May 2012

Fort Keogh Researcher

In cooperation with

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Introduction

Dr. Mark Petersen, Research Leader

Greetings from Fort Keogh. What a difference one year makes. Last year at this time we were cold and wet while this year we have already had a 90° day and need moisture. We also had the 1902 bridge spanning the Yellowstone River and today that structure does not exist. The bridge was badly damaged in the ice jam during the winter of 2011 and was an imminent hazard poised to collapse into the river and then possibly causing damage to the infrastructure in Miles City. Although we lament the loss of a great historical bridge (which we used nearly every day) we are also happy we got it off the river before it collapsed. The assistance of our Area and Headquarters offices is appreciated.

Another change we are experiencing is in our research goals. We have outlined and defined new goals for the next five years which will start in January 2013. Our beef cattle research plan is currently in review by a scientific panel and the range research draft plan is near completion for a preliminary review within the Area Office. We have used this opportunity to converge some of our beef cattle objectives with important questions in the range research plan. The creation of some overlapping objectives we expect will enrich our research outcomes. We incorporated problems identified by our customer focus group to develop more effective practices for coping with drought and livestock production efficiency. The overall goal of our next research effort will be to reveal new knowledge leading to better understanding, new technologies or practices to enhance rangeland stability and to promote efficiency of beef cattle production.

One of the rewards for the scientific staff at Fort Keogh is to share our discoveries with our customers (anyone who uses the results of our research findings). Distributing the results of our research is different than conducting research but nearly as challenging as the research itself. Fortunately, our collaborative relationship with Montana State University allows for a Beef Cattle Extension Specialist to be officed at Fort Keogh who is Dr. Rachel Endecott. Her expertise is in Outreach and Communication and some of her responsibilities are to facilitate customers learning about and potentially adopting research

So long 1902 Bridge

Due to high water and ice jams over the years, the 1902 bridge over the Yellowstone River was about to fall into the river and had to be removed. Copp Construction out of Billings, Montana, was selected to dismantled it and did so by building a temporary bridge next to it and then took it apart span by span using cranes. It is sad to see it go but it was great the weather cooperated and it was accomplished safely.

Introduction (continued)

outcomes in their management. A glimpse at a few of the important findings that Rachel and others from the Fort have shown to customers includes: system benefits of returning rangeland fire to the plains to promote stability, lasting impacts of restoration techniques, and when to evaluate success and failure. In regards to beef cattle research findings we have provided a method to enhance cow longevity, conveyed important steps needed to assure maintenance of pregnancy within 20 days after conception and changes that occur in stock water quality due to source, season or year that can impact animal performance.

In addition to making our results more readily available, we are working to perfect more effective methods of keeping our customers interested. Our scientists are quite renowned and are invited to speak at numerous meetings during the year. These invitations range from International Scientific Symposiums, to national producer meetings such as the Range Beef Cow Symposium and local educational meetings such as Cow Capital Beef Days held in Miles City every year. We also celebrated the 3rd "Fort Keogh on the Road" in January 2012 at Big Timber. This is a meeting coordinated through Dr. Rachel Endecott, a county agent and a local Stock Growers group. Rachel solicits discussion topics from local groups. We then send back a list of approximately 10 - 12 topics which includes their input. Four to 5 topics are selected to present in their county to provide the program they asked.

Another method we use at Fort Keogh is to provide our results to customers through walking and/or vehicle tours of laboratories and research facilities. Usually groups contact us to discuss particular topics or they want a broad overview of everything we do. We like this because the groups want to come see us and discuss their questions with the scientific or agricultural staff. There are a number of these tours delivered every year. Look below and you can look at a summary of our Outreach efforts in the last year.

It is important for us to get the results of the research out to the people or groups that will use them. Our goal is to provide solutions for all types of customers including land managers, beef cattle producers and other scientists. We are working towards a report of our last 5 years of accomplishments that will be ready in June 2013. Stay tuned into our research.

We hope you have good spring and summer. Please contact us if we can facilitate an educational event or tour.

Type	Number	Audience	Attendance
Tours & Science Fair Dickinson State, Miles City & Area 1 & 5, Rural Schools, High School Ag Classes, Mental Health Clients, Montana Ag Teachers, Texas Tech Univ., Charolais Association Tour, Argentina Producer Tour	17	Students Teachers, Producers	700
Producer/Public Talks Weed & Range Seminar, Glendive—Weed & Range Seminar, Lewistown—Fort Keogh on the Road, Big Timber—MonDak Ag Days, Sidney, MT—Montana Weed Control Association, Great Falls, MT—Cow Capitol Beef Days, Miles City—Sheridan County Stockgrowers Association, Plentywood—Fallon County Grazing District—National Sheep Improvement Program at the Ram Sale, Miles City, MT—Prairie County Range Tour—Judith Basin County Range School, Geyser, MT Range Beef Cow Symposium, NE	19	Producers	1350+
Instructors at Meetings North American Invasive Plant Ecology & Management Short Course, Montana Range Days, Judith Basin County Range School	3	Peers Producers	300+
Scientific Exchange Genex (Pfizer)	1	Industry Cooperators	7
Congressional visit Tester and staffers	1	MT Senator	4
Professional Society Range Management, National Cattlemen's Beef Association, American Society Animal Science, Beef Improvement Federation,	16	Professional Scientists	3000+

Prescribed Fire Reduces Purple Threeawn Abundance
by Dustin Strong, Range Technician

Before I dive into the details of fire and purple threeawn, it's probably best I tell you how this North Dakotan ended up in Montana. It was 2010 and I was two months away from receiving my B.S. in Natural Resource Management from North Dakota State University in Fargo and the hunt was on to find a job. Through a professor at NDSU, I was able to line up an interview with a natural resource consulting company in Bozeman. So my wife, our three month old daughter, and I set off from the Red River Valley for the Gallatin Valley hoping to return with a job offer (or at least a second interview). The interview went well, but the more time we spent in Bozeman the less we could see ourselves sending roots down and raising a family there. Nothing against the Bozeman area, my wife and I are flatlanders and admitted a longtime ago we couldn't hack it in the mountains. So we left Bozeman the following morning, a little bewildered about what our next step would be, and around that time I received a call from my professor at NDSU informing me of a graduate student position in Miles City, Montana, with Fort Keogh. We figured it was worth a shot. After all, Miles City was close to our family in North Dakota and for a grass nerd like me, eastern Montana prairies are paradise. So, I stopped in at Fort Keogh for an interview with Range Ecologist Dr. Lance Vermeire and immediately felt like this is where I belonged. Dr. Vermeire offered me the graduate student position working with purple threeawn and I accepted. Fast forward to today, my family and I moved to Miles City, I am now a permanent employee at Fort Keogh, have a second daughter, and feel very blessed to work with all the wonderful people at Fort Keogh. I'll be finishing up the purple threeawn work this summer and will receive my M.S. in Range Science in December 2012. Well, enough about me, let's talk about purple threeawn and fire.

For those of you unfamiliar with purple threeawn, I'll do my best to get you acquainted with this grass. Purple threeawn (a.k.a. red threeawn) is a perennial native bunchgrass that occurs from British Columbia to Mexico. In Montana you are most likely to find this grass on hillsides, waste areas, and sandy soils. Within a healthy Montana rangeland plant community, purple threeawn will make up about 1-2% of the population. Livestock tend to avoid eating purple threeawn, mostly due to the three sharp awns (hence the name) which are attached to the seeds of this grass. These awns can cut the mouth, snout and eyes of livestock which may lead to infection and lots of discomfort for the animal. Also, sheep producers have trouble with these awns getting tangled in the coats of their sheep, which decreases the value of the fleece.

Through some research we are doing here at Fort Keogh we've discovered purple threeawn leaves have a high silica content, another reason cows would tend to avoid purple threeawn. Finally, even if cows would eat purple threeawn this grass does a poor job of supplying the nutrients our cattle need to survive.

Well, after reading the above paragraph you're probably wondering, what the heck purpose does purple threeawn serve? It seems like a "worthless" grass. However, it's important to remember this grass is part of our native plant communities and while our cows may not like to eat purple threeawn, it does help keep our rangelands healthy. Purple threeawn has a huge root system which it puts a ton of energy into producing right after it starts growing. I mentioned earlier we find this grass in Montana on hillsides and purple threeawn's roots system help to hold soil in place on these hillsides which decreases the soil erosion potential. This keeps soil out of our rivers and creeks which improves water quality for livestock and wildlife. Additionally, over time (a long, long time) purple threeawn roots die and break down and may increase soil fertility. So now that I have gone from saying this grass is no good to saying this grass is an important part of rangelands, you may be unsure of how to think about purple threeawn. Is purple threeawn a good guy or a bad guy? Welcome to my world. This is the question I have wrestled with almost every day since starting on this project and the answer is still not clear to me. What I can tell you is that when purple threeawn makes up 60-70% of the population in a plant community, from a livestock production standpoint, this is a problem. And this is the exact situation we ran across outside of Terry, MT.

We started this research in the summer of 2010 as a cooperative project between the Bureau of Land Management, Fort Keogh, and North Dakota State University. We have two research sites which are located about 5 miles southwest of Terry, MT on BLM grazing allotments. The primary goal of this research is to identify rangeland management tools that will reduce purple threeawn abundance and at the same time pave the way for other native plant species to move in and set up shop. We identified two tools that we believed would reduce purple threeawn numbers and encourage other native plants to colonize the area. One of these tools was nitrogen fertilizer. There were some folks in Colorado in the 1970s that had some luck reducing purple threeawn with nitrogen fertilization so we were interested in seeing if this strategy would work in Montana. It did not. We applied nitrogen at a low and high rate. Basically, the nitrogen fertilizer treatments did little but increase the size of purple threeawn plants regardless of how much we applied. For those of

Threeawn story, continued

those of you familiar with Dr. Lance Vermeire's work, I will give you one guess as to what the second treatment was. That's right, prescribed fire. Some research by a couple of range scientists in Texas during the 1960s suggested that fire could damage purple threeawn. We tested fires during different seasons (summer and fall) and we got some pretty exciting results. Drum roll please. Summer fire reduced purple threeawn biomass by 90% and fall fire reduced purple threeawn biomass by 75%. We expected fire to have a negative effect on purple threeawn but we did not expect to see such a dramatic effect.

Purple Three Awn (*Aristida purpurea* Poaceae

Picture from http://museum2.utep.edu/chih/gardens/plants/aristpurp.htm.

There are a couple of reasons why we think purple threeawn is negatively impacted by fire. One reason is purple threeawn is a bunchgrass. Bunchgrasses tend to have dead material buildup in and around individual plants over time which increases the amount of fuel associated with the plant. Higher amounts of fuel = hotter fires and hotter fires increases the likelihood the growing points of purple threeawn will be damaged by fire. A second reason fire reduces purple threeawn abundance is a result of this grass' photosynthetic pathway. Purple threeawn is a warm-season grass, which means it is most active during the peak summer months (July and August) and into the fall depending on the weather. This is likely part of the reason summer fires did such a number on purple threeawn.

So what does all this mean? As I said before, purple threeawn is a grass that is rarely grazed by livestock in the Northern Great Plains. However, when you burn purple threeawn, the plants that survive lose most of the features that discourage cattle from eating them. Those bothersome awns are burned off, the litter within the plant is consumed by fire, and the year following fire the re-growth of purple threeawn plants not killed by fire is relatively nutritious. Burned purple threeawn plants contain less silica and more crude protein and magnesium than plants that were not burned. These characteristics improve the palatability of purple threeawn. In addition, since some purple threeawn plants are killed by fire, this means there is the potential for other species to fill the spaces deserted by purple threeawn. An easy way to think about this is to imagine the plant community as a hotel. Like all hotels, the plant community only has so many rooms available. Before fire, purple threeawn was occupying the majority of the rooms and the hotel was fully booked. Following fire, most of the purple threeawn packed its bags and "checked out." This means there are now open rooms which may be "checked into" by other species, possibly desirable forage species.

At this point I can say with confidence that prescribed fire, particularly applied in the summer, will significantly reduce purple threeawn biomass and cover. From a livestock production standpoint, this is important for three reasons: 1) by removing purple threeawn from the plant community the overall grazing value of that plant community increases, 2) the purple threeawn not killed by fire is likely to be grazed by animals, and 3) the "rooms" vacated by purple threeawn are now open to be "checked into" by more desirable forage species.

This study will be wrapped up at the end of summer 2012, but we have plans to continue working with purple threeawn. So, if you made it all the way to this point in the article I know I've captured your attention (at least a little) and encourage you to be on the lookout for purple threeawn research coming out of Fort Keogh. Also, if you would like to chat with Dr. Vermeire or me about purple threeawn or any other rangeland ideas, our contact information can be found on Fort Keogh's website. Thanks for reading and Happy Spring!

Notes of Interest

A Gateway to Better Grazing

By Don Comis

Location, location, location: It's not just a mantra for real estate agents, but ranchers as well, according to Agricultural Research Service (ARS) scientist **Matt Rinella**.

Dr. Matthew Rinella

Rinella, a rangeland ecologist at the ARS Fort Keogh Livestock and Range Research Laboratory at Miles City, Mont., studied 7,200 hours of cattle-traveling activity data on mountainous range in Oregon. He used data downloaded from Global Positioning System (GPS) collars worn by up to 52 cattle in a herd of 500. The herd grazed for 50 days a year for 18 years in the experimental site.

He and colleagues from the U.S. Forest Service Pacific Northwest Research Station in La Grande, Ore., studied the dataset to see if it offered clues for solving a perennial problem of ranchers and other grazing land managers: how to get livestock to graze pastures evenly.

Rinella gridded the 5,864-acre study pasture into cells, each grid cell representing 9.9 acres. Then he identified the 10 most heavily grazed grid cells for further analysis. The stocking rate was based on the size of the pasture, but in reality cattle often ignored large portions of the pasture and focused grazing in and around the heavily grazed "hotspots."

Rinella was struck by how simple it can be to dramatically even out grazing in large mountainous pastures. In odd-numbered years, the cattle had entered the pasture along the east side. In even-numbered years, they entered through the southernmost gate.

In even-numbered years, grazing in the hotspots was down 50 percent, compared to odd years.

Rinella figured the reason was the distance and ease of access to the hotspots. Cattle entering the east gate had two roads that would take them to their favorite areas in two days. Conversely, when they entered through the south gate, they were much farther from those areas, with difficult mountainous terrain to cross, and no roads. So it took them weeks longer to locate and settle into the overgrazing-prone hotspots when they entered through the south gate.

Switching the entrance gates each year evened out the grazing quite a bit, without the expense of fencing, water troughs, herding or other methods typically used to overcome patchy grazing.

This made Rinella think that ranchers and other land managers could benefit by putting GPS collars on a few of their cattle. This would allow them to identify areas at risk of overgrazing and experiment with simple, cost-effective methods for encouraging livestock to graze more evenly. The key to this problem could very well be the one that opens their gates.

ARS is the principal intramural scientific research agency of the U.S. Department of Agriculture (USDA). Findings from this research, which supports the USDA commitment to sustainable agriculture, were published this year in the journal *Ecological Modeling*.

Retirements

Dr. Mike MacNeil

Dr. Michael D. MacNeil, Quantitative Geneticist, retired on December 15, 2011, after 28 years of Federal service of which the last 24 yeas were spent at Fort Keogh. Mike worked to improve beef cattle through genetic selection. His research using Line 1 Hereford cattle led not just to better genetic selection and line breeding, but also greater confidence on the part of the beef breeders in theoretical and applied genetic manipulation. His efforts to identify quantitative trait loci in beef cattle and his work to establish a national cattle evaluation system have brought untold benefits to beef breeders and consumers alike.

Sue Miles

Sue Miles also retired on December 15, 2011, after more than 10 years with the federal government including 3 years in the Army. Sue decided it was time to cut back on working and spend more time with the grandsons! She will be teaching at Miles Community College part time, working with the Barn Player's, and maybe working part-time too. Sue has been a very effective front desk person as well as a poster designer/builder and master of many other trades as they became necessary. Her bubbly personality and bright smile will be missed by all those that walk in the front door at Fort Keogh!

Fort Keogh Outreach Activities

March 16, 2012 – Senator Jon Tester and staff visited Fort Keogh. They toured the remodeled building and Lance Vermiere gave a fire demonstration. Andy Roberts gave a talk titled, "Beef cattle reducing cost of efficient beef production," and showed them the individual barn and grow safe feeding system.

February 9, 2012 – Tom Geary, Sue Bellows, Vicki Leesburg, Brad Eik, Dustin Strong, and Marnie Rout participated as judges at the annual Rural School Science Fair. Approximately 85 students participated.

February 9, 2012 – Andy Roberts traveled to Glendive, MT, to the Weed & Range Seminar sponsored by Dow AgroSciences, Crop Production Services, S "N" Weeds, LLC, Land O'Lakes, DuPont and BASF, and gave a talk titled, "Cost of early vs late calving."

February 1-4, 2012 – National Cattlemen's Beef Association meetings, Nashville, TN. Mark Petersen attended and represented Fort Keogh on the research committee.

January 28-February 1, 2012 – 2012 Annual meetings of the Society for Range Management, Lessons from the Past – Strategies for the Future, in Spokane, WA. Posters: Multi-trophic Effects of Russian Olive Removal and Restoration: Getting Information from Weed Eradication - Erin Espeland, Mark Petersen,and Jennifer Muscha; Variability in Range Cow Mineral Use is Associated with Season and Daily High Temperature in Northern Great Plains - J.M. Muscha, J.T. Mulliniks, A.J. Roberts, R.C. Waterman, J.A. Paterson, and M.K. Petersen; Fire Season and Frequency Effects on Native Grass Bud Banks in the Northern Great Plains - Morgan Russell (this poster received 1st place), NDSU graduate student of Lance Vermeire, Presentations: Fire and Nitrogen Effects on Purple Threeawn-invaded Plant Communities - Dustin J. Strong, Lance T. Vermeire, and Amy C. Ganguli, Fire and Nitrogen Fertilization Effects on Purple Threeawn in Vitro Fermentation and Gas Production - Nickolas Dufek, Lance Vermeire, Richard Waterman, Amy Ganguli.

January 26, 2012 – Andy Roberts traveled to Lewistown, MT to the Weed & Range Seminar held at the Eagles Club and gave a talk titled, "Cost of early vs late calving."

January 24, 2012 – **Fort Keogh on the Road** appeared in Big Timber, MT, with Drs. Geary, Roberts, Waterman, Espeland, Reinhart, Petersen, Mulliniks, and Endecott giving presentations. Lunch was hosted by the Crazy Mountain Stockgrowers.

January 23, 2012 – Tom Geary gave a talk on synchronization to the Genex representatives and customers in Lewistown.

January 18, 2012 – Brad Eik gave a tour to the High School Ag class.

January 12, 2012 – Andy Roberts traveled to Sidney, Montana, and gave a talk titled "Factors that affect cow efficiency" at MonDak Ag Days.

January 12, 2012 – Matt Rinella gave a talk to Montana Weed Control Association in Great Falls, MT.

January 6, 2012 – Cow Capital Beef Days, Eagle Lodge, Miles City, MT – talks were given by Matt Cronin, visiting scientist, and Rachel Endecott, Extension Beef Specialist.

November 30, 2011, Andy Roberts traveled to Mitchell, NE, and gave a talk at the Range Beef Cow Symposium titled "Feed efficiency: How should it be used for the cow herd" to about 630 attendees.

November 12, 2011—Richard Waterman gave a talk 'Nutrient utilization due to season, physiological state, and management' at the annual Sheridan County Stockgrowers Association in Plentywood, MT.

Fort Keogh Current Publications

Dufek, N.A., Vermeire, L.T., Waterman, R.C., Ganguli, A.C. 2012. Fire and nitrogen fertilization effects on Purple Threeawn in vitro fermentation and gas production. Society for Range Management. Meeting Abstracts #0160.

Endecott, R.L., Cox, S.H., Rubio, C.M., Loest, C.A., Hawkins, D.E., Petersen, M.K. 2012. Effects of supplements with increasing glucogenic precursor content on reproduction and nutrient partitioning in young postpartum range cows. Livestock Science 145:109–118.

Funston, R.N., Summers, A.F., Roberts, A.J. 2011. Implications of nutritional management for beef cow/calf systems. Journal of Animal Science. Online first doi:10.2527/jas.2011-4569.

Funston, R.N., Martin, J.L., Larson, D.M., Roberts, A.J. 2012. Nutritional aspects of developing replacement heifers. Journal of Animal Science. 90:1166 -1171.

Geary, T.W. 2012. Effects of adrenocorticotropic hormone and flunixin meglumine on pregnancy retention in beef cows. Journal of Animal Science 90:207 -211.

Muscha, J.M., Mulliniks, J.T., Roberts, A.J., Waterman, R.C., Paterson, J.A., Petersen, M.K. 2012. Variability in range cow mineral use is associated with season and daily high temperature in Northern Great Plains. Society for Range Management Meeting Abstract #0261.

Pohler, K.G., Geary, T.W., Atkins, J.A., Perry, G.A., Jinks, E.M., Smith, M.F. 2012. Follicular Determinants of Pregnancy Establishment and Maintenance. Cell and Tissue Research. DOI 10.1007/s00441-012-1386-8. Online.

Reinhart, K.O., Johnson, D., Clay, K. 2012. Effects of trees on their recruits in the southern Appalachians, USA. Forest Ecology and Management. 263:268-274.

Rinella, D.J., Wipfli, M.S., Sticker, G.A., Heintz, R.A., Rinella, M.J. 2012. Salmon returns and consumer fitness: growth and energy storage in stream-dwelling salmonids increases with spawning salmon abundance. Canadian Journal of Fisheries and Aquatic Science 69:73-84.

Roberts, A.J., Funston, R., Mulliniks, T., Petersen, M.K., MacNeil, M.D. 2011. Feed efficiency -how should it be used for the cow herd?. Range Beef Cow Symposium Proceedings XXII:122-131.

Russell, M.L., Vermeire, L.T., Hendrickson, J.R., Ganguli, A.C. 2012. Fire Season and Frequency Effects on Native Grass Bud Banks in the Northern Great Plains. Society for Range Management Abstract #0057.

Sawyer, J.E., Mulliniks, J.T., Waterman, R.C., Petersen, M.K. 2012. Influence of protein type and level on nitrogen and forage utilization in cows consuming low-quality forage. Journal of Animal Science. Online: http://jas.fass.org/content/early/2012/01/27/jas.2011-4782.

Strong, D.J., Vermeire, L.T., Ganguli, A.C. 2012. Fire and nitrogen effects on purple threeawn invaded plant communities. Society for Range Management Meeting Abstract #0117.

Assistant's Corner
By Brad Eik

Greetings friends and neighbors,

Hope everyone is enjoying the nice spring weather and getting calving and branding all wrapped up for another year. Just a little update on a few things going on with the cow herds at Fort Keogh. We enjoyed the mild winter and have a big hay stockpile from this winter which was nice as we had to buy 300 bales the year before. We were able to take advantage of all the old grass this winter in pastures along with some 20% protein range cake and the cows look as good as they ever have.

Calving has been good to us as well with very limited death loss and we are hoping to continue that trend through the grazing season.

We had a very good Line 1 production sale this year in March averaging $4,002.00 on 26 bulls and $1,794.12 on 17 head of females. We were very pleased and would like to thank all the new and repeat buyers for supporting our research and our cattle.

It is almost breeding time again and most of the cows have already had their prebreeding vaccinations consisting of Trivib 5L and Pyramid 5. Branding is close to being done with only 80 calves out of 1200 cows calving this spring left. We are starting another year of our fly control study. The cow herds are split up with half receiving fly tags and the other half starting on mineral with IGR at the end of last month. It's shaping up to be a bad fly year and we are hoping for good results in year two of this trial.

Research supports the old saying that "the black baldie female is the queen of the prairies." I have spent this spring trying to buy registered Black Angus heifers to match our Line 1 heifers for a new heterosis project slated to start this breeding season. We are planning to split the Line 1 and Angus heifers into two breeding groups with a Timed AI on all of them—one half bred Black Angus and the other half bred Line 1 Hereford. Clean up bulls will be turned out the same way. The scientists will be finding genetic reasons and markers that may be useful in helping producers select a certain type of bull or cow to help their existing cows be more efficient and increase production and profits. I raise black baldies at home and I'm very excited to see results from this study. We could use a few more registered black heifers before we get going. If anyone knows of any available please contact me ASAP at 406-853-2635.

I hope everyone has a great summer and don't forget if you ever have any questions or ideas about our research here or anything else cattle related please contact us. We would be glad to listen and try to find some answers for you. Helping producers is what we are here for.

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If you have email and would rather
Receive this newsletter as a .pdf file,
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Fort.Keogh@ars.usda.gov

Fort Keogh
On the Road

Rangeland, Livestock, and Nutrition Seminar

Wednesday May 23, 2012
9:00am-12:00pm Choteau, MT
City Park Pavilion 202 1st St NE

Topics Include:

Reproductive Success from Nutritional Assessments of Range Cows,
Travis Mulliniks, Graduate Student NMSU, USDA Agricultural Research Service- Fort Keogh LARRL

Principles of Rangeland Supplementation
Dr. Mark Petersen, USDA –Agricultural Research Service - Fort Keogh LARRL

Heifer Development and Lifetime Production Efficiency
Dr. Andy Roberts, USDA-Agricultural Research Service - Fort Keogh LARRL

Variability in Stock Water Quality and Winter Water Temperature Effects
Dr. Mark Petersen, USDA –Agricultural Research Service - Fort Keogh LARRL

Hosted By: Teton County Conservation District

Sponsored by:

USDA-ARS

USDA-NRCS

Front Range Supply

NutraLix