

IFRB 2019

POINTS OF INTEREST:

- The IFRB was organized in 1992 and is one of the largest Reproductive Biology Programs in the US
- Membership includes 39 faculty from 9 departments, 4 colleges and 2 system components
- IFRB sponsored activities: 25th Annual R.O. Berry Lecture, 26 year old IFRB Repro Forum Seminar Series, 25th Texas Forum on Reproductive Sciences, Annual IFRB Retreat

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2019, ISSUE 1

New IFRB Faculty Spotlight



In 2019, the IFRB welcomed three new members, **Drs. Linglin Xie, Kurt Zhang and A. Phillip West.**

Dr. Linglin Xie is an Associate Professor in the Department of Nutrition and Food Science who joined the Department in 2015. She completed graduate education at Huazhong University of Science and Technology and a M.D. degree from Tongji Medical College. Following completion of a M.S. in Human Nutrition at Kansas State University, she earned a Ph.D. in Molecular, Cellular and Developmental Biology and completed postdoctoral studies in Pediatrics at the University of Chicago.

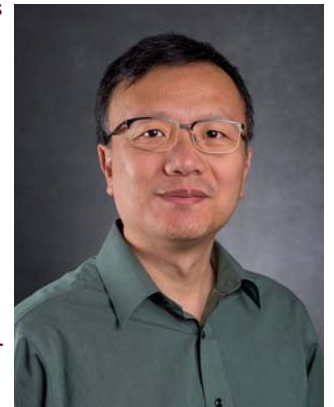


The long-term goal of Dr. Xie's research is to provide or promote strategies that achieve primal, primary and secondary prevention of obesity and its related metabolic complications. It is now well established that in utero and in early life exposure to over-nutrition can disrupt normal growth and development and thus increase the risk of offspring obesity. Therefore, development of a healthy pre-pregnancy diet strategy, would be beneficial to improve pregnancy outcomes in obese women. Unfortunately, although women of childbearing age are suggested to modulate their BMI to a value within the normal range before conception by engaging in lifestyle changes, no evidence-based strategy regarding the optimal duration of the intervention is currently available. Therefore, current work is focused on how different maternal diet intervention before pregnancy would prevent metabolic syndrome in adults.

Dr. Xie is also interested in the molecular and genetic basis of heart development and the ontology of congenital heart disease (CHD). CHD is the most common type of birth defect that affects 1% live birth and accounts for 1/3 of all birth defects. Her research has been focused on understanding how important transcription factors and signaling pathways for heart development such as Tbx5, Gata4 and Hh signaling networks in regulating the inflow and outflow tract development. She is also interested in understanding how maternal obesity or diabetes

increases the risk of congenital heart defects.

Dr. Kurt Zhang is an Associate Professor in the Center for Epigenetics and Disease Prevention at the Institute of Biosciences & Technology, Texas A&M University HSC. He also holds a joint appointment in the Department of Nutrition and Food Science at Texas A&M University. He joined both programs in 2018.



Dr. Zhang completed a B.S. in Biochemistry at Wuhan University, China and completed M.S. and Ph.D. degrees in Computational Biology and Statistics at Kansas State University. He was a Research Statistician at Abbott Laboratories before joining the Pathology Department at the University of North Dakota and rose to the rank of Associate Professor before joining Texas A&M University Health Science Center.

Dr. Zhang's long-term goal is to decode genetic events and molecular interactions of biological processes, and rigorously represent the complex molecular behaviors with mathematical models. He uses advanced high-throughput technology and robust stochastic models to obtain the systematic picture of a biological process. Multiple types of omics data, such as microarray, RNA-seq, ChIP-seq, lipidomics and proteomics are collected through innovative study designs in animals and humans, and are modeled for integrative analysis. Using embryonic mouse as a model system, one of his current focuses is to untangle the spatial and dynamic gene-gene interaction networks during heart development, and illustrate how environmental factors introduce adverse molecular changes and morphological defects. He is also investigating the transgenerational epigenetic variations carried from overweight mother to the offspring, and how the change of lifestyles would prevent childhood obesity. Drs. Linglin Xie and Kurt Zhang are both well funded and currently serve as multiple PIs on a NIH NIDDK R01 grant "A poly-omic study of the molecular mechanisms underlying maternal diet interventions for offspring obesity and NAFLD."

(continued on page 2)



IFRB New Faculty Spotlight (cont'd from page 1)

Dr. A. Phillip West, is an Assistant Professor of Microbial Pathogenesis and Immunology at the Texas A&M University Health Science Center. He joined the Department of Microbial Pathogenesis and Immunology in 2016. He completed B.S. degrees in Biological Sciences and Science Education, both *summa cum laude* at North Carolina State University and subsequently earned a Ph.D. in Immunology at Yale University followed by completion of a postdoctoral fellowship in Departments of Pathology and Genetics funded by the American Society.



Dr. West's overall research interests are in the role of mitochondria in processes including energy generation, programmed cell death, signal transduction, and immunity. Consequently, mitochondrial stress can drastically alter cell and tissue function and is increasingly implicated in aging and diseases such as type 2 diabetes, neurodegeneration, inflammatory disorders, and cancer. Research is focused in 3 major areas:

1) Mitochondrial Control of Innate Immune Signaling: The innate immune system constitutes the first line of defense against pathogens, and mounting evidence suggests that mitochondria are critical participants in innate immunity. His lab is currently exploring the signaling pathways linking mitochondria to innate immunity, with the ultimate goal of characterizing how these pathways modulate host responses to pathogens

and influence the pathobiology of mitochondrial disorders and inflammatory diseases.
2) Modulation of Mitochondrial Function by Pathogens: Many viral and bacterial pathogens target mitochondria to rewire cellular metabolism and interfere with innate immunity. Defining the microbial effector mechanisms used to manipulate these organelles could reveal new therapeutic avenues to limit virulence and boost host immunity. The lab is therefore collaborating with labs across campus to define how viral and bacterial pathogens alter mitochondrial function and dynamics.

3) Mitochondrial Dysfunction in Melanoma: Alterations in mitochondrial function and cellular metabolism have long been recognized as hallmarks of cancer. Moreover, mitochondrial genome instability has been observed in many aggressive cancers including melanoma, and recent reports indicate that mitochondrial DNA (mtDNA) dysfunction can engage stress signaling responses to enhance tumor growth and invasion. The lab utilizes a physiologically relevant mouse model of metastatic melanoma and patient-derived melanoma cell lines to explore how mitochondrial stress and mtDNA instability influence the development and progression of this cancer. A particular interest is defining how mitochondrial dysfunction modulates innate and adaptive immunity in the melanoma microenvironment to shape anti-tumor immune responses.

Dr. West's laboratory is funded by a HHV6 Foundation, Dharam Ablashi Pilot Grant, a Cancer Prevention & Research Institute of Texas grant and two DOD grants.

26th Texas Forum for Reproductive Sciences (TFRS)

SAVE THE DATE

The Twenty-Sixth TFRS meeting will be held on April 16-17 at the MD Anderson Onstead Auditorium

Thursday Plenary Speaker,
Dr. Stephanie Pangas
Associate Professor
Baylor College of Medicine
Department of Pathology

Friday Plenary Speaker
Dr. Swathi Arur
Associate Professor,
MD Anderson Cancer Center
Department of Genetics
Department of Veterinary Physiology and Pharmacology

IFRB Postdoctoral Trainee Spotlight



***Dr. Dr. Rebecca "Becky" Poole** joined **Dr. Ky Pohler's** research group in July 2019. She received her B.S. in Animal Science from North Carolina State University in 2014. She then pursued her M.S. degree in Animal and Poultry Sciences at Virginia Tech under the direction of Drs. Michelle Rhoads and Kiho Lee. During this time, she used a porcine model to explore how high saturated fat and fructose consumption facilitated obesity-induced infertility. Through utilization of an in vitro culture system, she observed a disruption in early embryonic development, specifically occurring at the 4-cell stage, which is indicative of cellular stress. Following completion of her M.S. degree in 2016, she then decided to implement her knowledge of fertility towards improving beef cattle production at North



Carolina State University under the mentorship of Dr. Daniel Poole (no relation).

Her Ph.D. research focused on the interaction between fescue toxicosis, a syndrome caused by chronic consumption of endophyte-infected tall fescue, and heat stress on reproductive performance, as well as investigating various mitigation strategies to improve overall performance. Her research identified that by utilizing the slick hair trait (i.e. a mutation in the prolactin receptor gene that improves the thermoregulatory ability of affected animals), this offset the heat stress related symptoms associated with fescue toxicosis and improves pregnancy rates. She completed her Ph.D. in Animal Science in May 2019.

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IFRB Faculty Spotlight: Dr. William Foxworth



***William (Bill) B. Foxworth, Ph.D. is a Research Scientist at the International Goat Research Center, Prairie View A&M University (PVAMU).** He began his career at PVAMU in 2013 after co-establishing two livestock biotechnology companies in the College Station area. A native Texan, Dr. Foxworth received his B.S. in Animal Science from the University of Wyoming, in 1986, before attending college at Sophia University, in Tokyo Japan. He returned to enroll in graduate school at Texas A&M University (TAMU), where he received his Ph.D. in Veterinary Physiology, under the mentorship of Dr. Duane Kraemer, in 1993. He was a post-doctoral student at TAMU prior to becoming a Research Scientist in Veterinary Pathobiology at TAMU. In 2002, he was a member of the Texas Agricultural Lifetime Leadership (TALL) Class VII and then graduated from the Advanced International Affairs Program at the George Bush School of Government and Public Service, TAMU in 2005.



vasectomized bucks to determine optimal breeding time. The does were bred by live cover or artificial insemination, and transrectal ultrasonography will be performed on the does to determine pregnancy status at 30, 45 and 90 days.

To better understand the failure of the incompetent caprine CL, Dr. Foxworth's group has sought to characterize the steroid hormone profiles, the morphologic and ultrastructure, differential gene expression through RNA sequencing and immunohistochemical localization and relative immuno-reactive quantification of related gene products in the normal cycling (days 3, 5, 11, 17 and 18) and abnormal regressing (day 4 and 5) caprine CL. The lab can identify, in vivo, the abnormal regressing CL between days 3-5 of the estrous cycle through real time progesterone (P4) analysis. Abnormal CL produce P4 up to day 3, but P4 drops below 1 ng/ml by day 5. The rise in P4 in abnormal CL occurs earlier in the estrous cycle than in normal CL (**Figure 1**).

Dr. Foxworth's research focuses on artificial reproductive technologies and methodologies in the goat and the underlying physiologic and molecular mechanisms that inhibit their successful usage. Three main areas of interest are; artificial insemination (AI) techniques, synchronization of estrus/ovulation for timed AI and the incompetent caprine corpus luteum (CL).

The use of synchronization of estrus/ovulation and artificial insemination are the most powerful technologies available, to both large and limited resource producers, for genetic improvement and reproductive management in the goat. Due to the constraints involved in the logistics and technique for limited resource farmers, both domestic and international, it is a necessity to use timed artificial insemination (TAI) in the goat. This process is hampered by the frequent incompetency and loss of (CL) function during metestrus following synchronization of estrus/ovulation.

To better understand the impact of insemination technique, on pregnancy per AI (P/AI), in a fixed-time artificial insemination (FTAI) program, the lab evaluated the use of transcervical (TC) and intracervical (IC) semen deposition in the goat. Three breeds of goats (Alpine, Boer, and Spanish) were synchronized for FTAI using a Co-synch program and then inseminated by TCAI or a commercial ICAI (RamGo, TecnoGen) technique. 49-50 hours post CIDR removal, the does were inseminated with fresh, cooled (4OC) semen. No difference in P/AI was noted between the TC or IC technique (45.7 and 30.8 %, respectively). Additionally, no interactive effect on P/AI was found between insemination method and breed. The timing of FTAI did present a significant difference in the P/AI among the breeds. Spanish does demonstrated a lower P/AI than the Boer and Alpine does (10 vs 41.2 and 46 %, respectively). These studies demonstrated that ICAI requires less technical proficiency and is a practical technique for FTAI in the goat, increasing the breadth of peoples that can utilize this management tool. The P/AI results further revealed a need for continued evaluation of the optimal timing of insemination between different goat breeds. To further study this breed difference in response to the synchronization program, the lab currently, is studying 200 goat breedings (Alpine, Boer and Spanish) in which the does were synchronized using a Co-synch program. Estrus timing and status was defined using intact and

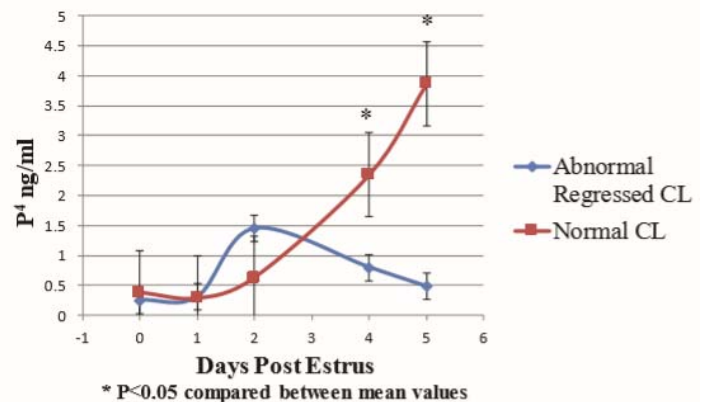


Figure 1. P4 levels of does comparing abnormal regressing and normal cycling CL..

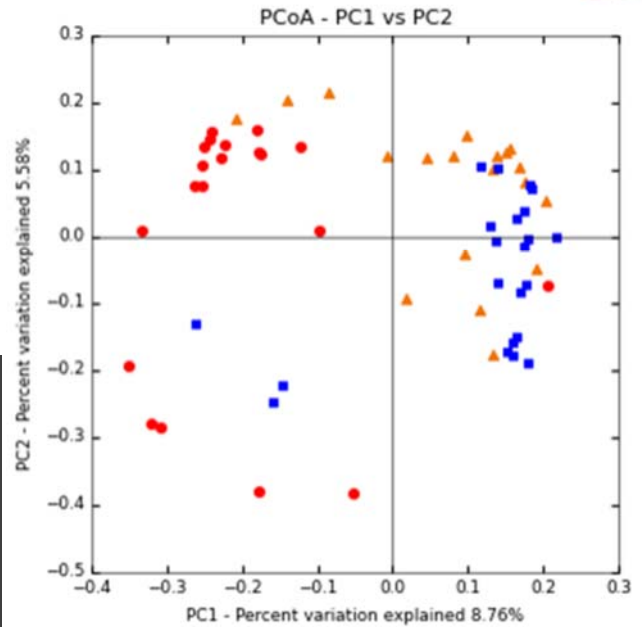
The ovulation/s resulting in abnormal CL are fertile and result in viable embryos. The introduction of an exogenous P4 source results in successful embryo recovery from the uterus, of does with abnormal regressed CL, on days 5-6 following fertilization. Without the exogenous P4 source the embryos are non-recoverable. Paraffin embedded sections, stained with hematoxylin and eosin (H&E) and Masson's Trichrome, reveal a poorly organized cellular architecture in abnormal day 5 CL. Sections processed for IHC to assess markers for progesterone synthesis (anti-HSD3B7), the distribution of M1 (anti-TRAF3) and M2 (anti-CD163/M130) macrophages and the presence of 4-hydroxynonenal (anti 4-HNE), a product of lipid peroxidation, demonstrate staining pattern and intensity differences, when abnormal day 5 CL are compared to normal day 5, 17 and 18 CL. Staining inten
(continued on page 10)

IFRB Postdoctoral Trainee Spotlight



Dr. Poole's research at Texas A&M University will continue to investigate the biological mechanisms associated with reduced fertility in beef cattle. A specific research interest is the relationship between the reproductive tract microbiome and the correlating reproductive hormone and immune changes. Utilizing uterine flush samples for 16S rRNA gene sequencing collected on days -21, -9, and -2 (prior to artificial insemination), preliminary data from the Pohler lab observed a decrease in operational taxonomic units (OTU) leading up to artificial insemination for cows that subsequently establish a pregnancy. Moreover, there was a shift in uterine bacterial diversity over time (Figure 1), potentially in response to hormonal changes leading up to insemination which may have a positive influence on pregnancy outcomes.

Figure 1. Principal coordinate analyses (PCoA) determined significant clustering of uterine samples by day (d) using UniFrac unweighted metrics. Legend: d -21, Orange triangles; d -9, blue squares; d -2, red circles. "Uterine and vaginal bacterial community diversity prior to artificial insemination between pregnant and non-pregnant postpartum cows." Ault et al., 2019a, J. Anim. Sci. doi:10.1093/jas/skz210



This shift in bacterial diversity described may be due to differences in the taxonomic composition of these bacterial communities (Figure 2).

Additionally, resulting pregnant cows have greater uterine concentrations of the anti-inflammatory cytokine, transforming growth factor beta (TGFβ), prior to insemination which has the potential to positively impact fertility. The female reproductive tract is dynamic; constantly undergoing structural and hormonal changes and the results suggest that bacterial communities of the reproductive tract also undergo rapid changes.

The interplay between the microbial community and the reproductive tract is of interest to Dr. Poole and she has submitted both a USDA-NIFA-AFRI Postdoctoral Fellowship and NSF Postdoctoral Research Fellowship in Biology to further investigate this research area.

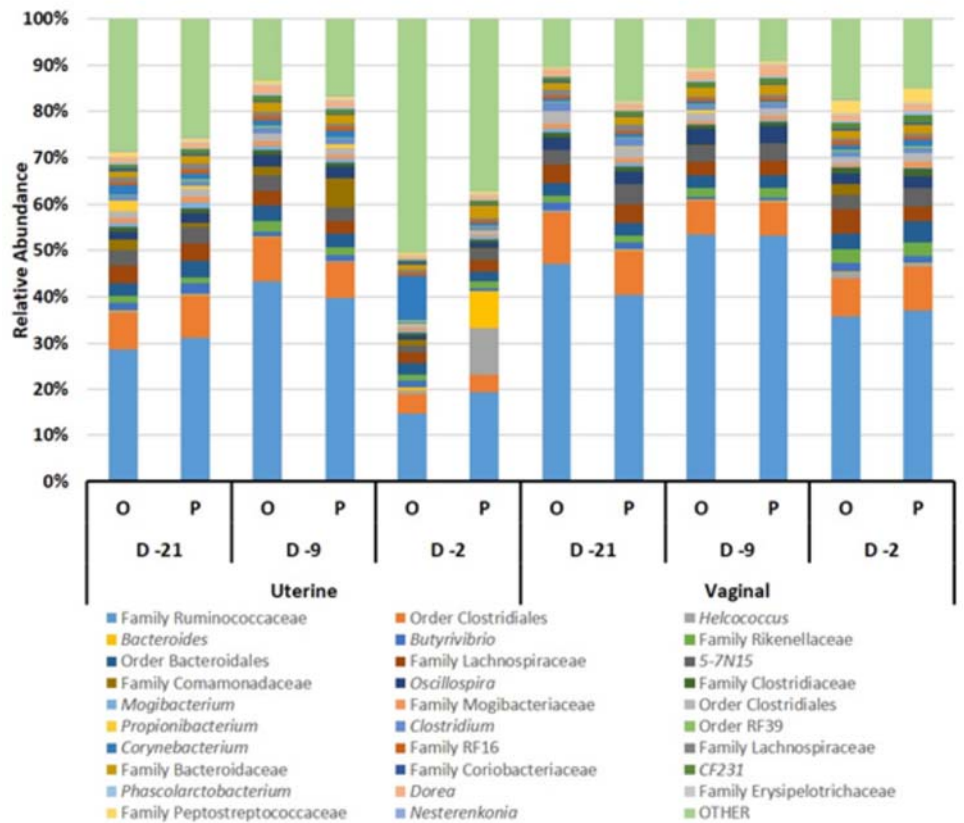


Figure 2. Bacterial relative abundance at the genus level. Samples were grouped by the day, uterus or vagina, and pregnancy status. O represents open cows and P represents pregnant cows. "Bacterial taxonomic composition of the postpartum bovine uterus and vagina prior to artificial insemination." Ault et al., 2019b, J. Anim. Sci. doi:10.1093/jas/skz212

IFRB Seminar Series, 2019



The IFRB Seminar Series, Reproductive Biology Forum, has been held during the Fall and Spring Semesters since 1990. The IFRB Seminar Series is coordinated by **Dr. Sakhila Banu**.

January 18, **Linglin Xie, MD, PhD**, Associate Professor, Dept. of Nutrition & Food Science, Texas A&M University, "From One Carbon to fatty Acid: Maternal High Fat Diet Plays a Transgenerational Effect on Offspring Lipid Homeostasis in the Liver."

January 25, **Kurt Zhang, PhD**, Associate Professor, Center for Epigenetics & Disease Prevention, Institute of Biosciences & Technology, Texas A&M University, "Second Heart Field Cell Migration: An Outflow Track Defects"

February 1, **Claire Stenhouse, PhD**, Post-Doctoral Research Associate, Department of Animal Science, Texas A&M University, "Investigating the Porcine Feto-Maternal Interface: Associations with Foetuses of Different Size and Sex."

February 8, **Stephanie A Pangas, PhD**, Associate Professor, Pathology & Immunology, Baylor College of Medicine, "Wrestling with Reproduction: Novel Roles of Protein SUMOylation in Oocyte Development."

February 15, **Kent Thornburg, PhD**, Professor of Medicine, Director, Institute for Nutrition & Wellness, School of Medicine, Oregon Health and Science University, "The Placenta and Heart Disease: The Big Picture."

February 22, **A. Phillip West, PhD**, Assistant Professor, Microbial Pathogenesis & Immunology, Texas A&M University, College of Medicine, "Mitochondrial Control of Innate Immunity in Health and Disease"

March 1, **Lane Christenson, PhD**, Professor, Department of Molec-

ular & Integrative Physiology, University of Kansas School of Medicine, "A-to-I RNA Editing and its Role in Oocyte and Ovarian Function."

March 8, **John T. Brosnan, DPhil, DSc, FRSC**, Hagler Institute Faculty Fellow, John Lewis Paton Distinguished Professor, Department of Biochemistry, Memorial University of Newfoundland, "Roles of Formate in Reproductive Biology."

March 22, **Richard Pursley, PhD**, Department of Animal Science, Michigan State University, "Key Manipulations of Follicle and Corpus Luteum Development that Improve Pregnancy Rate Per AI in Lactating Dairy Cows."

April 5, **Milan K. Bagchi, PhD**, Deborah Paul Professor of Molecular & Cellular Biology, University of Illinois at Urbana-Champaign, "Molecular Pathways Underlying Maternal Adaption during Implantation."

April 26, **Mahua Choudhury, PhD**, Associate Professor, Irma Lerma Rangel College of Pharmacy, Texas A&M Health Sciences Center, "Environment, Epigenetics, and Endocrinology."

September 20, **Heath Blackmon, PhD**, Assistant Professor, Department of Biology, Texas A&M University, "Sex Chromosome Evolution and Aneuploidy Patterns Suggest an Alternate Explanation for the Evolution of Alternative Forms of Meiosis."

September 27, **Joe Arosh, PhD**, Professor, Department of Veterinary Integrative Biosciences, Texas A&M University, "Chronic Pain in Endometriosis: No Brain-No Pain."

October 4, **Pierre Comizzoli, DVM, PhD**, Senior Program Officer for Science, Office of the Provost for Museums, Education and Research, Smithsonian Institution, Research Biologist, Center for Species Survival, Smithsonian Conservation Biology Institute, "Fertility Preservation and Cryobanking



in Wild Animal Species" October 11, **Rebecca Poole, PhD**, Postdoctoral Research Associate, Department of Animal Science, Texas A&M University, "The Reproductive Microbiome in Beef Cattle."

October 25, **Maris Laan, PhD**, Professor of Human Genetics, Institute of Biomedicine & Translational Medicine, University of Tartu, Estonia. "Genomics of Placenta and Pregnancy Complications."

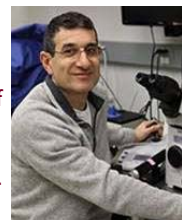
November 1, **Pedro L. P. Fontes, DVM and Nicola Oosthuizen, MS** Graduate Research Assistants, Department of Animal Science, Texas A&M University, "Impact of Fetal Vs. Maternal Contributions of Bos Indicus and Bos Taurus Genetics on Fetal Development and Postnatal Performance" and "The Effect of Resynchronization and Delayed TAI with Sexed Semen on Pregnancy Rates in Beef Heifers."

November 8, **Yuksel Agca, DVM, PhD**, Associate Professor, College of Veterinary Medicine, University of Missouri-Columbia, "Rat Modeling of Ovarian Tissue Cryopreservation and Autografting."

November 15, **Erin D. Giles, PhD**, Assistant Professor, Department of Nutrition & Food Science, Texas A&M University, Targeting 'Menopausal' Weight Gain to Decrease Postmenopausal Breast Cancer Risk: Insights From Preclinical Studies."

November 22, **Mario Binelli, PhD**, Assistant Professor of Physiology, Department of Animal Science, University of Florida, "Insights on the Receptive Uterus of the Cow."

December 6, **Jon Hennebold, PhD**, Professor, Oregon National Primate Research Center Chief, Division of Reproductive & Developmental Sciences Oregon National Primate Research Center, Oregon Health and Science University, "Using Gene Editing and Assisted Reproductive Technologies to Create Nonhuman Primate Disease Models."





TFRS 25th Annual Meeting & Celebration of Dr. Bazer's Scientific Career

***The 25th Annual Texas Forum for Reproductive Sciences regional reproductive biology meeting was hosted by Texas A&M University at The Texas A&M Institute for Preclinical Studies, on April 11-12, 2019.**

Meeting Organizers were **Drs. Greg Johnson and Qinglei Li** from Texas A&M and **Chandra Yallampalli** from the Baylor College of Medicine. The TFRS meeting was held in conjunction with a **"Celebration of Dr. Fuller Bazer's Scientific Career"** that spanned over 50 years following the TFRS meeting organized by **Dr. Greg Johnson**.

Over 90 speakers and participants contributing to two plenary talks, 18 platform lectures and 45 posters at the meeting came from Texas A&M University, Prairie View A&M University, Baylor College of Medicine, University of Texas at San Antonio, and University of Texas Southwestern Medical Center. About a third of the abstracts were submitted by Texas A&M faculty and students.

Dr. Tracy Clement, Assistant Professor, Department of Veterinary Physiology & Pharmacology opened the meeting with a plenary talk for the Thursday afternoon session entitled, "Discovering Spermiogenic Programs for Actin' like a Sperm."

Platform presentations on the first day of the meeting included:

"Mutation of the conserved SUMOylation site in NOBOX leads to premature ovarian aging in mice," Bethany Patton, Dept. of Pathology & Immunology, Baylor College of Medicine, Houston.

"New transcriptomic insights into processes associated with formation of egg-white in the magnum of laying hens, Nirvay Sah, Depts of Food & Animal Sciences, University of Hawaii at Manoa.

"Associations between plasma estradiol concentration, ovarian expression of KI67, P53 and PTGFR mRNAs, and fetal size in the pig," Claire Stenhouse, Dept. of Animal Science, Texas A&M.

"Post-natal glucocorticoids affect GnRH-induced luteinizing hormone in female house sparrows," Grace Jacquelyn, Dept of Animal Science, Texas A&M University.

"Differential RA responsiveness among prospermatogonia in the developing mouse testis," Anukriti Singh, Dept. of Biology, University of Texas at San Antonio.

"Quantification of PAG genes in semen of high and low fertility sires using droplet digital PCR," G.A. Franco, Dept. of Animal Science, Texas A&M University.

"Comparing stallion fertility records with FKBP6 genotype and copy numbers of Y ampliconic genes," Caitlin Castaneda, Dept. of Veterinary Integrative Biosciences, Texas A&M.

"Severe male subfertility and sperm motility defects in

Fam170a KO mouse model," Darius J. Devlin, Dept. of Pathology & Immunology, Baylor College of Medicine, Houston.

Following the poster session, meeting participants attended a Dinner/Social at the Hilton Conference Center in College Station.

Platform sessions on the second day of the meeting included:

"Impact of adrenomedullin blockage on lipid metabolism in female mice exposed to high fat diets," Yuanlin Dong, Department of Obstetrics and Gynecology, Baylor College of Medicine, Houston.



"Porcine conceptuses differentially metabolize glucose and fructose to produce pyruvate and lactate," Avery C. Kramer, Dept. of Veterinary Integrative Biosciences, Texas A&M University.

"The role of glucose and storage temperatures on the stallion sperm quality during cooled storage," C. Hernandez-Aviles, Dept. Large Animal Clinical Sciences, Texas A&M University.

"A high-glucose environment caused congenital limb and heart defects at different embryonic stages," Zehuan Ding, Dept. of Nutrition and Food Sciences, Texas A&M University.

"Mechanobiology of the developing mouse heart," Andrew L. Lopez III, Dept. of Molecular Physiology and Biophysics, Baylor College of Medicine, Houston.



Right: Presentation of a timeline prepared by Dr. Mala Mahendroo listing over 80 Postdoctoral Fellows and Ph.D. Graduate Students in the Laboratory of Dr. Bazer covering 50 years of service as a mentor. Another 44 M.S. trainees were mentored in his lab during this time.

“Quantitative mass spectrometry reveals differential fetal regional rat brain protein signature in FASD,” Raine Lunde-Young, Dept. of Veterinary Physiology & Pharmacology, Texas A&M University.

“Functional interactions between estrogen and relaxin signaling in the myometrium,” Sudeshna Tripathy, Dept. of Obstetrics and Gynecology, UT Southwestern Medical Center, Dallas.

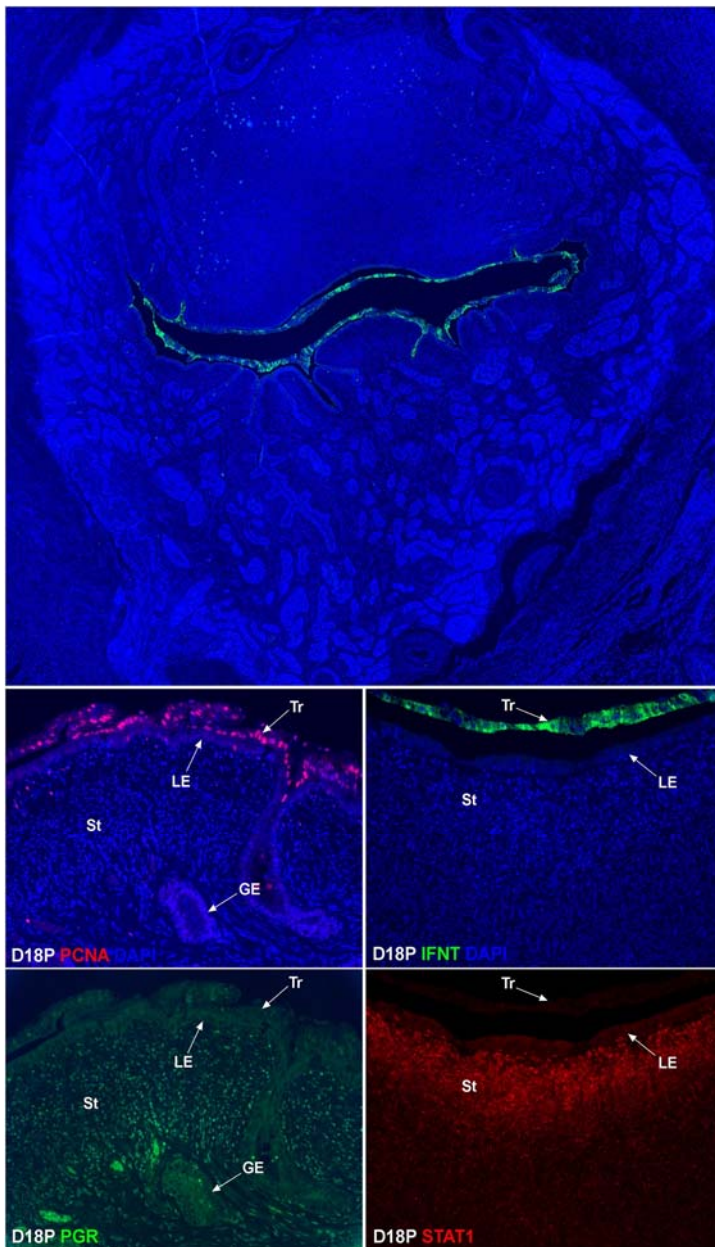
“Prostaglandin profile in pregnant cows during initiation of active placentation,” Sydney Reese, Dept. of Animal Science, Texas A & M.

“SIM2s prevents breast cancer progression by promoting genomic stability and alleviating replication stress,” Scott Pearson, Dept of Veterinary Integrative Biosciences, Texas A&M University.

“Prenatal androgen excess transforms the transcriptome of neonatal murine ovaries,” Liubin Yang, Dept. of Obstetrics and Gynecology, Baylor College of Medicine, Houston.

The second plenary talk was presented by **Dr. Fuller Bazer** at the conclusion of the annual TFRS meeting. The title of his talk was “Snapshots of Research Interests, Results of Research and Collaborations Over the Past 50 years.”

Right: Mechanisms for the Establishment and Maintenance of Pregnancy in Sheep. Top Panel: During early pregnancy in sheep, the mononuclear cells of the placental trophoderm synthesize and secrete interferon tau (IFNT), the signal for maternal recognition of pregnancy. IFNT acts on the endometrial luminal epithelium (LE) and superficial glandular epithelium (GE) to block increases in transcription of estrogen receptor α to preclude estrogen receptor α interactions with SP1 and/or AP-1 that otherwise stimulate oxytocin receptor expression, thereby preventing oxytocin from inducing release of luteolytic pulses of prostaglandin F2 α . Shown is a paraffin-embedded thin section of an elongated, implanting conceptus within the uterine lumen of a Day 18 pregnant sheep that has been immunofluorescence (IF) stained for IFNT (green), and stained with DAPI (blue) for histological reference. Bottom Four Panels: Higher magnification of the same implantation site illustrating 1) Top Left, multiple proliferating conceptus trophoderm cells [PCNA], but few proliferating endometrial LE cells 2) Bottom Left, progesterone receptors (PGR) are expressed by the endometrial stromal cells, but no PGR expression is observed in the luminal or glandular epithelial cells 3) Top Right, IFNT expression by trophoderm cells, and 4) Bottom Right, the classical interferon stimulated gene [signal transducer and stimulator of transcription 1 (STAT1)] expression by cells in the stroma, but no expression of STAT1 by luminal epithelial cells. Figure was commissioned by Dr. Fuller Bazer and conceptualized by Dr. Greg Johnson. IF staining was performed by Dr. Heewon Seo.



Above: Former trainees and collaborators participating in the Celebration (from left to right): Drs. Niamh Forde, Xiaoqiu “Churchill” Wang, Hakhyun Ka, Asgi Fazleabas, William Thatcher, Greg Johnson, Tod Hansen, Fuller Bazer, Rodney Grisert, Jeff Vallet, Skip Bartol, Troy Ott, Tom Spencer, Kathrin Dunlap, Guoyao Wu, Gary Newton, and Shaye Lewis. Drs. Forde traveled from the University of Leeds, United Kingdom and Dr. Ka from Yonsei University, Republic of Korea.

IFRB Trainee News

RECENT GRADUATES

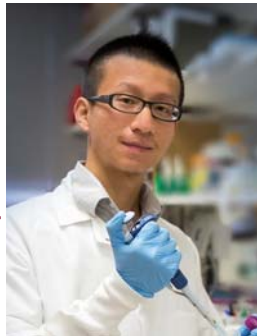
***Pedro L. P. Fontes, DVM, MS, completed the requirements for the PhD degree in Physiology of Reproduction under Dr. Cliff Lamb** in the Animal Science Department. The title of his dissertation was "Impacts of Fetal Versus Maternal Contributions of *Bos indicus* and *Bos taurus* Genetics on Fetal Development and Postnatal Performance." In July of this year he received the 2019 ASAS Wettemann Graduate Scholar in Physiology Award, presented to him during the Physiology and Endocrinology Session III, at the 2019 ASAS-CSAS Annual Meeting held in Austin, Texas. The ASAS Early Career Achievement Award recognizes an individual who has shown outstanding achievement as a young scholar working in the research areas of physiology, endocrinology and/or reproduction. This award is sponsored by the Robert Wettemann Appreciation Club. During his graduate career, Dr. Fontes published 10 manuscripts in peer-reviewed journals, 1 book chapter, 3 conference proceeding, 33 abstracts, and 19 extension articles. In January 2020, Dr. Fontes will be a faculty member in the Department of Animal and Dairy Science at the University of Georgia.



***Dakshnapriya Balasubramanian, MS, completed requirements for the PhD degree in Medical Sciences under Dr. Brett Mitchell** in the Department of Medical Physiology at the Texas A&M University Health Science Center College of Medicine. The title of her dissertation was "Role of Renal Lymphatics in Blood Pressure Regulation During Hypertension." During her graduate program she published 6 manuscripts in peer-reviewed journals, four of which as senior author. She will be joining the laboratory of Dr. Diane Bielenberg at Boston Children's Hospital as a postdoctoral fellow.



***Richard Cheng-An Chang, completed requirements for the PhD degree in Biomedical Sciences under the direction of Dr. Michael Golding.** The title of his dissertation was "Preconception Paternal Alcohol Exposure Has Intergenerational Effects of Offspring Growth and Hepatic Function, Which Persists Across the Life Course." During his graduate program he contributed to 8 manuscripts in peer reviewed journals, 3 of which were as senior author. His recent paper published in *Molecular Metabolism* was featured on the journal website. Richard joined the laboratory of Dr. Bruce Blumberg in the Department of Developmental and Cell Biology



at the UCI School of Biological Sciences, Irvine on September 1, 2019.

***Sydney O'Daniel completed the requirements for the MS in Physiology of Reproduction under the direction of Drs. Tom Welsh (ANSC) and Ron Randel (Overton/ANSC)** and graduated August, 2019. She earned her B.S. degrees in Crop Science and Animal Science at TAMU in 2017. Sydney's thesis research entitled, "Effect of Acute Inflammatory Events and Parity on Length of Telomeres in Brahman Cattle," was conducted in College Station and at the Overton AgriLife Research Center. She now serves as a University of Nebraska Beef Systems Extension Educator located in Webster County, NE.

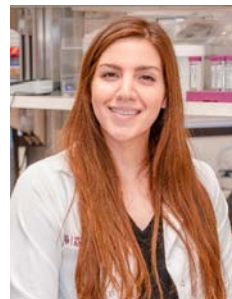


***Ramiro Oliveira completed the requirements for the MS in Physiology of Reproduction under the direction of Dr. Ky Pohler.** He graduated in December 2019. The title of his thesis was: "Novel Challenges and Strategies to Optimize Reproductive Efficiency of Cattle Adapted to Tropical and Subtropical Climates." He is beginning his PhD program with Dr. Pohler.

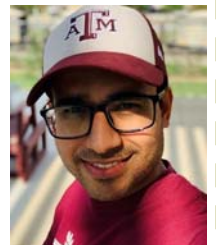


NEW TRAINEES & STAFF

***Nicole Mehta, MSc, PhD** is a new postdoctoral fellow in the lab of **Dr. Mike Golding**. She is from Beaverton, Oregon, where she attended the University of Oregon. Nicole received both her Master's and PhD degrees from Texas A&M University, where her research focused on regenerative medicine and cardiomyocyte differentiation. Nicole's current projects focus on epigenetic changes influencing cardiovascular development and the contribution of preconception or early life alcohol exposures to the development of congenital heart defects.



***Nirvay Sah** is a PhD student in Physiology of Reproduction in the Animal Science Department. He joined the lab of **Dr. Fuller Bazer** in January 2019 after earning an MS in Animal Science from University of Hawaii in 2018 and a DVM in 2016 from Tribhuvan University, Nepal. His research focus on understanding the importance of one-carbon metabolism for sheep conceptus growth during early pregnancy. He teaches the undergrad laboratory for Reproduction in Farm Animals.



(continued on page 12)



Frontiers in
Reproduction
Course:
Molecular and
Cellular Concepts and Applications

<http://www.mbl.edu/fir/>

April 25 to June 7, 2020.

Application
deadline January 16, 2020



A Snapshot of IFRB Research, 2019

The IFRB is recognized as one of the most productive interdisciplinary research and education programs in reproductive biology in the U.S. The following “snapshot” of publications illustrates the multiple investigator research activities of the IFRB, involving extensive participation of trainees during 2019:

- Aceves M, Termino MN, Okoreeh A, Aceves AR, Gong YM, Polanco A, Sohrabji F, Hook MA. Morphine increases macrophages at the lesion site following spinal cord injury: Protective effects of minocycline. *Brain Behav Immun*. 2019 Jul;79:125-138.
- Alshanbari F, Castaneda C, Juras R, Hillhouse A, Mendoza MN, Gutiérrez GA, Ponce de León FA, Raudsepp T. Comparative FISH-Mapping of MC1R, ASIP, and TYRPI in New and Old World Camelids and Association Analysis With Coat Color Phenotypes in the Dromedary (Camelus dromedarius). *Front Genet*. 2019 Apr 16;10:340. doi: 10.3389/fgene.2019.00340.
- Arosh JA, Banu SK. Dual inhibition of ERK1/2 and AKT pathways is required to suppress the growth and survival of endometriotic cells and lesions. *Mol Cell Endocrinol*. 2019 Mar 15;484:78-92. doi: 10.1016/j.mce.2018.12.011.
- Ault TB, Clemmons BA, Reese ST, Dantas FG, Franco GA, Smith TPL, Edwards JL, Myer PR, Pohler KG. Bacterial taxonomic composition of the postpartum cow uterus and vagina prior to artificial insemination I. *J Anim Sci*. 2019 Oct 3;97(10):4305-4313. doi: 10.1093/jas/skz212.
- Ault TB, Clemmons BA, Reese ST, Dantas FG, Franco GA, Smith TPL, Edwards JL, Myer PR, Pohler KG. Uterine and vaginal bacterial community diversity prior to artificial insemination between pregnant and nonpregnant postpartum cows I. *J Anim Sci*. 2019 Oct 3;97(10):4298-4304. doi: 10.1093/jas/skz210.
- Bae H, Lim W, Bazer FW, Whang KY, Song G. Mitigation of ER-stress and inflammation by chemokine (C-C motif) ligand 21 during early pregnancy. *Dev Comp Immunol*. 2019 May;94:73-84. doi: 10.1016/j.dci.2019.01.016.
- Baily MP, Avila F, Das PJ, Kutzler MA, Raudsepp T. An Autosomal Translocation 73,XY,t(12;20)(q11;q11) in an Infertile Male Llama (Lama glama) With Teratozoospermia. *Front Genet*. 2019 Apr 16;10:344.
- Bake S, Okoreeh A, Khosravian H, Sohrabji F. Insulin-like Growth Factor (IGF)-I treatment stabilizes the microvascular cytoskeleton under ischemic conditions. *Exp Neurol*. 2019 Jan;311:162-172.
- Balasubramanian D, Lopez Gelston CA, Lopez AH, Iskander G, Tate W, Holderness H, Rutkowski JM, Mitchell BM. Augmenting Renal Lymphatic Density Prevents Angiotensin II-Induced Hypertension in Male and Female Mice. *Am J Hypertens*. 2019 Aug 20. pii: pz139.
- Balasubramanian D, Goodlett BL, Mitchell BM. Is IL-12 pro-inflammatory or anti-inflammatory? Depends on the blood pressure. *Cardiovasc Res*. 2019 May 1;115(6):998-999.
- Balasubramanian D, Lopez Gelston CA, Rutkowski JM, Mitchell BM. Immune cell trafficking, lymphatics and hypertension. *Br J Pharmacol*. 2019 Jun;176(12):1978-1988.
- Bazer FW, Professor John A. McCracken, PhD, 1935-2019. *Biol Reprod*. 2019 Apr 1;100(4):863-864. doi: 10.1093/biolre/iox018.
- Bedi Y, Chang RC, Gibbs R, Clement TM, Golding MC. Alterations in sperm-inherited noncoding RNAs associate with late-term fetal growth restriction induced by pre-conception paternal alcohol use. *Reprod Toxicol*. 2019 Aug;87:11-20. doi: 10.1016/j.reprotox.2019.04.006.
- Brom-de-Luna JG, Salgado RM, Canesin HS, Diaw M, Hinrichs K. Equine blastocyst production under different incubation temperatures and different CO2 concentrations during early cleavage. *Reprod Fertil Dev*. 2019 Oct 23. doi:10.1071/RD19211.
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- Cardoso RC, Padmanabhan V. Developmental Programming of PCOS Traits: Insights from the Sheep. *Med Sci (Basel)*. 2019 Jul 11;7(7). pii: E79. doi: 10.3390/medsci7070079.
- Castaneda C, Juras R, Khanshour A, Randlaht I, Wallner B, Rigler D, Lindgren G, Raudsepp T, Cothran EG. Population Genetic Analysis of the Estonian Native Horse Suggests Diverse and Distinct Genetics, Ancient Origin and Contribution from Unique Patrilineal Genes (Basel). 2019 Aug 20;10(8). pii: E629. doi:10.3390/genes10080629.
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- Chatterjee S, Walsh EN, Yan AL, Giese KP, Safe S, Abel T. Pharmacological activation of Nr4a rescues age-associated memory decline. *Neurobiol Aging*. 2019 Oct 14. pii: S0197-4580(19)30356-2. doi: 10.1016/j.neurobiolaging.2019.10.001.
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- Fan X, Li S, Wu Z, Dai Z, Li J, Wang X, Wu G. Glycine supplementation to breast-fed piglets attenuates post-weaning jejunal epithelial apoptosis: a functional role of CHOP signaling. *Amino Acids*. 2019 Mar;51(3):463-473. doi: 10.1007/s00726-018-2681-9.
- Fang X, Ni N, Lydon J, P., Ivanov I, Bayless K, J., Rijnkels M., & Li Q. (2019). Enhancer of Zeste 2 Polycomb Repressive Complex 2 Subunit Is Required for Uterine Epithelial Integrity. *AMERICAN JOURNAL OF PATHOLOGY*. 189(6), 1212-1225.
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- Filho RVO, Franco GA, Reese ST, Dantas FG, Fontes PLP, Cooke RF, Rhinehart JD, Thompson KW, Pohler KG. Using pregnancy associated glycoproteins (PAG) for pregnancy detection at day 24 (continued on page 15)



Faculty Spotlight, Dr. Foxworth (cont'd from page 3)

Caprine Corpus Luteum - TRAF3 Macrophage (M1)

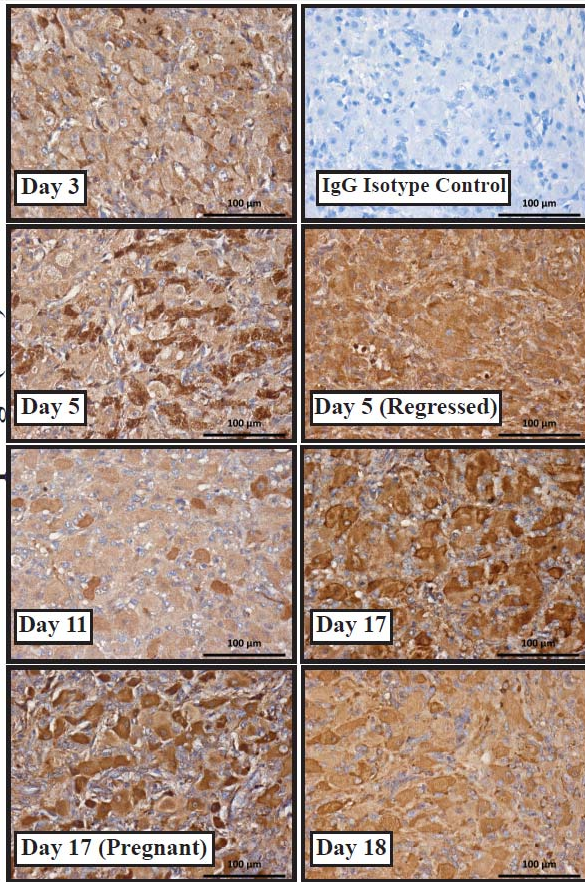
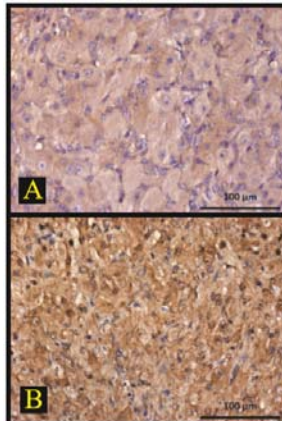


Figure 2. (above) Immunohistochemical (IHC) staining for M1 macrophages with anti TRAF-3 antibody is strong on day 17 in normal CL and in abnormal day 5 CL.

Figure 3. (below) IHC staining for 4-HNE showing the presence of lipid peroxidation. Day 5 cycling (A) and abnormal abnormal regressing CL (B).

sity for HSD3B7 is stronger in normal day 5 and day 17 CL when compared to normal day 18 CL. Staining in abnormal day 5 CL is weak and diffuse. Staining for M1 macrophages is strong on day 17 and in abnormal day 5 CL (**Figure 2**), while staining for M2 macrophages is most intense in the normal day 5 CL. Therefore, abnormal day 5 CL present reduced steroidogenesis and contain macrophages that are associated with luteolysis (M1), rather than a luteotropic environment (M2).

IHC for 4-HNE demonstrates the presence of lipid peroxidation in the CL of abnormal regressing day 5 and not normal cycling day 5 (**Figure 3**).



The group's transmission electron microscopy (TEM) studies with day 5 normal cycling and abnormal regressing caprine CL have shown that the large luteal cells (LLC) in the normal cycling day 5 CL are intact and appear structurally normal, whereas the LLC in the abnormal regressing CL appear collapsed and are undergoing some form of degradation with lysosomes (**Figure 4**).

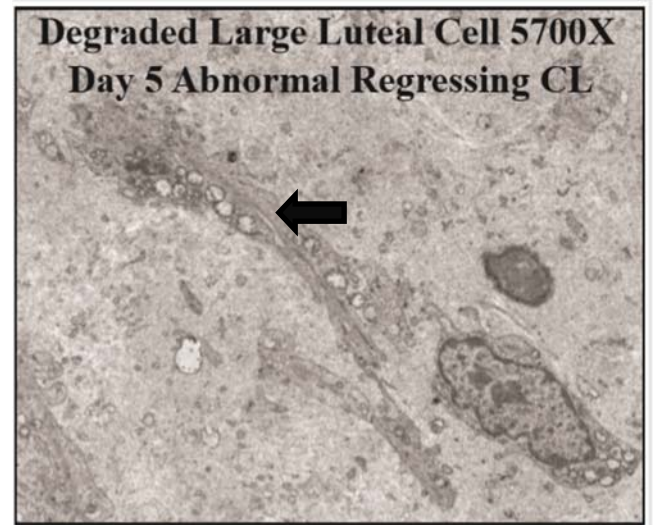
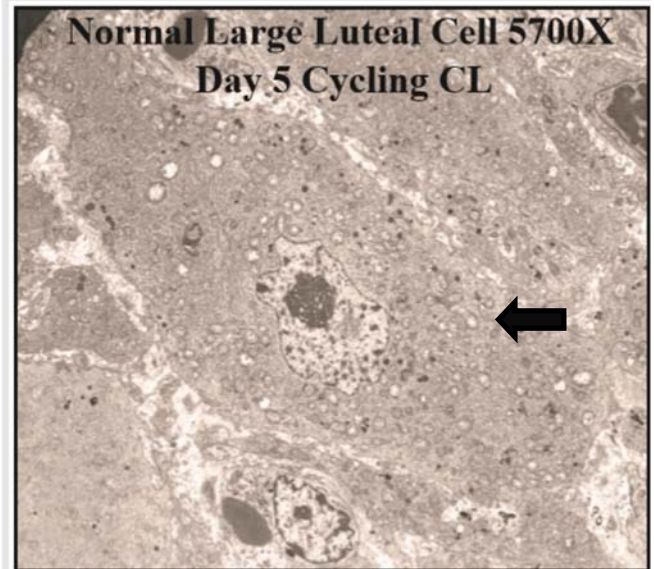


Figure 4. Comparison of normal and degraded large luteal cells (arrows) in electron micrographs of normal Day 5 cycling CL (top panel) and Day 5 abnormal regressing CL.

(continued on page 16)

25th Annual Dr. Raymond O. Berry Memorial Lecture

The Twenty-Fifth Annual Dr. Raymond O. Berry Memorial Lecture, sponsored and organized by the Interdisciplinary Faculty of Reproductive Biology, was held at Prairie View A&M University, on October 18, 2019. Elizabeth A. Bonney, MD, MPH, Professor and Head, Division of Reproductive Sciences, Department of Obstetrics, Gynecology and Reproductive Sciences, College of Medicine, University of Vermont was selected to present the Lecture entitled "A Theory of Maternal Immunity."

Professor Bonney received her B.S. in Chemical Engineering from the University of Minnesota and then served as a Medical Student Scholar in the Department of Medicine at the Stanford University Medical School before receiving her M.D. from Stanford University Medical School and the Masters of Public Health from the Harvard School of Public Health. Her postdoctoral training was as an Intern and later a Resident in Obstetrics and Gynecology Brigham and Women's Hospital and Massachusetts General. Professor Bonney also conducted research in the laboratories of Drs. Joseph A. Hill and Deborah J. Anderson, Dept. of Obstetrics and Gynecology, and Reproductive Biology, Harvard Medical School. Later, she served as a Research Associate in both the Lymphocyte Biology Section, Laboratory of Immunology, and the Laboratory of Cellular and Molecular Immunology in the National Institute of Allergy and Infectious Diseases of the National Institutes of Health. After serving as a Clinical Fellow in Obstetrics, Gynecology and Reproductive Biology, Harvard Medical School and Staff Obstetrician and Gynecologist at Prince George's Hospital Center, Cheverly, Maryland, Professor Bonney joined the faculty of the Department of Obstetrics and Gynecology at Emory University and then the faculty of the Department of Obstetrics and Gynecology and Reproductive Sciences at the University of Vermont.

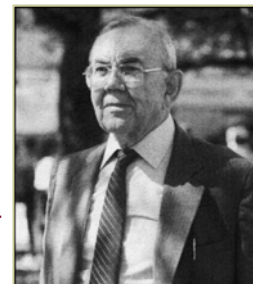
Professor Bonney's research focus is on maternal immunity with particular interests in maternal immune response to fetal and exogenously acquired antigens, feto-maternal cellular trafficking, preterm birth, antiviral immunity during pregnancy, developmental functions of cytokines in pregnancy, diversity of dendritic cells in reproductive states, maternal influence on neonatal immunity, interactions between maternal immune and vascular systems and fetal membrane biology. Her research is funded by grants from the NIH, the March of Dimes and the University of Vermont. Results of her research have been published in more than 35 referred scientific journals, 20 scientific commentaries, 4 book chapters, as well as 45 abstracts of papers presented at national and international scientific meetings. Those are in addition to numerous presentations at national and international conferences, lectureships, seminars and visiting professorships. Professor Bonney is very active as a mentor for undergraduate and graduate students,



postdoctoral fellows and clinical fellows, as well as medical students and residents.

Professor Bonney's service to the scientific community includes membership on the National Institute of Child Health and Development Board of scientific counselors, Advisory Board of the American Society for Reproductive Immunology, Secretary-General of the Pre-Term Birth International Collaborative, and reviewer of grants for NIH's study sections on Human Embryology and Development, Cellular and Molecular Integrative Reproduction, Infectious Disease, and Reproductive Health, Asthma, and Pulmonary Epidemiology, as well as the Medical Research Council of England, Burroughs Wellcome Fund, and the American Heart Association. In addition, Professor Bonney is actively engaged in her professional societies, and outreach and community service.

For her outstanding contributions, Texas A&M University recognizes the work of Dr. Bonney through the Raymond O. Berry Memorial Lecture which was established in 1994 by Dr. Fuller W. Bazer. This Lecture Series ensures that his contributions will continue to inspire students and faculty whose application of biotechnology to the field of reproductive biology contributes to animal agriculture and impacts the biomedical community. Dr. Berry's pioneering studies of genetic factors affecting reproduction contributed basic knowledge about maternal immune recognition of the fetal-placental unit. These principles are now fundamental to the discipline of reproductive immunology.



"Dr. Berry's pioneering studies contributed basic knowledge about maternal immune recognition of the fetal-placental unit."

-Fuller W. Bazer

Below: Meeting organizers and presenters (left to right), Drs. Ky Pohler, Greg Johnson, Gary Newton, Bill Foxworth, Fuller Bazer, Dr. Elizabeth Bonney and members of Dr. Berry's family (granddaughter, daughter, M Carl Thompson, son-in-law, Mrs. Dorothy McLemore, Dr. Berry's daughter and Dr. Joe McLemore, (son-in-law). For the past 24 years, Dr. Duane Kraemer, who worked with Dr. Berry during his early years as a graduate student, has led off the Lecture by providing an entertaining presentation that included memories of Dr. Berry. This year, Dr. Kraemer was unable to attend, Dr. Bill Foxworth, a former trainee of Dr. Kraemer, presented comments on some of Dr. Berry's contributions.





***Viviana Garza** who holds B.S. and M.S. degrees in Animal Science from Texas A&M University-Kingsville will begin PhD program (Physiology of Reproduction) in spring semester, 2020 under mentorship of **Drs. Gary Williams and Rodolfo Cardoso** and will focus on nutritional programming of puberty in heifers at the neuroendocrine level.

***Kara Thomas** received her MS degree from Texas A&M University, where her work focused on the application of assisted reproductive technologies to livestock production. After working in the bovine IVF industry, Alexis is now pursuing her PhD in **Dr. Golding's lab**. Her research focuses on defining the interactions between alcohol consumption, the microbiomes of the GI and male reproductive tract, and paternally-inherited alterations in developmental programming.

***Payal Shah** is a new Ph.D. student with



Dr. Annie Newell-Fugate. She earned a MS in Endocrinology along with an Advanced Diploma in Clinical Research. She has a strong background in reproductive endocrinology and developmental biology. Payal is also a recipient of the TAMU CVM Diversity Fellowship. Payal's research goal is to investigate the impact of diet-induced obesity on ovarian and oocyte health and metabolism.

***Kadden Kothmann** is a new technician with **Dr. Newell-Fugate**. He graduated *summa cum laude*

with a B.S. in Biomedical Sciences from Texas A&M in May 2019. Kadden previously worked at the Texas Veterinary Medical Diagnostic Laboratory for two years as an undergraduate student. He has an interest in equine reproductive physiology/endocrinology and volunteers in the laboratory of **Dr. Hinrichs** assisting with oocyte sorting and selection for ICSI. Kadden is currently applying for Ph.D. programs with a focus on ovarian and oocyte physiology.

***Audrey Earnhardt** is a new Ph.D. student supported by a COALS Excellence Fellowship and mentored by **Drs. Tom Welsh and Ron Randel**. Audrey, earned her B.S. and M.S. degrees (Animal Science) in 2017 and 2019, respectively, from North Carolina State University. Her thesis research was conducted at Smithfield Premium Genetics and focused on the genetics of functional teats in swine. As a doctoral student Audrey has initiated her

research at the Overton Center and in College Station. She is studying the effect of prenatal transportation stress on the adrenal gland and postnatal immune function of Brahman calves. In addition, she is examining the influence of sire, dam and seasonality on age at first calving in Brahman heifers.

***Dr. Matheus Felix** recently rejoined **Dr. Katrin Hinrichs'** lab as a Research Assistant working on methods for oocyte recovery via transvaginal ultrasound-guided follicle aspira-



tions in mares, intracytoplasmic sperm injection and equine sperm capacitation. Dr. Felix obtained his DVM Brazil in 2017. While working on his DVM, he completed internships in Large Animal and Animal Reproduction Federal University of Lavras under the supervision of Professor Dr. Flamarion Tenório de Albuquerque with emphasis in pathophysiology of reproduction followed by one at Equine Embryo Laboratory, Texas A&M University, with Dr. Katrin Hinrichs.

***Dr. Luisa Ramirez-Agamez**, a visiting intern working in the laboratory of Dr. Katrin Hinrichs conducting a project on the effect of different energy sources on motility characteristics and acrosome reaction on equine sperm. She was originally from Bogotá, Colombia, where she attended the National University of Colombia graduating with a DVM degree in 2017. Her research interests are focused on equine theriogenology, with emphasis in assisted reproductive technologies in the mare, and sperm physiology.

GRDUATE STUDENT AWARDS

***Dr. Brittini P. Littlejohn** was the recipient of the 2019 ASAS Agri-King Outstanding Animal Science Graduate Student

Award, presented to her during the Physiology and Endocrinology Session II, at the 2019 ASAS-CSAS Annual Meeting Austin, Texas. Dr. Littlejohn is currently a Postdoctoral Associate in the Department of Animal and Dairy Sciences at Mississippi State University. She earned a PhD degree in Physiology of Reproduction with **Drs. Tom Welsh and Ron Randel**. Her graduate work focused on the influence of prenatal transportation stress on postnatal physiology in

cattle.

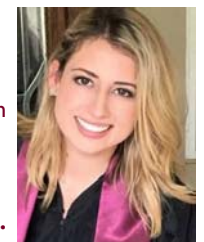
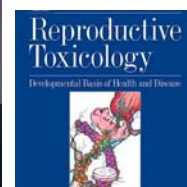
***Sarah West**, MS Student in the laboratory of **Dr. Rodolfo Cardoso** received a 2019 Charles Robertson Graduate Scholarship from the Department of Animal Science, Texas A&M University.

***Raine Lunde-Young**, doctoral student the laboratory of **Dr. Jay Ramadoss** in the department of Veterinary Physiology & Pharmacology was awarded a F31 predoctoral grant from the National Institutes of Health (NIH), National Institute on Alcohol Abuse and Alcoholism, "Brain Circulatory Adaptations of Fetal Alcohol Spec-

trum Disorders,

***Dr. Yudishtar Bedi's** paper "Alterations in sperm-inherited noncoding RNAs associate

with late-term fetal growth restriction induced by pre-conception paternal alcohol use." was the over article in the August 2019 issue of *Reproductive Toxicology*.





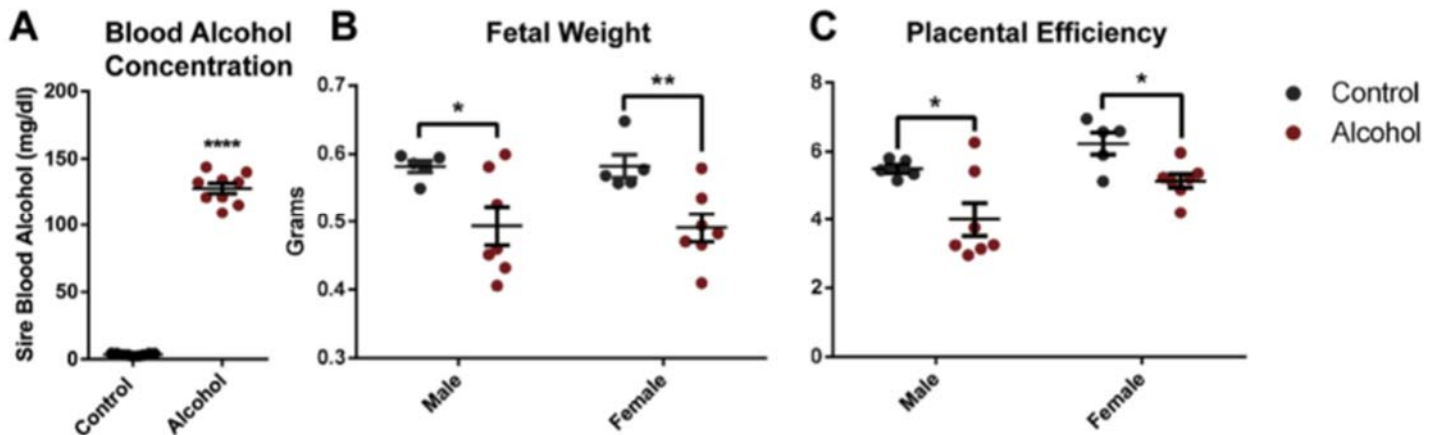
IFRB Graduate Student Spotlight

***Alexis Roach** is a first year Ph.D. student in the Department of Veterinary Physiology and Pharmacology mentored by Dr. Michael Golding. She received her MSc. in Physiology of Reproduction from Texas A&M where she concentrated on assisted reproductive technologies using biological acids and polyols for livestock reproduction extenders. Before joining Dr. Golding's lab in August of 2019, she worked in the research and development department where she was a product engineer for STgenetics in Navastoa, Texas. Alexis' research focuses on defining the interactions between alcohol consumption, the microbiomes of the gastrointestinal (GI) and male reproductive tract, and paternally-inherited alterations in developmental programming. Alcohol (ethanol, EtOH) exposure creates dysbiosis and bacterial overgrowth in the GI tract which can lead to tract inflammation, alcoholic liver disease, and other parthenogenic complications. Alexis is using the microbiome in the EtOH treated GI tract as a precursor to examine the microbiota and metabolite presence within the EtOH exposed seminal plasma. Epigenetic research from Dr. Golding's lab, using a mouse model, has demonstrated that male alcohol consumption influences the development of fetal alcohol spectrum disorders (FASDs), which include physical and mental defects. Prior to conception, alcohol affects male gamete small non-coding RNA that causes low placental efficiency in utero, restricted growth, and metabolic complications in a sire's offspring. Alexis' current mouse model study uses applied RNA sequencing and liquid chromatography mass



spectrometry of the GI tract microbiomes between males exposed to chronic EtOH consumption and naïve males. Her research theory is centered around the utilization of metabolites from the seminal vesicles by the spermatozoa. She speculates that the EtOH changes the quantity and families of both the microbiota and metabolites in the seminal plasma which could alter the small non-coding RNA profile inside the acrosome. This could result in affecting the conceptus in vivo, and this study will potentially show how FASDs are interrelated to the seminal plasma.

Alexis continues to apply her past industry experience to strengthen her critical thinking skills and develop research strategies. Her master's research is patent pending and is currently being applied in industry products. She finds it beneficial to combine her academic and industrial perspectives in her data collection and analysis, presentations, and in the classroom. Alexis takes great pleasure working as a graduate research assistant in the Golding laboratory where she is excited to continue gaining irreplaceable experiences and passing down discoveries down to future researchers. When Alexis is not in the lab, she enjoys the outdoors where she likes to hike, hunt, and fish. She is looking to establish her committee in the spring of 2020 with researchers who are interested in epigenetics, reproduction, microbiology, or small non-coding RNA. Alexis' ultimate goal is to return to industry in a research leadership capacity after learning the basic and signaling mechanisms of spermatozoa and how treatments and environmental exposures impact them on a molecular level.



Preconception paternal alcohol exposure causes reduced fetal weight and placental efficiency. Mean blood alcohol concentrations were evaluated using an unpaired t-test between alcohol-exposed and control sires (n=9) where alcohol levels averaged 127 mg/dL (A). The matings between alcohol-exposed males (n=7) and naïve females produced growth-restricted offspring, separated by sex at gestational day 16.5, compared to litters sired by control males (n=7) (B). Each gram of fetus produced per gram of placenta defines placental efficiency, and fetal pups sired by alcohol-exposed males displayed a significant reduction in placental efficiency (C). Comparisons between offspring and their measurements were conducted using a two-way ANOVA. SEM is represented by error bars; data points with distinct asterisk superscripts are different at *P<0.05, **P<0.01, and ***P<0.0001. From Chang et al. *Mol. Metab.* 2019 Sept 29; (30): 31767168.

IRFB Faculty Activities, Awards, etc.

NEW GRANTS:

***Dr. Qinglei Li** (PI), received a new R03 grant from the National Cancer Institute entitled “A novel mouse model of testicular granulosa cell tumors.” 12/1/19 - 11/30/21.



***Dr. Michael C. Golding** (PI) with Co-PIs, **Drs Tracy Clement and Ivan Ivanov**, received a W.M. Keck Foundation Medical Research Grant, “Paternal contributions to fetal alcohol spectrum disorders: questioning the prevailing paradigm.” 7/1/19 - 7/01/23, \$1,387,403.



***Dr. Terje Raudsepp** (PI) with Co-PIs, Drs. Brian Davis and Rytis Juras received a USDA-AFRI Grant, “Refining the sequence and annotation of complex regions in the horse sex chromosomes to enhance knowledge of functionally important genes.” 5/1/19 - 04/30/22.



***Dr. Raudsepp** (PI) with Co-PIs Drs. Ahmed Tibary, Brian W. Davis, Rytis Juras, Jan Janecka received a Morris Animal Foundation Grant, Identification of Y chromosome regions critical for stallion fertility. 2/28/19-2/27/22.

***Dr. Raudsepp** was also a Collaborator on a grant, “Unraveling the genetic basis of congenital sensorineural deafness in blue-eyed white alpacas.” (Felipe Avila, PI) from the Alpaca Foundation. 9/1/19-8/31/22.

***Drs. Thomas H. Welsh, Jr, Rodolfo Cardoso, Ron Randel, Penny Riggs, David RILEY** (Co-PIs) received a grant from USDA-AFRI entitled, “ Prenatal Stress Modulation of the Hypothalamic-Pituitary-Adrenal Axis.” 5/1/19 - 4/30/22, \$251,000.

***Drs. Ky G. Pohler and Juliano da Silveira** received a Sprint TAMU/FAPESP grant, “International consortium for study of serum extracellular vesicles during early embryonic development in livestock species. 2019-21.



Drs. Pohler (PI), **Jose Vasconcelos and Ronaldo Cerri** (Co-PIs) received a grant from Select Sires, “Paternal contribution to pregnancy loss in cattle.2019-21.

Drs. Pohler, Greg Johnson and David Forest received a TAMU T3 grant, “Paternal effect on pregnancy establishment and maintenance in cattle.” 2019-2021.

Drs. Washburn, Cardoso, and Cook received a TAMU T3 grant, “Novel biomarkers to predict fertility in cattle” 2019-2012.

Drs. Pohler, Susanta Behura, Matt Lucy and John Cole (Co-Is) with **Tom Spencer** (PI) received an NIH/USDA Dual Purpose with Dual Benefit Grant “Physiological and genetic insights into pregnancy loss.”2019-2024.

***Dr. Joe Arosh**, received an USDA AFRI grant, “Epigenetic Regulation of Progesterone Receptor-B in the Endometrium During Luteolysis in Ruminants.” 7/1/19 - 7/01/23, \$500,000.

***Dr. Bill Foxworth** (PI) received a USDA,NIFA Grant , “Incompetent Caprine Corpora Lutea: Abnormal Luteal Regression During Metestrus.” 2020-2023, \$200,000.

AWARDS & HONORS:

***Dr. Qinglei Li** joined the NIH Study Section-Cellular, Molecular and Integrative Reproduction (CMIR) as a regular member (2019-2023).

Dr. Li also served as a chairperson for the 2019 Texas Forum for Reproductive Sciences held at Texas A&M

***Dr. Duncan MacKenzie** was the recipient of two awards including an Association of Former Students University-level Distinguished Achievement Award for Teaching and the



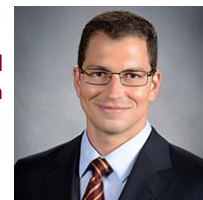
Wells Fargo Honors Faculty Mentor of the Year Award from the TAMU Honors Student Council in September.

***Dr. Annie Newell-Fugate** received the 2019 Janice Bahr Junior Scientist Travel Award at the 53rd Annual Meeting of the Annual Society for the Study of Reproduction Meeting held in San Jose, CA. The title of her invited talk was “DVM PCOS and Metabolic Dysfunction: Is It All About Androgens?”



Dr. Newell-Fugate also received the CVM 2019 Outstanding Young Faculty Research Award..

***Dr. Rodolfo Cardoso**, Assistant Professor in the Department of Animal Science, received the 2018 Dr. William A. Dugas Early Career Award for Research Excellence from Texas A&M AgriLife Research. The award honors an early career AgriLife Research Faculty member, who has “made an exceptional contribution to the agency and research in the prior year



***Dr. Dana Gaddy** received the 2019 Excellence in Mentorship Award in recognition of outstanding support provided by a senior scientist who has helped promote the independent careers of young investigators in bone and mineral metabolism.



INVITED LECTURES

***Dr. Newell-Fugate** presented the following invited talks:

“The battle of the sexes: androgens and estrogens in control of white adipose tissue metabolism” at the Symposium: The role of sex steroids in metabolic health and disease, Organization for the Study of Sex Differences, Washington, DC, May 6, 2019.

“Toward a better planet: one trainee at a time,” Toward a Better Planet Symposium, NC State University Libraries, Raleigh, NC, June 6, 2019.

(continued, on page 18)

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Faculty Spotlight, Dr. Foxworth (cont'd from page 8)

RNA sequencing of day 5 normal cycling and day 5 abnormal regressing caprine CL suggest a number of interesting avenues to better understand the mechanism of fate determination of the caprine CL during metestrus (Table I). The data strongly suggests that,

abnormal regressed caprine CL appears to utilize a different mechanism than normal luteolysis in ruminants.

Dr. Foxworth recently received USDA funding to investigate the hypotheses that: 1) high resolution ultrasound imaging, using 3D/4D and real time Doppler tech-

Area	Genes
Steroidogenesis	STAR ↓ 3BHSD ↓ 17BHSD7 ↓ 17BHSD11 ↑
Oxidative Stress	TXNIP ↑ TXN ↓ GDF15 ↑ CAT ↑ SOD1 ↓ SOD3 ↑ COX2 ↓ SCARA3 ↑
Autophagy	SQSTM1 ↑
Ferroptosis	GPX4 ↓ FPN ↑ DMT1 ↓
Apoptosis	BCL2 ↑ TNFRSF19 ↑

along with downregulation of genes related to steroid production and angiogenesis, there is an upregulation of genes related to oxidative stress and programmed cell death. Notably, the programmed cell death appears to be related to autophagy and ferroptosis. The down regulation of GPX4 reduces the only known peroxidase capable of reducing phospholipid hydroperoxides within cell membranes thus inhibiting ferroptosis. The functional and structural luteolysis process of the day 5

nology, in conjunction with circulating hormone metabolome analysis can identify proestrus follicles in the goat that are fated to develop into subnormal CL that abnormally regress by day 5 of the estrous cycle and 2) comparative proteomics, using LC-MS/MS, of caprine CL from normal cycling day 5, 17 and 18 and abnormal regressing day 5 will identify the proteins involved in the functional and structural luteolysis of the normal and subnormal CL.

Dr. Thomas Spencer Elected to National Academy of Sciences

*Dr. Thomas Spencer, a former IFRB faculty member in the Department of Animal Science, was elected as a member of the National Academy of Sciences (NAS) in April, 2019. Membership in the NAS is considered one of the highest honors a U.S. scientist can receive.

Dr. Spencer grew up in Auburn, Alabama. He graduated from Auburn University with a B.S. and M.S. in Animal and Dairy Sciences and earned a Ph.D. at Texas A&M University in Physiology of Reproduction Texas A&M University in 1995 in the lab of Dr. Fuller Bazer. Following postdoctoral research in molecular and cell biology at Baylor College of Medicine in Houston, Texas, he joined the faculty of Texas A&M University-College Station, where he rose to the rank of Full Professor. In 2015, he joined the University of Missouri-Columbia, where he was named a Curators' Distinguished Professor of Animal Sciences and Obstetrics, Gynecology and Women's Health in 2018. Spencer has actively served the scientific community as a member of the NIH Pregnancy and Neonatology study section, chair of the Gordon Research Conference on Reproductive Tract Biology, faculty in the Frontiers in Reproduction course, and various leadership roles in the Society for the Study of Reproduction. He has received



numerous awards, including the Society for the Study of Reproduction Research Award (2013) & Trainee Mentoring Award (2016). He is also a fellow of the American Association for the Advancement of Science.

Dr. Spencer's laboratory seeks to define critical physiological and genetic pathways that regulate uterine development, function, and regeneration in order to improve reproduction and health of women and animals. His earlier work established that the glands of the uterus are essential for embryo survival and growth using the ovine uterine gland knockout model. Subsequent research revealed fundamental aspects of postnatal uterine development and uterine receptivity as well as illuminated the evolutionary biology and functional role of endogenous retroviruses in placental development. Current research foci in his lab include: cellular and molecular mechanisms governing development of the uterus; biological role of extracellular vesicles (exosomes and microvesicles) in uterine function; maternal and paternal regulation of pregnancy establishment in cattle; placental development in domestic animals; development of animal models to study uterine function; and biological roles of uterine glands and their products in uterine receptivity,

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(continued on page 19)

Faculty Activities, cont'd from page 14

"Sex steroids and dietary fat in control of metabolism, Stellenbosch University, Department of Biochemistry, Stellenbosch, South Africa, October 21, 2019.

"Sex steroids and dietary fat in control of metabolism," Oregon National Primate Research Center, Portland, Oregon, November 14, 2019.

***Dr. Greg Johnson** was an invited lecturer at the D.H. Barron Reproductive and Perinatal Biology Research Program, as the D.H. Barron Lecturer. "Metabolic and Histologic Adaptation to the Hypoxic Environment of Placentation in Pigs and Sheep, University of Florida, March 13, 2019



***Dr. Qinglei Li** gave an invited lecture entitled "Dysregulation of TGF-beta Signaling and Ovarian Cancer" at the College of Veterinary Medicine & Interdisciplinary Toxicology Program. The University of Georgia. Athens, GA.



***Dr. M. Carey Satterfield** gave an invited lecture, Understanding Placental Adaptation to Maternal Malnutrition" at a Placental Adaptations to Adversity Focus Session during the 53rd Annual Meeting of the Annual Society for the Study of Reproduction Meeting held in San Jose, CA.

***Dr Jay Ramadoss** received a CVM 2019, Zoetis Award for Veterinary Research Excellence.

***Dr Shannon Washburn** received a CVM 2019, Richard H. Davis Teaching Award.

INTERNATIONAL ACTIVITIES & LECTURES

***Dr. Chuck Long** spent 3 months (October-November) as a Visiting Fellow of the Indo-U.S. Genome Engineering/Editing Technology Initiative (GETin) Program. During the fellowship he participated in a hands-on Workshop "CRISPR Editing in Mammalian Cells and Embryos" November 4-9 in the ICAR-Central Institute for Research on Buffaloes (CIRB), Hisar, Haryana, India.

***Dr. Fuller Bazer** presented invited lectures entitled, "Nutrients in Histotroph for Conceptus Survival, Growth and Development. At Wuhan Polytechnic University, May 26, 2019 and at the World Laureates Sanya Forum and Sanya Academician Association Inaugural Meeting Sanya, China, May 22-23, 2019. He was also a Member of the Panel Discussion Modern Agriculture and Ecology Industry at the same meeting.

***Dr. Terje Raudsepp** and co-authors, Caitlin Castaneda, Andrew Hillhouse, Alyssa Dubrow, Matt Jevit, Rebecca Bellone, Rytis Juras, Brian Davis, presented "The horse X chromosome: old tricks, new insights" at the 37th International Society for Animal Genetics Conference, July 7-12, 2019 Lleida, Spain.

***Dr. Katrin Hinrichs** presented the following lectures, "Oocytes and ICSI - State of the art" and "Cloning in horses" Sport Horse Breeders Programme and "Translating ART research to clinical practice" at the Irish Equine Reproduction Symposium, October 12 and 13, 2019, Kildare, Ireland,

Dr. Hinrichs also presented "Standard in vitro fertilization in the horse - a challenge yet to be met," Flanders Training Workshop for Life Science (f-TALES), Sept.18, 2019, Ghent, Belgium.

***Dr. Greg Johnson** gave invited presentations, "A controlled

inflammatory environment supports restructuring of endometrium and placenta for implantation and placentation in pigs, at the Hubei Key Laboratory of Animal Nutrition and Feed Science, Wuhan Polytechnic University, Wuhan, China and at Zhejiang Ocean University, Zhejiang, China

BOOKS & BOOK CHAPTERS

***Drs. Fuller Bazer, G. Cliff Lamb, and Guoyao Wu** edited and contributed chapters to a new book "Animal Agriculture: Sustainability, Challenges and Innovations" published by Academic Press in October.

Contributing faculty members from the Department of Animal include Drs. Fuller Bazer, Cliff Lamb, Ky Pohler, Stephen Smith, Luis Tedeschi, Travis R. Whitney and Guoyao Wu.

Contributing graduate students are Pedro Fontes, Hector Manuel Menendez, III, and Nicola Oosthuizen. Dr. Patrick Stover (Vice Chancellor and Dean for Agriculture and Life Sciences and Director, Texas A&M AgriLife Research) wrote a forward for the

book emphasizing the importance of animal agriculture in improving human nutrition and health. Chapters contributed by IFRB members included:

***Wu, G., F.W. Bazer, and G.C. Lamb.** Introduction: Significance, challenges and strategies of animal production. In: *Animal Agriculture: Sustainability, Challenges and Innovations*, Eds. Bazer FW, Lamb GC, Wu, G. Academic Press, Waltham, MA, pp. 1-20.

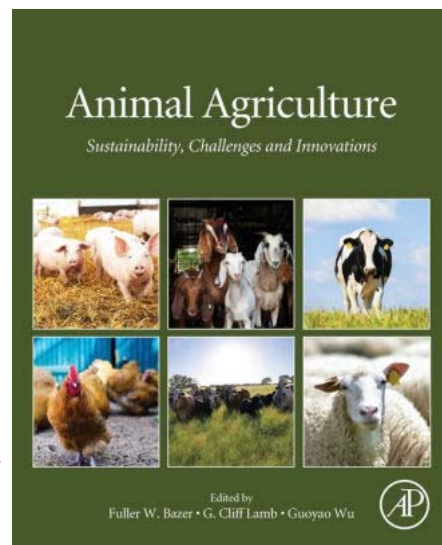
***Bazer, FW.** Reproductive physiology of sheep (*Ovis aries*) and goats (*Capra aegagrus hircus*). In: *Animal Agriculture: Sustainability, Challenges and Innovations*, Eds. Bazer FW, Lamb GC, Wu, G. Academic Press, Waltham, MA, pp 199-209

***Dai, Z.L., L. Cui, J. Li, B.G. Wang, L.N. Guo, Z.L. Wu, W.Y. Zhu, and G. Wu.** Fermentation techniques in feed production. In: *Animal Agriculture: Sustainability, Challenges and Innovations*, Eds. Bazer FW, Lamb GC, Wu, G. Academic Press, Waltham, MA, pp. 407-430.

***Wu, G.** Management of metabolic disorders (including metabolic diseases) in ruminant and nonruminant animals. In: *Animal Agriculture: Sustainability, Challenges and Innovations*, Eds. Bazer FW, Lamb GC, Wu, G. Academic Press, Waltham, MA, pp. 471-492.

***Daigle C, Herring AD, Bazer FW.** 2019. Breeding and Welfare, Genetic Manipulation of Beef and Dairy Cattle. In: *Cattle Welfare in North America*, Eds. Engle T, Klingborg D, Rollin B. CRC Press, Boca Raton, FL, Pp 93-108.

***Pohler KG,** GA Franco, ST Reese, MF Smith. 2019. Physiology and Pregnancy of Beef Cattle. *Animal Agriculture: Challenges, Innovations, and Sustainability.* Elsevier Inc. Philadelphia, PA.



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13th Annual IFRB Retreat, 2019



The 13th Annual IFRB Retreat was held on October 18, 2019 in conjunction with the 25th Annual Dr. Raymond O. Berry Memorial Lecture.

Over 80 IFRB faculty and trainees from the Colleges of Veterinary Medicine & Biomedical Sciences and Agriculture and Life Sciences, Science and Medicine, along with Prairie View A&M participated in the Retreat which was held at Prairie View A&M University, Prairie View, TX

Dr. Ky Pohler, Assistant Professor, Department of Animal Science presided over the meeting.

Organizers of the retreat were Drs. Gary Newton from Prairie View A&M and **Greg Johnson** from Texas A&M.

Trainee platform presenters included:

Yudi Bedi, "Paternal alcohol consumption alters the sperm epigenome and leads to fetal growth restriction."

Robyn Moses, "Utilization of glucose and fructose by ovine conceptuses during the peri-implantation period of pregnancy."

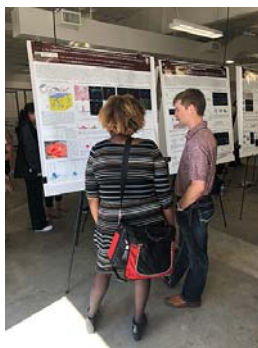
Marcus Orzabal, "Impact of electronic cigarette aerosol on pregnancy and development."

Tatiane Maia, "Do pre and postnatal nutrition interact to program reproductive phenotype in sexually mature heifers?"

Nick Holloway, "Evidence for expression of the sodium iodide symporter (NIS) in novel neural and ovarian locations in teleost fish."

Camilo Hernandez-Aviles, "A study of energy substrates for equine spermatozoa subjected to cooled storage."

Xin Fang, "New insights into testicular granulosa cell tumor development."



Gessica Franco, "Male contribution to pregnancy loss in cattle."

Invited faculty presenters included:

Dr. Joe Arosh, "Corpus luteum survival and establishment of pregnancy in ruminants: a molecular and cellular revisitation of concepts."

Dr. Guoyao Wu, "Adverse impacts of maternal exposure to air pollution during gestation on organogenesis and long-term metabolic health in rat offspring."

Retreat participants also attended a trainee poster session that included 25 posters from TAMU and PVAMU.

Support for the 12th Annual IFRB Retreat and Dr. Raymond O. Berry Memorial Lecture was provided by **Dr. Cliff Lamb**, Department of Animal Science, **Drs. Jane Welsh** and **Larry Suva**, Departments of Veterinary Integrative Biosciences, and Veterinary Physiology & Pharmacology and **Dr. Fuller Bazer**, through his Distinguished Professor account.

IFRB Faculty Transitions



***Dr. Katrin Hinrichs**, Professor and Patsy Link Chair in Mare Reproductive Studies and 17 year member of the IFRB, has been appointed Chair of the Department of Clinical Studies at New Bolton Center in the School of Veterinary Medicine at the University of Pennsylvania (Penn Vet). She will also hold the Dr. Harry Werner Professorship in Equine Medicine which serves as the centerpiece of a program for equine wellness and welfare at New Bolton Center. Beginning March 2, 2020 she will lead a department of 49 faculty members who conduct efforts in diagnostic and clinical health areas, including laminitis, equine joint trauma, reproductive medicine, pharmacology, food animal health and productivity, large animal medicine and surgery.

Dr. Hinrichs received her PhD from Penn, and her DVM and BS degrees from the School of Veterinary Medicine at U.C. Davis. She completed her residency in Reproductive Studies at Penn Vet's Hofmann Center for Animal Reproduction at New Bolton Center. In 1988, she joined the faculty at Tufts University's School of Veterinary Medicine as assistant professor. She was later appointed associate professor, heading the Theriogenology and Large Animal Clinical Sciences sections. Hinrichs went on to join the faculty at Texas A&M, and in 2002, she was named professor of in 2005, Hinrichs became the first Patsy Link Chair in Reproductive Studies, and in 2015, she was appointed Regents Professor.

Dr. Hinrichs has received many awards and honors, several of which including: Doctor Honoris Causa in Veterinary Medicine from the University of Copenhagen (2007); Outstanding Faculty Award, Tufts (1997); TVMA Faculty Achievement Award (2013); Theriogenologist of the Year from the American College Theriogenologists (2003); the Distinguished Achievement Award in Research, Texas A&M (2019); and notably, the 2016 Simmet Prize for Assisted Reproduction from the International Congress of Animal Reproduction, the most prestigious award in animal reproductive science.

***Dr. Ron Randel**, a founding member of the IFRB, retired May 31, 2019 after 45 years of service in positions as Reproductive Physiologist, Texas A&M AgriLife Research Center, Overton and Professor, Department of Animal Science. He was the Physiology of Reproduction Section Leader for nearly a decade. His research focused on the reproductive and stress physiology of tropically adapted cattle, the nutrition-reproduction interaction, the influence of temperament on health, feed efficiency, and reproduction. Other research on pituitary and gonadal functions of Brahman cattle contributed to development of procedures to successfully manage reproductive efficiency in tropically adapted breeds of cattle. As evident by receipt of the L.E. Casida Award from the American Society of Animal Science (ASAS), Dr. Randel excelled as a mentor to over 100 graduate students and undergraduate research interns. He became an icon in bovine reproductive physiology and management due to numerous research findings acquired and disseminated by his students.

Dr. Randel's internationally recognized research and graduate training program resulted in presentation of invited papers on six continents. The many awards issued to his students and the honors bestowed on Dr. Randel (e.g., Senior AgriLife Research Fellow, Regents Fellow, Southern Section ASAS Distinguished Service Award, ASAS Research Fellow, ASAS Physiology & Endocrinology Award) reflect the lab group's impact. An endowment enabled the ASAS Southern Section to establish the annual Randel Physiology Lecture series to promote farm animal physiology research and graduate trainee development. Dr. Randel continues as Professor Emeritus and PI and Co-PI of two recently issued USDA grants (and mentor to 2 students) to assess the epigenetic and telomeric aspects of prenatal stress on postnatal health and performance of Brahman cattle. The IFRB extends its sincere congratulations, appreciation, and best wishes to Dr. Ron and Colleen Randel.



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52nd SSR Annual Meeting, San Jose, CA 2019 American Society for Animal Science, Austin, TX



The 52nd Annual Meeting of the Society for the Study of Reproduction was held at the San Jose McEnery Convention Center, San Jose, California, July 18-21, 2019. The theme of the Meeting was “Beyond Possible: Remarkable Transformation of Reproductive Biology.” This year 13 IFRB faculty and 16 trainees contributed to the annual program. This included 8 trainees who submitted first-authored abstracts accepted for presentation at the Annual SSR meeting and received IFRB trainee travel funds to attend the meeting.



2019 ASAS-CSAS Annual Meeting and Trade Show

Austin Convention Center
Austin, TX
July 8-11, 2019

The 2019 American Society for Animal Science was held at the Austin Convention Center, Austin, TX July 8-11, 2019. More than 50 presentations were given by TAMU faculty including 12 IFRB members and 20 trainees. This included 7 trainees who submitted first-authored abstracts accepted for presentation at the ASAS meeting and received IFRB trainee travel funds to attend the meeting. The IFRB gratefully acknowledges funding provided by the Texas A&M University Division of Research, Deans and Department Heads of the Colleges of Agriculture and Life Sciences, Medicine and Veterinary Medicine & Biomedical Sciences.



2020 ASAS-CSAS Annual Meeting and Trade Show

Monona Terrace Community and Convention Center
Madison, WI
July 19-23, 2020

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David Forrest



IFRB RESEARCH AND TRAINING MISSION:

Reproductive Biology is at the epicenter of the life sciences. Focal areas of research and graduate/postdoctoral training in the IFRB are interdisciplinary and cover both genders, encompass humans, domestic animals, laboratory animals and wildlife, and include: assisted reproductive techniques, biological clocks, cloning, conservation of endangered species, contraception, developmental biology, diseases of the reproductive tract, endocrinology, fertilization, fetal growth retardation, gametogenesis, gender-biased diseases and health issues, immunology, infertility, lactation, pregnancy and pregnancy-related disorders, premature labor, recovery of function, science and health policy, stem cell biology, systems biology and functional genomics, toxicology, and uterine biology. The outcomes of this research are impacting Texas, our nation and the world.

Mail Stop 2471
College Station, TX 77843-2471
Phone: 979-845-5929
Fax: 979-862-2662
Email: ifrb@tamu.edu

Comments,
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Contact
Newsletter Editor
Bob Burghardt