410 Group size alters postures, and maintenance, oral, locomotor, and social behaviors of veal calves. E. M. Abdelfattah*[2], M. M. Schutz[3], D. C. Lay Jr.[1], J. N. Marchant-Forde[1], and S. D. Eicher[1], *[1]USDA-ARS, W. Lafayette, IN, [2]Banha University, Moshtohor, Qalyubia, Egypt, [3]Purdue University, W. Lafayette, IN.*

The objective of this study was to evaluate the effect of group size on behavior of veal calves. Holstein-Friesian bull calves (n = 168; 44 ± 3 d of age), were randomly assigned to 1 of 3 treatments of group housing with 2, 4, or 8 calves per pen (1.82 m^2 per calf for all groups). Behavior was observed from video data recorded from 0700 to 1700 h using instantaneous scan sampling every 5 min within 30 min observation sessions, one day each month for 5 mo. Continuous focal sampling around feeding time (30 min before feeding, 30 min during feeding, and 30 min after feeding) on d 0, 1, 5, 14, 42, and 70 after grouping focused on all instances of oral and aggressive behaviors. Data were analyzed as a RCB with repeated measures using PROC MIXED (SAS). Calves in groups of 2 spent more time at the feeders ($P = 0.001$) than calves in groups of 4 or 8. Calves housed in groups of 4 or 8 showed more conspecific contact ($P \leq 0.05$), standing ($P < 0.001$), and less self-licking ($P < 0.001$) than calves housed in groups of 2. An interaction ($P = 0.001$) between treatment and month was observed for manipulation of objects. Calves in groups of 2 manipulated objects more than calves in groups of 4 or 8 in mo 3. While in mo 4, calves in groups of 2 and 4 manipulated objects more than calves in groups of 8. An interaction ($P < 0.001$) between treatment and month was reported for lying behavior; in mo 2, calves from groups of 2 lay more than calves from groups of 4 or 8, while in mo 3 and 5 calves in groups of 2 and 4 lay more than calves in groups of 8. An interaction ($P = 0.003$) between treatment and month was observed for walking; in mo 4 and 5, calves from groups of 4 and 8 walked more than calves from groups of 2. During feeding times group size had no effect ($P > 0.05$) on any behavioral patterns except for duration of conspecific contact. Groups of 2 had had more ($P = 0.01$) conspecific contact than groups of 4 or 8. Additionally, occurrence of play and aggression were similar ($P > 0.05$) around feeding for all treatments. In conclusion, larger groups changed how oral needs were manifested and increased use of available space, improving social welfare.

Key Words: group size, behavior, veal calf

411 Efficacy of radiant barrier covers in reducing heat in polyethylene calf hutches. W. R. Binion* and T. H. Friend, *Dept. of Animal Science, Texas A&M University, College Station.*

The objective of this study was to determine the ability of a radiant barrier hutch cover to moderate the effect of ambient temperature and radiant energy in polyethylene hutches. The cover consisted of a single layer of 2-sided reflective aluminized polyester film with polyester scrim reinforcement (reflectivity = 95%, R = 2.7). At each of 2 dairies, 6 hutches were either un-covered (control) or had reflective covers across the top and sides of the hutch, leaving the front, back, and pen exposed. Each hutch had a 1.2 × 1.8-m attached outdoor wire pen. Calves were allowed ad libitum access to feed and water. Loggers mounted 20 cm above the flooring, on the interior side of each hutch, recorded interior temperature at 30-min intervals over 24 d during late August to early September. The mean daily interior peak temperature over the 24-d observation period (40.5 ± 10.0°C) was 4.2 ± 0.2°C less ($P < 0.05$) in the hutches with the reflective cover than in the un-covered hutches, and did not differ ($P = 0.72$) between dairies. During the 10 d of the observation period with the highest peak temperatures (43 ± 7.5°C), reflective covers resulted in an interior hutch temperature 4.7 ± 0.1°C lower ($P < 0.001$) when compared with the control. Interior roof temperatures were recorded on 4 different days using an infrared thermometer during the early afternoon. Interior roof temperature (43.3 ± 16.7°C) was 9.3 ± 1.7°C lower ($P < 0.001$) for the reflective hutches compared with the control. Highest recorded interior hutch temperatures during the overall sampling period were 50.5°C for control, and 43.5°C for the reflective hutches. Reflective barriers moderated hutch microclimate, suggesting reflective covers can be useful for reducing solar heating of hutches.

Key Words: dairy, radiation, hutch

412 Adoption of practices to improve cow comfort on dairy farms. C. Nash*[1], D. Kelton[1], D. Pellerin[2], T. DeVries[3], A. M. de Passillé[4], J. Rushen[4], G. Charlton[4], E. Vasseur[5], and D. Haley[1], *[1]University University of Guelph, Guelph, ON, Canada, [2]Université Laval, Québec, QC, Canada, [3]University of Guelph – Kemptville Campus, Kemptville, ON, Canada, [4]Agriculture and Agri-Food Canada, Agassiz, BC, Canada, [5]University of Guelph – Alfred Campus, Alfred, ON, Canada.*

The Canadian code of practice for the care and handling of dairy cattle include requirements and recommendations that aim to improve cow comfort. However the degree of implementation of these practices at the farm level is unknown. The objective of this project was to encourage the implementation of cow comfort practices on farm and identify barriers that producers face when considering these changes. In this intervention study, we visited 40 farms in Ontario and measured the level of cow comfort on each farm through various animal (body condition, injuries, lying time), management (cleaning and feeding routine) and resource (stall design and pen design) based measures. We then provided each producer with a diagnostic tool to evaluate risk factors for cow comfort on their farm using the code of practice recommendations. We conducted semi-structured interviews with these producers 12 to 18 mo later to determine if they had adopted new practices to improve cow comfort and meet code of practice requirements. Data on producer demographics, types of changes that were made and prevention to further change was also collected. The mean age of producers was 45 years (range: 27–61) with an average herd size of 115 (47–530). The sample included 23 freestall, 15 tiestall and 2 automated herds. Of the producers interviewed, 60% had received post-secondary education. Following our intervention, 73% of producers had made changes. The most commonly adopted cow comfort practices were improved bedding managements (22.7%), improved hoof-trimming management (18.2%) and improved stall base (18.2%). The most commonly identified barriers for the prevention of further change were lack of funds (43.3%), satisfaction "with the comfort of their cows" (30%) and lack of time (23.3%). Only 25% of the non-adopters had identified a successor for their farm, while 64% of the producers that had made changes had identified a successor. These results demonstrate that our intervention study was successful at encouraging change on dairy farms; however, certain barriers still exist to the implementation of cow comfort practices, including farm decisions about successorship.

Key Words: adoption, cow comfort, diagnostic tool

413 Effect of stocking density on lying behavior of dairy cows. K. M. Lobeck*, M. I. Endres, A. R. Dresch, and R. C. Chebel, *University of Minnesota, St. Paul.*

The objective of this study was to investigate the effect of 2 feedbunk stocking densities on prepartum lying behavior of dairy cows. Jersey cows at 4 wk before expected calving date were assigned randomly to 1 of 2 treatments. Treatments were 80% (38 cows/48 headlocks; 80D) or 100% (48 cows/48 headlocks; 100D) feedbunk stocking density. Headlocks were 0.61 m. Four pens with sand bedded freestalls were utilized: 2 multiparous and 2 primiparous pens over 3 repetitions. Cows were balanced for body condition score and no cows with locomotion score > 2 were included in the study. One hundred-2 80D and 123 100D cows were selected as lying behavior focal cows. Lying behavior was measured with HOBO Pendant G data loggers. The mean number of focal cows in each pen was 19 with a range of 14–23 cows. Loggers were attached to the cow's rear leg 1 d after entrance to the pen and were left on for 12 d, removed for 7 d and reattached for 12 d or until the cow calved. Data were analyzed by Proc Mixed in SAS. Overall there were no differences between treatments for lying time (12.8 ± 0.04 h/d). Primiparous cows in the 80D and 100D treatments spent 12.5 and 12.4 h/d lying down, respectively, whereas multiparous cows in the 80D and 100D treatments spent 12.4 and 13.0 h/d lying down, respectively. There was a treatment by lactation interaction ($P = 0.02$). Multiparous cows in 100D treatment pens spent 0.6 h/d more lying down than 100D primiparous cows ($P < 0.01$). There were differences in the number of lying bouts between treatments and lactation number. Multiparous cows in the 100D treatment had 0.91 more bouts/d than 80D cows (14.7 vs. 13.8; $P < 0.01$). Primiparous cows had more lying bouts than multiparous cows (16.1 vs. 12.3; $P < 0.01$). Lying bout duration did not differ between treatments (1.32 ± 0.04 h). Multiparous cows had longer ($P < 0.01$) lying bout duration (1.54 h) than primiparous cows (1.13 h). In conclusion, 100% stocking density only affected the number of lying bouts with no differences between treatments for lying time and lying bout duration. More differences in lying behavior were observed between multiparous and primiparous cows.

Key Words: lying behavior, stocking density, feedbunk space

414 The effect of stall surface compressibility on dairy cow behavior. A. C. Main*[1], C. B. Tucker[2], N. B. Cook[3], T. F. Duffield[1], and D. B. Haley[1], *[1]University of Guelph, Guelph, ON, Canada, [2]University of California, Davis, [3]University of Wisconsin, Madison.*

Optimizing the time dairy cows spend lying is critical for production, rest, and welfare, and one of the most important factors influencing lying behavior is the softness of the stall surface. Our objective was to determine whether aspects of the cow's activity and lying behavior change with the use of 2 stall bases, differing in their compressibility. A foam and gel mattress were compared (gel = more compressible, 5.7 psi, vs. foam = 11.6 psi). Nonlactating Holstein dairy cows (n = 18) were kept individually in a freestall barn where they had been housed previously. Cows experienced 2 stall surfaces, 3 d/surface, in a balanced order. Prior to onset of the study cows had free access to both surfaces for 24 h. Behavior was video recorded and accelerometers were used to record standing and lying. The first 2 d on each surface were acclimatization days so this video data was not analyzed. A logistic regression model with a logit-transformation was run to analyze the odds ratios and the proportion of time cows spent on each stall surface lying, standing and perching (standing with front legs in the stall, back legs in the alley) on the final d on each surface (d 3 and 6). There was a lower odds of lying on the foam stall (OR = 0.88, $P = 0.11$) and an increased odds of perching on the foam compared with the gel stalls (OR = 1.37, $P = 0.11$), however these were non-significant. Cows were at a higher odds of standing in the foam stall compared with the gel (OR = 1.52, $P = 0.014$). Paired *t*-tests calculated from the accelerometer data indicated that the mean lying bout frequency, duration and lying time were similar on both surfaces (mean ± SE; bout frequency gel = 9.0 ± 0.57 vs. foam = 9.5 ± 0.57, $P = 0.1656$; bout duration gel = 1.7 ± 0.05 vs. foam = 1.7 ± 0.05, $P = 0.70$; lying time foam = 15.0 ± 0.37 vs. gel = 15.2 ± 0.27, $P = 0.8769$ h/24 h). These findings are consistent with previous studies that report higher standing times on firmer stall surfaces, even when no differences in lying time exist. As with this previous work, other indicators such as the preference for and long-term health implications of these surfaces are likely important and warrant further investigation.

Key Words: cow comfort, stall flooring, dairy cow

415 Effect of parity on daily activity patterns prior to parturition in Holstein dairy cows. M. Titler*, M. G. Maquivar, S. Bas, E. Gordon, P. J. Rajala-Schultz, K. McCullough, and G. M. Schuenemann, *Department of Veterinary Preventive Medicine, The Ohio State University, Columbus, OH.*

Recognizing the signs of imminent birth for primiparous (PRIM) and multiparous (MULT) cows and utilizing proactive management practices around the time of calving are critical to prevent the negative effects of dystocia on both the dam and calf. The objective of the present study was to assess the effect of parity (PRIM vs MULT) on activity patterns of cows experiencing unassisted births 4 d before parturition. A total of 130 unassisted Holstein cows (PRIM, n = 31 and MULT, n = 99) housed in freestall barns from 3 dairy herds were used. Periparturient animals were moved into a close-up pen 15 d before the expected calving date and were monitored for imminent signs of birth (appearance of amniotic sac outside the vulva) and then moved into a contiguous maternity pen until birth. Electronic data loggers (IceQube, IceRobotics, Edinburgh, UK) were placed on the hind leg of prepartum PRIM and MULT cows 7 ± 3 d before the expected calving date and remained until 14 ± 3 DIM. Calving ease (CE; scale 1–4) of cows, parity, and calving date and time were recorded. The number of steps, standing time (min), number of lying bouts (LB), and mean duration of LB (min) were recorded. Data were analyzed using MIXED (activity patterns) and GLIMMIX (stillbirth) procedures of SAS. The effect of parity on activity patterns of cows were adjusted for the effect of herd. The proportion of stillbirth was not different ($P > 0.05$) between PRIM and MULT cows. Unassisted PRIM cows spent less ($P < 0.05$) time standing (16–19%), had fewer LB (32–45%), and LB of longer duration (22–37%) 2 d, 1 d and 12 h before birth compared with MULT cows. These findings provided evidence that unassisted PRIM and MULT cows had distinct behavioral activity patterns 1–2 d before calving. Recognizing the signs of parturition as well as the cow activity patterns before calving, especially for PRIM cows, should be considered for precision calving management practices. The use of electronic data loggers to monitor cow activity may allow calving personnel to identify those cows at risk for dystocia 24 h around the clock; thus, improving the overall cow-calf survival and welfare.

Key Words: cow activity, stillbirth, calving management

416 Effect of cow genotype and milk production system on cow behavioral activities. A. I. Roca-Fernández*[1], C. P. Ferris[2], E. R. Vance[2], and A. González-Rodríguez[1], *[1]Agrarian Research Centre of Mabegondo, La Coruña, Galicia, Spain, [2]Agri-Food and Biosciences Institute, Hillsborough, United Kingdom.*

This trial studied the behavioral activities of 2 cow genotypes (n = 80), Holstein-Friesian (HF, n = 40) vs. Jersey x Holstein-Friesian (Jx, n = 40), when managed within 2 milk production systems, a low inputs grazing system (G, n = 40) vs. a high inputs confinement system (C, n = 40). A randomized block design with a 2 × 2 factorial arrangement of treatments was performed using primiparous (n = 20) and multiparous (n = 60) spring calving cows (161 DIM) from AFBI Hillsborough cattle. Four treatments were established (n = 20): HF-G, HF-C, Jx-G and Jx-C. Cows were observed in 3 periods (P1, end July; P2, middle August; P3, end August) at 20 min. intervals between 1600 and 2200 h and 0700–1400 h. Individual cow behavioral activities were recorded: feeding, lying, standing and ruminating. Data were analyzed using REML analysis by Genstat. Cows in the C system showed higher ($P < 0.001$) milk yield (MY) (+6.9 kg cow^{-1} day^{-1}) than those in the G system (20.1 kg cow^{-1} day^{-1}). The HF cows (+3.1 kg cow^{-1} day^{-1}) showed higher ($P < 0.01$) MY than the Jx cows (22.0 kg cow^{-1} day^{-1}). The Jx cows showed higher milk protein (g kg^{-1}) ($P < 0.05$, +1.9) and fat content (g kg^{-1}) ($P < 0.01$, +4.2) than the HF cows (35.7 and 44.4 g kg^{-1}, respectively). Cows on the G system spent more time ($P < 0.001$) grazing (522 min.) than those on the C system spent feeding (173 min). Cows on the C system spent more time ($P < 0.001$) lying (C, 411 vs. G, 212 min), standing (C, 236 vs. G, 85 min) and ruminating (C, 244 vs. G, 141 min) than those on the G system. Time spent lying ($P < 0.001$), feeding ($P < 0.01$) and ruminating ($P < 0.001$) differed between periods, while time spent standing did not differ between periods. The G cows spent more time lying (+53 min) and ruminating (+21 min) in P3 than in P1 (289 and 186 min., respectively). None of the behavioral activities were affected by cow genotype. To conclude, cows normally adapt their daily time budget to the selected milk production system for satisfying cows' feeding, lying, standing and ruminating needs.

Key Words: cow breed, milk production system, behavioral activities

417 Thermal comfort and milk production of two dairy genotypes during the summer in central Chile. C. Herrera[1], R. Larrain[1], F. Gonzalez[1], T. L. Mader[2], and R. A. Arias*[3,4], *[1]Pontificia Universidad Catolica de Chile, Santiago, Chile, [2]University of Nebraska-Lincoln, Lincoln, [3]Universidad Catolica de Temuco, Temuco, Chile, [4]Nucleo de Investigacion en Produccion Alimentaria, Temuco, Chile.*

A total of 29 mature cows (15 Holstein and 14 Montbéliarde × Holstein), 67 ± 6 d in milk, were used to assess animal thermal comfort and milk production during the summer time. The study was conducted at 33°40′12″ S, 70°35′06″ W, in 3 periods: January 18–25, February 4–8, and March 19–24 of 2010. All cows were fed with the same diet (corn silage and alfalfa), kept in open pens with shaded areas, and milked 3 times per day. Thermal comfort was estimated based on respiration rates (RR) and the comprehensive climate index (CCI). The CCI combines 4 meteorological variables. Each cow received a device to record tympanic temperatures (TT) at 10 min intervals. Data were analyzed under a CRD arrangement ($\alpha = 0.05$). The MIXED procedure of SAS was used for repeated measurements analysis with genotype, hour, type of day and their interaction as factors in the model. When CCI ≥20°C, type of day was considered as warm day (Wd). Over the 19 d of study 18 were Wd. There was no difference for mean TT between genotypes ($P = 0.19$). The TT was higher during Wd than during normal days (37.78 vs. 37.68 ± 0.068°C, $P < 0.001$). The interaction genotype by hour was significant, with Holsteins having a lower TT at 5:00 ($P = 0.038$) and a trend for lower TT between 2100 and 1100 h. The interaction between type of day and hour was significant, with higher TT during Wd between 2200 and 0400 h, at 1600, 1900 and 2000 h. There was also a trend for higher TT during Wd at 1700 and 1800 h. No differences were observed for milk production between genotypes. There was an inverse correlation (IC) of CCI between 1200 and 1700 h on milk production at midday milking ($P = 0.008$), and a trend for an IC at the afternoon milking ($P = 0.059$). Cows had higher RR ($P < 0.001$) in the afternoon (68.0 ± 13.4) vs. morning (56.7 ± 9.6). Only 1% of cows had moderately high RR during the morning (1100 h) but 6% had it during the afternoon (1600 h). The use of shade plus during daytime plus the decreasing air temperature at night could explain the lack of differences in milk production. Finally, based on our results we conclude that both genotypes showed a slight degree of heat stress.

Key Words: heat stress, tympanic temperature, animal behavior

418 Effect of age and anatomical differences in dairy cattle craniums on placement and success of captive bolt for humane euthanasia of cattle. S. S. Aly*[1,2], T. W. Lehenbauer[1,2], S. Jenkins[2], M. Cuneo[3], J. D. Champagne[2], and J. P. Reynolds[4], *[1]Department of Population Health and Reproduction, School of Veterinary Medicine, University of California, Davis, Davis, [2]Veterinary Medicine Teaching and Research Center, School of Veterinary Medicine, University of California, Davis, Tulare, [3]William R. Pritchard Veterinary Medical Teaching Hospital, School of Veterinary Medicine, University of California, Davis, [4]The College of Veterinary Medicine, Western University, Pomona, CA.*

The AVMA lists penetrating captive bolt as a method for humane euthanasia of cattle conditional on immediate loss of consciousness and subsequent death. At the recommended placement, the intersection between the base of the horns and medial canthi, personnel report cattle may not become immediately unconscious. The objective of this trial was to identify the optimum placement for euthanizing cattle using a captive bolt. A total of 271 calves and 156 adult cows from 17 dairies and 2 calf ranches in California were randomly assigned to one of 4 placements. Candidate placements targeted the brain stem and were identified using post-mortem cross-sections of cattle crania. In calves, placements included 1 and 2 inches above the AVMA recommended placement (control) and the occipital region. In cows, placements included 2 and 3 inches above the control, and the occipital region. The 2 inch and occipital placements were each 2.15 times more likely to result in immediate loss of consciousness compared with the control placement in calves ($P < 0.01$). Similarly, calves euthanized at the 1 inch placement were 2 times more likely to result in immediate loss of consciousness compared with the control ($P < 0.01$); however, only the 2 inch and occipital placements resulted in immediate loss of consciousness in 100% of the calves. In cows, the 3 inch placement was 4.25 times more likely to result in immediate loss of consciousness compared with the control in cows ($P < 0.01$). Similarly, the 2 inch and occipital placements were each 4 times more likely to result in immediate loss of consciousness compared with the control in cows ($P < 0.01$); however, only the 3 inch placement resulted in immediate loss of consciousness in 100% of the cows. In comparison, the control resulted in immediate loss of consciousness in 46.4% of calves and 23.5% of cows. Results of the field trial showed that higher placements of the captive bolt were more likely to result in immediate loss of consciousness in both calves and cows.

Key Words: cattle euthanasia, captive bolt, placement