NC1029 Annual Report, 2016

Minutes of the annual meeting

Columbus, Ohio on Nov 10 and 11, 2016

<u>In-person participants</u>: Katy Proudfoot, Monique Pairis-Garcia, Brianna Gaskill, Amber Adams-Progar, Lindsey Hulbert, Andres Cibils, Tina Horback, Richard Blatchford, Kathy Holcomb, Rachel Dennis, Janice Siegford, Marcia Endres, Ernie Minton

<u>Electronic participants</u>: Cassandra Tucker, Carissa Wickens, Maja Makagon, Courtney Daigle

1. Introduction to NC1029 Multistate Research Project and Reporting (Cass Tucker)
    a. Project from the last 5 years is wrapping up after this meeting
    b. Project for next 5 years has been approved
    c. Officers (2016/2017): Monique Pairis-Garcia (Chair), Katy Proudfoot (Secretary)
    d. New Officers (2017/2018): Katy Proudfoot (Chair), Rachel Dennis (Secretary)
    e. Reporting
        i. Cass has circulated template for us to all complete by 12/15/16
        ii. Report this year will be under new project (old project ended Oct 2016)
        iii. Ernie suggests that it is important to capture the impact of the group in our reporting, so we can continue to demonstrate the value of the project
    f. Future meetings
        i. Ernie suggests trying to meet in person as often as possible, but at least 3 of the next 5 years
        ii. Group agrees with timing meeting with the welfare judging contest or regional ISAE
        iii. Not all members currently get funding for travel – new members are encouraged to check with their departments or ag experiment station leadership about funding for meetings.
2. Station reports:
    a. Janice Siegford (Michigan State University)
        i. Assessing welfare in laying hens housed in large groups
        ii. Breeding sows that cope better in confinement housing
    b. Monique Pairis-Garcia (Ohio State University)
        i. Impact of weaning on stress and health of lambs
        ii. Sow euthanasia training program
        iii. Rubber mat in farrowing stalls
    c. Carissa Wickens (University of Florida)
        i. Aversion to ammonia in horses
        ii. Selection criteria of temperament for therapeutic riding lessons
        iii. Extension – training ag law enforcement officers to identify signs of cruelty and educate owners
        iv. Emily Miller-Cushon: Sickness behavior in calves
    d. Katy Proudfoot (Ohio State University)
        i. Determining prevalence of health concerns in veal calves
        ii. Assessing the impact of sleep deprivation in dairy cows (in collaboration with University of Tennessee and University of Kentucky)
    e. Lindsey Hulbert (Kansas State University)
        i. Impact of prebiotics on calf health and immunity
        ii. Effect of plane of nutrition on calf sucking behavior
    f. Andres Cibils (University of New Mexico)

      i. Sheep and beef cow rangeland management
      ii. Reproductive efficiency of cows and sheep
      iii. Grazing behavior in beef heifers
- g. Courtney Daigle (Texas A&M)
  - i. Effect of exercising cattle on behavior and immunity
  - ii. Sickness behavior using facial expressions and activity collars (Mooniters)
  - iii. Mind-gut axis in cattle
- h. Brianna Gaskgill (Purdue)
  - i. Chronic ammonia exposure and cognition (University of Illinois)
  - ii. Heat stress with Don Lay and Jay Johnson (USDA)
- i. Rachel Dennis (University of Maryland)
  - i. Gut-brain health and probiotics in poultry
- j. Richard Blatchford (UC Davis)
  - i. Some new hires are coming up – welfare epidemiologist, vet extension, social science and welfare
  - ii. Backyard flock survey on physical conditions and management variations
- k. Tina Horback (UC Davis)
  - i. New hire – previous research with marine mammals, elephants and sows
  - ii. Personality traits and coping styles in sows
- l. Kathy Holcomb (UC Davis)
  - i. Welfare concerns with Bureau of Land Management horses
- m. Maja Makagon (UC Davis)
  - i. Keel bone problems in laying hens
  - ii. Effects of social grouping on duck behavior
  - iii. Broiler enrichments
- n. Amber Adams-Progar (Washington State University)
  - i. Behavioral indicators of disease in calves and cows
  - ii. Monitoring heat stress in dairy cows
- o. Marcia Endres (University of Minnesota)
  - i. Recently hired Beth Ventura to teach animal behavior/welfare
  - ii. Robotic milking systems
  - iii. Assessing Sensors (SCR rumination collars, Cow Manager, automatic calf feeders)

3. USDA-NIFA Update (Margo Holland and Peter Johnson)
   - a. Funding opportunities
     - i. AFRI – currently operating at 325 million, asking for 375 more
     - ii. Exploratory Grant – 1 year, $100,000
     - iii. Post-doctoral fellowship program (ELI) for undergraduates, doctoral students, and post-doctoral fellows
   - b. Stakeholder Input Webinars
     - i. Poultry Layer webinar 11/10
     - ii. Animal welfare webinar in late October – we can still provide input via email (animal.health@nifa.usda.gov)
   - c. Collaboration opportunities with the UK
     - i. UK has AWRN workshops coming in 2017
       1. Email Peter and Margo if you would like to join but need help with travel costs

Impact Nuggets

Washington State University implemented an innovative, non-invasive method to collect calf body temperatures and documented the impact of environmental conditions on calf temperature, health, and behavior. This method showed a 92% precision with traditional methods.

New Mexico State University is working on developing livestock behavior-based indicators to inform grazing management decisions on western rangelands. These efforts include the use and calibration of tools such as GPS, accelerometers, proximity sensors, temperature sensors, and drones as well as big data processing and analysis systems to derive criteria for animal welfare and land use assessments.

The Ohio State University has created an application for hand-held devices to deliver educational material to swine producers about timely euthanasia. We have also completed two large projects assessing the welfare of veal calves and group-housed sows.

The transition period from late gestation to early lactation is very critical in the life of dairy cows. At one of our studies at the University of Minnesota we found that mature cows that develop two or more health disorders after calving, had changes in feeding behavior prior to calving compared to herd mates that were healthy. Technology can be used to identify these animals at risk, resulting in improved productivity and reduced mortality in dairy herds.

University of Florida has active research, teaching, and extension programs focused on both equine and dairy cattle behavior and welfare.

The Department of Animal Science at Texas A&M University has been evaluating husbandry practices, animal behavior, and technologies to enhance our ability to detect disease and quantify welfare for feedlot cattle.

The Department of Poultry Science at Texas A&M University has been evaluating husbandry practices, animal behavior, and technologies to enhance our ability to determine animal welfare and reduce stress in poultry.

Michigan State University provides leadership and international expertise through research on behavior and welfare of hens in alternative housing systems and use of behavioral phenotypes to selectively breed for pigs suitable for group housing. Station members serve as officers of international professional societies, on scientific committees for industry groups and corporations and as expert speakers at symposia for veterinarians, animal professionals and lay audiences. Station members also train undergraduate, graduate and veterinary students to assess animal welfare using the collegiate welfare judging competition and via coursework and research.

New Facilities and Equipment

Washington State University purchased live-feed farm monitoring cameras to be used to collect cow feeding behavior video footage on cooperating dairies across the state.

New Mexico State University purchased:

- 3D Robotics Y6 Multi-copter (3D Robotics, Berkeley, CA) fitted with a two-axis brushless gimbal with a BaseCam open source controller and a GoPro Hero 3 Silver Digital Camera (GoPro, San Mateo, CA)

- Lotek 3300 collars fitted with GPS, temperature sensors, and two axis accelerometers (n = 6). These new collars will be added to our existing pool of 14 GPS collars of the same brand and model.

- Sirtrak proximity loggers (n=4) were added to our existing pool of 12 loggers of the same brand and model.

Michigan State University expanded and renovated the Sheep Teaching and Research Facility in 2016. New facilities include a 5800 ft^2 climate-controlled lambing unit and a 7900 ft^2 multi-use housing area. These buildings are fitted with a center aisle feeding system to allow feeding of a total mixed ration. The facilities can be used for multi-season lambing and are designed to allow monitoring of animals without disturbance during and after birth.

Unique Project Related Findings

New Mexico State University found that movement patterns of nursing beef cows in rangeland pastures during the weeks immediately following calving were significant predictors of calf 205-day adjusted weaning weights. We also found that rangeland beef cows with different personalities (behavioral types) showed lifetime differences in reproductive efficiency. Finally, off-the-shelf drones could be a useful tool to monitor rangeland beef cattle feeding behavior. However, their potential is currently limited by relatively short battery autonomy and stringent Federal Aviation Administration regulations.

In our work at the University of Minnesota with calves in group housing and automated feeders, we found that herds that monitored their calves' drinking speed had lower mortality rate than herds that did not pay attention to this feeding behavior.

Michigan State University found that individual laying hens show substantial variability in how much time they spend in different areas of tiered aviaries, with some hens spending roughly equal amounts of time between various tiers and litter areas while other hens never access litter and prefer one tier over another. However, nest use by all hens appears to be relatively similar. Litter substrate in aviaries can impact hen behavior, with hens spending more time on litter and straw than on AstroTurf.

Michigan State University found that laying hens of different strains behave differently when housed in the same style of multi-tiered aviary. At night, white W-36 and DeKalb hens crowd into upper tiers to roost at height while brown Hyline and Bovans hens distribute themselves more evenly among the tiers. Brown hens appear to move more between tiers at night than white hens, and the downward direction of movement suggests this might be due to falling. White hens accessed litter more quickly after a period of deprivation compared to brown hens and continued to use litter at higher rates for several weeks after gaining access to litter. Brown hens laid more eggs in the morning and laid outside the nest and damaged more eggs than white hens who laid eggs into early afternoon and in the nest at higher rates.

Social aggression in pigs occurs in varying levels and patterns among pigs; however, Michigan State University found that aggression does not appear to be related to fear or to pigs' response to humans. Aggression is heritable and could be incorporated into selection indices to breed for less aggressive pigs. There is some relationship between aggression, weight gain, and leanness and loin muscle area, but it should be possible to select against pigs that actively engage in damaging aggression without impacting these production traits. Pig producers self report that they do consider behavior when assessing and managing pigs, and report that most of their information on pig behavior comes from veterinarians.

Accomplishment Summaries

Washington State University conducted two studies related to the impact of environmental conditions on dairy calf health, behavior, and growth. The first study focused on heat stress in Holstein calves; whereas,

the second study focused on cold stress in Jersey calves. Each study measured calf body temperatures using a non-invasive method, environmental conditions using data loggers, and behavior using video cameras. Calf weights were also recorded and average daily gains were calculated. Both studies documented the direct relationship between environmental conditions and calf body temperatures. Additionally, behavioral cues of illness were identified in calves to help dairy producers detect calf illnesses earlier and provide timely care.

New Mexico State University identified previously unknown relationships connecting the rangeland grazing environment with movement patterns of nursing beef cows and weaning wrights of their calves. Global positioning system data were collected over 4 years by recording 5-min interval locations of 52 crossbred cows grazing a 146-ha woodland/grassland pasture for approximately 20 days. Weights of weaned calves (n = 42) were also recorded. Forage allowance (adequate vs. high) influenced day vs. night movement patterns, habitat use, and movement path sinuosity. Weather factors associated with thermal comfort affected daily variation in both daytime and nighttime movement patterns of cows. A dam's movement pattern in the weeks immediately following calving were correlated with steer but not heifer calf weaning weights. Moderate stocking rates (adequate forage allowance) induced behaviors that resulted in more uniform rangeland use and heavier steer calf weaning weights.

NMSU also studied relationships between cow temperament and lifelong reproductive output. Cows classified into behavioral type groups on the basis of a suite of correlated behaviors showed contrasting rangeland use patterns and different reproductive efficiency. These differences resulted in temperament-related culling rates over a 6 year period. This study explores the question of whether beef cows with behavioral types best suited to rangeland environments are able to produce calves that will adapt well to feedlot environments.

NMSU and local collaborators tested the feasibility of using unmanned aerial vehicle (UAV) video monitoring to predict intake of discrete food items of rangeland-raised non-nursing beef cows. Thirty-five cows were included in this study. Video footage of arena tests was acquired with a three dimensional Robotics Y6 Multi-copter fitted with a two-axis brushless gimbal and a GoPro Hero 3 Silver Digital Camera. Video files were processed to extract a total of 4,893 two-second-interval still images that were viewed to determine cow feeding activity. Cows that were naïve to the sound of the UAV fed as frequently as their adapted counterparts during 12-min pilot tests. Significant positive correlations between video-derived feeding frequency estimates and amount of food consumed were observed. Our results suggest that UAV video monitoring could be a useful tool to monitor feeding behavior of rangeland cows.

Over the last year, researchers at OSU have created a euthanasia training program for swine producers for hand-held devices. Identify quantitative and qualitative decision criteria for on-farm euthanasia of pigs. This application is a 'proof-of-concept' application to deliver educational material on timely decisions for euthanasia of pigs to employees. Based on our successes thus far with the application, we plan to apply the idea to other species and topics.

Through a collaborative effort between academia and industry (The Ohio State University, Iowa State University and Kraft Foods/Oscar Mayer), we have collected data for a project assessing the 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.

Over the last year, researchers at OSU have finished collecting data on a project assessing veal calf welfare. The project aimed to assess the prevalence of injuries and clinical health problems when young

calves first arrive to the veal farm. Research in this area can help reduce the risk of disease and improve welfare of young calves in the veal industry.

UC Davis VMTRC has studied strategies to treat moderately lame cows. The effects of therapeutic trimming of moderate lameness on milk yield and lameness progression were evaluated on 148 cows vs. 150 control cows housed on 2 dairies (herd A: 2,374 cows; herd B: 2,800 cows). Treatment had no effect on milk yield in herd A but tended to decrease milk yield in herd B. Lameness progression was not affected by treatment. But, 2 wk after intervention, treated cows on herd A tended to have a higher predicted lameness probability than control cows. Therapeutic trimming had very limited benefits on moderately lame cows, possibly because over half of the treated cows had either no lesion or thin soles. This research work was supported by the USDA National Institute of Food and Agriculture, project 1002607 and Nutrius LLC (Kingsburg, CA).

The quick identification of animals at risk of becoming sick before their health disorder becomes more severe or they die could help improve animal welfare in dairy farms. When animals are housed in groups (the trend in the industry), it is more difficult to monitor individual animals. At the University of Minnesota we are investigating how certain behaviors such as feeding or rumination time in adult cows, or visits to the feeder and drinking speed for calves, could potentially help identify these animals at risk. We found some promising results for transition cows and calves. Some of these results were published in 2016 and some data analysis is ongoing. We are also validating an ear tag technology that monitors feeding, resting, rumination and activity behavior of cows in a grazing system. A technical note article will be submitted soon.

Research at the University of Florida in the past year in the area of dairy calf behavior and welfare has produced results describing the impact of nutritional enrichments for individually housed calves on feeding behavior and cognition. Collaborative projects have identified impacts of heat stress on feed sorting behavior of cattle and on behavior and welfare of calves born to heat-stressed cows.

Equine extension and research activities during the past year have been focused in three main areas. University of Florida has delivered three Livestock Education and Certification for Agricultural Law Enforcement (LECALE) training programs (March, December, 2015 and March 2016) to provide Ag law enforcement personnel knowledge and skills necessary for assessing the welfare of livestock, with a primary focus on cattle and horses. Results of a recent post-course evaluation determined the LECALE curriculum has improved attendees' abilities to respond to cases of animal neglect and has provided skills and resources necessary for discerning and communicating animal welfare concerns. 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. Finally, in the past year, research on aversion of horses to different ammonia concentrations has demonstrated the impact of higher concentration of ammonia on the behavior and physiology of horses.

Texas A&M University evaluated two different exercise regimes for efficacy and identified an impact of breed on responsivity to handling and exercise programs for cattle. Areas of research interest include the impact of exercise and the human-animal interaction on cattle behavior, productivity, and immune functioning at the research and commercial level. Additional research has been investigating the efficacy of facial expression technology to identify sick or stressed cattle.

Texas A&M University evaluated several feed additives for their efficacy in reducing stress in poultry. Additional research has been conducted investigating the use of light to improve welfare and stress of poultry. Research evaluating different lighting technologies and programs to reduce stress in poultry are

also being conducted. Finally, research looking for means to evaluate stress in poultry via less invasive means are ongoing.

Michigan State University completed publication of data from a 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. J. Siegford and postdoc A. Ali have begun publishing findings from a comparison of laying hen strains in aviary housing and are completing work with former postdoc D. Campbell on impact of litter substrate on hen behavior in aviaries. This body of work related to how hens actually behave in aviaries and use resources that are considered to be important will help ensure that alternative housing systems for laying hens, such as aviaries, are designed in a way that actually improves hen welfare to meet public expectations.

Michigan State University (J. Siegford) is leading a research team examining the relationship of social behavior phenotypes to underlying genotypes in pigs with the goal of expanding swine breeding selection programs to include behavior. By selecting for desirable behaviors and against damaging aggression, pigs can be bred that are better suited for group-living in commercial production conditions. This work was jointly funded by grants from USDA NIFA Food Security, National Pork Board, and MSU's Rackham Foundation and involves a team of colleagues at MSU (Extension, Veterinary Medicine and Animal Science) and Scotland's Rural College.

Michigan State University (C. Heleski) work on assessing the welfare of horses and donkeys and developing codes of practice continues to 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. She has recently moved to University of Kentucky and will continue teaching and research related to behavior and welfare there.

At Michigan State University, 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).

The University of California, Davis, conducted work examining wound healing after disbudding with a hot iron in dairy calves. The results provide initial evidence that these wounds take up to 10 weeks to heal and represent a considerable injury during this time. UC Davis identified appropriate sampling methodology for two contexts: measuring behavior of dairy cattle in freestall barns and assessing heat load on commercial dairy farms. This work makes recommendations about how often researchers need to record the behavior or physiological responses of animals and thus informs robust animal welfare assessment.

Impact Statements

Dairy cattle well-being studies at Washington State University have investigated the influence of environmental conditions (hot weather and cold weather) on dairy calf health and behavior. This information was compiled and shared with dairy producers, veterinarians, and 4-H dairy project members through workshops, extension factsheets, and newsletters. The importance of detecting the onset of calf illnesses by observing behavioral cues has also been shared with dairy producers and employees.

Understanding how individual variation of beef cow behavior (behavior types, personalities or temperaments) affects animal movement patterns and fitness (production efficiency) in rugged rangeland environments at New Mexico State University has the potential to improve current animal selection

criteria. In the longer term, selecting behavioral types that are better suited to rangeland grazing environments will improve the reproductive performance of beef herds while enhancing animal welfare and reducing environmental footprint of beef production. At current beef prices, we have estimated that differences in beef cow behavioral type could result in a gain or loss of as much as $89.00 per weaned calf.

The new application for hand-held devices created at Ohio State University will be the first to deliver educational material about timely euthanasia to swine producers. We expect that this application will aid in the delivery of educational material to a wide range of producers across the U.S., and will help them make better decisions about when and how to euthanize compromised pigs. This application also serves as a model that can be used for other species and topics to educate producers about animal welfare topics. 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 3% would result in an estimated economic benefit of over $500 million to the US dairy industry. Better health is one aspect of good animal welfare and achieving it requires improving many aspects of the cow's environment and management.

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. Data in the past year have determined that the development of a novel feeding box system shows promise as a tool for investigating horse aversion to ammonia in the barn 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 focused on how housing factors for dairy calves impact behavioral development, cognition, and longer-term behavior and welfare. Data in the past year determined positive effects of nutritional enrichments for individually housed calves on cognition in early life. More recent experiments with pending results have explored the expression of sickness behavior in group-housed calves, and the adaptation of previously individually-housed calves into a social group after weaning.

At TAMU, feed additive studies have shown promise in using nutritional means to reduce stress in poultry while maintaining or improving production. Light incubation research has demonstrated improved hatchability and chick quality as well as reductions in post hatch stress and flightiness. Further work on immune function and other welfare indicators is underway. Lighting research in layers and broilers has shown reduction in stress while using LEDs and that intensity and photoperiod can alter stress and welfare of birds differently than published research that used older technology.

Researchers at MSU are examining the relationship between behavior of individual hens and at the flock level to determine whether group-level behavior adequately captures the experience of the individual. They are also examining the relationship between assessments of hens' physical welfare using a standardized assessment (Welfare Quality Protocol) to their behavior to determine what information is captured or absent if standardized physical assessments are used in the absence of behavior by auditing or assessment programs on farm.

Published Written Works

Journal articles

Ali ABA, Campbell DLM, Karcher DM, Siegford JM. 2016. Influence of geneticstrain and access to litter on spatial distribution of 4 strains of laying hens in an aviary system. *Poultry Science*, 95:2489-2502.

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Goodman, L.E., A.F. Cibils, R.L. Wesley, J.T.Muliniks, M.K. Petersen, E.J. Scholljegerdes, S.H. Cox. 2016. Temperament affects rangeland use patterns and reproductive performance of beef cows. Rangelands 38: 292-296.

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Book chapters

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Outreach

Adams Progar, A. 2016. Amber's top ten tips: understanding dairy FARM evaluations. WSU Dairy Newsletter, June 2016.

Adams Progar, A. 2015. Amber's top ten tips: understanding group housing in calves. WSU Dairy Newsletter, December 2015.

Adams Progar, A. 2016. Heat stress success: managing heifer growth. Pacific Northwest Animal Nutrition Conference, Boise, ID, January 2016.

Adams Progar, A. 2016. Understanding cow behavior and its effect on reproduction. Producer's College, Lynden, WA, January 2016.

Archer, G.S. Manejo de la luz antes del procesamiento. (2016) Programa Tentativo del XII Simposium de Procesamiento e Inocuidad de Productos Avícolas. Queretaro, Mexico.

Archer, G.S. Lighting prorams for welfare and production in layers and broilers. (2016)   1st Simposium de Bienestrar Animal, Produccion Organica y Libre de Antibiotics. Queretaro, Mexico.

Archer, G.S. (2016). Lighting for Incubation and Hatch: Increasing Production. Symposium on Lighting in Poultry Facilities. 2016 Poultry Science Association Annual   Meeting, New Orleans, La.

Callanan, J., H. A. Young, and A. L. Adams Progar. 2016. Relationship between cow lying behavior and free-stall barn design. WSU Showcase for Undergraduate Research & Creative Activities, Pullman, WA, March 2016.

Chen JM, Mintline EM, DeVries TJ, Tucker CB. 2016. Feeding motivation in feedlot cattle. 100th Annual Convention of the California Cattlemen's Association & California Cattlewomen, Inc., Reno, NV.

Endres, M.I. 2016. Is automated calf feeding right for your farm? WCDS Advances in Dairy Technology (2016) Volume 28: 233-241.

Endres, M. and B. James. 2016. Facility systems for the young dairy calf: Implications for animal welfare and labor management. Pg 62 in ADSA Large Dairy Herd Manag. Conf. Proc. Oak Brook, IL. Available from www.adsa.org/meetings/largedairyherdmanagement.aspx

García-Munoz A, S. Navdeep, and N. Silva-del-Río. 2016. Impact of early detection and treatment of moderate lameness on disease progression and cow performance. *In:* Proceedings of the 49th Annual Convention of the American Association of Bovine Practitioners, Charlote, NC.

Miller-Cushon, E. K. 2016. Assessing Cattle Welfare. Cattle Health and Well-being In-service Training Session. University of Florida. February 24, 2016.

Miller-Cushon, E. K. 2016. Consequences of feeding and housing practices for animal welfare and performance. Dairy Cattle Welfare Symposium. Columbus, Ohio. May 20, 2016.

Miller-Cushon, E. K. 2016. Animal Behavior and Welfare. US Agricultural Information Network Conference. Gainesville, Florida. April 26, 2016.

Pineda M, A. Ibrahim, A. Lago, and N. Silva-del-Río. 2016. Hoof trimmer performance on California dairies based on hoof measurements before and after therapeutic trimming. *In:* Proceedings of the 49th Annual Convention of the American Association of Bovine Practitioners, Charlote, NC.

Proudfoot, K, Huzzey, J, Presenter. "Behavior of transition cows and relationship with health." Presented at Large Dairy Herd Management (May 2016)

Proudfoot, K, Presenter. "Cow comfort during transition." Presented at Penn State Nutrition Workshop (Feb 2016)

Proudfoot, K, Presenter. "Cow comfort during the transition period." Presented at Cargill Technical Exchange (Jan 2016)

Proudfoot, K, Presenter. "Maternity pen design and management from the cows' perspective." Presented at Leading Producer Conference (Jan 2016)

Shearer, J., M.F. Hutjens and M. Endres. 2016. Managing the herd to minimize lameness. Pg 104 in ADSA Large Dairy Herd Manag. Conf. Proc. Oak Brook, IL. Available from www.adsa.org/meetings/largedairyherdmanagement.aspx

Siegford J, Bates, R, D'Eath R, Gemus-Benjamin M, Ison S, Jensen L, Raney N, Roehe R, Steibel J, Turner S, Wurtz K. 2016. Relating behavioral phenotypes to genotypes to improve genetic selection in pigs. 2016 National Swine Improvement Federation Annual Conference and Symposium, Raleigh, NC.

Trearchis, D., Pempek, J., Masterson, M., Habing, G., and K. Proudfoot. 2016. Prevalence of failure of passive transfer, dehydration, and health outcomes in veal calves on the day of arrival to the farm.

Merial Veterinary Scholars Program 2016 Symposium. Duluth: Merial. (poster presentation)

Tucker, CB. 2016. Cattle behavior: insights from the animals to improve their welfare. Invited talk at 4-H Animal Science State Symposium in Davis, CA.

Tucker, CB. 2016. From lab to life: taking research findings into the world. Invited talk at 9th Boehringer Ingelheim Expert Forum on Farm Animal Well-Being Conference, Montreal, Canada.

Tucker, CB. 2016. Animal welfare assessment:the US perspective. Invited talk at the NOVA seminar, Fork to Farm in Helsinki, Finland.

Tucker, CB. 2016. Effective cow cooling: how do we know when we've got it right? Invited talk to Northern San Joaquin Veterinary Medical Association, Hilmar, CA.

Tucker, CB. 2016. Research updates in dairy welfare assessment. Invited talk at National Milk Producers Federation FARM Evaluators' Conference in Nashville, TN.

Wickens, C. 2016. Normal Behavior of Horses. Rutgers Equine Management Seminar. New Brunswick, New Jersey. February 14, 2016.

Wickens, C. 2016. Stereoptypic Behavior in Horses. Rutgers Equine Management Seminar. New Brunswick, New Jersey. February 14, 2016.

Wickens, C. 2016. Assessing Equine Welfare. Equine Health and Well-being In-service Training Session. University of Florida. January 11, 2016.

Young, H. A. and A. L. Adams Progar. 2016. Behavioral and physiological responses to hot weather conditions in Holstein calves. WSU Showcase for Undergraduate Research & Creative Activities, Pullman, WA, March 2016.

Scientific presentations

Ali AB, K Gutwein, C Heleski. 2016. Exploring the relationship between heart rate variability and behaviour – Social isolation in horses. 12th International Equitation Science Conference, Saumur, France.

Alvarado,C.Z., J. Fang, G. Casco, J. A. Byrd, P. T. Price, G. Archer, D. P. Smith and H.O. Pavlidis. (2016). Effect of feeding Original XPC on Salmonella enumeration and prevalence in ceca, breast and ground breast meat in heat stress and non-heat stressed broilers. 2016 Poultry Science Association Annual Meeting, New Orleans, La.

Archer, G.S. (2016). The effect of raising broilers under 3000K or 5000K LED light on production, stress, and behavior. 2016 Poultry Science Association Annual Meeting, New Orleans, La.

Archer, G.S. and J. Delabbio. (2016). Using White with Red LED Lighting to improve hatchability and chick quality in broilers and layers . 2016 Poultry Science Association Annual Meeting, New Orleans, La.

Byrd, J.A. and G.S. Archer. (2016). The effect of different spectrums of LED light on hen production and welfare from 18-30 weeks of age. 2016 Poultry Science Association Annual Meeting, New Orleans, La.

Byrd, J.A. and G.S. Archer. (2016). The effect of different spectrums of LED light on Salmonella shedding in 30 weeks of age Laying hens. 2016 Poultry Science Association Annual Meeting, New Orleans, La.

Campler, M.R. and M.D. Pairis-Garcia. 2016. The effect of rubber mats on lying and feeding behavior of lame and non-lame sows housed in farrowing stalls. Edinburgh: International Society for Applied Ethology, page 251 (poster presentation)

Chen JM, Schütz KE, Tucker CB. 2016. Heat load affects measures of aversion in dairy cows. 50th International Congress of the International Society for Applied Ethology, Edinburgh, Scotland.

Dayton, A., A. P. A. Monteiro, X. Weng, S. Tao, and E. K. Miller-Cushon. 2016. Effects of acute and chronic heat stress on feed sorting behavior of lactating dairy cows. Journal of Diary Science E. Suppl. 94:36.

Daigle CL, Hester PY, Lay DC, Cheng HW. 2016. Could the ultraviolet reflectivity of feathers phenotypically identify hens targeted for feather pecking? Poster Presentation. *50th International Society of Applied Ethology. July 12-16, 2016, Edinburgh, Scotland.*

Daigle CL, Baber J, Wickersham TA, Sawyer JE. 2016. Impact of diet on the behavior of limit-fed beef cows in drylots. Poster Presentation. *2016 Joint Annual Meeting of the American Society of Animal Scientists, Salt Lake City, UT.*

Farnell, M.B. M.J. Moreira, and G.S. Archer. (2016). The effect of housing single combed white Leghorns in conventional cages versus enriched colony cages from 23 weeks to 79 weeks of age on stress and fear. 2016 Poultry Science Association Annual Meeting, New Orleans, La.

Goodman, L., A.F. Cibils, L. Owensby. 2016. Individual-based variation in grazing behavior of rangeland-raised beef cows. Proceedings of the 50th Congress of the International Society for Applied Ethology. July 12 – 15, 2016, Edinburgh, Scotland. P.148.

Gutwein K, Ali AB, Heleski C. 2016. Food anticipation in domestic horses – anticipating something good or frustrated with waiting for a desired resource? 12th International Equitation Science Conference, Saumur, France.

Heleski CR, 2016. 052 Equine welfare in a competitive setting–What can ten-plus years of research by the equitation science community tell us? (And what critical pieces are still missing?). American Society of Animal Science Midwest Section Meeting, Des Moines, IA.

Horvath, K., and E. K. Miller-Cushon. Cognition of dairy calves exposed to nutritional enrichments during the milk-feeding stage. Page 197 *in* Proceedings of the 50th Congress of the International Society for Applied Ethology, July 12 to July 15, 2016, Edinburgh, United Kingdom. Dwyer, C., M. Haskells, and V. Sandilands, eds. Wageningen Academic Publishers.

Horvath, K., and E. K. Miller-Cushon. Influence of milk feeding method on dietary selection of dairy calves. Page 231 *in* Proceedings of the 50th Congress of the International Society for Applied Ethology, July 12 to July 15, 2016, Edinburgh, United Kingdom. Dwyer, C., M. Haskells, and V. Sandilands, eds. Wageningen Academic Publishers.

Hunniford, ME, Siegford J, Widowski TM. 2016. The devil is in the details: How a simple design feature might affect laying hens' perception of nest sites in furnished cages. 9th Annual Campbell Centre for the Study of Animal Welfare Research Symposium, Guelph, Canada.

Jensen L, O'Malley C, Ison S, Wurtz K, Steibel J, Bates, R, Ernst C, Siegford J. 2016. Is leaner meaner? The effect of leanness on pig-pig aggression and pig-human interactions in finisher gilts. 50th Congress of the International Society for Applied Ethology, Edinburgh UK.

Jorgensen, M. and M.I. Endres. 2016. Risk factors for calf mortality on farms using automated calf feeders in the Midwest USA. J. Dairy Sci. 99 (E-Suppl 1): 582.

Manning, H., Pempek, J., Cosentino, E., Eastridge, M., and K. Proudfoot. 2016. Dairy calf preference for enrichment items when housed in an individual hutch. Edinburgh: International Society for Applied Ethology, page 255 (poster presentation)

Miller-Cushon, E. K., K. Horvath, G. E. Dahl, J. Laporta. 2016. In-utero exposure to heat stress during late gestation has prolonged negative effects on activity patterns of dairy calves. Journal of Dairy Science E. Suppl. 94:36.

Miller-Cushon, E. K., and T. J. DeVries. 2016. Influences of feeding and housing practices on the behavior and performance of dairy calves. Journal of Dairy Science E. Suppl. 94:26.

Miller-Cushon, E. K., and T. J. DeVries. 2016. Influences of feeding and housing practices on the behavior and performance of dairy calves. ADSA Southern Section Symposium. 2016 ADSA ASAS Joint Annual Meeting. Salt Lake City, Utah. July 19-23, 2016.

Newsome N, Ali A, Campbell D, Siegford J. 2016. Open or Under? Occupancy and dust bathing in different litter areas by 4 strains of laying hen. 50th Congress of the International Society for Applied Ethology, Edinburgh UK.

Nyamurekung'e, S., A. Cibils, R. Estell, A. Gonzalez, O. Roacho-Estrada, F. Rodriguez-Almeida. 2016. Movement and spatial proximity patterns of rangeland-raised Raramuri Criollo cow-calf pairs. J. Anim, Sci. Vol 94. E. Suppl. 5, P. 39.

Nyamurekung'e, S., A.F. Cibils, R.E. Estell, A.L. Gonzalez. 2016. Use of a UAV-Mounted Video Camera to Assess Feeding Behavior of Raramuri Criollo Cows. Proceedings of the 10th International Rangeland Congress, Saskatoon, Canada, July 17-22, 2016, P. 1070-1072.

Onafowokan, A.A., J. A. Byrd, G. Archer, and C. Alvarado. (2016). Effect of lighting intensity on transmission of Salmonella among broiler chicks. 2016 Poultry Science Association Annual Meeting, New Orleans, La.

O'Malley C, Wurtz K, Steibel J, Ernst C, Bates, R, Siegford J. 2016. Fear and its relationship to social aggression in group-housed swine. 50th Congress of the International Society for Applied Ethology, Edinburgh UK.

Pineda P., and N. Silva-del-Rio. 2016. Management and dimensions of footbaths on California dairies. J. Dairy Sci. Vol. 99, E-Suppl. 1.

Proudfoot, K., Franks, B., and M. von Keyserlingk. Individual differences and the social environment affect risk of endometritis in dairy cows. Edinburgh: International Society of Applied Ethology, page 159 (poster presentation)

Price, P.T., H.O. Pavlidis, D.R. McIntyre, J.A. Byrd, and G.S. Archer. (2016). Dietary supplementation of Original XPC to reduce stress in heat stressed and non-heat stressed broilers. 2016 Poultry Science Association Annual Meeting, New Orleans, La.

Pullin, A., Campbell, B.J., Campler, M.R., and M.D. Pairis-Garcia. 2016. Impact of weaning on grazing and drinking behavior in pastured lambs. Edinburgh: International Society for Applied Ethology, page 122 (poster presentation)

Simon GE, Tucker CB. 2016. A training website for assessing cow-calf health and handling. 5th International Symposium on Beef Cattle Welfare, Manhattan, KS.

Swanson J, Mench J. 2016. Can animal welfare science have a role in creating a sustainable future for animal agriculture? 50th Congress of the International Society for Applied Ethology, Edinburgh UK.

Tresoldi, G, Schütz KE, Tucker CB. 2016. Cooling cows with soakers: spray duration affects heat loss in dairy cattle. Joint Annual Meeting of the American Dairy Science Association and the American Society of Animal Science, Salt Lake City, UT.

Tucker CB. 2016. Invited talk: Assessing and improving welfare in cow-calf systems. Joint Annual Meeting of the American Dairy Science Association and the American Society of Animal Science, Salt Lake City, UT.

Tucker CB. 2016. Invited Plenary: Assessing and improving welfare in cow-calf systems. Welfare Quality Network Seminar, Helsinki, Finland.

Tucker, Z., D. Jeffery, and G.S. Archer. (2016). Increasing hatchability in duck eggs by exposing them to LED light during incubation. 2016 Poultry Science Association Annual Meeting, New Orleans, La.

Villanueva, S, Ali A, Campbell D, Siegford J. 2016. Effect of different laying hen strains on daily egg laying patterns and egg damage in an aviary system. 50th Congress of the International Society for Applied Ethology, Edinburgh UK.

Wickens, C., M. J. Hersom, R. G. Easterly, E. Jennings, B. Myers, J. Shuffitt, B. Stice, and J. Weir. 2016. Creation, Delivery, and Assessment of the Livestock Education and Certification for Agricultural Law Enforcement Extension Program. J. Anim. Sci. 94:275-276.

Wickens, C. 2016. Creation, Delivery, and Assessment of the Livestock Education and Certification for Agricultural Law Enforcement Extension Program. Extension Section. 2016 ADSA ASAS Joint Annual Meeting. Salt Lake City, Utah. July 19-23, 2016.

Wurtz K, O'Malley C, Siegford J, Bates, R, Ernst C, Raney N, Steibel J. 2016. Estimation of heritability and environmental effects of number of scored lesions in group-housed pigs. 50th Congress of the International Society for Applied Ethology, Edinburgh UK.

Meeting Organization

J. Siegford and C. Heleski helped organize the 16th Annual Collegiate Animal Welfare Judging and Assessment Competition held at Ohio State University in November 2016 in collaboration with the American Veterinary Medical Association. J. Siegford prepared scenarios and postdocs S. Ison and A. Ali

coached undergraduate students. Approximately 110 students competed, assessing the welfare of purebred dogs, guinea pigs, meat sheep and laying hens.

J. Siegford co-organized and spoke at a workshop at the National Swine Improvement Federation 2016 Meeting in Raleigh, NC. The workshop presented information related to research being conducted at MSU and Scotland's Rural College relating social phenotypes (particularly) aggression in swine to their underlying genotypes and how producers currently use and manage behavior in pigs.

Fund leveraging, specifically, collaborative grants between stations and members

Funded Collaborative Grant between Ohio State University, University of Tennessee and University of Kentucky:

Aug 2016 Proudfoot, K, Krawczel, P, Pighetti, G, Bewley, J, Donohue, K, O'Hara, B. "Living up to her potential: Increasing dairy cow productivity and welfare using an improved understanding of sleep" U.S. Department of Agriculture. $100,000 (USD).

Funded Collaborative Grant between Ohio State University and University of Tennessee:

Dec 2015 Proudfoot, K, Krawczel, P, Dann, H. "The effect of visual seclusion and stocking density on the behavior and welfare of transition dairy cows" U.S. Department of Agriculture. $500,000 (USD).

Funded Collaborative Grant between University of Florida and University of Tennessee:

Miller-Cushon – PI – IFAS Early Career Scientist Seed Funding, Investigating the expression of sickness behavior in group-housed dairy calves, $42,584. Funded April 2016-2017.

J. Siegford and J. Swanson are co-PIs on a USDA Higher Education Challenge Grant led by C. Croney at Purdue University. Other collaborators on the grant include faculty at landgrant universities across the U.S. including University of Maryland (R. Stricklin) and Texas A & M. (G. Varner) as well as University of Alaska, Anchorage (R. Anthony) and University of Montana (D. Scott).

Other relevant accomplishments and activities

n/a