**NCERA057: Swine Reproduction**

**Members:**

**Administrative Advisor –** Dr. Deb Hamernik

University of Nebraska-Lincoln

Associate Dean of Agricultural Research Division

207 Ag Hall

Lincoln, NE 68583-0908

Tel: 402-472-2045 Fax: 402-472-9071

Email: dhamernik2@unl.edu

**Illinois –** Dr. David Miller

University of Illinois

Department of Animal Sciences

132 Animal Science Lab

1207 West Gregory Drive

Urbana, IL 61801

Tel: 217-333-3408 Fax: 217-333-8286

Email: djmille@uiuc.edu

**Indiana** – Dr. Kara Stewart

Purdue University

Department of Animal Sciences

3235 Lilly Hall

West Lafayette, IN 47907

Tel: 765-496-6199 Fax: 765-494-9346

Email: krstewart@purdue.edu

**Iowa** – Dr.Jason Ross

Iowa State University

Department of Animal Science

2356E Kildee

Ames, IA 50011-3150

Tel: 515-294-8647 Fax: 515-940-4471

Email: jwross@iastate.edu

**Kansas –** Dr. Duane L. Davis

Kansas State University

Department of Animal Science & Industry

256 Weber Hall

Manhattan, KS 66506

Tel: 785-532-1224 Fax: 785-532-7059

Email: davis@ksu.edu

**Missouri –** Dr. Timothy J. Safranski

University of Missouri-Columbia

Department of Animal Science

S133 Animal Science Center

Columbia, MO 65211

Tel: 573-884-7994 Fax: 573-884-4545

Email: safranskit@missouri.edu

**Missouri –** Dr. Rodney Geisert

University of Missouri-Columbia

Department of Animal Science

S133 Animal Science Center

Columbia, MO 65211

Tel: 573-884-7994 Fax: 573-884-4545

**Nebraska –** Dr. Brett R. White

University of Nebraska-Lincoln

Department of Animal Science

A224 Animal Science Building

Lincoln, NE 68583-0908

Tel: 402-472-6438 Fax: 402-472-6362

Email: bwhite2@unl.edu

**North Carolina –** Dr. Mark Knauer

North Carolina State University

Polk Hall

Box 7621

Raleigh, NC 27695

Tel: 919-515-8797 Fax: 919-515-6884

Email: mark\_knauer@ncsu.edu

**South Dakota –** Dr. Jeffrey Clapper

Department of Animal and Range Sciences

Animal Science Complex 108, Box 2170

South Dakota State University

Brookings, SD 57007

Tel: 605-688-5417 FAX: 605-688-6170

Email: jeffrey.clapper@sdstate.edu

**USDA – ARS –** Dr. Jeremy Miles

US Meat Animal Research Center

Reproduction Research Unit

P. O. Box 166

Clay Center, NE 68933

Tel: 402-762-4184 Fax: 402-762-4382

Email: jeremy.miles@ars.usda.gov

**USDA – ARS –** Dr. Lea Rempel

US Meat Animal Research Center

Reproduction Research Unit

P. O. Box 166

Clay Center, NE 68933

Tel: 402-762-4185 Fax: 402-762-4382

Email: lea.rempel@ars.usda.gov

**USDA – NIFA –** Dr. Adele Turzillo

1400 Independence Avenue, S.W.

Stop 2220

Washington, DC 20250-2220

Tel: 202-401-6158 Fax: 202-401-1602

Email: aturzillo@csrees.usda.gov

**West Virginia** – Dr. Matt Wilson

Division of Animal Science

G048 Agricultural Sciences Building

PO Box 6108

West Virginia University

Morgantown, WV 26506

Tel: 304-293-2631

Email: mwilso25@wvu.edu

**Wisconsin –** Dr. John J. Parrish

University of Wisconsin

Department of Animal Sciences

1675 Observatory Drive

Madison, WI 53706

Tel: 608-263-4324 Fax: 608-262-5157

Email: parrish@ansci.wisc.edu

**Mississippi –** Dr. Jean-Magloire Feugang

Department of Animal and Dairy Sciences

Wise Center, Rm 4025

Mississippi State University

Starkville, MS 39762

Tel: 662-325-7567 Fax: 662-325-8873

Email: jn181@ads.msstate.edu

**USDA – ARS –** Dr. Timothy Ramsay

(station representative)

Beltsville Agricultural Research Center

Animal Bioscience and Biotechnology Laboratory

Building 200, Room 206 BARC-East

Beltsville, MD 20705-2350

Tel: 301-504-5958 Fax: 301-504-8623

Email: timothy.ramsay@ars.usda.gov

**Location of the NCR-26 and NCR-57 (NCERA057) Committee Meetings**

|  |  |
| --- | --- |
| 1961 | University of Illinois |
| 1962 | Iowa State University |
| 1963 | University of Missouri - Columbia |
| 1964 | University of Nebraska |
| 1965 | Purdue University |
| 1966 | University of Wisconsin |
| 1967 | University of Illinois |
| 1968 | Beltsville |
| 1969 | University of Minnesota |
| 1970 | Ohio State University |
| 1971 | Kansas State University |
| 1972 | Michigan State University |
| 1973 | Iowa State University |
| 1974 | University of Nebraska |
| 1975 | North Dakota State University |
| 1976 | University of Missouri - Columbia |
| 1977 | Purdue University |
| 1978 | University of Wisconsin |
| 1979 | Purdue University |
| 1980 | South Dakota State University |
| 1981 | Ohio Agricultural Research & Development Center |
| 1982 | R. L. Hruska Meat Animal Research Center |
| 1983 | Beltsville Agricultural Research Center |
| 1984 | University of Missouri - Lincoln |
| 1985 | University of Illinois |
| 1986 | University of Minnesota |
| 1987 | Pennsylvania State University |
| 1988 | Ohio State University |
| 1989 | University of Nebraska |
| 1990 | Kansas State University |
| 1991 | North Dakota State University |
| 1992 | Iowa State University |
| 1993 | University of Missouri - Columbia |
| 1994 | Oklahoma State University |
| 1995 | University of Wisconsin |
| 1996 | R. L. Hruska Meat Animal Research Center |
| 1997 | Beltsville Agricultural Research Center |
| 1998 | University of Missouri - Lincoln |
| 1999 | Purdue University |
| 2000 | University of Illinois |
| 2001 | University of Missouri - Columbia |
| 2002 | University of Nebraska - Lincoln |
| 2003 | Kansas State University |
| 2004 | Iowa State University |
| 2005 | University of Wisconsin-Madison |
| 2006 | North Caroline State University |
| 2007 | Michigan State University |
| 2008 | Purdue University |
| 2009 | West Virginia University |
| 2010 | University of Illinois (Maschhoff Farms) |
| 2011 | R. L. Hruska, U.S. Meat Animal Research Center, Nebraska |
| 2012 | Iowa State University |
| 2013 | Beltsville Agricultural Research Center, Maryland |
| 2014 | University of Nebraska |
| 2015 | Kansas State University |
| 2016  2017 | University of Missouri  University of Missouri |

**NCERA057 Officers**

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Secretary P. J. Dzuik

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Vice Chair P. J. Dzuik

Secretary L. L. Anderson

1971 Chairman P. J. Dzuik

Vice Chair L. L. Anderson

Secretary G. H. Kiracofe

1972 Chairman L. L. Anderson

Vice Chair G. H. Kiracofe

Secretary E. Clegg

1973 Chairman G. H. Kiracofe

Vice Chair E. Clegg

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1974 Chairman E. Clegg

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1975 Chairman V. G. Pursel

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2015 Chairman J. Parrish

Secretary J. Feugang

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Secretary L. Rempel

2017 Chair L. Rempel

Secretary J. Clapper

2018 Chair J. Clapper

Secretary K. Stewart

**Project/ Activity Title: NCERA57 – Swine Reproductive Physiology (Multistate Research Coordinating Committee and Information Exchange Group)**

**Date of Annual Report:** 08/10/2017

**Annual Meeting Dates:** 06/15/2017

**Period the Report Covers:** 10/01/2016 - 09/01/2017

**In Attendance:**

Davis, Duane [davis@ksu.edu] Kansas

Feugang, Jean-Magloire [jn181@ads.msstate.edu] Mississippi

Flowers, William [william\_flowers@ncsu.edu]

Geisert, Rodney [geisertr@missouri.edu] Missouri

Miles, Jeremy [jeremy.miles@ars.usda.gov] USDA-USMARC

Miller, Dave [djmille@illinois.edu] Illinois

Morton, Jodi - Kansas (student)

Mote, Benny [benny.mote@unl.edu] Nebraska (visitor)

Rempel, Lea [lea.rempel@ars.usda.gov] USDA-USMARC

Ross, Jason [jwross@iastate.edu] Iowa

Safranski, Tim [safranskit@missouri.edu] Missouri

White, Brett [bwhite2@unlnotes.unl.edu] Nebraska

**Summary of Minutes:**

On Thursday, June 15, welcome and introduction was given by institutional co-host, Dr. Tim Safranski. Dr. Bill Lamberson, Interim Chair of the Division of Animal Science, gave an overview of the University of Missouri – College of Agriculture, Food and Natural Resources (CAFNR), of which, approximately 500 undergraduate and 60 graduate students are within the Animal Science curriculum. Current NCERA57 Chair, Dr. Lea Rempel, USMARC, opened the annual meeting portion with greetings and appreciation to University of Missouri, the local hosts, Drs. Tim Safranski and Rod Geissert for their generous hospitality and coordination of the meeting facility. Station reports from several institutions were given.

Station Reports: Each institution provided a brief presentation of current research with group discussions.

1. Kansas State University, Dr. Duane Davis

Recent studies completed at Kansas State evaluated split nursing to enhance the intake of colostrum in small pigs. The removed pigs were placed in a plastic tub with a heat lamp and after 1.5 h were returned to the farrowing crate. Weight gain to d7 was greater (P < 0.05) for when the heaviest pits were removed but not when the first half of pigs farrowed were removed.  Pigs born in the first half of the birth order had greater (P < 0.05) immunocrits than pigs born in the last half of the litter and pigs in higher birth weight categories had greater (P < 001) weights at d7 and 20. Immunocrit and colostrum intake were positively correlated.

Another series of studies confirmed the ability of litter separation and boar exposure to induce estrus, ovulation, and allow fertility in lactating sows. A potentially practical method was developed that allowed the sows and pigs to remain in farrowing crates with a boar introduced for stimulation once/d. A robot controlled remotely guided the boar to each pair of sows for stimulation. The pigs were alternately allowed to nurse one of each pair of sows for 12 h/d.

1. Mississippi State University, Dr. Jean Feugang

Dr. Jean M Feugang presented an overview of the recent development in nanotechnology that can enhance livestock productivity through assisted reproduction. The current status of semen purification procedures leading to the selection of best or high quality spermatozoa for successful in vitro/in vivo fertilization was provided (e.g., swim-up, filtration, density gradient centrifugation, and lab-on-chips). Furthermore, a special focus on new developed quantum dot nanoparticles for sperm imaging, liposomes for imaging and delivery, and magnetic nanoparticles for sperm selection. Our previous and current works indicate the beneficial use of these nanoparticles on boar spermatozoa, with the expectation of their further optimization to tremendously impact swine productivity.

1. University of Missouri, Drs. Rod Geisert and Tim Safranski

True effects of heat stress on the sow may be greater if heat stress (HS) of the pregnant sow causes long-term developmental damage to subsequent offspring. Sows respond to HS during gestation with increased rectal temperature, respiration rate, and skin temperature. An additional coping mechanism is reduced activity that may change body composition (favoring fatter less muscled sows). The HS sows have shorter gestation length and reduced birth weight of their litters. Lactation performance appears normal because weaning weights are not changed when sows are heat-stressed during lactation. Heat stress during gestation causes insulin resistance during lactation but this metabolic state does not seem to affect lactation or rebreeding performance. Boars and gilts from sows that are gestational heat stress have a variety of unique phenotypes related to body temperature regulation, carcass composition, and reproduction.  Most studies have found greater body temperature and greater fat deposition in offspring from heat stress sows. With respect to reproduction, the data suggest damage to both the developing ovary and testis caused by gestational heat stress. Most of the available data are preliminary. Further replication is necessary to confirm the observed effects of gestational heat stress which have the potential to significantly impact the economics of the swine industry.

1. USDA, ARS, US Meat Animal Research Center, Drs. Jeremy Miles and Lea Rempel

Dr. Lea Rempel provided a presentation upon the use of genomics and metabolomics to investigate the genetic and physiological events associated with weaning-to-estrus interval. Several genetic regions with potential candidate genes were identified in first and second parity dams. These regions included Sus scrofa chromosomes 1 and 9 for parity 2 dams. Others have reported QTL for puberty in gilts and a QTL for swine matings on SSC 9 in the same region. A candidate gene of interest that lies within this region is *SET and MYND domain containing 2*, which can inhibit estrogen receptor 1. Furthermore, a preliminary LCMS plasma metabolite profiling study suggested that parity 1 females that fail to return to estrus following weaning had greater abundance of the putative metabolites; mesitylene, pentylbenzene, and 1,3-octadiene. Elevated benzene products have been shown to reduce intrafollicular estradiol and decrease oocyte retrieval in humans.

The business meeting reconvened following the station reports. Members decided that we need to encourage other institutions to participate therefore recruitment efforts for the NCERA57 group were discussed. Several potential recruits were mentioned and current members volunteered to initiate an invitation to the NCERA57. The following current members volunteered to contact possible recruits. Jason Ross will contact Clay Isom; Billy Flowers will contact Shelly Rhoads, Steve Moeller, and Troy Ott; and Jeremy Miles will contact USDA, ARS, BARC.

A secretary for 2018 was elected and we are glad to say that Kara Stewart, Purdue, was nominated by Duane Davis, seconded by Tim Safranski, and unanimously voted into this position. Jeff Clapper was promoted from current secretary into the position of NCERA57 Chair for 2018. Congratulations to the elected officials for 2018 NCERA57.

John Parrish mentioned that the NCERA57 program was likely up for renewal in 2018 and that we should be aware. We will work via email interactions over the course of the next year to prepare the renewal since the 2018 meeting will be shortened due to the mini-symposium. Online efforts will include developing new objectives and updating the accomplishments for the current 12 objectives. A draft renewal document will need to be completed by October, 2018.

Dr. Chris Hostettler, Director of Animal Science for the National Pork Board (NPB) gave updates on their organization (9 committees, 6 of which are in Science and Technology). Explained the Animal Science committee is interested in reproduction, genetics, and nutrition. There is an effort on sow lifetime productivity with the goal to raise number of pigs in a lifetime from 34 to 43. This goal fits the strategic plan of NPB by increasing sustainability. A special sow lifetime productivity pre-/ post- weaning survival RFP went out this spring and five proposals were received. Dr. Hostetler talked about annual funding for sow lifetime productivity ($425K), nutritional efficiency ($?) and seasonality ($200-300K), and that all expire in 2017. So the Animal Science committee will have to decide focus (extension of programs or a redirect). He anticipates they will be interested in learning about sow prolapse and mortality issues in the breeding herd.

A brief USDA-NIFA update was provided by Dr. Adele Turzillo in the form of an email. Program outcomes for FY2016 for Animal Health and Production and Animal Products provided $28 million total program funds. Eight areas of research interest have been developed within the request for applications for FY 2017. These include; 1) Food, Agriculture, Natural Resources and Human Sciences Education and Literacy Initiatives, 2) Foundational Programs, 3) Food Security Challenge Area, 4) Food Safety Challenge Area, 5) Childhood Obesity Prevention Challenge Area, 6) Water for Food Production Systems Challenge Area, 7) Resilient Agroecosystems in a Changing Climate Challenge Area, and 8) Sustainable Bioenergy and Bioproducts Challenge Area.

It was decided that the 2018 meeting/mini-symposium would be held at Brookings, SD (SDSU) with the new swine research and educational facility as well as a large commercial and production swine base in SD and MN. Jeff Clapper was unable to attend the meeting in person, but we did manage to establish a conference call in order to develop a draft agenda and appoint responsibilities to NCERA57 members. The NCERA57 2018 meeting and symposium to be held May 21-23, 2018 with the mini-symposium to be held May 22, 2018 at SDSU, Brookings, SD. A committee was formed consisting of Lea, Jason, Tim, and Jeff to work out the finer details. The draft agenda is as follows:

10:00-12:00 Open house and swine facility tour

12:00 Lunch, sponsored by JBS United Animal Health (Duane Davis will contact)

1:00 Tribute to Dr. Phil Dzuik (Steve Webel)\*

1:10 PRRS Update, SDSU or other local swine vet

1:40 Anatomy and Physiology of Pregnancy and Parturition, NCERA member will present that will ‘set-up’ the following presentation

2:10 Uterine prolapse and sow mortality (Gene Gourley or Mark Fitzsimmons suggested)

3:00 Break

3:30 Pre-weaning survival with normal and large litters (NCERA member or other)

4:10 Failure of the parity 1 female to return to estrus (NCERA member)

4:45 General discussion and adjournment

\*Dr. Phil Dziuk, a founding member of this committee, will be given special recognition at the 2018 mini-symposium. Duane Davis volunteered to ask Steve Webel to provide a brief memoriam (5-10 minutes) and possibly sponsor the meal for the symposium.

Tim Safranski will contact the Chris Hostetler, NPB, about providing Pork Checkoff funds to assist with the costs for the symposium. Jeff Clapper will coordinate and secure the facilities and request funding support from the department head, Dr. Joe Cassady and or the university, for speakers and a portion of the meal. The conference call with Jeff Clapper was concluded.

No other business was needed to discuss therefore the meeting was officially adjourned.

**Accomplishments:**

Committee members performed research this past year that has provided insights into key aspects of swine production and reproduction, in particular. Areas of investigation encompassed applied approaches to improve reproductive efficiency as well as more basic approaches to gain a fundamental understanding of mechanisms of biological mechanisms involved in swine reproduction. Areas of research included; identification of genes involved in signal transduction pathways of porcine oocytes at fertilization, how in utero heat stress affects growth and reproduction of boars, supplements to semen extenders, steroidogenesis in boar testis, inducement of puberty and artificial insemination techniques, factors affecting motility patterns of spermatozoa, and genetic influences affecting puberty, postweaning estrus, heat stress, and feeding behavior in pigs.

**Impacts:**

Reported peer –reviewed publications from cooperating institutions within the NCERA-57 group yielded 49 manuscripts, abstracts, proceeding and book chapters associated with swine reproduction, physiology or genetics.

**Publications:** For SAES-422 reports list the publications for **current** year only (with the authors, title, journal series, etc.). If the list exceeds the maximum character limit below, an attachment file may be used. (Max characters = 50,000. Single line breaks are not preserved, use double line breaks instead or use a <p> tag to separate paragraphs.)

**Boar Performance (IN, NE, IL)**

J. A. Proctor, D. W. Lugar, M. C. Lucy, T. J. Safranski and K. R. Stewart. 2017. Effects of in Utero Heat Stress on Boar Growth and Reproduction Prior to, during, and after Puberty. Midwest ASAS, Omaha, NE. Abstract.

D. W. Lugar, W. A. Krom, J. A. Proctor, P. D. Mings, and K. R.Stewart. 2017. Effects of Supplemental Betaine to Semen Extenders on Semen Quality in Boars. Midwest ASAS, Omaha, NE. Abstract.

Lents, C.L., J.F. Thorson, A.T. Desaulniers and B.R. White. 2017. RFamide-related peptide 3 and gonadotropin-releasing hormone-II are autocrine-paracrine regulators of testicular function in the boar. Mol. Reprod. Dev. May 5. doi: 10.1002/mrd.22830. [Epub ahead of print] Review.

Gonzalez-Pena D, Knox RV, Rodriguez-Zas SL. 2016. Contribution of semen trait selection, artificial insemination technique, and semen dose to the profitability of pig production systems: A simulation study. Theriogenology. 85:335-44.

Silva E, Frost D, Li L, Bovin N, Miller DJ. 2017. Lactadherin is a candidate oviduct Lewis X trisaccharide receptor on porcine sperm. Andrology doi: 10.1111/andr.12340

Winters RA, Nettenstrom LM, Lopez DG, Willenburg KL, Vishwanath R, Miller DJ. 2017. Effect of sorting porcine spermatozoa by sex chromosomes on oviduct cell binding. Submitted.

**Sow and Gilt Performance (IN, NE, IL, KS, USMARC)**

Cabezon, F. K.R. Stewart, A.P. Schinckel, B.T. Richert, M. Gandarillas, M. Pasache, and W.A. Peralta. 2016. Effect of betaine supplementation during summer on sow lactation and subsequent farrowing performance. Professional Animal Scientist, 32(5), pp 698-706.

Cabezón, F.A., Schinckel, A.P., Richert, B.T., Stewart, K.R., Gandarillas, M. and Peralta, W.A., 2016. Analysis of lactation feed intakes for sows including data on environmental temperatures and humidity. The Professional Animal Scientist, 32(3), pp.333-345.

N.M. Chapel, C.J. Byrd, D. W. Lugar, K. R. Stewart, T.J. Safranski, L.H. Baumgard, and J.S. Johnson. 2017. The effects of *in utero* heat stress on fasting heat production in growing pigs. Midwest ASAS, Omaha, NE. Abstract.

Thorson, J.F., N.L. Heidorn, V. Ryu, K. Czaja, D.J. Nonneman, C.R. Barb, G.J. Hausman, G.A. Rohrer, L.D. Prezotto, R.B. McCosh, E.C. Wright, B.R. White, B.A. Freking, W.T. Oliver, S.M. Hileman and C.A. Lents. 2017. Neuropeptide FF receptor function affects gonadotropin secretion and age at puberty in gilts. Biol. Reprod. 96:617-634.

Knox RV, Esparza-Harris KC, Johnston ME, Webel SK. 2017. Effect of numbers of sperm and timing of a single, post-cervical insemination on the fertility of weaned sows treated with OvuGel®. Theriogenology 92:197-203.

Knox RV, Shen J, Greiner LL, Connor JF. 2016. Effect of timing of relocation of replacement gilts from group pens to individual stalls before breeding on fertility and well-being. J. Anim. Sci. 94:5114-5121.

Knox RV. Artificial insemination in pigs today. Theriogenology. 2016.85: 83-93.

Arend L, Knox RV, Greiner L, Graham A, Connor J. 2016. Effects of feeding melatonin during proestrus and early gestation in gilts and P1 sows to minimize the effects of seasonal infertility. Midwest ASAS/ADSA Annual Meeting.

Arend LS, Duangkamol P, Knox RV. 2016. Administration of melatonin during the follicular and early luteal phase to mimic short days and minimize seasonal infertility for prepubertal gilts housed under differing hours of light and heat. Allen D. Leman Swine Conf. St. Paul, MN.

Vaughn, M., C. Serrano, D. Burnett, D. Davis, J. Woodworth, and J. Gonzalez. 2016. Influence of Porcine Plasma Supplementation on Gestating Sow Serum IGF-1 Concentration and Litter Weights. Professional Agricultural Workers Journal. 4: No. 1, 6.

H. L. Frobose, M. D. Tokach, J. M. DeRouchey, S. S. Dritz, R. D. Goodband, J. L. Nelssen, and D. L. Davis. 2017. Follicle development, incidence of lactational estrus, and ovulation in sows exposed to different suckling reduction strategies. International Conference on Pig Reproduction. June 11-14, Columbia, MO.

J.M. Morton, A.J. Langemeier, T. Rathbun, D.L. 2017. Split suckling and birth weight affects colostrum intake and pre-weaning weight gain. International Conference on Pig Reproduction. June 11-14, Columbia, MO.

Vallet JL, Meyer S. 2016. Effect of glucosamine supplementation on litter size in a commercial setting - NPB #14-238. National Pork Board.

Vallet, J.L., Miles, J.R. 2017. The effect of farrowing induction on colostrum and piglet serum immunocrits is dependent on parity. Journal of Animal Science 96(2): 688-696. doi:10.2527/jas.2016.0993.

**Growth, Development, Physiology (NE, IL, USMARC)**

McNeel, A.K., É.M. Soares, A.L. Patterson, J.L. Vallet, E.C. Wright, E.L. Larimore, O.L. Amundson, J.R. Miles, C.C. Chase Jr., C.A. Lents, J.R. Wood, A.S. Cupp, G.A. Perry and R.A. Cushman. 2017. Beef heifers with diminished numbers of follicles have decreased uterine protein concentrations. Anim. Reprod. Sci. 179:1-9.

Yates, D.T., C.N. Cadaret, K.A. Beede, H.E. Riley, A.R. Macko, M.J. Anderson, E.E. Camacho and S.W. Limesand. 2016. Intrauterine growth-restricted sheep fetuses exhibit smaller hindlimb muscle fibers and lower proportions of insulin-sensitive Type I fibers near term. Am. J. Physiol. Regul. Integr. Comp. Physiol. 310:R1020-1029.

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JEFF THIS SECTION NEEDS TO BE COMPLETED – refer to the publication lists within the station reports (pdf)

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