

Animal Behavior and Well-Being 2

304 ASAS Early Career Award Presentation: Working to foster the discovery, sharing, and application of knowledge concerning the well-being of farm animals. A. Johnson*, *Iowa State University, Ames.*

In developed countries there has been intense marketing, social and political interest in farm animal well-being and husbandry procedures. The need for relevant science that can be applied in education, assessment, audits and legislation has escalated. Yet in the US there are minimal farm animal ethologists compared with the more traditional sciences of nutrition, physiology and reproduction. Ethologists have risen to this challenge by working together and across disciplines on farm animal well-being research and extension. This approach creates a more efficient delivery mechanism to share and apply contemporary scientific knowledge. Three central themes have driven my research and extension program (1) maintenance behaviors of farm animals (2) handling and system design for the finisher pig and (3) sow productive lifetime. It is certain that progress in these areas requires collaboration of experts in many disciplines and our efforts in developing handling and system designs for the finisher pig will be highlighted. Three important questions must be addressed in regards to the occurrence of market pigs that become injured, non-ambulatory or die during the marketing process (1) science; what is the etiology of the non-ambulatory pig? (2) economics; it was calculated that transport losses cost the US swine industry \$50 to \$100 million loss/yr (2009) and (3) legislation whereby if passed these animals would not be allowed into the human food chain resulting in approximately \$500 million/loss/yr to the US swine industry alone. Several of our studies have addressed loading gantry design, pre-sorting and raising pigs in large and small pens. Data collected from these studies will provide science back to decision makers and information for extension such as the Transport Quality Assurance program, posters, flyers, media stories and fact-sheets in addition to peer review abstracts and papers. The overall aim of these efforts will be to reduce stressors that impinge on the pig at marketing, reduce transportation losses and maintain the well-being of the pig.

Key words: handling, swine, transport

305 The effect of reactive state on the physiology of dairy cows milked in a novel environment. M. A. Sutherland*¹ and G. A. Verkerk², ¹AgResearch Ltd., *Animal Behaviour and Welfare Group, Hamilton, New Zealand*, ²DairyNZ, *Hamilton, New Zealand*.

Differences in the way animals react behaviorally and physiologically to a stressor may reflect differences in fearfulness or coping style. The objective of this study was to determine if reactive state affects the physiology of dairy cows being milked in a novel environment. The reactive states of multi-parous cows were assessed using 4 behavioral tests: restraint test, exit velocity, flight distance, and an approach test. After this initial testing, 20 cows were selected and separated into 2 groups: low responders (LR: n = 10) and high responders (HR: n = 10). Cows were milked according to their established routines in a rotary shed and physiological data as well as milk production parameters were collected over 5 consecutive days. On Days 2 and 5, blood samples were collected via the tail vein before and after milking to measure cortisol and oxytocin concentrations, and heart rate monitors were attached to measure autonomic responses during milking. The following week, cows were milked in a novel environment (herringbone parlor within the same farm facility) over 5 consecutive days,

and the sampling program was repeated. Data were analyzed using the MIXED procedures of SAS. Pre-milking cortisol concentrations were greater ($P < 0.05$) in HR than LR cows, and cortisol concentrations were greater ($P < 0.05$) when cows were milked in the herringbone compared with the rotary parlor, regardless of reactive state. Pre-milking heart rate was greater ($P < 0.05$) in HR than LR cows, and heart rate was greater ($P < 0.05$) in HR cows in response to being milked in the herringbone parlor than in LR cows. Milk yield was greater ($P < 0.06$) and milking duration longer ($P < 0.05$) for LR compared with HR cows. Average milk flow did not differ ($P > 0.05$) between LR and HR cows, but the milk let-down pattern was affected ($P < 0.001$) by cow reactive state and milking environment. These results indicate that baseline physiological measures differ between cows of differing reactive states, and that a cow's reactive state will affect the way she responds to a novel environment.

Key words: behavior, dairy, stress

306 The effect of reactive state and training on the behaviour and milk production of heifers during the first week of lactation. M. A. Sutherland*¹ and G. A. Verkerk², ¹AgResearch Ltd., *Animal Behaviour and Welfare Group, Hamilton, New Zealand*, ²DairyNZ, *Hamilton, New Zealand*.

Differences in the way in which animals react behaviorally and physiologically to new situations may reflect differences in fearfulness or coping style. The objective of this study was to determine if training before calving could modulate the reactive state in heifers during their introduction to milking routines after calving. The reactive state of heifers was assessed pre-partum using 4 behavioral tests: restraint test, exit velocity, flight distance, and an approach test. On the basis of this testing, 40 heifers were selected and denoted as either low (LR: n = 20) or high (HR: n = 20) responders. One month before calving, half the heifers from each group were allocated randomly for training in the rotary milking-parlor over a 2 d period while the other heifers were left undisturbed in the paddock. During the first 5 d of lactation, behavioral and physiological data were collected from all heifers, including behavior during cup attachment, milk yield, milk flow rate, and residual milk volume. Data were analyzed using the MIXED procedures of SAS. Behavior scores during cup attachment (scale: 0 = no hind foot movement, 4 = backward kick with a hind leg) were higher ($P < 0.05$) in trained LR compared with non-trained LR heifers, indicating an increased level of reactivity; but training did not influence scores for behavior during cup attachment in HR heifers. Milk yield did not differ ($P > 0.05$) between trained and non-trained LR heifers, but was lower ($P < 0.001$) in trained HR compared with non-trained HR heifers. The patterns of milk flow-rate differed ($P < 0.01$) between trained and non-trained, LR and HR heifers, with trained HR heifers having the lowest flow rate. Percentage residual milk volume was lower ($P < 0.005$) in trained HR compared with non-trained HR heifers, and tended ($P = 0.07$) to be reduced in trained compared with non-trained LR heifers. Training to the milking parlor negatively affected the behavioral response of heifers to milking and milk production, and this response was further influenced by individual reactive state.

Key words: behavior, dairy, milk production

307 Effect of frequency of feed delivery on the behavioral patterns of dairy cows milked in an automatic system. J. A. Deming*¹,

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The primary objective of this study was to determine the effect frequency of feed delivery has on the behavior of dairy cows milked in an automatic milking system (AMS); the secondary objective was to determine if this effect is influenced by lameness. Ninety lactating Holstein dairy cows, kept in a free-stall barn in 1 of 2 pens, each with a free-traffic AMS, were monitored on each of 2 treatments in a cross-over design with 35-d periods. The treatments were delivery of TMR: 1) 1x/d (at 0730h) and 2) 2x/d (at 0730 and 1730h). During the last 7 d of each period standing/lying behavior of the cows were recorded with data loggers, while milking frequency and yield were recorded by the AMS. Cows were lameness scored (scale of 1 = sound to 5 = severely lame) twice each period. Data were analyzed in a general linear mixed model including lameness score as a covariate. There was a tendency ($P = 0.06$) for cows to get milked more frequently when fed 2x/d (2.6 vs. 2.5 milkings/cow/d; SE = 0.08). Cows with higher lameness scores got milked less frequently ($P = 0.02$). Frequency of feed delivery did not affect ($P = 0.6$) milk yield (34.7 kg/d; SE = 1.9). Cows spent 10.9 h/d (SE = 0.2) lying down split into 7.2 lying bouts/d (SE = 0.3); these did not vary ($P = 0.2$) with treatment. Cows with higher lameness scores spent more time lying/d ($P = 0.045$) and had more lying bouts/d ($P = 0.03$). When fed 2x/d, cows milked in the AMS closer in time (SE = 57.9; $P < 0.001$) to feed delivery (milking on average 17.1 min from a feed delivery), while when fed 1x/d cows milked in the AMS at time points much further away from feed delivery (milking on average 264.5 min from a feed delivery). Despite having less of an incentive to remain standing, cows still spent more time standing after milking when fed 1x/d (94.7 vs. 86.2 min; SE = 5.8; $P = 0.03$). Cows with higher lameness scores tended ($P = 0.09$) to lie down sooner after milking. The results suggest that frequency of ration delivery has some effect on the behavior of AMS-milked cows; further the results show that, regardless of feeding frequency, these behavioral patterns are affected by lameness.

Key words: automatic milking, behavioral pattern, lameness

308 Effect of yearly climate on milk yield in a sub-tropical environment. J. C. Lees* and J. B. Gaughan, *The University of Queensland, Gatton, Queensland, Australia*.

Heat load is a major cause of milk yield (MY) loss in tropical and subtropical dairy production. In this study the long-term effects of heat load on MY in a sub tropical environment were investigated. Individual daily MY was obtained from 250 Holstein-Friesian cows housed outside over 3 summers (340 d) and 2 winters (119 d). The cows had access to a feed pad and pasture. Ambient temperature (TA), black globe temperature (BG), and relative humidity (RH), were obtained at 10 min intervals from an automated on-site weather station. The effects of TA, BG, RH and THI on daily MY were determined for the herd (N) using Pearson partial correlation analysis (days in milk used as a co-variant). The relationship between daily MY and the climate variables at 0800, 1200, 1600, 2000, 0000 and 0400 h was established. The effects of previous heat load on current MY (d 0) were examined using the mean daily THI for d -1, -2, -3 and -4. Cows were categorized by MY as low (LO < 19kg/d), medium (MD 19 to 27kg/d) or high (HI > 27kg/d) and subjected to the same analysis as N. Increasing

THI, BG and TA had negative correlations with MY on a herd basis. Climate data obtained at 0800 h had the highest correlations with daily MY. Whole herd correlations ($P < 0.0001$) between MY loss, TA, BG and THI at 0800 h were -0.39, -0.43, and -0.39 respectively. There were weak correlations ($P < 0.05$) between the climatic variables and MY of LO cows, and consistently strong negative correlations for MD and HI cows. The MY of HI cows had the best correlation (-0.54; $P < 0.0001$) with BG at 0800 h. The relationship between daily MY and mean daily THI was -0.38 for N, -0.10 for LO ($P > 0.05$), -0.31 for MD, and -0.45 for HI ($P < 0.0001$). The relationship between climatic variables on previous days was a better indicator of d 0 MY than on d 0. When lag effects were examined the best correlation for d 0 MY was mean THI on d -2 (-0.54; $P < 0.0001$). This suggests that effects of heat load on MY are cumulative. Heat stress models need to be developed that will account for the impact of cumulative heat load on production and welfare.

Key words: heat load, milk yield, dairy cows

309 Evaluation of two different cooling systems on a Sicilian dairy farm: Physiological parameters and milk aroma. R. Ben Younes^{1,3}, G. Azzaro², I. Schadt², G. Belvedere², M. Caccamo², R. Petriglieri², G. Licitra^{3,2}, and S. Carpino^{*2}, ¹*INAT, Tunis, Tunisia*, ²*CoRFiLaC, Regione Siciliana, Ragusa, Italy*, ³*DISPA, Catania University, Catania, Italy*.

Two cooling systems were evaluated on a Sicilian dairy farm, during summer time, with regard to cows' responses in terms of respiratory rates (RR) and rectal temperatures (RT) and milk chemical composition. The effects on milk aroma were also evaluated, because cows' body temperature might influence milk temperature, oxidation processes and stability as a result. Cows were assigned to 2 groups of 10 animals with similar average days in milk (DIM), milk production and composition. One group was cooled with a sprinkler system (SP) the other was cooled by showers (SH). Both had additional ventilation. Cows initial average values of DIM, milk yield (kg/cow/d), fat (%), protein (%), lactose (%) \pm standard deviation in SP were 141 (± 88.3), 36 (± 10.2), 3.7 (± 0.4), 3.2 (± 0.1), 4.2 (± 0.6), and 139 (± 73), 35 (± 6.6), 3.6 (± 0.4), 3.2 (± 0.2), 4.6 (± 0.5) in SH, respectively. Individual milk samples were analyzed for fat, protein and lactose content and RR and RT were measured 6 times with 15 d intervals, beginning at the end of June. At each test day, THI values were calculated. Milk samples of the last 3 test days were additionally analyzed by SmartNose for milk aroma profiles. THI values were 73.3, 79.7, 79.6, 77.8, 74.1 and 72.3 at test d 1 through 6, respectively. Cows cooled with SH compared with SP had significantly higher RT and RR ($P < 0.001$). Measured RT and RR (LSMeans \pm SE) in SH and SP were 39.26 \pm 0.001, 59.92 \pm 0.018 and 38.95 \pm 0.001 and 54.84 \pm 0.018, respectively. SmartNose analysis highlighted differences in milk volatile composition between treatments. Fat, protein and lactose (%) were not different between groups ($P > 0.05$). These parameters were only affected by test day ($P < 0.001$). Relative humidity with SH might be higher compared with SP and might have increased heat stress of dairy cows. Milk aroma profile was apparently related to RR and RT and oxidation processes might be involved. Further investigations on the effects of cows' body temperature on milk oxidation processes and stability might be needed.

Key words: cooling systems, heat stress, milk aroma profile

310 Assessment of a web camera to evaluate farm management and cow behavior. G. Licitra^{1,2}, G. Azzaro¹, R. Petriglieri¹, M. Cac-

camo¹, and J. D. Ferguson*³, ¹CoRFiLaC, Regione Siciliana, Ragusa, Italy, ²DISPA, Catania University, Catania, Italy, ³University of Pennsylvania, PA.

The objective of this project was to evaluate the use of a web camera to assess cow behavior and management activities on a dairy farm. Often advisors are requested to provide expert advice to management based on observation of cow behavior from a farm visit. This can be biased as often observations are made from a one-time visit, however to view the farm more frequently may be expensive if the advisor is coming from a distance. Using a web camera or digital videos taken at times throughout the day may provide views of cow behavior and facility use relative to management activities, such as feeding and milking, facilitating a more comprehensive evaluation of the farm avoiding the expense of repetitive farm visits. In addition, as developing countries expand their dairy industry, expert advisors may be contacted in countries with mature dairy industries to provide support and training of local professionals through the internet without a physical visit to the dairy in question. Use of digital media has the potential to expand interaction across regions and enhance training and support of novice dairy advisors and producers. Assessment of cow behavior, cleanliness, body condition, lameness, and facility comfort via web technology was evaluated against assessments made from farm visits. Assessments were made from 2 farms with 2 observers visiting the farm contemporary to an individual viewing the farm(s) via a web camera. Subsequently, observations by all 3 individuals were made using the web camera at different times of the day from separate computers. In general, cow behavior assessments between observers and methods were consistent, but there were differences in assessing BCS between methods and observers and in assessing cleanliness and lameness between methods. The web camera enabled assessment of management activities over successive periods. Results therefore demonstrate that visual assessment of animal behavior and management of a facility may be performed through distant imaging by precluding advisors a visit to the farm in working with dairy producers and local advisors.

Key words: cow behavior, management evaluation, visual assessment

311 Novel techniques for anesthesia during disbudding of calves. K. R. Tapper*¹, J. P. Goff¹, B. L. Leuschen², J. K. West², and S. T. Millman^{1,2}, ¹Iowa State University Department of Biomedical Sciences, Ames, ²Iowa State University Veterinary Diagnostic and Production Animal Medicine, Ames.

The objective of this study was to evaluate novel anesthetics to alleviate pain during disbudding. Efficacy was determined by latency for loss of sensation (LS), as well as presence and duration of analgesic effect. Thirty calves were randomly assigned to one of 3 corneal anesthetic treatments: 100% ethanol (E), depot solution of 2% lidocaine suspended in peanut oil (D), or control 2% lidocaine (C). On Day 0, 2 mL/horn anesthetic was injected and LS was measured at 5 min increments using a needle prick test at 4 locations around the horn bud. Calves with sensation at +10 min received an additional 1 mL anesthetic injection. When LS was achieved, calves were disbudded using heat cautery. Presence and duration of analgesic effect were determined using pressure algometry (PA), which quantified mechanical nociceptive thresholds as kilograms of force (kgf) relative to a head withdrawal response. Four landmarks around each horn bud and a non-painful control location were measured hourly for the first 9 h on Day -1 and Day 0, and at 12 h increments on Day+1 through Day+3 post-disbudding. Mean latency for LS was analyzed in SAS version

9.2 using a mixed model. There was a significant difference in loss of sensation at 10 min, such that treatments differed for the number of calves that required an additional injection (E: 6/10 calves; D: 7/10 calves; Control: 2/10 calves, $P < 0.0001$). However, there was not a treatment difference for latency to LS (min) \pm SEM: E 26.40 \pm 6.12; D 25.60 \pm 4.78; Control 13.50 \pm 4.47). PA data were analyzed using PROC GLIMMIX by treatment and trial day. Ethanol did not differ from C at hour +1, but displayed higher pain thresholds thereafter from Day0 through Day+3 (Raw Means, [kgf] \pm SEM: Day0 = E 4.4 \pm 0.1; C 3.6 \pm 0.1; Day+3 = E 4.6 \pm 0.1; C 3.3 \pm 0.1; $P < 0.01$). Depot did not differ from C for PA response nor for latency to LS (Raw Means [kgf] \pm SEM: Day0 = D 3.2 \pm 0.1; Day+3 = D 3.0 \pm 0.1). In conclusion, longer latency to LS was associated with E and D anesthetics compared with control (C). Ethanol provided superior analgesia compared with C, whereas D did not when pain was measured using PA.

Key words: analgesia, disbudding, pain

312 The effect of pain relief on the physiology and behavior of calves after castration and/or dehorning. M. A. Sutherland*^{1,2}, B. L. Davis¹, T. A. Brooks¹, and M. A. Ballou¹, ¹Texas Tech University, Animal and Food Sciences Department, Lubbock, ²AgResearch Ltd., Animal Behaviour and Welfare Group, Hamilton, New Zealand.

Calves are commonly castrated and/or dehorned without pain relief once they enter the feedlot. The objective of this study was to determine the efficacy of pain relief to alleviate the pain caused by dehorning and/or castration in 3 mo old calves. This study comprised of 8 treatments (n = 10 per treatment): 1) control handling (SHAM); 2) castration (CAS); 3) dehorning (DH); 4) castration and dehorning (CD); 5) control handling plus analgesia (ANA); 6) castration plus analgesia (CAS+A); 7) dehorning plus analgesia (DH+A); 8) castration and dehorning plus analgesia (CD+A). Analgesia involved administering local anesthetic around each horn (DH+A, CD+A, and ANA) and/or into the testes (CAS+A, CD+A, and ANA treatments) before performance of the treatment and a non-steroidal anti-inflammatory drug (NSAID) was administered immediately after. Sequential blood samples were collected to measure leukocyte counts and percentages, and cortisol concentrations. Behavior was recorded using 5 min scan samples. Calves were weighed before and 24 h after treatments were performed. Data were analyzed using the MIXED procedures of SAS. At 360 min, the neutrophil to lymphocyte ratio was lower ($P < 0.05$) in CAS, DH, and CD calves that received analgesia compared with castrated and/or dehorned calves that did not receive analgesia. The integrated cortisol response was greater ($P < 0.05$) in CAS, DH, and CD compared with SHAM calves, but similar in CAS+A, DH+A, CD+A, and SHAM calves. The frequency of tail wagging was greater ($P < 0.05$) and eating was reduced ($P < 0.05$) in CAS, DH, and CD compared with SHAM calves, but similar among castrated and/or dehorned calves that received analgesia compared with SHAM calves. Body weight decreased ($P < 0.05$) in CAS, DH, and CD calves compared with ANA calves. Administration of analgesia prevented body weight loss in CAS ($P = 0.05$) and DH ($P = 0.07$) calves, but not in CD ($P = 0.31$) calves. The behavioral and physiological changes caused by castration and/or dehorning are indicative that these animals experience pain, which can be reduced by administering a local anesthetic in combination with a NSAID.

Key words: dairy, pain, welfare

313 Physiological and immunological effects of surgical castration and amputation dehorning and the influence of anesthetics and analgesics in Holstein calves. M. A. Ballou*¹, M. A. Sutherland^{1,2}, B. L. Davis¹, T. A. Brooks¹, C. J. Cobb¹, and L. E. Hulbert^{1,3}, ¹Department of Animal and Food Sciences, Texas Tech University, Lubbock, ²Animal Behavior and Welfare Group, AgResearch, Hamilton, New Zealand, ³Department of Animal Science, University of California at Davis, Davis.

Objectives were to determine the physiological and immunological effects of surgical castration and/or amputation dehorning and the influence of anesthetics and analgesics in Holstein calves. Eighty 3-month old Holstein bull calves were completely randomized to treatments in a 2 × 2 × 2 factorial arrangement with castration, dehorning, and anesthetic/analgesic as the main effects. Peripheral blood samples were collected before and 0.5, 1.5, 2.5, 4, 6, 24, and 72 h after the respective procedure and analyzed for total leukocyte and differential counts. Plasma cortisol and haptoglobin concentrations were also determined. Blood samples collected before and at 0.5 and 24 h after the procedures were analyzed for ex vivo innate immune responses. Both castration and dehorning elevated ($P < 0.01$) total leukocyte counts and neutrophil:lymphocyte ratios, and the administration of anesthetic/analgesic ($P < 0.01$) attenuated the leukocyte responses. Plasma cortisol and haptoglobin responses were increased ($P < 0.01$) following castration and/or dehorning and the combination of the 2 procedures was additive ($P < 0.01$). Anesthetics/analgesics reduced the peak and persistency of the elevated cortisol response ($P < 0.01$), and the haptoglobin concentrations at 24 h after the procedure ($P < 0.01$). Castration and dehorning together tended ($P = 0.09$) to decrease TNF- α secretion 24 h after the procedure, and administration of anesthetic/analgesics alleviated ($P < 0.01$) the response. In addition, anesthetic/analgesics lessened ($P < 0.01$) the suppressed neutrophil oxidative burst observed 24 h after castration and/or dehorning. Dehorning decreased ($P < 0.04$) neutrophil L-selectin expression and administration of anesthetic/analgesics reversed the response ($P < 0.05$). Both castration and dehorning cause distress and suppress innate immune responses. The administration of anesthetic/analgesic alleviated the adverse effects associated with castration and dehorning.

Key words: analgesia and anesthesia, castration, dehorning

314 Effects of pair housing versus limited social contact on the response of dairy calves to separation. L. R. Duve*¹, M. B. Jensen¹, and D. M. Weary², ¹University of Aarhus, Tjele, Denmark, ²University of British Columbia, Vancouver, British Columbia, Canada.

There is much variety in the extent of social contact allowed to pre-weaned dairy calves; some are housed individually with no opportunity for physical contact, some are allowed limited physical contact with calves in neighboring pens, and others are group housed for part or all of the milk feeding period. A former study indicated that calves allowed limited physical contact still established a social bond; however, the strength of this relationship may differ from calves with full social contact. The aim of this study was to test the effect of the level of social contact on the strength of the social relations, as measured by calf responses during a 20 min period of separation (and 10 min after reunion) from their social companion. Twenty-seven pairs of calves were reared from birth until 6 weeks in either individual pens (with limited social contact between bars; L-calves), pair housed (with full social contact; F-calves), or in individual pens for 3 weeks and in pairs

for the next 3 weeks (LF-calves). The separation test was conducted in the home pen when the calves were 34d old. Responses measured were the number of steps, time spent not moving, and maximum heart rate (MHR). Data were analyzed with a general linear mixed model (SAS). F and LF did not differ for any measure, but these calves spent more time standing (F: 850 ± 99, LF: 824 ± 104, L: 510 ± 99 s; $P < 0.01$), took more steps (F: 21 ± 2, LF: 20 ± 3, L: 13 ± 2; $P = 0.05$) and spent less time not moving (F: 779 ± 64, LF: 730 ± 68, L: 975 ± 64 s; $P = 0.03$) during the separation and reunion phase of the test, compared with those calves allowed limited social contact. MHR did not differ among treatments during separation ($P = 0.52$), but was higher for F than L (F: 172 ± 6, LF: 162 ± 7, L: 151 ± 6; $P = 0.04$) during the reunion phase (LF-calves did not differ from either treatment). In conclusion, calves housed in pairs from birth or from 3 weeks of age were more active when separated from their companion in the home environment at 5 weeks of age, suggesting that calves raised with full social contact have a stronger relation with their companion than do calves housed with limited contact.

Key words: dairy calves, social contact

315 Lameness, leg injuries and lying times on 122 North American freestall farms. A. K. Barrientos*¹, D. M. Weary¹, E. Galo², and M. A. G. von Keyserlingk¹, ¹Animal Welfare Program, University of British Columbia, Vancouver, Canada, ²Novus International Inc., St Louis, MO.

The aim of the study was to describe the variation in lameness, leg injuries and lying behavior on dairy farms in 3 regions of North America: California (CA); North Eastern states (NE; New York, Pennsylvania and Vermont) and British Columbia (BC). Data were collected by the same 2 trained individuals from approximately 40 Holstein herds in each region. One group of high production multiparous cows was monitored on each farm. Cows were gait scored using a 5-point Numerical Rating System where 1 and 2 are considered non-lame, ≥ 3 clinically lame, and ≥ 4 severely lame. Prevalence of knee injuries was recorded based on swollen carpal joints (yes/no). Focal cows ($n = 40$), randomly selected from the assessment group, were evaluated for hock injuries on a scale of 1 to 3 (1 = healthy and 3 = evident swelling or severe lesion). Electronic data loggers recorded lying behavior of the focal cows at 1-min intervals for 3 d. The analysis was descriptive and all results are presented as means ± SD. Prevalence of clinical lameness averaged 30.8 ± 15.5% in CA, 54.8 ± 16.7% in NE and 27.8 ± 13.9% in BC; severe lameness averaged 3.6 ± 4.2% in CA, 8.2 ± 5.6% in NE and 7.1 ± 5.3% in BC. Prevalence of swollen knees was minimal in CA (0.3 ± 0.6%), but high (23.1 ± 16.3%) in the NE (not scored in BC). Overall prevalence of hock injuries (≥ 2) was 56.2 ± 21.6% in CA, 81.2 ± 22.5% in NE, and 40.7 ± 26.3% in BC; prevalence of severe injuries (3) was 1.8 ± 3.1% in CA, 5.4 ± 5.9% in NE and 3.5 ± 5.2% in BC. Lying times were similar across regions (10.4 ± 0.8h/d in CA, 10.6 ± 0.9h/d in NE, and 11.0 ± 0.6h/d in BC) but cows within farms varied from, 3.7 to 17.5h/d, 2.8 to 20.5h/d, and 4.2 to 19.5h/d in CA, NE and BC, respectively. These results show considerable variation in lameness and leg injury prevalence among freestall farms in North America. The very low prevalence of these ailments on some farms shows great opportunity for improvement on other farms.

Key words: cow comfort, welfare assessment