

CONTESTANT NO. _____

**2016 UNDERGRADUATE RANGE MANAGEMENT EXAM
(a mini-URME)**

Wyoming Section - Society for Range Management

Instructions

This examination consists of 50 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. **(4 pts)** Globally, rangelands occupy about _____% of the earth's land area and approximately _____% of the global terrestrial net primary productivity originates from rangelands.
 - a. 25, 25
 - b. 50, 25
 - c. 50, 75
 - d. 75, 75

2. Animal protein production is predicted to increase by _____% by the year 2050 to accommodate an additional 2 billion humans and a sharp rise in the global middle class.
 - a. 10
 - b. 25
 - c. 70
 - d. 200

3. **(4pts)** The projected growth rate for human population in Cody, Wyoming for the next decade is 4.7%; how many years will it take to double the population of Cody?
 - a. 14.9
 - b. 21.3
 - c. 27
 - d. Not enough information provided to answer

4. A caespitose growth form for plants best describes a:
 - a. sod-forming grass.
 - b. suffrutescent woody plant.
 - c. solitary stemmed forb.
 - d. bunch grass.

5. A non-heritable shift in the physiological state of an organism in response to exposure to an environmental condition is:
 - a. genetic shift
 - b. acclimation
 - c. genetic modification
 - d. natural selection

6. How much usable solar radiation available to range plants is utilized in photosynthesis?
 - a. <1%
 - b. 5-10%
 - c. 60-70%

7. In soil horizons, which soil particles are most often leached?
 - a. Sand
 - b. Silt
 - c. Clay

For questions 8 and 9, please use the following figure (Madsen et al. 2016 Soil Biology and Biochemistry)

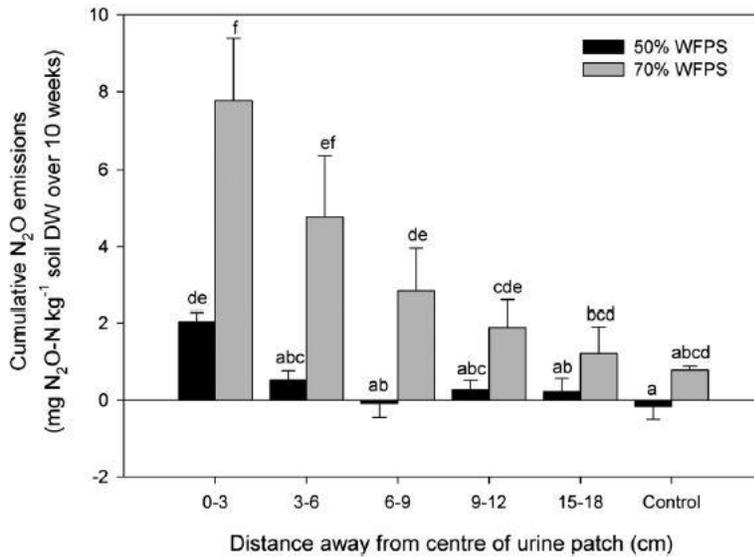


Fig. 4. Cumulative nitrous oxide emissions following sheep urine application to a Eutric Cambisol, maintained at either 50% or 70% water-filled pore space (WFPS) and sampled at increasing distances away from direct area of urine application. Bars represent means \pm SEM ($n = 4$) and different letters indicate significant differences (Fisher's LSD, $p < 0.05$).

8. (4pts) Regarding the influence of water-filled pore space (WFPS), which of the following statements is most correct?
- Cumulative N₂O emissions are greater for the 70% WFPS treatment across all of the distances away from the center of the urine patch.
 - Cumulative N₂O emissions are less for the 70% WFPS treatment across all of the distances away from the center of the urine patch.
 - Cumulative N₂O emissions are greater for the 70% WFPS treatment for distances > 12 cm away from the center of the urine patch.
 - Cumulative N₂O emissions are greater for the 70% WFPS treatment for distances < 9 cm away from the center of the urine patch.
9. (4 pts) Regarding the influence of distance away from the center of the urine patch, which of the following statements is most correct?
- For distances > 3 cm cumulative N₂O emissions are lower than emissions from the 0-3 cm distance for the 50% water-filled pore space (WFPS).
 - For distances > 3 cm cumulative N₂O emissions are lower than emissions from the 0-3 cm distance for the 70% water-filled pore space (WFPS).
 - For distances > 6 cm cumulative N₂O emissions are greater than emissions from the control for the 50% water-filled pore space (WFPS).
 - For distances > 6 cm cumulative N₂O emissions are greater than emissions from the control for the 70% water-filled pore space (WFPS).

10. A volcano erupted five years ago and destroyed all organic life (microbes included) under a thick layer of ash. Currently, plant life is beginning to appear. What is this an example of?
- Restoration
 - Secondary succession
 - Tertiary succession
 - Primary succession
11. El Niño is a climatic phenomenon characterized by the warming of surface ocean waters in the eastern and central equatorial Pacific Ocean. El Niño events:
- typically last for 7-10 years.
 - typically occur once every 20 years.
 - typically are similar in magnitude of effects across events.
 - all of the above
 - none of the above

II. GRAZING MANAGEMENT (24 points)

12. Cattle density is highest in which country?
- Argentina
 - Brazil
 - India
 - United States
13. In the United States, over 50% of the beef cattle herds have less than 50 cows.
- True
 - False
14. Which of the following crops grown for biofuel have byproducts which are used by livestock?
- Corn
 - Sugarcane
 - Both A and B
 - none of the above
15. Sub-Saharan Africa is a global hotspot for high greenhouse gas emission intensities from livestock due to:
- poor management.
 - low quality feeds.
 - animals with low productive potential per animal.
 - A and B
 - B and C

16. Genetic improvements for feed efficiency are using the metric Residual Feed Intake (RFI) which is:

- reduced feed consumption required to support maintenance and production compared to the predicted or average quantity.
- enhanced feed consumption required to support maintenance and production compared to the predicted or average quantity.
- the amount of feed intake to support one animal unit for one month.
- the amount of forage remaining in a pasture following the grazing event.

17. (4 pts) About _____% of the cows in Canada and the United States bear a live calf every year, whereas the percentage drops to _____% in South American countries like Brazil and Argentina.

- 90, 25
- 90, 55
- 70, 55
- 50, 25

For question 18, please use the following figure (Onatibia and Aguilar 2016 J of Arid Environments)

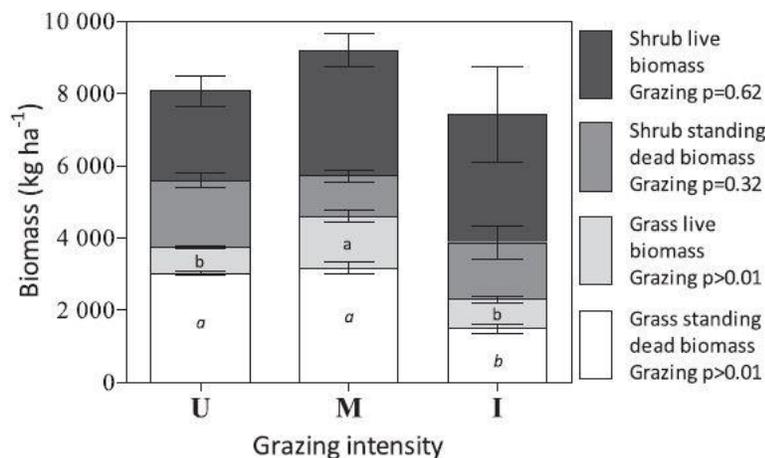


Fig. 1. Total aboveground live and standing dead biomass of grasses and shrubs under three grazing intensities (U: Ungrazed; M: Moderately grazed; I: Intensively grazed). Bars correspond to mean values and vertical lines indicate standard errors. Different letters indicate significant differences ($P < 0.05$) among grazing intensities within each biomass category and life form (Tukey test).

18. (4pts) Which of the following is correct regarding shrub biomass?

- As grazing intensity increases, shrub live biomass increases.
- As grazing intensity increases, shrub standing dead biomass increases.
- As grazing intensity increases, both shrub live and standing dead biomass is unaffected.

19. Ruminant livestock uniquely convert the high _____ biomass of grasses, forbs and woody plants produced on rangelands as a renewable dietary source of energy and animal protein for human consumption.

- carbohydrate
- cellulose
- fructose
- sucrose

For question 20, use the information in the following figure (Henkin et al. 2015 REM).

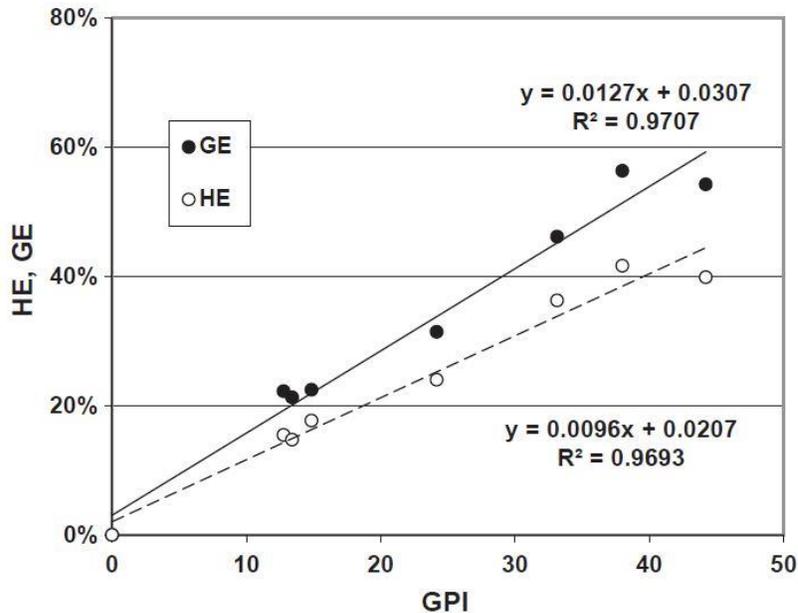


Fig. 4. The relation between the grazing pressure index (GPI, AUD·Mg⁻¹) and harvest efficiency (HE; herd forage intake/annual forage productivity) and grazing efficiency (GE; [herd forage intake–end-of-grazing residual herbage]/annual forage productivity).

20. (4pts) As Grazing Pressure Index (GPI) increases, the relationship between harvest efficiency (HE) and grazing efficiency (GE):

- remains similar.
- increases.
- decreases.
- exhibits a transitional shift at levels of GPI above 50.

IIa. GRAZING MANAGEMENT PROBLEM (5 points) – See END OF TEST

III. RANGE IMPROVEMENT (26 points)

21. On a rangeland seeding:

- cost per unit bulk seed is less than cost per unit Pure Live Seed (PLS).
- % PLS increases with decreases in seed germination.
- % PLS decreases with increases in seed purity.
- all of the above

22. Which of the following are nitrogen amendments to the soil that result in increasing soil nitrogen?
- Sucrose
 - Sawdust
 - Straw
 - all of the above
 - none of the above
23. **(4 pts)** A herbicide sprayer has a 30 m spray width and outputs 25 liters/minute. How fast should the operator drive if the desired application rate is 140 liters/ha?
- 2.2 km/hr
 - 2.9 km/hr
 - 3.6 km/hr
 - 5.2 km/hr
24. **(4 pts)** How many kg of pure live seed are in a 255 kg sack of bulk seed with the following information: germination is 67%, heterogenesis is 72%, purity is 82% and inert materials is 30%?
- 40
 - 54
 - 101
 - 140
25. **(4 pts)** A tractor mounted sprayer outputs 2100 liters/hr, the operator drives the sprayer at 8.8 km/hr, and the desired application rate is 120 liters/ha. What is the spray width?
- 20 cm
 - 200 cm
 - 20 m
 - 200 m
26. What is the most common method of changing soil pH from acidic to neutral or basic conditions?
- Application of manure
 - Application of compost
 - Application of lime
 - Application of biosolids
27. Increasing the abundance of legumes in a plant community will typically:
- decrease forage production.
 - increase soil acidity.
 - increase the C:N ratio of litter inputs into the soil.
 - increase soil nitrogen.

28. Targeted grazing is the use of livestock as a grazing tool for improving land health through weed and/or invasive plant control, reduction of fuel loads for wildfires and aiding in restoration projects.

- a. True
- b. False

For question 29, please use the following information regarding herbaceous fuel loads on south Texas rangelands (biomass obtained from a 20 cm X 0.50 m quadrat). The total biomass is on average 35% green and 65% non-green due to recent drought years. The water content of the green biomass is 50%, whereas the non-green is assumed to have water content of 0%.

Plot #	1	2	3	4	5	6	7	8	9
Total Biomass (g)	48	52	57	27	44	50	37	39	42

29. (4 pts) What is the average water content of the total amount of biomass from these 9 plots?

- a. 17.5%
- b. 25.0%
- c. 32.5%
- d. 37.5%

IIIa. RANGE IMPROVEMENT PROBLEM (5 points) - SEE END OF TEST

IV. RANGE REGIONS (14 points)

30. Alpine tundra ecosystems are dominated by which plant functional group?

- a. Trees
- b. Shrubs
- c. C3 grasses and graminoids
- d. C4 grasses

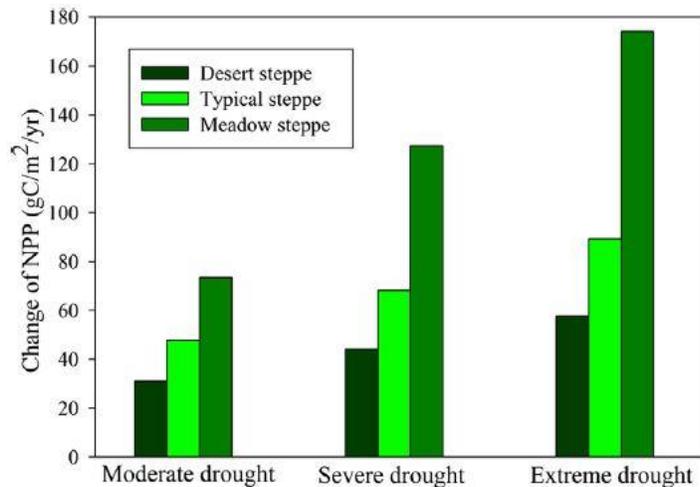
31. Which of the statements regarding the Cold Desert is correct?

- a. The sagebrush grassland region occurs on less saline soils than the salt desert shrubland region.
- b. The salt desert shrubland region occurs at lower elevations than the sagebrush grassland region.
- c. The sagebrush grassland region has higher precipitation and cooler temperatures than the salt desert shrubland region.
- d. all of the above
- e. none of the above

32. In the Douglas fir-aspen zone of the Western Coniferous forest, which of the following statements is correct?

- a. Douglas fir is fire tolerant, but not shade tolerant.
- b. Aspen is fire tolerant, but not shade tolerant.
- c. Aspen is both fire and shade tolerant.
- d. all of the above

For questions 33 and 34, please use the following figure (Lei et al. 2015 Science of the Total Environment)



33. (4 pts) Which of the following statements is most correct?
- Within each drought category, the magnitude of change in net primary productivity (NPP) was greater for typical steppe compared to meadow steppe.
 - Within each drought category, the magnitude of change in net primary productivity (NPP) was greater for desert steppe compared to typical steppe.
 - Within each drought category, the magnitude of change in net primary productivity (NPP) was less for desert steppe compared to meadow steppe.
 - all of the above
 - none of the above
34. (4 pts) Which of the following statements is most correct?
- The magnitude of change in net primary productivity (NPP) increases between typical steppe and desert steppe as drought increases from moderate to extreme levels.
 - The magnitude of change in net primary productivity (NPP) increases between meadow steppe and typical steppe as drought increases from moderate to severe levels.
 - The magnitude of change in net primary productivity (NPP) increases between meadow steppe and desert steppe as drought increases from severe to extreme levels.
 - all of the above
 - none of the above

V. RANGE INVENTORY AND ANALYSIS (20 points)

35. Range inventory:
- is an assessment of vegetation/resources at a point in time.
 - provides a representation of existing conditions.
 - is used for collection of baseline data to aid in planning and management.
 - all of the above

For questions 36 and 37, please use the following information:

Students in a rangeland inventory and monitoring class used the point transect method to determine plant basal cover on Site A. They randomly located 5 transects that were each 5 meters long. They proceeded to take a point sample every 10 cm along each transect for a total of 50 points per transect. Their data is reflected in the following table:

	Transect				
	1	2	3	4	5
Species 1	8	6	3	7	2
Species 2	3	5	6	1	9
Species 3	6	1	9	7	10
Species 4	5	8	7	2	9
Species 5	12	8	11	6	9

36. **(4 pts)** What is the relative basal cover of Species 3?
- 13.2%
 - 20.6%
 - 33.0%
 - 66.0%
37. **(4 pts)** Assuming that only the 5 species were encountered on the 5 transects, what is the absolute basal cover of non-plants?
- 3.6%
 - 18.0%
 - 36.0%
 - 56.3%
38. When conducting an experiment, the following are assumptions made in the sampling:
- samples selected are representative of the population.
 - samples selected are independent of one another.
 - measurement error are random.
 - A & B
 - all of the above

For questions 39 and 40, please use the following figure (Vander-Weide and Hartnet 2015 Oecologia)

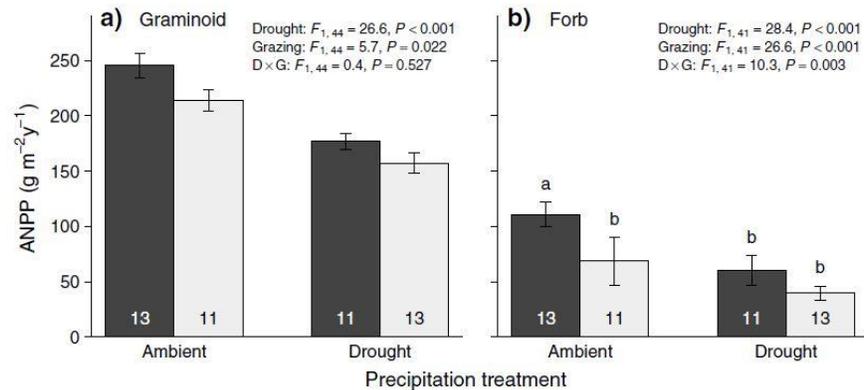


Fig. 1 Effects of drought and grazing treatments on **a** graminoid and **b** forb aboveground net primary productivity (ANPP) in grazed (dark gray) and ungrazed (light gray) treatments. Forb analysis excludes three outliers (ambient, not grazed = $269.63 \text{ g m}^{-2} \text{ year}^{-1}$; ambient/grazed = $196.16 \text{ g m}^{-2} \text{ year}^{-1}$; drought/grazed = $192.26 \text{ g m}^{-2} \text{ year}^{-1}$), caused by the presence of large clonal forbs or woody

shrubs on the plots. When included in the analysis, drought and clipping effects remain significant ($P < 0.01$), while the interaction is not ($P = 0.194$). Bars mean \pm SE. Lowercase letters indicate significant differences among all treatment combinations. Sample size numbers are shown inside bars

39. (4 pts) Regarding the effects of drought on aboveground net primary productivity (ANPP), which of the following is correct?
- Graminoid ANPP in the grazed treatment was reduced by drought.
 - Graminoid ANPP in the ungrazed treatment was not reduced by drought.
 - Forb ANPP in the grazed treatment was not reduced by drought.
 - Forb ANPP in the ungrazed treatment was reduced by drought.
40. (4 pts) Regarding the effects of grazing on aboveground net primary productivity (ANPP), which of the following is correct?
- Forb ANPP in the ambient treatment was not reduced by grazing.
 - Forb ANPP in the drought treatment was reduced by grazing.
 - Graminoid ANPP in the ambient treatment was reduced by grazing.
 - Graminoid ANPP in the drought treatment was not reduced by grazing.

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

VI. MULTIPLE USE RELATIONSHIPS (16 points)

41. Purchasing conservation easements on rangelands can be used to protect intact, functioning ecosystems and biological diversity, while providing open space.
- True
 - False
42. Which of the following is NOT a factor in the soil formation process?
- Climatic conditions
 - Topographical position
 - Time
 - none of the above

43. (4 pts) Soil was collected in a container measuring 0.04 m in diameter and 8 cm in height. Moist weight of the soil with the container was 215 g, and the container weighed 0.02 kg. Dry weight of the soil without the container was 134. What is the bulk density?
- 0.81 g/cm³
 - 1.13 g/cm³
 - 1.33 g/cm³
 - 2.14 g/cm³
44. In designing a clearcut in a forest to create maximum edge for wildlife, which of the following spatial configurations of the clearcut would provide the most edge?
- Circle
 - Square
 - Rectangle
45. Which of the following habitats in woodland vegetation would be most favorable for mule deer?
- Large open areas of herbaceous vegetation and small patches of woodland.
 - Large unbroken blocks of woodland.
 - Interspersed small blocks of open herbaceous vegetation and woodland.

For question 46, please use the following figure (Gharibvand et. al. 2015 Rangeland Journal)

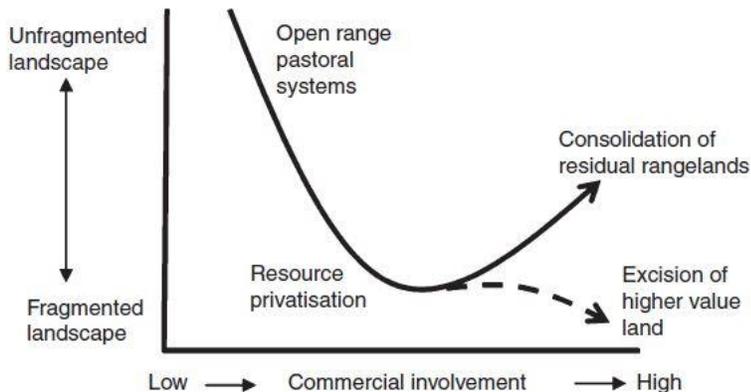


Fig. 1. Hypothetical patterns of rangeland fragmentation and consolidation (Behnke 2008).

46. (4 pts) Which of the following statements is most correct?
- With low commercial involvement, landscapes are often fragmented.
 - With low commercial involvement, landscapes often have pastoral systems as the primary land management strategy.
 - With high commercial involvement, landscapes are mostly unfragmented.
 - all of the above
 - none of the above

GRAZING MANAGEMENT PROBLEM (5 points)

A multi-national company has recently purchased a ranch between the Patagonia and Pampas regions in Argentina. The owners of this company have enlisted your expertise in grazing management for a nominal fee since your consulting firm is just starting, but they are paying your travel costs to Argentina for a twice yearly week trip to collect data. With your first visit, you conduct a ranch overview survey of the property via truck and horse, and drone video and high-resolution satellite imagery of the entire property is available. You advise that the ranch should be managed in two management units: Maroon and White (due to your degree at one of the universities in the US). Based on historical data, your survey of the ranch and expertise of rangeland scientists in Argentina, the carrying capacity of the Maroon unit is 296 AU_Y, and for the White unit the carrying capacity is 75% of that for the Maroon unit.

47. **(5 pts)** For the Maroon unit, the recommendation from you to the new owners is to graze yearling steers ($AUE=0.75$) from December 15 to April 15. How many steers are needed for the Maroon unit to properly stock it for the grazing period?
- 99
 - 947
 - 1184
 - 1579

RANGE IMPROVEMENTS PROBLEM (5 points)

President of the Society for Range Management, Dr. Val Anderson, has a state land lease of 259 ha in remote part of southern Utah. Dr. Anderson typically grazes this state land lease with his herd of 250 sheep during the cold month of January (so he can take care of them there prior to the annual meeting dates for the Society for Range Management). Because the existing water source is very unreliable, and Dr. Anderson is tired of toting water from a well in the closest town to this property, he would like to install a new water well and tank. The officials with the State Lands Department agree to this request by Dr. Anderson, with the stipulation that water from this well and tank needs to also provide water to 40 pronghorn that occupy this general area during this time period. Dr. Anderson purchases a circular concrete tank that has a diameter of 4 m and 1 m in height. He will bury this tank halfway underground to facilitate easier drinking access by the sheep and pronghorn. Evaporation and other water loss is assumed to be 2% daily of the total volume of the tank.

48. **(5 pts)** How much water will the circular concrete tank hold?
- a. 6283 liters
 - b. 12566 liters
 - c. 25133 liters
 - d. 50266 liters

RANGE INVENTORY AND ANALYSIS PROBLEM – 10 points total

Ranger Rick and Rancher Rob of the Rock River rolling hills area of Wyoming are discussing management plans associated with the Reading Railroad allotment for the Round Robin ranch (Robin was the wife of Randall who homesteaded at the end of the 1800s). This allotment is a checkerboard land ownership pattern with no cross-fences in the 40 sections (each 259 ha) of land alternating in ownership between private and public lands. Rancher Rob's grandfather Richard and father Ron have a seventy plus year history of grazing this allotment. Ranger Rick estimated the density of wild horses in that allotment at 0.20 per ha seven years ago and the population growth rate since that time has averaged 10%. Wild horses are assumed to have an AUE=1.3 and be potentially grazing on this allotment the entire year. Ranger Rick's inventory of the Reading Railroad allotment seven years ago indicated a carrying capacity for cattle grazing at 0.15 AUM/ha with a grazing period from June 16 to August 16.

49. **(5 pts)** What was the total potential consumption (in AUMs) by the wild horses on the Reading Railroad allotment seven years ago?

- a. 1,594
- b. 2,694
- c. 19,126
- d. 32,323

50. **(5 pts)** What is the current estimate for density of wild horses on the Reading Railroad allotment?

- a. 0.20/ha
- b. 0.27/ha
- c. 0.34/ha
- d. 0.40/ha