RANGE BULLETIN

Livestock & Natural Resources Newsletter

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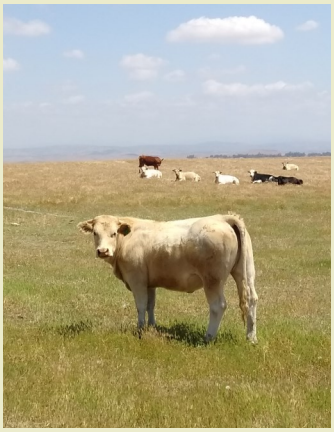

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Find us on Facebook! Search for **@UCCEFresnoMaderaLivestock** or visit the page directly at **https://www.facebook.com/UCCEFresnoMaderaLivestock/** for weekly updates on upcoming events, recent news, and research information.

News Briefs

San Joaquin Valley Livestock Symposium

Save the date! The Livestock Symposium will be held on February 27 (Catheys Valley and Visalia) and February 28 (Bakersfield).

Presentation topics will include:
- Deworming and vaccination protocols
- EPDs and genetic research
- Ranch water quality
- And more!

Visit **https://ucanr.edu/sites/livestockandnaturalresources/Events/** or call Rebecca at 559-241-6564 for more information.
Pre-registration will be available in early February.

In the works - Oak Research

UCCE livestock and range advisors in the San Joaquin Valley and Central Coast are developing a new research project to examine oak mortality and oak populations. We need your feedback to help us focus the project!
Please fill out our 3-minute, anonymous survey here:
http://ucanr.edu/oaksurvey.
If you already responded to the survey, **thank you**!

Cattle Genetics: From Range (or Dairy) to Lab

By Rebecca Ozeran

San Joaquin Valley livestock are an important part of ongoing genetic research at UC Davis - even after they've gone to slaughter.

Last fall, I got a call from Dr. Alison Van Eenennaam, UC Davis Specialist, asking if I was interested in being part of a new genetics project. In particular, she wanted to know if I was up for a unique task: collecting cow ovaries.

Photo: a cow ovary, detached from the uterus.
Based on my recent ovary collection experience, I estimate that this ovary measures about 2 inches long and 1 inch in diameter. Cow ovaries can be as small as a grape or nearly the size of one's hand, depending on the stage of follicle development and other factors.
Photo © University of Wisconsin Dept. of Animal Sciences, accessed at http://www.ansci.wisc.edu/jjp1/ansci_repro/lec/lec1/female_hist.html

Yes, ovaries.

As it turns out, UC Davis has had an agreement with the Cargill processing plant in Fresno for many years now, in which Cargill or a UC employee will collect ovaries from the cows that are processed, and then a UC Davis employee will drive the ovaries up to the university. Once in the lab, the ovaries provide oocytes (egg cells) for genetic research.

This is only possible because the Cargill plant receives hundreds of cull cows every day, which provide most of the lean meat used in their ground beef and some retail cuts. Many of these cows come from nearby dairies and beef operations in the San Joaquin Valley, and some come from farther away to fill in gaps in local culls. While the carcasses are being processed and turned into beef cuts and byproducts, a Cargill employee or a researcher can collect ovaries off the reproductive tracts.

Dr. Van Eenennaam and the other researchers in her lab realized that the long drive made it difficult to keep the oocytes alive between Fresno and Davis. They saw fewer viable oocytes when the ovaries were transported in a large plastic bag than when they were transported in an insulated container - a thermos.

This article continues ▶

Genetics cont'd

Why was this? Normal cow body temperature is similar to humans; a healthy cow should be around 37-38°C (98-101°F). In the plastic bags, the ovaries were not being well insulated from the ambient air temperatures and after the 3-hour drive, they often cooled to around 26°C (79°F). As you can imagine, 26°C is not a temperature that will keep cells alive if they normally thrive at 37°C. If a live cow had a temperature of 26°C, she would be hypothermic and might not be alive for much longer.

Because it takes an hour or two to collect the ovaries the lab needs, it isn't feasible for a UC Davis employee to drive down, collect ovaries, and return to Davis in a reasonable time to process the ovaries in the same day. However, when Cargill employees collect the ovaries on behalf of UC Davis, they can only put them in the large plastic bags. Cargill can't afford the extra time on the conveyor belt to trim the ovaries of excess tissue, either, which means more work for UC Davis researchers to access the oocytes.

That's where a local collaborator can be helpful. With a pair of scissors, I can collect ovaries without interrupting normal processing activities, trim the ovaries to remove unnecessary tissue, and place them into insulated containers with saline to limit the temperature change. By keeping the ovaries safely above 30°C, the lab in Davis should reliably have higher numbers of oocytes to work with. These oocytes are ultimately fertilized to create embryos which can be transferred to recipient cows at UC Davis.

Photo: cow embryos at UC Davis, which were created using oocytes from ovaries collected at Cargill.
Photo © Joey Owen, 2018.

Why do they need so many oocytes?

In genetic research, the number of embryos that are still viable after the various kinds of manipulation - *in vitro* fertilization (IVF), gene editing, biopsy to sequence DNA, freezing, and so on - is a tiny fraction of the number of oocytes originally collected. Each time an embryo is handled, its probability of survival decreases. Even without gene editing, the rate of successful pregnancy from embryo transfer of fresh embryos is only 60-70%; frozen-thawed embryos have approximately 50% pregnancy rates[1]. Biopsy of embryos – often done so that a researcher can sequence the DNA, for example to see if edited genes were successfully integrated into the genome – can reduce pregnancy rates to as low as 23-31%[2,3,4] depending on biopsy method, stage of embryo development, and whether the embryo is also frozen and thawed after biopsy.

Thus, the more oocytes that are in good shape, the better chance of embryos that will result in a viable pregnancy. In genetic research projects, viable pregnancies are critical.

This article continues ▶

Genetics cont'd

Photos: Thawing frozen embryos in a petri dish (left) to transfer into recipient cows (right). The cow outside the chute had already received an embryo and was probably offering moral support to her peer.
Photos © Rebecca Ozeran, 2018.

For example, graduate student Joey Owen is working with Dr. Van Eenennaam to test a new gene editing strategy called CRISPR/Cas9. (For more information about CRISPR/Cas9, visit: https://ghr.nlm.nih.gov/primer/genomicresearch/genomeediting.)

Below is Joey's research abstract:

> Animals engineered for improved health, nutrition, or production traits have the potential to positively impact the global food supply. However, current methods for inserting a gene into a targeted location in the genome need to be improved in order to efficiently generate such animals. Additionally, management practices to minimize associated physical and biological risks to the environment need to be developed. Some methods for environmental containment have been proposed, but recent advances in the field of gene editing, such as the discovery of the CRISPR/Cas9 system, may facilitate the development of animals that would present few or no new environmental risks. One such method would be to create a construct that renders animals carrying the transgene infertile, thereby containing the transgene to a single generation. Despite these containment issues, there is growing concern regarding our nation's role in fighting hunger and ensuring global food security. As worldwide demand for animal-source protein continues to rise, efficient and sustainable production of livestock is of growing importance.

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Genetics cont'd

> Increasing the proportion of male offspring that result from a terminal sire (i.e. a sire used to produce offspring specifically for slaughter) mating would result in improved efficiency of beef production since males finish at heavier weights, gain weight more quickly and efficiently than females, and are easier to manage due to lack of estrus behavior. It is hypothesized that a CRISPR/Cas9-mediated gene knock-in of SRY onto the X chromosome in cattle will produce fertile $X_{SRY}Y$ cisgenic bulls. When mated with XX females, these bulls will produce phenotypically all male offspring, half of which will be fertile XY males, and the other half of which will be infertile cisgenic XX_{SRY} phenotypic males. This would provide an approach for containment of transgenes that could be transferred alongside the X_{SRY} gene knock-in. The objectives of this project are to develop an efficient gene knock-in approach using the CRISPR/Cas9 system; to evaluate the effects of copy number variation in *SRY* on fertility; and to determine if this single gene knock-in of the endogenous bovine *SRY* gene is sufficient and necessary to produce all phenotypically male offspring. This work could aid in the development of methods to efficiently create gene-edited animals using gene knock-in through the CRISPR/Cas9 system, which could ultimately address food supply and food security concerns by improving the efficiency of beef production. It may also provide a method for containment of transgenes by inserting the *SRY* gene into a region that does not undergo recombination, thereby limiting transmission of the transgene to sterile males.

In brief, his goal is to see if gene editing can produce bulls that will give only male offspring for terminal (market) crosses, by manipulating one of the key gene sequences that impact physical sex characteristics. If they are successful, although half of the offspring would have the XX genotype – which is normally a female genotype – they would have male physical characteristics because of the *SRY* gene insertion. If Joey's research does not result in viable pregnancies, then he will have no way of knowing whether this gene knock-in can be successfully used to breed fertile bulls with the edited gene. It will also take a second generation to know if the $X_{SRY}Y$ bulls indeed produce only (phenotypically) male offspring.

What is the value of this research to livestock operations?

To Joey, "the most important points are the benefit to producers that this technology (i.e. CRISPR) can have towards improving livestock health, welfare and production, as well as how safe and effective it can be."

Genetic research is complex and can often seem theoretical, especially when experiments require many years of making small steps forward before there is a production-ready genetic tool available. UC Davis is working on many projects like Joey's with a big-picture goal of a more productive and economically viable livestock industry, and livestock from the San Joaquin Valley are directly contributing to this exciting research.

If you would like to know more about genetic research happening at UC Davis, visit Specialist Alison Van Eenennaam's website at https://animalscience.ucdavis.edu/people/faculty/alison-van-eenennaam or register for the upcoming Livestock Symposium in Cathey's Valley, Visalia, or Bakersfield, where Dr. Van Eenennaam will be presenting.

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Genetics cont'd

References and Helpful Links:

1. Pinto, C. R. F. n.d. **Embryo Transfer in Cattle**. Merck Veterinary Manual. Available at https://www.merckvetmanual.com/management-and-nutrition/embryo-transfer-in-farm-animals/embryo-transfer-in-cattle and accessed on 9 January 2019.
2. Polisseni, J., W. F. de Sá, M. de Oliveira Guerra, M. A. Machado, R. V. Serapião, B. C. de Carvalho, L. S. de Almeida Camargo, and V. M. Peters. 2010. **Post-biopsy bovine embryo viability and whole genome amplification in preimplantation genetic diagnosis**. Fertility and Sterility 93:783-788. Available at https://www.sciencedirect.com/science/article/pii/S0015028208042817 and accessed on 9 January 2019.
3. Agca, Y., R. L. Monson, D. L. Northey, D. E. Peschel, D. M. Schaefer, and J. J. Rutledge. 1998. **Normal calves from transfer of biopsied, sexed, and vitrified IVP bovine embryos**. Theriogenology 50:129-145. Available at https://www.ncbi.nlm.nih.gov/pubmed/10734481/ and accessed on 9 January 2019.
4. Cenariu, M., E. Pall, C. Cernea, and I. Groza. 2012. **Evaluation of bovine embryo biopsy techniques according to their ability to preserve embryo viability**. Journal of Biomedical Biotechnology v.2012:541384. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3468301/ and accessed on 9 January 2019.

Livestock Distribution and Stockmanship

By Matthew Shapero

Traditionally, the ideal distribution of livestock on rangeland extends the area of use as widely as possible and reduces impacts to sensitive resources. Livestock, however, are naturally selective in their foraging habits and do not graze pastures uniformly. An animal's choice of where to graze can be influenced by many things: topography and elevation; forage quality and quantity; the physical features within a pasture, such as fencing or stock water; and other natural and artificial attractants, such as supplementary salt or riparian areas. As a result, pastures are often utilized unevenly: grazing can become excessive where livestock concentrate, while other areas in the same pasture can support continued use.

Managing the distribution of grazing livestock is critical to promoting sustainable ranching practice and sustainable ecosystems. Recognizing this need, the NRCS Environmental Quality Incentives Program (EQIP) currently supports cost-share practices that are intended to improve livestock distribution, such as installing off-stream water points, cross-fencing, and/or riparian fencing. These practices, however, can be impractical or uneconomical at large spatial scales across rugged landscapes. **As an alternative, stockmanship—or, the knowledgeable and skillful handling of livestock in a safe, efficient, and low-stress manner—is another tool that can help address concerns over uneven utilization.** More specifically, low-stress herding can be used to strategically place livestock within a pasture to ensure uniform utilization of forage and to avoid excessive use of sensitive resources.

This article continues ►

Stockmanship cont'd

The livestock industries in Ventura and Santa Barbara are continually faced with new sets of production challenges. Unprecedented drought in recent years has forced ranchers to substantially de-stock and ranches are not supporting the number of animals they once did. Additionally, statewide regulators are increasingly concerned by the potential impacts that cattle pose to water quality. Recently, for example, the Los Angeles Regional Water Quality Control Board issued a regulatory action on the Ventura River that is impacting grazing operations within the watershed. This action, and others like it statewide, signal a trend of greater focus on water quality on rangelands and corresponding regulation for ranchers.

Stockmanship and low-stress herding are production strategies that would directly benefit ranchers in the region by lessening the impact of drought on their operation and helping avoid livestock-related impairments to water quality. Researchers on rangelands have noted that up to a third of the available forage in pastures goes unutilized because of poor livestock distribution. Using herding to improve distribution provides an opportunity to substantially increase the number of animal units that can graze in a pasture, which would provide critical relief during drought conditions. Stocking rate is the single most important indicator of profitability on a ranch, and low-stress herding has the potential to increase it by over 30%. Furthermore, low-stress herding will reduce the amount of time that cattle spend grazing near sensitive resources, namely riparian areas, and will protect against potential livestock-related water quality impairments. In a study on livestock distribution, researchers found that herding reduced the time cattle spent within 100 yards of streams by about 3 hours per day. Correspondingly, stubble heights in riparian areas where cattle were herded were about 3 inches higher than in areas where cattle were allowed to roam freely. While there may be some as start-up costs associated with herding to an operation's bottom line (increased labor or infrastructure to administer herding), we expect the long-term benefits (increased production due to increased stocking rates, more even herbaceous heights throughout the pastures, and diminished impacts to sensitive resources) will offset the costs.

But what is "herding" and "low-stress livestock handling," really? Many of the basic concepts of this kind of stockmanship were developed by the late Bud Williams. Bud did not "invent" herding or low-stress handling but instead organized deeply traditional handling techniques into a novel system. There are many modern teachers, but the kind of stockmanship instruction that I am most familiar with comes from Steve Cote, who studied with Bud for many years. As Steve puts it, in his "Manual of Stockmanship," "[stockmanship is] handling that 'fits' every animal in the herd….'Fits' means that the handler adjust position, angles, and speed of approach in order to set it up so that the stock want to do what they want, then he (or she) stays out of the way of their doing it but controls how they do it. Stock move not out of a sense of self-preservation but because it's profitable. They've experienced that they can stop or control pressure, which they want to do. They view the handler as dictator (albeit benevolent) so they turn over control and relax even more. The control you get over cattle makes it a powerful range management tool and a time and money saving tool on any operation. Stockmanship doesn't just up the level of control, it transforms traditionally handled herds—from troubled or scared to calm, trusting, healthy, and easy to control." The kind of stockmanship that Steve teaches includes principles that would strike most ranchers as counter-intuitive (for example, standing at the end of a chute and turning an animal from its head as it emerges, rather than from its hip), but it's amazing to see how calmly and effectively Steve can work stock in all kinds of different situations.

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Stockmanship cont'd

In October, I travelled to northeast Nevada to attend a four-day workshop hosted by Steve Cote and his wife, Susan. We were immersed in stockmanship and low-stress handling techniques and had an opportunity to work a number of different types of cattle: mature cows, heifers, recently weaned calves, etc. One story I was most impressed by was how—once your cattle are re-trained to these new handling techniques—you are able to herd and **place** cattle so that they'll stay where you put them. Steve showed video from a ranch in Idaho where they gathered and drove cattle up a draw that was half a mile from the nearest water point. The cattle stayed bunched there for over a week, and every late morning during that week they'd trail down to the water to take their fill, and then trail right back up to where the rancher had placed them. It is this kind of control that I believe has the greatest potential to improve distribution and increase stocking rates (due to improved forage utilization) on large ranches in Ventura and Santa Barbara Counties.

I am currently involved in a three-year study with Mike Williams, of Diamond W Cattle Company, on his 12,000-acre ranch in northern Los Angeles County. Mike and I are funded by a grant to examine how effective herding and low-stress livestock handling could be in a production ranching setting. We are using GPS collars to track cows over the course of three years on his ranch. The first year is our "control," or business as usual (i.e. no herding). In Years 2 and 3, Mike will apply our "treatment," or the regular gathering and placement of cattle using low-stress techniques. We are measuring the effectiveness of this technique using a combination of the GPS collars (to see if the cattle are staying where they get put), seasonal fecal pat counts (as another measurement to see if the cattle are using areas of the ranch differently), and we are monitoring Mike's labor (to see how much more time he spends in the herding treatments as opposed to business as usual, and to calculate what that time costs him).

Photo: Gathering fecal pat counts along a 50-meter transect at the Ritter Ranch, northern Los Angeles County. Number of feces will be counted seasonally in heavy-use areas of the ranch where cattle currently loaf and in light-use areas of the ranch that will be targeted in the herding treatments. December 2018 © Matthew Shapero.

In July 2019, we plan to hold a multi-day workshop out at Mike's ranch, to demonstrate the basic principles of stockmanship in the field and to share with participants our preliminary data and results. We plan to bring Steve Cote out for the workshop, in addition to academics from New Mexico State University, UC Davis, and Chico State who have studied livestock distribution. I will be sure to include an announcement for the workshop in future newsletters.

If you are interested in learning more about stockmanship, herding, and low-stress herding, here are some resources:

"Manual of Stockmanship," Steve Cote. This is Steve's most recent (and much longer) publication; contact him directly to obtain a copy: 731-336-1167.

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Stockmanship cont'd

Photo: Mother cow with GPS collar. GPS locations will be recorded every 10 minutes during the course of the study. Cows will be handled every six months and GPS data will be collected from collar. July 2018 © Matthew Shapero.

"Stockmanship: a powerful tool for grazing lands management," Steve Cote

Steve's 2004 summary of stockmanship principles. Pushed by NRCS and Butte Soil and Water Conservation District, it can be found at the following website: http://www.grandin.com/behaviour/principles/SteveCote.book.html

"Stockmanship Journal," Whit Hibbard

Whit is a Montana rancher and another stockmanship teacher. He has collected a lot of good information on his website: http://www.stockmanshipjournal.com/

"Evaluation of low-stress herding and supplement placement for managing cattle grazing in riparian and upland areas," Derek Bailey et al.

Research paper from Montana examining the effectiveness of herding. If you are interested in reading the results, please email me or visit my office to obtain a hard copy.

Editor's note: Matthew Shapero is a Livestock and Range Advisor with UCCE in Ventura and Santa Barbara Counties. You can contact him at mwkshapero@ucanr.edu *or* **(805) 645-1475** .

2019 CA Rangeland Climate & Drought Workshops

Weather, Grass, and Drought: Planning for Uncertainty

UC Cooperative Extension in partnership with the National Drought Mitigation Center, the USDA California Climate Hub, and the National Integrated Drought Information System is hosting 4 regional workshops on climate and drought resources to support short- and longer-term rangeland drought planning. Click the links in blue below to register or contact your local UCCE Office.

Topics include: *Behind the Scenes Look at US Drought Monitor; Overview of Drought Programs and Assistance; Weather Monitoring and Forecast Products; and Drought Early Warning Systems.*

Coastal California – Solvang

February 6th, 5:00-8:15pm
Solvang Veterans' Memorial Hall – Legion Wing
1745 Mission Drive, Solvang, CA 93463
ceventura.ucanr.edu/live_stock_-_range_programs/workshops

Central California – Tulare

February 7th, 5:00-8:15pm
Tulare County Cooperative Extension
4437-B S. Laspina St., Tulare, CA 93274
cekern.ucanr.edu

Sacramento Valley/Foothills California – Loomis

February 12th, 9:00am-1:30pm
Loomis Veteran's Memorial Hall
5945 Horseshoe Bar Road, Loomis, CA 95650
ucanr.edu/loomisdroughtworkshop

Northern California – Susanville

February 13th, 12:00-4:30pm
Susanville Elks' Lodge
400 Main Street, Susanville, CA 96130
ucanr.edu/survey/survey.cfm?surveynumber=26446

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