

Shortgrass Steppe Long Term Ecological Research Project

**2012
Field Crew Sampling Protocols**

Nicole Kaplan, SGS-LTER Information Manager

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Principal Investigator: Bill Lauenroth, wlauenro@uwyo.edu

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Principal Investigator: Dan Milchunas, Daniel.Milchunas@colostate.edu

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Principal Investigator: Indy Burke, iburke@uwyo.edu

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Principal Investigator: Justin.Derner@ars.usda.gov

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NutNet80

Principal Investigators: julia.klein@colostate.edu, cynthia.s.brown@colostate.edu (Cini),
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Principal Investigators: Dan Milchunas, Daniel.Milchunas@colostate.edu and Mark Vandever,
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Principal Investigators: Dan Milchunas, Daniel.Milchunas@colostate.edu, Mark Vandever,
vandeverm@usgs.gov, and Cynthia Brown, cynthia.s.brown@colostate.edu (Cini)

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Principal Investigator: Joe von Fischer, jcvf@lamar.colostate.edu

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Principal Investigators: Dan Milchunas, Daniel.Milchunas@colostate.edu David Augustine,
David.Augustine@ARS.USDA.GOV, and Paul Stapp, pstapp@fullerton.edu

Objective

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Locations
Procedures
Quality Control

SGS/LTER Field Staff & Research Assistants 2012

CSU SGS/LTER Field Station Address:
14791 Weld County Road 114
Nunn, Colorado 80648

SGS/LTER Field Research Staff

Site Manager: Mark Lindquist
(970) 897-2210, mark.lindquist@colostate.edu

Field Crew Leader: Kevin Meierbachtol

Assistant Crew Leader: Trace Martyn

SGS/LTER Research Assistants (May 16 to August 22)

Melissa Perkins
Brian Gley

ARS

*For Emergency use
Site Manager: Mary Ashby
(970) 897-2226

SGS-LTER HOUSE RULES

Kitchen:

Immediately wash dishes, cooking pots, pans and utensils after each use.
 Immediately dry and put dishes, cooking pots, pans and utensils away.
 Keep counters, stove, microwave, refrigerator, and toaster clean.
 Sweep and mop floors when necessary.
 Frequently take the trash out to the dumpster.
 Keep kitchen door locked over night.
 There is no recycling service on-site, bring recyclables back to town once per week!

Field Station Conference, Laboratory, and Bathrooms:

Sweep and mop floors once per week on Fridays and before meetings.
 Trash removal once per week on Fridays and before meetings.
 Wipe off counter and tops of tables once per week on Fridays and before meetings
 Clean bathrooms and re-stock with paper goods once per week Fridays, when necessary or before meetings.
NO PETS ALLOWED!

Dormitory Rooms:

Keep the bathroom clean and stock with paper goods once per week on Fridays.
 Remove trash once per week on Fridays.
 Make sure door is completely closed at night or when the room is unoccupied.
 Sweep and mop floors once per week on Fridays.
 Quiet time at the station will be from 10 pm to 7 am.
NO PETS ALLOWED!

Computer and Office Space:

Respect the working space of the SGS-LTER field crew, graduate students and PIs. They have priority over use of the computers and any reference materials.
 Always check out books, field guides, or publications with the Site Manager.
 Take turns using the computer and limit yourself to fifteen minutes.
 Do not download any material under any circumstances without permission.
 To log on to the computer:
 User: sgslder, Password: pawnee

Instructions for Hardwire Connections

1. Open your local area network settings as follows:
 Click **Start>Control Panel>Network Settings**
 Double Click **Local Area Connections**
2. Click the General Tab and Double Click **Internet Protocol (TCP/IP)**
3. In the properties dialog click these options
Obtain an IP Address Automatically
Obtain DNS server automatically

Instructions for Wireless Connections

1. Open your wireless network settings as follows:
 Click **Start>Control Panel>Network Settings**
 Double Click **Wireless Network Connections**
2. Click **View Wireless Networks**
3. Double Click **sgslder** network box
 Enter this network key (and in confirm box too): **16AB845E0C** (Note the 0 is numeric zero)

SGS/LTER Field Crew Guidelines

Work Schedule

- Meet North of Jack Christiansen Track east of railroad tracks in Z-zone, Parking Lot # 440 at 0645
- Leave for SGS/LTER at 0700 in van that is provided
- The SGS-LTER research site is about 25 miles south of Cheyenne, WY and 25 miles north of Ault, Colorado to the east of highway 85. Research is conducted on both the CPER and PNG.
- Upon arrival the crew has 15 minutes to stow lunches etc.
- The work day is from 0800-1700
- The crew has 30 minutes for lunch and two 15 minute breaks
 - Usually one break in the morning and one break in the afternoon
- The crew will work 5 day a week, Monday-Friday
- The crew does not get paid for travel time.
- Please note some work needs to be performed at odd hours during dawn, dusk, and night

Duties

Assorted duties which are all important and which are to be carried out with equal attention to detail.

- Read protocol before workday.
- Field Work: Vegetation Sampling (clipping, estimation), soil coring, root washing, arthropod identification, coyote and swift fox scat count, squirrel trapping, lagomorph count, fencing, animal surveys, reptile and amphibian identification, ocular estimates of prairie dog numbers
- Building Maintenance: sweeping, mopping, cleaning, mowing, watering weekly
- Lab Work as Directed by Judy Hendryks.

Driving Rules

- Need Valid License and background clearance from CSU
- Driving duties will be shared and rotated at the discretion of crew leader.
- The State Vehicle will need to be gassed every 2 to 3 days; this will be done at the motor pool on campus, upon returning in the afternoon so it is ready to go in the morning at the discretion of the crew leader.
- While at the field site speeds will not exceed 45 m.p.h. on main county roads or what is safe for conditions.
- While on arterial roads the State Vehicle will be driven at a comfortable speed for the occupants and a speed which is not destructive to the vehicle.
- **There will be no driving off of existing roads, see road policy for central plains experimental range (on the following pages).**

Personal Equipment

Extra Clothing: Shell/Windbreaker (Preferably Waterproof)

Sweater
 Warm Hat
 Sun Hat
 Work Gloves
 Long Pants
 Sunglasses
 Sunscreen
 Personal Water Bottles
 Cactus Proof Footwear

The weather can change drastically in minutes and will differ greatly from the weather in Fort Collins, so it is recommended that you have these items with you at all times.

SGS-LTER Guidelines for Field Safety and Courtesy

NO PETS ALLOWED!

Roadways:

- Observe CPER and USFS road signs and signs on private property.
- Stay on roads and don't drive on the range.
- Be very careful of soft shoulders.
- 45 mph is the recommended speed, 20 mph on 2 tracks
- Don't park on blind hills or curves.
- Leave gates the way you found them (open/closed).

Medical Dangers and Precautions

911 works out here!!!! Make sure to know your location so you can give it to the dispatcher if need be. The location of the field station is 14791 Weld County Road 114 (on the eastern side of the junction of Hwy 85 and WCR 114). The phone number is 970-897-2210. A basic First Aid kit is available at the SGS-LTER Field Station.

- **Prairie rattlesnakes** are abundant. Watch where you walk and listen for the characteristic rattle.
- **Poisonous spiders** include the Black Widow (identified by a red hour-glass shape on a shiny black body) and the Brown Recluse (identified by a brown fiddle shape on a lighter brown body). Do not reach into small and/or dark spaces (ex. pitfall traps) without protective tools or gloves.
- **Heat exhaustion/stroke** can be prevented by drinking plenty of water, wearing light-colored clothing, and wearing a hat.
- **Sun burns** are common. Bring sunscreen and a hat for yourself.
- **Infected wounds** can occur from abrasions, lacerations, and punctures that go untreated. Barbed wire cuts can easily become infected even when the wound seems small and insignificant. A first aid kit is provided. You may want to consider getting a tetanus shot if you haven't had one recently (consult physician).
- **Rapidly Changing Weather** – Lightening, hail, snowstorms, and tornados are all possible.
- **Hanta Virus** can be carried by the deer mouse and can be transmitted to humans who come in contact with deer mouse feces. If you will be working with deer mice or in areas where feces may be present (garages, barns), you may want to take precautions recommended by CDC.
- **Bubonic Plague** can be carried by prairie dogs and fleas. If you will be working with p-dogs, you may want to take precautions recommended by CDC.

ROAD POLICY FOR CENTRAL PLAINS EXPERIMENTAL RANGE (CPER)

The USDA-Agricultural Research Service (ARS) Central Plains Experimental Range (CPER) has an extensive 67-year history of rangeland research directed at understanding how land management and grazing practices affect plant and animal responses in the shortgrass steppe. Currently, there are over 60 ongoing experiments at the CPER. This number of studies, coupled with the need to protect the integrity of the CPER land area for current and future research needs, necessitates that all persons utilizing CPER assist in efforts to protect the rangeland resource at CPER. Therefore, we are requesting that all persons utilizing CPER 1) refrain from driving any vehicle off of established roads and 2) adhere to the gate policy of closing a gate behind you if it was closed when you arrived; open gates can remain open.

Established roads are characterized by the complete lack of vegetation in the wheel tracks. A current map of the established roads can be found at the following website:

<http://limberpine.cnr.colostate.edu/About/SiteLocatorMap/SiteLocatorMap.htm>. When working in an area, vehicles should be parked immediately adjacent and parallel to the established road to facilitate travel on the road by other personnel. When turning a vehicle around, please back up until perpendicular to the road and then proceed forward to the road. In all cases, please minimize the area that is disturbed when turning vehicles around.

To prevent degradation of established roads during wet conditions, please refrain from driving on roads unless travel is deemed absolutely necessary; if travel is warranted under these conditions, please use slow speeds to prevent splashing from puddles in the road. Roads with vegetation in the wheel tracks are defined as 1) those that have been abandoned and are in the process of healing or 2) those which have been created without authorization; please refrain from driving a vehicle on these roads. If off-road travel is truly warranted for one-time sampling or other endeavors, the person(s) must request permission from Mary Ashby (Station Manager, CPER, 970-897-2226, or Mary.Ashby@ars.usda.gov) **prior to** any off-road driving. Failure to adhere to this policy will result in a written warning to the person(s) and his/her supervisor(s) for first time violation, and subsequent violations may result in the loss of use of CPER for the person(s). If you have any questions pertaining to this road policy at CPER, please contact the Scientist-in-Charge of CPER, Justin Derner, at 307-772-2433 x. 113, or Justin.Derner@ars.usda.gov.

TRAVEL ON THE PAWNEE GRASSLAND

The Pawnee National Grassland has established motor vehicle travel controls in order to enable safe motorized travel while also protecting natural resources and minimizing conflicts with nonmotorized uses. Specific rules are implemented by order of the Forest Supervisor and are available at the District Ranger's Office. A network of numbered roads will take you within easy walking distance to almost all parts of the Grassland. Travel by motorized vehicles is authorized only on constructed roads, two-track roads, and specific areas designated for travel. These vehicles must comply with State law. Open roads are shown on this map and are marked by a sign with a Forest Service shield and road number. To protect prairie vegetation and avoid soil erosion, motorized travel cross-country is generally prohibited, except for over-snow travel by snowmobile. Cross country hiking and horse travel is permitted and is an excellent way to enjoy the prairie. Direct motorized vehicle access is authorized to suitable parking sites within 300 feet of an open road for recreation activities such as camping, picnicking, bird-watching, or hunting.

Phenology

Principal Investigator(s): Bill Lauenroth (and Lynn Moore, Graduate Student)

Study Objectives: to study the life stages of 22 individuals of different species of plants through the growing season.

What to know before you start sampling:

- ✓ You are able to identify the species of plants correctly
- ✓ You understand the life stages of different types of plants
- ✓ You have trained the crew on identifying species and life stages correctly
- ✓ You are aware of which species of annuals may not be measured if it is a dry year

Study Area Location: The site is located in 27NE, the meteorological station enclosure. For this reason, it is extremely important that you CLOSE THE GATE. Most labeled plants are labeled to the east of and around the standard meteorological equipment; however individuals of SETR and barrel cacti are north and west in the enclosure.

Experimental Design:

- 22 species of plants
- 10 reps of each plant
- Sampled April – September, approximately 24 dates
- Individual sample size is individual plant

Sampling Protocol:

You will need the phenology data sheet, pencils, plant guide or reference, alternate between marking plots with or without pin flags (>144 tall, recycled pin flags).

At the beginning of each field season, remark the individual plants with new small pin flags and ring shank nails. Around each nail secure an aluminum tag with the species code and individual plant number. Check to see that 10 individuals are marked for each species listed on the data sheet. Please note that BRTE, VUOC, LEDE, PLPA, and SAIB are only sampled in wet years. Please check with Mark whether to mark and sample these species.

Return to each of the ten marked individuals for each species every other week during the field season. One week, place a large, recycled pin flag next to the individual as you record the data. It is best to work with one other person. One person should record, while the other examines the plant and leaves behind the marker or pin flag. The next time you return to the site, remove the flags. Consider the absence of a flag to be the indication that the individual was examined and the data were recorded.

Use the phenology codes on the bottom of the data sheet to qualify the growth stage of each individual of each plant. Record the code in the correct species row under the correct number column for that individual of that species. Note that some life forms may range across codes. For example, consider whether a plant had grown more than its first green visible leaves, it is still early in the season, but the individual is not as tall or lush as that species can get. You may record the species code as a 4.

Record any plant deaths, disturbances, etc. in the notes area on the data sheet.

QAQC Instructions:

It is a good idea to check on the plants and re-label the individuals at the beginning of each sampling season. Be certain that you do not measure a plant twice and that you are not observing a plant that has died. If you need to replace an individual, be sure to label it correctly in the field and make a note on the data sheet.

Phenological Stage Descriptions. * Denotes stages that are recoded once during a growing season.

Code	Stage	Description	Special Case
1	Winter Dormancy	Beginning of year stage in which no green leaves are apparent. May be used more than once.	
2*	First Green Leaf	First sign of a green leaf at the base of the plants. Can only be used once in a growing season.	
3	Spring Biomass	Early growth in which the green leaves are below the height of the previous years growth. May be used more than once.	Cactus observations begin at this stage.
4	Early Green Biomass	Growth in which new leaves equal the height of the previous years growth and leaf branching occurs. May be used more than once.	
5	Summer Green Biomass	Growth in which leaves extend beyond the previous years growth and secondary leaf branching occurs. May be used more than once.	
6	Late Summer Biomass	Full growth, plant is fully leafed out but no reproductive structures. May be used more than once.	
7*	First Bud	First floral buds for forbs, cactus, and shrubs. In the boot for grasses. Can only be used once in a growing season.	Annual Grasses begin at this stage
8	Persistent Floral Buds	Persistent floral buds, May be used more than once.	
9*	First Flower	Open flowers, may have buds present, but this is the first sign of open flowers. Can only be used once in a growing season.	
10	Flowering and Fruiting	Continual open flowers, may still have buds, and may have some fruiting, indicates a full reproductive status, may be persistent for several weeks. May be used more than once.	
11	End of Flowering-No fruits	Indicator of end of flowering for plants which do not produce visible fruits. May also indicate aborted flowers. May be used more than once.	Eg. Common starlily
12	End of flowering-with fruits	End of flowering, no open flowers. < 25% dispersal. Persistent fruiting and seed dispersal. May be used more than once.	
13	Late Season Declining Growth	Plants that have stopped flowering or fruiting. >75% of fruits dispersed. Also used for plants with missing fruiting or flowering structures. The individual is still green. May be used more than once.	Can only be used for plants that have been reproductive at some stage during the growing season.
14	Senescence	Plants are fully brown and dead.	

Datasheet:

PHENOLOGY STUDY

Date: _____ Location: _____ Recorder: _____

GRASSES AND GRASSLIKES

SPECIES	1	2	3	4	5	6	7	8	9	10	Notes
Pasm											
Arlo											
Bogr											
Brte*											
Cael											
Sihy											
Stco											
Vuoc*											

*only sample in wet years

FORBS AND SHRUBS

SPECIES	1	2	3	4	5	6	7	8	9	10	Notes
Arfr											
Hevi											
Chvi											
Covi											
Ecvi											
Eref											
Gusa											
Lede*											
Lemo											
Oppo											
Plpa*											
Saib*											
Setr											
Spco											

PHENOLOGY CODE:

1: Winter Dormancy

*2: First Visible Leaves

3, 4, 5, 6: Green Biomass (See Stage descriptions)

7: First Floral Buds

8: Continued floral buds, no open flowers

9: First Open Flower (Anthesis in Grasses)

10: Open flowers, some buds, some fruiting

11: Aborted flowers or no visible fruits

12: No open flowers, <25% fruit dispersal

13: >25% fruit dispersal, green leaves still present

14: Senescence, no green leaves present

* = can only be entered once per year per plant

ARS #03 Vegetation Sampling for Humus Experiment

(Overlaid on Ecosystem Stress Area, ESA)

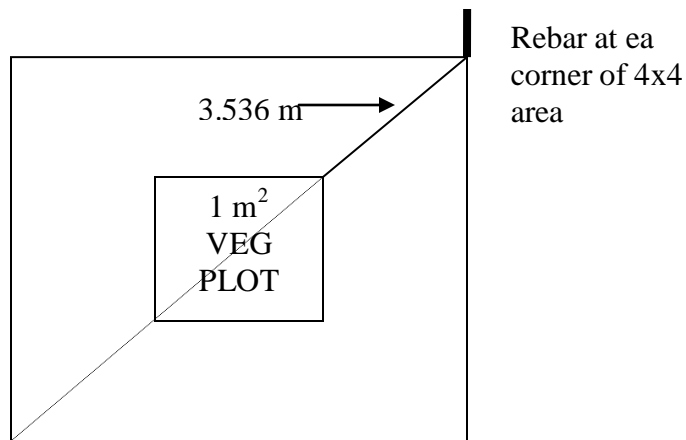
Principal Investigator: Indy Burke

Study Objective: to collect plant species composition and above ground NPP for the humus project.

Study Area Location (please see following page): This sampling is conducted on transects overlaid onto the historical ESA plot treatments to the west of the LTER Headquarter Buildings and to the north of WCR 114. It is important to record both the historical treatment and recent humus treatment on each data sheet when sampling.

Experimental Design:

- 2 blocks (east and west)
- 4 historical treatments in each block
- 3 transects in each treatment
- 6 plots with new sub-treatments in each transect
- Sample once per year at end of growing season
- Individual sample size is 1 m²



Humus Plot Layout

2 reps (blocks) → E = East, W= West (historic ESA treated plots)

3 transects in each block → 1,2,3

6 sub-plots within each transect → 1,2,3,4,5,6 sub-plots are marked in the field with an engraved orange cap on the sw corner rebar of 3 m² area sub-plot.

Plot nomenclature example:
EN11
East, Nitrogen, transect 1, control

<p>This area not used for study.</p> <p>Humus treatments codes for sub-plots</p> <p>1=Control</p> <p>2=Sugar</p> <p>3=Lignin</p> <p>4=Sawdust</p> <p>5=Lignin + Sugar</p> <p>6=Sawdust + Sugar</p>	<p>E Nitrogen</p> <p>3/5/4/2/6/1 1</p> <p>4/5/3/6/1/2 2</p> <p>1/2/6/3/4/5 3</p>
<p>E Water + Nitrogen</p> <p>3/5/4/2/6/1 1</p> <p>4/1/3/6/5/2 2</p> <p>5/4/3/6/2/1 3</p>	<p>E Water</p> <p>3/5/4/2/6/1 1</p> <p>2/1/6/3/5/4 2</p> <p>5/4/3/6/2/1 3</p>
<p>E Control</p> <p>3/5/4/2/6/1 1</p> <p>4/5/3/6/1/2 2</p> <p>5/4/3/6/2/1 3</p>	<p>W Water + Nitrogen</p> <p>3/5/4/2/6/1 1</p> <p>4/5/3/6/1/2 2</p> <p>5/4/3/6/2/1 3</p>
<p>W Water</p> <p>3/5/4/2/6/1 1</p> <p>4/5/1/3/6/2 2</p> <p>5/4/3/6/2/1 3</p>	<p>W Nitrogen</p> <p>3/5/4/2/6/1 1</p> <p>4/5/3/6/1/2 2</p> <p>5/4/3/6/2/1 3</p>
<p>W Control</p> <p>3/5/4/2/6/1 1</p> <p>4/5/3/6/1/2 2</p> <p>4/5/3/6/2/1 3</p>	<p>This area not used for study</p>

R
O
A
D

N ←

Equipment:

Meter square quadrat frame
 Point frame
 Data sheets (one for density and basal cover; one for canopy cover)
 Plant ID reference material
 Digital camera
 Nails for plot markers
 Meter tape

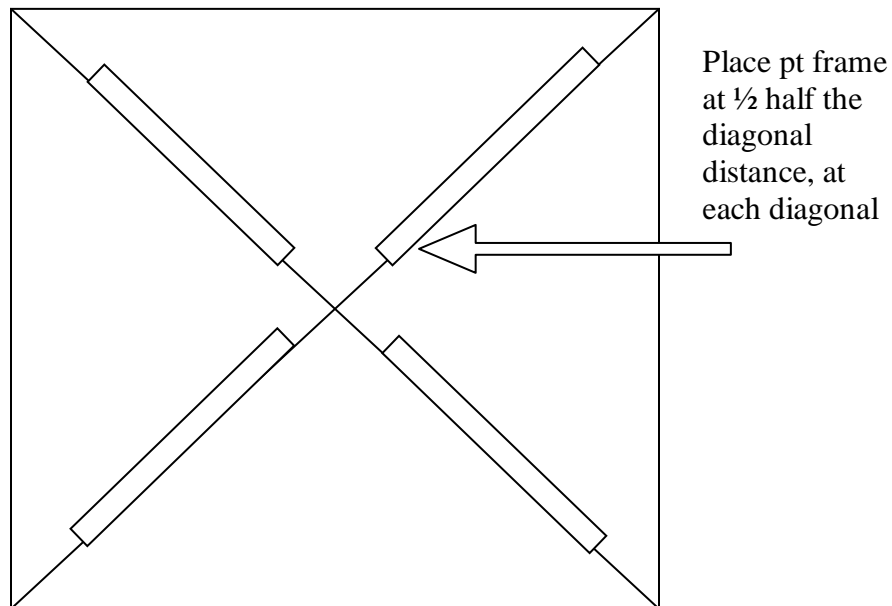
Density sampling (number of individuals of each species/m²):

Count all the individuals for each species in a 1 m² quadrat in the center of each of the 144 – 4 x 4 m plot. The corners of the center of the plot are marked by 4 nails. If a nail is missing or out of place, use the measurements along the diagonals to locate the corner of the plot and re-install the nail.

For bunchgrass (i.e. STCO) count the individual plants, not the tillers. For single stemmed grasses (i.e. AGSM), count each tiller. For all dicots and sedges, count individuals. Count by 1's up to 30. After 30, begin counting by 10's. Use a string or wire to divide the quadrat into quarters, which will make counting more manageable.

Basal Cover Sampling (m²/m²):

Use a 10 point frame to estimate cover in each 1 m² quadrat in which density was estimated. The point frame should be placed in 4 different locations, along each diagonal, as shown in the diagram, in each quadrat. Flip a coin to decide which direction the points should face. You may use the same directions for every diagonal in every quadrat. This will provide a total of 40 point contacts for each quadrat. The categories to records are plant species (use codes), litter, bare ground, and rocks. Be very critical about what the contact is. The accuracy of the methods is determined by how carefully contacts are made. Record only what the exact tip of the point touches at the soil surface. You may need to ignore a hit on a leaf to reach the soil surface. Do not penetrate the soil surface. All points must hit inside the quadrat.



Density and Point Frame Datasheet:**HUMUS EXPERIMENT DATA SHEET**

Date _____ Recorder(s): _____

Block: _____ (E or W) Treatment: _____ (W, N, W+N, or C)

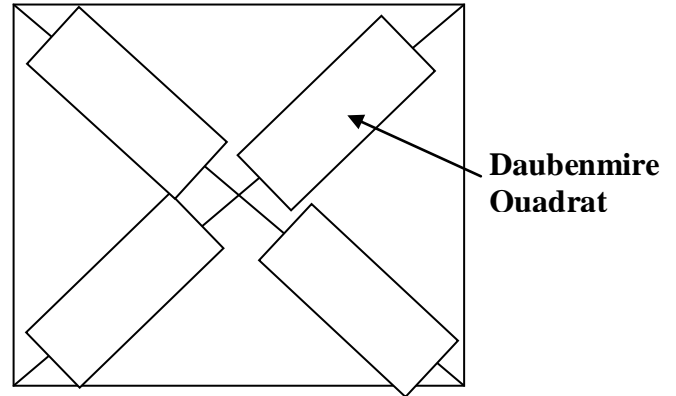
Transect: _____ (1, 2, or 3) Plot: _____ (1, 2, 3, 4, 5, or 6) Dig Image File: _____

Density Data: _____ **Point of Intercept:** _____

Species (count)	# of Individuals		Hit	Notes
		1		
		2		
		3		
		4		
		5		
		6		
		7		
		8		
		9		
		10		
		11		
		12		
		13		
		14		
		15		
		16		
		17		
		18		
		19		
		20		
		21		
		22		
		23		
		24		
		25		
		26		
		27		
		28		
		29		
		30		
		31		
		32		
		33		
		34		
		35		

Canopy Cover Sampling (Daubenmire cover classes, note added 2007):

Locate each of 4 quadrats centered on a diagonal of the 1 m² plot half way between the center and a corner of the plot (see figure). In each quadrat, estimate canopy cover (the projection of the canopy of all the individuals of each species onto the soil surface) using the following set of cover classes record the projected canopy cover. For each Daubenmire quadrat you will record on the Canopy Cover datasheet the cover class (1, 2, 3, 4, 5, or 6) for each group of species.



Cover Classes: T=Trace (1%), 1=1-5%, 2=6-15%, 3=16-25%, 4=26-40%
5=41-60%, 6=>60%

Canopy Cover Data Sheet:

Humus Experiment Canopy Cover	
Date:	Recorder:

Daubenmire Cover Classes: T=Trace (<1%), 1=1-5%, 2=6-15%, 3=16-25%, 4=26-40%, 5=41-60%, 6=>60%

Block (E, W)	ESA Treatment (W, N, C, W/N)	Transect # (1-3)	Sub-Plot # (1-6)	Daub Quadrat # (1-4)	Species	Canopy Class Code (1-6)

Biomass Sampling (using digital photography) (g/m²):

Take an image of each of the 144 quadrats as nearly vertical as possible. Use a ladder to get high enough to get the entire 1 m² quadrat from a bird's eye view in the image. Record the image number on the datasheet for that plot. Record image numbers and memory cards number(s) that contain the images for this project in the orange digital camera log book. Label the memory card with Humus, Year, along with other project titles for which data are on that memory card.

QAQC Instructions:

IMPORTANT –When starting a block-treatment, one person will be in charge of checking off plots as the data are collected from each transect. Make sure all 6 quadrats from each combination of treatments are sampled and labeled corrected, then move onto the next transect for sampling. Also be sure to record the block and historical treatment, as well as the image number on each data sheet. Collate the data sheets by transect and then block. Make sure everything is there before leaving the block. When all the sampling is done, there should be 8 different packets of data sheets, each clipped together and containing 18 datasheet (3 transects x 6 quadrats per block).

ARS #06 A -- Herbaceous Long Term Net Primary Production

Principal Investigator(s): Daniel Milchunas and Bill Lauenroth

Study Objectives: Monitor long-term above ground net primary production at sites with different soil textures and topographic positions.**What to know before you start sampling:**

- ✓ **You have been shown the locations of the six sampling sites**
- ✓ **You have been instructed how to layout transects and plots in the ungrazed areas in Owl Creek and ESA**
- ✓ ****Note that 2 different sized frames will be used for clipping****
 - a smaller 0.10 m² Daubenmire (20x50 cm) frame will be sampled in the center of a larger 0.25 m² circular frame
- ✓ **You have noted what to clip and what not to clip**
 - clip live plus recent dead (one sample of current-year's growth) by functional group as defined below
 - separate bags must be labeled for both quadrat sizes, the 0.10 m² Daubenmire frame and the 0.25 m² circular frame
 - old standing dead (last year's growth, usually grey) will be collected and placed in a separately labeled bag (all groups combined in on bag)
 - no litter, no lichen, no OPPO, no ATCA and no CHNA is collected
 - clip only current year's growth, on shrubs this is green material plus new stem growth
- ✓ **You have been trained to identify old versus new growth of shrub and grass/forb groups**
- ✓ **You have been provided labels and various sample bags**
- ✓ **Cages are moved the following spring not the current year.**
- ✓ **You have been instructed on how to inventory and deliver bags to the sample prep lab at CSU**
- ✓ **You have the sample check-off sheet**
- ✓ **You have been instructed on what to do if you see a grub-kill or any other disturbances (ant mound, etc.)**
- ✓ **IF YOU HAVE NOT RECEIVED INSTRUCTIONS ON IDENTIFICATION AND COLLECTION OF 1) live, 2) recent dead, 3) old standing dead, 4) litter (not collected for biomass), 5) lichen (not collected for biomass), 6) shrub recent year growth THEN STOP AND DO NOT CLIP.**

Study Area Locations: There are 6 sites: ridgetop (ridge), midslope (mid), swale, ESA (replicate 1 not 2; see 1D ARS #3 ESA map), Section 25 (SEC 25), and owl-creek (OC). Each location has 15 plots. There are 3 transects with 5 plots in each transect. Plots in the grazed locations are protected by cages. The entire 50 m transect for LTNPP should be relocated 1m north or south perpendicular to the transect every new LTER iteration (i.e. every 6 years to lessen the effects of long term destructive sampling while keeping soils, habitat, etc. the same.) The cages are moved to new random locations every year. In the spring of 2010 move the cages to random locations (random numbers generated by Excel) for the clipping this August and re-stake the cages. New plot locations are chosen randomly each year. If a random number for the new placement hits on the present location of a cage, then pick a new random number. The 3 transects are marked by rebar or plates. Measure the distance to the random location of the five plots along each transect. The next transect move will be in 2014 and each will be moved 1m perpendicular north or east depending on site layout, and in 2020 will be moved perpendicular 1m south or west depending on site layout. **See appendix for "Directions for CPER Study Sites Map" ARS #6 sampling locations.**

Experimental Design:

- 6 sites
- 3 transects at each site
- 5 plots on each transect
- Sample once per year at end of growing season
- Individual sample size is 0.25 m² circle frame with a 0.10 m² Daubenmire frame inside

Clipping Protocol:

Clip just above crown-level for all individuals, except for shrubs. Clip only current year growth of shrubs, usually grows from an older woodier branch (see Mark/Kevin for description). DO NOT clip cactus, ATCA, CHNA or collect lichen (see separate cactus protocol below). All live plus recent dead material needs to be harvested from each plot by functional group and all old-standing-dead is combined in one bag for each plot. Old-standing-dead is "standing", NOT the LITTER that is lying on the surface of the ground. Both recent dead and old standing-dead are standing and both are dead, but they are not the same, and need to be collected differently. Recent dead and green are combined for each functional group, because they were both produced in the current year. You can brush the basal old-dead material away from the clipped material with your fingers into a standing dead bag. Check your plot for unclipped plants along the edge of the quadrat and for material that should be collected that may have been left on the ground before moving to next one.

Function group classifications for ANPP (see additional plant species list on the next pages for group they are in):

BOBU= *Bouteloua gracilis* and *Buchloe dactyloides* combined

WSPG= Warm season perennial grass other than BOGR and BUDA (includes SPCR, ARLO, MUTO, DISP, etc)

CSPG= Cools season perennial graminoids (includes CAEL, PASM, SIHY, STCO, ORHY, etc)

CSAG= Cool season annual grass (includes VUOC, BRTE. etc)

FORB= All forbs

SS= Subshrubs (includes ARFR, EREF, CELA, etc ****Do Not Collect ATCA, CHNA, or YUGL****)

OSD= Old Standing Dead, previous years growth, grayish material

DO NOT CLIP ANY CACTUS or COLLECT LICHEN.

Do not clip on an ant mound or large disturbance (select new random number for placement if this occurs). Note other more minor small mammal, ant, and other disturbances on the bag. Place all envelopes or small bags from each plot into the largest sample bag from that plot, keeping the 0.10 m² Daubenmire frame separate from the 0.25 m² circular frame. This is usually, but not always, the BOGR bag. If there happens to be two or more large bags from one plot, try to keep them together. If there are, for example, two or three bags for one species, label the bags "1 of 2 or 3, 2 of 2 or 3, and 3 of 3".

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Example Label for LTNPP (Labels will be provided):

STUDY	LTNPP
DATE (month, day, yr)	08 01 93
SITE	SWALE
TRANSECT #-PLOT #	T-2 P-3
Functional Group CODE	FORB, SHRB, CSAG, CSPG, WSPG, BOBU, SD

QAQC Instructions:

IMPORTANT: In the field at the end of each site, gather all bags together and sort by transect. Then check that all plots are there for each transect, and they are labeled correctly and accounted for. ****Make sure there are bags for both quadrat sizes (0.10 m² & 0.25 m²)****. This entails more than just counting that there are 5 plots for each of the 3 transects---are there two labeled the same? ---are all envelopes in the large bag labeled with the same site and transect-plot numbers? *** The check off sheet MUST be filled out.**

IMPORTANT: When drying bags in the oven, temperature must be 55°C--not more and not less. Arrange bags by date placed in oven. Be careful not to rip bags on metal shelves.

IMPORTANT: During the first week of September (at the least) Kevin, Judy, David, and Mary will go into the field to discuss the current year's growth situation. For example: PLPA could look black but is current year's growth, CAHE can re-green so can have dead brittle CAHE and fresh green (both being current), etc... This will assure that sorting done by both LTER and ARS in the lab are set to similar levels.

Sample Check Off and Delivery Instructions:

IMPORTANT: Organize the samples bags by project and then location and then put them in a larger bag to be transported to the SGS-LTER Sample Prep Lab. Double check that all of the transects and plots sampled from one location are being transported to the SGS-LTER Sample Prep Lab together. Label the larger bags with the year the samples were collected, the name of the project, and the plot numbers from which the samples were collected. Make sure that the larger bags are tied down in the back of the pick-up truck when they are being transported to CSU campus. Keep an inventory of what bags have been brought to campus and what bags remain in the drying oven.

Check-off Sheet:

[illegible]

ARS #28 Chart/Oppo Project**Principal Investigator:** Bill Lauenroth**Study Objectives:** to follow the long-term growth patterns of individual plants under different grazing regimes.*****Pictures only for the 2012 field season*******ARS #32 Grazing and Soil Texture (GZTX)****Principal Investigator(s):** Dan Milchunas**Study Objectives:** To evaluate the plant community species composition, and aboveground net primary production (ANPP) in response to long-term grazing by cattle.**What to know before you start sampling:**

- ✓ *Have you visited each GZTX site and are the treatment areas clear*
- ✓ *Have you been instructed by ARS or an SGS-LTER PI on Daubenmire's method and class codes for sampling canopy and basal cover (note- all species, litter, bare, lichen, etc are sampled by this method)*
- ✓ *You have been instructed on Robel Pole*
- ✓ *You have been instructed on how to clip biomass*
 - *clip live and recent dead by species*
 - *collect 'old' standing dead (biomass NOT produced in the current year)*
 - *no lichen, no cactus, no litter*
 - *no old growth on shrubs, only new growth (**Do NOT Clip ATCA, CHNA, YUGL**)*
- ✓ *You have been provided the cover datasheets*
- ✓ *You have been provided labels and various sample bags for clipped samples*
- ✓ *You have been instructed on how to inventory and deliver bags to the sample prep lab at CSU*
- ✓ *You have the sample check-off sheet*
- ✓ *You have been instructed on what to do if you see grub-kill and/or other disturbances*
- ✓ **IF YOU HAVE NOT RECEIVED INSTRUCTION ON IDENTIFICATION AND COLLECTION OF 1) live, 2) recent dead, 3) old standing dead, 4) litter, and 5) shrub recent year growth THEN STOP AND DO NOT CLIP.**

Study Area Locations:

There are 4 treatments at 3 of the 6 sites (24, 19, 11) including grazed/grazed, grazed/ungrazed, ungrazed/grazed, and ungrazed/ungrazed. There are 5 treatments of the remaining 3 sites (7C, 5W, and 5E) including an additional rodent/ungrazed treatment. The codes are GZ/GZ, GZ/UN, UN/GZ, UN/UN, and RO/UN (rodent ungrazed). It is important to code the treatments correctly – remember, treatment codes are “what grazing used to be, then what grazing is now”, (for example, the GZ/UN used to be grazed until 1991, after which and now it is ungrazed and has a barbed wire fence around it to exclude the cattle). Be sure you know what site and treatment you are working in –check your maps and look to see if you are in a fenced or unfenced treatment, and a caged or uncaged plot. **See appendix for “Directions for CPER Study Sites Map” ARS #32 sampling locations. All six treatment maps are on the following pages.**

Experimental Design for Vegetation Structure and Composition (revised to drop density and add canopy cover in 2009, added Robel Pole 2011):

- 6 sites
- 3 sites with 4 treatments, 3 sites with 5 treatments
- 36 plots per each treatment at each site
- Each plot includes basal and canopy cover estimates along with Robel Pole measurements
- Plot are measured once per year, mid-season
- Individual plots are .1 m²

Experimental Design for Clipping (**UTIL PLOTS DROPPED FOR 2012**):

- 6 sites (24, 11, 19, 7, 5W, and 5E)
- 3 sites with 4 treatments (24, 19, 11), 3 sites with 5 treatments (7, 5W and 5E)
- Site 24 & 11
 - 6 NPP plots in UU
 - 6 NPP plots under cages GG
- Site 19
 - 6 NPP plots in UU
 - 10 NPP plots under cages GG
- Site 7, 5W, and 5E
 - 6 NPP plots in the UU
 - 10 NPP plots under cages GG
- Plots are sampled once per year at the end of the growing season
- Individual plots are 0.25 m²

Vegetation Structure and Composition Sampling Protocol:

Basal and Canopy Cover Protocol:

Plots in each treatment will be randomly flagged and sampled. For treatments with 20 plots, flags will be labeled 1-20 (in UU and GU flags 1-6 will be labeled with a C to indicate the need for clipping after growing season). For treatments with 35, flags will be labeled 1-35 (in UU flags 1-6 will be labeled with a C and in GU, and RU flags 1-10 will be labeled with a C to indicate the need for clipping after the growing season). **All flags labeled with a C must remain after basal and canopy measurements, all other flags can be removed.** An mark, such as an "x" should be placed on the flag after cover sampling to indicate basal and canopy cover data were collected. The other flag may be re-used from site to site, but the flags left in the field marking future clipped plots will need to be replaced at the next treatment or site.

Randomly flagging each treatment:

1. Find the corner of each treatment with a marking plate or post (use GZTX Enclosure Maps).
2. To find the middle of the treatment area pace half the distance west or east (depending on treatment) and then pace half the distance to the center either north or south (depending on the treatment).
*Distances can be found on the GZTX Enclosure Maps.
3. Once at the middle face north. Make four transect going 310°, 45°, 130°, and 220°. Each transect should be 15 m in length and can be paced off.
4. At the end of each transect randomly toss ¼ of the flags, where ever the tip of the flag lands is the sample location.
5. If a flag has landed outside of the treatment area or on any type of disturbance (grub kill, gopher mound, ant mound, rabbit burrow) re-toss the flag until an appropriate location is found.

Place the Daubenmire .10 m² frame over the flag, with the legs up, if any. Go around the edge and determine what is rooted inside and out of the quadrat. The plants being measured for basal cover must be rooted inside, but plants measured for canopy cover may be rooted outside the frame with parts of its' upper canopy growing into the plot.



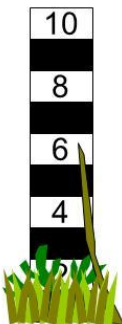
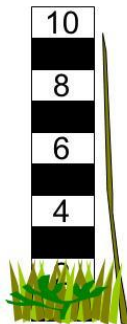
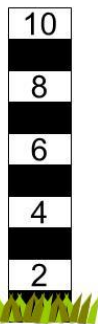


Unknowns should be labeled as forb, grass or shrub with the codes UNFB, UNGR, or UNSH. If an unknown is encountered several times it should be given a number or name, and identified at a later date, **and the data sheets recoded with the correct four-letter species code. Daubenmire cover classes should be used for recording basal cover of each species rooted in the plot, bareground and litter, and canopy cover of each species.**

Estimate canopy cover and then basal cover for species 1, then canopy and then basal for species 2, and so on (this way you only have to focus on each species once, and subtract the extra canopy portion to obtain the basal portion). After all species have been recorded then do bare ground and litter (which are the same for both canopy and basal estimates). The Daubenmire cover classes are as follows: T= Trace (<1%), 1 = 1-5%; 2 = 5-14%; 3 = 15-24%; 4 = 25-39%, 5 = 40-59%, 6 = 60-100%. The code for bare ground is BARE, litter is LITT, and lichen is LICH. Scat, including rabbit, pronghorn, and cow should be considered as part of the litter cover. We identify only one *Astragalus/Oxytropis* to species—the vine like one is ASGR (with thinner leaves and small purple flowers). All others are lumped under the code ASOX. The two *Orabanche* species are coded OROB.

The canopy cover may be less or more than 100% as much of the plot may be litter or bare ground or the canopy may be layered and each species overhanging in the plot must be recorded. Basal cover should theoretically add to 100%, but because you are doing classes and not actual percentages the midpoint of the classes will only approximately add to 100%.

At each location, we also sample veg structure using a robel pole with 1 cm increments, taking an observation on the pole in each of the 4 cardinal directions. We record both the number of intervals completely obscured by vegetation, and the highest interval with some kind of obstruction, with the pole constructed and sighting height and distance according to Robel (1970), but with the modification of using 1 cm increments. See the file “Robel_Pole_Method_HighvsLow.ppt” for instructions on how to read the low and high values from the pole. In addition, ***record the species that is responsible for causing the obstruction associated with the LOW reading; if more than one species is involved, record the tallest species associated with the LOW reading. Only one species code is recorded for each robel reading – there will be no species recorded in association with the HIGH reading.*** See example file.

Robel Pole Method Examples:

High reading:	10	9	6	2	1	1	0
Low reading:	4	3	2	2	1	0	0
Species:	BOGR	BOGR	SPCO	BOGR	BOGR	BOGR	BARE
							

Root Ingrowth Donut Procedure:

See the “Root Ingrowth Donut Protocol” below in this manual for sampling method details. Below is only the information concerning the numbers and locations of samples specific to GZTX.

There are two (2) root ingrowth donuts at each treatment within each site. Only the GZGZ and UNUN treatments are sampled and only five of the six sites (5 west, 5 east, 7, 11, 24 – 19 is not sampled for roots). Therefore, there are 5 sites X 2 treatments X 2 locations = 20 donuts. There are two depths

sampled at this study (0-10 and 10-40cm), except that two of the donuts are not beveled and the 0-10cm depth must be cut without the PVC guide (bring a ruler with cm to measure this).

Use check-off sheet to account for all samples at end.

Bag label example:

GZTX donuts

Date (mo/day/yr)

Site (5 west, 5 east, 7, 11, 24)

Treatment (GZGZ or UNUN)

Plot (plot 1 or plot 2)

Depth (0-10 or 10-40)

Bag number (1 of 2or3..., 2 of 2or3,

QAQC Instructions for cover:

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IMPORTANT – Double check-off procedure (use the correct check-off sheet for that site and treatment). When starting a site-treatment, one person will be in charge of checking off plots on the master check-off sheet as the flags are inserted. As each team collects data from a plot they must pull the flag, unless it is a CLIP plot in the ungrazed treatments. The plot number should have a C, indicating CLIP, if the flag should stay. Each team will call the plots from where they have collected data to the person with the check-off sheet. The person with the check-off sheet and the team member will double check the plot numbers. The team member will make sure that this information is complete and correct on the data sheet. The person with the check-off sheet will double check that basal and canopy cover data have been collected from each and every plot. All sheets will be given to the call-check person, who will be the last to leave the treatment area. Again, the call-check person must verify that all plots that are listed on the master check-off sheet are on the data sheets. This entails more than just counting the number of plots – are there two labeled the same? The sheets for a particular site-treatment should be clipped together and placed in the envelope for that site. The check-person should not proceed to the next site before completing the master check form, and verifying the site and treatment code by checking the map for that site. When the site is done, there should be four or five (depending on the site) separate packets of sheets (one for each of the 4 or 5 treatments.)

If leaving for lunch or for the day before all plots in a site-treatment have been read, check off plots when physically standing in the treatment – not in the van or at the station headquarters. Give Mark or Nicole the check-off sheet when all plots for all site-treatments have double check marks.

Example Data Sheet:

Exclosure Study

Date: _____ Collected By: _____

Year	Site #	Treatment			Plot #			Species				Basal Cov Class	Canopy Cov Class	Notes
		Prev	Now											

Cover Class: T=Trace (<1%), 1=1-5, 2=6-15, 3=16-25, 4=26-40, 5=41-60, 6=>60

2012 Check-off Sheet (please use following pages):

24 U/G Plots	Check Off	24 G/G Plots	Check Off	24 G/U Plots	Check Off	24 U/U Plots	Check Off
1		1		1C		1C	
2		2		2C		2C	
3		3		3C		3C	
4		4		4C		4C	
5		5		5C		5C	
6		6		6C		6C	
7		7		7		7	
8		8		8		8	
9		9		9		9	
10		10		10		10	
11		11		11		11	
12		12		12		12	
13		13		13		13	
14		14		14		14	
15		15		15		15	
16		16		16		16	
17		17		17		17	
18		18		18		18	
19		19		19		19	
20		20		20		20	
Notes:							

19 U/G Plots	Check Off	19 G/G Plots	Check Off	19 G/U Plots	Check Off	19 U/U Plots	Check Off
1		1		1C		1C	
2		2		2C		2C	
3		3		3C		3C	
4		4		4C		4C	
5		5		5C		5C	
6		6		6C		6C	
7		7		7		7	
8		8		8		8	
9		9		9		9	
10		10		10		10	
11		11		11		11	
12		12		12		12	
13		13		13		13	
14		14		14		14	
15		15		15		15	
16		16		16		16	
17		17		17		17	
18		18		18		18	
19		19		19		19	
20		20		20		20	
Notes:							

11 U/G Plots	Check Off	11 G/G Plots	Check Off	11 G/U Plots	Check Off	11 U/U Plots	Check Off
1		1		1C		1C	
2		2		2C		2C	
3		3		3C		3C	
4		4		4C		4C	
5		5		5C		5C	
6		6		6C		6C	
7		7		7		7	
8		8		8		8	
9		9		9		9	
10		10		10		10	
11		11		11		11	
12		12		12		12	
13		13		13		13	
14		14		14		14	
15		15		15		15	
16		16		16		16	
17		17		17		17	
18		18		18		18	
19		19		19		19	
20		20		20		20	
Notes:							

GZTX Clipping Protocol:

There are two types of plots clipped in this experiment. One estimates aboveground net primary production (labeled "ANPP or NPP") and the other consumption (utilization, and labeled "UTIL") if the treatment is grazed. The NPP plots are located under the cages in the grazed treatments and in the ungrazed treatments, and the UTIL plots are uncaged in the grazed treatments. The cages are moved, secured, and labeled earlier in the field season. See the Experimental Design for Clipping section at the start of this procedure for the number of plots at each treatment-site. In areas that contain cages, NPP samples are clipped from under the cages and utilization (UTIL) sample are clipped 3 meters to the east of each cage, unless a disturbance exists or you will reach the end of the treatment area. Be sure to record the plot number for all samples on the bags. In the ungrazed treatments, only NPP samples are collected. The NPP samples may come from the first 6 or 10 plots that were sampled in 24, 19, and 11 or 7C, 5W, and 5E, respectively during the basal and canopy cover study. Flags for these plots should have been left in the ground after sampling for basal and canopy cover. Upon collection of the NPP samples, remove the flags so not to leave equipment behind in the field and to let others know that the plot has been sampled.

Cages are moved and secured before cattle are introduced to the CPER for summer grazing. Cages will be moved 4 m west from previous location for 2010, this can be paced off. Adjust appropriately if there is a disturbance (grub kill, ant mound, gopher mound, etc.) or if the cage will be placed outside the treatment area. This can be anything from moving 2 m south and 2 m east to moving 3 m north. Each cage will be labeled with a metal tag. Tags will be labeled with the Section ID, Treatment (U/G, G/G), Plot #, and a U if a Utilization plot is associated with that cage (ex: 24 G/G 1C U or 19 G/G 7C). Tags are secured to the top middle of the cage. Make sure to fold tags in half so cows are not enticed to eat them.

Clip around the cactus, as not to disturb the future growth of the cladodes. Remember that standing dead will be collected and put into one separate bag for each plot (labeled OSD). Old-standing-dead is "standing", NOT the LITTER that is lying on the surface of the ground. Both recent dead and old standing-dead are standing and both are dead, but they are not the same, and need to be collected differently. Recent dead is part of this year's growth, so is combined with green material for estimating ANPP. Clip just above crown-level, except for shrubs. Clip only current year growth of shrubs as some species grows from an older, woodier branch (DO NOT CLIP UNLESS YOU HAVE BEEN INSTRUCTED ON HOW TO IDENTIFY GROWTH CLASSES. All live plus recent dead material needs to be harvested from the plot by functional group, and old standing dead is combined into one bag/plot. – check your plot for plants along the edge and pieces left on the ground before moving to the next one. **Do not collect pach (lichen), ATCA, CHNA, YUGL, or clip or remove any cactus species from anywhere on the site.**

Function group classifications for ANPP:

BOBU= *Bouteloua gracilis* and *Buchloe dactyloides* combined

WSPG= Warm season perennial grass other than BOGR and BUDA (includes SPCR, ARLO, MUTO and DISP)

CSPG= Cools season perennial graminoids (includes CAEL, PASM, SIHY, STCO and ORHY)

CSAG= Cool season annual grass (includes VUOC and BRTE)

FORB= All forbs

SS= Subshrubs (includes ARFR, EREF, CELA ****Do Not Collect ATCA, CHNA, YUGL****)

OSD= Old Standing Dead, previous year's growth

Place all envelopes or small bags from each plot into the largest sample bag from that plot. Note all small mammal, ant and any other disturbances on the largest sample bag from that plot. This is usually, but not always, the BOGR bag. If there happens to be one or more large bags from one plot, keep track of them by labeling the bags, for example, "1 of 3, 2 of 3, and 3 of 3". Make sure that your writing is clear and legible and that the bags are labeled using a sharpie permanent marker.

Example Label:

Labeling for GZTX	Example
Study	GZTX
Date (month, day, year)	01 08 00
Site	19
Treatment	GG
Sample Type	NPP (or UTIL)
Plot number	P – 1C
Functional Group 4 letter code from ARS	BOBU (WSPG, CSPG, etc..)

QAQC Instructions:

IMPORTANT--- When starting a site-treatment, the crew leader will be in charge of checking-off plots, for all clip-teams, on master check sheet as a team starts to clip the plot. Each team will call the number of the plot they are starting to the person with the check-off sheet (this is the 'call-check'). If you are ready to move to the next treatment at a site, do not leave the treatment with bags. All bags should be left at one collection point (in the treatment, not the truck). If the 'call-check' person is not the last to leave the treatment, he/she will leave the check sheet at the bag collection point. The last person leaving the treatment must check that all plots are there (this is the 'final-check'), and that they are labeled correctly. This entails more than just counting the number of bags---are there two labeled the same? ---Are all envelopes in the large bag labeled the same?--Is there a paired UTIL bag for each caged plot in the currently grazed treatments? ARE THE PLOT NUMBERS CORRECT? Each plot needs to be checked off again on the check-off sheet . At this time, the master-check-sheet should have two check-marks beside each plot number (1 for the 'call-check', and 1 for the 'final-check'). If leaving for lunch or for the day before all plots in a site-treatment have been clipped, check-off plots on master sheet when physically **standing in the treatment**--not at the truck or at headquarters. Give Mark the check-off sheet when all plots for all site-treatments have double check marks, and Judy should get this when the dried samples are delivered to the lab.

2010 Field Season GZTX Clipped NPP and Util plots
Exclosure 24

24 U/U	Check Off	24 G/G	Check Off
1C		1C	
2C		2C	
3C		3C	
4C		4C	
5C		5C	
6C		6C	

Exclosure 11

11 U/U	Check Off	11 G/G	Check Off
1C		1C	
2C		2C	
3C		3C	
4C		4C	
5C		5C	
6C		6C	

Exclosure 19

19 U/U	Check Off	19 G/G	Check Off
1C		1C	
2C		2C	
3C		3C	
4C		4C	
5C		5C	
6C		6C	
		7C	
		8C	
		9C	
		10C	

Exclosure 7

7 U/U	Check Off	7 G/G	Check Off
1C		1C	
2C		2C	
3C		3C	
4C		4C	
5C		5C	
6C		6C	
		7C	
		8C	
		9C	
		10C	

Exclosure 5W

5W U/U	Check Off	5W G/G	Check Off
1C		1C	
2C		2C	
3C		3C	
4C		4C	
5C		5C	
6C		6C	
		7C	
		8C	
		9C	
		10C	

Exclosure 5E

5E U/U	Check Off	5E G/G	Check Off
1C		1C	
2C		2C	
3C		3C	
4C		4C	
5C		5C	
6C		6C	
		7C	
		8C	
		9C	
		10C	

Delivery Instructions:

When you are finished collecting samples at each location, gather all bags together and sort them out by site and treatment. Then check that all plots are there for each treatment and plot type, and they are labeled correctly. This entails more than just counting the bags– are there two labeled the same? - Are all envelopes and small bags within the larger sample bags labeled with the correct location, site-treatment -plot numbers, and species codes?

IMPORTANT: Place the bags in the drying oven at a temperature of 55 C – not more and not less (check oven with lab thermometer). Arrange bags by site or location in the oven. Be careful not to rip bags on the metal shelves of the drying oven.

IMPORTANT: Organize the samples bags by project and then location and then put them in a larger bag to be transported to the SGS-LTER Sample Prep Lab. Double check that all of the plots sampled from one location are being transported to the SGS-LTER Sample Prep Lab together. Label the larger bags with the year the samples were collected, the name of the project, and the site, treatment and plot numbers from which the samples were collected. Make sure that the larger bags are tied down in the back of the pick-up truck when they are being transported to CSU campus. Keep an inventory of what bags have been brought to campus and what bags remain in the drying oven.

IMPORTANT: During the first week of September (at the least) Kevin, Judy, David, and Mary will go into the field to discuss the current year's growth situation. For example: PLPA could look black but is current year's growth, CAHE can re-green so can have dead brittle CAHE and fresh green (both being current), etc... This will assure that sorting done by both LTER and ARS in the lab are set to similar levels.

ARS #99 Lagomorph Count**Principal Investigator:** Paul Stapp**Study Objectives:** to track temporal changes in the relative abundance of these important species on the study area. Please see directions for CPER Study Sites in Appendix.**What to know before you start sampling:**

- ✓ Are you familiar with the 3 species of rabbit
- ✓ Are you prepared with warm clothes
- ✓ Do you have back-up lights and a measuring tape
- ✓ Have people been trained on the range finder

Study Area Locations and Design: see transect map across CPER for lagomorph and scat counts**Sampling Protocol:****EQUIPMENT:** Truck with functional tripometer, two "Q-beam" spotlights plus one spare, data sheets, range finder, back-up 50-m tape, one driver and 4+ observers.

1. Route driven on one night in April, July, October, and January (if enough volunteers can be found for winter sampling) during the period of the new moon (between last and first quarter-moons).
2. Start at dark at the cattle guard at the fence line road near the driveway to site manager's house in 21SE.
3. Three observers in back of truck, two with spotlights. The spotlights should sweep out from the road to a 45 degree angle as you drive along. The third observer watches for rabbits and measures the distance of animals from the road with the range finder. The driver or another observer watches for rabbits, especially in the road at the 0 distance and records data.

When an animal is spotted, one observer spotlights animal to make sure that it is not recorded later as a new observation, and the other observer spotlights the spot on the ground where the animal was first sighted. The driver moves the truck so that the bed is perpendicular to where the rabbit(s) were originally spotted. The third observer uses the rangefinder to measure the perpendicular distance from the side of the truck bed to where the animal was sighted.

4. The observers in the truck record the data. Data to be recorded at each sighting:

SPECIES:

SYAU	desert cottontails (<i>Sylvilagus audubonii</i>)
LECA	black-tailed jackrabbits (<i>Lepus californicus</i>)
LETO	white-tailed jackrabbits (<i>Lepus townsendii</i>)
LESP	unknown jackrabbit (couldn't tell if LETO or LECA)
UNLAG	unknown rabbit/lagomorph (couldn't tell if cottontail or jackrabbit but it was a rabbit)
BUOW	burrowing owl

ODOMETER READING (to nearest 0.05 mi)**PERPENDICULAR DISTANCE TO ANIMAL (to nearest 0.5 m)****NUMBER OF ANIMALS AT THAT DISTANCE (for animals in groups)****TIME (military 24hr, hhmm)****APPROXIMATE DIRECTION FROM VEHICLE (N, S, E, W)****TOPOGRAPHY (use codes provided)****VEGETATION (use codes provided)****COMMENTS (anything unusual or interesting; record nearby cattle guards, tanks, windmills, enclosures, etc.)**

5. Record sightings and odometer readings for other animals on a separate record on the data sheet. Do not record direction, topography or vegetation. Do record the time, mileage and number of animals. For cells on the datasheet left blank enter a dash.

MISCELLANEOUS SPECIES:

CALA	coyote	VUVE	swift fox
TATA	badger	MEME	striped skunk
MUFR	long-tailed weasel	DIOR	kangaroo rat
GHOW	great-horned owl	BAOW	barn owl

QAQC Instructions:

Make sure to fill in all of the information on the header of each and every datasheet, including page ___ of ____.

Record the time and starting and ending mileage immediately at each location. Record any changes in the weather or weather events over the past 24 hours. Make sure record and report scat tallies on the data sheet. Clip data sheets together for each night.

Data Sheet:

**SGS-LTER Long-Term Monitoring Project
Spotlight Rabbit Count**

On CPER:

DATE (day-month-year) _____

OBSERVERS _____

WEATHER _____

START TIME _____ END TIME _____

INITIAL MILEAGE _____ END MILEAGE _____

SPECIES	MILEAGE	DISTANCE	# ANIMALS	TIME	DIRECTION	Topogr	Veg	COMMENTS
					N S E W			
					N S E W			
					N S E W			
					N S E W			
					N S E W			
					N S E W			
					N S E W			
					N S E W			
					N S E W			
					N S E W			
					N S E W			
					N S E W			

Topography codes:

FU flat upland	RG ridgetop
FL flat lowland	SW swale
MS midslope	CR creek drainage

Vegetation codes:

AC saltbush	GR grassland
YU yucca	HU human structure (<30 m)
MX mixed grassland (w/AC or YU)	

ARS #118 SPTR Trapping

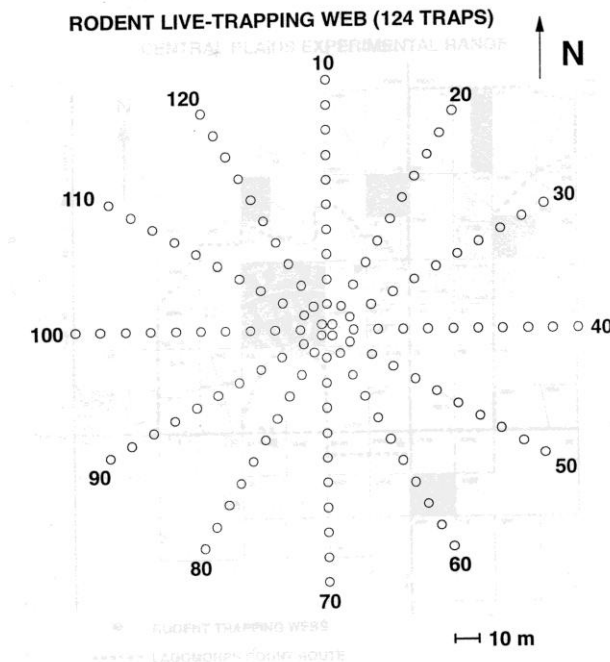
Principal Investigator(s): Paul Stapp

Study Objectives: (1) Assess spatial and temporal patterns of abundance and species composition of thirteen-lined ground squirrels among representative prairie cover types; (2) Provide baseline information to aid future population and ecosystem-level studies on the site; (3) Establish a long-term database that could be used in comparative studies in association with data collected at other sites, including others in the LTER network.

What to know before you start sampling:

- ✓ **You have been given a trapping vest and it is stocked with all the necessary equipment**
- ✓ **You can identify different species of small mammals, as well as its sex, age and reproductive status**
- ✓ **You are familiar with codes used to record the data about each animal**
- ✓ **You have been instructed on how to handle and mark animals**
- ✓ **You are familiar with the grid locations and very familiar with the design and trap numbers**
- ✓ **You are familiar with when and how to euthanize an animal (see Mark)**
- ✓ **Patch burn areas and OPPO areas will be sampled in July 2008-July 2011**

Study Area Locations and Experimental Design: Small mammal trapping grids are located in quarter sections in three shrubland sites (13NW, 13SW, and 24NE), three upland grassland sites (25NE, 27NE, and 31NE). Each grid must be recorded with the section number and quarter-section direction on the data sheet. Grids are set up 10 traps X 10 traps with 15m in between each trapping station. The SW corner is A1 and the SE corner is A10 and labeling continues North until J1-J10.



Sampling Protocol:

EQUIPMENT: 400 Sherman large live traps, peanut butter/oats balls in wax paper (ca. 500), loose peanut butter/oats mixture, wool, (3) each of blue/green Sharpies marking pens, data sheets, 3 pesola scales (100-300g each), (3) 6" rulers, (2) boxes of 1-ga Ziploc bags, 3-4 technicians (depending on experience), a pair of dikes, pencils.

PERMITS: Annual reports and trapping permit renewal from Colorado Division of Wildlife; Renewal of permission from CSU Animal Care and Use Committee; Annual reports to CPER/LTER.

1. Each grid trapped for four consecutive days in late-May and in late-July. Three grids are trapped concurrently,

with both upland and lowland webs represented in each period.

2. Prior to the trapping sessions, all missing flags at odd numbered trap stations should be replaced and re-marked. Excluding the perimeter lines, a single trap is placed at every station and a spare placed at the A1 corner post (64 traps per grid). Traps are covered with pvc shades with nails or tent stakes and oriented so that the trap is shaded. Bait balls are placed at the backs of trap doors before setting, and a small (ca. 1.5" dia) ball of wool is placed at the rear of the trap. Once set, a small pinch of loose bait mixture "chum" is placed on the open door. Begin setting traps at 06:30.

3. Check traps at 10 am, close opened traps, and record traps with animals or sprung. Record weather, using temperature at LTER headquarters. Grab animal by nape of neck and mark throat and chest thoroughly with marking pen (each web in a given trapping period will use a different color mark). If an animal has already been captured and marked, always re-mark. Record age, sex, reproductive status, and identify animal to species (see codes). In comments section record the number of warbles/scars from botflies. Weigh animal in bag and record mass. Release animal at capture location. Weigh bag and remaining contents, and calculate mass by subtraction. Wash traps, re-bait, and replace wool at head quarters. Make sure that all traps are closed.

4. At 06:00, replace clean traps at correct stations and re-open all traps with re-bait "chum" on the doors.

5. On the fourth day, pick up all traps and move to other grids. After all grids have been trapped, remove bait balls and store cleaned traps in garage at LTER headquarters.

6. To be recorded at start:

- DATE (day-month-year) GRID #
- NIGHT (1,2,3,4) OBSERVERS (initials)
- CLOUD (% cloud cover)
- PRECIP (D=dry, R=rain, S=snow, F=fog, L=light rain/drizzle)
- TEMP (in C degrees)
- WIND (use approx. mph or LTER codes)
- COLOR (if using web mark color)
- #SPRUNG (#traps closed but empty that morning)

7. To be recorded at capture stations:

TRAP # (01-124, starting with N line; 2 traps at center are all recorded as 61 & 62)
 CAPT history (N = first capture, R = recapture,)
 SPECIES (SPTR)
 AGE (A=adult, S=sub adult, J=juvenile; see list of codes)
 SEX (M=male, F=female)
 REPR (R=reproductive, N=non-reproductive; see list of codes)
 WEIGHT (to nearest 0.5 g)
 COMMENTS (total mass - mass of bag/contents, any unusual marks, injuries, etc.)

QAQC Instructions: Write down the numbers of traps containing animals and sprung traps. Report those trap numbers to Mark, so he can record them on the data sheet immediately. Process the animals in the traps assigned to you and be sure to write down the trap number with the other data from the animal. Hold the animals firmly to not let them get aware or bite you. Be sure to record the data as you collect it from the animal before you let it go. Before you leave the grid or bring the dirty traps back to the truck, report the trap numbers for the animals you processed along with the data. Mark must check off the list of traps containing animals in order to be sure NO animals are left in the traps to bake in the hot sun. As you visit the traps during this study also check that the sun shade over the trap is in good shape and angled to protect the animal inside effectively. Collate data sheets together for a signal grid and deliver them to the information manager.

SGS-LTER Long-term SPTR Monitoring Project Small Mammal Populations

DATE _____ WEB _____ DAY _____ #SPRUNG _____ COLOR _____

FIELD CREW _____ CLOUD _____ PRECIP _____ TEMP _____

[illegible]

ARS#118 Grasshoppers on the Small Mammal Trapping Grids

Principal Investigator(s): Paul Stapp

Study Objectives: Track changes in relative abundance and species diversity of grasshoppers on small mammal trapping grids to estimate changes in prey abundance.

What to know before you start sampling

- ✓ ***You can identify grasshoppers using the provided key***
- ✓ ***You are familiar with the study site***
- ✓ ***You have been trained in all sampling techniques, grasshopper counts and sweeps***

Study Area Locations: The small mammal trapping grids are located in quarter sections in three shrubland sites (13NW, 13SW, and 24NE) and three upland grassland sites (25NE, 27NE, and 31E). Each grid must be recorded with the section number and quarter-section direction on the data sheet.

Experimental Design:

- 6 sites
- 3 transects at each site
- 60 hoops (10 for each transect)
- Sampled once in June, July and August
-

Sampling Protocol:

Timetable: Sample first during the second or third week of June, then the third or fourth week of July, and finally as late in August as possible. These samplings coincide with three peaks in grasshopper diversity, and should provide enough of a window for the crew to get a few days of good weather to sample in. The June sampling will be tricky, because the grasshoppers have peak densities for a short time and may require sampling earlier if the adult grasshopper emerge too early.

General Methods: Grasshopper density counts and Community sampling sweeps

Equipment required:

Butterfly nets (3-4)	Orange metal grasshopper sampling hoops
Clipboard, pencils, datasheets	Ziploc bags (1 gallon)
Long sticks for counts	Grasshopper reference collection

SPECIFIC METHODS:

Grasshopper density:

Choose 6 random letters representing trap “columns” A-J to find the starting point for the 6 lines of 10 hoops. Choose 6 random numbers between 2-7 representing meters away from a given random trap column (this will ensure you are no more than half the distance to the next column. For each selected trapping column flip a coin to randomly select to the left or right of the selected trap column, with the constraint that if you have selected column A or J, you always go INTO the grid, not outside. For each selected trap column, flip a coin to go right or left (E or W?) of the selected trap column, with the constraint that if you have selected column A or J, you always go INTO the grid, not outside. Choose 6 other random numbers between 2 and 7 to represent the distance in meters south of trap row 1 (the northern edge of the grid) to start. This will give you a set of 6 x,y coordinates between trap rows 1 and 2 to serve as starting locations for lines of hoops, and should insure that each point in most of the grid has about an equal chance of being sampled each year. Starting at this point, the hoops should be evenly spaced 15 m apart, with the 6 lines going N-S. It’s ok to go a little off the grid (<10 m).

After a minimum of 24 hours following hoop placement, return to the grid to count the number of nymph and adult grasshoppers that flush from each hoop. Approach each hoop slowly and carefully while counting any grasshoppers that flush out of the hoop before you arrive. Any grasshoppers that flush into the hoop before you arrive should be ignored. Use a pole (1-2 m long) to flush all grasshoppers from the hoop, and record the number of nymphs and adults that flushed on the data sheet. If zero grasshoppers are in the hoop be sure to record a ‘0’; if the hoop could not be sampled record a ‘-’. Proceed to the next hoop and repeat. Do not sample on rainy days, days with high winds (>25 kph), or at times when temperatures are cool (<17 °C). Better counts can be achieved by walking against the wind and not casting a shadow on the hoops as you approach them.

During hoop counts, recorders should make an effort to distinguish adults from nymphs by following a dispersing grasshopper until it lands. Nymphs can be distinguished from adults by size, dispersal pattern, and wing morphology (Fig. 1). Nymphs are very small (<0.5 cm) to small (<1.5 cm); have short, flightless hops; and have small, incomplete wing pads. Adults range from small (>1 cm) to large (>30 cm); have long jumps that are usually followed by flight; and most have large, fully developed wings that are about as long as their abdomen. Distinguishing grasshopper age requires some experience, so novice samplers should practice finding and determining the age of grasshoppers before participating in grasshopper counts.

Fig. 1. Comparison between a nymph (left) and adult (right) grasshopper (scale in cm). Photo credit: S. Hauser.



Community sampling:

On the same day as the hoop counts, conduct at least 200 sweeps with butterfly nets through an undisturbed area in or around the grid. 100 low sweeps (just above the ground) should be made while walking at a normal pace, and 100 higher sweeps (along the top of the vegetation) should be made while walking at a brisk pace. Continue sweeping if <30 grasshoppers have been captured. Better sweeps can be achieved by walking with the wind, and an effort should be made to collect 1-2 specimens of all grasshopper species that are observed in the area (i.e. grasshoppers that disperse too fast to be randomly caught during a sweep). At the end of the sweeps on a given site, place all grasshoppers in a 1-ga Ziploc bag with a piece of paper labeled with the site and date. Put the bags from all the sites in the freezer to euthanize the grasshoppers.

Following euthanization, sort the specimens from any debris in the bag. Count the number of early instars, late instars, and adults. Identify the sex and species of all adults using the provided keys and the station's reference collection, and record all counts on the species identification data sheet. Designate any unknown species with a unique species code (e.g. UNK A), then pin out 1-2 specimens (preferably males) and label with the site, date and unknown species code. Take the unknowns to CSU Entomology for identification.

Grasshopper Density Data Sheet

Site _____ Date (DD-Month-YYYY) _____ Recordors _____

Time (Military) _____ Temp. (>17°C) _____ Wind (<25kph) _____ Cloud Cover (%) _____

Hoop Counts (write number of adults and nymphs flushed along each transect):

Transect		Hoop																				
#	Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	Nymph																					
	Adult																					
2	Nymph																					
	Adult																					
3	Nymph																					
	Adult																					
Notes:																		Nymph Total				
																		Adult Total				

Site _____ Date (DD-Month-YYYY) _____ Recordors _____

Time (Military) _____ Temp. (>17°C) _____ Wind (<25kph) _____ Cloud Cover (%) _____

Hoop Counts (write number of adults and nymphs flushed along each transect):

Transect		Hoop																				
#	Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	Nymph																					
	Adult																					
2	Nymph																					
	Adult																					
3	Nymph																					
	Adult																					
Notes:																		Nymph Total				
																		Adult Total				

Site _____ Date (DD-Month-YYYY) _____ Recordors _____

Time (Military) _____ Temp. (>17°C) _____ Wind (<25kph) _____ Cloud Cover (%) _____

Hoop Counts (write number of adults and nymphs flushed along each transect):

Transect		Hoop																				
#	Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	Nymph																					
	Adult																					
2	Nymph																					
	Adult																					
3	Nymph																					
	Adult																					
Notes:																		Nymph Total				
																		Adult Total				

Identification Date _____ (DD-Month-YY)
Identifier's initials _____
Collection Date _____ (DD-Month-YY)
Collection Site _____

Instar Count	
Early	Late

Oedipodinae Adult Count		
Species	♀	♂
ARCO		
ARPS		
DEHA		
ENCO		
SPEQ		
TRKI		
TRSP		
XACO		

Gomphocerinae Adult Count		
Species	♀	♂
AGDE		
AMCO		
COCR		
COOC		
ERSI		
OPOB		
PAWY		
PHQU		
PSDE		

Melanoplinae Adult Count		
Species	♀	♂
AETU		
HEVI		
MEAN		
MEBI		
MEBO		
MECO		
MEFE		
MEGL		
MEIN		
MELA		
MEPA		
MEOC		
MESA		

Notes:

Identification Date _____ (DD-Month-YY)
Identifier's initials _____
Collection Date _____ (DD-Month-YY)
Collection Site _____

Instar Count	
Early	Late

Oedipodinae Adult Count		
Species	♀	♂
ARCO		
ARPS		
DEHA		
ENCO		
SPEQ		
TRKI		
TRSP		
XACO		

Gomphocerinae Adult Count		
Species	♀	♂
AGDE		
AMCO		
COCR		
COOC		
ERSI		
OPOB		
PAWY		
PHQU		
PSDE		

Melanoplinae Adult Count		
Species	♀	♂
AETU		
HEVI		
MEAN		
MEBI		
MEBO		
MECO		
MEFE		
MEGL		
MEIN		
MELA		
MEPA		
MEOC		
MESA		

Notes:

ARS#118 Vegetation on the Small Mammal Trapping Grids

Principal Investigator(s): Paul Stapp

Study Objectives: to detect differences between years in vegetation percent cover and vegetation height and structure.

What to know before you start sampling:

- ✓ ***You can identify plants to species***
- ✓ ***You are familiar with the sampling methodologies***
- ✓ ***You are familiar with the study sites and grid layout***
- ✓ ***You are familiar with Robel Pole***

Study Area Locations: Each year the structure of the vegetation is measured on all 6 small mammal trapping grids. The small mammal trapping grids are located in quarter sections in three shrubland sites (13NW, 13SW, and 24NE) and three upland grassland sites (25NE, 27NE, 31E). Each grid must be recorded with the section number and quarter-section direction on the data sheet.

Experimental Design:

- 6 sites
- 3 transects at each site
- 10 plots per transect
- Plots are sampled once per year, mid-season
- Individual plot size is .10m² and Robel Pole measurements

Sampling Protocol:

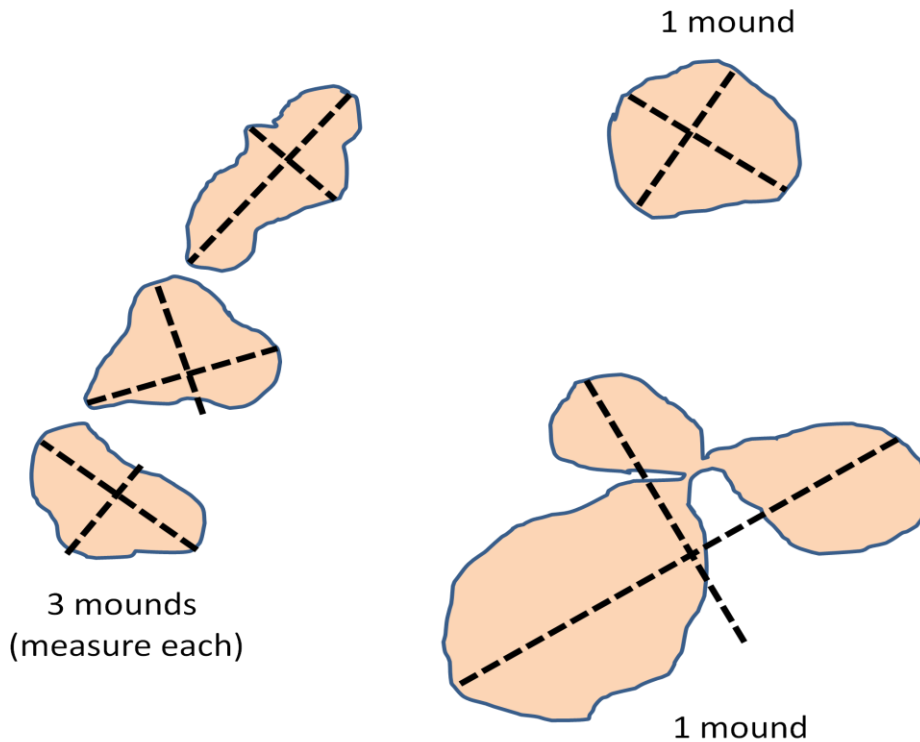
Items Needed:

1. Pin Flags (60-80)
2. Meter Sticks
3. Daubenmire Rectangles
4. Meter Tapes (2x60 meters)
5. Robel Pole

Procedures:

1. Choose 3 random trap stations from list of 12 midpoints (D4, D5, D6, D7, E4, E7, F4, F7, G4, G5, G6, G7) and random bearings for each transect. This is so that potentially all points – or nearly all – on the grid should be “at risk” of being sampled in a given year.
2. Establish transects. Run the tapes in that random bearing direction 50 m from the trap station and then for 50 m at 180 degrees, in the opposite direction.
3. Sample at each 10-m interval point along the transect tape. (Ten points per transect tape will be sampled. Thirty points per web.) [Be sure to not sample within 2 m of a trap station because of the disturbance. Move randomly left or right of the transect.]
4. Place flag at right or left of the transect tape to establish each sampling point.
5. At each point, record the number of half shrubs (CHNA, GUSA, ARFR, EREF) rooted within 1m radius of the point.
6. At each point, record the number of ATCA, gopher mounds, active ant mounds, and burrows (≥ 3 cm in diameter) note larger burrows, like badgers or fox dens within a 3-m radius of the point.
7. At each point, measure distance to and dimensions of the nearest ATCA, ant mound and gopher mound. The nearest ATCA, ant and gopher mounds may be within 3 m of the point (from step #6). If there are none within 3m, do your best to find the closest one but don't wander out farther than a 30 m radius from the point. If there isn't one present, write a “.”.

- dimensions (L X W X H, in cm) of nearest ATCA
- dimensions (L X W, in cm) of nearest ant mound
- dimensions (L X W, in cm) of nearest gopher mound



Record the major axis (in cm) and the longest minor axis (in cm, perpendicular to major axis). Mound must be at least 25 cm long (major axis) to be counted as a mound. Mounds in cluster are separate mounds if they are separated by continuous vegetation.



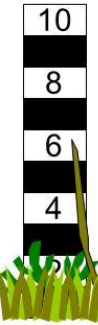
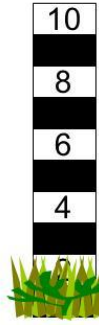
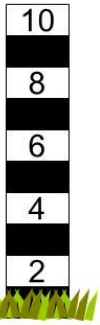
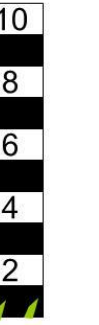
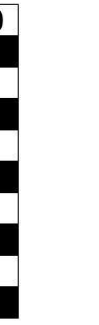
8. Record the percent canopy cover in quadrat frame by species (will require multiple rows on the data sheet). Round cover percent to the nearest 5%. Use 1% to describe the presence of an individual of a thin growing species. Also record the percentage of bare ground and litter in quadrat. (Note: You may record the percentage cover of different species and then subtract from 100 to get bare ground, litter, or a dominant species like Bogr.)

9. Throw the pin flag randomly over your shoulder and then record the maximum height (in cm) of the nearest forb, shrub or half-shrub, and grass species. (Carex may be categorized as a grass).

Robel Pole Procedures:

At each location, we also sample veg structure using a robel pole with 1 cm increments, taking an observation on the pole in each of the 4 cardinal directions (N,S,E, and W). We record both the number of intervals completely obscured by vegetation, and the highest interval with some kind of obstruction, with the pole constructed and sighting height and distance according to Robel (1970), but with the modification of using 1 cm increments. See the file "Robel_Pole_Method_HighvsLow.ppt" for instructions on how to read the low and high values from the pole. In addition, **record the species that is responsible for causing the obstruction associated with the LOW reading; if more than one species is involved, record the tallest species associated with the LOW reading. Only one species code is recorded for each robel reading – there will be no species recorded in association with the HIGH reading.** See example file.

Robel Pole Method Examples:

High reading: 10	9	6	2	1	1	0
Low reading: 4	3	2	2	1	0	0
Species: BOGR	BOGR	SPCO	BOGR	BOGR	BOGR	BARE
						

QAQC Instructions: Be sure to complete all the information required at the top of the data sheet on each and every data sheet. Record the grid code with the pasture number and the quarter-section direction. Before you leave the site double-check that data were collected from all ten points along all 3 transects. Collate the data sheets for a single small mammal trapping grid. Be sure other people can read your handwriting. Please note it is important to measure the gopher mounds correctly.

Data Sheet:

Web _____, p. _____ of _____

SGS-LTER Monitoring Project Vegetation on Small Mammal Webs

Date Surveyed _____

Surveyed / Recorded by _____

[illegible]

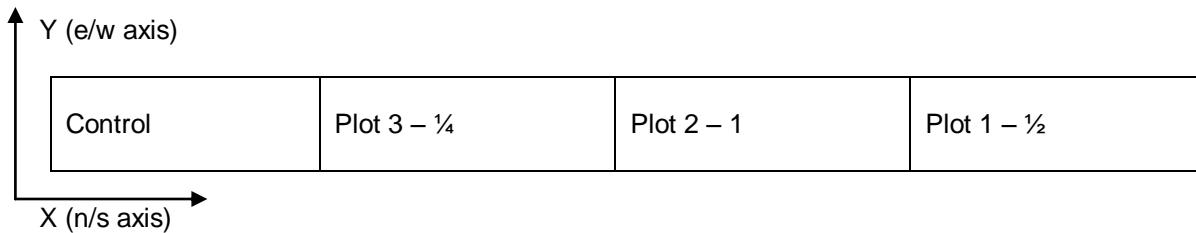
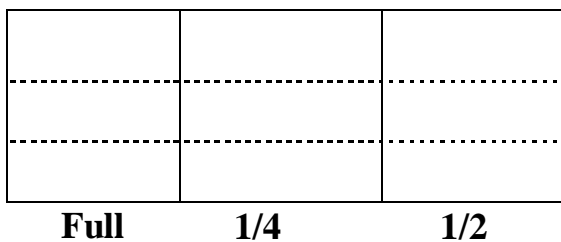
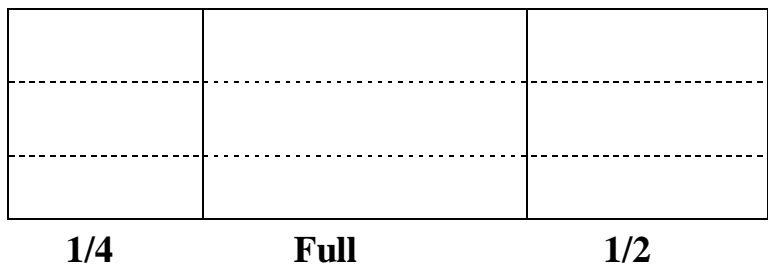
ARS# 156 RAINOUT SHELTER (revised 2010)**Principal Investigator(s):** Indy Burke**Study Objectives:** To determine the effect of drought on ecosystem functioning in the shortgrass steppe.**What to know before you start sampling**

- **Are you familiar with study location and control and treatment plots**
- **Have you been instructed on how to collect, manage and apply data from the tipping rain bucket data logger? Have you checked that the PPT data compares to the rain stick data collected by Mark at the Standard Meteorological station?**
- **Are you familiar with Daubenmire's method of measuring density and cover?**

Study Area Locations: The rain out shelters are located to the east of the SGS-LTER Headquarters. Four plots are located at each shelter. The treatment plots are between the rails, get covered by the roof when it rains and get watered each Tuesday (**WATERING STOPPED Field Season 2010**). The control plots are to the north each shelter. This diagram illustrates the design as if you are standing with your back to the SGS-LTER office buildings. The block to the northeast is called NORTH and the block to the southwest is called SOUTH. The coordinate grid in each sampling plot runs along the east-west flashing and north-south rails.

Experimental Design:

- 2 blocks
- 4 treatments per block
- 5 quadrats per treatment
- Quadrats are sampled once per year, late season
- Individual Quadrats are $\frac{1}{4} \text{ m}^2$

**Plot Level Design:****Mark's house****NE- rain out****SW-rain out****Field Procedures for digital photography:**

Equipment: Digital camera, black wood frame, digital camera log book, SGS-LTER flash card for that year's data.

Method: Place the round wood frame with the Daubenmire metal frame in the middle of the wooden circle, then remove the metal Daubenmire frame. Stand directly over the plot to gain a bird's eye view of the plot. Run your finger along the edge of the wood frame and pull vegetation in that is rooted within the frame and out that is rooted outside of the frame. Pictures should be captured at a 640 x 480 resolution. Review the picture on the screen to be sure that the image was captured. Keep track of the image # and plot label in the digital camera orange field book or on a data sheet that is provided. It is very important to keep this record it is the only way to identify this image as this plot!!!!

Archiving Images:

The images will be stored on the SGS-LTER field season memory cards each year. Label each memory card with the date and Number Card of Total Number of Cards. Record the date, project, and image number in the orange field book that is kept with the camera. When you fill a memory card, remove it from the camera and return it to the black cabinet. Insert a fresh memory card and label it correctly. Remove the batteries from the camera and put them in the charger overnight. The images will be downloaded from the memory card and archived by the data manager.

Density and Basal Cover Protocol:

Equipment: Daubenmire frames (20 X 50 cm); 2 x 60 meter tapes; 5 (x, y) random coordinates; > 5 flags; data sheets (Rain-out.xcl); plant press for unknown specimens, see procedures for digital photography.

Methods: Choose five random coordinates (x between 0.10 – 1.50 and Y between 0.10 – 3.50) meters. Lay out the measuring tapes along the x and y axis and measure to each random coordinate and place a flag there, with the coordinates written on it. Repeat for all five random quadrats, using the same coordinates, within each plot.

Basal vegetation cover and Daubenmire cover classes are then estimated and the number of individuals of each species is counted in each of the five quadrats, in all eight plots.

First, place the Daubenmire quadrat over the flag, with the legs up, if any. Go around the edge and determine what is rooted inside and out of the quadrat. The plants being measured must be rooted inside, regardless of the canopy cover.

Next, count the number of individuals of each species and record the data. Number may be estimated, if necessary. For example, Carex may be abundant and in an area the palm of your hand may cover five individuals. You can then use the palm of your hand to estimate the total number of individuals in the area of the quadrat. It is also necessary to run your fingers along the base of sod-forming species, such as BOGR and BUDA. Individuals are defined as clumps, which are not connected by rhizomes or stolons.

Finally, estimate Daubenmire cover classes for each species listed, percent bare ground and litter. The Daubenmire cover classes are as follows: T=Trace (<1%), 1 = 1-5%; 2 = 5-14%; 3 = 15-24%; 4 = 25-39%, 5 = 40-59%, 6 = 60-100%. Record the Daubenmire cover class (T, 1, 2, 3, 4, 5, or 6) number on the data sheet.

2012 Rainout Random Coordinates for Use in Each Density and Basal Cover Plot

Quadrant	X	Y
1	.5	1.7
2	.2	2.1
3	1.1	2.5
4	.8	2.8
5	1.3	.6

Data Sheet:

Rain Out Shelter Data Sheet: Density and Basal Cover							
U:SGS-LTER Field Station/Field Studies/CrossSite/CrossSite-datasht							
Date: _____							
Shelter (ne or sw): _____				Recorder(s): _____			
*Daubenmire Cover Classes: T=Trace (<1%), 1= 1-5%, 2 = %5-14%, 3 = 15-24%, 4 = 25-39%, 5 = 40-59%, 6 = 60-100%							
Plot # - Trt/Control	(x, y)	Species	#Individuals	Cover Class	Litter	Bare Ground	NOTES :

QAQC Instructions: The sensor, wheels and rails need to be checked often. If the shelters are not closing during a precipitation event report this immediately to Mark. The data from the tipping rain bucket also need to be checked against the precipitation data recorded by Mark every day at the SGS-LTER standard meteorological station in Section 27 enclosure. Be sure to record the watering data in the excel log workbook. Calculations for water to be added to the north OR south shelter plots are DIFFERENT. Be sure you are calculating and applying the water additions correctly.

ARS #200 Vegetation on Plover-Grazing Study Plots – revised 2009

Principal Investigator: Bill Lauenroth and Justin Derner

Study Objectives: to detect differences in vegetation height and structure between years and grazing sites, by measuring vegetation basal and canopy percent cover of each species.

What to know before you start sampling

- ✓ ***You are familiar with the study sites and treatments***
- ✓ ***You can identify plants and are familiar with the plant codes to record on the data sheet***
- ✓ ***You have been instructed on Daubenmire's methods for measuring basal and canopy cover (density dropped in 2009)***

Study Area Locations: There are 2 randomly located 30m diameter macroplots (upland, U, and upland with supplemental feed, UF) in each spring grazed half section (pastures 21N and 1W). There is an upland macroplot located in each summer grazed quarter section pastures (15 SW and 7 NW). (lowland sites were dropped in 2009)

Each macroplot contains 36 plots in a 6 x 6 grid with 10 m in between plots. Basal and canopy cover measurements are collected in each plot using Daubenmire cover classes. The pasture, macroplot, and plot number (1-36) are recorded on the data sheet. 36 plots are sampled on each of the 6 macroplots for a total of 216 plots.

Site codes and treatments are as follows:

1W-U
1W-UF
21N-U
21N-UF
15SW-U
7NW-U

Experimental Design:

- 4 pastures
- 1 to 2 macroplots in each pasture (2 in spring grazing pastures due to upland + supplemental feed macroplot, 36 plots at each macroplot in a spatial 6x6 grid)
- Plots are sampled once per year, late June
- Individual plots are 20X50 cm or 0.10 m²

36	35	34	33	32	31
25	26	27	28	29	30
24	23	22	21	20	19
13	14	15	16	17	18
12	11	10	9	8	7
1	2	3	4	5	6

10 meters between plots
35 meters from center to SW corner to begin

Sampling Protocol:

Items Needed:

Daubenmire Rectangles

Reference plant list with species codes

Procedures:

Unknowns should be labeled as forb, grass or shrub with the codes UNFB, UNGR, or UNSH. If an unknown is encountered several times it should be given a number or name, and identified at a later date, **and the data sheets recoded with the correct four-letter species code.**

For basal cover, the code for bare ground is BARE, litter is LITT, scat or cow dung is DUNG and lichen is LICH. Scat, including rabbit, pronghorn, and cow should not be considered as part of the litter cover. Record the cover class number on the data sheet. All individuals measured for basal cover should be rooted in the frame. (In 2008 we added T as a cover class for both basal and canopy with T=<1%, now cover class 1 is 1-5%)

Cover Classes: T=0-1, 1=1-5, 2=6-15, 3=16-25, 4=26-40, 5=41-60, and 6=>60 Enter – for none

We identify only one Astragalus/Oxytropis to species—the vine like one is ASGR (with thinner leaves and small purple flowers). All others are lumped under the code ASOX. The two Orobanchae species are coded OROB.

For canopy cover, record the cover class number on the data sheet for the quadrat frame by species. Follow the same rules as stated above for recording basal cover. Do not re-estimate LITT, BARE, LICH, and DUNG. Individuals may not be rooted in the frame, as their canopy may be hanging over the sampling area.

Cover Classes: T=0-1, 1=1-5, 2=6-15, 3=16-25, 4=26-40, 5=41-60, and 6=>60 Enter – for none

QAQC Instructions

Double-check that all data sheet are complete and correct before leaving the study site. Make sure that you can the hand-writing on the data sheet. Collate data sheets by site sampled.

Data Sheet:

Study: ARS #200 Plover Grazing Study

Sampling Date: _____ **Collected by:** _____

Cover Classes: T=0-1, 1=1-5, 2=6-15, 3=16-25, 4=26-40, 5=41-60, and 6=>60 Enter – for none

Pasture (Site)	MacroPlot	Plot #	Species or Type Code	Basal Cover	Canopy Cover	BARE	LITT	LICH	DUNG

ARS#200 Vegetation Structure for Small Animals on Plover Grazing Pastures

Principal Investigator(s): Paul Stapp

Study Objectives: to detect differences between years in vegetation percent cover and vegetation height and structure in plover-grazing pastures.

What to know before you start sampling:

- ✓ ***You can identify plants to species***
- ✓ ***You are familiar with the sampling methodologies (Daubenmire and Robel Pole)***
- ✓ ***You are familiar with the study sites***

Study Area Locations and Design: 25 pastures listed under ARS#200 Vegetation on plover-grazing plots

Vegetation Sampling:

Items Needed:

1. Pin Flags (60-80)
2. Meter Sticks
3. Daubenmire Rectangles
4. Meter Tapes (2x60 meters)
5. Robel Pole

Procedures:

1. Find one corner of the grid using the coordinates below (there should be something at the corner – orange stake, nail or pin flags). Lay out 3 transects 100 m long in 3 random directions and sampled every 10 m for each pasture.
2. Place flag at right or left of the transect tape at each sampling point.
3. Record the percent canopy cover in quadrat frame by species (will require multiple rows on the data sheet). Round cover percent to the nearest 5%. Use 1% to describe the presence of an individual of a thin growing species. Also record the percentage of bare ground and litter in quadrat. (Note: You may record the percentage cover of different species and then subtract from 100 to get bare ground, litter, or a dominant species like BOGR.)
4. Throw the pin flag randomly over your shoulder and then record the maximum height (in cm) of the nearest forb, shrub or half-shrub, and grass species. (CAREX may be categorized as a grass).



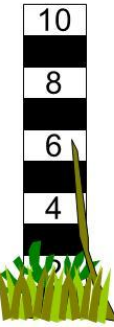
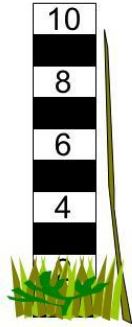
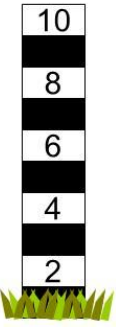
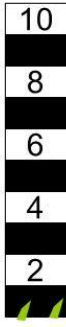

5. Within 3-m radius of sampling point, record:

- number of ATCA (include only those rooted within plot)
- number of gopher mounds (those with center in plot and have recently mounded soil) use a 30 m radius to locate a mound to measure, if there were none counted within the 3 m radius.
- number of active ant mounds (those with center in plot)
- number of burrows (≥ 3 cm in diameter) note larger burrows, like badgers or fox dens
- Within 1 – m radius of sampling point, record:
number of half shrubs rooted within 1 m (CHVI, GUSA, ARFR, EREF) of the point

Robel Pole Procedure:

At each location, we also sample veg structure using a robel pole with 1 cm increments, taking an observation on the pole in each of the 4 cardinal directions (N, S, E and W). We record both the number of intervals completely obscured by vegetation, and the highest interval with some kind of obstruction, with the pole constructed and sighting height and distance according to Robel (1970), but with the modification of using 1 cm increments. See the file “Robel_Pole_Method_HighvsLow.ppt” for instructions on how to read the low and high values from the pole. In addition, ***record the species that is responsible for causing the obstruction associated with the LOW reading; if more than one species is involved, record the tallest species associated with the LOW reading. Only one species code is recorded for each robel reading – there will be no species recorded in association with the HIGH reading.*** See example file.

Robel Pole Method Examples:

High reading: 10	9	6	2	1	1	0
Low reading: 4	3	2	2	1	0	0
Species: BOGR	BOGR	SPCO	BOGR	BOGR	BOGR	BARE
						

Coordinates UTM NAD 27 Conus Zone 13T

Site	Corner	Easting	Northing
1W a	A1	522686	4523417
1W a	A7	522729	4523487
1W a	G1	522609	4523465
1W a	G7	522656	4523539
1W b	A1	522524	4523929
1W b	A7	522519	4524018
1W b	G1	522428	4523922
1W b	G7	522428	4524013
1W in	A1	522643	4523076
1W in	A7	522651	4523157
1W in	G1	522564	4523075
1W in	G7	522569	4523164
21W a	A1	519064	4519422
21W a	A7	519085	4519519
21W a	G1	518975	4519442
21W a	G7	518994	4519530
21W b	A1	518459	4519005
21W b	A7	518418	4519104
21W b	G1	518353	4518988
21W b	G7	518335	4519081
21W in	A1	518778	4518849
21W in	A7	518862	4518882
21W in	G1	518734	4518910
21W in	G7	518808	4518956
15SW a	A1	519467	4519629
15SW a	A7	519459	4519718
15SW a	G1	519378	4519636
15SW a	G7	519367	4519722
15SW b	A1	519306	4519896
15SW b	A7	519360	4519964
15SW b	G1	519225	4519934
15SW b	G7	519280	4520004
7NW a	A1	524671	4522033
7NW a	A7	524674	4522121
7NW a	G1	524582	4522045
7NW a	G7	524584	4522132
7NW b	A1	524716	4522339
7NW b	A7	524716	4522432
7NW b	G1	524628	4522363
7NW b	G7	524617	4522452

10 LTX	A1	520251	4521204
10 LTX	A7	520242	4521304
10 LTX	G1	520182	4521215
10 LTX	G7	520176	4521304
15 LTX	A1	520464	4520712
15 LTX	A7	520452	4520808
15 LTX	G1	520378	4520704
15 LTX	G7	520370	4520796
22 LTX	A1	520466	4518365
22 LTX	A7	520471	4518466
22 LTX	G1	520379	4518360
22 LTX	G7	520371	4518449
23 LTX	A1	521215	4518786
23 LTX	A7	521221	4518867
23 LTX	G1	521126	4518783
23 LTX	G7	521128	4518871
7 LTX	A1	525254	4521882
7 LTX	A7	525256	4521969
7 LTX	G1	525176	4521887
7 LTX	G7	525170	4521978
10SW	A1	519848	4521177
10SW	A7	519844	4521271
10SW	G1	519761	4521177
10SW	G7	519753	4521268
15NE	A1	520151	4520686
15NE	A7	520229	4520733
15NE	G1	520096	4520754
15NE	G7	520170	4520807
24SW	A1	522542	4518431
24SW	A7	522540	4518521
24SW	G1	522449	4518435
24SW	G7	522452	4518525
25NW	A1	522526	4517589
25NW	A7	522530	4517686
25NW	G1	522437	4517591
25NW	G7	522431	4517674
7SW	A1	524319	4521861
7SW	A7	524314	4521958
7SW	G1	524229	4521868
7SW	G7	524224	4521961
22PD N	A1	520274	4518674
22PD N	A7	520274	4518764
22PD N	G1	520185	4518674
22PD N	G7	520184	4518764

27PD N	A1	519437	4517121
27PD N	A7	519454	4517209
27PD N	G1	519349	4517137
27PD N	G7	519365	4517224
35PD N	A1	521411	4516091
35PD N	A7	521411	4516181
35PD N	G1	521321	4516091
35PD N	G7	521322	4516180
5PD N	A1	526251	4523037
5PD N	A7	526251	4523127
5PD N	G1	526161	4523037
5PD N	G7	526161	4523127
22PD	A1	519616	4518383
22PD	A7	519695	4518426
22PD	G1	519571	4518461
22PD	G7	519649	4518503
27PD	A1	519745	4517052
27PD	A7	519797	4517121
27PD	G1	519667	4517091
27PD	G7	519721	4517164
29PD	A1	526926	4517162
29PD	A7	526933	4517253
29PD	G1	526843	4517152
29PD	G7	526845	4517243
35PD	A1	521111	4515726
35PD	A7	521168	4515791
35PD	G1	521037	4515778
35PD	G7	521092	4515843
5PD	A1	526086	4522783
5PD	A7	526074	4522873
5PD	G1	525997	4522787
5PD	G7	525993	4522877

Study: _____

Date: _____

Pasture: _____

Observers: _____

Treatment: _____

	Height (cm)											
Direction	N			E			S			W		
Reading	HIGH	LOW	SPP	HIGH	LOW	SPP	HIGH	LOW	SPP	HIGH	LOW	SPP
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
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16												
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32												
33												
34												
35												
36												

Robel Pole

ARS #243 Fire Ecology Studies – Patch Study

Principal Investigator(s): Justin Derner

Study Objectives: determine if the patch burning approach [burn a portion of a pasture each year (i.e. patch), moving the patch around over time] currently used in mesic rangelands can be extended to a semi-arid rangeland ecosystem.

What to know before you start sampling:

- ✓ You have been scheduled to collect samples with ARS staff
- ✓ You are familiar with the sampling protocols
- ✓ You are familiar with the species of plants

Study Area Locations and Design: Patch burn pastures are 26NW, 26NE and 30NW. One quarter (or corner) of each of these 3 treatment pastures will be burned each year. A different quarter will be burned each year (SE quarter of the pastures 26NW, 26NE and 30NW) were burned in November 2007, then SW quarter in November 2008, NW quarter in November 2009, NE quarter in November 2010, then through the sequence again, beginning 2011). Sampling on each macroplot has been modified from 54 plots (prior to 2009 to now 36 plots in a 6 X 6 grid with 10 m in between plots. 6 x 6 Grids (for cover, and 10 cages around each for biomass) will be established in each of the 4 quarters of the 3 burn pastures (thus 12 grids total). *(Still using the 0.1m² Daubenmire plots, but the spatial arrangement in this grid permits scaling for other work that David Augustine is conducting these same pastures.)*

36	35	34	33	32	31
25	26	27	28	29	30
24	23	22	21	20	19
13	14	15	16	17	18
12	11	10	9	8	7
1	2	3	4	5	6

10 meters between plots
35 meters from center to SW corner to begin

Basal Cover Protocol:

Cover will be sampled in late June. Thirty-six 0.1 m² daubenmire quadrats will be sampled on each of the grids located in each corner of each of the three burned areas thus far and control area. Unknowns should be labeled as forb, grass or shrub with the codes UNFB, UNGR, or UNSH. If an unknown is encountered several times it should be given a number or name, and identified at a later date, **and the data sheets recoded with the correct four-letter species code.**

For basal cover, the code for bare ground is BARE, litter is LITT, scat or cow dung is DUNG and lichen is LICH. Scat, including rabbit, pronghorn, and cow should not be considered as part of the litter cover. Record the cover class number on the data sheet.

Cover Classes: T=<1%, 1=1-5, 2=6-15, 3=16-25, 4=26-40
5=41-60, 6=>60

We identify only one Astragalus/Oxytropis to species—the vine like one is ASGR (with thinner leaves and small purple flowers). All others are lumped under the code ASOX. The two Orobanch species are coded OROB.

For canopy cover, record the cover class number on the data sheet for the quadrat frame by species. Follow the same rules as stated above for recording basal cover. Do not re-estimate LITT, BARE, LICH, and DUNG

Cover Classes: T=< 1%, 1=1-5, 2=6-15, 3=16-25, 4=26-40
5=41-60, 6=>60

QAQC Instructions:

Double-check that all data sheet are complete and correct before leaving the study site. Make sure that you can the hand-writing on the data sheet. Collate data sheets by gridsampled. Be sure to record the pasture quarter section as well as the direction of the corner of the quarter section which contains that burned grid you are sampling (example: in 2006 the "pasture" would be recorded as 26NW and the "quarter burned" would be recorded as SE).

Data Sheet:**Study: _ ARS #243 Fire Ecology Patch Study: Cover of Vegetation**

Sampling Date: _____ **Collected by:** _____

Cover Classes: T=0-1, 1=1-5, 2=6-15, 3=16-25, 4=26-40, 5=41-60, and 6=>60

Enter – for none

Pasture & Quarter Section	Macroplot (Grid) # (1-4)	Plot# (1-36)	Species or Type Code	Basal Cover	Canopy Cover	BARE	LITT	LICH	DUNG

Clipping Protocol: Biomass data from 7 SW and 19 NW for the GZTX GG NPP sampling and from the ridge in 24 SW for the LTNPP study will provide data from the control pastures. For the patch burn pastures, biomass will be collected from all 4 grids in each pasture (total of 12 grids) with 10 temporary exclosure cages around each of the grids. Biomass is clipped in early August by functional group (BOBU, CSPG, CSAG, WSPG, FORB, SS) from 10, .10 m² quadrats from each burned grids (total of 120 quadrats). Clip just above crown-level, except for shrubs. Clip only current year growth of shrubs that is green and has leaves, and which grows from an older woodier branch. All live plus recent dead material (i.e., last year's growth) needs to be harvested from the plot. Old-standing-dead is "standing", NOT the LITTER that is lying on the surface of the ground. Both recent dead (this year's growth but already completed growth) and old standing-dead (last year's growth) are standing and both are dead, but they are not the same, and need to be collected differently. All old-standing-dead are put in one bag for each plot. You can brush the basal old-dead material away from the clipped material with your fingers and sort out other taller stems. -- check your plot over before moving to next one.

Plots are clipped by functional group. It is usually easier to first clip groups other than WSPG. *(In 2009 clipping changed to .10m², by functional group and Robel pole readings on each plot should be taken prior to clipping to see if we can come up with a non-destructive method for biomass estimations)*

Do not clip on an ant mound or large disturbance. Note all small mammal, ant, and any other disturbances on the bag. Place all envelopes or small bags from each plot into the largest sample bag from that plot. This is usually, but not always, the WSPG bag. If there happen to be two or more large bags from one plot, try to keep them together. If there are, for example, three bags for one species, label the bags "1 of 3, 2 of 3, and 3 of 3".

CAN OTHER PEOPLE UNDERSTAND YOUR WRITING???

IMPORTANT: During the first week of September (at the least) Kevin, Judy, David, and Mary will go into the field to discuss the current year's growth situation. For example: PLPA could look black but is current year's growth, CAHE

can re-green so can have dead brittle CAHE and fresh green (both being current), etc... This will assure that sorting done by both LTER and ARS in the lab are set to similar levels.

Example Label:

STUDY	PATCH FIRE
DATE (month, day, yr)	08 01 93
PASTURE	26NW
QUARTER-BURN	SE
PLOT # (1-10)	P-1
FUNCTIONAL GROUP CODE	(BOBU,CSPG, CSAG, WSPG, FORB, SS)

ARS #243 Fire Ecology Studies – Small Plot Burns**Principal Investigator(s):** Justin Derner**Study Objectives:**

- 1) Determine if seasonality or frequency of fire, or their interaction, influences vegetation and ecosystem attributes in shortgrass steppe
- 2) Determine the effects of spring and fall burning without grazing on productivity, composition, diversity, nutrient cycling and soil variables
- 3) Determine if prescribed fire reduces the abundance of prickly pear cactus

What to know before you start sampling

- ✓ **You have been scheduled to collect samples with ARS staff**
- ✓ **You are familiar with the sampling protocols**
- ✓ **You are familiar with the species of plants**

Study Area Locations and Design: Treatments include frequency of fire (0, 1 and 3 years), and season of burn (spring or fall). There 4 reps of each combination of burning frequency and season. In section 15nw, 20, 20X20 m plots, each subdivided into 4, 10X10 m quadrants numbered 1, 2, 3, and 4. Quadrant 1 is located in the NW corner of each plot and is for biomass, Quadrant 2 in the NE corner and is for soil respiration, trace gas, soil sampling, soil water, soil temperature, etc., Quadrant 3 in the SW corner and is for cactus, and Quadrant 4 in the SE corner is sampled for Daubenmire basal and canopy cover classes.

Basal Cover Protocol: Cover will be sampled in early August. Sample 25, 0.1m² plots within Quadrant 4 area for each treatment quadrat, plots are randomly located (600 quadrats). Unknowns should be labeled as forb, grass or shrub with the codes UNFB, UNGR, or UNSH. If an unknown is encountered several times it should be given a number or name, and identified at a later date, **and the data sheets recoded with the correct four-letter species code.**

For basal cover, the code for bare ground is BARE, litter is LITT, scat or cow dung is DUNG and lichen is LICH. Scat, including rabbit, pronghorn, and cow should not be considered as part of the litter cover. Record the cover class number on the data sheet.

Cover Classes: T=<1, 1=1-5, 2=6-15, 3=16-25, 4=26-40
5=41-60, 6=>60

We identify only one Astragalus/Oxytropis to species—the vine like one is ASGR (with thinner leaves and small purple flowers). All others are lumped under the code ASOX. The two Orobanchae species are coded OROB.

For canopy cover, record the cover class number on the data sheet for the quadrat frame by species. Follow the same rules as stated above for recording basal cover. Do not re-estimate LITT, BARE, LICH, and DUNG

Cover Classes: T=<1, 1=1-5, 2=6-15, 3=16-25, 4=26-40
5=41-60, 6=>60

QAQC Instructions:

Double-check that all data sheet are complete and correct before leaving the treatment and quadrant area 2. Make sure that you can the hand-writing on the data sheet.

Data Sheet:**Study: _ ARS #243 Fire Ecology Plot Study: Cover of Vegetation****Sampling Date:** _____ **Collected by:** _____

Cover Classes: T=0-1, 1=1-5, 2=6-15, 3=16-25, 4=26-40, 5=41-60, and 6=>60

Enter – for none

Pasture & Quarter Section	Quadrat #(1-4)	Plot# (1-25)	Species or Type Code	Basal Cover	Canopy Cover	BARE	LITT	LICH	DUNG

Clipping Protocol: For peak standing crop, Biomass is clipped by functional group (BOBU, CSPG, CSAG, WSPG, FORB, SS) from 10, .10 m² quadrats from each burned grids (3 burn frequencies x 2 seasons x 4 reps x 10 plots = total of 240 plots). Clip just above crown-level, except for shrubs. Clip only current year growth of shrubs that is green and has leaves, and which grows from an older woodier branch. All live plus recent dead material (i.e., last year's growth) needs to be harvested from the plot. Old-standing-dead is "standing", NOT the LITTER that is lying on the surface of the ground. Both recent dead (this year's growth but already completed growth) and old standing-dead (last year's growth) are standing and both are dead, but they are not the same, and need to be collected differently. All old-standing-dead are put in one bag for each plot. You can brush the basal old-dead material away from the clipped material with your fingers and sort out other taller stems. -- check your plot over before moving to next one.

Plots are clipped by functional group. It is usually easier to first clip groups other than WSPG. *(In 2009 clipping changed to .10m², by functional group and Robel pole readings on each plot should be taken prior to clipping to see if we can come up with a non-destructive method for biomass estimations)*

Do not clip on an ant mound or large disturbance. Note all small mammal, ant, and any other disturbances on the bag. Place all envelopes or small bags from each plot into the largest sample bag from that plot. This is usually, but not always, the WSPG bag. If there happen to be two or more large bags from one plot, try to keep them together. If there are, for example, three bags for one species, label the bags "1 of 3, 2 of 3, and 3 of 3".

CAN OTHER PEOPLE UNDERSTAND YOUR WRITING???

IMPORTANT: During the first week of September (at the least) Kevin, Judy, David, and Mary will go into the field to discuss the current year's growth situation. For example: PLPA could look black but is current year's growth, CAHE can re-green so can have dead brittle CAHE and fresh green (both being current), etc.... This will assure that sorting done by both LTER and ARS in the lab are set to similar levels.

Example Label:

STUDY	SMALL PLOT BURN
DATE (month, day, yr)	08 01 93
FREQUENCY (0, 1 or 3)	0
SEASON (S/F/)	S
PLOT # (1-10)	1
FUNCTIONAL GROUP CODE	(BOBU, CSPG, CSAG, WSPG, FORB, SS)
# of OPPO Pads	22

NutNet

Principal Investigators: Julia Klein, Cini Brown, Dana Blumenthal, Alan Knapp

Study Objectives: to examine nutrient versus grazing controls on plant and soil processes as part of a multi-site grassland study.

What you should know before you start sampling:

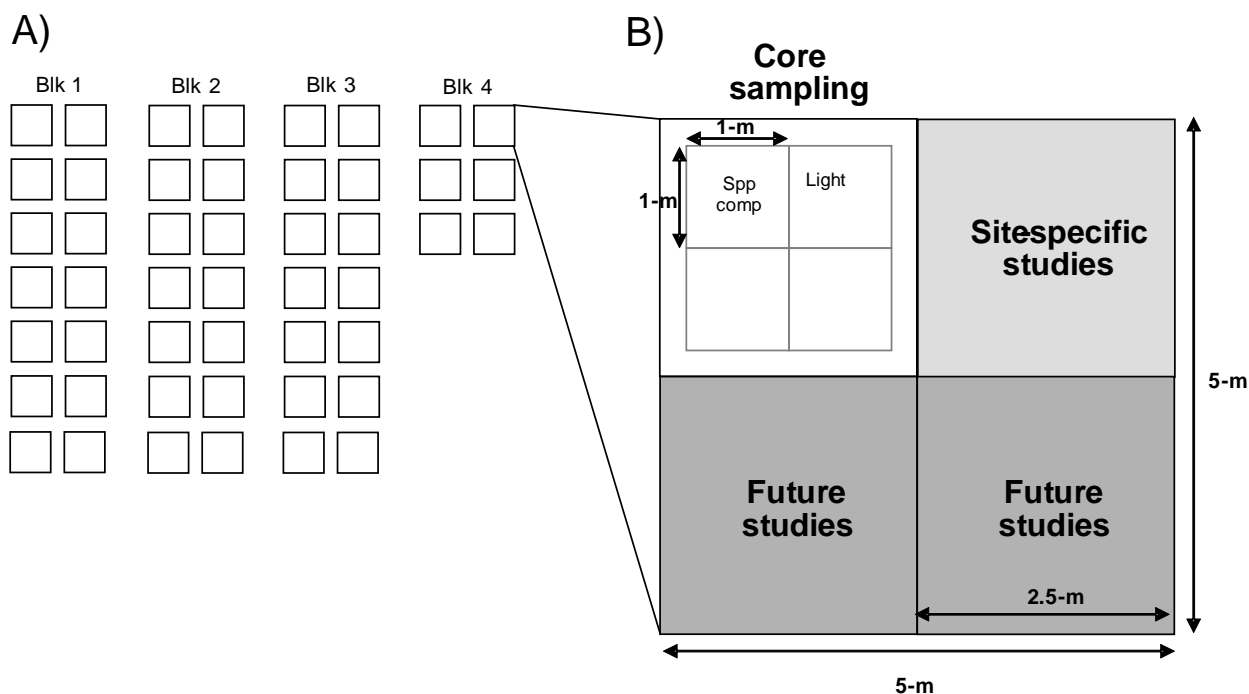
- Double check plot locations prior to applying nutrients.
- Not all plots are sampled. Non-sampled plots are randomized with sampled plots.

Study Area Location: The study site is a flat upland area located within 15NW.

Experimental Design: The plots are laid out in three main blocks, with each block consisting of fourteen 5 x 5m plots and a fourth block with six plots for a total of 48 plots. Plots are demarcated by wooden stakes at the four corners, and orange plastic stakes that mark the center of each core sampling area (see below). There is a 1m walkway between blocks. Within each of the main three blocks, there are three nutrient treatments (Nitrogen, Phosphorus, Potassium), each with two levels (Control, Added), which are crossed in a factorial design, for a total of 8 nutrient treatment combinations. Also within each of the three main blocks, there is a small herbivore enclosure treatment crossed with the Control and NPK treatments, for an additional 2 herbivore treatment plots. Finally, within each block, there are extra plots (for a future experiment) that are treated with nutrients but not yet sampled in any way. Within the fourth block, there are three Control and three NPK plots. What this means for sampling is that not every plot is sampled. The experiment map must be consulted to determine which plots are sampled.

Each 5 x 5m plot is divided into four 2.5 x 2.5m subplots, with one randomly located subplot dedicated to the core sampling. The core subplot is then further divided into 4 1 x 1m sub-sub plots. The middle of the core subplot is marked by an orange plastic stake. The 1-m² sub-sub plot in the same position as the “Core” subplot (denoted on the site diagrams) within the larger plot is used for biomass harvesting, while the 1-m² sub-sub plot in the same position as the “Site” subplot within the larger plot is used for species composition and light availability measurements. A plot layout scheme is attached to the end of this protocol.

- 4 blocks total; blocks 1-3 have 14 plots per block; block 4 has 6 plots
- 5 x 5m plots
- Nutrient additions and herbivore enclosures occur at the whole plot scale (5 x 5m)
- Sampling occurs within the ‘core’ subplot (2.5 x 2.5m) within each plot; the middle of the core subplot is indicated by an orange stake
- Species composition and light availability measurements occur within the 1 x 1m sub-sub plot within the core subplot in the same position as the “Site” subplot within the larger plot.
- Biomass harvesting occurs within the 1 x 1m sub-sub plot within the core subplot in the same position as the “Core” subplot within the larger plot.



Nutrient Additions

Time of year: close to May 1

Equipment needed: Pails for mixing nutrients, rubber gloves

Nutrient Addition protocol: Lay nutrient bags out on appropriate plots according site map prior to application. At each plot, thoroughly mix the different nutrients within each bag. Spread nutrients evenly over each plot by hand. Starting at the top of each plot, spread approximately $\frac{1}{4}$ of the nutrients over the entire plot, in 5, 1m wide rows. Turn 90 degrees, and repeat starting on the side of each plot. Continue until all nutrients are used.

Herbivore Exclosures

Time of year: close to May 1

Equipment needed: Fence stretcher, metal bar, Zip ties

Herbivore Exclosure protocol: Unroll fences adjacent to each exclosure (identifiable by the t-posts. Attach one end to a corner t-post with zip ties (4 ties should be sufficient). Attach to next t-posts by threading metal bar through chicken-wire and using the fence stretcher from the t-post to the metal bar. Move from one fence post to the next, stretching at each stage.

Species Composition Sampling

Time of year: at peak biomass

Equipment Needed: 1m² frame, data sheets, pen/pencil

Light availability is measured using a light meter (e.g., 1-m length Decagon Ceptometer if possible) capable of integrated measures of photosynthetically active radiation (PAR, $\mu\text{mol m}^{-2} \text{sec}^{-1}$). Light availability will be measured at the same time and in the same 1-m² subplot used for the species composition measurements. Light readings must be taken on a cloudless day as close to solar noon as possible (i.e., 11 am to 2 pm). For each subplot, two light measurements at ground level (at opposite corners of the 1-m² plot, diagonal to each other) and one above the canopy will be taken. Light availability will be calculated as the ratio of PAR below and above the canopy. If you use a point sensor, record the mean of at least 10 readings in different locations (this is done automatically with the linear sensors).

[illegible]

Biomass Harvesting

Time of year: at peak biomass

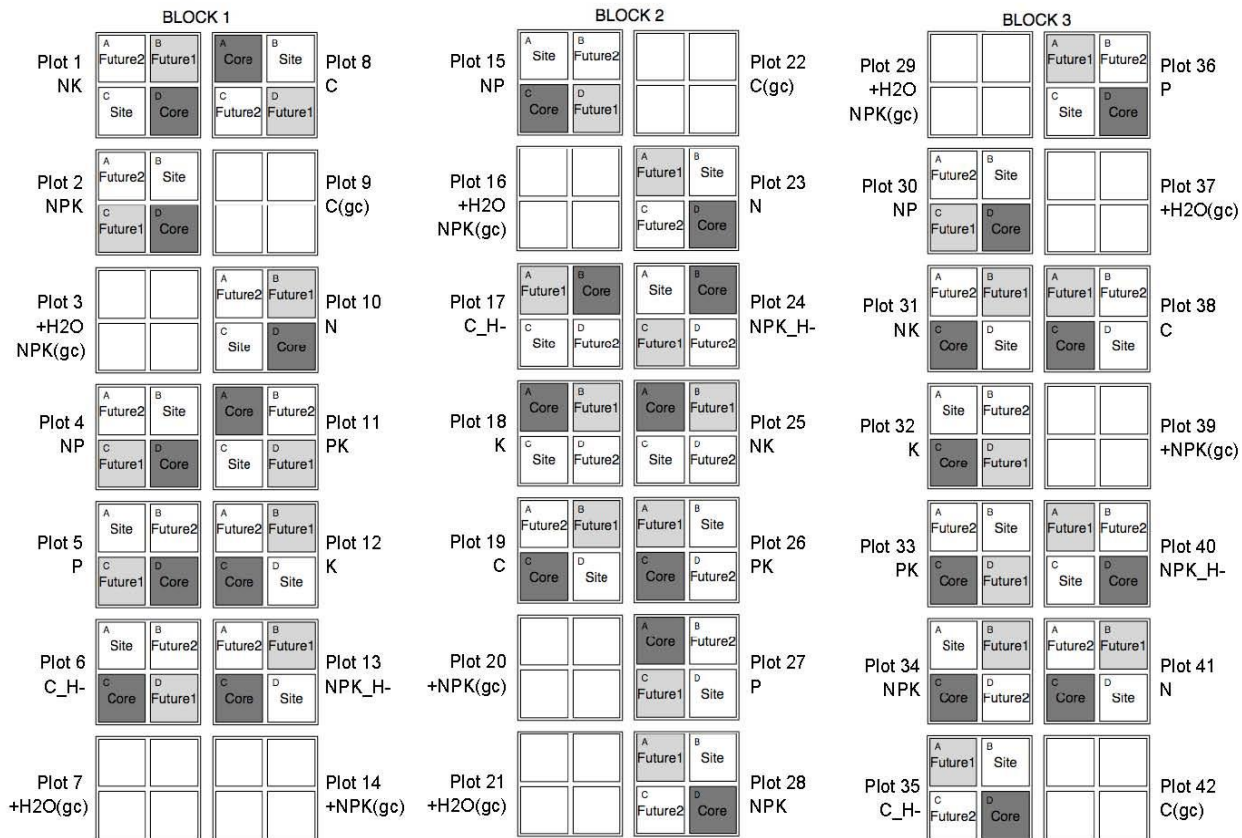
Equipment Needed: clippers, labeled paper bags, stapler, sharpies, sampling frame with 0.1m x 1.0m area delineated with string.

Biomass harvesting protocol:

Align the 1 x 1 m² frame using the center point of the “Core” subplot, as indicated by a plastic stake, and the diagonal corners of the 1-m² sub-subplots, as indicated by orange-tipped roofing nails. The 1-m² frame should be oriented East to West.

Two 0.10-m by 1.0-m strips within the 1-m² subplot are harvested, with the same two strips within the frame harvested for all “Core” plots. Harvesting is conducted by clipping the graminoid just above the crown, and clipping the forb or subshrub just above the soil surface, or at the junction of the current and previous year’s growth. Lichens are also collected and bagged. The SGS research site includes several species of Cactaceae, which are measured either for diameter and height or number of cladodes per plant prior to harvesting. Harvested biomass is bagged separately for each strip within the 1-m² subplot. Throughout harvesting, plant litter that is unattached and on the ground is not collected. Plants are considered to occur within the sampling area only if the plant is rooted within the area.

SGS NutNet site design



Grazing of CRP

Principal Investigator: Dan Milchunas and Mark Vandever

CRP ANPP 2011, 2012 Protocol

At each of the CRP root ingrowth treatment replicates (See CRP root ingrowth protocol) there is a cage (if a grazed treatment) or a corner fiberglass pole (if ungrazed treatment) at north side of plot, and a cage or clip location at south side. For ungrazed sites, there were wood stakes at south side also, but they may no longer be there. If south stakes cannot be located, it is important to pace distance between north and south plot borders, and be sure to be outside the plot (because one half was mowed in the past, and ANPP should be in the ungrazed treatment not the mowed. Plots are 10 m by 20 m, with the north and south borders the 20 m sides, so pace 30 m if cages or stakes marking north and south sides cannot be located - be sure not to cross into a different allelopathy strip though if in new field (watch the vegetation differences that used to be the wheat-sorghum(fallow) strips. On grazed treatments it does not matter if you are in the plot, since the mowed treatment was only in the ungrazed pasture.

One quadrat is clipped on the north side, and one on the south side. On grazed treatments, these are under the cages. Quadrats are NOT the standard LTER ones, but are 100 by 30 cm, placed in center of cage if a grazed treatment. Clip all recent year growth (live + recent dead) all as one total biomass sample. If there is ARLO or a lot of old dead that is not easily sorted out, clip it and include in the same bag - its percentage will be estimated later in the lab. We have only 2 of the 100 x 30 cm quadrats, so possibly a couple more string-and-nail ones may be made. Be sure to write on the bag 'quadrat N' or 'quadrat S' for the north and south quadrats at each treatment/rep. Since GZTX is the 'control' native site for this (as is the ingrowth for BNPP) we will also need to clip at GZTX as well, but follow old GZTX protocol for groups/quadrat size, etc., and do all treatments not just the ones with ingrowth. NOTE that ANPP at CRP is ONLY at the ingrowth sites, not all treatments (see ingrowth protocol). Root biomass is at all treatment sites, but ingrowth BNPP and ANPP are not at all.

Estimating removal or 'utilization': Before clipping for ANPP, look inside where the cage used to be -- remove stake from one side and lift cage up on side. Estimate the difference between the ungrazed vegetation and the 'average' amount outside the cage in all surrounding sides that were grazed. Write on the bag to hold the clipped sample the % removed -- how much less is outside? State it as, for example, "20% UTIL", writing the util as well to make sure the % refers to the amount removed (less) -- not the residual amount left.

Check all bag IDs and rep N or S quadrats after finishing each treatment-rep before loading into van. Dry at 55°C.

Root Ingrowth:

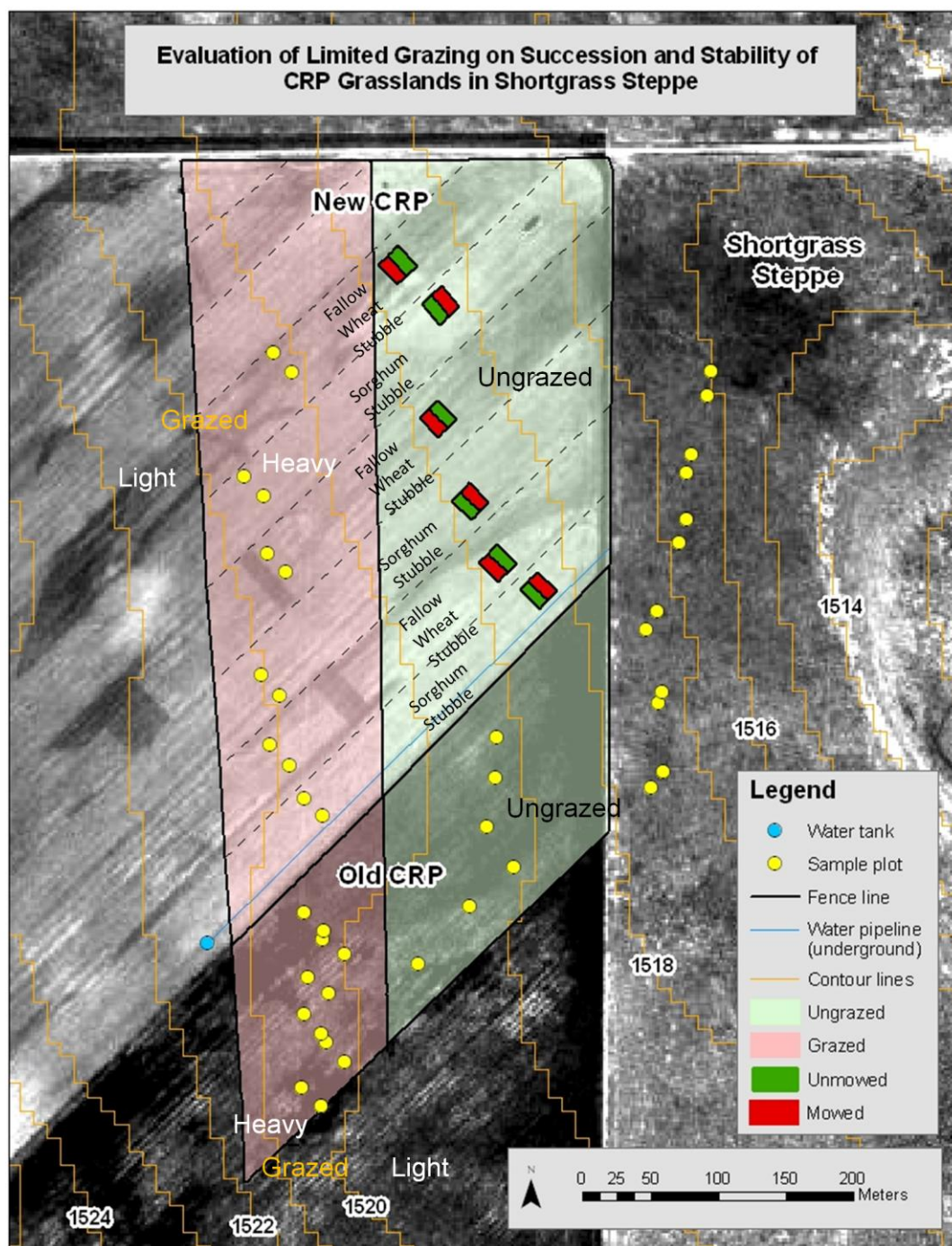
See instructions for this under project Root Ingrowth Donuts.

Root Biomass (2011 sampling only):

Use the standard 66.5mm inside diameter 'root cores' and to a depth of 35 cm. A one-time sampling to be done at the CRP site and part of the GZTX site as a control shortgrass site. Design at the CRP site is 6 cores (one at each replicate plot) X 3 treatments (ungrazed, heavily grazed, lightly grazed) X 2 field-types (old crp and new crp plantings) = 36 total cores. Design at GZTX is 6 cores (one at each replicate site/treatment) X 3 treatments (GG, GU, RU) = 18 total cores. CRP+GZTX= 54 total. At CRP sites, locate the north side of each plot (rep). For ungrazed sites use the pole marking a corner, and for grazed sites use the north ANPP-clip-cage. Measure north 5 m, and place core at that point (avoid any ant or small mammal mounds or other disturbances by moving point another 5m north if necessary). At GZTX sites, throw a random flag and core at bottom of wire. Score the place to be cored with bit, and clip out any crown and aboveground plant material and remove any litter before coring. Record on the bag the primary plant species that was in core, or "between" if there was no live aboveground plant material removed.

Do a bag count and ID check at finish of each site or treatment/field before loading them into van. Is the total number correct, and are treatment/site/field ID's all the same, with correct rep (CRP) or site (GZTX) number?

Washing/flotation is same as in old 'root harvest/biomass' protocol at ¹⁴C site. Be sure to use a #35 sieve (0.0197 in mesh) as the final catch. Dry at 55°C and take to lab for weighing and ashing.



Root Ingrowth Donuts (for both GZTX and CRP studies)

Principal Investigators: Milchunas, Brown, Vandever

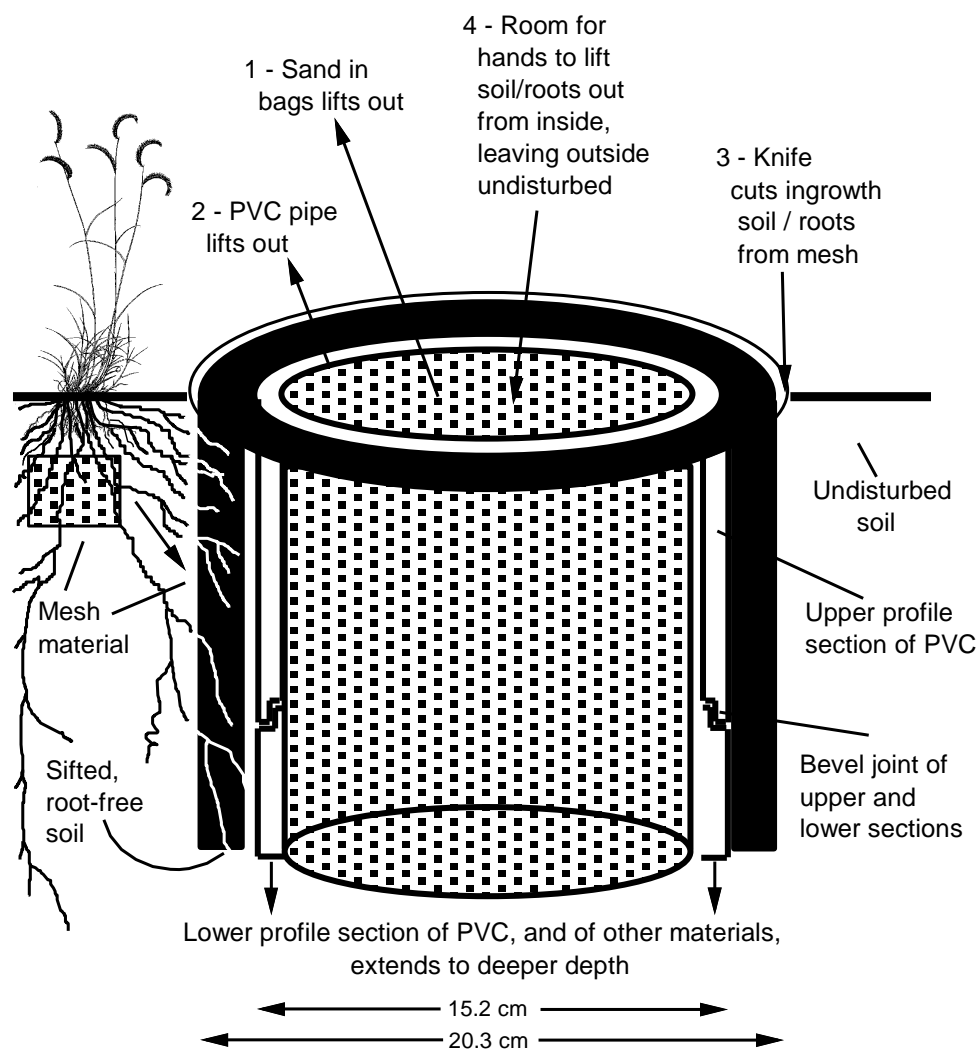
Separate instructions concerning the experimental design (numbers of in each treatment) for ingrowth donuts are in each of the "GZTX" and "Grazing of CRP" protocols. Covered here are instructions for sampling each donut cylinder in either study.

Root ingrowth is a method of estimating root production rather than just root biomass. If you are interested details and comparisons with other methods can be found in:

Milchunas, D. G., A. R. Mosier, J. A. Morgan, D. LeCain, J. Y. King, and J. A. Nelson. 2005. Root production and tissue quality in a shortgrass steppe exposed to elevated CO₂: Using a new ingrowth method. *Plant and Soil* 268:111-122.

Milchunas, D. G. 2009. Estimating root production: comparison of 11 methods in shortgrass steppe and review of biases. *Ecosystems* 12:1381-1402.

A quick view picture of the method is:



Six inch diameter PVC pipe is placed in the middle of larger 8 inch holes and filled with sand bags (use 1 inch doweling to space PVC in middle). This creates a one inch donut space width all around the cylinder. The donut space between the cylinder and the ingrowth cloth (the wire mesh material) is filled with root-free sifted soil from an adjacent area, and packed to a similar bulk density as outside soil using doweling. Roots are sampled the

following year by removing the sand bags and lifting out the PVC pipe using two vice-grip pliers as grips). A sharp, flexible bread knife is placed next to the hard wire mesh and the root and soil donut cut away from the surface and into the space created by removing the PVC and sand bags. A large can placed at the bottom of the hole before cutting speeds removal of the upper soil (a large coffee can fits perfectly). Each early April after soil and roots that grew in during the previous year are removed and bagged, new sifted, root-free soil is placed in the donuts and stays in place for the full year until next April.

In all but two of the GZTX donuts, two pieces of PVC pipe were beveled on opposite sides to prevent movement (Fig. 1). The top cylinder is 10 cm and the bottom 30 cm long, representing 0-10 and 10-40 cm increments in the soil profile when stacked. The double cylinder method allows removal of the upper portion of the sample while the lower cylinder still holds the lower portion of the sample in place. A small knife that can be held horizontally in the hole after removing the upper cylinder is used to cut around the top of the lower cylinder before cutting of sides of the upper portion of the donut sample. After bagging and labeling the upper sample as "0-10cm", cut bag and label the lower half as "10-40cm" for the particular site and treatment. Take a meter-stick to check that you do not go below 40cm from surface – this can usually be determined by feeling to the bottom of the metal mesh material and not going beyond that. Samples at the CRP study will only have one depth (0-40cm) and do not need a depth label on bags. SEE specific instructions for "CRP" and "GZTX" under the protocols for those studies.

Check sides of wire mesh liner for roots that knife may not have cut cleanly, and use scissors or small clippers to remove and place in appropriate sample bag.

Be sure to never remove the wire mesh cloth that lines the outer surface of the donuts.

Use check-off sheet to make sure all donuts have been sampled. This must be done.

Place bags in oven at 55°C until dry so roots do not decompose.

Use the root washing procedure for all root removal from soil.

Do NOT proceed with root washing unless you have been instructed on what mesh sizes to use, and never change the mesh size for any reason.

Joe von Fischer, CSU Biology Dept. & NREL
office: 491-2679, cell: 310-6840
jcvf@lamar.colostate.edu
April 2012

Overview

Plant and soil microbial processes both produce and consume gases that we can measure to learn about the way ecosystems work. These gases, carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) are also important greenhouse gases. For this project, you will measure the rates that these gases are exchanged with the atmosphere, and you will also measure some of the features of the soil that are important for determining the rates of gas exchange.

The gas flux measures are made by placing a chamber over the soil surface and measuring how the concentrations of gases change in the headspace of that chamber change over time. I also ask you to measure soil temperature, soil moisture, and note the % plant cover at each chamber. Please make special note in the lab book if you encounter any thing that you think might possibly affect the gas flux rates (e.g., recent rain, cattle activity, problems with equipment). These notes are really helpful.

One of the most important factors for determining the gas flux rates is the “diffusivity” of the soil which is how quickly gases can move through it. We will measure diffusivity by adding a small amount of an inert tracer gas (SF₆) to the chambers and then measure how that concentration falls over time as an index of soil diffusivity.

Study areas

Two field sites; Clay soils in Pasture 25 and Sandy soils in Pasture 15E on both the topographical locations of the summit and the toeslope positions. Please sample the cross-site (ARS#143) twice a month in 2012.

Field Protocol for Methane Sampling

1. Pre-trip Prep and Supply List

Be sure to have the following items prepared:

- Charged Laptop (check to make sure laptop is functioning properly)
- USB cord for Data Logger
- Intact chamber lids
- SF₆ Vials
- Evacuated vials
- 60ml syringes
- 30ml syringes
- 22g Needles
- Ruler
- Data sheets & pens
- Clipboards
- Soil auger/tools for scraping soil
- Plastic Bags for soil samples/sharpies
- Anemometer
- 5 gallon bucket/sand
- Shovel
- Gloves & Sunscreen
- Gas standards (2)
- Watch
- Cooler with frozen blue ice

2. Set up Anemometer

Make sure upwind direction is clear of obstructions (people, equipment, etc.), clipping tall grass if needed. Anemometer should be as close to ground level as possible. Start the anemometer recording by pushing the top button. Record anemometer start time on data sheet

3. Measure maximum vegetation height

At some study sites, the vegetation will grow to be too tall for placing the chamber lid onto the ring. At these sites, the vegetation should be clipped down to “simulate grazing,” bringing the vegetation height down enough to allow the lid to fit easily.

At all sites, the maximum height of vegetation in each ring should be measured prior to gas sampling, and prior to any clipping.

4. Conducting Gas Sampling

[Note: Each field worker will be sampling at 2 chamber sites simultaneously]

At each of the 6 sampling sites set out the following materials:

- 60mL syringe
- 30mL syringe
- Two needles
- Bag of four sample vials
- Bottle of SF₆
- Chamber lid (bowl is open to free air)

SF₆ Dilution

Apply needle to 60ml syringe and close syringe valve. Remove the needle cap.

Pierce SF₆ bottle, open valve

Pull 20-25mL of SF₆ (note: it may take a few seconds until the gas has flowed through the needle so do this slowly) close valve

Pull the needle and syringe from SF₆ bottle making sure the needle remains attached

Remove needle from syringe and replace to plastic packaging

Open valve and expel the SF₆ down to 15 ml, then dilute pulling in free air to 60 ml, close valve

Set aside SF₆ syringe (60mL) and needle

(Note: keep this needle separate from sampling needles because it is now contaminated with SF₆.)

At first chamber site:

Secure chamber lid on the plot ring (start time=0:00)

Orient plates on ground horizontally at ground level

SF₆ Injection

Insert SF₆ syringe onto chamber tube (all valves closed)

At time=0:30, open valves and inject entire syringe of SF₆

Pump 3 times (using all 60mL of syringe volume)

Close valves and remove syringe

Gas Sampling

Prepare to take gas sample

Apply 30mL syringe to chamber tube (both valves closed)

At time= 1:00, open both valves

Pull to 15mL, pump back to 0mL, and pull to 30mL

Close both valves

Remove 30mL syringe from chamber tube

Apply sample needle (not SF₆ needle) and open syringe valve

Quickly inject sample into first vial, close valve

(Note: If there is significant pressure in the vial; this indicates an un-evacuated vial. The sample should be quickly-retaken from the chamber and injected in to new evacuated vial.) Note this on the datasheet.

Replace needle to plastic packaging

(Note: this needle should be used for all of the air samples from this chamber. Also, the needles should be sent back to CSU in the same plastic baggie that holds the vials from that chamber.)
Record vial number on the data sheet.

At second chamber site:

At time=3:00, secure chamber lid and orient plates

At time=3:30, inject SF₆

At time=4:00, take first sample

Move back and forth between the two chamber sites as outlined on data sheet.

Measure height of chamber from the ground level to the top edge of the thick PVC ring that connects the metal chamber bowl and the PVC (see pictures). Measure the height at three points around the circumference of the chamber lid.

5. Fill gas standard vials

There are two blue cylinders of gas standards, one labeled “low” (containing N₂ gas) and the other “high” (containing 5ppm CH₄). Please fill 2 vials with the low standard and 2 with the high standard. Note the vial numbers on the datasheet.

To fill the standard vials, connect the 30ml sampling syringe to the standard bottle. Slowly open the standard bottle to fill the syringe with >15ml of standard air as a rinse. Expel this standard air and fill the syringe up to 30ml. Close the syringe valve and the standard tank valve. Apply the needle to the syringe and open the syringe valve so that the syringe air is at atmospheric pressure and filled to 30ml. Put the standard air into the vial in the same manner as you would for the chamber air samples.

6. Record Anemometer Data

When gas sampling has finished, record anemometer stop time, distance traveled (DIST/DAY), and maximum speed (MAXSPEED) on data sheet.

7. Conducting Soil Sampling

Remove soil residue from soil auger (does not need to be spotless)

Chose 3 random sampling points on each side of the plot, at least 1m away from the sample rings

Take soil sample (making sure that the soil agar stays vertical)

Start by combing any vegetation out of the way

Auger down until the bottom of marker is at the soil level (~12 cm)

Wipe off excess soil from outside of the soil agar

Empty corer into labeled bag

Remove air and seal bag

Place soil samples in cooler with ice. Protect soils from overheating in the field using enough ice to cool the samples rapidly.

Fill holes with sand

Bag Labeling

Site Name- Sample # Date

Ex. SGS Sand-3 5/31/2011

8. Obtaining Data from Data Logger onto Laptop

Set-up and Connections

Open data logger, power on laptop and connect using USB cord in polyurethane case to portal labeled “COMM PORT”. Open icon on desktop “ECH2O Utility.” Under “Connect Via:” choose “Direct on COM3 Decagon UCA” on the drop down list. Hit “Connect.” Make sure that all 5 ports are set to “5TE Moisture/Temp/EC.” The measurement interval should be “60 minutes.” If any changes are made, be sure to click “Apply” at the bottom of the window.

Check that all connections are working by clicking “Scan,” all 5 ports should have a valid input of reasonable values. If an invalid input appears check to make sure the connection to the data logger is secure. Try unplugging and plugging back in the probe cords to the data logger. Record any problems with the data logger on data sheet. Once all connections are valid, close the scan window.

Downloading data

To download data from the Logger click “Data” from the top tool bar. Choose “Download All Data.” Save the file with an appropriate name. Record the name of the file on the data sheet. Send information via portable USB Drive or in email back to CSU.

Hit the power button to put the laptop in hibernate mode.

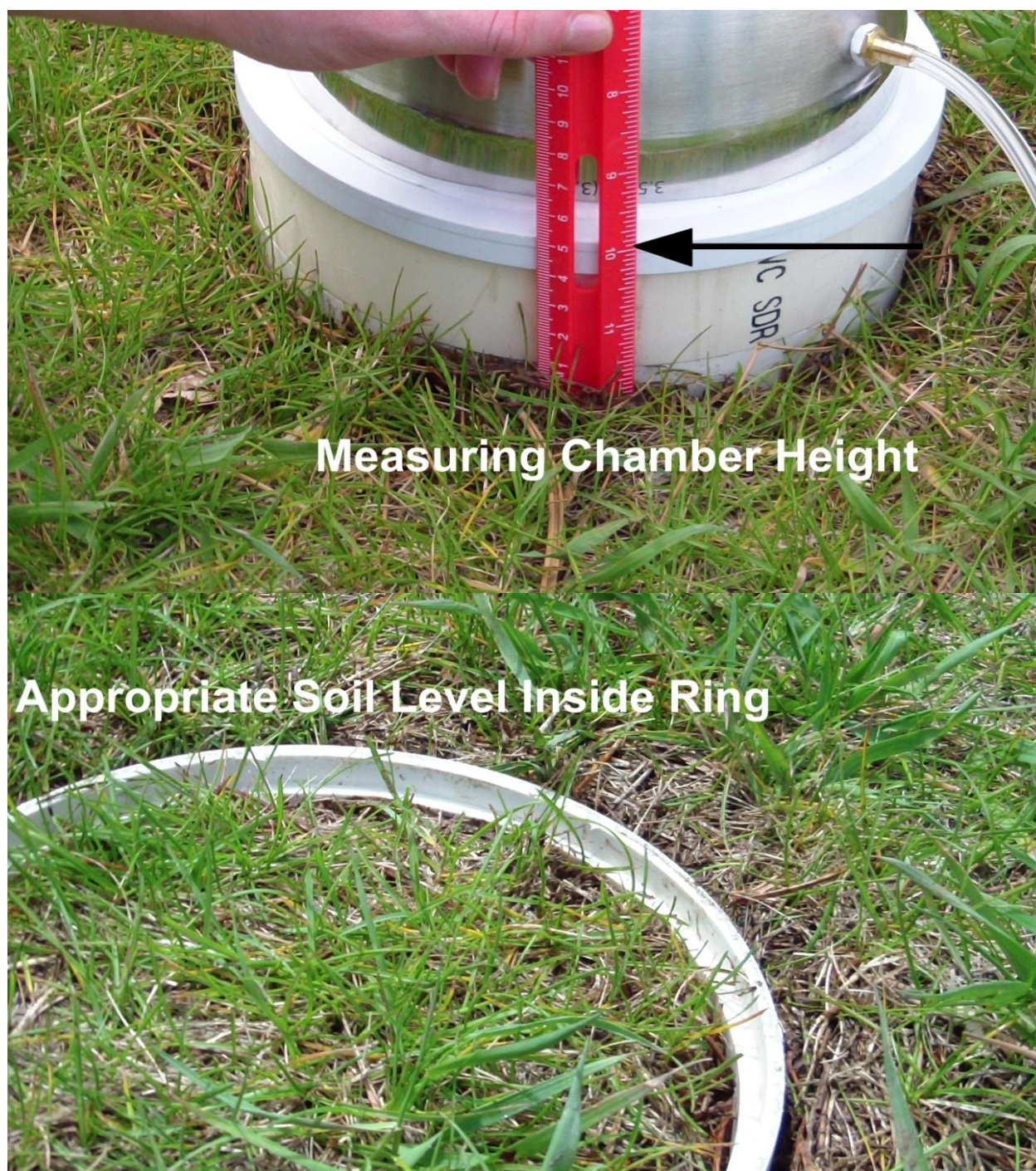
9. Send Soil and Gas Samples Back

Crease data sheet and place in bag with designated sample vials.

Place capped, used sampling needle in the same bag that holds the vials from the chamber.

Avoid sending samples on Thursday/Friday. If samples are taken on these days refrigerate and ship after the weekend.





Measuring Chamber Height

Appropriate Soil Level Inside Ring



Modified vegetation sampling for ESA rodent studies (13 Aug 2012, P. Stapp)

1. There are a total of 8 original ESA plots that have been trapped in Sep over most of the past decade. Rough vegetation measurements were taken in 1996 and should be repeated in 2012, especially because there have been no ESA vegetation measurements since 2007.

2. Trapping grids are 7 by 5 traps, with 15 m between traps on the 5 rows and 9 m between traps on the 7 columns (54 x 60 m = 0.324 ha). I suggest establishing 4 transects between the 5 trap rows and sample at 3 random points on each transect, for a total of 12 points per plot. Points should be chosen randomly but be at least 5 m apart.

Avoid other disturbances (humus experiment, known grub kill areas) by choosing other random points if needed.

3. At each random point, record the following:

- in one 0.5-m² circular quadrat per point, record % canopy cover of

shortgrass SG

midgrass MG

cactus CA

forbs FB

shrubs SH

bare ground BG

litter LT

- number of cactus plants (plants, not individual cladodes) within a 2-m radius of the point

- number of small shrubs (GUSA, EREF, ARFR, CELA, etc) within a 2-m radius of the point

- number of large shrubs (ATCA, YUGL) within a 2-m radius of the point

4. Within the area bounded by the trap lines (the entire 0.324-ha grid), count the number of

harvester ant mounds ($\geq 0.2\text{-m}^2$ in area)

pocket gopher / kangaroo rat mounds ($\geq 0.2\text{-m}^2$ in area)

other large mounds ($\geq 0.2\text{-m}^2$ in area)

5. At 10 randomly chosen gopher mounds per plot, record the dimensions (width x length, in cm), following the conventions used for the rodent trapping webs/ LTREB protocols.

Vegetation on ESA rodent trapping areas (1) – Whole grid counts

Date _____

Recorders _____

Area surveyed per plot: _____ ha

[illegible]

Vegetation on ESA rodent trapping areas (2) – Point-based counts

Date _____

Recorders _____

Plot (TRT_REP) _____

	% canopy cover in one 0.5-m ² quadrat							Within 2-m radius			Gopher mound dim in cm	
Point	SG	MG	CA	FB	SH	BG	LT	# cacti	# sm shrubs	# lg shrubs	length	width

(12 data rows)

CAREX = Cattle and Rabbit Exclusion Experiment

Experimental Plot Study Site: Pastures 5E, 19NW, 19SW, 24NW, 11S

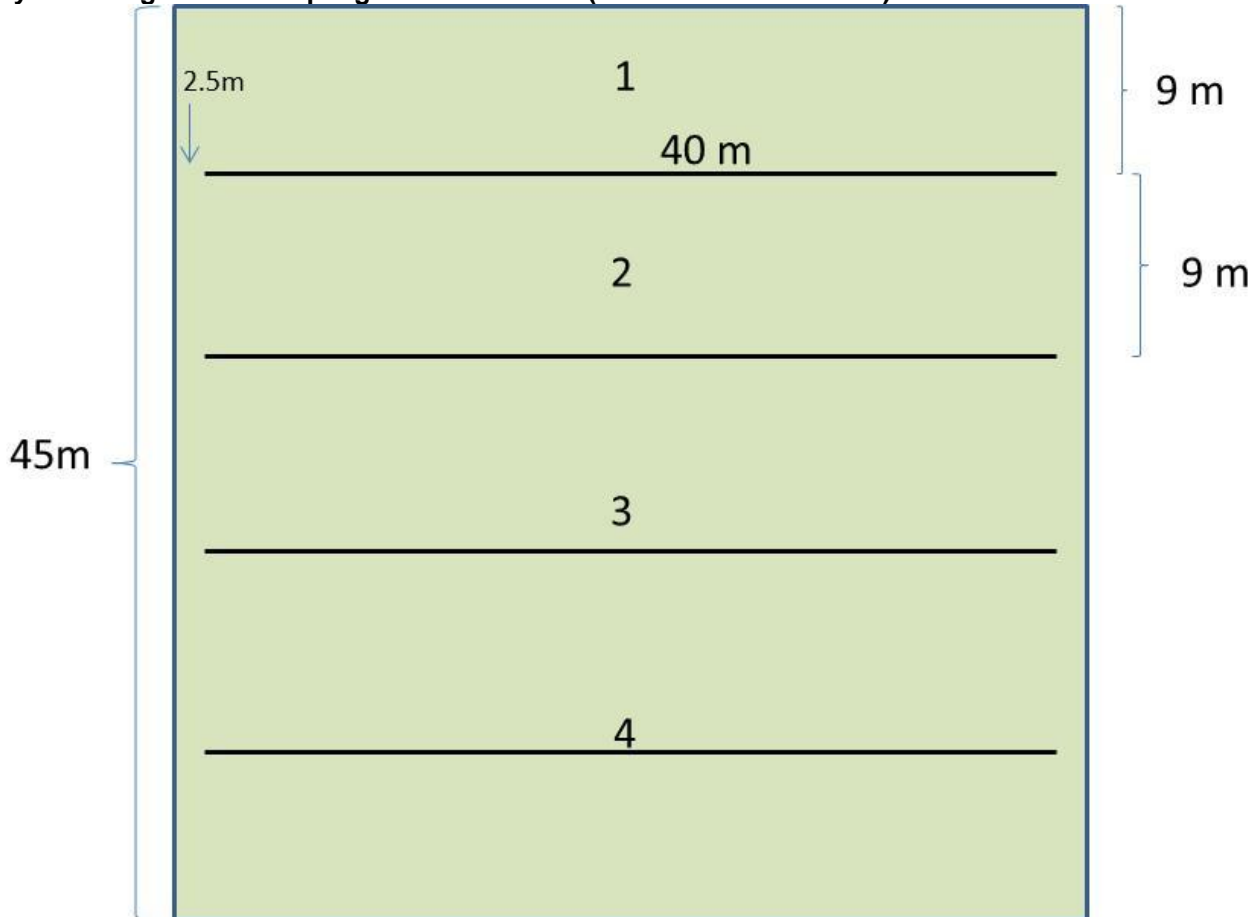
Experimental Layout:

4 Plots per Site; 1 Plot per Treatment

Treatments: Only Cattle Excluded (CE); Cattle and Rabbits Excluded (CRE); Only Rabbits Excluded (RE); All herbivores present (AH)

Each Plot = 45 x 45 m; currently with orange stakes marking plot corners; the CE, RE, and CRE plots all share one side (i.e. are contiguous); the AH plot is located nearby typically 10-15 m away from the boundaries of the other treatment plots.

Layout of vegetation Sampling within each Plot (black lines = transects):



Mark the start (0.0 m) and the end of each of the 4 transects, with the end point marked at 40.5 m so as to not interfere with pin-contact reading at 40.0 m. Mark start and 40.5 m with nail and washer.

Vegetation measurements along each transect:

Every 50 cm	Line point intercept: Pin contact for canopy and basal cover	80 interceptions per transect; 320 total
Every 5 m (0, 5, 10, 15 .. 40)	Robel pole in 4 directions, 0.25 m ² circular plot for rare spp.	9 quads/robels per transect; 36 total
Full length of each transect	measure intersection lengths with all types of large (>25x25cm) bare patches	160 m of line transects
Full length of each transect	ARFR density/ dimensions in 2-m wide belt; All other shrubs in 4-m belt	160 m of belt transects
0-10m and 30-40m on each transect	Small rabbit pellets in 1-m belt on north side; Large rabbit pellets and pronghorn groups 1-m belt on N side and 1-m belt on S side	80 m of belt transects

Line Point Intercept. This measure produces foliar cover and basal cover. Start at 50 cm on tape, and take a reading every 50 cm out to 40 m. At each point, drop a pin vertically into the vegetation. Pin must be exactly vertical. Record the basal contact of the pin (e.g. bare, litter, dung, rock, or basal cover of a plant species) and the number of contacts of the pin with any canopy species (record the number of contacts of the pin with each species). Also record any contacts with standing dead material (code = STDE). In some rare cases, if the pin contacts a piece of litter (non-attached dead biomass) that is above ground level, record it as a canopy contact with species code = LIT). The last intercept will be at 40.0m. Pin diameter is extremely important: only use a standard pin from a pin flag; pin must be perfectly straight and placed exactly vertical, without bias toward vegetation.

Robel Pole = Use same protocol as in all other experiments at CPER. Record in 4 directions from each sampling point (cardinal directions). Start at 0m, and go every 5 m out to 40 m. The first (0m) and last (40m) will be at plot markers, so shift the Robel pole 10 cm east and 10 cm north for these recordings to avoid influence of the plot marker.

Rare Species Circular Plots = Place a circular, 0.25m² plot centered over the point the tape at 5-m intervals along the tape, including at 0.0 m (9 readings per transect). Count the number of individuals of **each species of forb** (record each species separately), the number of **STCO**, **SIHY**, **ARLO**, and **SPCR** individuals (bunches), the number of **PASM** tillers, and the number of **OPPO** cladodes (live cladodes only).

ARFR: Count density of ARFR within a 1 m belt on each side of each transect (2-m wide belt transect) Measure height/length/width of the first 8 individuals encountered on each transect (32 total per plot), or measure all individuals in the transect if less than 8.

All other Shrubs and Subshrubs (ATCA, GUSA, EREF, CELA; shouldn't be any YUGL): Count total number individuals of each species within 2 m of either side of each transect (4-m wide belt transects). Measure height/length/width of the first 8 individuals encountered on each transect (32 total per plot), or measure all individuals in the transect if less than 8.

Note - all measurements are made across *live* biomass, and in *centimeters*. If more than 8 individuals of a given species is encountered in a belt, then stop recording height/length/width for that species, and just count the number of individuals.

Rabbit/Pronghorn pellets: These counts will be done from 0-10m and 20-30m along transects 1 and 3, and from 10-20m and 30-40m along transects 2 and 4. The counts for each of the two sections of each transect are recorded separately. For a 1-m wide belt along the NORTH side of each 10-m transect, collect all rabbit pellets and count/clear all pronghorn dung groups. Separate the rabbit pellets into (a) pellets less than or equal to 8 mm in diameter, and (b) pellets greater than 8 mm in diameter. Record the number of pellets less than 8mm dia on datasheet. Then on south side of the transect, for a 1-m wide belt collect all rabbit pellets greater than 8 mm dia, and count/ clear pronghorn pellet groups. Record total number of large (>8 mm) diameter pellets from both the

north and south sides of the transect as a single number. Record total number of pronghorn pellet groups on the north and south side of the transect as a single number.

Gopher mound/Burrow/Shrub Cover by transect interception: We will identify any patches of bare/disturbed soil that are larger than 25 cm in both length and width. Where any such patches intersect with the tape measure along each of the 4 transects, record the length of that portion of the bare patch that intercepts the tape. Codes to use are: bare patches not caused by animal disturbance (BARE), harvester ant mounds (POOC), gopher mounds/disturbances (THAT), prairie dog burrow mound (PDOG), other burrow entrances (BE) or burrow entrances with excavated soil (BEES). Use footnotes to record any estimates what species caused BE or BEES.

MAPS



