

CONTESTANT NO. \_\_\_\_\_

**2014 UNDERGRADUATE RANGE MANAGEMENT EXAM  
(a mini-URME)**

**Society for Range Management, Wyoming Section**

**Evanston, WY  
November 19, 2014**

**Instructions**

**This examination consists of 49 multiple choice questions. Choose the one best answer for each question and fill in the appropriate circle on the scantron answer sheet provided.**

**Put your assigned contestant number on this examination booklet. Put your name and contestant number on the scantron answer sheet.**

**Length of Testing Period**

**60 Minutes**

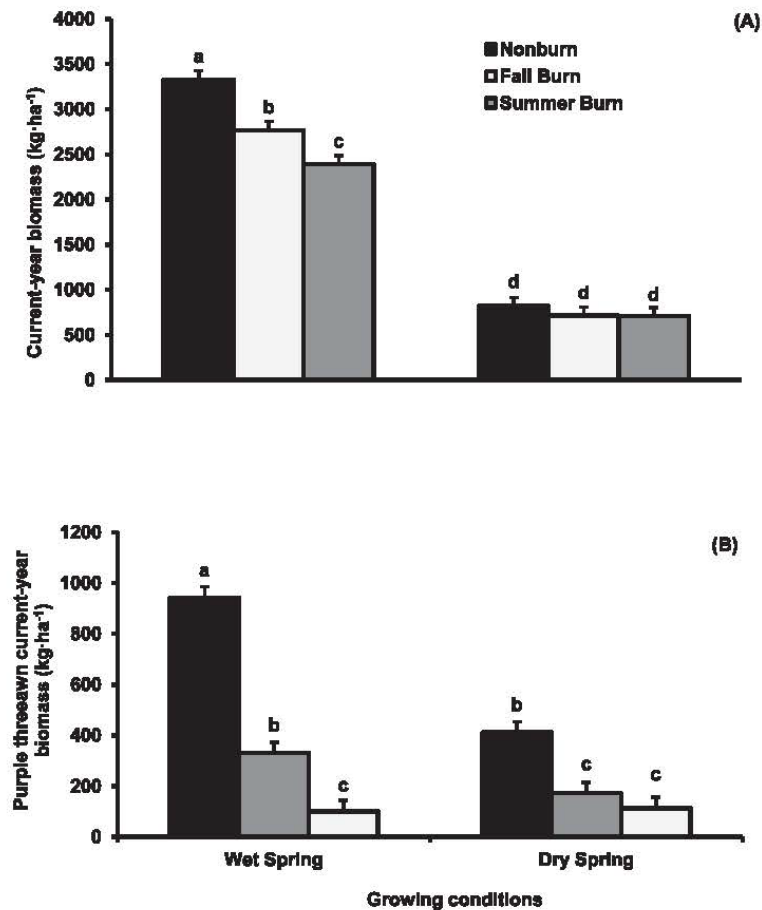
**Grading**

**The entire examination is worth 150 points.**

**I. RANGE ECOLOGY (30 points)**

1. The total surface area per gram of soil \_\_\_\_\_ as particle size decreases.
  - a. **Increases**
  - b. Decreases
  - c. Stays the same
  
2. A soil with a pH of 8 is \_\_\_\_\_ times as alkaline as a soil with a pH of 5.
  - a. 3
  - b. 30
  - c. 100
  - d. **1000**
  
3. (4 pts) If the  $\delta^{13}\text{C}$  value for a  $\text{C}_4$  plant monoculture is  $-13\text{‰}$ , and  $\delta^{13}\text{C}$  value for a  $\text{C}_3$  plant monoculture is  $-27\text{‰}$ , what is the percentage of the plant community that is  $\text{C}_4$  plants if the  $\delta^{13}\text{C}$  value is  $-17\text{‰}$ ?
  - a. 29
  - b. 36
  - c. 64
  - d. **71**
  
4. Dyksterhuis used plant response groups (e.g., decreasers) in his rangeland condition classification to generate condition estimates for categories that included:
  - a. Early-seral, mid-seral, and late-seral
  - b. **Poor, fair, good and excellent**
  - c. Degraded, transitioning, restored, and healthy
  - d. Native, introduced, invaded and exotic
  
5. (4pts) If a population growth rate is 2%, how many years does it take to double the population?
  - a. 25
  - b. **35**
  - c. 50
  - d. 140
  
6. How does phosphorus normally enter ecosystems?
  - a. Photosynthesis
  - b. **Rock weathering**
  - c. Geologic uplifting (subduction and volcanism)
  - d. Atmospheric deposition
  
7. Of the usable solar radiation available to plants on rangelands, how much is NOT used by photosynthesis?
  - a. <1%
  - b. 25%
  - c. 75%
  - d. **>99%**

For questions 8 and 9, please use the following figure (Strong et al. 2013 REM)



**Figure 3.** Fire effects on A, current-year biomass (+SEc) and B, purple threeawn current-year biomass (+SEc) one growing season postfire under wet and dry spring growing conditions. Means marked with the same letter within a panel are similar ( $P > 0.05$ ).

8. **(4 pts)** Current year biomass:

- Is reduced by a similar magnitude by both fall and summer burns in a wet and dry spring relative to the control plots
- Is influenced by burning when a dry spring occurs, but not for a wet spring
- Is influenced more by summer burning than by fall burning in a wet spring**
- Is influenced more by fall burning than by summer burning in a dry spring

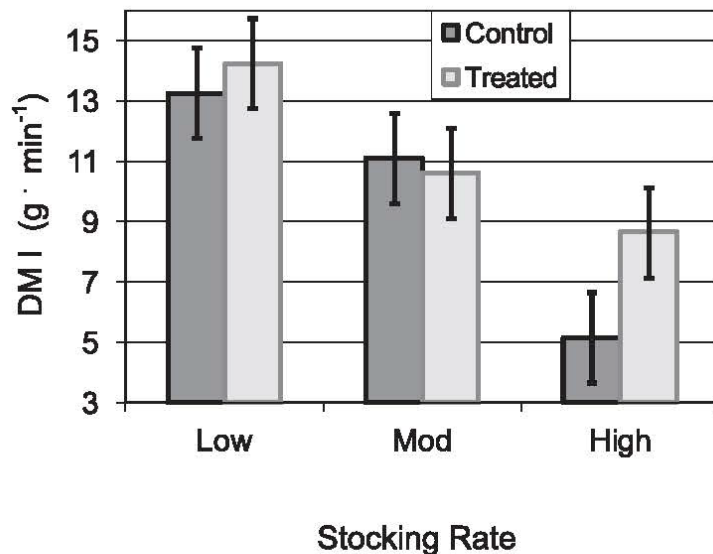
9. **(4 pts)** Purple threeawn current year biomass:

- Is reduced by a similar magnitude by both fall and summer burns in a wet and dry spring relative to the control plots
- Is influenced by burning when a dry spring occurs, but not for a wet spring
- Is influenced more by fall burning than by summer burning in a wet spring**
- Is influenced more by summer burning than by fall burning in a dry spring

10. Livestock grazing is not adequately simulated by clipping studies because:
- Plant parts and plant species are nonselectively consumed by livestock
  - Plant species are selectively consumed by livestock but plant parts are nonselectively consumed by livestock
  - Plant parts are selectively consumed by livestock but plant species are nonselectively consumed by livestock
  - Plant parts and species are selectively consumed by livestock**
11. The least mature tissue of a leaf blade is located:
- At the tip of the leaf
  - At the mid-portion of the leaf
  - At the base of the leaf**

## II. GRAZING MANAGEMENT (24 points)

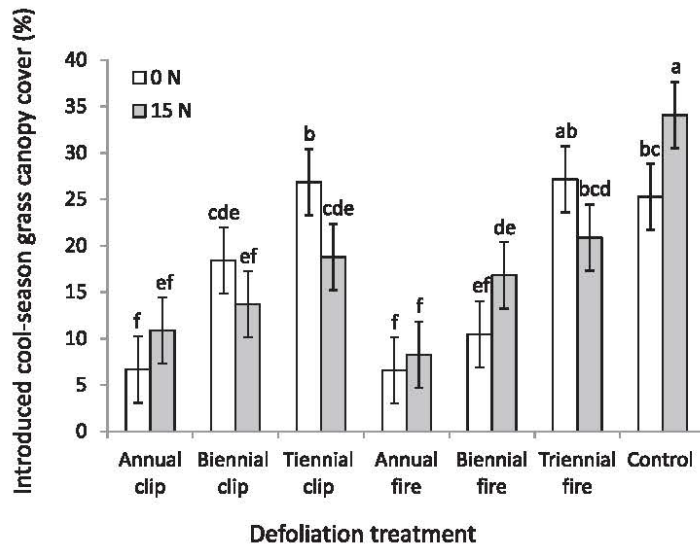
For question 12, please use the following figure (Clark et al. 2013 REM)



**Figure 1.** Grams dry matter consumed · min<sup>-1</sup> of cattle grazing at low, moderate, and high stocking rates in control and treated pastures at the Starkey Experimental Forest and Range, northeast Oregon (data averaged over 2005 and 2006). Grams consumed · min<sup>-1</sup> decreased in both control and treated pastures as stocking rate increased ( $P=0.003$ ; pooled SE=1.68,  $n=4$ ).

12. (4 pts) Dry matter intake (grams of dry matter consumed per minute):
- Increases with increasing stocking rate
  - Decreases with decreasing stocking rate
  - Decreases with increasing stocking rate**
13. Younger plants compared to older plants have a \_\_\_\_\_ percentage of lignin and cellulose and \_\_\_\_\_ digestibility.
- Lower, higher**
  - Lower, lower
  - Higher, lower

For questions 14 and 15, please use the following figure (Smart et al. 2013 REM)



**Figure 2.** Introduced cool-season grass canopy cover (%) defoliation treatment by nitrogen interaction ( $P=0.03$ ) 0 or 15 kg N·ha<sup>-1</sup> averaged over years at the native prairie site located in east-central South Dakota. Columns with different letters are significantly different ( $P < 0.05$ ).

14. (4 pts) Introduced cool-season grass canopy cover:
- Was consistently higher in the 15 kg N/ha treatment compared to the 0 kg N/ha level across the fire defoliation treatments
  - Was consistently lower in the 15 kg N/ha treatment compared to the control level across the clipping defoliation treatments**
  - Was consistently lower in the 15 kg N/ha treatment compared to the 0 kg N/ha level across the clipping defoliation treatments
15. (4 pts) Defoliation treatment influence introduced cool-season grass canopy cover as:
- Annual clip and annual fire had differential effects on canopy cover across the nitrogen levels
  - Biennial clip and biennial fire had differential effects on canopy cover across the nitrogen levels
  - Triennial clip and triennial fire had differential effects on canopy cover across the nitrogen levels
  - All of the above
  - None of the above**
16. (4 pts) You have a 6-pasture rotational grazing system (pastures all the same area) with a stocking rate of 1.4 AUM/ha. You have 600 yearling steers (AUE=0.70), that graze the pastures from April 30 to October 1. Each pasture has how many hectares?
- 250 ha**
  - 300 ha
  - 1500 ha
  - 1800 ha

17. **(4 pts)** If a plant community within an ecological site produces 40 g from a circular quadrat with a diameter of 80 cm, and the desired use on this plant community is 40% and livestock consumption represents half of the desired use, how much forage is available for livestock consumption?
- 40 kg/ha
  - 160 kg/ha**
  - 320 kg/ha
  - 640 kg/ha
18. On the “Grass Used to be as High as the Stirrups on My Horse” ranch, the grazing strategy in 2014 was to have 20 yearling steers (AUE=0.70) in each of ten, 129.5 ha pastures from May 15 to October 1. For 2015, the steers will be combined into a single herd and rotated among the ten pastures from April 30 to September 15. Which of the following statements concerning stocking rate and stock density is correct?
- Both stocking rate and stocking density are the same for 2014 and 2015
  - Stocking density throughout the grazing season is 10 times higher in 2015 compared to 2014, and stocking rates are the same between 2014 and 2015**
  - Stocking rate is ten times higher in 2015 compared to 2014, and stocking density is the same between 2014 and 2015

**IIa. GRAZING MANAGEMENT PROBLEM (6 points) – See END OF TEST**

**III. RANGE IMPROVEMENT (24 points)**

19. Which of these improvement practices would be considered the least intensive?
- Deferred grazing**
  - Fertilization
  - Revegetation
  - Irrigation
20. In arid and semiarid rangelands, watering facilities for cattle distribution purposes should be:
- Clustered together to create areas of high use and areas without use
  - Located at distances beyond 10 km to prevent cattle from using more than one watering facility at a time
  - Systematically-spaced at a set distance apart in a grid pattern regardless of terrain/topography to ensure similar use by cattle on all areas
  - All of the above
  - None of the above**
21. To increase efficacy of control of a noxious weed using herbicides, which of these approaches would be best?
- Apply the herbicide at a higher rate than recommended on the label
  - Ensure that the herbicide volatilizes during application
  - Apply the herbicide using different equipment than recommended on the label
  - All of the above
  - None of the above**

For questions 22-23, please use the following table (Strong et al. 2013 REM)

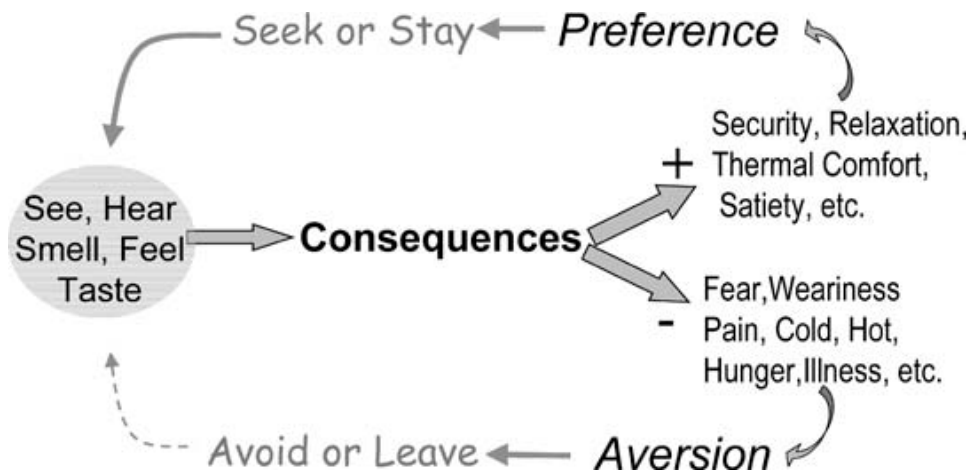
**Table 1.** Ground cover response to spring growing conditions, fire, and nitrogen amendments by effect and component.

Independent variable	Basal cover (%)		Bare ground (%)
	Purple threeawn	Needle-and-thread	
<i>Year</i>			
Wet spring	11.3 b <sup>1</sup>	0.7 b	46.6 b
Dry spring	15.2 a	1.8 a	66.4 a
<i>Fire</i>			
No burn	32.5 a	2.1 a	32.4 c
Fall burn	5.3 b	0.7 b	65.6 b
Summer burn	2.0 b	0.9 b	71.6 a
<i>Nitrogen</i>			
0 kg N · ha <sup>-1</sup>	13.8 a	1.1 a	60.3 a
46 kg N · ha <sup>-1</sup>	13.6 a	1.1 a	53.8 b
80 kg N · ha <sup>-1</sup>	12.4 a	1.6 a	55.4 ab

<sup>1</sup>Means with the same letters within year, fire, and nitrogen effect and response variable are similar ( $P > 0.05$ ).

22. (4 pts) Which of the following statements is correct regarding basal cover responses to fire?
- Fall and summer burns had similar effects on basal cover of purple threeawn and needle-and-thread**
  - Fall and summer burns has similar effects on bare ground
  - Reductions in basal cover due to fall and summer burns were greater for needle-and-thread compared to purple threeawn
23. (4 pts) Which of the following statements is correct regarding basal cover responses to nitrogen addition?
- Additions of 46 kg N/ha and 80 kg N/ha had different effects on basal cover of purple threeawn
  - Additions of 46 kg N/ha and 80 kg N/ha had similar effects on basal cover of needle-and-thread**
  - Additions of 46 kg N/ha and 80 kg N/ha had similar effects on bare ground
24. (4 pts) If a tractor mounted sprayer travels at 8.8 km/hr, has an output of 35 liters/min, and a desired application rate of 120 liters/ha, what is the spray width?
- 2 m
  - 8 m
  - 20 m**
  - 40 m

For question 24, please use the following figure (Launchbaugh and Howery 2005 REM)



25. (4 pts) Using the above figure, which of the following statements is correct?
- A positive consequence of the animal within this habitat will result in the animal leaving the habitat
  - Taste is most often the sensory stimuli that results in a negative consequence for an animal within a habitat which leads to the animal subsequently avoiding the habitat
  - Taste is most often the sensory stimuli that results in a negative consequence for an animal within a habitat which leads to the animal subsequently avoiding the habitat
  - All of the above
  - None of the above**
26. Consider the following two fuel types, both have equal weight and been exposed to a lengthy drying period: Type A is a loose pile of twigs and small boles whereas Type B is a tightly packed pile of large boles. Which of the following statements is correct?
- Type A will burn at a higher intensity and burn longer than Type B
  - Type B will burn at a higher intensity and burn longer than Type A
  - Type A will burn at a lower intensity and burn faster than Type B
  - All of the above
  - None of the above**

### IIIa. RANGE IMPROVEMENT PROBLEM (6 points) - SEE END OF TEST

### IV. RANGE REGIONS (16 points)

27. Plant-soil interactions in mesic grassland ecosystems are driven by \_\_\_\_\_ constraints and in xeric grassland ecosystems plant-soil interactions are driven by \_\_\_\_\_ constraints.
- Aboveground, belowground**
  - Aboveground, aboveground
  - Belowground, aboveground
  - Belowground, belowground



28. Which of the following statements is correct regarding temperature and precipitation gradients in the Great Plains?
- Temperature increases from east to west, and precipitation decreases from south to north
  - Precipitation increases from west to east and temperature increases from north to south**
  - Temperature decreases from west to east and precipitation increases from north to south
  - Precipitation decreases from west to east and temperature decreases from north to south
29. Which of the desert regions receives the largest percentage of summer precipitation?
- Cold desert
  - Mojave desert
  - Sonoran desert
  - Chihuahuan desert**
30. Which of the following is the correct order regarding size of the hot deserts (smallest to largest)?
- Mojave, Chihuahuan, Sonoran
  - Chihuahuan, Sonoran, Mojave
  - Sonoran, Mojave, Chihuahuan
  - Mojave, Sonoran, Chihuahuan**
31. Which of the following range regions has timber production as a primary use, common land management includes periodic prescribed winter burning to reduce mulch accumulation, and phosphorus is deficient in soils?
- Southern pine forest**
  - Eastern deciduous forest
  - Oak woodland
  - Western coniferous forest
32. Which of the following represents the correct order of the lowest to highest elevations of forest zones in the Western Coniferous Forest?
- Douglas fir, Ponderosa pine, Piñon-Juniper
  - Piñon-Juniper, Douglas fir, Ponderosa pine
  - Piñon-Juniper, Ponderosa pine, Douglas fir**
  - Ponderosa pine, Douglas fir, Piñon-Juniper
33. Which of the following is correct for the Alpine Tundra?
- Characterized by long, warm growing seasons and short, cold winters
  - Vegetation can have a high percentage of cryptogams present**
  - A majority of the precipitation occurs as rain
  - The primary environmental attribute affecting function of this system is wind

34. Which of the following is correct for vegetation structure?
- Rangelands with less vegetation structure heterogeneity have a higher diversity of grassland birds
  - Rangelands with more vegetation structure heterogeneity have a lower diversity of grassland birds
  - Rangelands with short levels of vegetation structure are often lacking grassland birds that have tall structure habitat requirements**
  - All of the above
  - None of the above

## V. RANGE INVENTORY AND ANALYSIS (20 points)

For questions 35-36, please use the following table. Canopy cover data from sampling one 10 m transect using line intercept method. Start/end represents beginning/ending of cover for each class/species. Values in table are in cm.

Class/species	start	end	start	end	start	end
Bare soil	0	30	590	640	920	970
<i>Artemisia tridentata</i>	30	450	670	740	790	920
<i>Artemisia frigida</i>	450	520	640	670	990	1000
Perennial grasses	520	590	740	790	970	990

35. (4 pts) What is the cover of *Artemisia tridentata*?
- 6.2%
  - 42%
  - 62%**
  - 620%
36. (4 pts) Based on the table in the previous question, which of the following statements is correct regarding canopy cover?
- Bare soil is higher than perennial grasses
  - Bare soil is one-fourth the amount of canopy cover as *Artemisia tridentata*
  - Bare soil is 18% higher than *Artemisia frigida***
37. What is the range of values that is expected to include the true population size, or any other parameter of interest, a given percentage of the time?
- Coefficient of variation
  - Standard error
  - Confidence interval**
  - Standard deviation
38. The mode is the \_\_\_\_\_ number in a data set.
- Most common**
  - Middle
  - Least common
  - Average

39. Which monitoring technique would provide the most desirable information on a key forage species for determining stocking rate?
- Basal cover
  - Density
  - Biomass**
  - Frequency
40. Which monitoring technique provides information related to determining the presence/absence of a species?
- Basal cover
  - Density
  - Biomass
  - Frequency**
41. The mean is the \_\_\_\_\_ number in a data set.
- Most common
  - Middle
  - Least common
  - Average**
42. An assessment of the direction of change in range condition based on a qualitative assessment is called:
- Actual trend
  - Apparent trend**
  - Resource rating trend
  - Ecological rating trend

**Va. RANGE INVENTORY AND ANALYSIS PROBLEM (10 points) - SEE END OF TEST**

**VI. MULTIPLE USE RELATIONSHIPS (14 points)**

43. Which of the following animals typically causes the most soil surface disturbance in rangeland ecosystems?
- Cottontail rabbits
  - Prairie dogs**
  - Antelope
  - Ground nesting birds
44. (4 pts) On the dominant ecological site at your ranch, bulk density of the soil is 1.25 g/cm<sup>3</sup>. Soil was collected in a container that was 0.05 m in height and 60 mm in diameter. The fresh weight (moist) of the soil was 263 g without the weight of the container. What was the mass of the water in the soil?
- 52 g
  - 86 g**
  - 210 g
  - 329 g

For questions 45-46, please use the following table (Groom and Western 2013 REM)

**Table 2.** Descriptive statistics and Mann–Whitney U test results for comparison between densities of different wildlife guilds on Mbirikani (unsubdivided) and Merueshi (subdivided). Grazers included zebra, wildebeest, Thomson’s gazelle, oryx, and Coke’s hartebeest; browsers included gerenuk, giraffe, and lesser kudu; and mixed feeders included eland, Grant’s gazelle, and impala.

	Wildlife guild	Ranch	Mean $\pm$ SE	Median (inter-quartile range)	<i>W</i>	<i>Z</i>	<i>P</i>
Dry season <sup>1</sup>	Grazers	Mbirikani	7.7 $\pm$ 1.49	0.0 (0.00–3.57)	72 354.50	–5.210	< 0.01 <sup>3</sup>
		Merueshi	3.0 $\pm$ 0.68	0.0 (0.00–0.00)			
	Browsers	Mbirikani	0.9 $\pm$ 0.21	0.0 (0.00–0.00)	73 579.50	–5.761	< 0.01 <sup>3</sup>
		Merueshi	0.2 $\pm$ 0.07	0.0 (0.00–0.00)			
	Mixed feeders	Mbirikani	2.8 $\pm$ 0.55	0.0 (0.00–1.28)	74 499.50	–3.719	< 0.01 <sup>3</sup>
		Merueshi	2.5 $\pm$ 0.51	0.0 (0.00–0.00)			
Wet season <sup>2</sup>	Grazers	Mbirikani	13.5 $\pm$ 2.03	0.0 (0.00–10.15)	96 422.00	–6.007	< 0.01 <sup>3</sup>
		Merueshi	8.0 $\pm$ 2.55	0.0 (0.00–0.00)			
	Browsers	Mbirikani	1.2 $\pm$ 0.36	0.0 (0.00–0.00)	100 294.50	–5.983	< 0.01 <sup>3</sup>
		Merueshi	0.5 $\pm$ 0.16	0.0 (0.00–0.00)			
	Mixed feeders	Mbirikani	3.0 $\pm$ 0.50	0.0 (0.00–2.52)	98 511.50	–5.527	< 0.01 <sup>3</sup>
		Merueshi	2.1 $\pm$ 0.35	0.0 (0.00–0.00)			

<sup>1</sup>*N* – 235 transects on Mbirikani and 297 on Merueshi.

<sup>2</sup>*N* – 338 transects on Mbirikani and 327 on Merueshi.

<sup>3</sup>Indicates Mbirikani value is greater than Merueshi value.

45. (4 pts) Which of the following statements regarding the effects of land use (subdivided vs. unsubdivided) is correct for the dry season?
- Grazers are less on the unsubdivided than the subdivided lands
  - Browsers are greater on the unsubdivided than the subdivided lands**
  - Mixed feeders are greater on the subdivided than the unsubdivided lands
46. (4 pts) Which of the following statements regarding the effects of land use (subdivided vs. unsubdivided) is correct for the wet season?
- Grazers are greater on the unsubdivided than the subdivided lands**
  - Browsers are greater on the subdivided than the unsubdivided lands
  - Mixed feeders are less on the unsubdivided than the subdivided lands

## GRAZING MANAGEMENT PROBLEM (6 points)

Following the extended droughts of 2011-2013 in parts of the Great Plains of North America, the It Is Only Wet After a Rain Ranch received two offers from overseas ranchers regarding grazing their rangeland. One rancher is from Brazil, the other from Kazakhstan. The owners of the It Is Only Wet After a Rain Ranch have hired you, based on recommendations from the President of the Society for Range Management, to determine which of the two offers would provide a greater income source for the ranch in 2014. The two ranchers have submitted sealed grazing bids for the upcoming 2014 grazing season, and you are about to open them and find out the offers.

The offer from the rancher in Brazil is: Graze 1400 yearling steers (0.75 AUE) from June 15 to October 31, with a 0.80 kg/head/day expectation of weight gain. He is offering \$30/AUM, with a discount of \$8/AUM if the weight gain of the steers is below 0.75 kg/head/day, and an incentive of \$5/AUM if the weight gain of the steers is 0.90 kg/head/day or above.

The offer from the rancher in Kazakhstan is:

Graze 300 cows (1.0 AUE for six months without a calf, 1.3 AUE for six months with calf) year-round. He is offering you the heifer calves from the cows as payment (assume 90% weaning percentage, and steer:heifer ratio is 50:50).

47. (6 pts) Which of the following price per heifer calf values would exceed the payment from the Brazil offer assuming the yearling steer weight gain is 0.85 kg/head/day?
- \$950
  - \$1000
  - \$1050
  - \$1100**

Answer: 135 heifer calves X \$1,100 = \$148,500 whereas the Brazil offer is \$141,750

Brazil offer is 4725 AUM (1400 X 0.75 X 4.5) X \$22/AUM (discount rate) = \$103,950; X \$30/AUM (regular rate) = \$141,750.

Kazakhstan offer is 135 heifer calves (300 cows X 90% weaning percentage = 270 live calves at weaning, and half of these are heifers) X \$1,100 = \$148,500

**RANGE IMPROVEMENTS PROBLEM (6 points)**

On your N Stands for Nitrogen and kNowledge Ranch, you are considering two alternatives for increasing the nutrient status of your soils, and as a result, enhancing your forage quantity. One option is to interseed a legume, with expected responses of a 42% increase in forage production above the typical values of 1,600 kg/ha for your ranch. Your ranching operation currently runs 900 yearling steers (AUE=0.7) from April 15 to October 15, with a stocking rate of 0.8 AUM/ha.

48. **(6 pts)** What is expected forage production increase for the ranch if  $\frac{1}{2}$  of the ranch is interseeded?
- a. 672 kg
  - b. 1,270,080 kg
  - c. 1,587,600 kg**
  - d. 5,367,600 kg
  - e. Not enough information provided to determine a correct answer

Answer: 900 steers X 0.7 AUE X 6 M = 3780 AUM. Divide this by 0.8 AUM/ha to get 4725 ha for the ranch size.  $\frac{1}{2}$  of this is 2362.5 ha, and the increase in forage production is 42% of 1600kg/ha (or 672 kg/ha increase), so multiply 2362.5 by 672 to get 1,587,600 kg.

### RANGE INVENTORY AND ANALYSIS PROBLEM – 10 points total

The Board of Directors of the Society for Range Management have asked you for assistance in the strategic, long-term planning for ranches in the northern mixed-grass prairie. With climate change influencing precipitation amounts and seasonal distribution, the Board is wanting to ascertain how forage and livestock production may be impacted. You know that spring (April, May and June) precipitation is influential for both forage and livestock production. You find a regression equation of forage production (kg/ha) =  $4008x / (564 + x)$ , where  $x$  is equal to the summation of the April+May+June precipitation amounts (in mm). You find a regression equation of livestock production (kg/ha) =  $0.2537x$ , where  $x$  is equal to the summation of the April+May+June precipitation amounts (in mm). From looking at weather data at the High Plains Regional Climate Center, you find that the April through June precipitation total is 16.4 cm. According to the IPCC (Intergovernmental Panel on Climate Change), the prediction for the northern mixed-grass prairie is 10% increase in spring (April-June) precipitation with a range from 5 to 20%.

49. **(10 pts)** For livestock production with the predicted changes in spring precipitation, which of the following statements is correct?
- Livestock production is 62 kg/ha greater with the 20% prediction increase in spring precipitation compared to the 5% prediction increase
  - Livestock production is 42 kg/ha greater with the 10% prediction increase in spring precipitation compared to current levels
  - Livestock production is greater by 5, 10 and 20%, respectively, with the 5, 10, and 20% prediction increases in spring precipitation**
  - Livestock production is 8.3 kg/ha greater with the 20% prediction increase in spring precipitation compared to the 10% prediction increase

Answer: the equation is linear, so any increase in livestock production will be proportional to the increase in precipitation.