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Shortgrass Steppe Long Term Ecological Research Project

**2008
Field Crew Sampling Protocols**

Nicole Kaplan, SGS-LTER Information Manager

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-Appendix-

Workers compensation information

Species Lists

Plants (see Mary Ashby, botanical expert on the CPER, for hands-on training and identification of unknowns)
 Arthropods
 Reptiles and Amphibians
 Small Mammals
 Birds

Maps

Directions for CPER Study Sites (ARS #6, 32, 98, 99 and 118)
 CPER/Pawnee Nat'l Grassland (PNG) – General Vicinity Map
 CPER Detail Map

SGS/LTER Field Staff & Research Assistants 2008

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: Dan Tripp

Assistant Crew Leader: Kevin Meierbachtol,

SGS/LTER Research Assistants:

Trace Martyn, May 19 to August 22.
Brian Gley, May 19 to August 22.
Michael Vollmer, May 19 to August 22.
Stacey Plummer, May 19 to August 22.

Leah Kennedy, June 30 to August 22.
Chris Campton, July 7 to August 22.

After Pingree:

Blake Osborne, July 14 to August 22.
Chelsea Weiskerger, July 14 to August 22.

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: sgslter, Password: pawnee

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
- 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**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.

Data Sheet(s):

PHENOLOGY STUDY

Date: _____ Location: _____ Recorder: _____

GRASSES AND GRASSLIKES

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

PHENOLOGY CODE:

- | | |
|--|---|
| 1: Winter Dormancy | 8, 9: Floral Buds Open Flower (Anthesis in Grasses) |
| 2: First Visible Leaves | 10, 11, 12, 13: Green & Ripe Fruit & Dispersing Seeds |
| 3, 4, 5, 6: Peak Green Biomass (Possible Multiple Dates) | 14: Dispersing Seeds and Senescence |
| 7: First Floral Buds | |

Root Harvest**Principal Investigator(s):** Bill Lauenroth**Study Objectives:** to assess belowground production**What to know before you start sampling:**

- ✓ Only core where you are told to core!!
- ✓ It is very important that you use the correct core with the correct diameter for this sampling. The correct core size diameter is 6.65 cm.
- ✓ It is very important that you use the correct smaller size sieve for the root washing as well. The correct smaller size sieve is 500 micrometers.

Study Area Location: These samples are taken south of the C14 plots approximately five yards from the outside perimeter of the C14 plots. (Until 2000 they were taken to the North of the C14 plots). This sampling is performed the 15th of April – September each year. Root washing is performed at the root washing station outside the field station.

Experimental Design:

- 8 transects
- 5 plots in each transect
- 6 sampling dates, April – September
- Individual sample size is soil core (6.65 cm x 20 cm)

Sampling Protocol:

Equipment:

Data sheet to record species codes for aboveground plant material clipped at ground level prior to coring

Pin flags (40)

Clippers

Short Corers 6.65 cm in diameter (20 cm)

Sledge Hammers

Jack with Chain and Bolt

Forty Medium Sized Paper Bags (pre-labeled 1-1 through 8-5)

Wheel Barrow or bucket and shovel

South of C14 plots approximately 5 yards randomly place five pin flags in line with existing C14 so there are a total of 8 plots with 5 pin flags in each.

At each pin flag, score the soil with a soil corer. Clip out the blue grama crowns and above ground vegetation. Before coring, please record the plant codes for the vegetation you just clipped down to the ground level. Leave all roots in place. Core the root sample, break up the soil core and put it in the correct bag. Place samples in garage drying oven at 55 degrees centigrade for 3 days. Then root wash.

Fill in the holes left from the core with soil from the near by soil pit. Fill the hole neatly, so the soil is level with the existing ground level.

Root Washing Protocol:

Equipment: metal pans with spouts, 500-micrometer sieve, larger opening sieve, water hose, and sprayers at root washing station, coin envelopes, and a sharpie.

Procedure:

1. Place larger sized sieve on top of bars running across the metal pail.
2. Place 500 micrometer sieve on table beneath pail spout and place an object (tent stakes work well) beneath this sieve to allow water to run out.
3. Take a paper bag with a soil sample and copy information (i.e. study, location, data, etc.) onto a coin envelope.
4. Carefully dump soil into large sieve.

5. Take sprayer connection and gently wash soil through large sieve. While washing, place one hand in between large sieve and pail spout to prevent rocks from flowing into the 500-micrometer sieve.
6. When all the soil has been washed off, take the roots in the large sieve (while being careful not to grab any rocks) and place them in the coin envelope.
7. To collect remaining roots, carefully pour water in pail through 500-micrometer sieve (roots should float to the top and rocks and soil should sink to the bottom of the pail). Pour off water just until soil/rocks start to flow out. It works well to pour water near one side of the sieve so the roots collect in one spot. You may use the sprayer to spray roots to one edge of the sieve, but do so gently.
8. Grab roots in 500-micrometer sieve, wring out the water, and place in coin envelope.
9. Take the sprayer and agitate the soil in bottom of the pail. After allowing the soil/rocks to settle again to the bottom of the pail, pour off water and roots through the 500-micrometer sieve. Repeat this 3 times, or until it appears that all of the roots have been collected.
10. Clean any soil/rocks out of the pail and wash out any roots stuck in the sieves before processing the next sample.

QAQC Instructions: It is very important that you use the correct core with the correct diameter (6.65 cm) for this sampling. Make sure that all samples have been taken before leaving the site. When root washing make sure that you are using the correct smaller size sieve (500 micrometers) and that all envelopes are labeled correctly. Be sure both soil core samples and root samples are stored in the drying oven at 55 degrees C when they not out being processed.

Data Sheet for recording species codes for aboveground plant material:

Root Harvest Data Sheet
Principal Investigator(s): Bill Lauenroth

Instructions: Please record the SGS-LTER plant codes for the plants that were clipped aboveground from the root harvest plot.

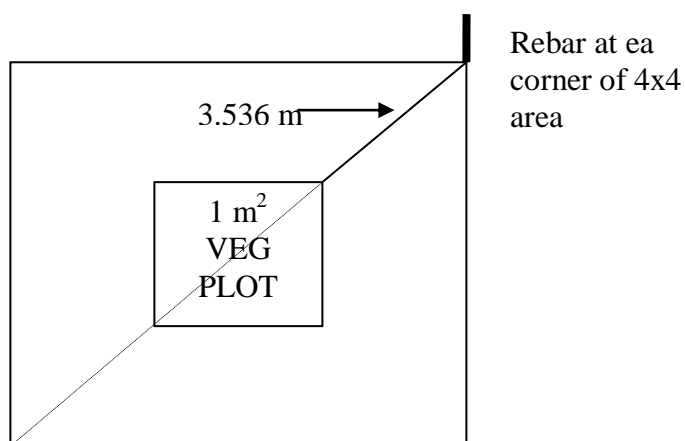
Date: _____

Data Recorder(s): _____

PLOT #	PLANTS clipped from the plot	Notes:
1-1		
1-2		
1-3		
1-4		
1-5		
2-1		
2-2		
2-3		
2-4		
2-5		
3-1		
3-2		
3-3		
3-4		
3-5		
4-1		
4-2		
4-3		
4-4		
4-5		
5-1		
5-2		
5-3		
5-4		
5-5		
6-1		
6-2		
6-3		
6-4		
6-5		
7-1		
7-2		
7-3		
7-4		
7-5		
8-1		
8-2		
8-3		
8-4		
8-5		

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 1=Control 2=Sugar 3=Lignin 4=Sawdust 5=Lignin + Sugar 6=Sawdust + Sugar</p>	<p style="text-align: center;">E Nitrogen</p> <p style="text-align: right;">3/5/4/2/6/1 1</p> <p style="text-align: right;">4/5/3/6/1/2 2</p> <p style="text-align: right;">1/2/6/3/4/5 3</p>
<p style="text-align: center;">E Water + Nitrogen</p> <p style="text-align: right;">3/5/4/2/6/1 1</p> <p style="text-align: right;">4/1/3/6/5/2 2</p> <p style="text-align: right;">5/4/3/6/2/1 3</p>	<p style="text-align: center;">E Water</p> <p style="text-align: right;">3/5/4/2/6/1 1</p> <p style="text-align: right;">2/1/6/3/5/4 2</p> <p style="text-align: right;">5/4/3/6/2/1 3</p>
<p style="text-align: center;">E Control</p> <p style="text-align: right;">3/5/4/2/6/1 1</p> <p style="text-align: right;">4/5/3/6/1/2 2</p> <p style="text-align: right;">5/4/3/6/2/1 3</p>	<p style="text-align: center;">W Water + Nitrogen</p> <p style="text-align: right;">3/5/4/2/6/1 1</p> <p style="text-align: right;">4/5/3/6/1/2 2</p> <p style="text-align: right;">5/4/3/6/2/1 3</p>
<p style="text-align: center;">W Water</p> <p style="text-align: right;">3/5/4/2/6/1 1</p> <p style="text-align: right;">4/5/1/3/6/2 2</p> <p style="text-align: right;">5/4/3/6/2/1 3</p>	<p style="text-align: center;">W Nitrogen</p> <p style="text-align: right;">3/5/4/2/6/1 1</p> <p style="text-align: right;">4/5/3/6/1/2 2</p> <p style="text-align: right;">5/4/3/6/2/1 3</p>
<p style="text-align: center;">W Control</p> <p style="text-align: right;">3/5/4/2/6/1 1</p> <p style="text-align: right;">4/5/3/6/1/2 2</p> <p style="text-align: right;">4/5/3/6/2/1 3</p>	<p style="text-align: center;">This area not used for study</p>

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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

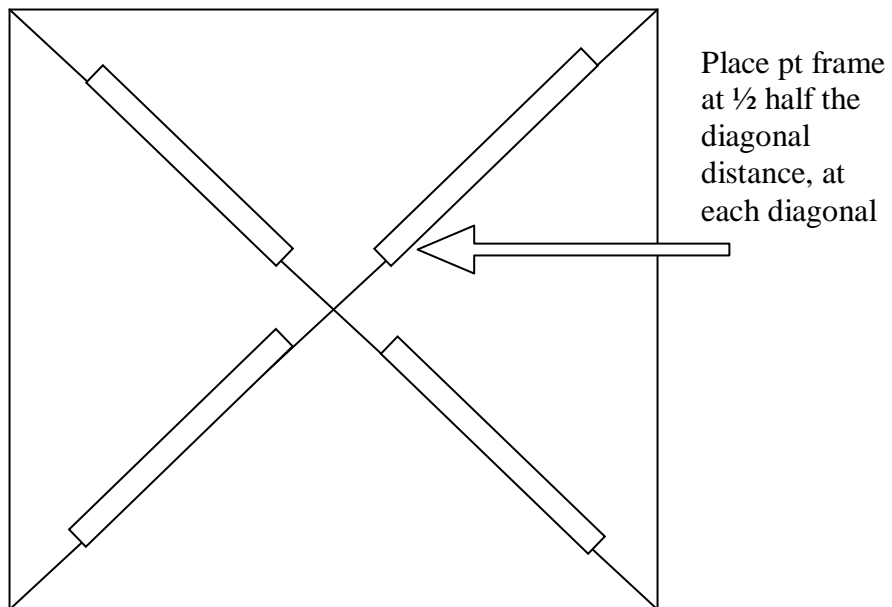
Density sampling (number of individuals of each species/m²):

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.

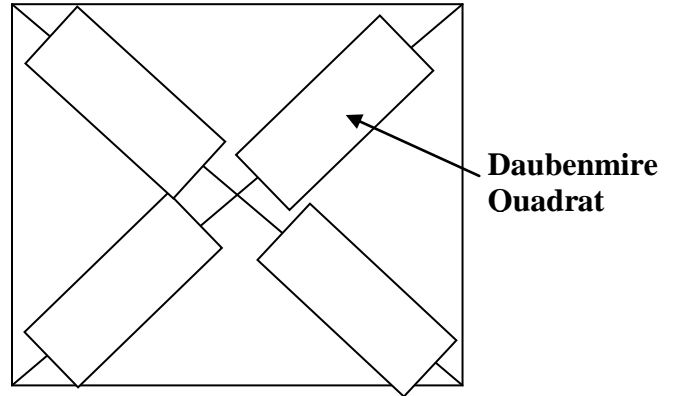
Basal Cover Sampling (m²/m²):

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:**

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: **1**=0-5%, **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: **1**=0-5%, **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 #03 Humus Experiment – Soil Coring
(Overlaid on Ecosystem Stress Area, ESA)

Principal Investigator: Indy Burke

Study Objective: to assess soil properties and biogeochemical processes

Study Area Location (please use the provided maps for vegetation sampling): 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 for Soil Coring:

- 2 blocks (east and west)
- 4 historical (ESA) treatments in each block
- 3 transects in each treatment
- 6 plots with Humus treatments (carbon additions) in each transect
- 1 core in each plot to be taken between individual plants
- 2 segments for each core - Individual sample core size is 10 cm deep to be split into two equal parts of 0-5 cm and 5-10 cm, 6.65 cm diameter; OR two 10 cm deep cores split into two parts if using a 5 cm diameter core (combine the two upper core parts in one sample bag, the two lower sample cores in another)
- Fill in the holes with soil taken from near the plots

Equipment:

Short soil Corers (6.65cm diameter), marked at 10 cm deep.

Pin flags (~20)

Sledge Hammers

Clippers

Cafeteria tray with measured tick marks for 0cm, 5cm, and 10 cm to cut the segments out of the cores

Wide metal spackle knife for cutting coil segments

Kitchen tablespoon and table knife for getting soils out of corers and/or out of the core holes if soil conditions are very wet or very dry

288 Medium Sized Paper Bags (pre-labeled) OR smaller bags (these samples will be small!)

Shovel

Sample Label:

Date: DD-MM-YYYY

Block: E or W

ESA TRT: ESA-C, ESA-N, ESA-W, or ESA-NW

TRANSECT: T-1, T-2, or T-3 (T1 is eastern most transect)

PLOT: P-Con, P-Sug, P-Saw, P-Lig, P-Sug/Lig, P-Sug/Saw

DEPTH: 0-5 or 5-10

CORE DIAMETER: W = wide (6.65cm), N = narrow (5 cm)

Starting from the SE corner of each plot, place a pin flag at 0.5 m north and 2.75 m west. (NOTE: if something makes the first set of coordinates unusable (ant hill, etc.) use the alternate coordinates of 1.25 m north and 0.75 m west. Please note on sample bags if core comes from this alternate coordinates. Locate the closest area of soil between plants. Remove any litter on the soil surface. (NOTE if it's between plants there really should not be a need to clip vegetation, but if it is impossible to avoid capturing some aboveground vegetation do clip it down to the crown level, but leave any roots in place.)

Core the soil sample at least to 10 cm deep. Carefully push sample out of corer (start at the cutting edge and push towards the top of the core bit – soil slides out easier this way) and place on the cafeteria tray. Cleanly cut off any soil below or deeper than the 10 cm mark. Then, cut the core into a 0-5cm segment and a 5-10 cm segment. Please fill in the holes with soil, if possible taken from near the plot. Bag and label these two samples separately! If the soils are very dry and tend to fall out of the corer, please make note of that on the sample bag. Place samples in garage drying oven at 55 degrees centigrade for 3 days. E-mail beckyr@warnercnr.colostate.edu when sampling is complete.

QAQC Instructions: Sample once in 2008 with all cores collected within one week. It is very important that you use the correct core with the correct diameter (6.65 cm OR two cores/plot using a 5 cm diameter core) and split two segments out of each core at the correct depths (0-5 cm, 5-10cm). It's ok to use one size corer in some plots and another size in other plots as long as the core diameter is marked on the sample bags. Make sure that all samples have been taken before leaving the site. Be sure soil core samples are stored in the drying oven at 55 degrees C. Be careful to not tear sample bags on the drying oven shelves.

ARS #06 Long Term Net Primary Production

Principal Investigator(s): Daniel Milchunas

Study Objectives: Monitor long-term net above ground primary production of the shortgrass steppe community.

What to know before you start sampling:

- ✓ **You have been shown the locations of LTNPP sampling**
- ✓ **You have been instructed how to layout transects and plots in the ungrazed areas in Owl Creek and ESA**
- ✓ **You have been instructed on how the ridge in site 24 will be clipped differently for the ARS**
- ✓ **You have noted what to clip and what not to clip ****OLD-STANDING DEAD ON THE RIDGE IN SECTION 24 SHOULD BE COLLECTED FIRST FOR ARS SAMPLES******
 - clip live and recent dead by species
 - **for old dead (last year's growth, usually grey) For RIDGE, SECTION 24 ONLY- FIRST collect 'old' standing dead (biomass NOT produced in the current year and usually grey). For all other sites (sec 25, esa, owl creek, swale and mid-slope in sec 24) the standing old dead is sorted out the same way, but not saved.**
 - no litter, no lichen
 - only new growth (cladodes) for OPPO, but no barrel cactus
 - only new, green growth on shrubs
- ✓ **You have trained the crew on this clipping protocol**
- ✓ **You have been provided labels and various sample bags**
- ✓ **You have been instructed on how to move and restake the cages for next 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, 5) lichen (not collected for biomass), 6) shrub recent year growth and 7) new growth cactus cladodes 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). Make sure all are done. Each location has 15 plots. There are 3 transects with 5 plots in each transect. Plots in the grazed locations are protected by cages. Choose a random direction and distance to move the cages for the LTNPP harvest next year and re-stake the cages. Plots in the ungrazed locations are chosen randomly each year. The 3 transects are marked by rebar or plates. Measure the distance to the random location of the five plots along each transect. **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 $\frac{1}{4}$ m² and circular in shape

Digital Photography Protocol: A digital picture must be taken of every plot before it is clipped. Use the $\frac{1}{4}$ m² black wood frame to show the perimeter of the plot. Label the white board with the same information used on the sample bags (shown below) and place to the side of the frame.

Equipment:

Orange Field Book for Digital Camera
 White board
 Dry erase markers and eraser
 Cleaner and paper towels
 Black $\frac{1}{4}$ m² wood frame

Field Procedures for digital photography:

Stand directly over the plot to gain a bird's eye view of the plot. Be sure that the wood frame is delimiting the plot as accurately as possible. Run your finger along the edge of the frame and pull vegetation in that is rooted within the frame and out that is rooted outside of the frame. A photo may need to be taken of the vegetation underneath a cage. In this case, remove the stakes around the cage and place the middle frame under the cage in the center of the plot. Lift and rotate the cage one meter to the east and south and re-stake the cage. Create a complete label for that project and plot on the white board. The label should be consistent and include the project name, date, transect, and plot or treatment description. Place the labeled white board to the right or left of the plot. Pictures should be captured at 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. It is very important to keep this record in case we need to go back and verify a digital image. Place a pin flag with the plot and transect number or coordinates in the middle of the metal frame after you capture the image. This marks the center of the plot that was beneath a cage. Put the cross of the metal clipping frame at the pin flag and clip the sample right away.

Archiving Images:

The images will be stored on the memory cards. 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.

Clipping Protocol:

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 (see Mark for description). All live plus recent dead material needs to be harvested from the plot. For the ridge in **section 24 OLD-STANDING DEAD will also be collected, but not by species**. This means that all old-standing-dead are put in one bag for each plot by species. 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. Old-standing dead is not included in samples from other LTNPP sites. It should be sorted out the same way but it is not saved. Old-dead is not included in any samples (the gray colored material). 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 species. It is usually easier to first clip species other than BOGR-BUDA. There are three cactus species on the site. Only current year growth of OPPO is clipped - these are the small pads. The two 'barrel' cactus are not clipped. There are only some times when combining of species may be done, but it is important that the following 'combining-rules' be followed:

1) The only time combining is allowed is when two species are each less than a gram (this is a few leaves, or one very small stem of an individual). 2) Some species are never combined even if there is only a very small quantity - these are BOGR, BUDA, SPCO, and CAHE. 3) When combining, never combine forbs with shrubs, grasses with forbs, etc. Only combine grasses with grasses, forbs with forbs, shrubs with shrubs. Envelopes with combined species should have codes for all species on the envelope.

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 BOGR 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???

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
SPECIES 4 LETTER CODE	CAHE

QAQC Instructions:

IMPORTANT: 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. 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?

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.

Sample Check Off and Delivery Instructions:

When you are finished collecting samples at each location, gather all bags together and sort them out by transect. Then check that all plots are there for each transect, and they are labeled correctly. 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 and small bags within the larger sample bags labeled with the correct location, transect-plot numbers, and species codes?

IMPORTANT: Place the bags in the drying oven at a temperature of 55 C – not more and not less. 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 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:

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.**What to know before you start sampling:**

- ✓ **Accuracy and precision are important to this project, so take the time to identify individuals correctly and try to stay comfortable.**
- ✓ **Study locations are sampled in a specific order each year**
- ✓ **This study requires special training, do not complete until this has occurred and every field crew member has been trained.**
- ✓ **Digital photos are taken from the chart plots and OPPO plots. The chart plots are sampled. The OPPO plots are not sampled.**
- ✓ **Large boxes from appliances can be picked up from appliance stores in Fort Collins. They are comfortable to sit on adjacent to the plot. Always flatten the box and label one side UP and the other side DOWN. Always sit on the UP side and let the DOWN side absorb the cactus spines.**
- ✓ **Check that the equipment is in good repair, complete and organized before you go out to the field.**
- ✓ **Color copies of past year's data sheet are in the filing cabinet and may be used as a reference for plant identification of buda vs. bogr**
- ✓ **Always return the equipment to building, and never leave it in the van once you are finished sampling for the day.**
- ✓ **Bring plenty of snacks, water, etc. so that you can finish sampling a plot in one long morning and schedule a late lunch. This will minimize having to remove equipment from the field for breaks, taking the time to set everything up again and having to re-calibrate.**

Study Area Locations: Please see GZTX maps under ARS#32. Return to the plots each year in the same order: 19, 11, 24, 7, 5a and 5b.

Experimental Design:

- 6 sites
- 2 treatments at each site
- 2 plots per treatment (1 plot without cactus sampled intensively, 1 plot with cactus photographed only)
- Individual plot size is 1m²

Equipment:

ladder	knee pads (1 kneeling, 2 knee)	extra leads	water
film	chair (recorder only)	toothpicks	sunscreen
camera	good eraser	nails (?size)	plant press
square frame	color pencils	hammer	measuring tape (m)
marker board	mechanical pencil	field guide for plants	clippers
project binder	pencil sharpener	exclosure maps	

Sampling Protocol:Photographing Plot Procedure:

You will need the digital camera with the current field season flash card and orange log book, and a step ladder to hover over the plot. Place the ladder on the southern end of the plot, photograph from directly over the plot (while facing north) with camera. Make sure there are no shadows in the photo. Write down project title (Chart Project or Oppo Project), date, GZTX site and treatment in the log book with the flash card number and image number from the camera. These images along with other from that year's field season will be archived from the flash cards to the SGS central server.

Plotting Procedure:

Locate the research plots by looking for white metal plates in the ground (plain white plates with holes in the middle) (Oppo plots have the letter C with an O in the middle). Put the project board to the west of the plot. Orient yourself to the north. Make sure the board is aligned with the plot so that all of the data will fit neatly on the sheet. Secure the board with the proper size nails and be very careful not to jiggle the board once you have begun. Take turns as being the drawer and data collector. Record the date and time that you started collecting data from the plot. Using the mechanical graphite pencil, record the tic points by marking solid dots for all 4 holes and an X through each dot. Then mark the outline of the metal plates in each of corner of the plot. After mapping is done a line connecting the ticks is drawn in the lab.

Visually break the plot up into four quadrats and work in one quadrat at a time. The data collector should identify an individual plant by running his or her finger along the ground to find the base of the plant. Once the individual is identified, the data collector should tell the drawer to put the “pencil down”. The data collector should then trace the individual with the non-drawing tip of the board’s arm while the drawing tip of the arm marks the ground. When tracing the plant, pull back the vegetation so that only the point where the plant contacts the ground is recorded. When the data collector is finished tracing that individual, place a “brightly colored” toothpick there to keep track of individuals that were already traced. The recorder should always use the graphite mechanical pencil to draw individuals, and then fill in the polygons with the pre-selected color for that species. (Fill the color in dark and evenly). Except carex, which should be drawn with the LIGHT GREEN pencil. The crown of plants should also be recorded, but should not overlay with the live vegetation. The crown area should be filled in with straight hatch marks. Make sure the hatch marks are straight and clear. Seedlings, forbs and plants such as AGSM should be recorded as a dot when they are not wide enough to be traced. Use the appropriate color pencil to outline the dot. If there is no pre-determined color for that species, then choose a color that will not be used on that map and add it to the map legend (for individual tillers and seedlings) or label the map feature with the first two letter of the plant genus. Don’t use similar colors for two plants that have the same architecture, for example forbs that grow from a central stem. If you encounter an unknown species, then take a sample from outside the plot and press it to be identified later. On the map, use “Unk___” to name the unknown species. If bare ground exists in the vegetation structure then show this on the map with X’s. Make plant covered ground and bare ground clearly distinguishable on the map. Take lots of notes regarding the amount of vegetation, disturbances, weather conditions etc.

QAQC Instructions:

Dos and Don’ts:

- Re-calibrate the tic marks if the board is knocked.
- Adjust the tightness of the arm and pencil holder when necessary.
- Keep pencils sharp and make clear marks.
- Don’t overlap your marks.
- Don’t place hands or feet directly on the vegetation. Use your kneepads and kneeling pad to work around the plot.
- Take copious notes about the plot. Remember that these data will be analyzed by someone who was not there when the data were collected. Explain in words anything you think will be unclear. Also note whether there was more buda then bogr or whether there was a lot of litter.
- If oppo exists in the plot, remove it.
- Communicate clearly and consistently with your partner. Familiarize yourself with how each species grows (rhizomes, stolons, bunchgrass, etc.) and other distinguishing characteristics.
- Check last year’s reference map to help identify species and distinguish between similar plants, like buda and bogr.
- Do not hatch over large areas indicating lots of crown. Note on the datasheet there is a lot of crown material, but be sure to follow the significant crown material with the arm to capture the size and shape.

Vegetative characteristics for grasses:

- *BUDA- really hairy on both sides and grows with stolons (aboveground)
- *BOGR- hairy ligule and grows with rhizomes. If it is hairy on both sides, but with a bogr seedhead call it bogr.
- ARLO has hairy ligule (like BOGR) and the blades are fine (Bunch grass). It can look like bogr
- STCO is large and has a large membranous, papery ligule. It is usually coarse (bunchgrass)
- SIHY has auricles and is a bunchgrass. Greens early in the season and is sort of blue in color.
- AGSM grows as individual tillers and is mint green and deeply veined.
- SPCR (bunchgrass) is coarse. It can be confused with buda. The ligule is extremely hairy, unlike other grasses.
- MUTO is a small bunchgrass?? And grows like turf. It has very fine, short blades. Looks like SCPA, but has a ligule.
- SCPA is also a small bunchgrass. It is a little larger than MUTO. Has a ligule and a different seed head.
- CAREX – dark green sedge with edges; grows individually like a triangle.
- VUOC – annual, short grass. Comes out in spring, inflorescence looks braided.
- SPCO – deeply lobed leaves, sage color, cool season forb, and rose-colored flower

Data Sheet: (See the following page)

ARS #32 Grazing and Soil Texture (GZTX)

Principal Investigator(s): Dan Milchunas

Study Objectives: to evaluate the aggradation and degradation of ecosystem structure and function in response to long-term grazing by cattle.

What to know before you start sampling:

- ✓ **Have you visited each GZTX site and are you aware of the coordinate system within each treatment area**
- ✓ **Have you been instructed on Daubenmire's method for sampling density and cover**
- ✓ **You have been instructed on how to clip biomass and NOTE: the GG NPP plots in Sections 7 and 19 will be clipped differently for the ARS**
- ✓ **You have noted what to clip and what not to clip ****OLD-STANDING DEAD in the NPP PLOTS in the GG Treatment of sections 7 and 19 SHOULD BE COLLECTED FIRST FOR ARS SAMPLES******
 - clip live and recent dead by species
 - **For GG – NPP 7 and GG- NPP 19 GG-NPP ONLY- FIRST collect 'old' standing dead (biomass NOT produced in the current year). For all other sites the standing old dead is sorted out the same way, but not saved.**
 - no lichen, no cactus, no litter
 - only new, green growth on shrubs
- ✓ **You have trained the crew on cover and clipping protocols**
- ✓ **You have been provided the cover and density datasheets**
- ✓ **You have been provided labels and various sample bags for clipped samples**
- ✓ **You have been instructed on how to move and restake the cages for next 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 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, 5) lichen (not collected for biomass), and 6) 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, 5A, and 5B) 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, “what used to be, then what is now.” Be sure you know what site and treatment you are working in –check your maps. **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 Density and Cover:

- 6 sites
- 3 sites with 4 treatments, 3 sites with 5 treatments
- 20 plots per treatment at each site with 4 treatments, 35 plots per 4 treatments at each site with 5 treatments, and 45 plots per fifth treatment
- Plot are measured once per year, mid-season
- Individual plots are .1 m²

Experimental Design for Clipping:

- 6 sites
- 3 sites with 4 treatments, 3 sites with 5 treatments
- Site 24 & 11
 - 4 plots in each of 2 ungrazed treatments
 - 8 plots (4 caged, 4 utilized) in each of 2 grazed treatments
- Site 19
 - 4 plots in each of 2 ungrazed treatments
 - 8 plots (4 caged, 4 utilized)in one grazed treatment, 14 plots (10 caged, 4 utilized) in other grazed treatment

- Site 7, 5A, and 5B
 - 10 plots in each of 3 ungrazed treatments
 - 20 plots (10 caged, 10 utilized) plots in each of 2 grazed treatments
- Plots are sampled once per year at the end of the growing season
- Individual plots are $\frac{1}{4}$ m²

Density and Basal Cover Protocol:

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, and lichen is LICH. Scat, including rabbit, pronghorn, and cow should be considered as part of the litter cover. Please double-check that your percent basal cover does not exceed 100%. Of course, you will need to take into consideration whether a species is at the low end or the high end of the cover class.

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.

Density of BOGR, BUDA, BARE, and LITT are not recorded (they are estimated in the basal cover reading.) Density of OPPO is counted as the number of live cladodes (pads). Density of bunchgrass species, such as SIHY, ARLO, SPCR, and STCO is the number of clumps, and for grasses such as AGSM, it's the number of tillers. Density of forbs and shrubs is the number of stems separately emerging from the surface of the ground:
REMEMBER look for CAHE.

QAQC Instructions:

CAN OTHER PEOPLE UNDERSTAND YOUR WRITING???

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 as the flags are inserted on master check-off sheet. 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 coordinates of 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 number and coordinates. 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 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? ARE ALL THE PLOT COORDINATES CORRECT? 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.

Data Sheet:

Exclosure Study

Date

Collected By:

Year	Site #	Treatment					Species or	Density	Basal Cov	Notes
		Prev	Now	X	Y	#	Type			

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

2008 Random Coordinates and Check-off Sheet (please use following pages):
Coordinates have been randomized for 2008

2008 Field Season - ROUN (Rodent Ungrazed Enclosure in 7C, 5A, and 5B) - Daubenmire Plots (If plot numbers contain a "C", leave flag in the field to clip later.)

Plot Number	x	y	Check-off	Check-Off
1C	25	9		
2C	11	10		
3C	12	16		
4C	18	27		
5C	2	9		
6C	16	18		
7C	27	21		
8C	4	26		
9C	2	17		
10C	12	6		
11	8	25		
12	7	12		
13	3	14		
14	7	2		
15	18	23		
16	22	15		
17	19	24		
18	15	27		
19	20	13		
20	18	14		
21	5	25		
22	28	20		
23	2	19		
24	3	21		
25	9	3		
26	24	22		
27	4	12		
28	28	21		
29	27	2		
30	5	28		
31	4	13		
32	12	8		
33	21	2		
34	10	8		
35	20	18		
36	25	2		
37	17	26		
38	2	1		
39	3	5		
40	12	15		
41	27	3		
42	21	18		
43	4	14		
44	15	10		
45	21	27		
EXTRA #	12	18		
EXTRA #	24	23		

GZTX Field Procedures for digital photography:

Stand directly over the plot to gain a bird's eye view of the plot. Be sure that the wood frame is delimiting the plot as accurately as possible. Run your finger along the edge of the frame and pull vegetation in that is rooted within the frame and out that is rooted outside of the frame. A photo may need to be taken of the vegetation underneath a cage. In this case, remove the stakes around the cage and place the middle frame under the cage in the center of the plot. Lift and rotate the cage one meter to the east and south and re-stake the cage. 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. Place a pin flag with the plot and transect number or coordinates in the middle of the metal frame after you capture the image. This marks the center of the plot that was beneath a cage. It is very important to keep this record in case we need to go back and verify a digital image.

GZTX Archiving Images:

The images will be stored on the extra memory cards. 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.

GZTX Clipping Protocol:

The NPP plots are located under the cages in the grazed treatments. The cages are moved, secured, and labeled earlier in the field season. In 24 and 11 there are four cages in each grazed treatment. In 19 there are 4 cages in the UG treatment and 4 NPP plots sampled in the ungrazed exclosures. *In 19 GG 10 cages will be installed to harvest 10 NPP samples, however only 4 UTIL samples need to be harvested.* In 7C, 5A, and 5B, there are ten cages in each grazed treatment. 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 coordinates for the UTIL plots on the sample bags. Make notes any time you sample the UTIL plot in another direction or distance from the NPP plot due to a disturbance, etc. In the ungrazed treatments, only NPP samples are collected. The NPP samples may come from the first 4 or 10 plots that were sampled in 24, 19, and 11 or 7C, 5A, and 5B, respectively during the cover and density study. Flags for these plots should have been left in the ground after sampling for cover and density. Upon collection of the NPP samples, remove the flags so not to leave equipment behind in the field.

Clip around the cactus, as not to disturb the future growth of the calodes. ***In the GG treatment of section 7 and 19 NPP standing-old dead should be collected FIRST from the NPP plots for the ARS.*** This means that all old-standing-dead are put in one bag for each plot first. 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. 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 needs to be harvested from the plot by species. Old-dead is not included in the sample (the gray colored material). 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 before moving to the next one. **Do not collect pach (lichen) or clip cactus for this sampling.**

Plots are clipped by species. It is usually easier to first clip species other than BOGR and BUDA. There are only some times when combining of species may be done. You must follow these rules when combining species.

- 1) The only time combining is allowed is when two species are each less than a gram (this may be a seedling, a few leaves, or one very small stem or leaf of an individual).
- 2) Some species are never combined even if there is only a very small quantity – these are BOGR, BUDA, SPCO, and CAHE.
- 3) When combining never combine forbs with shrubs, grasses with forbs, etc. Only combine grasses with grasses, forbs with forbs, and shrubs with shrubs. Envelopes that contain combined species should have codes for all species on the envelope.

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 “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 (day, month, year)	01 08 00
Site	19
Treatment	GZGZ
Sample Type	NPP (or Util)
Plot number	P – 1
X, Y coordinates	(24, 48)
Species 4 letter code from <i>List of Herbarium Plants, Central Plains Experimental Range, Collections Primarily of C.H. Wasser, M. Schoop and A. Engel</i>	CAHE

QAQC Instructions:

IMPORTANT— When starting a site-treatment, 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 coordinates 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 COORDINATES CORRECT? At this time, the master-check-sheet should have two check-marks beside each plot coordinate 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.

2008 Random Coordinates and Check-off Sheet (please use following pages):

2008 Field Season Clipped NPP and Util plots- (Check off sheets for 24, 19, 11) - Ask Mark how to move the cages after sampling

24 U/G	X	Y	Util (4m to E)		24 G/G	X	Y	Util (4m to E)	
1C	39	32			1C	27	38		
2C	53	10			2C	9	37		
3C	50	13			3C	10	52		
4C	74	40			4C	30	49		
24 U/U			No Util		24 G/U			No Util	
1	18	34			1	60	10		
2	25	24			2	90	80		
3	57	18			3	11	56		
4	44	4			4	57	95		

19 U/G	X	Y	Util (4m to E)		19 G/G	X	Y	Util (4m to E)	
1C	8	25			1C	42	25		
2C	7	30			2C	39	1		
3C	6	11			3C	5	26		
4C	6	38			4C	53	11		
					5C	22	51	n/a	n/a
					6C	43	17	n/a	n/a
					7C	2	24	n/a	n/a
					8C	24	2	n/a	n/a
					9C	40	13	n/a	n/a
					10C	6	35	n/a	n/a
19 U/U			No Util		19 G/U			No Util	
1	3	5			1	74	4		
2	23	9			2	45	17		
3	6	40			3	29	80		
4	3	44			4	25	25		

2008 Field Season Clipped NPP and Util plots- (Check off sheets for 24, 19, 11) - Ask Mark how to move the cages after sampling

11 U/G	X	Y	Util (4m to E)		11 G/G	X	Y	Util (4m to E)	
1C	4	27			1C	47	39		
2C	31	23			2C	2	7		
3C	49	25			3C	36	53		
4C	72	4			4C	2	50		
11 U/U			No Util		11 G/U			No Util	
1	42	22			1	55	84		
2	10	33			2	54	35		
3	48	32			3	92	61		
4	24	34			4	82	80		

2008 Field Season Clipped NPP and Util plots- (Check off sheets for 07, 5a, 5b) – Ask Mark how to move the cages when you are finished sampling

Exclosure 07 U/G	X	Y	Util (4m to E)		Exclosure 07 G/G	X	Y	Util (4m to E)	
1C	23	16			1C	18	30		
2C	5	29			2C	39	22		
3C	4	4			3C	27	39		
4C	25	39			4C	41	27		
5C	3	40			5C	39	9		
6C	43	4			6C	5	59		
7C	36	2			7C	16	45		
8C	22	18			8C	52	7		
9C	32	36			9C	44	30		
10C	18	27			10C	22	33		

07 U/U			No Util		7G/U			No Util	
1C	11	17			1C	52	67		
2C	39	38			2C	78	53		
3C	35	18			3C	35	75		
4C	16	34			4C	72	71		
5C	28	18			5C	35	47		
6C	25	40			6C	29	82		
7C	36	41			7C	44	66		
8C	45	21			8C	100	21		
9C	34	23			9C	44	30		
10C	45	14			10C	7	47		
07 roun			No Util						
1C	25	9							
2C	11	10							
3C	12	16							
4C	18	27							
5C	2	9							
6C	16	18							
7C	27	21							
8C	4	26							
9C	2	17							
10C	12	6							

Exclosure 5A U/G	X	Y	Util (4m to E)		Exclosure 5A G/G	X	Y	Util (4m to E)	
1C	39	3			1C	7	17		
2C	61	4			2C	14	41		
3C	63	6			3C	27	21		
4C	17	27			4C	45	46		
5C	16	5			5C	47	54		
6C	48	34			6C	7	10		
7C	56	15			7C	12	31		
8C	47	13			8C	58	15		
9C	23	9			9C	20	3		
10C	36	11			10C	34	21		
5A U/U			No Util		5A G/U			No Util	
1C	5	14			1C	19	10		
2C	56	4			2C	27	99		
3C	22	23			3C	91	56		
4C	46	24			4C	79	87		
5C	21	20			5C	82	90		
6C	44	3			6C	65	41		
7C	22	2			7C	83	37		
8C	17	13			8C	18	44		
9C	56	17			9C	60	18		
10C	3	29			10C	74	99		

5A roun			No Util						
1C	25	9							
2C	11	10							
3C	12	16							
4C	18	27							
5C	2	9							
6C	16	18							
7C	27	21							
8C	4	26							
9C	2	17							
10C	12	6							

Exclosure 5B U/G	X	Y	Util (4m to E)		Exclosure 5B G/G	X	Y	Util (4m to E)	
1C	57	35			1C	50	33		
2C	49	6			2C	33	17		
3C	79	41			3C	23	48		
4C	70	31			4C	18	58		
5C	20	43			5C	2	57		
6C	17	7			6C	21	37		
7C	4	19			7C	27	6		
8C	69	32			8C	19	46		
9C	57	2			9C	21	16		
10C	72	14			10C	19	21		

5B U/U			No Util		5B G/U			No Util	
1C	24	31			1C	37	76		
2C	45	12			2C	99	16		
3C	27	6			3C	77	33		
4C	2	18			4C	91	6		
5C	55	12			5C	15	66		
6C	5	39			6C	21	44		
7C	33	15			7C	97	88		
8C	45	30			8C	19	89		
9C	36	3			9C	56	39		
10C	16	1			10C	95	19		
5B roun			No Util						
1C	25	9							
2C	11	10							
3C	12	16							
4C	18	27							
5C	2	9							
6C	16	18							
7C	27	21							
8C	4	26							
9C	2	17							
10C	12	6							

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. 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.

ARS #32 Grazing and Soil Texture (GZTX) – Soil Coring**Principal Investigator(s):** Indy Burke**Study Objectives:** to evaluate the aggradation and degradation of ecosystem structure and function in response to long-term grazing by cattle.**Study Area Locations:**

There are 4 treatments sampled at 6 sites (24, 19, 11, 7C, 5A, and 5B) including grazed/grazed, grazed/ungrazed, ungrazed/grazed, and ungrazed/ungrazed. The codes are GG, GU, UG, and UU. It is important to code the treatments correctly – remember, “what used to be, then what is now.” Be sure you know what site and treatment you are working in –check your maps. **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 Soil Coring:

- 6 sites with 4 treatments at each site
- 10 (5 sets of between and under plants) cores in each treatment
- 2 segments for each core - Individual sample core size is 10 cm deep to be split into two equal parts, 6.65 cm diameter
- 240 cores, divided into 2 segments each = 480 samples

Equipment:

Short soil Corers (6.65cm diameter, marked at 5cm deep).

Pin flags (~60)

Clippers

Sledge Hammers

Cafeteria tray with measured tick marks for 0cm, 5cm, and 10 cm to cut the segments

Wide metal spackle knife for cutting coil segments

480 Medium Sized Paper Bags (pre-labeled) – these will be small samples, use small bags!

Shovel

Sample Label:**Date: DD-MM-YYYY****Site: 24, 19, 7, 5a, 5b or 11****GZTX TRT: GG, UG, UU, GU, RU****PLOT: P-1, P-2, P-3, P-4, P-5****PLOT COORDINATES: X, Y****PLOT LOCATION: U or B****DEPTH: 0-5 or 5-10****PLANT SPP CODE *(for samples taken from under plants only)****CORE DIAMETER (if different that 6.65 cm)**

Use the randomly generated coordinates for plots 1-5 in each treatment at each GZTX site. At each coordinate place two pin flags, one in an area of soil between plants and the other over vegetation. Remove any litter on the soil surface. (NOTE if it's between plants there really should not be a need to clip vegetation, but if it is impossible to avoid capturing some aboveground vegetation do clip it down to the crown level, but leave any roots in place.) For samples taken under plants, remove any litter on the soil surface and clip aboveground vegetation down to the crown level, but leave any roots in place. Note the species code of the plant on the bag, for which you sampled soil under.

Core the soil sample at least to 10 cm deep. Carefully slip sample out of corer and place on the cafeteria tray. Cleanly cut off any soil below or deeper than the 10 cm mark. Then, cut the core into a 0-5cm segment and a 5-10 cm segment. Please fill in the holes with soil. Bag and label these two samples separately! If the soils are very dry and tend to fall out of the corer, please make note of that on the sample bag. Place samples in garage drying oven at 55 degrees centigrade for 3 days. E-mail beckyr@warnercnr.colostate.edu when sampling is complete.

QAQC Instructions: Sample once in 2008 with all cores collected within one week. It is very important that you use the correct core with the correct diameter (6.65 cm) and split two segments out of each core at the correct depths (0-5 cm, 5-10cm). Coring depth is critical. Core diameter is less important as long as the core diameter is noted on each bag (if different that 6.65cm). Make sure that all samples have been taken before leaving the site. Be sure soil core samples are stored in the drying oven at 55 degrees C. Be careful to not tear sample bags on the drying oven shelves.

2008 GZTX SOIL CORE PLOTS

GZTX site: 5a

GZTX Treatment: G/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	17	22	B		
1	17	22	U		
2	20	9	B		
2	20	9	U		
3	25	27	B		
3	25	27	U		
4	6	28	B		
4	6	28	U		
5	8	22	B		
5	8	22	U		

GZTX site: 5a

GZTX Treatment: U/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	47	24	B		
1	47	24	U		
2	17	34	B		
2	17	34	U		
3	28	9	B		
3	28	9	U		
4	24	4	B		
4	24	4	U		
5	61	34	B		
5	61	34	U		

GZTX site: 5a

GZTX Treatment: G/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	53	17	B		
1	53	17	U		
2	70	42	B		
2	70	42	U		
3	24	33	B		
3	24	33	U		
4	36	3	B		
4	36	3	U		
5	38	90	B		
5	38	90	U		

2008 GZTX SOIL CORE PLOTS

GZTX site: 5a

GZTX Treatment: U/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	23	4	B		
1	23	4	U		
2	49	3	B		
2	49	3	U		
3	41	26	B		
3	41	26	U		
4	35	3	B		
4	35	3	U		
5	43	22	B		
5	43	22	U		

GZTX site: 5b

GZTX Treatment: G/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	2	46	B		
1	2	46	U		
2	10	4	B		
2	10	4	U		
3	53	17	B		
3	53	17	U		
4	59	13	B		
4	59	13	U		
5	6	50	B		
5	6	50	U		

GZTX site: 5b

GZTX Treatment: U/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	35	14	B		
1	35	14	U		
2	87	13	B		
2	87	13	U		
3	79	22	B		
3	79	22	U		
4	33	21	B		
4	33	21	U		
5	73	7	B		
5	73	7	U		

2008 GZTX SOIL CORE PLOTS

GZTX site: 5b

GZTX Treatment: G/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	41	97	B		
1	41	97	U		
2	75	91	B		
2	75	91	U		
3	17	81	B		
3	17	81	U		
4	10	18	B		
4	10	18	U		
5	38	80	B		
5	38	80	U		

GZTX site: 5b

GZTX Treatment: U/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	15	30	B		
1	15	30	U		
2	51	8	B		
2	51	8	U		
3	47	6	B		
3	47	6	U		
4	26	27	B		
4	26	27	U		
5	54	44	B		
5	54	44	U		

GZTX site: 7c

GZTX Treatment: G/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	54	32	B		
1	54	32	U		
2	20	6	B		
2	20	6	U		
3	30	50	B		
3	30	50	U		
4	53	54	B		
4	53	54	U		
5	56	5	B		
5	56	5	U		

2008 GZTX SOIL CORE PLOTS

GZTX site: 7c

GZTX Treatment: U/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	21	81	B		
1	21	81	U		
2	4	24	B		
2	4	24	U		
3	32	74	B		
3	32	74	U		
4	30	87	B		
4	30	87	U		
5	23	33	B		
5	23	33	U		

GZTX site: 7c

GZTX Treatment: G/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	8	71	B		
1	8	71	U		
2	56	19	B		
2	56	19	U		
3	71	19	B		
3	71	19	U		
4	93	11	B		
4	93	11	U		
5	68	99	B		
5	68	99	U		

GZTX site: 7c

GZTX Treatment: U/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	36	13	B		
1	36	13	U		
2	21	26	B		
2	21	26	U		
3	44	34	B		
3	44	34	U		
4	42	19	B		
4	42	19	U		
5	3	38	B		
5	3	38	U		

2008 GZTX SOIL CORE PLOTS

GZTX site: 11

GZTX Treatment: G/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	24	51	B		
1	24	51	U		
2	58	13	B		
2	58	13	U		
3	14	29	B		
3	14	29	U		
4	14	17	B		
4	14	17	U		
5	11	21	B		
5	11	21	U		

GZTX site: 11

GZTX Treatment: U/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	66	10	B		
1	66	10	U		
2	84	14	B		
2	84	14	U		
3	52	34	B		
3	52	34	U		
4	23	43	B		
4	23	43	U		
5	34	3	B		
5	34	3	U		

GZTX site: 11

GZTX Treatment: G/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	24	92	B		
1	24	92	U		
2	83	5	B		
2	83	5	U		
3	4	86	B		
3	4	86	U		
4	67	89	B		
4	67	89	U		
5	10	47	B		
5	10	47	U		

2008 GZTX SOIL CORE PLOTS

GZTX site: 11

GZTX Treatment: U/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	25	34	B		
1	25	34	U		
2	15	29	B		
2	15	29	U		
3	36	40	B		
3	36	40	U		
4	43	32	B		
4	43	32	U		
5	32	17	B		
5	32	17	U		

GZTX site: 19

GZTX Treatment: G/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	42	42	B		
1	42	42	U		
2	50	24	B		
2	50	24	U		
3	32	27	B		
3	32	27	U		
4	55	16	B		
4	55	16	U		
5	58	47	B		
5	58	47	U		

GZTX site: 19

GZTX Treatment: U/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	7	37	B		
1	7	37	U		
2	25	37	B		
2	25	37	U		
3	24	11	B		
3	24	11	U		
4	10	58	B		
4	10	58	U		
5	11	72	B		
5	11	72	U		

2008 GZTX SOIL CORE PLOTS

GZTX site: 19

GZTX Treatment: G/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	42	99	B		
1	42	99	U		
2	77	83	B		
2	77	83	U		
3	79	61	B		
3	79	61	U		
4	32	32	B		
4	32	32	U		
5	8	61	B		
5	8	61	U		

GZTX site: 19

GZTX Treatment: U/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	8	2	B		
1	8	2	U		
2	23	2	B		
2	23	2	U		
3	8	19	B		
3	8	19	U		
4	24	22	B		
4	24	22	U		
5	8	27	B		
5	8	27	U		

GZTX site: 24

GZTX Treatment: G/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	60	58	B		
1	60	58	U		
2	56	33	B		
2	56	33	U		
3	51	1	B		
3	51	1	U		
4	52	23	B		
4	52	23	U		
5	39	31	B		
5	39	31	U		

2008 GZTX SOIL CORE PLOTS

GZTX site: 24

GZTX Treatment: U/G

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	8	29	B		
1	8	29	U		
2	28	6	B		
2	28	6	U		
3	37	4	B		
3	37	4	U		
4	88	1	B		
4	88	1	U		
5	37	5	B		
5	37	5	U		

GZTX site: 24

GZTX Treatment: G/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	4	80	B		
1	4	80	U		
2	60	26	B		
2	60	26	U		
3	46	58	B		
3	46	58	U		
4	30	70	B		
4	30	70	U		
5	92	49	B		
5	92	49	U		

GZTX site: 24

GZTX Treatment: U/U

Plot #	X	Y	Between (B) or Under (U)	Check	Check
1	11	23	B		
1	11	23	U		
2	35	5	B		
2	35	5	U		
3	46	11	B		
3	46	11	U		
4	10	37	B		
4	10	37	U		
5	51	11	B		
5	51	11	U		

ARS #32 GZTX Bite Count**Principal Investigator(s):** Dan Milchunas**Study Objectives:** The objective of this study is to examine the density of bites in a grazed area and to determine whether some species of plants show evidence of grazing more so than others.**What to know before you start sampling:**

- ✓ *Have you visited each GZTX site and aware of the treatment areas*
- ✓ *You have been instructed in which treatment areas are sampled for the Bite Count: GZGZ, UNGZ, and UNUN*
- ✓ *You have been instructed on how to count a bite*
- ✓ *You have trained the crew on how to count a bite*

Study Area Locations: please see ARS #32 GZTX site and treatments maps**Experimental Design:**

- 6 sites
- 3 treatments at each site
- 5, 50 m transects in each treatment
- Sampled once a year, mid-season
- Individual sample is bites of individual species of plants along 50 m

Sampling Protocol:

In each of the three treatments (GZGZ, UNGZ, and UNUN), you will take data along 5, random 50 m transects. Work in teams of two, with one person recording and the other looking for bites. As you walk along the transect, hold a 10 cm long wire perpendicular to the tape. Look for bites in the area from the edge of the tape to the end of the wire. Take your fingers and pinch the area of the plant that shows evidence of being bitten by a large mammal. Each pinch should be considered a separate bite. Record the number of bites on each species of plant.

QAQC Instructions:

When starting a site-treatment, one person will be in charge of checking off each of the 5 transects sampled within each of the 3 treatment areas. Each team will call the treatment and transect number from where they have collected data to the person with the check-off sheet. The team member will make sure that all information is complete and correct on the data sheet. The person with the check-off sheet will double check that data have been collected from each and every transect in each treatment area.

All sheets will be given to the call-check person, who will be the last to leave the treatment area. 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 three separate packets of sheets (one for each of the 3 treatments sampled).

ARS #98 Scat Count**Principal Investigator:** Paul Stapp (pstapp@Exchange.FULLERTON.EDU)**Study Objectives:** to track temporal changes in the relative abundance of two mesocarnivore predators on the study area.***What to know before you start sampling:***

- ✓ You can identify scats from different species and ages
- ✓ You are familiar with different topography and habitat types across the CPER
- ✓ You are familiar with the codes recorded for each attribute on the data sheet

Study Area Locations and Design: see transect map across CPER for rabbit and scat counts. Please see directions for CPER Study Sites in Appendix.**Sampling Protocol:**

A minimum of two observers remove all scats from the 20-mile rabbit count route; these are recorded as the PRE-CENSUS count. Start at the cattle guard at the fence line road near the driveway to site manager's house in 21SE. The route is driven at approximately 3-4 mph (range 2-5 mph), with two observers on the front rack of the truck or sitting on the front rack. Approximately 14 days later, the route is driven again and the number of scats of each species is recorded and tallied (CENSUS). Mileage along the transect, type and age of the scat(s), the number of scats (if there are more than 1 at the same location, e.g. a latrine) and topography and habitat type are also recorded for each scat. Two or more scats found of different species or ages at the same location should be recorded on separate records on the data sheet. In addition, note when scats are observed near human structures (i.e. windmills, cattle guards, etc) using the codes provided. Scats can be collected for diet analysis if desired. The census is conducted in January, April, July, and October, and if possible near to the time of the rabbit survey.

QAQC Instructions:

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

Record starting and ending mileage immediately at each location. Record any changes in the weather or weather events over the past 24 hours. Also note if any of the roads have been re-graded during the past week. Make sure record and report scat tallies on the data sheet. Clip data sheets together for each sampling date and then clip the pre-census and census sheets together.

Data Sheet
SGS-LTER Long-Term Monitoring Project
Carnivore Scat Count

A minimum of two observers remove all scats from the 20-mile lagomorph count route; these are recorded as the PRE-CENSUS count. The route is driven at approximately 3-4 mph (range 2-5 mph), with two observers on the rack of the truck. Approximately 14 days later, the route is driven again and the number of scats of each species is tallied. Scats can be collected for later analysis if desired. The census is conducted in January, April, July, and October, and if possible near to the time of the rabbit surveys.

COUNT (circle): **PRE-CENSUS** **CENSUS**

DATE _____ **OBSERVERS** _____

COMMENTS _____

ENDING MILEAGE _____

TOTAL FR/VF: CALA _____ VUVE _____

TOTAL SCATS: CALA _____ VUVE _____

Mileage	Species	Age	No.	Topogr	Hab

Mileage	Species	Age	No.	Topogr	Hab

(21)

Species codes: CALA coyote
VUVE swift fox

(21)

Age: VO very old VF very fresh
OL old FR fresh

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

Habitat codes (separate by dashes if more than 1):
AC saltbush GR grassland
YU yucca MX mixed grassland (MXAC or MXYU)
HU human structures (<30 m): HUWI windmill,
HUBU bldg, HUCG cattle grid, HUNR not recorded

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 January, April, July, and October 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>)

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)

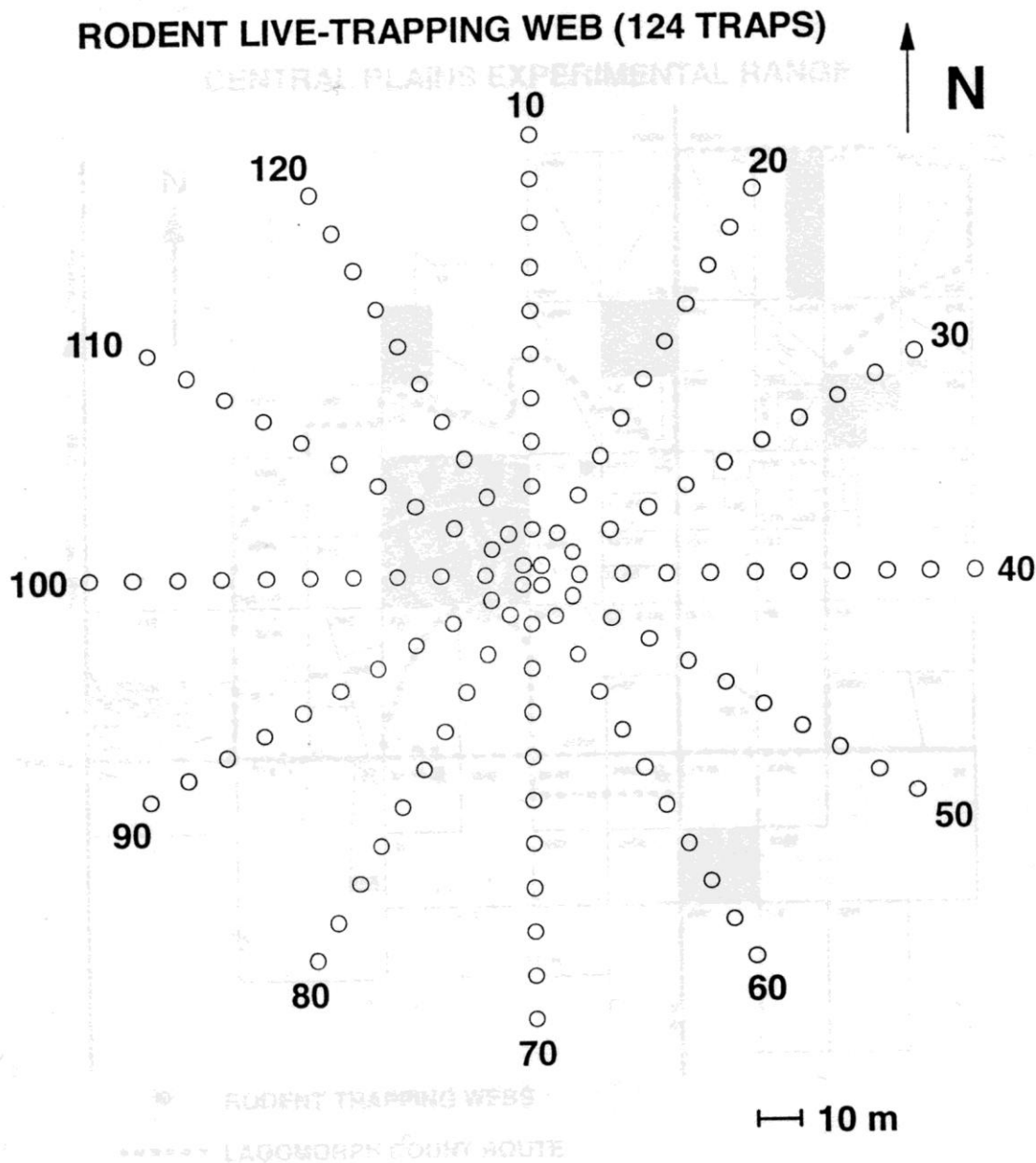
ARS #118 SPTR Trapping**Principal Investigator(s):** Paul Stapp

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 web 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 only***

Study Area Locations and Experimental Design: Small mammal trapping webs are located in quarter sections in three shrubland sites (13NW, 13SW, and 24NE) three upland grassland sites (25NE, 26NW, 27NE, and 31W). Each web must be recorded with the section number and quarter-section direction on the data sheet. ***Note that arthropods and vegetation are also sampled on the rodent live-trapping webs. Traps 121, 122, 123 and 124 are in the center of the web.***



Sampling

EQUIPME
butter/oats
each), (3)
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 web trapped for four consecutive days in late-May and in late-July. Three webs 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. A single trap is placed at every other station and two traps are placed in the center ring (62 traps per station). 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). 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 webs. After all webs 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) WEB #
 - 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 web 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 web and deliver them to the information manager.

ARS#118 Arthropods on the Small Mammal Trapping Webs**Principal Investigator(s):** Paul Stapp**Study Objectives:** Track changes in relative abundance and species diversity of arthropods on small mammal trapping webs to estimate changes in prey abundance**What to know before you start sampling**

- ✓ **You can identify arthropods to family and tenebrionidae to species**
- ✓ **You are familiar with the study site and grid layout**
- ✓ **You have field reference sheets for identification of common arthropods and lists species codes for recording data correctly (these should be in the filing cabinet or ask Mark)**

Study Area Locations: The arthropod trapping grids are on the southeast side of the small mammal trapping webs. The small mammal trapping webs are located in quarter sections in three shrubland sites (13NW, 13SW, and 24NE) three upland grassland sites (25NE, 26NW, 27NE, and 31E). Each web must be recorded with the section number and quarter-section direction on the data sheet. **Grasshoppers will be sampled on the Patch Burns 26, 25 and 31 in May, June, July, August, and September.**

Experimental Design:

- 6-7 sites (31E replaced 26NW in 2007)
- 4 transects at each site
- 5 plots (or hoops for grasshopper) at each transect
- Sampled once per month (April – September) during growing season
- Individual sample size is number of individuals of animals of a species in the trap (party cup size)

Sampling Protocol:**Timetable:** One trapping session in May, June, July, August, and September.**General Methods:** Live pitfall trapping of terrestrial arthropods**Equipment required:**

Pitfall traps (20), repair materials	PVC grasshopper sampling hoops
Clipboard and pencils	Long forceps
Film canisters (for unknowns)	Insect reference collection

SPECIFIC METHODS:

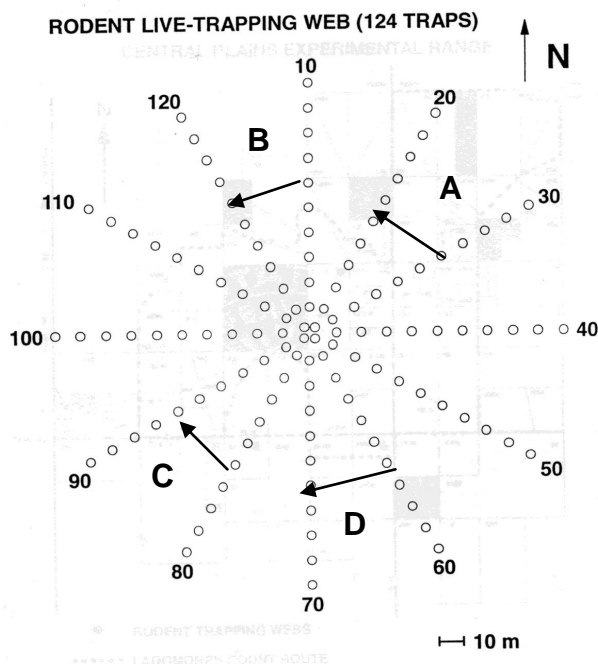
1. A small pitfall trap grid was established on all six (three shrub, grassland) small mammal live-trapping webs. Grids consist of 20 pitfalls (four columns A-D by five rows 1-5), with 10 m between traps. Grids are located 5 m south of web trapline 31-40. Trap A1 is south of trap 36, B1 south of 37, etc. Hoops will be placed in three transects with three hoops each spaced 20 m apart. Hoop transects are located 5 m to the east and west of the grid (parallel to columns at A1, 3, 5 and D1, 3, 5) and in the center of the grid (between B1-C1, B3-C3, and B5-C5).
2. Repair traps as necessary before beginning sampling and lay out grasshopper hoops. Traps will be left open for four consecutive days. Record the numbers of each group captured, using the most specific taxonomic grouping possible (Family or Genus-Species). All captured individuals will be marked and released. Bring any unknown specimens back to lab for identification.
3. Using a surveyors lath or net handle, flush and count the number of grasshoppers flushed from within each hoop. Record the number of grasshoppers in records A1, A3, A5, B1, B3, B5, C1, C3, and C5. If Zero grasshoppers are in the hoop be sure the record a 0. All cells that don't contain data in the hoop column of the datasheet should receive a dash line.

QAQC Instructions: Fill in all the information required on each and every data sheet and full web code, including pasture number and quarter-section direction. Don't forget to record the number of grasshoppers within each hoop. Please keep the traps and hoops in the field in good repair. Identify unknown arthropods upon returning to the station. Be sure to use the provided codes to records individuals of species. If you are recording an unknown be sure to write it down in the correct family or order column on the data sheet. Record the scientific and common names. Make sure that people can read your hand-writing and collate the data sheets by trapping date. Double check that all traps were checked, animals released, and traps closed before you leave the site.

SGS-LTER Monitoring Project Grasshopper Survey on Small Mammal Webs

Date Surveyed _____ Surveyed / Recorded by _____
 Ambient Temperature _____ Cloud Cover (0-100%) _____

Instructions: There are five hoops (1, 2, 3, 4, 5) along 4 transects (A, B, C, D) that run between the number 5 trapping stations on adjacent spokes on the web (please see diagram). Walk the transects from east to west trapping station, as shown by the arrows illustrating each transect. As you approach the hoops brush a meter stick over it. Count the number of grasshoppers that jump out and record that number in the correct cell of this data sheet. Be sure to record a zero if there are no grasshoppers in the hoop. Data for all six small mammal trapping webs should be recorded on one data sheet for one sampling date. Please combine the data back at the station if necessary. Remember to measure the ambient temperature and record the percent cloud cover as well. *Please use this datasheet at small mammal trapping webs: three shrubland sites (13NW, 13SW, and 24NE) three upland grassland sites (25NE, 26NW, 27NE, and 31E) and patch burns 26, 25 and 31.*



SITE	Hoop #	Transect B (5/115)	Transect A (25/15)	Transect D (55/65)	Transect C (75/85)
	1				
	2				
	3				
	4				
	5				

SITE	Hoop #	Transect B (5/115)	Transect A (25/15)	Transect D (55/65)	Transect C (75/85)
	1				
	2				
	3				
	4				
	5				

SITE	Hoop #	Transect B (5/115)	Transect A (25/15)	Transect D (55/65)	Transect C (75/85)
	1				
	2				
	3				
	4				
	5				

SITE	Hoop #	Transect B (5/115)	Transect A (25/15)	Transect D (55/65)	Transect C (75/85)
	1				
	2				
	3				
	4				
	5				

SITE	Hoop #	Transect B (5/115)	Transect A (25/15)	Transect D (55/65)	Transect C (75/85)
	1				
	2				
	3				
	4				
	5				

SITE	Hoop #	Transect B (5/115)	Transect A (25/15)	Transect D (55/65)	Transect C (75/85)
	1				
	2				
	3				
	4				
	5				

ARS#118 Vegetation on the Small Mammal Trapping Webs

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 web layout***

Study Area Locations: Each year the structure of the vegetation is measured on all 6 small mammal trapping webs. The small mammal trapping webs are located in quarter sections in three shrubland sites (13NW, 13SW, and 24NE) three upland grassland sites (25NE, 26NW, 27NE, 31E). Each web must be recorded with the section number and quarter-section direction on the data sheet.

Experimental Design:

- 6-7 sites (26NW replaced with 31E in 2007)
- 3 transects at each site
- 10 plots per transect
- Plots are sampled once per year, mid-season
- Individual plot size is .10m²

Sampling Protocol:

Items Needed:

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

Procedures:

1. Generate random #5 trap stations (5, 15, 25, 35, 45, 55.....) and random bearings, and then choose 3 of each.
2. Establish transects. Run the tapes in that random bearing direction fifty meters from the #5 trap station and then for fifty meters 180 degrees, in the opposite direction.
3. Sample at each 10m interval point along the transect tape. (Ten points per transect tape will be sampled. Thirty points per web.)
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 (CHVI, 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 m) of nearest gopher mound

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).

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 web 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 web. Be sure other people can read your handwriting. Please note it is important to measure the gopher mounds correctly.

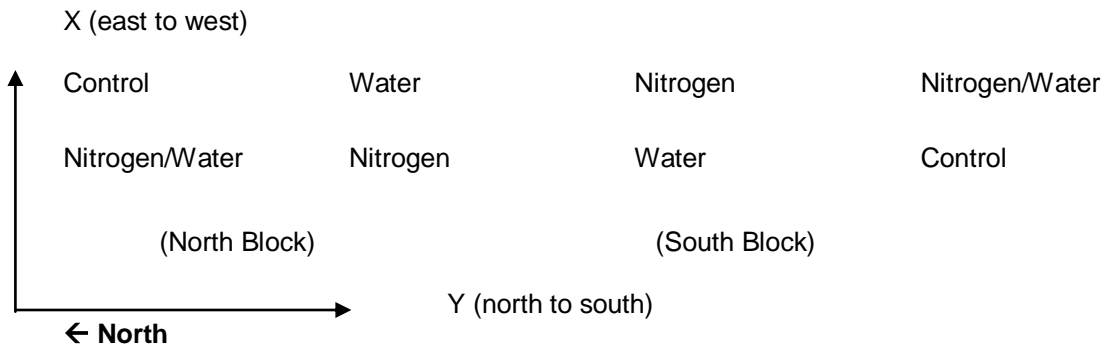
ARS #143 Cross Site Study**Principal Investigator(s):** Bill Lauenroth**Study Objectives:** To determine the important variables, which may control productivity, both in the SGS of the LTER and the taller prairie of Hayes, Kansas.**What to know before you start sampling**

- ✓ **Density and cover is collected in even years and aboveground biomass is harvest by clipping in odd years – know what kind of sampling you are performing this year?**
- ✓ **You are familiar with the experimental design and coordinate system**
- ✓ **You are familiar with the species codes**
- ✓ **You are familiar with Daubenmire's method for measuring density and basal cover of vegetation**
- ✓ **Do not sample anything from inside the heating cones!!!!!!!**
- ✓ **Be careful of wires and pipes running through the blocks.**

Study Area Locations: This experiment exists just east of the SGS-LTER headquarters building. This diagram is oriented as if you were looking at the blocks with your back towards the office buildings.

Experimental Design for Composition, Density and Cover:

- 2 blocks (north and south)
- 4 treatments in each block
- 50 plots per treatment
- Plots are sampled every other year, mid-season
- Individual plots are .10 m²



Density and Basal Cover Protocol: Fifty random coordinates (x, y) between 0 and 30 meters are provided on a check-off sheet (see following pages). Lay out the measuring tapes along the x and y axis and pace off to each random coordinate and place a flag there, with the coordinates written on it. Place pins flags for all fifty random quadrats. The same set of fifty coordinates may be used for all treatment areas.

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 must be rooted inside, regardless of the canopy cover.

Estimate the Basal vegetation cover using Daubenmire cover classes and count the number of individuals of each species are counted. 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, and lichen is LICH. Scat, including rabbit, pronghorn, and cow should be considered as part of the litter cover. Record the Daubenmire code for the appropriate cover class. Please double-check that your percent basal cover does not exceed 100%. Of course, you will need to take into consideration whether a species is at the low end or the high end of the cover class.

Density of BOGR, BUDA, BARE, and LITT are not recorded (they are estimated in the basal cover reading.) Density of OPPO is counted as the number of live cladodes (pads). Density of bunchgrass species, such as SIHY, ARLO, SPCR, and STCO is the number of clumps, and for grasses such as AGSM, it's the number of tillers. Density of forbs and shrubs is the number of stems separately emerging from the surface of the ground.

REMEMBER look for CAHE. We identify only one Astragalus/Oxytropus 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.

QAQC Instructions:

CAN OTHER PEOPLE UNDERSTAND YOUR WRITING???

IMPORTANT – Use the check-off sheets provided. When starting a treatment plot, one person will be in charge of checking off quadrants on master check-off sheet as the flags are inserted in the ground. As each team collects data from a quadrant they must pull the flag to be re-used in the next treatment plot. When data have been collected from all quadrants in a treatment plot, each team of data collectors will call the coordinates and numbers of the quadrants 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 number and coordinates. 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 data have been collected from each and every quadrant. 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?

Data Sheet:

Datasheet for Cross Site Density and Basal Cover

ARS # 143 Cross – Site Study

PI: Bill Lauenroth

Date: _____

Collected by: _____

Basal Cover Classes (by percentage of basal cover): **1** = 0-5; **2** = 6-15; **3** = 16-25; **4** = 26-40; **5** = 41-60; **6** > 60

Year	N or S Block	Treatment: C, W, N or N/W	X Y		Plot #	Density			Basal Cover		Notes:
						Species Code (Or bare, litt)	# of Ind.	Cover Class (1-6)			

2008 Random Density and Cover Coordinates and Check-off Sheet (please see the following page):

PLOT #	X	Y	Check	Check
1	6	11		
2	28	30		
3	25	28		
4	29	29		
5	25	25		
6	11	30		
7	8	8		
8	21	25		
9	22	26		
10	8	4		
11	20	24		
12	26	4		
13	1	20		
14	17	1		
15	26	18		
16	19	7		
17	14	12		
18	3	20		
19	15	15		
20	24	5		
21	28	4		
22	28	13		
23	2	9		
24	14	18		
25	13	22		
26	12	8		
27	9	5		
28	9	20		
29	21	13		
30	7	13		
31	4	16		
32	27	12		
33	3	7		
34	3	10		
35	15	21		
36	7	28		
37	5	15		
38	7	19		
39	19	10		
40	21	5		
41	2	21		
42	27	11		
43	12	29		
44	26	20		
45	2	12		
46	15	5		
47	27	27		
48	28	20		
49	4	2		
50	24	21		
51 EXTRA	6	1		

ARS #155 BOGR Removal Experiment (revised 4/12/07)

Principal Investigator(s): Bill Lauenroth

Study Objectives: to characterize important species in the Shortgrass Steppe plant community.

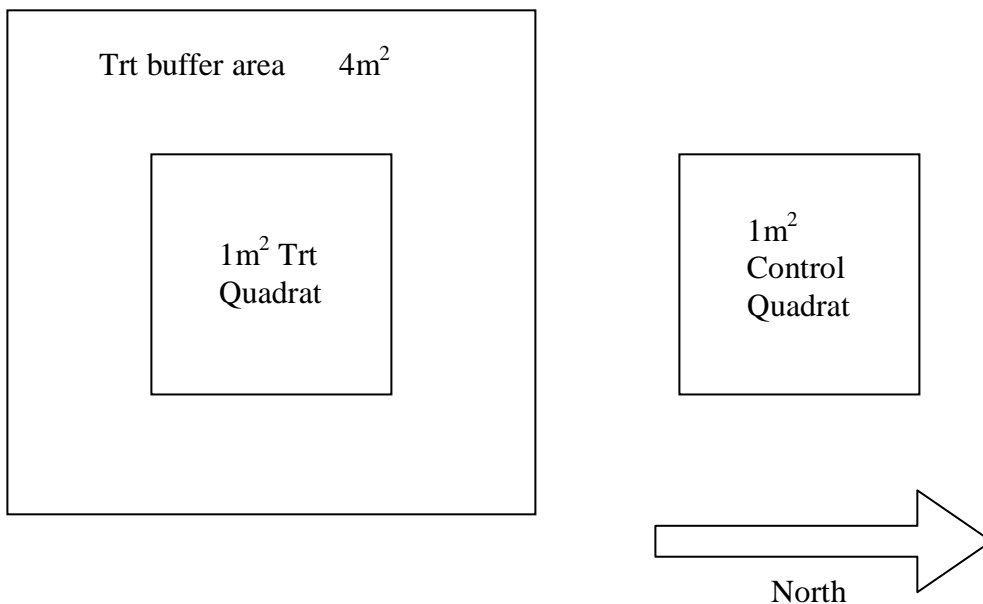
What to know before you start sampling

- ✓ **You are familiar with the study sites and treatment plots**
- ✓ **You are familiar with the density and point-frame methods**
- ✓ **You are familiar with the species codes**

Study Area Location and Design: 6 Grazing (Grazing and Texture, GZTX) Enclosures Sites (5a, 5b, 7, 11, 19, 24): 2 sets of treatment/control plots inside the Grazed/Ungrazed enclosure and 2 sets of treatment/control plots outside the GU enclosure. There are 8 quadrats at each GZTX site. **Control plots are not marked well (only 4 red nails, one at each corner of the plot), are located 3 meters to the north of each BOGR removal plot and should have no obvious disturbances.** BOGR removal treatment plots were disturbed in 1997 and have 4 orange nails, one at each corner of the plot. Each season the orange nails in the corners of the treatment quadrats and the red nails in the corners of the control quadrats need to be checked and replaced if missing. **Note that the nails in the treatment quadrats mark the corners of a buffer area around the actual 1m² sampling area.** (See GZTX maps provided under ARS #32.)

Experimental Design:

- 6 sites
- 2 grazing treatments per site
- 2 disturbance sub-treatments per grazing treatment
- 2 plots per sub treatment
- Plots sampled once per year, mid-season
- Individual plots are 1 m²



Density and Cover Sampling Protocols

Equipment: BOGR REMOVAL EXPERIMENT DATA SHEET; meter squared wood or metal quadrat; Point frame apparatus; plant press for unknowns.

Methods: First, measure plant species density in the 1 m² quadrats by counting the number of individuals of each species. Sod-forming grasses such as Bogr and Buda (most likely in the control plots) should be counted as individuals when there is no connection by rhizomes or stolons present. Use your fingers to run along the base of these plants to help identify true individuals. Also, keep track of what you have and have not counted. The large frame may be divided by string in order to make it more manageable. Density of OPPO is counted as the number of live cladodes (pads). Density of bunch-grass species such as SIHY, ARLO, and SPCR is the number of clumps, and for grasses such as FEOC, AGSM it's the number of tillers. Density for forbs and shrubs is the number of stems separately emerging from the surface of the ground.

Second, the Point Frame Intercept technique is repeated in four locations in each 1 m² quadrat halfway along the diagonal. This will provide a total of 40 points of contact for each quadrat. The categories to record are plant species code including BOGR and BUDA, litter (code = litt), bare ground (code = bare), and lichen (code = pach). Be very critical about what the contact really is. If the tip intercepts dead crown, record it as litter. If the tip intercepts live crown of a plant, record the species code. The accuracy of the method is determined by how carefully contacts are identified. Record only what the exact tip of the point touches at the soil surface. Ignore hits on leaves as point move through the frame to touch what occurs at the basal level. Repeat density and point frame sampling for each control and treatment plot, inside and outside the GU enclosure.

Other details: Unknowns should be labeled as forb, grass or shrub with the codes UNFB, UNGR, or UNSH.

Field Procedures for digital photography:

Equipment: Digital camera, white or metal 1m² frame, digital camera log book, SGS-LTER flash card for that year's data.

Method: Place the 1m² frame over the quadrat. Stand directly over the plot to gain a bird's eye view of the plot. Run your finger along the edge of the 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 and that is not a shadow cast over the quadrat. Keep track of the image # and plot label in the digital camera on the data sheet on which you have recorded the vegetation data from that quadrat. It is very important to keep this record it is the only way to identify this image as this quadrat!!!!

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. 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.

QAQC Instructions:

There are a few sampling procedures that must be followed in order to assure consistency through years, and to make certain that all quadrats have been sampled. These are permanent quadrats. It does matter how they are coded on the data sheet (i.e. east or west, treatment or control, inside or outside) and **must** be labeled the same each year. When all four quadrats on either side of the fence are sampled you need to review the datasheet to ensure that they were coded correctly and the image number was recorded from the digital camera. Check to see that you have an east and west treatment and control from that side of fence on which you are working and all 40 hit records have been filled in clearly. CAN OTHER PEOPLE UNDERSTAND YOUR WRITING??? Then you may move onto the next quadrats for sampling.

Data Sheet: Please see the following page

BOGR REMOVAL EXPERIMENT DATA SHEET-ARS#155 – Bill Lauenroth

Date _____ Section: _____ Recorder(s): _____ Dig Image #: _____
 Circle One: Treatment/Control, Inside/Outside GU Exclosure, East/West Plot Location
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		
		36		
		37		
		38		
		39		
		40		

ARS# 156 RAINOUT SHELTER**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**

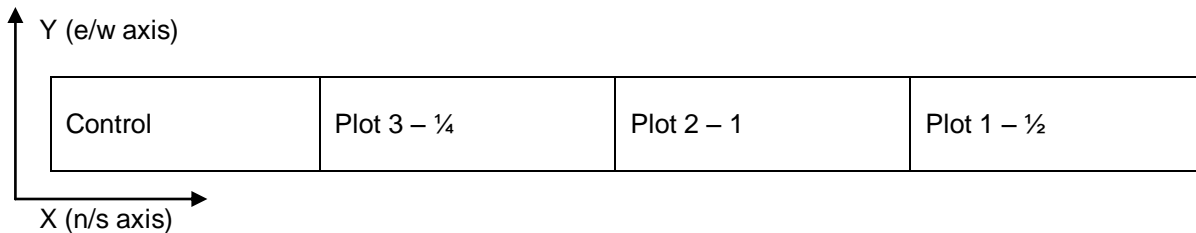
- **Are you familiar with study location and control and treatment plots**
- **Have you been instructed on how to collect, manage and apply data from the tipping rain bucket data logger? Have you checked that the PPT data compares to the rain stick data collected by Mark at the Standard Meteorological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

Full**1/4****1/2****SW-rain out**

	Full	1/2

Maintenance:**1/4**1-Data from tipping bucket

- Remove any debris from screen, Take off collection funnel. Data logger is attached by a clip inside. Take it out, ensuring that the black tipping mechanism is not disturbed
- Open data logger and attach patch cord from data logger to shuttle. Make sure connection is good.
- Press black button on Hobo shuttle. "Off loading" light blinks, then "testing". Press button again- "successful" lights up. Press button once more to turn off.
- Check red light is blinking on data logger- means battery is good.
- Put data logger back on clip. Put back collection funnel securely.

2-Downloading data

- Use computer facing Conference room
- Plug shuttle into patch cord from computer (shuttle should be off)
- Open box car pro

Logger->HOBO shuttle readout ("connecting")

If no reported data, click yes to save as

Ro (rainout), month, day, year

E.g. Ro 041701

Save in U:\LTER~1\2006

Then open file (the one you just saved)

->View file information

V. IMP- MAKE A NOTE OF **MAX VALUE**

Goto- File->print-> X file info

X graph

X logger data (check all three)

Staple sheets together on right hand corner – put in filing cabinet under Rainout file – back of first drawer

Open rainout form (shortcut on desktop)

You have to:-

- 1) Change date (bold type)
- 2) Put your max value into “number “1/100” box
- 3) Number will come up under “precip in mm” on right
- 4) Copy this + “Paste Special” into the other “precip in mm” cell in bold on the left. Check “value” box
- 5) Amount of water is calculated for each plot

Print sheet – this is used to apply water in the field, shows how much water to put in each treatment – “full”, “1/2” + “1/4”

Open RAINOUTLOG (shortcut on desktop)

Fill in column “precip in mm”+ Date (week measured)

Water added automatically adjusts

Make sure to input values in NORTH 08 + SOUTH 08 worksheets

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: 1 = <5%; 2 = 5-14%; 3 = 15-24%; 4 = 25-39%, 5 = 40-59%, 6 = 60-100%. Record the Daubenmire cover class (1, 2, 3, 4, 5, or 6) number on the data sheet.

2008 Rainout Random Coordinates for Use in Each Density and Basal Cover Plot

Quadrant	X	Y
1	.5	1.4
2	1.0	3.3
3	.3	2.9
4	.1	1.0
5	1.3	.4

Data Sheet:

Rain Out Shelter Data Sheet: Density and Basal Cover

U:SGS-LTER Field Station/Field Studies/CrossSite/CrossSite-datasht

Date:

Recorder(s):

Shelter (ne or sw): _____

***Daubenmire Cover Classes: 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

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 and density 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, and density***

Study Area Locations: There are 3 randomly located macroplots (circular with 30 m diameter) in 2 spring grazed quarter sections in pastures 21N and 1W. A lowland, upland and upland w/supplemental feeding area each contain 1 of the 3 macroplots. There are 2 macroplots located in summer grazed pastures in 15 SW and 7 NW. An upland and lowland area contain 1 of the 2 macroplots.

Each macroplot contains 48 plots where 3 different vegetation measurements are collected (basal cover, canopy cover and density). Three plots are located along the radius at every 20 degrees around the circle. The pasture, macroplot (1-3 in 21N and 1W; 1-2 in 15SW and 7NW), degree within the circumference around the circle and plot number (1-48) are recorded on the data sheet. 48 plots are sampled on each of the 10 macroplots.

Experimental Design:

- 25 sites
- 48 plots at each site
- Plots are sampled once per year, mid to late season
- Individual plots are .10 m²

Sampling Protocol:

Items Needed:

Pin Flags (60-80)

Compass and metric tape

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.

Cover Classes: 1=0-5, 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 Orobanche 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: 1=0-5, 2=6-15, 3=16-25, 4=26-40

5=41-60, 6=>60

Density of BARE, LITT, and DUNG are not recorded (they are estimated in the basal cover reading.) Density of OPPO is counted as the number of live cladodes (pads). Density of bunchgrass species, such as BOGR, BUDA, SIHY, ARLO, SPCR, and STCO is the number of clumps, and for grasses such as AGSM, it's the number of tillers. Density of forbs and shrubs is the number of stems separately emerging from the surface of the ground:
REMEMBER, look for CAHE.

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.

ARS #200 Bird Nest Surveys for Plover Study (Revised 4/12/07)**Principal Investigator:** Paul Stapp**Study Objectives:** Estimate density of bird nests (esp. passerines) on plover-grazing pastures and controls during the spring breeding season.**What to know before you start sampling**

- ✓ **You have been trained on sampling technique and trained the crew**
- ✓ **You can identify bird species likely to nest in shortgrass steppe**

Study Area Locations: There are 3 randomly located macroplots (circular with 30 m diameter) where we supply supplemental feed to cattle and create intensely grazed areas and heterogeneity within the larger pasture. Nests are surveyed in a total of 25 sites. 20 are located in pastures on the CPER and 5 in experimental enclosures.

Site codes and treatments are as follows:

1WA	7LTX	15SWB
1WB	10LTX	15SWA
1WIN	35PD	10SE
21WIN	29PD	15NE
21WB	5PD	25NW
21WA	22PD	7SW
22LTX	27PD	24SW
23LTX	7NWA	
15LTX	7NWB	

Sampling Protocol:

FREQUENCY: Every other week in April-May-June-July (or until nestlings have fledged the nest)

NUMBER OF TRANSECTS: Four random 30 x 400 m transects per pasture. For enclosures survey the entire area.

EQUIPMENT NEEDED:

- Compass
- 30-m rope (sturdy)
- Datasheet, clipboard and pencils
- Work gloves
- 2 Harnesses per pair
- GPS (used for measuring distance)
- Binoculars
- Bird nest and egg I.D. book
- Plot map

METHODS:

1. Randomly locate a starting point for the first transect at some point within the pasture where observers will walk 400 m in a randomly chosen direction, within the correct grazing treatment.
2. Write the type of vegetation cover type that the transect covers.

GR	grassland	YU	yucca
AC	saltbush	MX	mixed grassland/shrubland (AC or YU)
3. Stretch 30-m rope between two observers and hitch it onto harnesses.
4. From your random starting point, pace off 400 m with a GPS in a random direction. To stay on line, choose an object in the distance or on the horizon that is on the correct bearing.
5. Observers should walk a brisk and steady pace in the random direction gently bouncing the rope between the ground and their waist. Be careful to lift the rope over shrubs to avoid tangling.
6. Closely monitor the area under the rope for flushing birds. If a bird flushes, identify it, determine the location it flushed from and record all necessary data.

7. Look for nests or fledglings. Record the following for each nest:
- bearing
 - number of birds seen around the nest
 - species of bird (from adult that was flushed) – use standard codes (e.g., HOLA = Horned Lark)
 - type of nest (ground or shrub; scrape, grass or stick nest)
 - number of eggs
 - color/description of eggs
 - number of nestlings or fledglings
 - vegetation at nest: grass clump (record spp.), shrub clump (record spp.),
cattle pat, bare ground, prickly-pear

If you flush a single nestling outside of a nest, just record the species and note in Comments. Minimize disturbance to nests and work as quickly as possible to reduce mortality to young.

8. Continue along transect for 400 m, recording all flushes, nests and fledglings detected.

9. When the end of the first transect is reached, rotate 90° and begin the second 400 m transect from there. Note, upon finishing each plot, observers should have two “L”-like designs of four 400 m transects. Keep in mind the restriction that the four transects, when they are all laid out, should/will remain in the treatment pasture and that they do not overlap. Note in pasture 7, transect lines may overlap because the area is slightly smaller. Do not sample in persistent rain or high winds.

For enclosure plots, survey the entire area inside the enclosure and record the size (in sq. meters) of the enclosure.

QAQC Instructions:

10. HELPFUL HINTS:

- a) Make sure data from both transects are on ONE datasheet (this will make organizing and data entry significantly simpler).
- b) Make sure the headings on each datasheet are **filled in correctly and are consistent from session to session.**
- c) Birds sitting on nests typically will not flush until they are closely disturbed by observers (as they do not want to endanger their eggs or fledglings). Meanwhile, birds that are just feeding tend to flush further in the distance.

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***
- ✓ ***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:

5. Pin Flags (60-80)
6. Meter Sticks
7. Daubenmire Rectangles
8. Meter Tapes (2x60 meters)

Procedures:

1. Start with 3 random bearing within the trapping grid
2. Lay out 3 transects 100 m long and sampled every 10 m for each pasture.
3. Place flag at right or left of the transect tape at each sampling point.
4. 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.)
5. 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).
6. **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

QAQC Instructions: Use a check-off sheet.

Data sheet and check-off sheet on the following pages –

ARS #210 Trace Gas Sampling on the CPER

Joe von Fischer, CSU Biology Dept. & NREL
office: 491-2679, cell: 310-6840
jcvf@lamar.colostate.edu
Anita Kear (lab manager) 491-2287, cell 970.690.0810

Methods v1.5, April 2008

Materials list

Chamber rings	Channel lock pliers
Chamber tops	Filled 60ml serum vials (SF6)
Chamber pounding device	Battery Holders & extra batteries
30 ml & 60 ml syringes	Plastic bags for soil samples
22g Needles	5 gallon bucket
Sharps collection bottle	Shovel
Evacuated Vials	Gloves & Sunscreen
Digital Soil thermometer	Field notebook & pens
TDR Soil moisture sensor	Gas standards (2)
Ruler	Watch
Rubber mallet (TDR probe)	Datasheets/pens

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.

If you have any questions about the method, please don't hesitate to ask. Joe or Anita will be happy to help.

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.

Detailed methods**1) Chamber installation**

Select the location where each ring will be installed by choosing a location that is representative of average conditions in the vicinity. Avoid putting the chamber over cacti or ground that is obviously disturbed (e.g., unusual bare or adjacent to obvious animal activity). Chambers should sample ground that has a mix of grass cover and some bare ground as is typical.

PVC anchors (rings) are installed directly into field sites by using a heavy metal tamper, or a heavy piece of wood and hammer to pound the anchor level up to the inside lip (accounting also for any tall plants/cactus that may interfere with the chamber fitting on top). Measurements of the chamber height are made in three different places around the ring to account for total chamber volume.

2) Taking gas samples

1. Remove SF6 from vial. To remove the SF6 from the vials, insert the needle on a 60mL syringe into the vial and pull to 30 mL. Flush this back into the vial and pull sample. Draw the syringe plunger all the way out and close the valve. Remove the needle from the vial and then from the syringe. Open the valve and push the syringe to 15 mL.
2. Dilute the SF6. Take the 15 mL of SF6 in the syringe and pull field air into the syringe until it reaches 60 mL.
3. Install chamber tops. Attach battery pack (eight 1.5V batteries) to Chamber tops and make sure fans are running. Air- out chambers with field air (by holding up to field air or putting on their side) and place on top of anchor with the rubber seal pulled over the chamber/anchor connection. **Detach battery before placing chamber top onto the PVC soil anchor.**
4. Inject the 60 mL from the syringe into the chamber. Inject the diluted SF6 into the chamber and, using the same 60 mL syringe, mix the gas in the chamber by pulling syringe up to 60 mL and flushing back into chamber 3 times. **Pulse the fan prior to sampling about 3 seconds.**
5. Sample headspace. Take the first (T0) flux sample 30 seconds after injecting the SF6 (note time on datasheet) with the following method: place the sampling syringe on the chamber and draw up 15 mL of headspace gas, and flush it back into chamber. Then, draw up a 30 mL sample, close stopcocks on syringe and chamber top and inject it into the appropriated vial. Note the time and vial number! A well evacuated vial should draw in the gas from the needle (make a note about unusual vacuum and repeat the sampling if the vial is poorly evacuated). Push the syringe plunger all the way down and close the syringe valve. Pull the syringe off the vial by pulling the needle base out of the vial; if you pull by the syringe the needle will sometimes stay stuck in the vial and you will lose the sample. If any errors occur, repeat the sampling and note the new time. There should be plenty of spare vials. **Pulse the fan prior to sampling about 3 seconds.**
6. Sample timing: Gas flux samples will be collected at time 0, 5, 10 and 15 minutes. The placing of the chamber on the anchor & injection of the SF6 should start about 1 minute before the time T0 sampling for each chamber.

Pull the chamber off the ring and remove the ring after sampling.

Things to watch out for:

1. Make sure the stopcocks on the sampling syringes are screwed on tight.
2. Don't pull the syringes off chambers before closing both syringe and chamber stopcocks.
3. Protect the vials from UV light/direct sunlight (stoppers produce methane in UV)
4. Avoid bumping the chamber or the ground near the chamber.
5. Needles! Please don't share needles. Don't use the needles in the vials more than 2-3 times because it becomes difficult to pierce the septum. Make sure you pick up all needles from the site before leaving and take time to search for any stragglers. Use an empty pop bottle to contain all sharps and return the sharps container with the sample vials.
6. Be sure to pound the anchors down to the inside lip-SF6 diffuses laterally, so the depth of the anchor is important for good results.
7. If in doubt, repeat the sample. It just takes a minute and the extra effort can make a big difference for the quality of the data that you generate.

4) Ancillary measures

At each chamber, measure the soil **temperature** by pushing the probe in the full 10cm into the soil. Soil temperatures are taken in each sampling anchor, after conducting the gas flux measurements. Wait for the temperature to equilibrate (about 1 minute) and note the reading. Repeat any unusual measures or soil conditions.

Record the **height** of each chamber (with the lid on) by using a ruler at three points around the circumference of the chamber.

Determine the **soil moisture** using the Hydrosense handheld soil moisture probe. Insert the paired rods into each sampling anchor, after conducting gas flux measurements. If you hit a rock, remove the sensor and move to a new location. **Note: if soils are exceptionally hard, please don't force the rods into the soil.** Allow the reading to

equilibrate and note the value. Collect two readings, or more if the area shows unusually high variability. Poor contact between the rods and the soils allows air to enter and drives the probe to read unusually dry conditions.

Record the amount (%) of plant cover per chamber-see datasheets.

Take 3 soil samples (0-12cm) with soil auger inside the sampling anchors after conducting gas flux measurements and TDR readings (pick a wet, dry & average reading). Label and store each sample in a sealed Ziploc bag. Back fill holes with sand collected from site roadside.

5) Field standards

Sometimes, the concentration of gas that we measure from the vials is not the same as the air we put into it in the first place. To account for any differences, we load standards of known concentration into vials while in the field; one standard has low concentrations of gases and the other is high. Hold the gas standard can between your legs and quickly crack the valve to purge the tubing of any atmosphere. Then rinse the syringe 3x with about 5-10 ml of gas. Fill the syringe with gas. If the volume exceeds 25 ml, put the needle on and push the plunger down to 25ml. Put this 25ml of gas into the vial, and note the vial number on the data sheet. ***Make sure that the gas canisters are tightly closed when they are not in use.***

Changes made since last edition to methods:

1. Fans are kept on only in short term (about 3-5 second pulses) prior to injecting the tracer gas and before taking each sample. Lab studies have shown that fans continuously running actually promote diffusion in dry soils, so we just want to mix the headspace before sampling to collect an accurate measurement, via pulsing the fans.

Helpful Hints:

- After injecting the sample into the vials -pull the needle out by the base, versus pulling out using the syringe. This insures the sample doesn't de-gass (via needle stuck into septi sans syringe).
- Fit needles snugly and carefully back into the sleeves-this is the most common way to get pricked!
- Hold the TDR rods straight with hands prior to pounding into the soil; otherwise they tend to bend easily. Also do not twist probe connect-it will break the connection/instrument probe.
- Don't use the same needle to draw the SF6 tracer from the 60ml vial, to inject samples into the small vials.

Data Sheet:

Joe vonFischer Lab
LTER Gas Flux Data

Measure: Gas Flux Rate (see methodology), Soil Moisture, Soil Temperature, Amount of plant cover/pot, Time of sampling and Soil Samples

Date: _____ Site Name: _____ Bag # _____ Field Crew Members: _____

Chamber		Start Time:				Stop Time:			
		Time 0	Time 1	Time2	Time 3	Temp C	Chamber Height, cm		
							Hi1	Hi2	Hi3
1	Time	1:00	6:00	11:00	16:00				
	Vial #								
2	Time	3:00	8:00	13:00	18:00				
	Vial #								
3	Time	5:00	10:00	15:00	20:00				
	Vial #								
4	Time	1:00	6:00	11:00	16:00				
	Vial #								
5	Time	3:00	8:00	13:00	18:00				
	Vial #								
6	Time	5:00	10:00	15:00	20:00				
	Vial #								

Soil moisture using TDR probe: probe cm _____

Chamber	TDR- 1	TDR-2
1		
2		
3		
4		
5		
6		

Plant Cover %

Chamber	Bare soil	Grasses	Lichen	Other
1				
2				
3				
4				
5				
6				

Vial #'s for gas stds:

Hi std
1
2
3

Lo std
1
2
3

Notes:

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) will be burned in 2006, then SW quarter in 2007, NW quarter in 2008, NE quarter in 2009, then through the sequence again). Circular plots (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 circular plots total).

Density and Basal Cover Protocol:

Cover will be sampled in late June. Three, 0.1 m² daubenmire quadrats will be sampled on each of 18 systematically located 15-m transects that radiate out from the center of each circular plots (total of 54 quadrats per circular 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.**

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: 1=0-5, 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 Orobanche 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: 1=0-5, 2=6-15, 3=16-25, 4=26-40
5=41-60, 6=>60

Density of BARE, LITT, and DUNG are not recorded (they are estimated in the basal cover reading.) Density of OPPO is counted as the number of live cladodes (pads). Density of bunchgrass species, such as BOGR, BUDA, SIHY, ARLO, SPCR, and STCO is the number of clumps, and for grasses such as AGSM, it's the number of tillers. Density of forbs and shrubs is the number of stems separately emerging from the surface of the ground: REMEMBER, look for CAHE.

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 circular plot sampled. Be sure to record the pasture quarter section as well as the direction of the corner of the quarter section which contains that burned circular plot you are sampling (example: in 2006 the “pasture” would be recorded as 26NW and the “quarter burned” would be recorded as SE).

Data Sheet:

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 circular plots in each pasture (total of 12 circular plots) with 10 temporary enclosure cages around each of the circular plots. Biomass is clipped in early August by species from 10, ¼ m² quadrats from each burned circular plots (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 species. It is usually easier to first clip species other than BOGR-BUDA. There are three cactus species on the site. Only current year growth of OPPO is clipped - these are the small pads. The two 'barrel' cactus are not clipped. There are only some times when combining of species may be done, but it is important that the following 'combining-rules' be followed:

- 1) The only time combining is allowed is when two species are each less than a gram (this is a few leaves, or one very small stem of an individual).
- 2) Some species are never combined even if there is only a very small quantity - these are BOGR, BUDA, SPCO, and CAHE.
- 3) When combining, never combine forbs with shrubs, grasses with forbs, etc. Only combine grasses with grasses, forbs with forbs, shrubs with shrubs. Envelopes with combined species should have codes for all species on the envelope.

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 BOGR 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???

Example Label:

STUDY	PATCH FIRE
DATE (month, day, yr)	08 01 93
PASTURE	26NW
QUARTER-BURN	SE
PLOT # (1-10)	P-1
SPECIES 4 LETTER CODE	CAHE

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, Quadrant 2 in the NE corner, Quadrant 3 in the SE corner, and Quadrant 4 in the SW corner Biomass is sampled in quadrant 1 and cover data is sampled in quadrant 2 with ARS Staff. Quadrant 3 is for soil sampling and trace gas measurements. Quadrant 4 is for future research.

Density and Basal Cover Protocol: Cover will be sampled in early August. Sample 25, 0.1m² quadrats within Quadrant 2 area for each treatment plot, quadrats 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: 1=0-5, 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 Orobanche 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: 1=0-5, 2=6-15, 3=16-25, 4=26-40
5=41-60, 6=>60

Density of BARE, LITT, and DUNG are not recorded (they are estimated in the basal cover reading.) Density of OPPO is counted as the number of live cladodes (pads). Density of bunchgrass species, such as BOGR, BUDA, SIHY, ARLO, SPCR, and STCO is the number of clumps, and for grasses such as AGSM, it's the number of tillers. Density of forbs and shrubs is the number of stems separately emerging from the surface of the ground: REMEMBER, look for CAHE.

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.

Clipping Protocol: For peak standing crop, clip 10, 0.25 m² circular quadrats within Quadrant 1 area for each treatment plot by species. NOTE: also need to clip out standing dead from previous year(s). Quadrats are randomly located, but once a location is clipped it will not be re-clipped for at least 4 years. (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 species. It is usually easier to first clip species other than BOGR-BUDA. There are three cactus species on the site. OPPO is not collected, count OPPO pads, clip and discard away from plot area. Record the number of OPPO pads on the largest sample bag. The two 'barrel' cactus are not clipped. There are only some times when combining of species may be done, but it is important that the following 'combining-rules' be followed:

- 1) The only time combining is allowed is when two species are each less than a gram (this is a few leaves, or one very small stem of an individual).
- 2) Some species are never combined even if there is only a very small quantity - these are BOGR, BUDA, SPCO, and CAHE.
- 3) When combining, never combine forbs with shrubs, grasses with forbs, etc. Only combine grasses with grasses, forbs with forbs, shrubs with shrubs. Envelopes with combined species should have codes for all species on the envelope.

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 BOGR 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???

Example Label:

STUDY	SMALL PLOT FIRE
DATE (month, day, yr)	08 01 93
FREQUENCY (0, 1 or 3)	0
SEASON (S/F)	S
PLOT # (1-5)	1
SPECIES 4 LETTER CODE	CAHE
# OPPO pads	22

Appendix