Agenda NC1029 Annual meeting

November 11, 2015

9:00 – 14:00 PST
11:00 – 16:00 CST
12:00 to 17:00 EST

Participants: Jeffrey Bewley (University of Kentucky), Rachel Dennis (University of Maryland), Marcia Endres (University of Minnesota), Angela Green (University of Illinois), Anna Johnson (Iowa State University), Larry Katz (Rutgers University), Peter Krawczel (University of Tennessee), Joy Mench (UC Davis), Monique Pairis-Garcia (Ohio State University), Katy Proudfoot (Ohio State University), Janice Siegford (Michigan State University), Cassandra Tucker (UC Davis),

Brief Summary of Minutes of Annual Meeting:

1. Introductions, the Chair, Cassandra Tucker, called the meeting to order, welcomed participants, and made introductory remarks. The goal of this conference call to go over each station report and discuss opportunities for research and collaboration that fall under the following objectives:

1) To develop novel measurement techniques and to evaluate animal behavior and physiology as indicators of animal welfare.
2) To strengthen animal welfare assessment and auditing programs by improving our understanding of various aspects such as sampling protocols (including frequency of visits, number of animals/pens/cages monitored, and other aspects of methodology) and the appropriateness and feasibility of the 3 broad categories of measurement (resource-, outcome- and protocol-based).

2. Station reports

Anna Johnson, Suzanne Millman, Iowa State University:

Primary projects:

1. Cull pigs through buying stations – compromised swine going through the buying station
   Animal assessments outcomes (animal status) and assessment categories (what happened to the animal)
   Animal assessment outcome: skin lesions > fatigues > abscess
   Assessment category: reject off truck
2. Validation of a lameness diagnostic manual and tools for naturally occurring sow lameness
   Validate manual utilizing full clinical work up
   -Start June, 2016

Future projects:

3. CSIA

OSU and ISU group worked together to develop material for PAACO training
Creation of material, bumps in the road from a training aspect
Cass: How do we quantify the accuracy of auditors and ensure that audits are being conducted correctly and objectively. Is this verifiable and reliable?
Focus on support and funding opportunities

Janice Siegford, Michigan State University:

Primary projects:

1. Three grants (internal, NPB and USDA) using behavior and genetics to identify pigs for better group living. Evaluating social behavior of pigs during weaning, finisher and sow for gilt selection into replacement groups during mixing. Collecting information on frequency, location and duration of injury and aggression. Then look over time for performance and see if these aggressive profiles are consistent over time. Looking largely at negative interactions and correlate with genetic parameters associated with this trait. Don't want to do away with aggression all together but be able to identify those animals that are better suited for adapted to situations that we put them in. In addition, looking at pig temperament and how it is interacting with a genotype. PhD student looking at different elements overtime with a subset of barrows to determine what their temperament is like and evaluating this with injuries, aggression, handling and human tests.

Future projects:

2. AWJAC- develop the competition into training tools for other people –are there other potentials to use this platform for other opportunities

Marcia Endres, University of Minnesota:

Primary projects:

1. Risk factors for on-farm mortality
2. Large dairy herd management, welfare and economics
3. Activity in robotic milking system
4. Thermography to detect lameness (70-80% sensitivity/specificity)
5. Dry cow behavior and transition cow health
6. Rumen sensors and automatic feeding sensors
    a. Help associate behaviors with risk factors of disease

Future projects:

7. More work on how technology can help improve animal welfare and performance
    a. Objective 1

8. Data integration and decision making

    b. Assessments and audit information? What do we do with audit results?

Maya Makagon, UC Davis:

Primary projects:

1. Gait scoring in ducks- MS student evaluating this in terms of performance with treadmill
2. Pain assessment in ducks- NSAIDs – dosage of meloxicam to try and improve on gait score and walking performance of ducks

Future projects:

3. Welfare assessment of ducks on commercial farms- Standard method used in on commercial duck farms using random sampling- evaluate sampling size and come up with an assessment method that is going to be practical and easy to implement on-farm.

Joy Mench, UC Davis:

Primary projects:

All research being conducted is on zoo animals (elephants and giraffes)-couple of projects in the planning stage both dealing with on-farm surveys using outcome based measures

Future projects:

1. Outcome based measures on stocking density for broilers and turkeys
2. Keel bone issues and beak conditions on commercial farms

Cassandra Tucker, UC Davis

Primary projects:

1. Banding and castration
    a. Branding with hot iron with monitoring wound healing over a 10 week period. Results: even by 10 weeks out still scabbing and not completely healed. IN addition average temperature of branding area remain higher in temperature 42-71 days after and potentially capturing the healing process
    b. Response to mechanical stimulation- what happens when you use Von Frey- monitoring the force to illicit a behavioral response- results: brands remain sensitive to palpation up to 10 weeks. Raises a good point on why are we not evaluating longer-term pain management?

Future projects:

2. How to measure pain?
    a. Spontaneous behavior
        i. Wound directed, posture
        ii. Startle response
            1. Is the startle response a valid indicator of fear states?
                a. Daily habituation for 5 days for the milk set up and accelerometer
                b. Two treatments on day 6 1) Control urine, 2) predator urine
                    i. Results: large response with coyote urine

Goal: How do we evaluate pain from a more long term standpoint- What is the connection with fear and pain? Animal is in pain, increased predation risk and enhance startle response

Jeff Bewley, University of Kentucky:

Primary projects:

Completed large project at UK herd with 4 graduates in different areas of application of technology

1) Estrus
2) Lameness
3) Mastitis
4) Fresh cow disease

Rachel Dennis (Ray Stricklin), University of Maryland:

Primary projects:

1. UV lighting (objective1) –environmental enrichment in early development for young poultry. What is the impact of UV light and how does it influence feeding behavior. Results: Significant change in timing of feeding (when lights were on it would synchronize feeding behavior
2. Fear testing- Evaluated fear testing in open field test vs novelty- tried to evaluate fear stimulus. The most consistent parameter measured was looking at focal morphologies instead of just peak frequency or mortality, evaluating entropy
    a. Most likely using too high of intensity of light- preference test –provided spectrum over the entire room- intensity wasn't the key factor for choice but by ratio of light
        i. Evaluate impact of light on dawn, dusk and mid-day

Future projects:

3. Amino acid ratio- influence on behavior such as fearfulness, anxiety, and aggression as a lot of microbial probiotics/normal flora do secrete neuroactive chemicals and ability to get in the brain via blood brain barrier is higher in younger animals. Variability of serotonin, tryptophan and tyrosine in the breeding stock may influence youngstock.

Angela Green, University of Illinois:

Primary projects:

1. Laying hens- exposure to ammonia- collaborative effort looking at biomarker changes as indicator of clinical signs and health due to exposure to ammonia
2. Beef cattle- ecosystem management cropping system management- understanding patterns of movement on grazing systems
3. Don Lay, Breanna G. Jay Johnson- Heat stress in pigs- indicators of heat stress- what is the THI specific to pigs?

Larry Katz, Rutgers University:

Primary projects:

1. Scent marking behavior in goats

Peter Krawczel, University of Tennessee:

Primary projects:

1. Master's student that looked at recycled sand bedding source for lactating dairy cows- ISAE general results- designed as a straightforward behavior study and look at the microbiology of bacterial populations on teat ends and bedding source- recycled sand was not that wet when it was put on (4-5% wetter than fresh) no effect on behavior, preference and microbiology was significantly different. Biggest limitation on summer and winter with relatively short periods and sand was used just once- as you continue to recycle sand you accumulate more organic matter and most likely a tipping point on cow behavior, preference or udder hygiene and health
2. PhD student Randy Black- Impact of exercise on dry cows. When cows are dried off enrolled in three treatment 1)Control-remain in free stall during dry period 2) Exercise group- 5 days a week 1.5 hours of walking on a set course to determine total mileage 3) Enhanced free stall housing 1h access to pasture . Project is ongoing but looking at time budgets, overall hoof health. All cows enrolled are given a walking test upon enrollment and day 42 then evaluate physical fitness. Calving behavior is also evaluated to see differences in birthing behaviors. Not enough animal numbers for dystocia due to limited number. Evaluate calves to see if there are differences in response to acute stressors (i.e. weaning and dehorning). Continue to mid-December for data collection.
3. Pain abatement study. Funded by the Industry-look at see if we can have a pain mitigation effect on lactating dairy cattle

Future Projects:

Sleep study in spring in collaboration with Katy Proudfoot and Jeff Bewley. Another project that fits well with the group- collaborative-Sleep and lying behavior in lactating cows. General idea- USDA exploratory grant- group in Kentucky. Goal is to separate acute stress of not being able to lie down vs. acute stress of not being able to sleep. Sleep may be difficult for some lactating cows based on milking regimens, stocking density and facility design. Goal: How do we evaluate sleep behavior and long term goal integrating this to multi-species or farms to integrate into larger commercial facilities?

Monique Pairis-Garcia, The Ohio State University:

Primary projects:

1. Rubber mat: The objectives of this study are to assess the effects of rubber matting on reproductive performance, non-infectious lameness severity and recovery, feed intake, pain sensitivity and behavior of lame and non-lame sows during farrowing and lactation. Data collection will be done December, 2015 and data analysis will occur over the spring semester

2. Weaning Study: Assess the impact of alternative weaning techniques on lamb performance, health and immune response to infection with the parasite *H. contortus* and assess the impact of alternative weaning techniques such as social facilitation on development and refinement of grazing behavior of lambs.

Future projects:

3. Sow group housing: This project fosters a collaborative effort between academia and industry (The Ohio State University, Iowa State University and current U.S. swine producers, and Kraft Foods / Oscar Mayer). The objective of this study is to evaluate feeding patterns and behaviors of a sow herd transitioning from individually housed stalls to group housing utilizing the Gestal® as the sole feeding system. This project will quantify feeding patterns and frequencies of group housed sows and determine how experience and time using the Gestal® feeder alters sow feeding behavior. Currently video has begun recording and one group has entered pen system.

4. Euthanasia training APP: The objectives of this study are to:

1. Identify quantitative and qualitative decision criteria for on-farm euthanasia of pigs.
2. Develop a Proof of Concept Training App to deliver educational material on timely decisions for euthanasia of pigs to employees.
3. Identify via the Proof of Concept Training App, stockman characteristics that influence the euthanasia decision-making process

Katy Proudfoot, The Ohio State University:

Primary projects:

1. Enriching calf hutches- using a variety of toys, brushes, rubber nipples- evaluated with preference and novelty- ability to work with abnormal oral behaviors and jersey breeds

Future projects:

2. Large study evaluating facility design for cows around the calving period – create some hiding areas and evaluate preference for cows
    a. Combination of stocking density with provision of hiding area
3. Sleep study
4. Formula funds with Veal calf project.
    a. IGG health, colostrum intake –evaluate auction standpoint
    b. Electrolyte
    c. Audit- evaluation of the veal calves at the auction
    d. Disease APP
5. Immunity, health and behavior – social stressors during the calving period
    a. Social instability and crowding- impacts on uterine health, inflammation and immune response
    b. Individual variation and how it responds to stressors and how cows deal with that and how this impacts immunity

3. Accomplishments:

University of Florida has delivered two Livestock Education and Certification for Agricultural Law Enforcement training programs (March and December, 2015) to provide Ag law enforcement personnel knowledge and skills necessary for assessing the welfare of livestock, with a primary focus on cattle and horses. University of Florida has established a temperament assessment protocol suitable for quantifying phenotypes of startle in response to a novel moving object in young horses. Future research will combine these phenotypes with genome-wide marker panels for discovery of loci contributing to startle behavior in the horse. The University also conducted a study investigating the effects of feeding strategies (solid feed provision and milk feeding method) on development of feeding behavior and non-nutritive oral behavior. A pilot study was also focused on investigating cognitive development in response to early-life enrichments using a task that involved location discrimination, reversal learning, and response to a novel object. The University of Florida has also developed and offered for the first time two new courses in the area of animal welfare and animal behavior for both the graduate and undergraduate program.

Iowa State University has conducted research assessing vaccination impact on nursery pig behavior and has concluded that 6-h post-vaccination, nursery pig posture was different and that regardless of vaccine treatment, nursery pigs vaccinated laid down more frequently than those not vaccinated. These results are critical in determining guidelines on the evaluation of an animal-human paradigm during an on-farm welfare assessment / third party audit as it is important to know when the last time pigs were vaccinated as this may affect the pig's willingness to touch and orientate to a human in their pen.

J. Siegford and J. Swanson are publishing data from commercial scale project involving housing of laying hens in aviary systems (together with colleagues from UC Davis who focused on enriched colony cages). The project examined the sustainability of alternative housing systems with respect to hen health and behavior in an economic and environmental context with reference to food safety and worker health.

C. Heleski's work on assessing the welfare of horses and donkeys and developing codes of practice will lead to improved methods of assessing welfare of these animals, particularly in areas where they are used as working animals. C. Heleski is currently serving a 2-year term as Honorary President of the International Society for Equitation Science. This group continues to be at the forefront of providing a platform for horse behavior, horse welfare, and horse-human interaction research. C. Heleski is regularly interviewed by *The Horse*, providing her expertise in equine behavior and welfare in articles and in response to reader questions.

J. Swanson serves as taskforce chair for the annual scientific review and revision of the Michigan Generally Accepted Management and Agricultural Practices for the Care of Farm Animals under the Michigan Right to Farm Act (since 2007).

University of Minnesota has investigated whether cow behaviors and activity such as feeding and resting time, rumination and social ranking during the prepartum and early postpartum

period could be used to help dairy producers identify cows at risk for health disorders. It was found that some of these behaviors in cows housed in freestalls were associated with disorders such as mastitis, retained placenta, displaced abomasum, lameness, and ketosis. Future studies will further investigate how to optimize this approach. In addition, University of Minnesota is using rumination and behavior sensors at their organic dairy site and correlating those behaviors collected with these precision dairy tools with health and reproduction in their herd. Another study showed that the welfare of dairy cows in very large dairy operations (average of approximately 5,000 cows per herd) is adequate (based on low prevalence of lameness and hock lesions, low somatic cell count and mastitis incidence, and other measurements) and these dairies can dilute their cost of production per cow due to their economies of scale. They have specialized and efficient labor, averaging over 100 cows per FTE (full time employee equivalent). In addition, work recently published confirmed that most cows die or leave the herd during the first 40 days after calving confirming that the transition period (early postpartum) is a very critical time in the life of a dairy cow.

To date, no welfare assessment program has been developed for conventional U.S. cow-calf operations. As such, the University of California, Davis developed a cow-calf health and handling assessment, evaluating cattle during a procedure in the chute, and is making it available online for others to use. However, this requires a certain degree of assessor training in order to confidently compare results across assessors and over time. An online training module was developed for this cow-calf health and handling assessment, allowing the user to 1) learn a scoring system (e.g., what constitutes as an abrasion) 2) test the consistency of their evaluation on about 30 examples 3) download materials to apply it onto their ranch and 4) compare their results to those observed on 30 California ranches. This management tool can be used to monitor conditions and make improvements on the ranch.

There are a lack of well-validated tests for fear in farm animals. A particularly powerful tool that has been used to study negative emotional states in humans and rodents is the startle reflex – a ubiquitous, cross-species defensive response to sudden stimulation. It is well established that the startle reflex is amplified when the fear system is already aroused and is modulated by the same brain structures involved in other fear/defense responses. The University of California, Davis, tested the suitability of the startle response as a novel, non-invasive measure of fear in dairy calves. It was predicted that calves would demonstrate a stronger response to a sudden noise when a fear-eliciting stimulus (e.g., predator odor) was present. In agreement with this prediction, the magnitude of the startle response was higher when calves were exposed to coyote urine than to deer urine or water. The results provide support for the use of the startle response as a behavioral indicator of fear in cattle.

Washington State University housed groups of dairy cows in pens with different stocking densities, in which cow behavior was recorded using video cameras. Within each pen was a row of isolated stalls along one wall. Overall, few cows utilized the isolated stalls and, although neither pen was overstocked, cows housed in pens with higher stocking densities spent less time resting within the isolated stalls.

4. Impact statements

University of Florida
With the human population growing globally, the number of horses housed in confinement continues to increase. As a result, concerns over air quality for horses and their caretakers are also on the rise. The research conducted at the University of Florida comprises a necessary first step in determining the impact of ammonia emissions on the behavior and well-being of horses. The findings should build a foundation for future investigation of management solutions that can mitigate the negative impacts of ammonia and other greenhouse gas emissions on the health of humans, animals, and the environment.

The welfare of dairy cattle is of increasing concern to the public, and refining rearing practices for dairy calves has potential to improve both short- and longer-term animal welfare. Research at the University of Florida has yielded preliminary data regarding behavioral and cognitive development of dairy calves in response to early feed-factors. This work will form the basis of future work aimed at assessing the longer-term behavior and welfare implications of early life experiences.

Teaching and extension activities at the University of Florida have been implemented to improve understanding and awareness of animal welfare topics. New courses offered in 2015 included a graduate course (Concepts in Applied Ethology) with 6 students enrolled in Spring 2015, and an undergraduate course (Animal Behavior and Welfare) with 24 students enrolled in Fall 2015. As part of the 2015 Equine Science Society Symposium, the University of Florida co-organized a workshop focused on incorporation of equitation science and equine learning theory into undergraduate and extension curriculum for improved horse welfare and handler/rider safety. This was a collaborative effort between Michigan State University, Purdue University, the University of Florida, the University of Guelph, and the University of Vermont with 60 people in attendance.

Iowa State University
- On farm welfare assessment and third party auditing programs are becoming common in the USA.
- On farm assessment and third party auditing programs are usually compromised of resource- and animal based measures.
- One animal based measures is the human-animal paradigm.
- Considerable variation in the human-animal paradigm application exists in current on-farm assessment and third party auditing programs.

Michigan State University
Information from studies of laying hens in experimental and commercial aviaries by J. Siegford and J. Swanson can be used to refine aviary design and management protocols to minimize hen injury during flight, crowding on litter during times of peak dust bathing and activity, and to encourage hens to lay in nest boxes rather than in other locations in the system.

J. Swanson and M. Erasmus have completed analysis and are publishing work on the implications of fear and temperament on feather pecking and meat quality in turkeys. Different

genetic stocks of turkeys were utilized in the majority of this work including a random bred line that provides information on selection effects for production characteristics on fearfulness. Included in this work was the evaluation of three different fear assessment tests and their usefulness for turkeys.

The working equid assessment system and improved deworming methods developed by C. Heleski and A. B. Ali will help identify at risk populations, as well as hoping to monitor progress of welfare enhancement strategies. Information about horses' responses to commonly used restraint devices will provide practical guidelines for horse owners, trainers and veterinarians and can inform best practice guidelines.

University of Minnesota
The early identification of transition cows at risk, before they become severely ill, could reduce on farm cow mortality and improve animal health with significant economic and animal welfare benefits to the dairy industry. A reduction in on farm mortality from the current 6% to 4% would result in an estimated economic benefit of over $300 million to the US dairy industry.

UC Davis
A beef cow-calf health and handling assessment was developed and made available online for others to use. In addition, an online training module was developed, allowing the user to 1) learn a scoring system (e.g., what constitutes as an abrasion) 2) test the consistency of their evaluation on about 30 examples 3) download materials to apply it onto their ranch and 4) compare their results to those observed on 30 California ranches. This management tool can be used to monitor conditions and make improvements on the ranch.

Washington State University
Dairy cow well-being studies at Washington State University have investigated the influence of pen stocking densities and stall layouts in freestall barns on cow behavior. This information was integrated into a list of housing recommendations dairy producers should consider when designing their facilities for optimal cow well-being and production. Additionally, the results from this project may assist with disease detection on large dairies.

5. Publications

Book Chapters:

Heleski CR, McLean AK, Swanson JC. 2015. Ch. 17 Practical Methods for Improving the Welfare of Horses, Donkeys and Other Working Draught Animals in Developing Areas. In: Improving Animal Welfare: a Practical Approach, 2nd Ed., Ed. Temple Grandin, CABI, Wallingford, UK

Underwood W, McGlone JJ, Swanson JC, Anderson KA, Anthony R. 2014. Agricultural Animal Welfare. In: Laboratory Animal Welfare. American College of Laboratory Animal Series. Eds. Kathryn Bayne and Patricia V. Turner. Elsevier Academic Press, Oxford, UK.

Wickens, C. and K.A. Houpt. 2015. Stereotypic Disorders. In: Equine Neurology, 2nd Edition, Martin Furr and Stephen Reed (Editors). Wiley-Blackwell.

Refereed Journal Articles:

Ali, Ahmed B.A., El Sayed, M.A., Matoock, M.Y., Fouad, M.A., Heleski, C.R., (Accepted Dec 2015) A welfare assessment scoring system for working equids – A method for identifying at risk populations and for monitoring progress of welfare enhancement strategies (trialed in Egypt). Applied Animal Behaviour Science, http://dx.doi.org/10.1016/j.applanim.2015.12.001

Ali, B.A.A., El Sayed, M.A., Matoock, M.A., Fouad, M.A., Heleski, C.R., (2015) Comparing efficacy of three anthelmintic programs in working equids in Egypt. Journal of Veterinary Science & Medical Diagnosis, 4:4 http://dx.doi.org/10.4172/2325-9590.1000146

Ali ABA, Matoock MY, Fouad MA, Heleski CR. 2015. Are mules or donkeys better adapted for Egyptian brick kiln work? (Until we can change the kilns). *Journal of Veterinary Behavior* 10:158-165. doi: 10.1016/j.jveb.2014.12.003

Chebel, R.C., P. R. B. Silva, K. Luchterhand and M. I. Endres. 2015. Social stressors and their effects on immunity and health of periparturient dairy cows. J. Dairy Sci. 98, Suppl 2:277.

Chen, J. M., K. E. Schütz, and C. B. Tucker. 2015. Cooling cows efficiently with sprinklers: Physiological responses to water spray. Journal of Dairy Science 98: 6925-6938.

Daigle CL, Rodenburg B, Bolhuis E, Swanson JC, Siegford JM. 2014. Dynamic and rewarding environmental enrichment reduces feather pecking behavior in non-cage laying hens: implications for management practices and welfare. *Applied Animal Behaviour Science* 161:75-85. doi: 10.1016/j.applanim.2014.10.001.

Daigle CL, Siegford J*. 2014. Understanding the individual non-cage laying hen through the body-behavior connection: associations between welfare quality physical parameters and behavioral observations throughout a lay cycle. *Animal Welfare* 23:423-434. doi: 10.7120/09627286.23.4.423.

Endres, M.I. and J.A. Salfer. 2015. An evaluation of automated milking systems in the Midwest United States. J. Dairy Sci. 98, Suppl 2:114.

Endres, M., K. Lobeck-Luchterhand, P.B. Silva and R. Chebel. 2015. Is social rank associated with health of transition dairy cows? Proc. 49th Intern.Soc. Appl. Ethol.:88. Sapporo, Japan, September 2015.

Endres, M. 2015. Dairy welfare, management and behavior. Sustainable ethical practices. International Innovation 189:69-71.

Endres, M. 2015. Automated calf feeders and robotic milking: What are keys to success? Pg 126-132 *in* Proc. Precision Dairy Conference and Expo, Rochester, MN, June 2015, http://www.precisiondairyfarming.com/2015.

Erasmus MA, Lee HC, Kang I, Swanson JC. 2015. Relationship between temperament and post-mortem muscle characteristics in turkeys of two genetic strains. Poultry Science. doi: 10.3382/ps/pev208

Hansen, A, R. D. Moon, B. Heins, and M. Endres. 2015. Production of stable flies (Diptera: Muscidae) from two alternative winter housing systems for dairy cows. Entomological Society of America Meeting, Minneapolis, MN, 16 November, 2015.

Heleski, C., C. Wickens, M. Minero, E. DallaCosta, C. Wu, E. Czeszak, and U. Koenig von Borstel. 2015. Do soothing vocal cues enhance horses' ability to learn a frightening task? Journal of Veterinary Behavior: Clinical Applications and Research. 10: 41-47.

Jorgensen, M., A.Adams Progar, K. Janni, H.Chester-Jones, J. Salfer, and M.Endres. 2015. Housing and management practices on farms using automated calf feeders in the Midwestern United States. J. Dairy Sci. 98, Suppl 2:818.

Jorgensen, M., A.Adams Progar, S.Godden, H.Chester-Jones, A. M. de Passillé, J.Rushen, and M.Endres. 2015. Risk factors for abnormal calf health scores on farms using automated feeders in the Midwest USA. J. Dairy Sci. 98, Suppl 2:819.

Liboreiro, D. N., K. S. Machado, P. Basso Silva, A. E. Barreto, M. I. Endres, and R. C. Chebel. 2015. Characterization of peripartum rumination and activity of cows diagnosed with metabolic and uterine diseases. J. Dairy Sci. 98:6812-6827.

Lobeck-Luchterhand, K.M., P.R.B. Silva, R.C. Chebel, M.I. Endres. 2015. Effect of stocking density on social, feeding, and lying behavior of prepartum dairy animals. J. Dairy Sci. 98:240-249.

Lobeck-Luchterhand, K.M., P.R. B. Silva, R.C. Chebel, and M. I. Endres. 2015. Association between social ranking and health of transition dairy cows. J. Dairy Sci. 98, Suppl 2:565.

Miller-Cushon, E. K., and T. J. DeVries. Impact of social housing on the development of feeding behavior and social feeding preferences of dairy calves. Journal of Dairy Science. *In press.*

Miller-Cushon, E. K., and T. J. DeVries. 2015. *Invited Review*: Development and expression of dairy calf feeding behaviour. Canadian Journal of Animal Science. 95: 341-350.

Miller-Cushon, E. K., J. P. Vogel, and T. J. DeVries. 2015. Short Communication: Feed sorting of dairy heifers is influenced by method of dietary transition. Journal of Dairy Science. 98:2687-2692.

Rajapaksha, E., and C. B. Tucker. 2015. Stepping behavior and muscle activity of dairy cows on uncomfortable standing surfaces presented under 1 or 4 legs. Journal of Dairy Science 98: 295 304.

Rajapaksha, E., C. Winkler, and C. B. Tucker. 2015. Effect of rubber flooring on dairy cattle stepping behavior and muscle activity. Journal of Dairy Science 98: 2462-2471.

Shahid, M.Q., J. K. Reneau, H. Chester-Jones, R. C. Chebel and M. I. Endres. 2015. Cow and herd level risk factors for on-farm mortality in Midwest US dairy herds. J. Dairy Sci. 98:4401-4414.

Sjostrom. L.S., B.J. Heins, M.I. Endres, R. D. Moon, and U.S. Sorge. 2015. Evaluation of winter housing systems for effects on production, udder health, BCS, hygiene, frostbite, and rumination of organic dairy cows. J. Dairy Sci. 98, Suppl 2:818.

Swanson JC, Mench JA, Karcher D. 2015. Coalition for Sustainable Egg Supply: An introduction. *Poultry Science* 94: 473 -474.

Tucker, C. B., J. F. Coetzee, J. M. Stookey, D. U. Thomson, T. Grandin, and K. S. Schwartzkopf-Genswein. 2015. Beef cattle welfare in the USA: Identification of priorities for future research. Animal Health Research Reviews 16: 107-124.

Weimer, S .L., T. J Fangman, H. D. Tyler, L. A. Karriker, K. J. Stalder, and A. K. Johnson. 2015. Nursery pig behaviour assessed using a digital-image evaluation method pre- and post-vaccine injection. To be submitted to Animal Welfare.

Winckler, C., C. B. Tucker, and D. M. Weary. 2015. Effects of under- and overstocking freestalls on dairy cattle behaviour. Applied Animal Behaviour Science 170: 14-19.

Zhao Y, Shepherd TA, Swanson J, Mench JA, Karcher DM, Xin H. 2015. A holistic evaluation of three laying-hen housing systems: description of the production systems and management practices. *Poultry Science* 94: 475 -484.

Extension and Oral Presentations:

Adams Progar, A. 2015. Amber’s top ten tips: assessing dairy cow behavior. WSU Dairy Newsletter, March 2015.

Adams Progar, A. 2015. Amber’s top ten tips: calf management. WSU Dairy Newsletter, December 2014.

Adams Progar, A. 2015. Amber’s top ten tips: understanding heat stress. WSU Dairy Newsletter, June 2015.

Adams Progar, A. 2015. Evaluating calf care on your dairy. Dairy Business West Magazine 96(4):12.

Adams Progar, A. 2015. Surviving and thriving during cold weather. Dairy Speaker Series, Lynden, WA.

Ali, ABA, Gutwein K, Hitzler P, Heleski CR. 2015. Assessing the influence of nose twitching during a potentially aversive husbandry procedure (ear clipping) using behavioral and physiological measures. International Society for Equitation Science conference, Vancouver, BC, Canada.

Callanan, J. and A. L. Adams-Progar. 2015. Relationship between cow lying behavior and freestall barn design. J. Dairy Sci. 98(2):9 (poster presentation).

Carlisle, B., R. Easterly, M. Hersom, E. Jennings, B. Myers, and C. Wickens. 2015. Livestock Education and Certification for Agricultural Law Enforcement (LECALE). Proceedings of the 2015 EPAF Conference, August 31-September 4, Naples, FL.

Chen, J. M., K. E. Schütz, and C. B. Tucker. 2015. Effects of sprinkler flow rate on behavior and body temperature. 49th International Congress of the International Society for Applied Ethology, Sapporo, Japan

Chen, J. M., and C. B. Tucker. 2015. Soakers to cool cows: can we reduce water use? Invited talk at Managing Cow Comfort in Hot Weather, Tulare, CA

Daigle CL, Rodenburg TB, Bolhuis JE, Swanson JC, Siegford JM. 2015. Individual consistency of feather pecking behavior in laying hens. 104th Annual Meeting of the Poultry Science Association, July 27-30, Louisville, KY.

Dinerman, A.J., C.L. Wickens, J. Callaham, and S.A. Brooks. 2015. Preliminary investigation of phenotyping methods for response to a sudden novel stimulus in the horse. Proceedings of the 2015 Equine Science Society Symposium, Florida. J. Equine Vet. Sci. 35 (5): 398.

Greene E, Wickens C, Brady C, Heleski C. 2015. An exploration of factors affecting viewpoints of ISES Conference attendees. International Society for Equitation Science conference, Vancouver, BC, Canada.

Erasmus MA, Swanson JC. 2015. Feather pecking behavior of turkeys. 104th Annual Meeting of the Poultry Science Association, July 27-30, 2015, Louisville, KY.

Heleski CR. 2015. An update on equine welfare: contrasting the issues between developed and developing regions of the world (Invited speaker). Michigan Veterinary Medical Association Animal Welfare Conference. November 23, 2015, East Lansing, MI.

Miller-Cushon, E. K. Intensified pre-weaning calf feeding programs: Impacts on growth and behavior. Ruminant Nutrition Symposium, February 3, 2015, Gainesville, FL. pp 79-89.

Miller-Cushon, E. K. How feeding habits affect growth and welfare of dairy calves. Dairy Production Conference. April 29, 2015. Gainesville, FL.

Miller-Cushon, E. K. How feeding habits affect growth and welfare of dairy calves. South Georgia/North Florida Dairy Update. May 19, 2015.

Miller-Cushon, E. K. and T. J. DeVries. 2015. Social housing affects the development of feeding behaviour in dairy calves. 49th Congress of the International Society of Applied Ethology, September 14 to September 16, 2015, Sapporo, Japan.

Miller-Cushon, E. K. and T. J. DeVries. 2015. Social housing affects the development of feeding behaviour in dairy calves. Page 66 *in* Proceedings of the 49th Congress of the International Society of Applied Ethology, September 14 to September 16, 2015, Sapporo, Japan. Hotzel, M. J., and L. C. Filho, eds. Wageningen Academic Publishers.

Miller-Cushon, E. K., and T. J. DeVries. 2015. Associations between feed push-up frequency, lying and feeding behavior, and milk composition of dairy cows. Journal of Dairy Science E. Suppl.

Siegford J and Karcher D. 2015. Laying hen health and well-being (Invited speaker). Final Report: The Coalition for a Sustainable Egg Supply. March 16-17, 2015, St. Paul, MN.

Simon, G. E. 2015. Benchmarking cow-calf health and handling. Invited speaker at Siskiyou Co. Cattlemen's Beef Health Workshop, Yreka, CA

Simon, G. E., B. R. Hoar, and C. B. Tucker. 2014. Assessing cattle handling. Invited talk at California Department of Food and Agriculture training, Davis, CA

Simon, G. E., B. R. Hoar, and C. B. Tucker. 2014. Assessing cow-calf health and handling. Cattle Health & Well Being & BQA Committee, Reno, NV

Simon, G. E., B. R. Hoar, and C. B. Tucker. 2015. Assessing cattle health and handling on cow calf operations. Invited talk at the UC Davis Livestock Symposium Davis, CA

Simon, G. E., B. R. Hoar, and C. B. Tucker. 2015. Benchmarking cow-calf welfare. Joint Annual Meeting of the American Dairy Science Association and the American Society of Animal Science, Orlando, FL

Simon, G. E., and C. B. Tucker. 2015. Assessing cow-calf welfare. University of California Agriculture and Natural Resources advisor meeting, Reno, NV

Simon, G. E., and C. B. Tucker. 2015. Assessing cow-calf welfare. California Cattlemen's Association annual meeting, Reno, NV (poster presentation)

Simon, G. E., C. B. Tucker, and B. R. Hoar. 2014. Assessing cow-calf welfare: A pilot study on 10 California ranches. 4th International Beef Cattle Welfare Symposium, Ames, IA

Simon, G. E., C. B. Tucker, and B. R. Hoar. 2014. Assessing health and handling on California cow-calf operations. California Cattleman's Association mid-year meeting, Sacramento, CA

Swanson J. 2015. What have we learned from conducting this type of a research project (Invited speaker). Final Report: The Coalition for a Sustainable Egg Supply. March 16-17, 2015, St. Paul, MN.

Tresoldi, G., K. E. Schütz, and C. B. Tucker. 2015. Assessing heat stress in drylot cattle: A validation of methodology. California Animal Nutrition Conference, Fresno, CA

Tresoldi, G., K. E. Schütz, and C. B. Tucker. 2015. Validation of methodology for assessing heat abatement strategies in dry-lot cattle. Joint Annual Meeting of the American Dairy Science Association and the American Society of Animal Science, Orlando, FL

Tresoldi, G., K. E. Schütz, C. B. Tucker, and 2015. Cooling dairy cows efficiently with water: Effects of soaker flow rate on body temperature and behavior. California Animal Nutrition Conference, Fresno, CA

Tucker, C. B. 2015. Animal welfare assessment: The US perspective. Invited plenary talk at International Society for Applied Ethology, Sapporo, Japan.

Tucker, C. B. 2015. Assessing and improving animal welfare on your dairy. Invited talk at Managing Cow Comfort in Hot Weather, Tulare, CA

Tucker, C. B. 2015. Assessing and improving animal welfare on your dairy. Invited talk at California Animal Nutrition Conference Fresno, CA

Tucker, C. B. 2015. Beef cattle welfare audits. Invited talk at the UC Davis Livestock Symposium, Davis, CA

Tucker, C. B. 2015. Dairy cattle welfare. Invited talk at AVMA Animal Welfare Judging Competition, Columbus, Ohio

Tucker, C. B. 2015. Dairy cattle welfare: Research informing policy. Invited talk at NAU-UC Davis Graduate Education Conference on One Health, Davis, CA

Tucker, C. B. 2015. Pain sensitivity and healing of hot-iron brands in cattle. Invited talk at 8th Boehringer Ingelheim Expert Forum on Farm Animal Well-Being Conference, Niagara-on-the Lake, Canada

Weir, J., S. Brooks, A. Dinerman, J. McQuagge, J. Callaham, and C. Wickens. 2015. Preliminary investigation of a subjective temperament assessment to predict response to a sudden novel stimulus in young stock-type horses. Proceedings of the 11thInternational Society for Equitation Science Conference, August 5-8, Vancouver, Canada, P. 71.

Wickens, C.L. 2015. Equitation science: A research-based approach to improved understanding of horse perspective. Proceedings of the 66th EAAP Annual Meeting, August 31-September 4, Warsaw, Poland, P. 326.

Wickens, C.L. 2015. Coping or Vice? Cribbing, Weaving, and other Stereotypic Behaviors. Healthy Horses Conference, University of Florida College of Veterinary Medicine, April 25, Gainesville, Florida.

Wickens, C.L. 2015. Equitation science: A research-based approach to improved understanding of horse perspective. 66th EAAP Annual Meeting, August 31-September 4, Warsaw, Poland.

Wurtz KE, Steibel JP, Bates RO, Ernst CW, Siegford JM. 2015. Selection variables for predicting and comparing number of skin lesions in group housed swine. 2015 American Society of Animal Science Midwestern Section Meeting, March 16-18, Des Moines, IA.