



	<b>Instructor</b>	<b>Teaching Assistant</b>
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<b>Office Hours:</b>	Tuesday, 11AM – 12PM (8/22 – 10/13) or by appointment	TBD
<b>Website:</b>	None	

Term:	Fall 2018
Course Begin:	20 August 2017
Course End:	12 October 2017
Class/Lab Meeting Days:	T, Th
Class Meeting Hours:	1PM – 1:50PM
Lab Meeting Hours:	2PM – 4:40PM
Class/Lab Location:	NR201
Recitation Meeting Hours:	TBD
Recitation Location:	TBD
Course Credits:	3

### Course Overview

In this course students will learn the principles of vegetation sampling and techniques for assessing rangeland condition and health. We will emphasize appropriate sampling methods for different management objectives, and analyzing and interpreting the results in an adaptive ecosystem management context. The first-half of this course is built around labs and field trips that give students hands-on experience with sampling methods, data analysis and interpretation.

Graduate students will also explore application of vegetation sampling and experimental design principles to real-world monitoring and management. To this end, RS532 will meet for additional hourly recitation each week for the first half of the semester. In the second-half of the semester, student groups will plan, execute and present results of an independent project.

### Course Goals and Objectives

1. Demonstrate understanding of and apply the principles of vegetation sampling.
2. Define adaptive ecosystem management (AM) and describe the role of monitoring in AM.
3. Describe the process of developing monitoring and sampling plans and designing a sampling strategy to meet particular objectives.

4. Define vegetation attributes; describe their strengths, weaknesses, and utility for different monitoring objectives.
5. Measure or estimate vegetation attributes using several different field techniques and determine the appropriate technique(s) for a given vegetation type and sampling objective.
6. Conduct, interpret, and present simple statistical analyses of field data.
7. Calculate a range condition (similarity index) score for a given key area and ecological site and describe the evolution of concepts and practices in rangeland assessment.
8. Calculate forage utilization using 3 methods; describe strengths, weaknesses and utility of each.
9. Calculate grazing capacity using at least two different methods and state the assumptions and potential errors associated with each estimate of grazing capacity.
10. Assess rangeland health using the NRCS checklist and describe the ecological basis, strengths and weaknesses of rangeland health as an approach to rangeland ecosystem monitoring.
11. Demonstrate understanding of basic concepts in ecological research and research design as applied to rangeland vegetation and ecosystems.
12. Critically assess research and monitoring designs, analysis and interpretation for rangeland vegetation.
13. Independently design, carry out and analyze a vegetation sampling project.

### **Course Prerequisites**

1. EH307, EHCC307, ST201, ST301, ST307, STCC301 or STCC307
2. NR220 or RS331
3. RS300 (or concurrent registration)
4. Or, acceptance into the MNRS program

### **Required Texts and Materials**

See the schedule of readings (Pages 9-11 and on Canvas) for a list of readings that should be read prior to each lecture and/or lab. Be sure assigned materials are **read prior to class**.

- PDFs of the readings listed below are available through Canvas or <https://archive.org/details/blmlibrary>.
  1. Elzinga, C.L., D.W. Salzer and J.W. Willoughby. 1998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1. Denver: USDI, BLM
  2. Coulloudon, B., K. Eshelman, J. Gianola, N. Habich, L. Hughes, C. Johnson, M. Pellant, P. Podborny, A. Rasmussen, B. Robles, P. Shaves, J. Spehar, J. Willoughby. 1996. Sampling Vegetation Attributes. US Department of Interior, Bureau of Land Management, Interagency Technical Reference 1734-4. 163p.
  3. Coulloudon, B., K. Eshelman, J. Gianola, N. Habich, L. Hughes, C. Johnson, M. Pellant, P. Podborny, A. Rasmussen, B. Robles, P. Shaves, J. Spehar, J. Willoughby. 1996. Utilization studies and residual measurements. US Department of Interior, Bureau of Land Management, Interagency Technical Reference 1734-3. 174p.
- Karban, R., M. Huntzinger, I.S. Pearse. 2014. How to do Ecology, A Concise Handbook, 2<sup>nd</sup> Edition. Princeton: Princeton University Press. 182p.
- Gotelli, N.J. and A.M. Ellison. 2004. A Primer of Ecological Statistics. Sinauer Associates: Sunderland, MA.
- Other assigned readings will be available on Canvas.

### **(Optional) Supplementary Texts and Materials**

- Bonham, C.D. 2013. Measurements for Terrestrial Vegetation. 2<sup>nd</sup> Edition. Wiley-Blackwell, West Sussex (UK).
- Pellant, M., P. Shaver, D.A. Pyke and J.E. Herrick. 2005. Interpreting Indicators of Rangeland Health, Version 4. Denver: USDI, BLM. <https://www.blm.gov/nstc/library/pdf/1734-6rev05.pdf>
- The following 2-volume monitoring manual is available on Canvas or <http://jornada.nmsu.edu/monit-assess/manuals/monitoring>.

1. Herrick, J.E., J.W. Van Zee, K.M. Havstad, L.M. Burkett, W.G. Whitford. 2005. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems, Volume I: Quick Start. Las Cruces, NM: USDA-ARS Jornada Experimental Range.
  2. Herrick, J.E., J.W. Van Zee, K.M. Havstad, L.M. Burkett, W.G. Whitford. 2005. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems, Volume II: Design, Supplementary Methods and Interpretation. Las Cruces, NM: USDA-ARS Jornada Experimental Range.
- General principles of rangeland inventory and monitoring: Muire, S. M. McClaran. 1997. Rangeland Inventory, Monitoring, and Evaluation, <http://globalrangelands.org/inventorymonitoring>.

### **Library & Research Help**

The CSU Libraries Help Desk provides basic research and technical assistance either in person at Morgan Library or by phone at 970-491-1841. Virtual assistance is also available via the Libraries' Ask Us chat and email services (<http://lib.colostate.edu/help/ask-us>). Jocelyn Boice is the librarian supporting the Forest and Rangeland Stewardship Department and this course. Contact her for in-depth assistance at: [jocelyn.boice@colostate.edu](mailto:jocelyn.boice@colostate.edu) / 970-491-3882.

### **Important Dates to Remember**

Last Day to Add/Drop Classes Without an Instructor Override: Sun, Aug 26, 2018

Registration Closes: Wed, Sept 5, 2018

Withdrawal Deadline: Mon, Oct 15, 2018

Fall Recess: Sat, Nov 17 – Sun, Nov 25, 2018

Last Day to Process a University Withdrawal: Fri, Dec 7, 2018

RS432/RS532 Final Examination: Thurs, Oct 11, 2018 from 1 – 2PM in NR201

### **Course Schedule**

Course schedule: Pages 8-10 of syllabus

Course assignment schedule: Pages 8-10 of syllabus

Schedule of readings: Pages 11-14 of syllabus

### **Course Assignments**

**Assignments (3)** Assignments are designed to review or introduce material to support comprehension of lecture material and needed to complete field trips and/or lab reports; specific instructions will be provided for each. Assignments are due at the **beginning** of lecture the day the assignment is due, unless otherwise noted. Unexcused absences from labs will result in a 10% deduction on related assignments. If you have questions about an activity or assignment, please stop by to see me.

**Lab reports (4)** Lab reports are designed to give you experience synthesizing material presented in lectures, readings, and data gathered during field trips. Specific instructions will be provided for each lab report. Lab reports are due at the **beginning** of lecture the day the assignment is due, unless otherwise noted. Unexcused absences from field trips will result in a 50% deduction from the associated lab report. **Writing Assistance for lab reports:** In addition to consulting the instructor or TA, additional assistance on writing assignments can be sought from the Campus Writing Center, Eddy Hall, Rm. 23, 491-0222, email: [writing@colostate.edu](mailto:writing@colostate.edu), <http://writingcenter.colostate.edu>

**Exams (2)** There will be one 1-hour exam and a 1-hour comprehensive final exam. Exams will cover lecture, reading, and lab materials. Exams will utilize a variety of question formats, including calculations. Bring a calculator to exams – cellphone/internet devices **cannot** be used as calculators during exams.

**Lead discussion** for one recitation session (25 pts). Students will take turns leading discussion of the assigned readings from Week 2 through Week 6. All students are expected to complete the readings prior to class and participate in class discussions of the readings. A sign-up sheet will be circulated during first recitation.

**Paper critique** of a published journal article in Week 7 or Week 8 recitation (25 pts). Each student will select a relevant recently-published (2010 – present) journal article to read, critique and present to the other graduate students prior to a class discussion on the article. All students are expected to read the articles prior to class and participate in class discussions of the articles. A sign-up sheet will be circulated during first recitation.

**Independent project** Design, carry out and prepare a report on an independent monitoring project (200 pts). May be independent or as a group of 2-3 students enrolled in RS532. The emphasis of the projects should be on analyzing, presenting and reporting of monitoring data that has already been collected as part of a monitoring effort or designing a monitoring program to meet specific objectives of an agency/organization. Each group will present their work during the final exam time period on Thursday, December 13 from 9:40AM to 11:40AM. More details will be provided during recitation.

Basis for Final Grade

**Attendance and Participation** will be assessed throughout the semester. Unexcused absences from labs or field trips will result in a 10% (assignments) or 50% (lab report) deduction on related assignments. At the end of the course, attendance and participation may also be used to adjust final course grades for borderline point totals.

Assessment	Point value	Percent of Final Grade
Assignment 1	10	1.4%
Assignment 2	20	2.9%
Assignment 3	20	2.9%
Lab report 1	50	7.1%
Lab report 2	50	7.1%
Lab report 3	50	7.1%
Lab report 4	50	7.1%
Exam 1	100	14.3%
Lead recitation discussion	25	3.6%
Paper discussion and critique	25	3.6%
Final exam	100	14.3%
Independent project	200	28.6%
<b>Total</b>	<b>700</b>	<b>100%</b>

A = 90-100%, B = 80-89%, C = 70-79%, D = 60-69%, F = < 60%

**Course Policies**

**Late Work Policy**

Assignments will be penalized one letter grade (10% of points possible on assignment) for each day late. Late assignments will not be accepted if 5 or more days late and a grade of zero will be recorded unless prior arrangements have been made with the instructor.

**Extra Credit Policy**

Extra credit opportunities may be provided at the discretion of the instructor.

**Grades of "Incomplete"**

Per university policy, an instructor may assign temporary grade of Incomplete to a student who demonstrates that he or she could not complete the requirements of the course due to circumstances beyond the student's control and not reasonably foreseeable. A student must be passing a course at the time that an Incomplete is requested unless the instructor determines that there are extenuating circumstances to assign an Incomplete to a student who is not passing the course. When an instructor assigns an Incomplete, he or she shall specify in writing using the Department Incomplete Grade Form the requirements the student shall fulfill to complete the course as well as the reasons for granting an Incomplete when the student is not passing the course. The instructor shall retain a copy of this statement in his or her grade records and provide copies to the student and the department head or his or her designee. (Section I.6 of the *Academic Faculty and Administrative Professional Manual*)

### **Disability Access**

Colorado State University is committed to providing reasonable accommodations for all persons with disabilities. Students with disabilities who need accommodations must first contact Resources for Disabled Students before requesting accommodations from the professor. Resources for Disabled Students (RDS; <http://rds.colostate.edu/home>) is located in room 100 of the General Services Building. Their phone is (970) 491-6385 (V/TDD). Students who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations.

### **Attendance Policy**

Attendance of all lectures is high encouraged. Attendance of all labs and field trips is mandatory unless prior arrangements have been made with the instructor for an excused absence due to university-sanctioned or professional activities, or an emergency. The instructor may require documentation prior to excusing an absence. Please discuss any absences (planned or emergency) with the instructor as soon as possible to ensure adequate time for scheduling required make-up work.

### **Religious Accommodation**

Participation in official University activities, e.g., an out-of-town athletic event, or special religious observances may provide a legitimate reason for an excused absence. The student is responsible for discussing this with the instructor at the beginning of the semester.

### **Final Exam Policy**

Final examination week is part of the regular semester. Student attendance shall be consistent with University policy.

If a student has three or more final examinations (not classes) scheduled for the same day or if conflicts of examination times occur, the student may negotiate a time change with the instructors involved. If the parties involved cannot find a mutually agreeable time, the Registrar's Office indicates which courses must be changed. **Note:** The Registrar's Office must be notified at least one week prior to Final Examination Week to allow instructors time to make appropriate accommodations. It is the student's responsibility to initiate negotiations.

Any student who has a conflict with the examination schedule must inform the instructor as soon as possible before the examination. If an agreement cannot be reached between the instructor and student as to the appropriateness of a make-up examination the student should appeal to the department head.

<http://www.registrar.colostate.edu/final-exams>

### **Professionalism Policy**

Per university policy and classroom etiquette; mobile phones, iPods, etc. **must be silenced** during all classroom and lab lectures. Those not heeding this rule will be asked to leave the classroom/lab immediately so as to not

disrupt the learning environment. Please arrive on time for all class meetings. Students who habitually disturb the class by talking, arriving late, *etc.*, and have been warned may suffer a reduction in their final class grade. When emailing the instructor or TA, please include your full name, CSU ID, and the course number in your email.

### **Academic Integrity**

The Department of Forest and Rangeland Stewardship takes academic integrity seriously. At minimum, academic integrity means that no one will use another's work as their own. The CSU writing center defines plagiarism this way:

Plagiarism is the unauthorized or unacknowledged use of another person's academic or scholarly work. Done on purpose, it is cheating. Done accidentally, it is no less serious. Regardless of how it occurs, plagiarism is a theft of intellectual property and a violation of an ironclad rule demanding "credit be given where credit is due."

Source: (Writing Guides: Understanding Plagiarism.

<http://writing.colostate.edu/guides/guide.cfm?guideid=17>)

If you plagiarize in your work you could lose credit for the plagiarized work, fail the assignment, or fail the course. Each instance of plagiarism, classroom cheating, and other types of academic dishonesty will be addressed according to the principles published in the CSU General Catalog (under "Academic Integrity/Misconduct: <http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/>.)

Of course, academic integrity means more than just avoiding plagiarism. It also involves doing your own reading and studying. It includes regular class attendance, careful consideration of all class materials, and engagement with the class and your fellow students. Academic integrity lies at the core of our common goal: to create an intellectually honest and rigorous community. Because academic integrity, and the personal and social integrity of which academic integrity is an integral part, is so central to our mission as students, teachers, scholars, and citizens, we will ask to you sign the CSU Honor Pledge as part of completing all of our major assignments. While you will not be required to sign the honor pledge, we will ask each of you to write and sign the following statement on your papers and exams:

***"I have not given, received, or used any unauthorized assistance."***

### **Title IX Information**

CSU's Student Sexual Harassment and Violence policy, following national guidance from the Office of Civil Rights, requires that faculty follow CSU policy as a "mandatory reporter" of any personal disclosure of sexual harassment, abuse, and/or violence related experiences or incidents shared with the faculty member in person, via email, and/or in classroom papers or homework exercises. These disclosures include but are not limited to reports of personal relational abuse, relational/domestic violence, and stalking. While faculty are often able to help students locate appropriate channels of assistance on campus (e.g., see the CSU Health Network link below), disclosure by the student to the faculty member requires that the faculty member inform appropriate CSU channels to help ensure that the student's safety and welfare is being addressed, even if the student requests that the disclosure not be shared.

For counseling support and assistance, please see the CSU Health Network, which includes a variety of counseling services that can be accessed at: <http://www.health.colostate.edu/>. And, the Sexual Assault Victim Assistance Team is a confidential resource for students that does not have a reporting requirement and that can be of great help to students who have experienced sexual assault. The web address is

<http://www.wgac.colostate.edu/need-help-support>.

Source: <http://oeo.colostate.edu/title-ix-sexual-assault>

### **Non-Discrimination Statement**

Colorado State University does not discriminate on the basis of race, age, creed, color, religion, national origin or ancestry, sex, gender, disability, veteran status, genetic information, sexual orientation, gender identity or expression, or pregnancy. The University complies with the Civil Rights Act of 1964, as amended, related Executive Orders 11246 and 11375, Title IX of the Education Amendments Act of 1972, Sections 503 and 504 of the Rehabilitation Act of 1973, Section 402 of the Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended, the Age Discrimination in Employment Act of 1967, as amended, The Pregnancy Discrimination Act of 1978, Americans with Disabilities Act of 1990, the Civil Rights Act of 1991, the ADA Amendments Act of 2008, the Genetic Information Nondiscrimination Act of 2008, and all civil rights laws of the State of Colorado. Accordingly, equal opportunity of employment and admission shall be extended to all persons. The University shall promote equal opportunity and treatment in employment through a positive and continuing affirmative action program for ethnic minorities, women, persons with disabilities, and veterans. The Office of Equal Opportunity is located in 101 Student Services. Source: <http://oeo.colostate.edu/non-discrimination-statement>

RS532 Range Ecosystem Sampling  
**Tentative Topic/Activity/Assignment Schedule**

\*This schedule may change at the discretion of the instructor; students will be notified of any changes as soon as possible.

Date	Assignment Due	Lecture	Lab	Assignment Given	Recitation (Time, place TBD)
<b>Week 1</b>					
Tues Aug. 21		Intro to adaptive management & rangeland monitoring	Evaluating management objectives in written reports	Assign 1 Writing lab reports	Introduction
Thurs Aug. 23	Assign 1 Writing lab reports	Sampling design I	Working with sampling data	Assign 2 Working with data	
<b>Week 2</b>					
Tues Aug. 28	Assign 2 Working with data	Sampling design II	Statistical analysis of sampling data	Assign 3 Analyzing data	Developing a researchable ecological question
Thurs Aug. 30		Sampling design III	Field Trip: Ecological sites (Pineridge Natural Area)		
<b>Week 3</b>					
Tues Sept. 4	Assign 3 Analyzing data	Frequency & Density	Field Trip: Frequency & Density (Pineridge Natural Area)	LR1 Frequency & density	Discuss potential projects and group dynamics



Thurs Sept. 6		Cover	LR 1 Frequency and density data analysis	LR2 Cover & Density	
Date	Assignment Due	Lecture	Lab	Assignment Given	Recitation (Time, place TBD)
Week 4					
Tues Sept. 11	LR1 Frequency & density	Field Trip: Cover (CSU Waverly Property)			Designing ecological research
Thurs Sept. 13		Exam 1	LR2 Cover data analysis		
Week 5					
Tues Sept. 18		Production & Range Condition	Open lab to work on LR2, time allowing	LR3 Production & Range condition	Designing ecological research
Thurs Sept. 20	LR2 Cover & Density	Field Trip: Production (Eagle's Nest Open Space)			
Week 6					
Tues Sept. 25		Richness & Diversity	Production & Range condition data analysis (for LR3)		Assessing research results

Thurs Sept. 27		Field Trip: Utilization (Eagle's Nest Open Space)	LR4 Utilization & Carrying capacity	
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Date	Assignment Due	Lecture	Lab	Assignment Given	Recitation (Time, place TBD)
Week 7					
Tues Oct. 2	LR3 Production & Range condition	Utilization	Utilization data analysis (for LR4)		Paper critiques due
Thurs Oct. 4		Carrying Capacity	Carrying capacity data analysis (for LR4)		Paper critique presentations
Week 8					
Tues Oct. 9	LR4 Utilization & Carrying capacity	Rangeland Health & State-and-Transition Models	Catch-up/Exam review		Paper critique presentations
Thurs Oct. 11		Final Exam			
Week 12					
Nov 6 – 10					Communicating research results; Group updates
Week 16					
Thurs Dec. 13					9:40 – 11:40AM Project presentations

RS532 Range Ecosystem Sampling

**Tentative Schedule of Readings**– Material to read *prior* to class on indicated day.

\*Readings may change at the discretion of the instructor; students will be notified of changes as soon as possible.

Date		Topic(s)	Citation	Chapters/ Pages
<b>Week 1</b>				
Tues	8/21	Introduction	Elzinga, C.L., D.W. Salzer, J.W. Willoughby. 1998. Measuring and monitoring plant populations. US Department of Interior, Bureau of Land Management, BLM Technical Reference 1730-1. 477p.	Ch. 1
		Monitoring	Elzinga et al. (1998)	Ch. 2
		Management objectives	Elzinga et al. (1998)	Ch. 4
Thurs	8/23	Sampling principles	Elzinga et al. (1998)	Ch. 5
		Statistics	Elzinga et al. (1998)	Ch. 11
Recitation		Introductions	--	--
<b>Week 2</b>				
Tues	8/28	Sampling design	Elzinga et al. (1998)	P. 97-113
Thurs	8/30	Sampling design	Elzinga et al. (1998)	P. 113-153
Recitation		Research questions	Karban, R., M. Huntzinger, I.S. Pearse. 2014. How to do Ecology, A Concise Handbook. 2 <sup>nd</sup> Ed. Princeton: Princeton University Press.	Ch. 1, 2
<b>Week 3</b>				
Tues	9/4	Frequency and density	Elzinga et al. (1998)	P. 168-177
			Coulloudon, B., K. Eshelman, J. Gianola, N. Habich, L. Hughes, C. Johnson, M. Pellant, P. Podborny, A. Rasmussen, B. Robles, P. Shaves, J. Spehar, J. Willoughby. 1996. Sampling Vegetation Attributes. US Department of Interior, Bureau of Land Management, Interagency Technical Reference 1734-4. 163p.	P. 23-26, 37-43
		Frequency	Despain, D.W., P.R. Ogden, E.L. Smith. 1997. Chapter 2: Plant frequency sampling for monitoring rangelands. In D.W. Despain, P.R. Ogden, G.B. Ruyle, E.L. Smith (eds.) Some methods for monitoring rangelands and other natural area vegetation. University of Arizona, College of Agriculture, Extension Report 9043.	Ch. 2, Append. C
<b>Week 3 (Continued)</b>				
Thurs	9/6	Cover	Elzinga et al. (1998)	P. 178-186

			Coulloudon et al. (1996)	P. 55-69, 78-82
Recitation		Group dynamics	Karban et al. (2014)	Ch. 7
Week 4				
Tues	9/12	--	--	--
Thurs	9/14	--	--	--
Recitation		Designing research	Gotelli, N.J. and A.M. Ellison. 2004. A Primer of Ecological Statistics. Sinauer Associates: Sunderland, MA.	Ch. 6
Week 5				
Tues	9/19	Production	Bonham, C.D., 2013. Chapter 8: Biomass. In: Measurements for terrestrial vegetation, 2nd edition. John Wiley & Sons, New York	P. 175-201
			Bartolome, J.W., M.C. Stroud, H.F. Heady. 1980. Influence of natural much on forage production on differing California annual range sites. Journal of Range Management 33:4-8.	P. 4-8
			Coulloudon et al. (1996)	P. 50-54, 112-122
		Range condition	Dyksterhuis, E.J. 1949. Condition and management of range land based on quantitative ecology. Journal of Range Management 2:104-115.	P. 104-115
			Joyce, L.A. 1993. The life cycle of the range condition concept. Journal of Range Management 46:132-138.	P. 132-138
Thurs	9/21	Dry-weight rank method (production)	Smith, E.L., D.W. Despain. 1997. Chapter 3: The dry-weight rank method of estimating plant species composition. In D.W. Despain, P.R. Ogden, G.B. Ruyle, E.L. Smith (eds.) Some methods for monitoring rangelands and other natural area vegetation. University of Arizona, College of Agriculture, Extension Report 9043.	P. 27-47
		Comparative yield method (production)	Despain and Smith (1997)	P. 49-61, 87-90
Recitation		Designing research	Gotelli, N.J. and A.M. Ellison. 2004. A Primer of Ecological Statistics. Sinauer Associates: Sunderland, MA.	Ch. 7
Week 6				
Tues	9/26	Richness & Diversity	Magurran, A.E. 2004. Measuring biological diversity. Blackwell Science Publishing, Victoria, Australia. 256 P.	Chs. 1, 5

Thurs	9/28	Utilization	Sharp, L. K. Sanders, N. Rimbey. 1994. Management decisions based on utilization: is it really management? Rangelands 16:38-40.	P. 38-40
			Coulloudon, B., K. Eshelman, J. Gianola, N. Habich, L. Hughes, C. Johnson, M. Pellant, P. Podborny, A. Rasmussen, B. Robles, P. Shaves, J. Spehar, J. Willoughby. 1996. Utilization studies and residual measurements. US Department of Interior, Bureau of Land Management, Interagency Technical Reference 1734-3. 174p.	P. 89-102, 109-125
		Grazing response index (utilization)	Reed, F., R. Roath, D. Bradford. 1999. The grazing response index: a simple and effective method to evaluate grazing impacts. Rangelands 21:3-6.	P. 3-6
		Stubble height method (utilization)	Clary, W.P., W.C. Leininger. 2000. Stubble height as a tool for management of riparian areas. Journal of Range Management 53:562-573.	P. 562-573
Recitation		Managing data	Gotelli, N.J. and A.M. Ellison. 2004. A Primer of Ecological Statistics. Sinauer Associates: Sunderland, MA.	Ch. 8
Week 7				
Tues	10/3	Utilization	See 9/28 readings	
Thurs	10/5	Carrying capacity	Vallentine, J.F. 1990. Chapter 10: Grazing capacity inventory. In Grazing management. Academic Press, San Diego.	Ch. 10
			Holecheck, J.L. D. Galt. 2000. Grazing intensity guidelines. Rangelands 22:11-14.	
			Holocheck, J.L., R.D. Pieper, C.H. Herbel. 2001. Chapter 8: Considerations concerning stocking rate. In J.L. Holocheck, R.D. Pieper, C.H. Herbel (eds.) Range management, principles, and practices, 4 <sup>th</sup> edition. Prentice Hall: New Jersey.	P. 226-233
Week 8				
Tues	10/10	S&T models	Brestelmeyer, B.T., J.R. Brown, K.M. Havstad, R. Alexander, G. Chavez, J.E. Herrick. 2003. Development and use of State-and-Transition models for rangelands. Journal of Range Management 56:114-126.	P. 114-126

			Stringham, T.K., W.C. Krueger, P.L. Shaver. 2003. State and Transition modeling: an ecological process approach. Journal of Range Management 56:106-113.	P. 106-113
		Rangeland health	Pyke, D.A., J.E. Herrick, P. Shaver, M. Pellant. 2002. Rangeland health attributes and indicators for qualitative assessment. Journal of Range Management 55:584-597.	P. 584-597
		S&T models and rangeland health	Briske, D.D., S.D. Fuhlendorf, F.E. Smeins. 2005. State-and-Transition models, thresholds, and rangeland health: a synthesis of ecological concepts and perspectives. Rangeland Ecology and Management 58:1-10.	P. 1-10
Thurs	10/12	--	--	
Week 12				
Recitation		Presenting research	Karban et al. (2014)	Ch. 8