0.02). Alley width 0.9 was most conducive to easy handling based on the interaction effect of the least differences between group sizes on number of turn backs and handler intervention required. Group size four was preferred for minimizing stress and group size eight was preferred when efficiency is considered in conjunction with measures of handling and stress. Moving pigs in group sizes that are appropriate for the alley width used can reduce handling time and contribute to improved welfare.
Too old to care? Environmental enrichment has reduced reward value for middle-aged mice with enrichment-resistant stereotypic behaviour

Georgia J. Mason*1, Jamie Dallaire1 and Sarah-Lee C. Tilly2

1Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada
2Ethology & Welfare Centre (ECW), Department of Animals, Science and Society, Faculty of Veterinary Medicine, Utrecht University, The Netherlands

Living long-term in barren conditions and/or being elderly leads to forms of stereotypic behaviour (SB) that are hard to alleviate using environmental enrichment. This resistance to enrichment is often explained via mechanisms that could decouple SB from current welfare (e.g. processes whereby through repetition, behaviour patterns become fixed routines or habits; or changes in forebrain function that increase tendencies to inappropriately repeat motor patterns – see Dallaire & Mason abstract). If such hypotheses are correct, then animals with enrichment-resistant SB should still find enrichments rewarding. Alternatively, enrichment-resistant stereotypic behaviour could reflect a failure of enrichments to actually improve animal welfare. This is plausible because with age and chronic stress, fear of novelty typically increases, while abilities to experience pleasure decrease. If this alternative hypothesis is correct, then animals with enrichment-resistant SB should value enrichments less than their conspecifics. We tested these hypotheses using C57BL/6 mice, aged 10-11 months (middle aged) and 6-7 months (young adult), raised in pairs in barren laboratory cages. Mice were observed for SB in these barren cages, and then in large enriched cages. The effectiveness of enrichment on SB was calculated in three ways: the absolute decrease in SB with enrichment, the relative decrease in SB, and the residual for each mouse from a regression of pre- versus post-enrichment SB. As expected, enrichment reduced SB, and tended to be more effective on the younger animals (e.g. absolute decrease in SB: F 1,9 > 3.61, p < 0.072). The reward value of large enriched cages was then assessed by allowing access to them via progressively weighted doors, with the maximum weight pushed being used as a measure of their peak motivation. All mice would work to reach enrichment, but there was considerable variation between subjects in the maxima pushed. In older mice, pairs whose SB had been least reduced by enrichment also valued it the least, as assessed by this measure of motivation (e.g. absolute reduction in SB predicted maximum weight pushed: F 1,8 = 9.01, P = 0.017). This suggests that compared with younger mice, the welfare of middle aged-animals – as well as their stereotypic behaviour – is harder to improve via environmental enrichment. Future work will assess the additional possible role of perseveration in such effects (see Dallaire & Mason abstract).
On elephants in the 19th-century circus and animal welfare science research for historians

Dr. Susan Nance*

Department of History, University of Guelph, Guelph, Ontario, Canada

Many of us take for granted that animals have a past that matters to the common history of all species. Yet, many historians have been skeptical of this idea. While most acknowledge that we can understand historical ideas about and uses of other species, most would dispute that historical animal behavior can be documented reliably and its effect on human affairs proven. To address this misconception, this talk outlines the ways we can make good use of animal welfare science research as a sort of theoretical model for the interpretation of human-authored records of historical animal life. As a case study, it examines the elephants of 19th-century American circuses by analyzing memoirs, advertising, photographs and other historical materials documenting them. Kept singly or in pairs by wagon shows for many decades, by the 1870s the largest railway circuses kept herds of up to twenty elephants on a single production unit. To reduce risk and expense, animal managers innovated systems of chaining, manacling and punishing elephants to attempt to eliminate behaviors that did not produce value for circuses. At the same time, many elephants displayed behaviors (like stereotypic weaving) and body conditions (like overgrown foot pads) that Americans took as ‘normal’ because they had never seen elephants in any other material context. Recent research tells us these are indicators of compromised welfare and underfunded management systems. They help explain why the century saw increasing numbers of elephants killing people and people killing elephants, peaking around 1905. It was not that elephants were inherently defective, as elephant managers paternalistically claimed, but rather that circus workers themselves created the very animals they most feared. The circus companies persevered by pushing that bad news underground with centralized marketing plans persuading modern audiences that elephants were native to show business and eagerly consented to their use by humans. Since knowledge of the past helps us predict the future, today nineteenth-century elephant life provides critical insight into current debates over whether for-profit entertainment/education ventures like zoos, aquaria and circuses will be able to function, as many claim to do, as wild animal conservation organizations.
Behavioural changes of dairy cows during drying-off using abrupt cessation of milking

Painter, K.*, Tatone, E. and Leslie, K.E.

Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada

The dry period between successive lactations is crucial for regeneration of productive function of mammary tissue, preparation for high production, and to prevent new intramammary infections (IMI). With continually increasing milk production over time, abrupt cessation of milking at drying-off often occurs at production levels of greater than 25kg/d. As such, this process leads to considerable udder engorgement and potential discomfort, which could be a welfare concern. This discomfort may be reflected in changes in cow behaviour after abrupt drying-off. Furthermore, this process has been documented to represent an increased risk period for new IMI. The objectives of this study were to document standing and lying behaviours through the process of drying-off, and to evaluate the associations between parity (lactation 1 relative to lactation 2 and above) and production level (> 27 kg/d compared to < 22 kg/d) and changes in these activities. From June to October 2009, a total of 76 cows in a commercial free-stall herd, milking three times per day, were enrolled onto this study. Each cow was fitted with a HOBO® data logger (HOBO Pendant G Data Logger, Onset, Pocasset, MA) on the outside of the right hind leg, parallel to the floor (longitudinally). The HOBOs® were programmed to start data collection at 7am, two days prior to drying-off (d-2), and to continue for six days following drying-off (d6). Cows received their last milk-out at the second daily milking (d0, noon). The HOBO® recorded time-stamped standing and lying behaviour (including lying side) at one minute intervals, allowing for the calculation of total lying time per day. Simple univariable analysis by two-sample T tests was used to compare production level and parity against total lying time. Upon completion of the full dataset, multivariable analysis will be performed. Cows drying-off at high production had significantly lower lying times compared to cows at lower production levels on d1 (p<0.05; 634.71 211.04 vs 747.04 166.86 min) and d3 (p<0.005; 724.58 138.81 vs 836.15 116.03 min). Lactation 1 cows also showed significantly (p<0.001) lower lying times of almost 3 hours compared to multiparous cows on d1 (572 195.04 vs 751.61 170.66 min). In conclusion, these data suggest that abrupt cessation of milking at drying-off is associated with changes in standing and lying behaviours, potentially indicative of increased discomfort. These behavioural changes appear to be influenced by production level at the time of drying-off and by parity. Management interventions in the process of drying-off may be warranted.
Evaluation of the impact of health status on the behaviour of dairy heifer calves

Stanton, AL*1, Leslie, KE1, Widowski, TM2, Leblanc, SJ1, Kelton, DF1 and Millman, ST3

1Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada
2Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada
3Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames, IA, USA

The objective for this study was to identify the behavioural changes associated with disease in milk-fed dairy calves. Of particular interest was otitis media (‘ear droop’), a prevalent infection of young calves in large calf rearing operations which has the potential to cause pain during clinical disease. Signs of otitis are unilateral (UNI) or bilateral (BIL) ear droop, which may progress to neurological signs. A total of 25 calves, at a heifer raising facility in New York State, were enrolled on this study twice monthly, following their arrival from 5 source farms. Calves were individually housed in naturally ventilated nursery barns. An accelerometer (Icetag®) was attached to the mid-metatarsal region of one hind limb to measure lying and step activity, and a smaller device (Actical®) was attached over the poll region to measure headshaking. Both devices recorded data for 28 days, and datasets were complete for 22 calves. UNI and BIL were identified in 2 and 14 calves, respectively. Lying bouts, average lying duration, total lying time and Actical® measures were analyzed using generalized mixed models (PROC mixed) with repeated measures in SAS 9.1. Lying bouts, average lying duration, and total lying time were not significantly different in calves with ear droops compared to normal calves (P=0.15, P=0.14 and P=0.73, respectively). Calves with UNI performed 228± 102.6 fewer steps/day than normal calves (P=0.02). Actical® data was compared with steps to determine if there was an increased incidence of head shaking with otitis. These two measures were highly correlated (P<0.001). The Activity units/step did not differ between BIL and normal calves (p=0.63). These findings are consistent with the larger field trial, which found that UNI decreased average daily gain, but BIL did not. In conclusion, bilateral ear droop does not appear to have substantial affect on the behaviour of calves. This may indicate that BIL does not result in systemic infection which may limit the impact this disease has on welfare in the preliminary stages of the disease. Further research is needed to determine the impact of unilateral ear droop on behaviour.
Effects of free-access feeding and milk replacer acidification on calf performance and development of digestive anatomy

C.G. Todd*1, T.J. DeVries2, K.E. Leslie1, J.M. Sargeant1, N.G. Anderson3 and S.T. Millman4

1Department of Population Medicine, University of Guelph, Guelph, ON, Canada
2Department of Animal and Poultry Science, University of Guelph, Kemptville Campus, Kemptville, Ontario, Canada
3Ontario Ministry of Agriculture, Food and Rural Affairs, Elora, ON, Canada,
4Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames, Iowa, USA

Conventional milk feeding methods restrict calves’ intake of milk to a rate of 8 to 10% of body weight per day. There is, however, a growing body of research indicating that calves are motivated to consume much higher volumes of milk, as much as 20% of body weight. The effects of feeding higher volumes of milk to calves on rumen papillary development are unknown. The aim of this research was to examine the effects of free-access feeding and milk replacer acidification on calf performance and development of digestive anatomy. Holstein male calves (n=16) were randomly assigned at birth to 1 of 4 feeding programs: 1) free-access (ad libitum) feeding of milk replacer (22% CP and 17% fat), 2) free-access feeding of acidified milk replacer, 3) restricted (6 L/d) feeding of milk replacer and 4) restricted feeding of acidified milk replacer. Milk replacer, starter ration and water intakes were measured daily, while body weight gain was determined weekly for each calf. One calf from each feeding program was euthanized at 28, 42, 56 and 70 d of age. Rumen tissue samples were collected, and papillae length and width were measured. Multivariable regression models were constructed to examine the effects of free-access feeding and acidification on important outcome variables. Free-access feeding resulted in higher milk consumption (9.2 vs 5.3 L/d, P<0.01); acidification did not affect milk intake (P>0.05). Restricted calves began consuming starter ration significantly earlier (HR=12.3, P<0.01) and had greater starter intake (3.8 vs 1.0 kg, P<0.01) over the free-access calves. Milk replacer acidification was associated with earlier onset of starter consumption (HR=3.7, P<0.05). Free-access calves had higher body weight gain than restricted calves (26.0 vs 14.3 kg, P<0.05); acidification did not affect weight gain (P>0.05). Restricted calves had longer (P<0.05) and wider papillae (P<0.05). These results indicate that free-access feeding of milk replacer supports improved body weight gain, but delays starter ration consumption and rumen development, which could negatively impact the welfare of calves during the weaning period. Thus, it is recommended that further research be conducted to determine the optimum weaning protocol for calves fed higher volumes of milk.
Is all environmental enrichment meaningful? Effects of long term of housing and enrichment on behaviour, physiology and immune system reactivity in C57BL/6 and BALB/C mice

PV Turner*1, J Ovari1, D Bienzlee1, A Clipperton2, J Armstrong3 and E Choleris2

1Department of Pathobiology, University of Guelph, Guelph, Ontario, Canada
2Department of Psychology, University of Guelph, Guelph, Ontario, Canada
3Department of Biomedical Sciences, University of Guelph, Guelph, Ontario, Canada

Reducing and eliminating animal stress are key goals in research animal husbandry. Further, improving animal comfort is a tangible form of refinement that enhances the well-being of animals being cared for and is thought to augment the relevance of experimental results obtained with these animals. Husbandry standards for mice have received increasing scrutiny in Canada and the US in recent years as the scientific basis for the current standards is not always apparent and because of the large numbers of mice used in biomedical research. The purpose of this study was to evaluate the long term effects of enrichment on behaviour, physiology, and immune responsiveness of male and female C57BL/6 and BALB/C mice. A total of 160 mice (20/sex/strain/housing paradigm) were housed for 20 weeks in same sex groups (n=5) in either standard (sold bottom caging with hardwood chip bedding) or enriched (standard caging + cotton nesting material, clear amber tube, 10g wood wool, and food treats 3x/weekly) conditions. Body weights were collected weekly, animal behavioural scoring occurred monthly, feces were collected for corticosterone analyses monthly, a light-dark anxiety test was conducted approximately monthly, a low temperature hotplate test for nociception was conducted at weeks 5, 15, and 20, and at study end, half the mice in each group were challenged intra-peritoneally with lipopolysaccharide (LPS) (10 ug/mouse) or saline to evaluate immune responsiveness (CBC, WBC differential and lymphocyte subsets). Finally, brains were harvested at necropsy, fixed in Golgi-Cox solution, and sectioned and stained for evaluation and comparison of hippocampal CA1 dendritic spine complexity (pyramidal neurons). Significant interstrain and intersex differences were noted for many of the parameters evaluated; however, no consistent effects of enrichment were seen for any group. In conclusion, under the cage conditions of this study, beneficial effects of enrichment could not be demonstrated. Similarly, addition of environmental enrichment was not detrimental to any group. These findings raise questions regarding the adequacy of current rodent caging and methods used for environmental enrichment.
Lions and Tigers in Zoos, Oh My! An Exploration of Thermal Comfort and Its Implications for Zoo Exhibit Design

Tory Young¹, Dr. Robert Brown¹, and Dr. Esther Finegan²

¹School of Environmental Design and Rural Development, University of Guelph, Guelph, Ontario, Canada
²Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada

For species-appropriate enclosure design, one must understand the thermal comfort of the animal. This study’s goal was to determine whether zoo enclosure areas used by African lions (Panthera leo) and Siberian tigers (Panthera tigris altaica) can be predicted by microclimatic conditions in summer months. Two adult African lions (one male and one female) and two adult Siberian tigers (one male and one female) at The Toronto Zoo, Scarborough, Ontario, were the subjects of the study. The methods were as follows: 1) To observe each subject’s behaviour and use of its enclosure (for a total of 18 days, 4 or 5 days per subject) 2) To measure onsite microclimatic parameters (ambient air temperature, air humidity, solar radiation, and wind) 3) To investigate the relationship between the animals’ behaviour and their enclosures’ microclimate and 4) To develop design guidelines. Descriptive statistics showed that all of the subjects spent most of the day performing Comfort Behaviours, defined in this study as lying down, sitting, or, for the tigers, being in the water pool. On predominantly sunny days, all individuals used shaded locations more often than locations in the sun (ranging from 63% to 77% shade use). While on days where distinct shade was lacking for the majority of the day (categorized as Indistinct Days), locations in the ‘sun’ were used more than those in the ‘shade’ (ranging from 57% to 58% sun use). Results indicate that a gradient of shade is essential in enclosure design and that a water pool is a valuable resource for tigers. Energy budget, substrate, shade source, topography, water, winter, and activity rhythms emerged as the design guideline topics. The guidelines show how to maximize thermally comfortable spaces for zoo felids, thus acting as an important welfare tool in zoo design.
A modified design of the Zephyr is effective for euthanasia of neonatal piglets

Teresa M. Casey*1, Suzanne T. Millman2, Penny Lawlis3 and Tina M. Widowski1

1Department of Animal & Poultry Science, University of Guelph, Guelph, Ontario, Canada
2Veterinary Diagnostic & Production Animal Medicine, Iowa State University, Ames, Iowa, USA
3Ontario Ministry of Agriculture, Food & Rural Affairs, Ontario

On-farm euthanasia of low viability piglets is an inevitable task for producers. A non-penetrating captive bolt, modified Zephyr, has the potential to be used as an alternative method for the euthanasia of neonatal piglets. To be considered effective, the Zephyr must cause sufficient depression of the central nervous system and destruction of brain tissue resulting in immediate insensibility and rapid death. Ten experienced stock people were trained to use the Zephyr to euthanize 10 low-viability piglets < 72h of age (n=100). Each stock person restrained the piglet on its sternum on a hard, flat surface. Two shots were administered rapid fire on the frontal bone and a final shot delivered to the back of the skull. Signs of consciousness were assessed using brainstem and spinal reflexes: presence or absence of corneal reflex, pupillary light response, jaw tone, and response to a nose prick. Neuromuscular spasms (both clonic and tonic), breathing, and heartbeat were also monitored. Termination of tonic convulsions indicated estimated time of death (ETOD). Macroscopic scoring was used to assess fracture and hemorrhage at necropsy. A questionnaire was provided to each stock person to assess individual experience and rate the overall method. The Zephyr caused immediate insensibility without return to consciousness in all 100 piglets and led to death without a secondary step in 95% of piglets. ETOD averaged 227.5 ± 88.7 s (±S.D). Macroscopic scoring averages (±S.D) indicated moderate to severe damage to the skull and brain tissue in all piglets. Skull fracture, scored on 5 point scale, averaged 3.3 ± 0.5 (1=no fracture : 5=completely fractured). Hemorrhage was scored as follows on a 6 point scale (1=no coverage : 6=complete coverage); subcutaneous 4.5 ± 1.1, subdural-dorsal 4.3 ± 0.9, and subdural-ventral 4.4 ± 0.8. Stock personnel rated the effectiveness of the Zephyr at 8.7 ± 1.6 (1=completely ineffective : 10=highly effective). The modified Zephyr used in this trial was a highly effective method of euthanasia for neonatal piglets less than 72 hours of age. With modifications for safety and portability, the Zephyr has potential to be an effective and practical method of on-farm euthanasia within the swine industry.
Transforming Research into Action: How can we best maintain institutional animal care practices current with the most recent scientific literature?

Julia Henkel*¹, Tina Widowski¹ and Derek Haley²

¹Department of Animal & Poultry Science, University of Guelph, Guelph, Ontario, Canada
²Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, Ontario, Canada

Our aim is to address problems of knowledge management in animal care at research institutions to ensure that the latest science-based standards are put into practice. There is a vast amount of contemporary scientific literature looking at animal welfare and related fields, much of it providing insight on improved animal care, and this pool of information is expanding at a phenomenal rate. Rather than becoming “lost” in an ocean of data, this information needs to be translated into practical guidelines and put into practice so that animals at research institutions are receiving the best standards of care. The Canadian Council on Animal Care (CCAC) is an organization established to develop guidelines and promote high standards of animal care for experimental animals in Canada, but the major challenge is for the guideline development process to keep pace with the generation of new information. Institutions develop many of their own best care practices from the literature, which can lead to fragmented pools of knowledge and redundant efforts. Efforts can be synchronized if institutions can look to the CCAC’s guidelines as a “gold standard”. An analogous system using similarly growing pools of information is the health care system, which has used various knowledge management schemes to maintain valid and current guidelines, with varying degrees of success. Lessons can be taken from the health care industry to compose a starting point for information and knowledge management in the field of animal care. With an appropriate system and resources, the CCAC and research institutions can collaborate to synthesize information from the literature and update guidelines in real-time. We are using qualitative research methods to collect information about how animal care practices are currently being kept up-to-date at the CCAC and at certain post-secondary institutions in Canada. Responses to written surveys, and structured telephone interviews will be critically analyzed to develop a knowledge management model that is feasible for promoting rapid and efficient development of guidelines so that Canadian institutions can maintain high and current standards in animal care.
Early detection of lameness through pedometric activity and lying behaviour of dairy cattle

J.H. Higginson*1, S.T. Millman2, G. Cramer1,3, K.E. Leslie1, A.M.B. de Passille4, T.F. Duffield1 and D.F. Kelton1

1Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada
2Veterinary Diagnostic & Production Animal Medicine, Iowa State University, Ames, Iowa, USA
3Cramer Mobile Bovine Veterinary Services, Stratford, Ontario, Canada
4Agriculture and Agri-Food Canada, Agassiz, British Columbia, Canada

Lameness is one of the largest welfare concerns in the dairy industry. The objective of this pilot study was to examine changes in dairy cow activity around lameness events, a component of a larger ongoing investigation to determine the efficacy of pedometric activity for early lameness detection. The commercial Pedometer Plus system (SAE Afikim, Israel) provides information regarding the number of steps taken, the duration of lying time, and the number of lying bouts. The device was affixed to the hind limbs of 130 lactating cows and data was collected twice daily during milking. Hooves were examined for lesion identification every 3 months and trimmed every 6 months. In addition, between these, lameness cases identified by the producer were evaluated by a veterinarian, treated, and causal factors recorded. To date, five cows with new cases of digital dermatitis have been identified. Activity and lying behaviour were analyzed during two time periods - seven days prior to lameness identification and exam, and seven days following exam, with exam day excluded. A paired t-test demonstrated a difference in activity between time periods (p=0.03). On average (± sd), cows performed 65.1 (± 4.1) steps/hour prior to lesion identification and 76.2 (± 5.6) following identification. The mean number of lying bouts between time periods was not different (p=0.79), with mean lying of 10.0 (± 0.7) bouts/day prior to the lameness exam and 9.9 (±0.6) following the lameness exam. Lying duration also did not differ (p=0.54), with 693.1 (± 28.0) minutes/day prior to the lameness exam and 675.1 (± 34.5) minutes/day following the exam.

Our preliminary results suggest that during the seven days prior to identification of digital dermatitis, cows are less active. Continued enrolment of more cows will determine if other hoof lesions show similar changes. Further evaluation of activity around lameness events will determine if early detection through the use of pedometry is possible.
**Why wild-caught striped mice seldom stereotype**

Megan Anne Jones*1, Georgia Mason2 and Neville Pillay1

1School of Animal, Plant, and Environmental Sciences, University of the Witwatersrand, Private Bag 3, WITS, South Africa
2Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada

Wild-caught (WC) animals are generally less susceptible than captive-bred (CB) animals to developing stereotypic behaviour (SB). The striped mouse, Rhabdomys, is no exception: animals trapped as adults are much less likely to develop SB than their CB offspring (16% WC mice vs. 57% CB). In this study, we investigated three explanations for this birth-origin effect: (1) forebrain development is normalised in subjects maturing in the wild, allowing for greater behavioural flexibility; (2) WC individuals adjust better to captivity than CB conspecifics and do not need to stereotype; or (3) WC individuals are precluded from performing stereotypy due to greater anxiety/fear or apathy. We ran 30 WC and 14 CB striped mice through a series of behavioural tests to quantify anxiety and forebrain function (especially effects on behavioural flexibility), measured faecal corticosterone (n=31) as a physiological index of stress, and assessed home-cage behaviour. WC individuals, whether stereotypic or not, were more anxious/fearful than CB striped mice (e.g. proportion of time in dark compartment of light-dark box; F1,37=5.87, P=0.02) and had raised levels of corticosterone (F1,24=8.11, P=0.01). In their home-cages, WC non-stereotypic striped mice also spent the most time in their nest boxes (Wald $\chi^2=7.73$; P =0.01), suggestive of fear or apathy. Irrespective of birth-origin, stereotypic individuals showed less behavioural flexibility in the four-arm maze than non-stereotypic animals (Wald $\chi^2=10.99$, P<0.001) – and, because the incidence of SB was markedly lower in WC striped mice, the mean levels of behavioural flexibility in WC mice were correspondingly significantly higher. These results show that WC striped mice are less susceptible than CB individuals to develop SB because a higher proportion of animals benefit from normal forebrain function, with inactivity or apathy possibly also contributing to the absence of SB in some WC individuals. More broadly, these findings indicate that whilst the absence of SB is usually taken to indicate conditions associated with good welfare, the low levels of SB in WC striped mice are an important exception.
Assessing the effect of alternative diets and feeding strategies on behaviour, productivity, preference and welfare of broiler breeder hens

Krysta Morrissey*1, Tina Widowski1, Steve Leeson1 and Stephanie Torrey2

1Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada
2Agriculture & Agri-Food Canada, University of Guelph, Guelph, Ontario, Canada

Broiler breeders are selected for fast growth rates to decrease the time to market age for broilers, in order to accommodate consumer demands for affordable meat. This fast growth rate is coupled with an enormous appetite that cannot be met, as feeding them to satiation leads to obesity and associated problems such as lameness, ascites, reproductive failure, and high mortality. To limit growth rates, commercial broiler breeders are severely feed-restricted by up to 75% less than what ad libitum fed birds would eat. Feed restricted birds exhibit signs of chronic hunger and stress such as oral stereotypies including object pecking, litter pecking and excessive drinking. Daily rations are consumed within 10 minutes and birds are still highly motivated to feed even after consuming their daily ration. Improving broiler breeder welfare may lie in finding alternative feeding strategies that change the diet composition or feeding frequency without negatively impacting the desired growth rates. In Europe, there has been significant research into finding diet compositions that enable broiler breeders to be fed ad libitum while still limiting growth rates, thus improving their welfare. Dietary dilution has been examined through the addition of high fibrous fillers such as oat hulls, sawdust and wheat gluten. As much of the problem lies in breeders' huge appetites, another feeding strategy is to use appetite suppressants such as calcium propionate (CaP) to control feed intake without restricting feed access. One of the most efficacious diets has been a combination of oat hulls (included at 400g/kg of feed) and increasing levels of CaP (included at up to 10g/kg of feed). However, what remains unclear is whether broiler breeders prefer a diet that is less palatable in the short term but results in greater satiety in the long term. Further research is needed to assess the welfare effects of alternative diets in situations more applicable to North American producers. A popular trend that is re-emerging in North America in order to increase flock uniformity is skip-a-day (SAD) feeding. The efficacy of fibre sources more available in Ontario in combination with SAD feeding regimes is yet to be determined.
Relationships between eye white percentage, hair whorl position, feeding behaviour and temperament in beef cattle

Dayna Sills*, Steve Miller¹, Tina Widowski¹ and Derek Haley²

¹Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada
²Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada

Welfare-related traits that are correlated with calm temperament, and can be easily gauged on-farm, may eventually be used in selection for calmer beef cattle and thus increased profitability and better welfare. In previous studies, the percent of exposed eye white (EW) or sclera, that cattle display has been shown to be a trustworthy predictor of their temperament. There has also been evidence that hair whorl position may be useful in identifying temperament, however more research is needed to form a concrete conclusion. The objective of this experiment was to determine the relationships between percentage of exposed EW, hair whorl position and feeding behaviour to temperament. The accuracy and dependability of using these traits as predictors of temperament in beef cattle was also assessed. Animals were separated into three groups (heifers, bulls and steers) and ten animals from each group were assessed. Each animal was individually video recorded in a squeeze chute at Elora Beef Research Centre. Two still digital images from the video recording were selected to determine the level of eye white shown, and a single head shot of each animal was taken to determine placement of the hair whorl. Chute temperament scores (CTS) were ranked from 1 (calm) – 5 (agitated) using only whole numbers for each animal. Percentage of EW was analyzed using Sigmascan Pro 5. It is predicted that if the behavioural or physical traits are reliable indicators of temperament, there will be a positive correlation between the trait and CTS. In the future, temperament will also be assessed from age at weaning to about one year of age to verify if this trait is stable as the animal matures. Finally, feed behaviour data (recorded electronically) will also be assessed to determine any correlation with temperament as this has a direct economic significance for producers. This study, when complete, will be valuable in furthering the development of objective methods for temperament selection in beef cattle.
The Development of feather pecking in a commercial turkey facility: The effect of growing environment

Stephanie Torrey¹, ², Graham Duggan*², Ashleigh Arnone¹, Tina Widowski², and Lloyd Weber³

¹Agriculture & Agri-Food Canada, University of Guelph, Guelph, ON, Canada
²Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada
³LEL Farms, Guelph, Ontario, Canada

In the poultry industry, feather pecking is considered a major economic concern as victimized birds require increased feed intake and may succumb to injuries, resulting in losses for producers. Additionally, feather pecking is considered to be painful for the recipient and raises a number of welfare issues. While much of the research concerning feather pecking has been carried out with laying and broiler chickens, there is little information regarding this behaviour in domestic turkey flocks. There is a lot of evidence to suggest that feather pecking behaviour is multi-factorial and may be influenced by genetics, rearing environment, or lighting conditions. Attempts to control pecking have been made and these methods raise welfare concerns. The practice of beak-trimming has proven to be a painful procedure for young birds and has chronic and lasting effects throughout the bird’s growth. Light intensities are also routinely lowered in growing barns to stem the behaviour which raises additional welfare concerns such as eye damage and lack of conspecific recognition. Experimentally, light sources have been shown to affect the rate of feather pecking, with artificial lighting seeming to reduce the behaviour. However, this has never been examined in commercial-sized flocks. Currently in the North American poultry industry, new types of rearing and growing environments are being put in place to provide more natural settings and these may dramatically affect the rates of pecking. This study will compare the development and rates of feather pecking occurring between an environmentally controlled (artificial light) and curtain-sided (natural light) setting. In addition, enrichment will be added to half of the barns in the form of multicoloured play-pit balls in order to divert pecking behaviour away from conspecifics. By obtaining sample weights and feather scores throughout the growing period, we hope to see how pecking behaviour develops as the two flocks grow in two different environments and how the addition of enrichment may affect pecking rates.
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