CONTESTANT NO._____

2013 UNDERGRADUATE RANGE MANAGEMENT EXAM (a mini-URME)

Society for Range Management, Wyoming Student Competition

Sheridan, Wyoming
November 13, 2013

Instructions

This examination consists of 52 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. As energy moves upward through trophic levels, it is _____ at each step in the food chain through respiration, and its transfer is _____ considerably at each stage.
   a. Dissipated, decreased
   b. Increased, increased
   c. Concentrated, decreased
   d. Concentrated, attenuated

2. As particle size decreases, the total surface area per gram of soil:
   a. Increases
   b. Decreases
   c. Stays the same

3. A soil with a pH of 5 is _____ times as acidic as a soil with a pH of 8.
   a. 0.3
   b. 3
   c. 30
   d. 1000

4. Decreasing wind velocity will _____ evaporation and _____ the effectiveness of precipitation.
   a. Increase, decrease
   b. Decrease, increase
   c. Increase, increase
   d. Decrease, decrease

5. Which of the following would be a representative $\delta^{13}C$ value for a C_4 plant species?
   a. –13‰
   b. 0‰
   c. –27‰
   d. none of the above

6. Carbohydrates that consist of glucose, fructose, and sucrose are called:
   a. Structural
   b. Non-structural
   c. Fixed

7. According to _____, rangeland condition classification used plant response groups (e.g., decreasers) to generate condition estimates (excellent, good, fair, or poor).
   a. Clements
   b. Dyksterhuis
   c. Gleason
   d. Weaver

8. Plants undergo water stress when the rate of ____ is exceeded by the rate of ____.
   a. Absorption, transpiration
   b. Transpiration, precipitation
   c. Evaporation, infiltration

9. If an exponentially growing population had a constant growth rate of 5%, how many years would it take for that population to double?
   a. 5
   b. 10
   c. 14
   d. 25

10. The generalized grazing model of Milchunas et al. (1988) suggests that plant diversity in grassland communities in relation to grazing can be expressed along gradients of:
   a. Soil fertility and elevation
   b. Evolutionary history of grazing and moisture
   c. Temperature and nitrogen availability

11. Which of the following statements is most correct?
   a. Vegetation occurring at elevation X on the north slope of a mountain would be found at elevations greater than X on the south slope
   b. Vegetation occurring at elevation X on the south slope of a mountain would be found at elevations greater than X on the north slope
   c. Vegetation occurring at elevation X on the north slope of a mountain would be found at elevations less than X on the south slope

12. The fate of nitrogen as it moves from the atmosphere through the soil and back to the atmosphere is best depicted by which of the following?
   a. Nitrogen fixation, nitrification, denitrification, ammonification
   b. Nitrogen fixation, ammonification, nitrification, denitrification
   c. Nitrogen fixation, ammonification, denitrification, nitrification
   d. Nitrogen fixation, nitrification, ammonification, denitrification

13. Etiolated growth is used to investigate carbohydrate reserves in plants because it is:
   a. independent of nutrient absorption
   b. independent of current photosynthesis
   c. independent of stored photosynthetic products

14. Stability is a measure of persistence in the face of disturbance. Two components of stability are resistance and resilience. Resilience refers to:
   a. The ability of a community to avoid change in the face of disturbance
   b. The ability of a community to return to its former state after it has been displaced from that state
   c. The ability of a community to resist returning to its former state after it has been displaced from that state

15. The process which occurs when two or more organisms are making a common endeavor to acquire a resource in excess of immediate supply is called:
    a. Allelopathy
    b. Mutualism
    c. Competition
    d. Neutralism

II. GRAZING MANAGEMENT (24 points)

16. **(4 pts)** If feedstuff weighing 2.4 kg contains 60 g of nitrogen, what percent crude protein is the feedstuff?
    a. 0.4%
    b. 2.5%
    c. 14.4%
    d. 15.6%
    e. 40.0%

For questions 17-18, please use the following table (Fynn 2012 REM)

Table 1. Grass standing biomass at which various herbivores are expected to maximize energy intake. Herbivore mass is the upper range limit obtained from Smithers (1983). Optimum grass standing biomass derived from the equation: $\text{antilog}_{10} y = -0.088 + 0.86 \times \log_{10}$ body mass (Wilmshurst et al. 2000).

Species	Herbivore mass (kg)	Optimum grass standing biomass ($g \cdot m^{-2}$)
Springbok	47	22.4
Impala	65	29.6
Tsessebe	140	57.2
Wildebeest	250	94.2
Cow	500	171
Buffalo	800	256.2

17. **(4 pts)** Regarding the relationship of herbivore mass to optimum grass standing biomass, which of the following statements is most correct?
    a. As herbivore mass increases, optimum grass standing biomass decreases
    b. As optimum grass standing biomass decreases, herbivore mass decreases
    c. As herbivore mass decreases, optimum grass standing biomass increases
    d. As optimum grass standing biomass increases, herbivore mass decreases

18. **(4 pts)** If estimated grass standing biomass on your pasture is 2000 $kg \cdot ha^{-1}$, which herbivore would be expected to most closely maximize their energy intake?
    a. Springbok
    b. Impala
    c. Wildebeest
    d. Cow
    e. Buffalo

19. **(4 pts)** If a plant community within an ecological site produces 33 g/0.25 m^2, and the desired use on this plant community is 60% and livestock consumption represents half of the desired use, how much forage is available for livestock consumption?
    a. 66 kg/ha
    b. 264 kg/ha
    c. 396 kg/ha
    d. 660 kg/ha

For questions 20-23, please use the one of the two following answers regarding the most appropriate category of grazing resistance:

a. tolerance b. avoidance

20. Thorns: _____ b

21. Tannins: _____ b

22. Rapid regrowth:_____ a

23. Low growing points:_____ a

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

III. RANGE IMPROVEMENT (24 points)

24. Chemical and mechanical scarification break which type of seed dormancy?
    a. Hard seed
    b. Internal
    c. Impervious seed coat

25. Which of the following would be considered the most extensive (i.e., least energy input) rangeland management practice?
    a. Fertilization
    b. Use of herbicides to control invasive plants
    c. Targeted grazing to manipulate plant community composition

26. Which of the following is not one of the three sides of the environmental fire triangle?
    a. Weather
    b. Oxygen
    c. Topography
    d. Fuels

27. Which of the following is not one of the three sides of the physical fire triangle?
    a. Wind
    b. Fuel
    c. Oxygen
    d. Heat

For questions 28-29, please use the following figure (Madsen et al. 2012 REM)

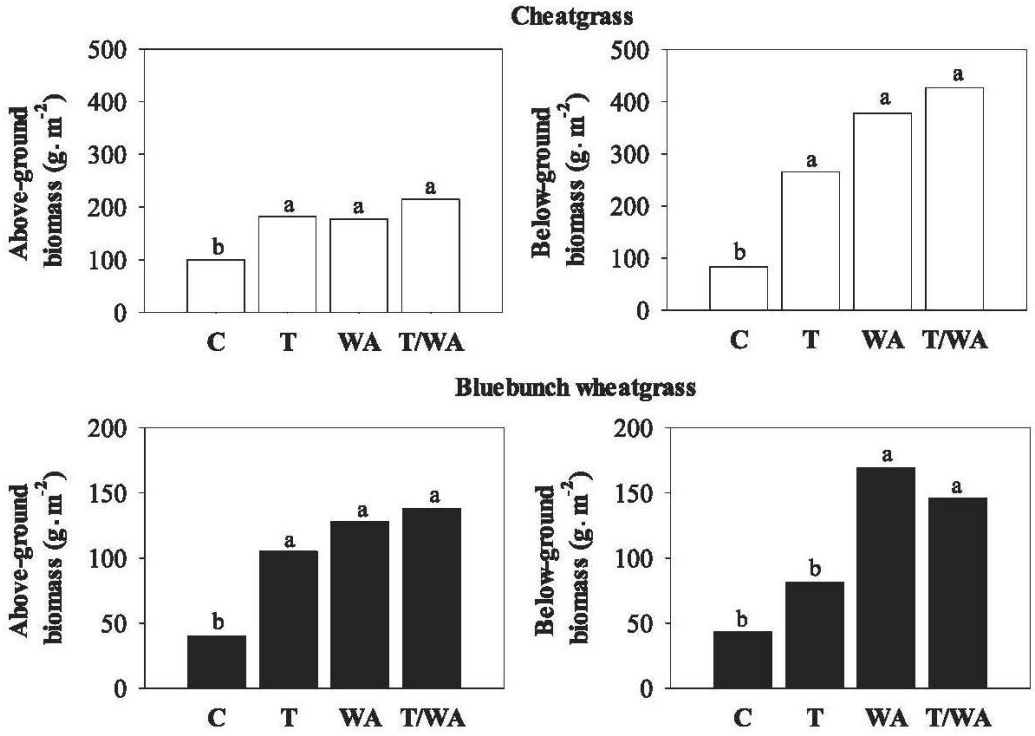


Figure 4. Above- and below-ground biomass of cheatgrass, and bluebunch wheatgrass grown on water-repellent soil, for control (C), till (T), wetting agent (WA), and till + wetting agent (T/WA) treatments. Different lowercase letters indicate significant differences among treatments ($P < 0.05$).

28. (**4 pts**) Regarding biomass responses to the treatments, which of the following statements is most correct?
    - **a. Both above- and below-ground biomass in cheatgrass responded positively to all three treatments, relative to the control (C) treatment**
    - b. Both above- and below-ground biomass in bluebunch wheatgrass responded positively to all three treatments, relative to the control (C) treatment
    - c. Belowground biomass was more responsive to the treatments in bluebunch wheatgrass than in cheatgrass
    - d. None of the above

29. (**4 pts**) For land managers, which of the following statements regarding management strategies for bluebunch wheatgrass on water repellent soils is most correct?
    - a. Tilling water repellent soils benefits both above- and below-ground biomass
    - **b. Adding a wetting agent benefits both above- and below-ground biomass**
    - c. Combining tilling and adding a wetting agent is more advantageous for both above- and below-ground biomass than the individual management strategy of adding a wetting agent alone

30. Discount rates reflect the influence of:
    - **a. Time**
    - b. Location
    - c. Commodity

31. What are the three primary plant macronutrients?
    a. Magnesium, sulfur and calcium
    b. Nitrogen, magnesium and potassium
    c. Phosphorus, calcium and nitrogen
    d. Potassium, phosphorus and nitrogen

For question 32, please use the following table (Henderson et al. 2012 REM)

Table 2. Botanical composition (± SE) of cattle and sheep diets in June or July on spotted knapweed–infested foothill rangeland in western Montana.

	Month	
	June	July
	% (SE)	
Cattle		
Graminoids	44 (3.1) a	34 (1.6) b[1]
Spotted knapweed	12 (2.3) a	26 (2.8) b
Other forbs	44 (1.7) a	41 (1.6) a
Sheep		
Graminoids	39 (1.6) a	31 (2.2) b
Spotted knapweed	11 (2.1) a	28 (4.7) b
Other forbs	50 (1.1) a	41 (2.6) a

[1]Means in the same row with the same letter are not different ($P > 0.05$).

32. **(4 pts**) Which of the following statements is most correct regarding botanical composition of diets?
    a. Diets of cattle have a lower composition of graminoids and higher composition of spotted knapweed in June compared to July
    b. Diets of sheep have a higher composition of graminoids and lower composition of spotted knapweed in July compared to June
    c. Composition of other forbs in the diets in June and July are similar for sheep, as well as for cattle
    d. None of the above

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

IV. RANGE REGIONS (16 points)

For questions 33-38, please use one of the three following answers regarding the timing of peak precipitation for each range region.

a. winter/spring b. summer c. fall

33. Sagebrush steppe: _____ a

34. Northern mixed-grass prairie: _____ a

35. Southern mixed-grass prairie:_____ b

36. Shortgrass steppe:_____ b

37. Salt desert shrub:_____ a

38. California annual grasslands:_____ a

For question 39, please use the following table (Ritten et al. 2012 REM)

Table 2. Carbon credit sequestration rate per hectare per year by geographic region.

Land resource region	Carbon credit[1] rate (credit · ha^{-1})
Northwest, Rocky Mountain, and Northern Great Plains	0.3
California	0.4
Central Great Plains	0.49
Western Great Plains	0.67

[1]A carbon credit is defined as 1 ton of CO_2e.

39. (**4 pts**) How many hectares are required in the given land resource region to produce the equivalent of the carbon credits per year from 2,200 ha in the Central Great Plains?
    a. 323 hectares in the Northwest, Rocky Mountain and Northern Great Plains land resource region
    b. 723 hectares in the Western Great Plains land resource region
    c. 2,695 hectares in the California land resource region
    d. None of the above

V. RANGE INVENTORY AND ANALYSIS (20 points)

40. Point methods can be used to:
    a. Estimate plant community composition
    b. Calculate plant diversity
    c. Sample for rare plant species

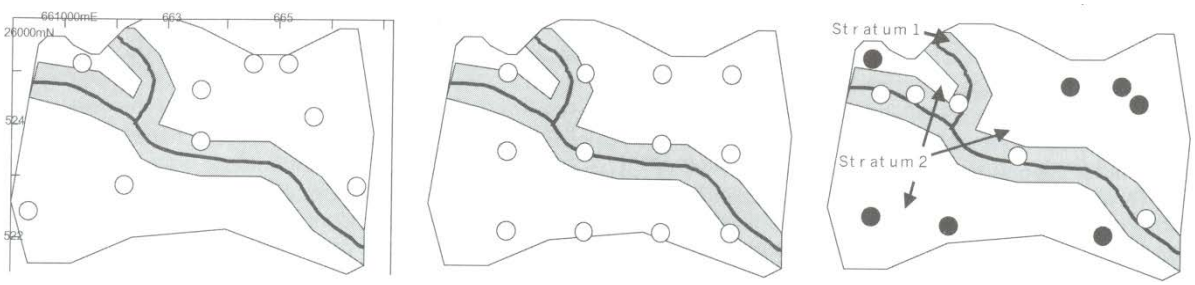
For questions 41-42, please use the following table which has a summary of regression relationships between sediment yield (SY) and runoff (Q) determined for stock pond watersheds within the Walnut Gulch Experimental Watershed in Arizona.

Stock Pond No.	Regression equation	R^2	P value
201	SY= 0.003Q + 39.0	0.26	0.09
207	SY = 0.008Q +2.8	0.63	0.01
208	SY = 0.005Q + 10.7	0.86	0.0003
213	SY = 0.008Q + 64.7	0.99	0.00
214	SY = 0.006Q + 352.0	0.15	0.16
215	SY = 0.006Q + 172.0	0.61	0.02
216	SY = 0.01Q + 104.0	0.63	0.02
223	SY = 0.02Q + 112.0	0.35	0.06

41. **(4 pts)** Which stock pond regression equation explains the most variability?
    a. 201
    b. 213
    c. 214
    d. 223

42. **(4 pts)** Which stock pond regression equation has the lowest slope?
    a. 201
    b. 213
    c. 214
    d. 216

For questions 43-44, please use the following figure, which relates to vegetation in a study area sampled with 3 sampling designs labeled A, B, and C. The grey region is a riparian area, whereas the white region is upland rangeland.



A **B** **C**

43. **(4 pts)** Which sampling design provides the most uniform coverage to sample variability in vegetation across the landscape?
    a. Sampling design A
    b. Sampling design B
    c. Sampling design C

44. **(4 pts)** The type of sampling depicted with the sampling design in A is:
    a. Stratified random
    b. Systematic
    c. Simple random

45. Which of the following is the most common monitoring technique used to determine how susceptible a rangeland is to soil erosion?
    a. Density
    b. Forage production
    c. Frequency
    d. Cover

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

VI. MULTIPLE USE RELATIONSHIPS (14 points)

Soil was collected in a container measuring 5 cm in height and 6 cm in diameter. The fresh (moist) weight of the soil without the container was 230 g. The dry weight of the soil without the container was 177 g. Using this information, please answer questions 46-47.

46. **(4pts)** What is the bulk density of the soil?
    a. 0.37 g/cm^3
    b. 0.98 g/cm^3
    c. 1.25 g/cm^3
    d. 1.63 g/cm^3

47. **(4pts)** What is the gravimetric water content of the soil?
    a. 1.3%
    b. 23.0%
    c. 29.9%

48. Interactions between cattle and elk that use a common resource that is in short supply is best described as:
    a. Intraspecific competition
    b. Interspecific competition
    c. Intraspecific commensalism
    d. Interspecific commensalism

For question 49, please use the following figure (Lewis et al. 2012 REM)

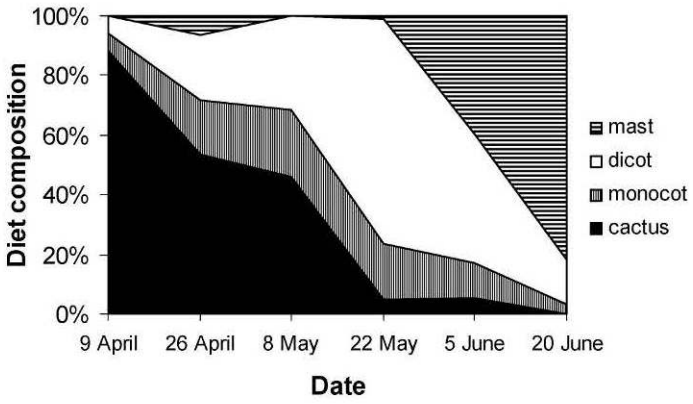


Figure 2. Diet composition of white-tailed deer based on analysis of rumen contents from deer collected during six periods after a 14–15 March 2008 wildfire in southern Texas.

49. (**4 pts**) Which of the following statements regarding white-tailed deer diet composition is most correct?
    a. Diet composition remained largely constant across sampling dates for the deer
    b. The proportion of cactus in the diet decreased as time since wildfire increased
    c. From mid-May to mid-June, deer shifted from a high composition of mast to a high composition of dicots

GRAZING MANAGEMENT PROBLEM (6 points)

The It Sure Got Dry This Year Ranch in the Sandhills of Nebraska has asked you to make drought management recommendations for the ranch in 2013. Given the widespread drought conditions across most rangelands in North America, you want to make a site visit to the ranch to assess the situation and learn what was done in 2012 (as well as earlier). On your site visit, you determine that the prominent ecological site on this ranch for summer grazing is Choppy Sands and the estimated aboveground productivity of the prevailing state in this ecological site ranges from 1,065 kg/ha (dry years), to 1,600 kg/ha (average years) to 1,960 kg/ha (wet years). You also glean that there are 10 pastures of 259 hectares each of summer pasture and that these pastures have been season-long (May 15 to October 15) grazed with large-sized cow-calf pairs (1.5 AUE) with a targeted utilization of 25% of aboveground productivity (using average years production). The ranch assumes that 1 AU consumes 273 kg of forage each month. The ranch destocked their cow herd by 50% in 2012 in response to the extreme drought.

50. **(6 pts)** Assume that 2013 is going to be a dry year and the plan is to graze the full summer grazing season, with the 25% targeted use. Which of the following statements is most correct regarding the management decisions regarding numbers of grazing animals for the It Sure Got Dry This Year Ranch to ensure proper use of available forage?
    a. The ranch should sell an additional 84 cows (AUE=1.5) prior to the summer grazing season.
    b. The ranch should sell an additional 169 cows (AUE=1.5) prior to the summer grazing season.
    c. The ranch should purchase 168 yearling stockers (AUE=0.75) prior to the summer grazing season.
    d. The ranch should purchase 337 cows with calves (AUE=1.5) prior to the summer grazing season.

Answer: Ranch has 2,590 ha (10 x 259 ha) of summer pasture. 2,590 ha x 1,065 kg/ha (production in a dry year) = 2,758,350 kg of forage x 25% use = 689,587.5 available for livestock. Divide this number by 5 months of summer grazing = 137,917.5 kg per month. Since 1 AU consumes 273 kg per month, the cow-calf pair (1.5 AUE) consumes 1.5 X 273 kg or 409.5 kg per month. Divide 137,917.5 kg forage per month by 409.5 kg forage demand = 337 cow-calf pairs could graze in 2013. Currently have 253 on ranch (due to 50% destocking in 2012). So 337-253 = 84 cow-calf pairs needed, but could also purchase 168 yearling stockers (since 1 stocker = 0.75 AUE or ½ of cow-calf AUE).

RANGE IMPROVEMENTS PROBLEM (6 points)

On your Dry as Dirt Ranch, the manager has interest in installing a solar pump to supply water to a tank that is 100 cm tall and has a diameter of 10m. This solar pump would replace an antiquated Dempster brand windmill that was installed just before the Dust Bowl years of the 1930s. Funding is available to cost share at least 50% of the installation costs of the solar pump, but the tank is in good shape having been replaced during the recent oil boom. Current livestock demand on this tank is from a herd of 100 cows that drinks 60 liters/cow/day. Also current evaporation causes losses of 1,000 liters/day.

51. **(6 pts)** What is the needed pump rate of the solar pump (in liters/minute) that will provide no net daily loss, while preventing any overflow from the tank (assume that the solar pump operates 12 hours in a day)?
    a. 8.33
    b. 9.72
    c. 291.67
    d. 500.00
    e. 583.33

Answer: Water demand by cattle for one day is 100 head X 60 liters/cow or 6,000 liters. Loss due to evaporation is 1,000 liters/day. Total water to be replaced daily is 6,000 + 1,000 or 7,000 liters. If the solar pump is operational for 12 hours, then 7,000 liters divided by 12 is 583.33 liters/hour. Take this value divided by 60 minutes is 9.72 liters/minute.

RANGE INVENTORY AND ANALYSIS PROBLEM – 10 points total

You have been tasked with creating a monitoring plan to provide real-time data to inform the manager at the Almost Got It Paid For Ranch to make adaptive management decisions on when to move livestock from one pasture to the next, rather than prior efforts which have been time-controlled (e.g., move the livestock according to a set calendar schedule). You decide to use the Robel pole method, which provides information on the height-density of the vegetation and can be correlated to remaining standing crop biomass (e.g., residue) for ecological sites, as the monitoring metric to determine livestock moves. On the Almost Got It Paid For Ranch, you determine that two ecological sites (Loamy Plains and Sandy Plains) represent the majority of the summer pastures. Reading the ecological site descriptions, you find that the average forage production for the existing vegetation state in the Loamy Plains is 800 kg/ha and for Sandy Plains, the value is 1000 kg/ha. The ranch has 6 summer pastures, they are only grazed once each grazing season, and the manager wants to leave 45% of the production as residue in Loamy Plains pastures and 55% of the production as residue in Sandy Plains pastures when the livestock are removed. You visit with rangeland professionals in the area and find out that prediction equations have been completed for determining standing crop biomass from Robel pole readings. For the Loamy Plains, the equation is $y = 160 + 50(x)$, where Y=standing crop biomass (in kg/ha), and x = height reading from Robel pole (in cm). For Sandy Plains, the equation is $y = 190 + 60(x)$.

You measure 77 locations for Robel pole height readings in a Sandy Plains pasture on July 6. The mean reading from these locations is 8 cm. This pasture is 800 ha and is being grazed by 1200 yearling heifers (AUE=0.7). Assume that this is an average production year, that no additional forage is produced in this pasture after July 6 and 1 AU consumes 9 kg daily.

52. **(10 pts)** When is the targeted date for moving these cattle from this pasture?
    a. July 7
    b. July 15
    c. July 18
    d. July 29
    e. There is not enough information provided to answer this question

Answer: Plugging 8 cm into the prediction equation for Sandy Plains yields $y = 190 + 60(8)$ or y=670 kg/ha. With 55% of average production left for residue (55% of 1000 kg/ha is 550 kg/ha), there remains 120 kg/ha to remove (670-550=120). Multiply 120 kg/ha by 800 ha and the total forage to remove is 96,000 kg. Daily demand is 1200 heifers X (0.7 X 9 kg) or 7,560 kg per day. Divide 96,000 kg available by 7,560 kg daily demand = 12.7 days of forage or need to move in 12 days to not exceed the threshold, so July 18.